Resource Management in A Coastal Zone Region (A Case Study of Gulf of Khambhat)

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C E R T I F I C A T E

Certified that the dissertation entitled "Resourse Management in A Coastal Zone Region" [A case study of Gulf of Khambhat] submitted by Rajnish Kumar Jenaw in fulfilment of nine credits out of total requirements of twenty four credits for the award of the degree of MASTER OF PHILOSOPHY of this University, in his original work and may be placed before the examiner for evaluation. This dissertation has not been submitted for the award of any other degree of this university or of any other university.

(SUMITRA CHISTI)
Chairperson

(R. C. SHARMA)
Supervisor

GRAM : JAYENU TEL. : 667676, 667557 TELEX : 031-73167 JNU IN

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P R E F A C E

In developing regions the man-nature relationship is significantly skewed in favour of environment, which impose several compulsions on the developmental processes. Indian coast especially the coast of Gujarat, represents a case where the harsh dry climatic regime along with fragile marine eco-system places limits on the developmental processes. In the proposed study, the component of coastal marine eco-system will be analysed and an attempt to identify the areas of the varying man-nature relationship.

This study will be a multidiciplinary in nature involving Geology, Oceanography, Ecology and Geography. In the Chapter 1st review of literature on coastal zone management will be presented. Geographical personality of the study area will be dealt in Chapter 2nd. The Chapter 3rd will be concerning with patterns and potentials of terrestrial and marine resources. The Chapter 4th will be dealing with utilisation pattern and growing pressure in the study area. Chapter 5th will be related to Oceanic orientation and future development of the study area. Finally Chapter 6th will be discussing with problems and strategies of the study area.

I sincerly wish to express deep and intellectual indebtness to Prof. R.C. Sharma for his supervision and advice as well as for his valuable suggestions, but for with, this study would have not been completed.

I wish to thank the officials of various state departments at Gandhinagar and Ahmedabad who made the relevent records and the publication available to me. A work of thanks especially to the officials of Bureau of Statistics, Fisheries, Groundwater Development Corporation, State Pollution Control Board for taking more than routine interest in answering my queries.

I would be feeling guilty if, I forget to express my thanks to my friends. Gajendra, Surendra, Mahesh, Rakesh and Anand for their constant help and encouragement.

Last but not least is the contribution of Mrs. & Mr. Ajit Garg who took pains in typing n manusiript.

Rajnish Kumar Jenaw

July, 1990 RAJNISH KUMAR JENAW

New Delhi.

I N T R O D U C T I O N

The 1970's witnessed the birth of a new object of enquiry: the coastal zone. The evolution of coastal management and planning has been the result of two parallel developments on the one hand a changing orientation of human activities and on the other hand an increasing awareness of environmental issues. So coast becomes a bio-physical environment for the socio-economic system, on environment to be used by man and ultimately to be either destroyed or managed by man.

In the light of the above fact coastal zone management takes prominence in any study concerning oceans and its surroundings. Management is essentially concerned with resources. Management is often defined as " getting things done through people". The actual functions of management of resourses involves both art and science, abililty and techniques qualitative and quantitative approaches.

Coastal zone management connotes the management of coastal water and shorelands. The fundamental goal is conservation of coastal eco- system at the optimum achievable carrying capacity (that is ability of yield resources of value to man). A programme for conservation of coastal eco-system should consists of four major elements (i) protection of all

ecologically vital area (ii) Elimination of all damaging discharges of pollution (iii) Control of site alteration in the shorelands to maintain the optium (natural) quality (iv) Control of excavation and alterations of the coastal water basins and their margins.

1.1 Review of Literature

Coasts and coastal zone management is not the new subject. Various studies have been conducted in this field in varied forms. Coastal morphology and regional description were taken into account by American and European authors. Initially study of the dynamics and morphology of coastal zone and trends comes under, the branch of Science and Technology. Leonardo Da Vinchi's work was one of them. In his study he gave the idea for the selection of part development and planning.

Afterwards coast defences become a part of the subject. French scientists Lanblaride (1789) and Emy (1831) and Itallion Lialdi (1866) and Cronaglia (1889, studies many processes in this context of the dynamics of the coastal zone. During the early ninteenth century a number of empirical laws had been established, such as the depth and

strength of wave action on the sea bed and coast, the coast and constructional features and the movement of material along the coast. Further instead of direct observation, model experiments has been developed. Many practical importance have been derived from these models. But in reality these model did little contribution to the general theory of coastal development.

Hydrographers also studied coasts for navigation, sailing direction and navigational charts. This was widely developed in 18th century specially in Russia. Eminent Russian hydrographers of this period were Litke and Bellingshausen. They were mainly interested in the origin of coasts but the genetic view in the description of coasts was developed.

Geologists such as Lyell(1830) and Elie de Beaumont (1845) paid main attention towards the sea along the coast. Afterwards many geologists studied the formation of plains of marine denudation and were interested in the structure of coastal deposits. Geomorphological and geological studies were mainly aimed towards the general course of the erosion cycle in the development of relief, as well as contemparary processes in the alternation of coasts. This was firstly done by Gilbert (1885) and Gulliver (1899).

Richthofen (1901) classified the coasts and gave important general conclusions. Davis (1912), Johnson (1919) of US and Passerge (1912) etc of Europe were summarised and classify the coasts.

Many universities now carrying out research on coastal zone management and development, i..e. California and Chicago universities are carrying out coastal research and publishing the results for many years. The theme and system of coastal management is not new in India.

It existed since ancient Indian history. Evidence of sea port system at Lothal (Gujarat) and at some other places indicate the existence of coastal management in the Indus Velly civilisation. Ancient and medieval man were simple and hard a limited type of coastal management based on needs, experience and knowledge. Data and literature on coastal management are meagre and in scattered form various scholar from different displine have contributed in this field.

Krishnaswamy (1954) worked on coasts of India. Author has divided the Indian coasts into five parts namely, the coastal strip , the Western coastline, the Malabar coast, the Madras

coasts, and the inlets of water and straits on the Indian coast. The east coast of India bears the unpress of recent elevatory movement. He stated that the oscillations of the sea-level have been much more complex on the west coast. Whereas the Kathiawar coast bears unmistakable signs of land uplift and especially so in the Rann of Kutch (mainly due to seismic activity, the earth quake of 1897). The Bombay and Malabar coasts, on the other hand show unmistakable signs of sub-mergence (the submerged forests on coasts of Malabar and Bombay).

Wager(1960) worked on human use of the earth. He identified to show man as the inhabitant and beneficiary of artificial environments, created by human efforts. This premise was that " there is an order and regularity in the geography of man's works.

Burton (1965) gave a good account of resource management and conservation. This article demonstrate that the study of conservation is emerging from an environmentalist, preservationistic, moralistic and ethical past as a distinctive intergrative discipline of using and manging the earths natural resouces. This article have been assembled into three main parts, each according to a seperate theme:

Part I the Malthusion Equation, part II the conservation of limited resources and part III the management of an expanding resource base.

Sen Gupta (1966) evaluated planning region for development in India. An attempt has been made by the author to delineate the base for perspective planning during the next two decades namely 70's and 80's. The principles and methods of physiographical regionalisation have been discussed followed by a discussion of principles and methods of delineating , marco economic regions for resource development. As a result, six major economic region and 42 sub regions have been marked out.

Horting(1969) has made a work on the conservation of mineral resources and its development. He has described the coastal mineral resources and its development. Coastal area can be divided into many zone of jurisdiction. Optimum resource allocation requires, the most effective application of the principles of multiple use to a specific area to the maximum degree of feasibililty.

Martino (1969) commented on management of resources and it is vital because of the rapid tempo in our modern age and the complexity of our understanding. The need is for a priority

system to ensure optimum allocation of resources. And thus process must be continual.....dynamics.....measuring derivations between predicted and actual resource use.....suggesting alternatives..... pinpointing the impact of decisions..... reacting within a time frame which will make the result of actions meaningful. Finally this book suggest solution to resource allocation problems and present methods for ultilising available resources efficiently and effectively. Translated into action, this book can be road map towards profitable resource management.

Peearson (1970) accounted a good study on environment and ecological problems in the coastal zone. He classified types of waste disposal and there solutions. He identified wast disposal system in two groups (i) the estuary coastal discharge dilemma (ii) the open coast disposal problems. Quality of the coastal environment can only be obtained through the treatment of the waste. Waste is directly influencing the living and non living communities and the human settlement in and around a coast.

Schafer(1970) defined the bio-logical resouoces of the coastal zone on the basis of human activities with marine and

marine environment. He remarked that coastal zone is an area where both terrestial and marine activities are influencing to each other. Rapid population growth and urbanisation around the coast adversely influenced the marine environment. In such a situtation it is difficullt to preserve the pre- existing ecological regime. He worked out a significant relationship between man and living organisims of coasts and conservation of biological resources. Finally he concluded that for the efficeint coastal planning, prerequisite is the availability of data on living resources, climatic conditions and human activities.

Dixit (1971) has analysied the morphological features of the Kharlands (saline wastes) of Gujarat. The Kharland are partly depositional and partly erosional features. Plenty of water is key to reclamation of land in an arid or semi arid environment. Reclamation of Kharland means decreasing the salinity of the soil by eliminating salt content which has accumulated because of the tidal effect of the sea. The washing and leaching of the salt are the two convinent methods of making the surface soil free of salt. The area around the Gulf of Khambhat has no permanent source of fresh water. The underground water is brakish. Building of large reserviors is therefore essential for the supply of freshwater needed to eliminate the salt by leaching and

flushing. One would prefer the agronomic method, which does not involve any large scale expenditure and is based on the age long experience of the farmers. The cultivation of salt resisting strains of crops is very plausible. Whatever the difficulties the Kharlands offer immense agricultural potentialities and in a region which is deficient in food, their reclamation is worth taking up with all the human and technical equipment.

Schneidowind (1971) discussed the important types of data which are needed for the coastal development planning. Two types of data are available - environmental and inventory data. Efficient development of the coasts is only possible with the centralised storage and processing unit of data in each coastal zone.

Sternlight (1971), emphasised the coastal planning and organisation systems. Planning includes systems structuring analysis & design, programming, feed back and evaluation. Conflicts can be solved by the surveying the social interest.

Mazumdar (1973) evaluated the various aspects of tribal population in Eastern Gujarat. Physical, Cultural and social aspects have forced the population to remain distinct. The tribal population have still not been able to get rid of

their economic and cultural backwardness. Which has resulted in tremendous problems before a developing country like India. But the tribes of the southern part, have changed to a great deal with the modern development and migration to the plains.

Dikshit (1974) has explained the mineral resources of the oceans. He divided these mineral resources into three parts (i) Minerals from the continental shelves and slopes (ii) Minerals from the Deep Sea Floor and (iii) Minerals from sea water.

Pal (1975) did an emperical study, intended to identify relatively less or more developed areas in India as compared to an average national level of development. His study was extended over all districts of India. He was the first person to use principal component analysis.

Sen Gupta (1977) attempted the study on marine pollution and its effect. He classified four types of marine pollution namely discharge of domestic sewage, petroleum seepage etc., radioactivity and finally contamination by various heavy metals, such as mercury, lead, cadium etc.

Gananathan (1978-79) has discussed the importance of the Arabian sea in the Economic development of India. Arabian

Sea influences the climate of India and marine mineral resources below the sea bed.

Clark (1978) explained that coastal geomorphology can be seen to have evolved in recent decades from a pure systematic study to a field with considerable potential for practical application. This new role for the geomorphologists spans activities such as formal understanding and delimitation of process systems, public information, remedial strategy, design and participation in the formulation of legislative and bureaucratic frameworks for coastal management decision - making.

Powell (1980) attempted for a flexible interpretative framework in various approaches to resource management. Problems of resource management can only be examined in their appropriate local settings. The maintenance of authority and stability in modern capitalist socities has become too heavily dependent on the achievement of economic production and the satisfaction of material needs.

Zindge (1980) analysed the effects of industrial waste disposal on the water quality of the river Kolak in the Khambhat region. About 6 MLD of industrial waste water is discharged without proper treatment in the fresh water zone

of the river Kolak. The river flow decreases considerably during the dry season.

Briggs etc (1982) evaluated the potential role of ecological mapping in coastal zone management in Europe. A major difficulty is of the consistent and reliable data on coastal environments and related inland areas. Ecological mapping involve the collection, storage, analysis and mapping of data on a wide range of environmental resources of land scape, land, water and air as well as the related natural hazards of flooding, erosion, earthquakes, landslips and climate extremes. Ecological mapping undoubtedly has a major role to play in facilitating integrated management in coastal zones. But it is primarily a problem seeking tool. It is not designed as a means of solving problems.

Camhis etc (1982) attempted on coastal planning and management perespectives. Coastal zone is a strip of land and sea has only recently been identified. Ecological revolution has contributed to raise coastal problem to an issue level. Author also delineated the coastal zone on the basis of morphology, land use, ecological or economic criterion. The coast is unique and valuable as a resource not only from an ecological perespective but also from a

socio - economic view. Pollution and environmental degradation exprsses the conflicts among the uses of coastal resources. Finally he emphasised seek for international cooperation.

Carlberg (1982) has discussed the coastal policy in Sweden : use and protection of marine resources. Author described that there is always a conflicting interests in coastal and sea areas. The future strategy for coastal develoment should envisage planning and coordination of activities. Finally he emphasised on the development of offshore technology.

Dix (1982) has attempted a study on some ecological aspects of the coastal development. He has attempted to define various terms such as ecology, conservation, pollution etc. His article provides information on regional planning and environmental change and pollution etc.

Lee (1982) wrote a paper on economic development and environmental protection in coastal zone. He says "that each coastal zone has its own economic system and environmental system. But each system is also linked to the other system through the flow of natural resources and waste material between them." Therefore the economic and environmental

conditions of the coastal zone, are independent and require a integrated planning and management.

Desai etc (1983) have attempted a comparative account on zooplankton in polluted and unpolluted estuaries of Gujarat. They found dominance of zooplankton groups varied with level of pollution in the unpolluted estuary invariably copepods were predominant. In the polluted estuaries during ebb tide gastropods, mysidr and polychetes formed the major part of the zooplankton. Diversity of different groups of zooplankton was relatively low in polluted estuaries.

Oldfield (1983) has attempted the main impact on the environment : some recent perspective. New techniques of peat and sediment dating can provide finely resolved chronologies for the last 10 to 200 years of accumulation. Case studies of sedimentation and erosion, and of heavy metal and particulate pollution, show how the repertoire of new techniques can provide detailed evidence for the changing impact of human activity on ecosystems.

Sharma (1984) has described the resource based development planning on a territorial basis. He classified the resource region of Sagar district on the basis of various parameters such as pollution distribution, crop combination,

agricultural efficiency etc. He further demarcated economic and functional regions. "The resource regions serves as a basic spatial units, but socio-economic infrastructure is essential for the development of natural resources.

Desai (1984) attempted the distribution of phytoplankton pigments Auranga, Ambika, Purna and Mindola estuaries of Gujarat. Estimation of phytoplankton pigments in four estuaries of South Gujarat indicates that all are fairly productive systems. Effects of pollution on phytoplakton production was discernible only at Mindola where the relatively higher level of nutrients stimulated enhanced growth of phytoplanton. Auranga and Ambika estuaries behaved identically while the other two showed their own specific pattern of distribution for phytoplanton pigments.

Rao (1985) has evaluated the biological monitoring for conservation of marine living resources along the Indian coast. Responses of marine biota, project the actual effect of any change - environmental or anthropogenic - in the biosphere. Lastly the longterm bilological monitoring of the environment will realistically helps in the conservation of self generating marine living resources.

Desai (1985) analysised the remote sensing techniques on oceanic climate. Monitoring the vast oceanic areas is a

difficult and expensive task; satelite remote sensing has been recoganised as a valuable means

Raju (1985) has evalutated the oceanic energy in the Indian context. India has got a very high potential for the renewable ocean energy, the most promising forms being Thermal (OTE), wave (forming part of a multibenefit system) and tidal energies. For each case the potential, principles of extraction, technological developments, work in progress at global level and the activities in India are briefly presented. The estimated potential of Ocean Thermal Energy (OTEC), wave energy and Tidal Energy are 50000 MW, 60000 MW, 8000 MW respectively. The eastern coast of India and islands of Lakshadweep and Andaman offer immediate of exploiting OTEC. Possibilities for wave Energy utilisation are available all along the Indian coast. Gulf of Kutch, Bombay on the west and Sundarbans area on east offer excellent sites for tidal power development.

Sengupta etc (1985) worked on petroleum - its present and future. They found out that in the recent years, both production and consumption of oil indicate a negative growth rate. With the present trend of development and better management of the available resources, the oil reserves exploiated will last well into the next country. The

present ration between production and consumption of oil in India is about 1 : 1.3. Analysing the present trend of increase in production and consumption, it has been estimated that India can become self sufficient in oil within the next few years. The existing onshore and offshore reserves in the country will at least last for the next 25 years.

Das (1986) has calculated the salinity gradient and potential in India. Salinity gradient, as a source of energy has recently been recognised. Four methods have been proposed for the extraction of power from salinity gradient (i) osmotic pressure difference (ii) vapour pressure difference (iii) reverse electrodialysis and (iv) mechano - chemical engines using collagens.

The salinity gradient energy sourse exists in the estuaries where fresh water flows into the sea water. Power potentials resulting from rivers discharge is calculated as under :

RIVERS	Average Annual discharge M3/sec	Power potential (MW)
Sabarmati	101	253
Mahi	269	673
Narmada	1290	3225
Tapi	570	1425

All the four method are either in the conceptual or in the experimental stage and economically they are not viable. However the first three methods described requires more attention from the commercial view point.

Mukerjee (1987) has analysed the conservation of eco-system. Irrational and unplanned exploitation of natural resources for centuries, led to an overall depletion of natural environment and imbalance in the ecosystem. To achieve overall development of a region without destruction of its ecosystem, it is essential to have a proper planning within an ecological framework. To conserve and restore the disbalanced ecosystem, proper utilisation of land seems to be the only remedy; and for this purpose detailed landuse maps are needed.

Bhasin (1988) attempted a fundamental conflicts between individual and group interests. These conflicts are basic and eternal. Further he has attempted a historical linkages. He also highlighted the concept of welfare geographers.

1.2 Selection of the Study area :

The coastal region of Gulf of Khambhat comprises of vast coastline and has varied resources from black cotton soil to oceanic resources. This region is influenced by both maritime

and continental climate, which ranges from dry climate in the north to moist climate in the south. It results variation in vegetation coverage. The rapid industrialisation and urbanisation has increased density of population. Location of these industries and urban centres polluted the rivers, oceans and atmosphere with domestic sevage and industrial effluents. Which posses many threat to man - nature relation, in the form of pollution, environmental degradation in and around the region. This phase of disequilibrium can only be resolved with efficient and optimum use of resources and control on environmental degradation.

1.3 Objectives :

The objective of the study is to find out :

- the relationship between increasing population pressure on various resources (terrestial and marine)
- Oceanic orientation of the economy in coastal talukas
- influence of developmental processes on population growth, occupational structure and land use pattern etc
- process of deforestation with rapid industralisation and population growth
- to formulate and develop the resource region in the study area
- to find out the problems and prepare strategies for the future development.

This study is multidisciplinary in nature involving geology, oceanography, ecology and geography.

1.4 **Data Base :**

Mainly this study is based on the secondary and primary source of data on demography, oceanic and terrestial resources, industries etc.

1.5 **Scheme of Chapertisation :**

The whole study is grouped into six chapters. Chapter I Contains the introduction to the subject matter, review of literature on coastal zone management and on the study area. It also includes the scheme of chapterisation, objectives and limitation.

Geographical personality the study area is given in chapter II. Special emphasis is given on the coastal geomorphology of the study area. Other indicators such as population, soil, vegetation, drainage, transport and communication are highlighted in this chapter.

Patterns and potentials of resources are discussed in the IIIrd chapter. Resources are classified according to their spatial distribution - terrestial and marine. Afterwards each resources have been discussed seperately with latest

available data on production and utilisation. In some cases talukawise study on coastal zone has been done. Finally on the basis of distribution of various an attempt is made to develop a resource regionalisation of the study area.

Chapter IV contains the utilisation pattern, growing pressure and identified the fragile region. Utilisation pattern of resources are firstly discussed and then attempt has been made to findout the impact of growing population on these resources.

Chapter V includes the oceanic orientation and future developmental strategies. Concentration of population, growth pattern, rural and urban population in all the coastal taluka are calculated. The shift of population in primary, secondary and tertiary sector is examined. Finally degree of oceanic orientation of different talukas has been assessed.

Last chapter deals with the various problems of coastal zone region and to findout the gravity of these problems. Finally suggest the future strategies for the efficiet and judicious use of resources along with management of eco-system.

1.6 Limitations :

Various efforts have been made to attempt this study a synthesize work but with time constraint it would not possibl to a great extent. Resource management is a very vague term. In such a case what resources should be taken and what left out pose a variety of problems. I have tried my best to give this study a concreate form but non availability of data and various other constraints, still it require more research.

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GEOGRAPHICAL PERSONALITY OF THE STUDY AREA

The Gulf of Khambhat region comes in the Western part of India. It is thrusting into Arabian sea and mainly covers the South - Eastern part of Gujrat state. Its longituditional expansion is from 72^{o} 45' to 74^{o} 30' East and latitudional from 20^{o} 23^{o} 30' North. It covers about 56,789 Km^{2} and has a population of over 1,68,92,051 comprising mainly the coastal districts of Gujarat, namely Bhavnagar, Kheda, Surat, Valsad, Vadodara, Ahmedabad and Bharuch. The Density of population is 297 person per Km^{2}. Area of the region is mentioned in Table no. 2.1.

2.1 The Physical Setting

(1) PHYSIOGRAPHY - The igneous debris that solidified led to the formation of highly foliated biotic schists and chlorite sehists, which together constituted the earliest composite geniss which covers much of Peninsular India and is exposed in Rajasthan extending south - westwaords into north east Gujarat. Thus a sedimentary cover over the Archaean igneous material was formed. Subsequent tectonic disturbances that occured during the Primary era initiated the process of metamorphisim and sediments were altered, resulting into rocks which were highly distinct from the early igeneous

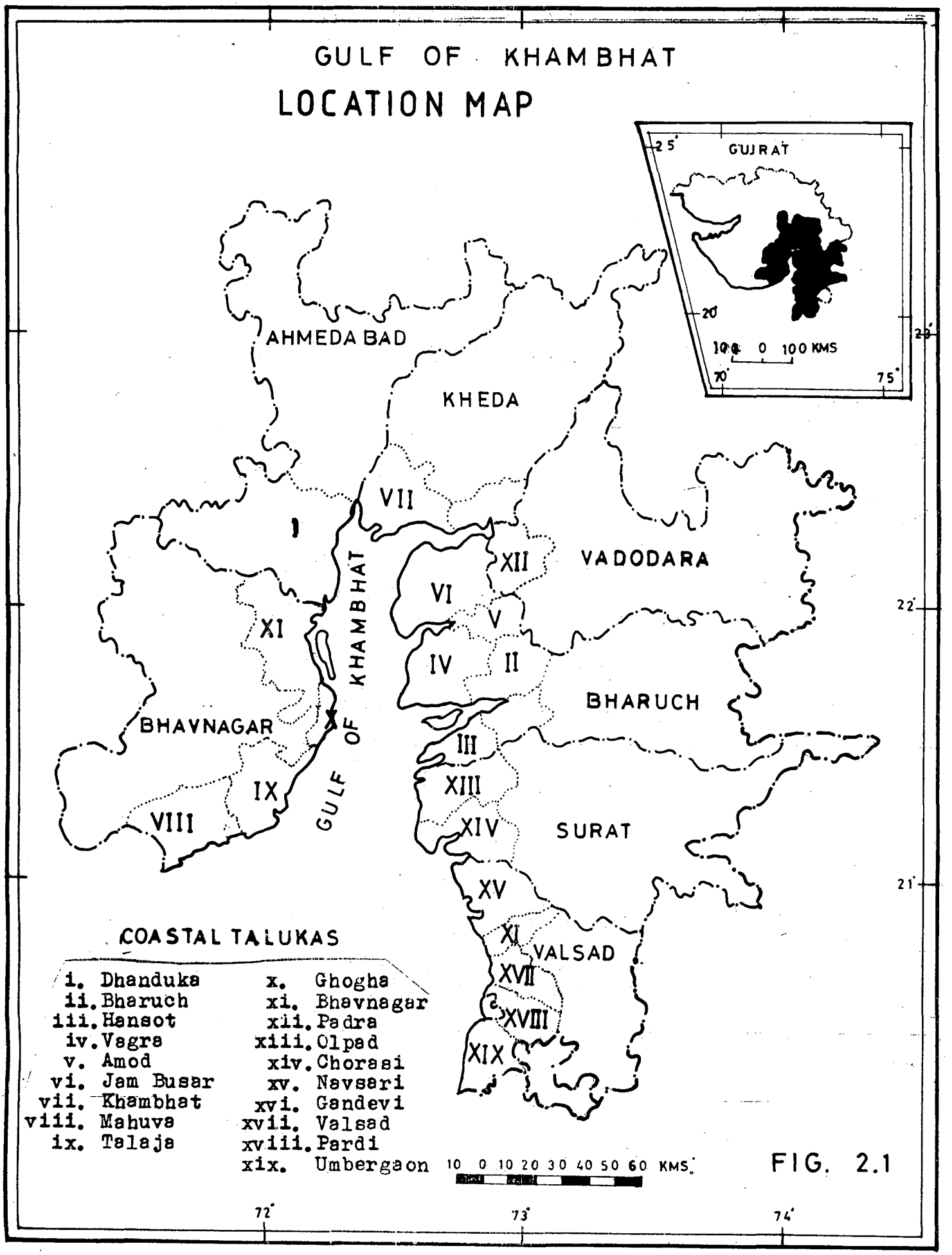
GULF OF KHAMBHAT
LOCATION MAP
GUJRAT
25°
20°
70°
75°
100 0 100 KMS
AHMEDA BAD
KHEDA
VADODARA
BHARUCH
SURAT
VALSAD
BHAVNAGAR
GULF OF KHAMBHAT
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
XIII
XIV
XV
XVI
XVII
XVIII
XIX
22°
21°
72°
73°
74°
COASTAL TALUKAS
i. Dhanduka
ii. Bharuch
iii. Hansot
iv. Vagra
v. Amod
vi. Jam Busar
vii. Khambhat
viii. Mahuva
ix. Talaja
x. Ghogha
xi. Bhavnagar
xii. Padra
xiii. Olpad
xiv. Chorasi
xv. Navsari
xvi. Gandevi
xvii. Valsad
xviii. Pardi
xix. Umbergaon
10 0 10 20 30 40 50 60 KMS.

FIG. 2.1

Table NO. 2.1

INDICATORS : GULF OF KHAMBHAT REGION

S.No	Name of District	Area in Km.	Total Popu. (1981) TOTAL	RURAL	URBAN	Density of of Popul. per Km.^{2}	Decemial Growth rate of popul. 1971 - 81
1.	AHMEDABAD	8707 (4.4)	38,75,794 (11.37)	10,94,716 (28.24)	27,81,078 (71.76)	441	31.96
2.	BHARUCH	9038 (4.6)	12,96,451 (3.80)	10,54,972 (81.37)	2,41,509 (18.63)	143	16.76
3.	BHAVNAGAR	11155 (5.69)	18,79,340 (5.51)	12,93,766 (66.7)	6,25,574 (33.3)	168	33.53
4.	KHEDA	7194 (3.67)	30,15,027 (8.85)	24,08,672 (79.89)	6,06,355 (20.11)	418	22.67
5.	SURAT	7657 (3.90)	24,93,211 (7.31)	14,27,172 (57.24)	10,66,039 (42.76)	325	39.41
6.	VADODARA	7794 (3.97)	25,58,092 (7.5)	16,07,565 (62.84)	9,50,527 (37.16)	327	28.79
7.	VALSAD	5244 (2.67)	17,74,136 (5.20)	13,85,274 (78.08)	3,88,862 (21.92)	338	23.95
	TOTAL	56789 (29.26)	16892051 (49.55)	10232107 (60.34)	6659943 (39.65)	2972	
	Gujarat State	195984	34085799	23484146	10601653	174	27.21

Source : Primary Census Abstract, Census of India 1981.
(Figures in brakets indicating percentages)

materials. This system of highly altered rocks, known as Dharwars, occurs in the eastern part of the area.

The Coast of Khambhat have resulted from the rise of land resulting from a testonic movement meets with certain difficulties. (Dikshit, 1971). Firstly we have no evidence of any deformation or tilting in any part of the rocks than the quaternary and above all the basaltic lava flows. Secondly in the softer rocks, there is no possibility of the deposits being disturbed, but one finds in this area deposits which are not at all disturbed. Thirdly a tectonic movement will present certain denivellation and will not have a uniform rise everywhere. Lastly, the survival of the relief in all the details is very striking and could not have been preserved if there were a tectonic movement. The Nalsarovar, the centre of the old arm of the sea connecting the Gulf of Khambhat with the Gulf of Kutch, is so intact as to make one believe that the sea has quietly departed from this area. The uniform rise everywhere on the one hand and the preservation of the past topography, on the others, suggest an eustatic origin of these surfaces.

(2) Coastal Geomorphology

Coastal geomorphology may be studied under the following

heads:

(i) Off - Shore features
(ii) Shore features
(iii) Coastal features
(iv) Evaluation of the littoral Geomorphology
(v) Littoral geomorphology in relation to human activities and problems.

(3) Continental shelf means the marine floor between the normal shoreline and the submarine contour of 100 fathoms (183 meters or 600 feet). The self is the widest near the gulf of Khambhat, about 400 Km. across and narrowest off the delta mouths where the width (near Sundarbans or Krishna mouth) is less than 30-35 Km.

The continental shelf off the eastern coast is approximately one third of the width of the shelf that occurs off the western coast of India. The slope of continental shelf is about 1 to 2 minutes near the Gulf of Khambhat from the shore of the 100 fathom submarine contour.

It is interesting to note that while the continental shelf off the Gulf of Khambhat is the widest (over 400 Km.) with the lowest gradient for the shelf as a whole (about 2'), the shelf nearer the shore is relatively deep and the 5 fathom contour intersects the coast near the mouth of the Narmada and Gogha river. This is particulary noteworthy in view of the fact that this coastal stretch is low and often swampy.

According to 10 fathom contour, however, the shelf gradient in the Khambhat region is lower (about 7').

The deposits on the continentall shelf around India are mostly those supplied from the subareal erosion of inland areas and from coastal erosion. These deposits are known to be gravels, sands, silts and muds. Formerely it was believed that sediments become fever away from the shore - Shepard (1963), Guilcher (1958) and others however, have shown that this is far from true and frequently the sediments nearer shore are fever than those reward. Silt flats and mud flats are found in the numerous estuaries, e.g. the Narmada and the Tapi in the gulf of Khambhat region. In the continental shelf of the Khambhat region the lava appears to be overlain with later deposits.

Some non-rocky low level islands are found in the Khambhat region. The estuarine islands are found on the mouth of a numbers of estuaries north of Valsad especially in the Tapi and Narmada estuaries where there are large bets (the local word for islands) e.g. Kadia Bet, Alia Bet and dogen other smaller non-rocky islands. All these islands are above the high water level. But there are numerous sandy banks and islands between high and low watermark also. These islands consisting of beach sand and mud banks, without any

vegetation, whose growth inhibited by the tidal submergence in the estuaries of the region, mark some important submarine phase and process.

Three types of islands are found in the Khambhat region. One category is represented by estuarine islands either submerged at high tide or permanently above the sea. They are sandy or muddy or marshy low - level surfaces. The second group is represented by the larger completely sandy islands near the Gulf - head. Finally, we have rocky islands, e.g. Piram island and scores of other smaller rocky island mostly of littoral concreate off the western shore of the Gulf. The islands of the first and second categories are related to the dominance of marine deposits over marine erosion offshore marine deposition or erosion is performed by waves or currents or streams. In this region the depositional action is magnified by the (i) protection enjoyed by the Gulf of Khambhat against the monsoon - engendered currents which do not enter in this relatively narrow northward - projecting area of the sea, (ii) moreover, the waves are also relatively mild because of the obstruction by Kathiawar Peninsula to the onshore winds which are predominantly from south - west, and (iii) the absence of strong waves and surrents also ensures greater deposition of the river - borne

sediments on the continental shelf. Some banks might be completely submerged and may later appear above the low water line.

The estuarine islands at the mouths of Tapi, Narmada, Dhadar, Mahi and Sabarmati are in depositional features. Some of these might have grown on the higher surfaces of the submerged marine floor. The depositional activity is increased during the period of the south - west monsoon when the swollen rivers held up be the rivers - borne sediments which cannot pass rapidly and easily out into the open sea.

Shoreline is the junction of sea and land. It is not static concept. It becomes longer and moves seaward at the low tides. It moves landward at high tides. Thus there is a lower limit of the shoreline at the lowest ebb of tides and there is an upper limit of the shoreline at the highest water level. The zone between these highest and lowest of shorelines can be called the shore. The part of the shore zone that lies between the ordinary low and high tide has been called as 'foreshore' and that above the same immediately at the cliff foot called as 'backshore'.

Sandy beaches are quite marked along the shore of the Gulf of Khambhat. The beach is about 1.5 Km. broad on the protected

western shore of the Gulf whereas it is 200 to 400 meters broad on the eastern shore. Occasionally the foreshore sandy beach passes laterally into marshes and mud flats, e.g. on the eastern shore of Kathiawar. Sometimes there are prominent beach ridges in the backshore. Thus between Navsari and Valsad we have four parallel lines of beach ridges.

Littoral concerete with impressive continuity over long stretches, e.g. 14 Km. is found near Daman. It is apparently in a process of formation.

Estuaries are dominating in this region. These are broad in the north of Valsad. All the rivers, e.g. the Tapi, the Narmada, the Dhadar, the Ulhas, the Mahi, the Sabarmati, the Kim, the Purnd, and the Ambika, etc. are marked by estuarine mouths, extensive mud flats and salt marshes and in some cases by estuarine islands. In some parts the marshes account for about one-forth of the width of the coastal plain. The marshy tracts occurring near the mouth of estuaries show the process of estuary filling. There are the several reason for the sedimentation (a) shallow continental shelf, (b) the relative calm waters of the Khambhat region (c) large sediment discharge of the Narmada, Tapi and (d) low attitude of coastal plains.

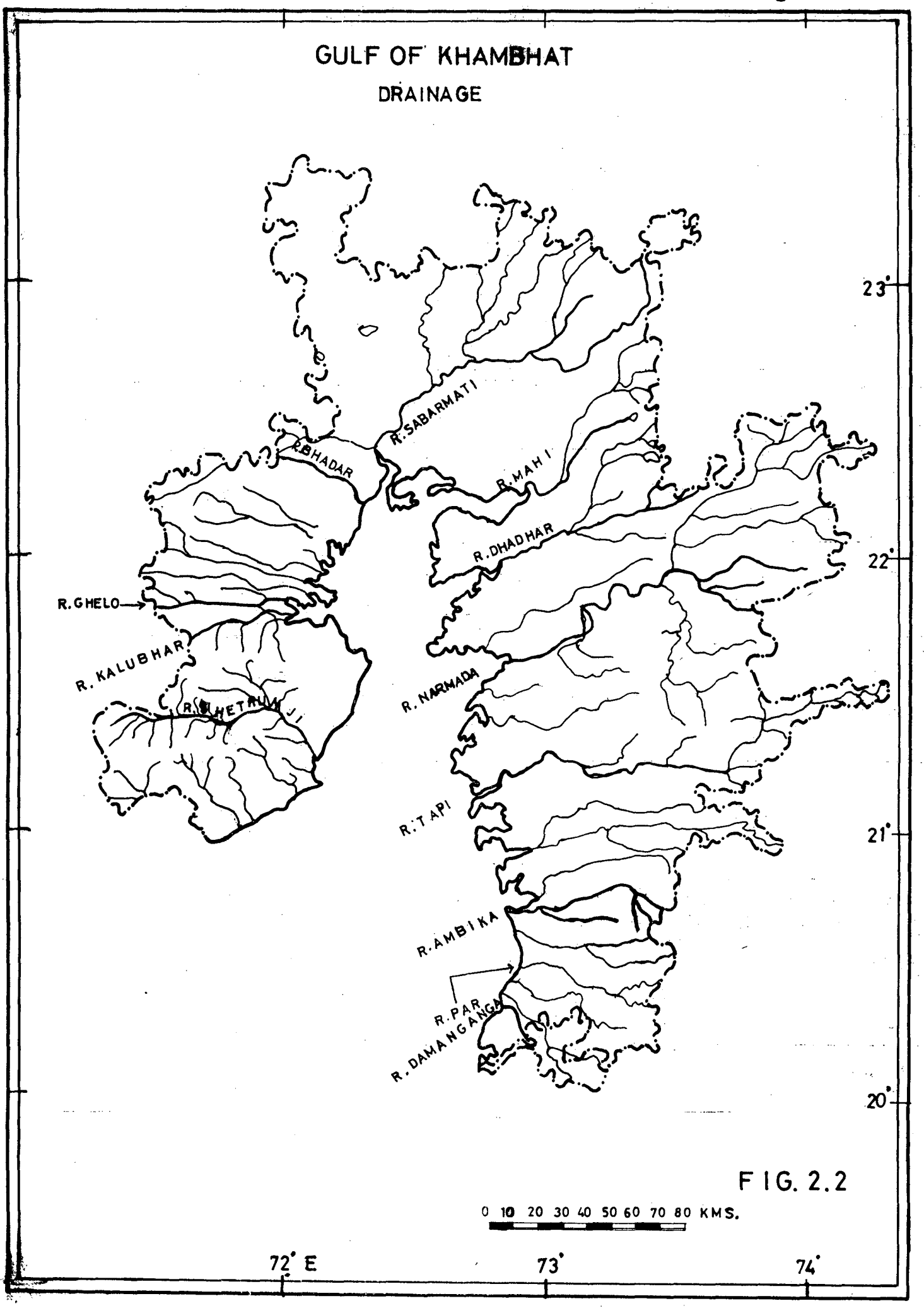
GULF OF KHAMBHAT
DRAINAGE
R.SABARMATI
R.BHADAR
R.MAHI
R.DHADHAR
R.GHELO
R.KALUBHAR
R.NARMADA
R.TAPI
R.AMBIKA
R.PAR
R.DAMANGANGA
23°
22°
21°
20°
72° E
73°
74°
0 10 20 30 40 50 60 70 80 KMS.

FIG. 2.2

(4) Drainage - The present drainage sets like a key to the past and portrays almost connected evolution of the deainage at least in the recent past. Drainage pattern of the region is flowing in three direction. On the western side rivers Bhaddar, Shetrunji etc. are flowing in an easterly direction and discharge their water in the Gulf of Khambhat. The important rivers of the north are Sabarmati and Mahi. The Sabarmati has a length of over 300 Km. and an extensive catchment area. The river has high banks particulary in its upper reaches, where they sometimes rise to a height of 60 meters. Even in the lower parts, the river has well marked bluffs rising from 10 to 15 metres above its bed. The Mahi is even bigger and has a 500 Km. long course. The lower parts of the Mahi are characterised by heavily gullied sand banks and numerous ravives that have produced badlands in part of Kheda district. The last 70 Km. of the river carry the tidal influence which have broadened the estnary.

The most important rivers of the region are Narmada and Tapi. These rivers are running from east to west align along the rift valleys. They enter the western coast of Peninnsular Indies to unite with the Gulf of Khambhat but the currents generated in the Khambhat wash away the silts of the Narmada and Tapi. The free movements of their silt is assested by

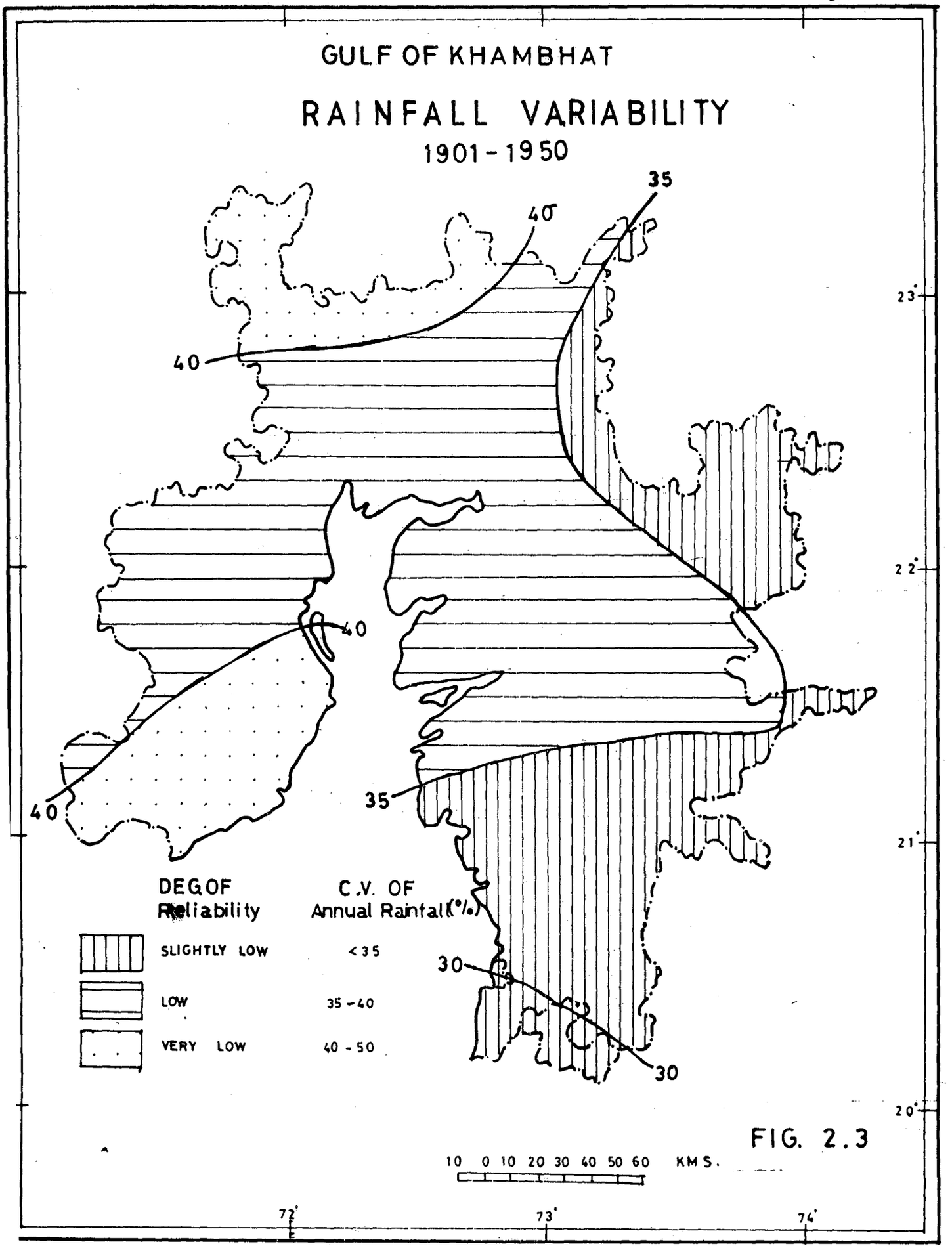
GULF OF KHAMBHAT
RAINFALL VARIABILITY
1901-1950
35
40
40
40
40
35
30
30
23°
22°
21°
20°
DEG OF Reliability
C.V. OF Annual Rainfall (%)
SLIGHTLY LOW
< 35
LOW
35 - 40
VERY LOW
40 - 50
10 0 10 20 30 40 50 60 KMS.
72°
73°
74°

FIG. 2.3

the Khambhat currents and is further responsible for causing estirary on their respective mouths. The streams south of the Taps are short, swift and young e.g. the Purna, the Ambika, the Par and the Damanganges. The mouth of all these rivers are affected by tidal flow.

(5) Climate - Climate is one of the most important factors that govern to a large extent the organic resources of a region and the mode of human activity. It has almost a decisive effect on the nature of the cropping pattern, agricultural practices, the livestock and forest economy of the region coastal zone of the region is having maritime climate where less variations in day night temperature. As we move towards interior the variation in increases.

Mean daily maximum temperature varies from 33 c' to 35 c' while the minimum mean daily ranges from 20.5 c' to 21.9 c'. Rainfall is mainly concentrated in the month of June to September. It is intense in South and decreases in north and west direction. Annual monthlly rainfall varies from 600.8 mm (Bhavnagar) to 1203.5 mm (Surat) co-efficient of variation (c.v) of monthly rainfall differs from 130.5 % (Bharuch) to 151.4% (Bhavnagar). It indicates that rainfall is more uniform in the Bharuch station in compare to other

GULF OF KHABHAT

SOILS

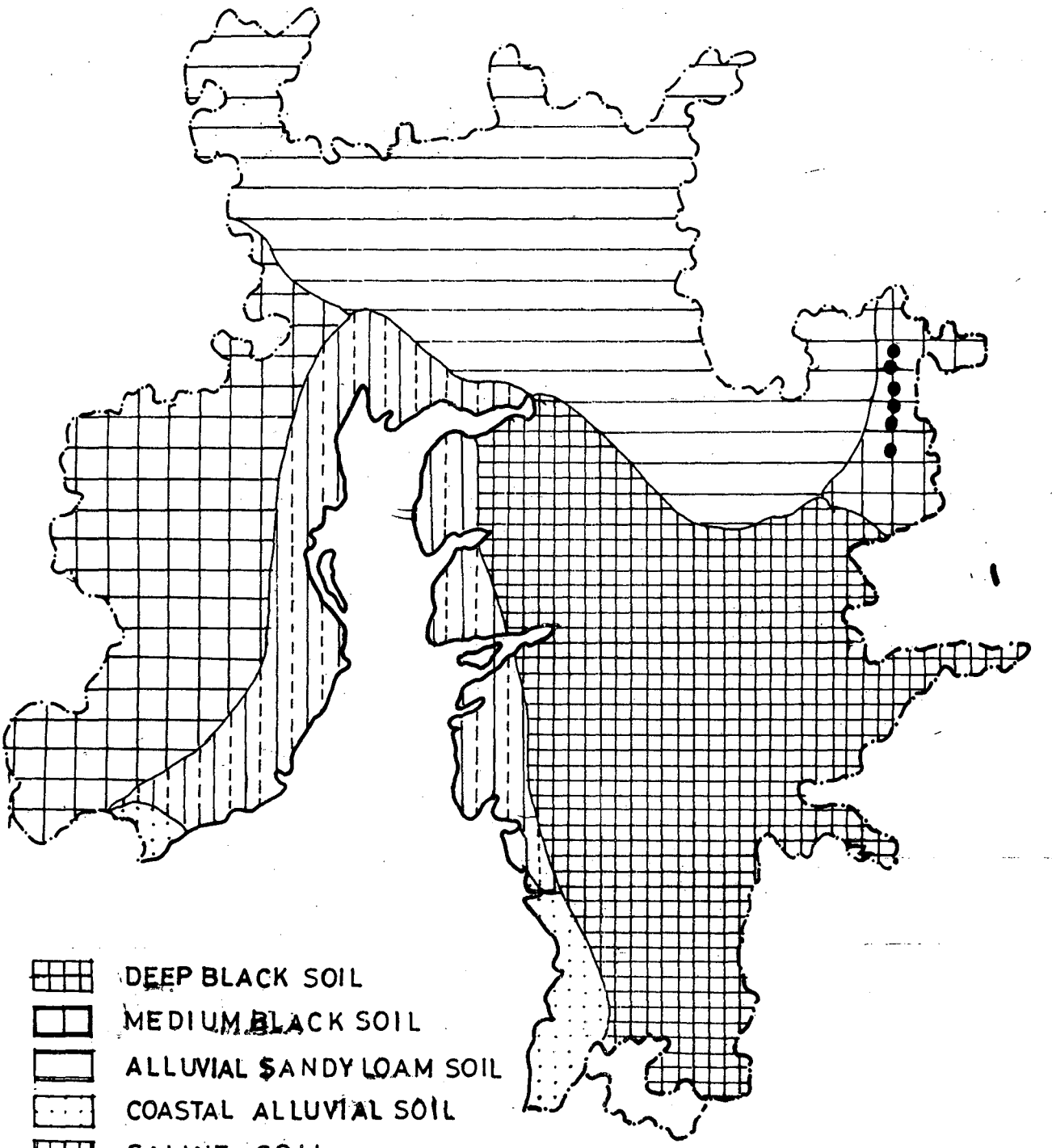

FIG. 2.4

TABLE NO. 2.2

Forest Area in Gulf of Khambhat Region

Sr. No.	Name of District	Reporting Area for Land (00 hectare)	Forest	
			00 hectares	% to total Report. Area
1.	Ahmedabad	8523	115	1.3
2.	Bharuch	7803	1454	18.6
3.	Bhavnagar	9789	310	3.17
4.	Kheda	6891	100	1.45
5.	Surat	7762	1417	18.2
6.	Vadodara	7773	825	10.6
7.	Valsad	5145	1249	24.2
	TOTAL	53686	5470	10.18

Source : Statistical Abstract, 1985.

station. Secondly rainfall is concentrated in the month of June to September.

(6) Vegetation - Table no. 2.2 reveals that natural vegetation is restricted to areas which receive adequate rainfall and at the same time agriculturally unproductive area. Area under forest coverage is around 10.18% of the total reported area. It is highest in terms of percentage in Valsad district (24.2%) while lowest in Ahmedabad district (1.3%). Most decidious forests is found in the Surat district. Forest resources of the region have been exploited at random and more than half its forest area has no working plan either for its development ir its explortation.

(7) **SOILS**

The nature and rapidity with which soil is formed depends largely on the lithological character of the parent rock and the bio climatic environment. The soils once formed, are retained distributed and eroded, depending on the surface configuration of the region. Five types of soils are found in this region namely alluiral soil, coastal alluvial soil, deep black soil, medium black soil and lateritic soil.

GULF OF KHAMBHAT

DENSITY OF POPULATION

1981

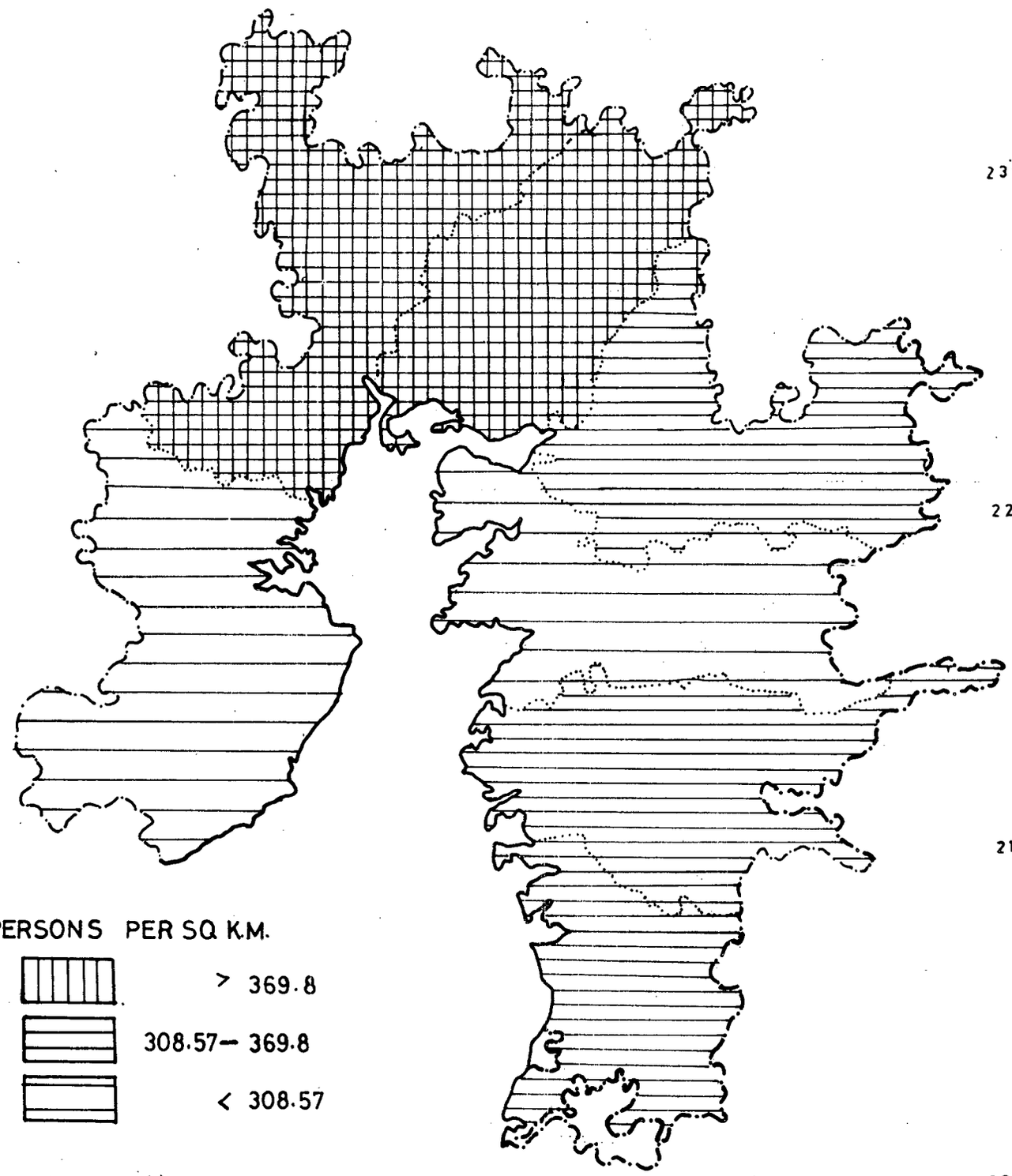

FIG. 2.5

2.2 Cultural Setting

(i) Population - The region is comprises the total population 1,68,92,051 person (table no. 2.1). Urban population is 39.5% while rural population 60.34%. Decennial growth rate of the population during 1971 & 1981 has recorded highest in the district Surat (39.41%), while lowest recorded in Bhaurch district (16.76%).

The population of the region is not uniformly distributed factors like land fertile soil, greater agricultural productivity and higher industralisation have attracted people to certain areas. Highest density is in the Ahmedabad district (441 person) while lowest in the Bhavnagar district (168 person). The average density of the Gulf region recorded 297 person.

In sphere of urbanisation the area is highly urbanised as compared to national average. Population living in the urban areas is 39.65% of the total population). Highly urbanised district is Ahmedabad, which recorded 71.76% of the total population in urban areas. The least urbanised district is Bharuch which is having only 18.65% of the total population in the urban areas. It is due to hilly terrain of the district.

TABLE NO. 2.3

Transport Net Work in Gulf of Khambat Region
31-12-1986 (in Kms)

Sr. No.	Name of District	Railway Length Broad + Metre + Narrow Gauge	Per 100 Kms	Lenght of Roads	Per 100 Kms
	GUJARAT	5700			
1.	Ahmedabad	412	4.7	3523	40.46
2.	Bharuch	257	2.8	3263	36.10
3.	Bhavnagar	387	3.5	3579	32.08
4.	Kheda	317	4.0	4023	55.96
5.	Surat	217	2.8	3733	48.75
6.	Vadodara	489	6.3	3396	43.57
7.	Valsad	163	3.1	3450	65.78
	Total of the Region	2242		24967	

Source : Statistical Abstract, Gujarat State (1987-88)

2.3 Transport and Communication

It constitute one of the most important imfrastructural facilities for supporting productive activities and distribution system and a well developed transport and communication system is curcial for development of agriculture, industries, trade, commerce and economy in general. Transsport thus plays a vital role in ensuring sustained economic growth. It also generate large employment opportunities. The different modes of Transport in Gujarat are roads, railways, ports and airways.

(i) Roads: Good roads are precondition for economic development and are the main arteries and veins through which the stream of economic development and activities flow. Total length of roads in the Gulf of Khambhat region is 24,967 Km. (Table no. 2.3). Density wise highest is recorded in Valsad district 65.78 Km. per 100 $Km.^2$ while lowest is recorded in Bhavnagar district 32.08 Km.

(ii) Railways: The history of railways construction in the region began in 1855 with the incorporation of Bombay - Baroda and Central India Railway Company. Presently the Western Railway serves the entire region with different

gauge. The region is having 2242 Km of total rail line. Highest density of railways per 100 Km is in vadodara district (6.3 Km.), followed by Ahmedabad (4.7 Km.), Kheda (4.0 Km.) and lowests is in Bharuch district 2.8 Km. per $100\ Km.^2$.

(iii) Airways: Ahmedabad, Vadodara, Bhavnagar are the having facility of air transport. The terminal facilities for storage of aircraft and for their fueling are available only at Ahmedabad. Air strips are available at Surat and Bharuch.

(iv) Pipeline: Nature has endowed this region with rich fields of oil and natural gas. During the period 1964-65, the three pipeline, namely Khambhat - Dhuwaran, Ankeshwar-Utram, and Ankeshwar - Vadodara were laid movement of gas for the use as fuel for fertiliser plant, other industries and for household consumption. During 80's HBJ pipeline was made for the transportation of natural gas to Jadishpur and Bijapur.

(v) Ports: Ports play a very important part in the development of Trade, Commerce and Industries and act as a catalyst for the development of coastal areas and the hinterland. This region comprises the intermediate port at Bhavnagar.

(vi) Inland Water Transport: It is one of the most energy efficient modes of transport and has considerable potential in limited areas which have a network of waterways. The Narmada and Tapi rivers offer good potential for development of inland water transport.

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3. Shepard, Francis. P (1963) Submarine Geology New York P-275.

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PATTERNS AND POTENTIALS OF RESOURCES

The growing importance of geography of resources at university level and in the planning of natural resources have created a demand for a systematic introduction to the subject. The need for considerable planning of natural resources of the world is created by two factors: Firstly a internal problem of population increasing at a greater rate than the means of production are not able to satisfy the increased demand. The burden on land has exceeds its limits and unless we create alternatives sources of employment, it wil not be possible to divert a portion of population from land. Secondly for the planning of natural resources, technical knowhow should be developed, so that natural resources can be used efficiently.

Many developed and developing countries of the world are facing an ever-increasing pressure of population upon land resources, which posses serious problems before the administrators and the planners alike. Under these circumstances planning of natural resources are the only solution to multi pronged agro- economic and socio- economic problems.

Geography of resources is concerned with the utilisation of natural gifts in area differentiation of economic phenomena.

Resources literally means the description of all the accessible and available wealth of the universe. Resources are those aspects of mans environment which facilitate the satisfaction of human wants and the attainment of social objectives. Unused wealth is not real resources, but merely a potential sources of the wealth of the nations. Only thus resources may become real economic goods or wealth. For instance, William J. Baumol(1951) still thinks that natural resources have a dominant role in economic growth. On the other extreme, Roy F. Harrod(1948) who refuses to attribute any role whatsoever to natural resources in his famous growth model. Third world countries where level of development is still very low, natural resources are of considerable importance. Most of these countries are laking capital, technical knowhow and enterprise, therefore only limited substitution of capital and labour for land and other natural resources is possible. Keeping in view these problems of the underdevloped countries, W.A. lewis (1955) asserts that the level and pattern of development of a country is often limited by its natural resources.

Resources geography deals with conditions on the earth, the distribution of people as biotic factors on the surface of

the earth and finally the relationship of man to the various resources. Man is actively engaged in changing the face of the earth, often in an appallingly destructive manner. According to Marsh, " man disrupts the fundamental harmony or balance of nature " (Akirsh 1963). The earth modified by human action is a conspicious fact of historical development. Reclamation of marhlands and submerged areas in the Netherlands is cited as the greatest geographical transformation that man has brought about on the earths surface. According to Zimmermann resources is a means of attainment of given ends.

3.2 Resources

Resources are generally defined as all those things available in mans physical environment on which he depends for the satisfaction of some want or the others. In broader sense, resources would include the surface of land, which man uses not only for habitation but also for farming and many other economic activities.

(i) Resource is Dynamic or Static Concept

Resource exploitation and conservation is a dynamic concept which is usually associated with changing uses of natural

resources, causing scarcity at one time and giving the appearance of abundance at other times. The concept of resources are not a static or stand still but dynamic element experiencing continuous change and constant evolution. The relationship between man and resources is ever changing, it is essentially a dynamic and never a static. Resources and resistances exist side by side. The degree of technological development is an important factors in the solution of the problem of the optimum allocation and use of resources.

(ii) Resources are not, they become

Resources are not, they become so, because of man co-operation as stated by Zimmermann. He introduced the concept of the 'phantom pile' which can be applied to all available and useable resources. Any advances in science and technology for example that increase production which increase the " pile" but actually reduce the amount of pile. Zimmermann's" phanton pile" is also applied on land- a basic resource. Any advancement in agriculture and other technology for exampIle, that increase yields on land of a given quality act to increase the "pile". On the other hand; practices inimical to the quality of the land, such as those allowing erosion and decrease of fertility, essentially reduce the "pile". But the law of diminishing returns, which

is a very important economic law is applicable in physical and biotic resources. How much land there is to how many man is a fundamental consideration in the life of any society, not in a simple quantitative sense, but in the man - land ratio. A qualitative concept of sociologists that takes into account all the human qualities bearing on productivity and all the enviornmental aspects, both natural and cultural affecting the availability of resources.

The question of resources arise on account of any or more of the following reasons :

1. Unlimited wants and scarce Resources
2. Growth of world population and Resources
3. Scarce Resources
4. Progress of Human Civilisation
5. The Role of Scientific progress
6. Development of Material Culture

(iii) Classification of Resources

Resources, " doesnot refer to a thing or a substance but to a function,which a thing or a substance may perform. Natural resources have been defined as" all the freely given material phenomena of nature within the zone of men's activities" (Ginsburg 1957). A resoursce is demanded because it has the power to satisfy the human wants.

Resources may be natural gifts which with a country is endowed and others may be man produced. Both of these categaries of means constitute the overall resources. Depending on whether they are natural gifts or man-produced, the resource may, therefore be regarded as natural resources and cultural resources. Land, water, air,sunlight, mines, oil and gas in the earth are examples of natural resources, while the services of produces and consumes goods fall in the category of cultural resources.

In general resources are classified into renewable and non renewable resources. Renewable resources are those one which man use as much as the desires without a fear that the supply ever will be exhausted, such as water resources, air and solar heat etc.

Non- renewable resources are those resources when once they are used, they are exhausted forever. They are very scare and their supply may be limited in quantity not to be replenished when they are used. Iron, coal etc are the example of non-renewable resources.

But in this study, we are more interested to classified

resources according to their occurence or spatial aspect. In such a case resource can be classified into two broad categories -

(i) Terrestial Resources and

(ii) Marine Resources

Resources which are found on land or continent called as terrestial resources. While resouces are related to oceans called as marine resources. These can be both living and non- living resources. These resources may be renewable or non- renewable in nature.

A Terrestial Resources

3.2 Human Resources -:

The industrialisation and mechanisation of the world economy have increased the importance of natural resources as a factor influencing the distribution of population. India and many other developing countries are now passing through the phase of population explosion. It is being argued that this situation has arisen because economic development in these countries have failed to maintain pace with population growth. A country can hope to get rid of population explosion when the process of industrialisation accompanied

by urbanisation become fast and education become widespread. Human resources are an important variable in the overall efforts of development. Human beings are ends and means at one and the same time give meaning and justification to the whole gamut of activities. Appendix 1 is highlighting some demographic features of the region which are as follows:

(i) Geographical Area & Population :

Gulf of Khambhat region occuping 29.26 percent of the total geographical area of the state, while contribute 49.55 percent of the total population to the state. Considering the population of different districts, Ahmedabad ranks first among all the district of the state as well as region and accounts fees. 11.37 percent of the total population of the state. This is because of the inclusion of Ahmedabad city having a population of the 21.59 lakh in this district. Kheda is the second largest populated district in the state, it constitute of 8.85 percent of the total population. The Dangs is the smallest district accounting for only 0.35 percent of the total population of the state. But in the region lowest population is of Bharuch (5.51 percent).

(ii) Growth Rate :

The decadal growth rate of Gujarat, during 1971-81 is recorded as 27.21 percent which is higher than the all India

average 24.43 percent (Appendix II). The corresponding figure of growth rate was 29.39 percent during the earlier decade of 1961-71. The district wise growth of population during 1971-81 reveals that Gandhi Nagar district has highest growth rate of population of 43.28 percent. It is followed by Surat district (39.41 percent). Lowest growth is recorded in Bharuch with 16.76 percent.

(iii) Rural - Urban :

The district wise analysis reveals that Ahmedabad district has the highest urban population of 71.76 percent (Appendix I). This is mainly due to very high population of Ahmedabad city, which is now the Seventh largest city among all the cities of the India. Next in order of highest urban population is Surat district with 42.76 percent of urban population. Lowest urban population is in Bharuch district 18.63 percent. It is due to inadequate infrastructural facilities in the town.

(iv) Density :

The density of population in different districts of Gujarat state as per 1981 census from 23 persons per sq. Kms to 443 persons per sq. Kms (Appendix I). The highest density of 443 persons per sq. Km is in Gandhinagar district which is

also the state capital and is small in area, followed by Ahmedabad district (441 persons per sq. Km) which includes the industrial metropolis of Ahmedabad city. Next in order is Kheda district, having density of 418 persons per sq. Km, which has rich soil and the most fertile tract of 'Charotar'. Lowest density of population is recorded in Bharuch district (143 persons per sq. Km) which reflects backwardness of the district and its large size.

(v) Workers by Industrial Categories :(1981 Census) :

The distribution of population by industrial categories is one of the crucial demographic indicators which provides a fairly good indication of the economic activities and the working force.

The workers have been classified into nine main industrial categories as per 1981 census and is given as under :

I. Cultivator
II. Agricultural Labourer
III. Livestock, forestry, fishing, hunting, plantation, orchards and allied activities.
IV. Mining and quarrying.
V. Manufacturing, processing, servicing and repairs.

(a) Household industry and
(b) Other than household industry.

VI. Construction
VII. Trade and Commerce
VIII. Transport, Storage and Communications.
IX. Other services.

GULF OF KHAMBHAT

PERCENTAGE OF WORKERS TO TOTAL-POPULATION, 1981

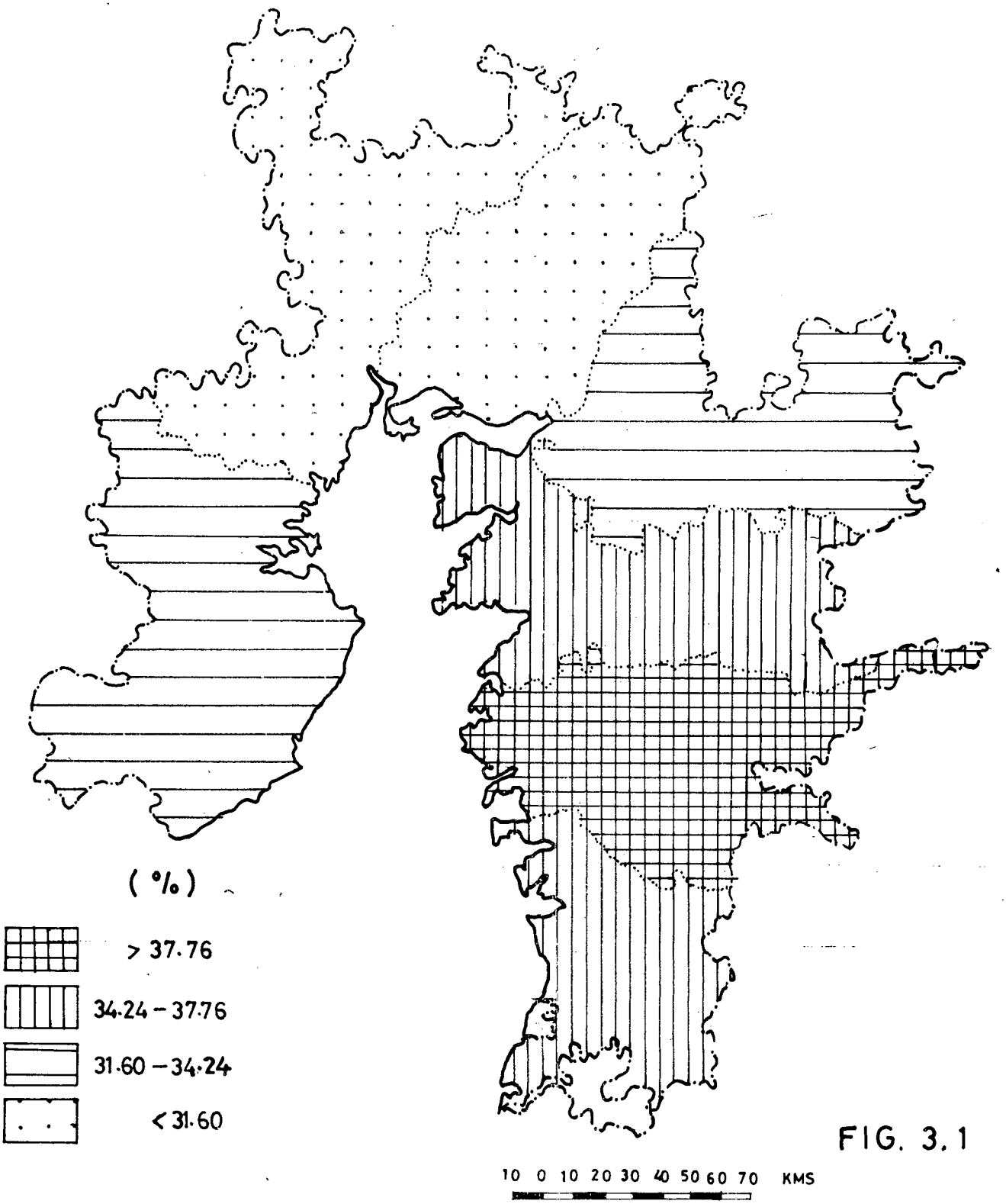

FIG. 3.1

Similarly, non-workers have been classified into seven categories as under :

1. Household duties
2. Students
3. Retired persons or rentiers
4. Dependents
5. Beggars
6. Inmates of penal, mental or charitable institutions.
7. Other non-workers.

According to 1981 census (Appendix IV) percentage of main worker to total population was 32.22 percent. Among the region it is highest in the Surat district (39.66 percent). It is because of the high percentage of workers in the secndary as well as in primary sector. Followed by Bharuch district where the percentage of main workers is 37.25 percent of the total population, which can be attributed to high percentage of worker in the primary sector. The classification of main industrial workers has been categorised into three major sectors of economic activity namely primary, secondary and tertiary sectors.

(1) Primary Sector - I + II + III

(2) Secondary Sector - IV + V + VI

(3) Tertiary Sector - VII + VIII + IX

Sectorwise analysis of Economic activityy in the district indicates that workers engaged in primary sector is highest

in Bharuch district 72.83 percent to total main workers. Thus it reflects that the concentration of economic activities is more in the primary sector. It is lowest in Ahmedabad district (26.93 percent) due to high rate of industraialisation and urbanisation process which has resulted worker engaged in secondary sector i.e 36.30 percent of the total main workers.

In the case of tertiary sector, it is again highest in the Ahmedabad 36.78 percent to total main workers. It is because ofthe same reasom as discussed earlier. Lowest percent is recorded in Bharuch district due to high dependency on the primary sector.

3.3 ANIMAL HUSBANDARY AND DAIRY DEVELOPMENT

Animal husbandary plays a very important role in the agricultural economy. This sector offers significant employment and income opportunities to small, marginal farmers and agricultural labourers. The main thrust of the development programme for animal husbandary has been as much on increasing the livestock products namely, milk, eggs, wool etc., as on upgrading the local strains and providing supplimentary sources of income to the weaker and vulnerable asections of the society.

GULF OF KHAMBHAT

LIVE STOCK

1983-84

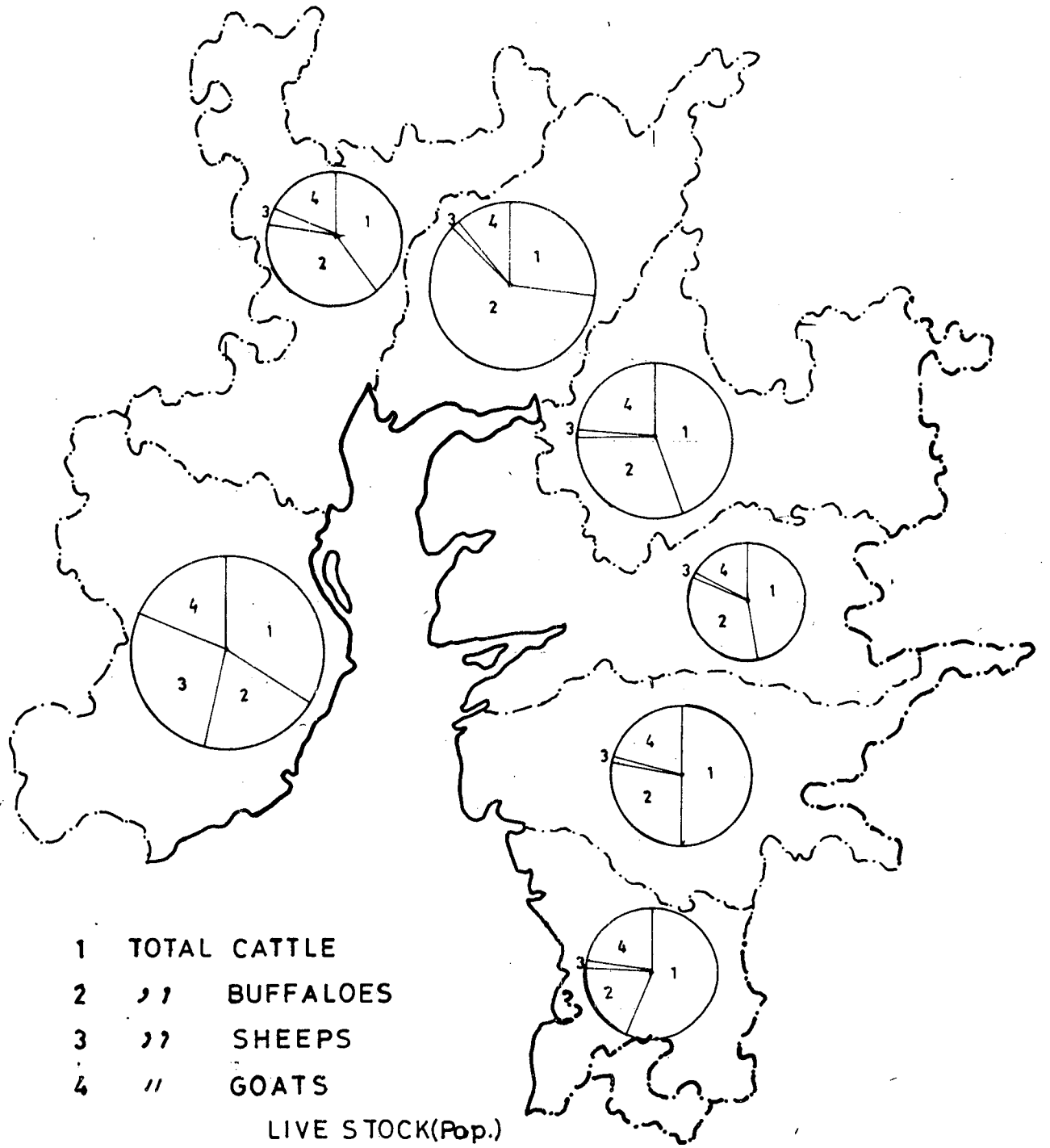

FIG. 3.2

(i) Livestock Wealth :

The main category of livestock in Gujarat state are cattle, buffalo, sheep, goat, horse, camel, mule, donkey and pigs. However, the bulk of livestock population of the state and in the region consists of first four categories.

According to 1982 census the total livestock population of Gujarat state was 175 lakhs of which Gulf of Khambhat region contribute 50 lakh livestock or 28.68 percent of the total state livestock. The region comprises 32 percent of the total cattle population, 39.96 percent of total buffaloes, 17.96 percent of sheeps, 30.34 percent of goats and 65.72 percent of total poultry of the state (Appendix V).

Districtwise data on livestock and poultry highlighted that the cattle population in various district of the region varies from 3.89 percent in Ahmedabad to 6.24 percent in Bhavnagar district. Kheda district with 13.13 percent of the total buffaloes has the largest number of buffaloes in the state. It is due to dairy development in the district. Valsad with 7.85 lakhs of poultry has the largest poultry population among all the districts and accounted for 21.98 percent of the total poultry population in the state.

(ii) Dairy Development :

Gujarat is one of the foremost state in the country in the field of dairy develpment. Dairy at Anand in Kheda district based on Polson model started its butter manufacturing in the year 1915. This dairy was established with the special plants obtained from Denmark. The Kheda district Co-operative Milk Producers Union Limited, Anand organised themselves for the first time in 1948 and started supplying pasteurized milk under the Bombay Milk Scheme.

The Anand Milk Union Ltd (AMUL) dairy made a humble begining in 1948 wwith the financial assistance from UNICEF, government of Newzealand and technical assistance from FAO. The milk is supplied to the dairy by 895 village Co-operative routies of the Kheda District Co-operative Union. The net work in milk collection, processing, and distribution has been acclaimed at the National level.

The dairy industry in Gujrat has mainly developed in the Co-operative sector and is a effective instrument for bringing about socio- economic changes in rural areas and ensuring economic upliftment of the weaker section

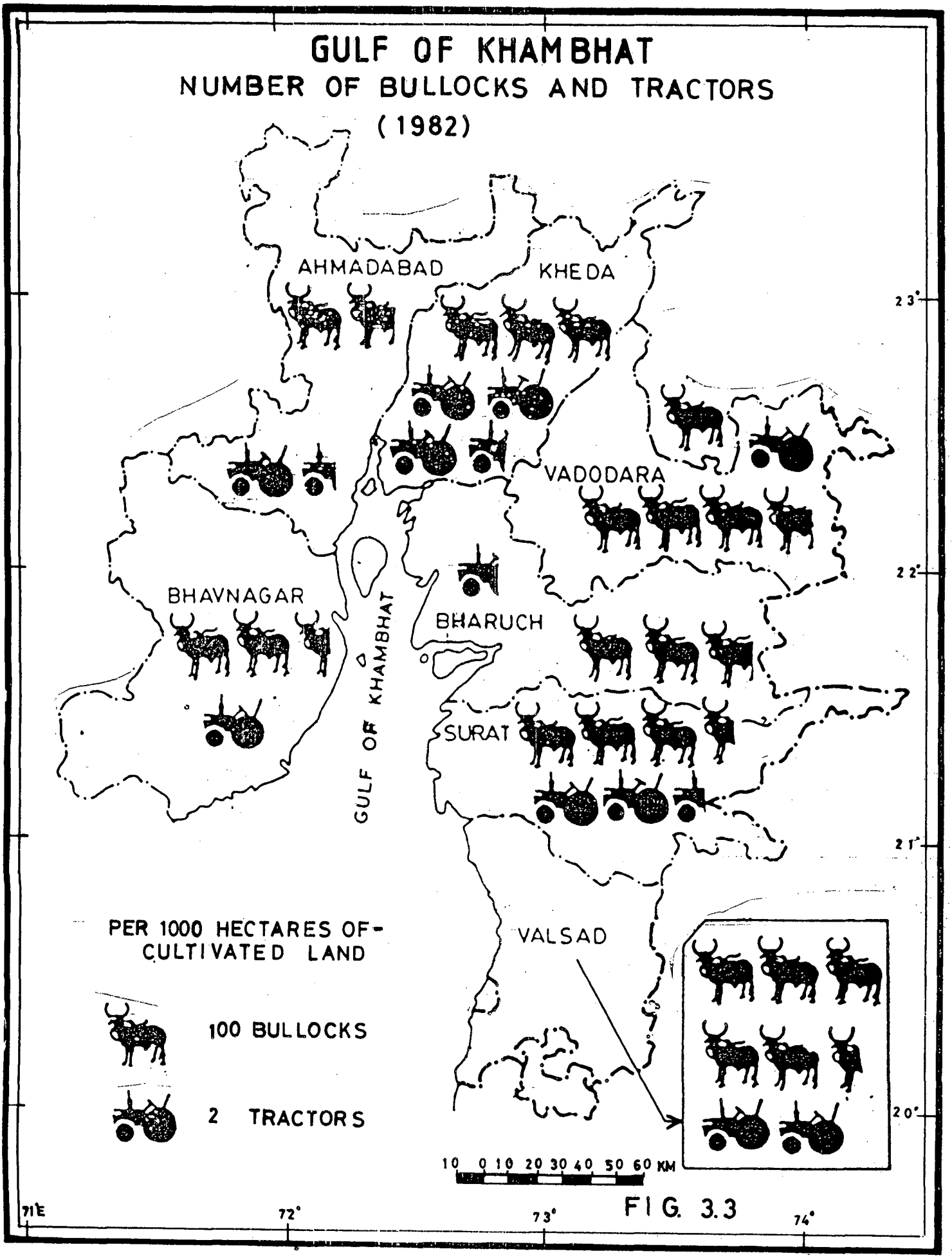
GULF OF KHAMBHAT
NUMBER OF BULLOCKS AND TRACTORS
(1982)
AHMADABAD
KHEDA
VADODARA
BHAVNAGAR
BHARUCH
SURAT
VALSAD
GULF OF KHAMBHAT
PER 1000 HECTARES OF-
CULTIVATED LAND
100 BULLOCKS
2 TRACTORS
10 0 10 20 30 40 50 60 KM
23°
22°
21°
20°
71°E
72°
73°
74°

FIG. 3.3

by providing them means of supplementing their income. Under the "Operation Flood" programme- I of July 1970, six districts of the state were covered in which three were from this region namely, Kheda, Vadodara and Ahmedabad. Under this programme, expansion/ establishment of dairies, cattle feed factories and technical inputs have been provided and this has resulted in the increase of the installed capacity of dairies covered by the operation flood programme to the extent of 8.50 lakh liter of milk a day.

The "Operation Flood" programme II started in October 1980. In Gujrat, 16 district were covered under this programme in two clusters. All the seven districts of the region were covered under this scheme. Curently "Operation Flood" programme III is in operation. The aims of the 'Operation Flood' programme is to provide remunerative price to rural milk producers by linking the producing centres wilth urban consuming areas, thereby helping in the enhancement of milk production and ensuring supply of quality of milk to consumers. It is an integrated programme for dairy development based on the Anand model co-operatives.

3.4 Forest Resources

The role of the forests and tree vegetation in maintaining environmental equilibrium has been well recoganised. They assist in the global cycling of water, oxygen, carbon and nitrogen. They level stability to hydrological system reducing the severty of floods and promoting the recharge of streams, springs and groundwater. Trees keep the soil from washing off, mountains sides and sand from blowing off, deserts. They help to hold top soil on agricultural fields. Forests house millions of plants and animals species that will disappear if the forests are destroyed. The environmental deteriration is brought out by rapid industrialisation. In recent it has brought into sharp focus the dangers of annihilation facing humanity.

(i) Economic Aspects of Forests

Forest play a vital role in the economy. They not only supply timber, fuel, fodder and a variety of other products but also have a moderating influence against floods and soil erosion and help to maintains soil fertility. Several industries such as construction, furniture, paper, plywood, matches and tanning depend on forests for supply of raw materials.

Forests by virtue of their proximity to rural populace can play a key role in creating employment opportunities in rural areas. The present and future demand for major and minor forest produce can be met by providing more avenues of employment in the forest sector. The planned output of forest products will contribute to the economic progress and also create employment opportunities for large sections of tribal and other population living in these areas.

Besides checking denudation and erosion in mountainous regions and catchment areas of rivers, forests provide grass and grazing crops for livestock. It helps in preserving ecological and environmental balance.

Ecologically the forests of Gujarat can be classified into three zones. The southern zone lying south of the river Narmada is in being the high rainfall region supports luxurient growth of valuable timber trees. The central zone between Narmada and Sabarmati is in the moderate rainfall region supports a medium type of forests capable of producing small timber, fuelwood and grasses. The northern zone north of Sabarmati river,

Kachchh and Saurastra penisula is in the semi arid zone supports only a scrub of vegetative growth and produces mostly grass and some firewood. Gulf of Khambhat region mainly comes under the first two zones.

(ii) Types of Forest

The forest of the region can be classified into the following types.

Moist deciduous forests occur in regions with an annual rainfall of over 1200mm. They are found in the southern-most portion of the region comprising Surat and Valsad districts. These forests are concentrated in the eastern portion of these district. These forests form the main source of commercial timber in the state.

Dry mixed deciduous forests thrive in regions with a rainfall between 600mm to 1200mm. These forests are found in the central part of the state comprising Bharuch and Vadodara districts of the region. They produce teak of low quality, timber, bamboos and firewood.

Dry scrub forests are found in Bhavnagar district of the region. It occurs in the region with less than 600mm rainfall, in small patches.

Mangrove forests are found in the Ahmedabad district of the region, in small patches.

For administrative purposes the forests have now been divided into six territorial circles. There are 22 divisions under six circles and two divisions under Gujarat state forest Development Corporations.

Table No. 3.1

Name of District	Territorial Circle
1. Bhavnagar	Junagarh
2. Kheda	Vadodara
3. Vadodara	Vadodara
4. Ahmedabad	Gandhinagar
5. Surat	Surat
6. Valsad	Surat
7. Bharuch	Surat

Source: Chief Conservator of Forests, Gujarat, 1984.

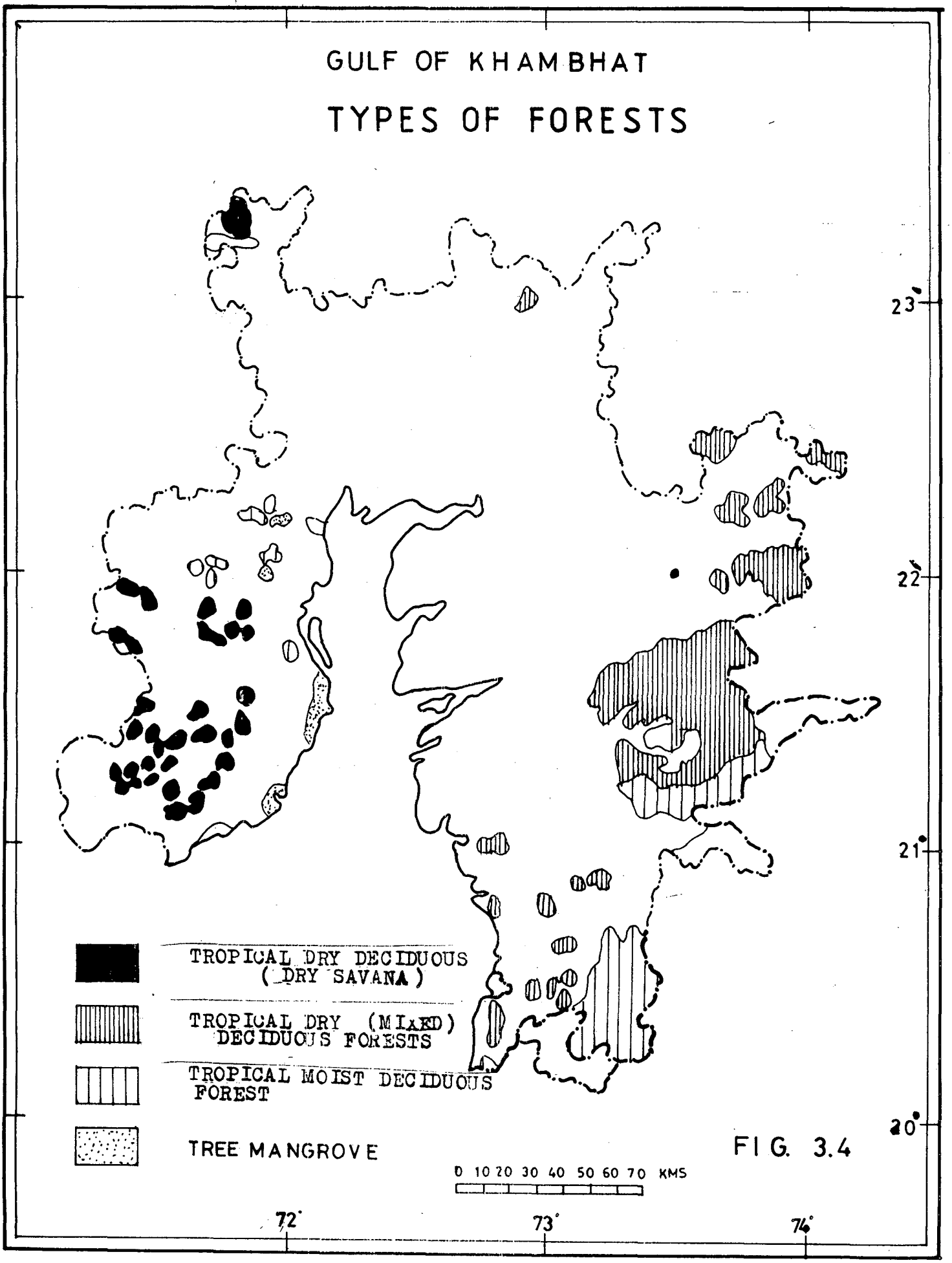
GULF OF KHAMBHAT
TYPES OF FORESTS
23°
22°
21°
20°
72°
73°
74°
TROPICAL DRY DECIDUOUS (DRY SAVANA)
TROPICAL DRY (MIXED) DECIDUOUS FORESTS
TROPICAL MOIST DECIDUOUS FOREST
TREE MANGROVE
0 10 20 30 40 50 60 70 KMS

FIG. 3.4

Table 3.2 showing divisionwise forest area reveals that the region occupies 27.87 percent of the total forest area in the state. Though the state has very little forests, it has inherited a rich variety of fauna comprising of about 40 species of mammals and 425 species of birds. The mains sanctuary and national park in this region are at Nalsarovar Bird Sanctuary(Ahmedabad), Sloth Bear Sanctuary in Dumkhal National Parks(Bharuch) Velavader Black Buch National Park(Bhavnagar), and Bansda National Park(Valsad).

(iii) Energy Plantation

Energy plantation can be defined as one that grows plant material for its fuel value. These plants have the unique capacity of converting solar energy into biomass by a process of photosynthesis. Wood as a find has benefits as under:

(a) It is one of the cheapest fuel both on the basis of weight and unit of heat.

(b) Wood fuel is a renewable natural resource with relatively short time cycle.

(c) No special storage facilities are required and the same time it can be stored safely for long periods.

(d) Fuelwood has no sulphur content and therefore there is no air and other population hazard.

Table No. 3.2
Divisionwise Forest area, 1980-81.

D I V I S I O N	A R E A (Sq. Kms)
Surat Circle	
Vyara	984.91
Rajpipala (East)	1140.98
Rajpipala (West)	780.57
Vadodara Circle	
Chhota Udaipur	1001.57
Junagarh Circle	
Bhavnagar	381.55
Valsad Division	1189.28
	5478.86
Total Gujarat State	19657.01
% of the area to total Forest area of state	27.87%

Source: Chief Conservator of Forest, Vadodara.

3.5 Mineral Resources

The mineral constitutes the basis for industrial development of a region. Its support many basic industries by providing raw materials. It is necessary to explore the mineral resources system atically and exploit them judiciously, so as to get the maximum benefits. Though State is not rich in metallic minerals, there is abundance of non-merallic minerals. Important minerals are limestone, magnese, bauxite, lignite, guesun, china clay, fire clay, felsbar, dolomite, glass, benotonite, agate, sand, quartz, pipe clay, soapstone etc. The figures relating to the latest available reserves of the important minerals in the state are given in table no. 3.3

Mineral resources can be grouped into the following way.

1. Non-metallic Minerals

   (a) Building Materials such as Building stone, sand, cement etc.

   (b) Mineral chemicals for example salt sulphur, asbestos, gupsum etc.

   (c) Gens such as agate, bergl, garent, zirson etc.

2. Metallic Minerals :-

   (d) The ferro - alloy metals such as iron, chromium, cobalt, nickel, tugston, magnese etc.

Table No. 3.3

Districtwise Production of major Minerals.

(Production in Tonnes)

Sr. No.	Minerals	District	1961	1971	1981
1.	Agate Stone	Bharuch	3004 (99.4)	722 (97.3)	1686 (100)
2.	Bauxite	Kheda	19468 (7.8)	10841 (4.9)	7282 (2.6)
		Valsad	-	-	-
3.	Calcite	Bhavnagar	-	8658 (92.13)	-
		Vadodara	-	-	-
		Bharuch	-	-	910 (53.5)
		Surat	-	-	-
4.	China Clay	Bhavnagar	-	-	-
		Surat	-	-	-
5.	Dolomite	Bhavnagar	-	-	3466 (1.7)
		Vadodara	4441 (100)	121779 (100)	196983 (98.2)
6.	Feldspar	Vadodara	-	15 (100)	-
7.	Limestone	Kheda	382934 (50.13)	318617 (13.79)	195123 (6.8)
		Vadodara	2313 (.30)	15914 (.68)	1098 (.04)
		Bharuch	-	-	25549 (.9)
8.	Quartz	Vadodara	-	1173 (4.04)	100 (.21)
9.	Chalk	Bhavnagar	-	32 (.065)	-
10.	Moulding Sand	Bhavnagar	-	4470 (92.9)	4265 (77.18)

Source: Statistical Abstract of Gujarat State 1986.

(e) Non - Férro or Semi - previous metals for copper, zinc, lead, antimony, aluminium, magnesium etc.

(f) The previous metals such as gold, silver, platinum etc.

3. The mineral fuels or power resources such as coal, petroleum etc.

3.6 Petroleum and Natural Gas

Petroleum excercises a deep influences or modern industrial civilisation. The discovery of oil and natural gas in commercial quantities has raised the states importance on the mineral map of the country. The efforts of oil and Natural Gas Commission (ONGC) to locate oil and natural gas started in the year 1957. In the alluvium covered central area of Gujarat, oil and gas in commercial quantity have been found. Generally, the depth of occurance of oil and gas is between 1200 metres to 2000 metres. Some fields have oil and gas at higher or lower depth. Ceaseless efforts are continuing in terms of seismic survey, geological assessment, drilling, production and creation of infrasructure to keep pace with production of oil and gas.

The Ankleshwar oil field is the largest procedure of

associated gas. The other type of gas, termed as 'non-associated' gas, occurs as a free gas and the important fields producing such a gas are Khambhat, Kalol and Sanand. The oil of Ankleshwar fields is of good quality yielding a large percentage of valuable higher fractions on distillation. The quality of oil north words deteriorates, and the north- west fields of Halol and Lanwa have very viscous and heavy oil

3.7 Water Resources

Water is a substance without which all life on earth would perish. By its presence in the atmosphere,it tempers the sun's heat, the rain that falls scours the hills and carries the sediment into the river valleys and deltas. The water that percolates into the rock crust of the earth may penetrate to great depth and take part in the formation of mineral deposits and emerge in the form of thermal springs. In its deeper reactions, it may lower the melting points of highly heated rocks and may be discharged as stream during volcanic eruptions. In the polar regions, water accumulates as great ice caps which may influence climatic and geographical changes by their increase or decrease in extent and thickness. Agriculture requires vast quantities of water. Water is a vital source of energy and provides important means if inland and ocean transportation. The

other operations performed by water are those of erosions. The water in the world goes through its own cycle, which is known as the hydrologic cycle, a sort of circular journey from ocean to sky and back to ocean again. The Hydrologic system in the largest natural system. But a major part of it is in the oceans and seas and this is the water that is available in the lakes, rivers and springs and underground which provides the main supplies of water for use. The utilisable water is approximately only 0.03 percent of total.

(i) Uses of Water :

The available water is apportioned for various types of requirements in accordance with 'need based' priorities. The priority of uses may change from region to region and time to time. The following priority of uses is normally followed for water planning.

(i) Domestic & Industrial use.

(ii) Irrigation

(iii) Hydropower.

(iv) Flood control

(v) Navigation & Fisheries

(vi) Pisciculture, wild life preservation, Recreation etc.

sometimes in flood affected regions, flood control might be given higher priorty over irrigation and or hydro-power.

(ii) Water resources can be classified into two broad categories on the basis of occurances :

(1) Surface Water and (2) Ground water

Surface water consists of rivers, lakes, canal, tank etc.. Rivers are dominant in the Gulf of Khambhat region. Water that is contained in the soil and underlying rock is called as ground water. Ground water may be derived from rain water that percolated down or from water that was trapped within the rock during its formation. The water percolates down to get gathered above impermeable layers of rock; eventually all the pore space above this layers become saturated with water forming the ground - water zone, the upper surface of which is the water table. This may emerge at the surface as a spring.

(iii) Surface Water :

Major surface water consists of rivers and river basins. Other source of surface water is dealing in the irrigation section.

A large body of flowing water constrained in a channel which may be defined as river. The term river is used for the main trunk of a drainage system. The catchment

GULF OF KHAMBHAT

RIVER BASINS

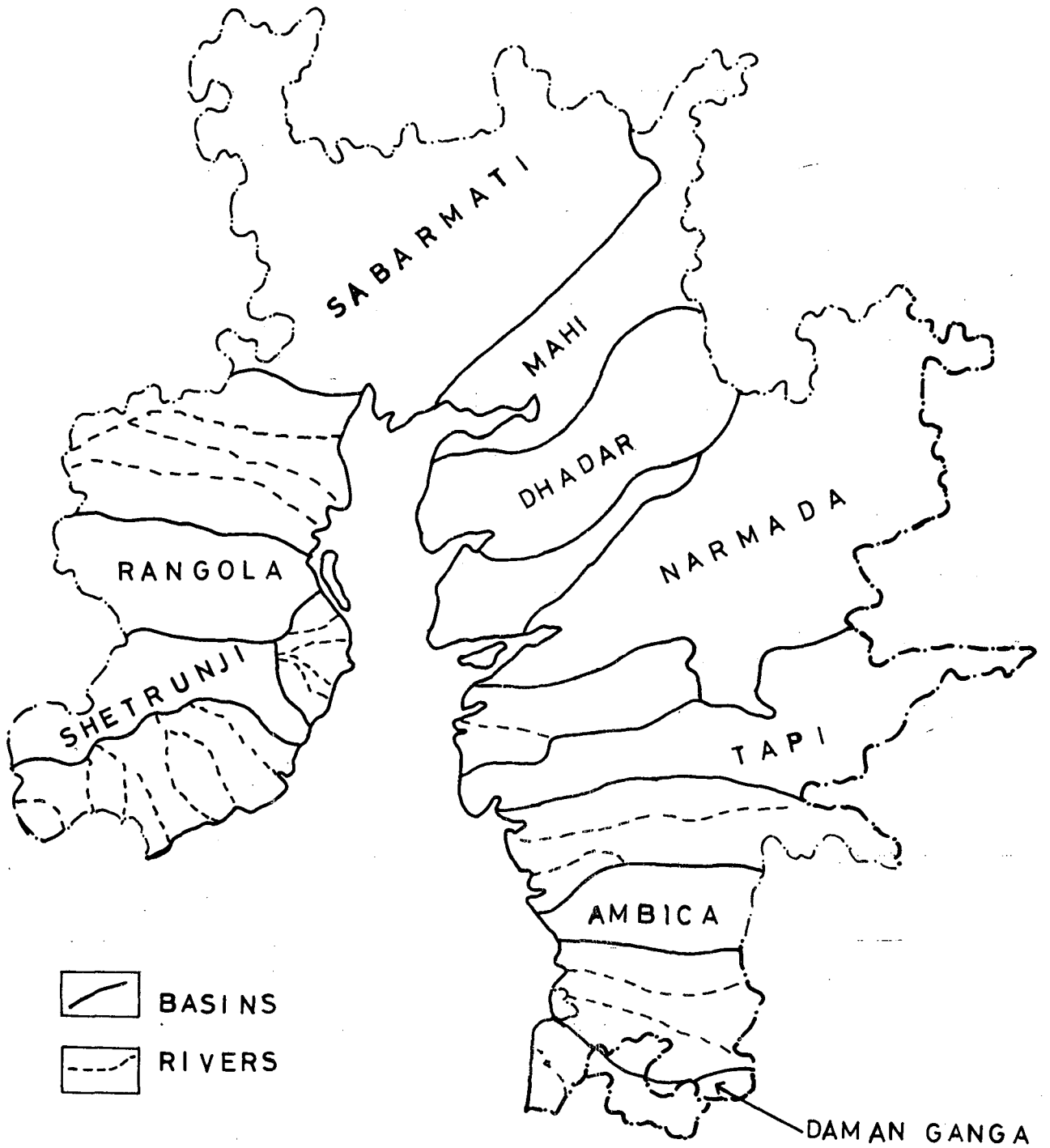

FIG.3.5

Table No. 3.4

Basinwise data on Cultivated and Irrigation Areas for Major Basin in Gujarat State.

(in thousand hectare)

Sr.No.	BASIN	Cultivable area	Net sown area	Gross sown area	cropping intensity (%)	Net irriga. area	Gross irrigat area	Irrigation intensity %
1.	Total Sabarmati Basin	1548	1264	1403	111.00	250	318	127
	Gujarat State	1343	1184 (88.16)	1299	109.71	226 (19.08)	285	126
2.	Total Mahi Basin	2210	1598	1799	112.58	189	270	143
	Gujarat State	806	750 (93.05)	836	111.47	102 (13.60)	166	163
3.	Total Narmada Basin	5901	4499	4762	105.84	220	284	129
	Gujarat State	837	738 (88.17)	753	102.03	85 (11.52)	94	111
4.	Total Tapi Basin	4292	3800	3965	104.37	208	222	107
	Gujarat State	169	149 (88.17)	155	104.03	16 (10.74)	17	106

Source : India's Water Wealth by K.L. Rao, Orient Longman Ltd., 1975.

or drainage area from which water is callected into the river varies widely from river to river. The water from the catchment flows into the main river through a number of tributaries and subsidary streams. The pattern of the tributary system depend on the physical characteristies of the area, nature of rocks and their erodibility. The shape of the catchment influences the run off pattern of the river. Thus the hydrograph of a river with a semi - circular catchment, is high and narrow, while in the case of a narrow rectangular catchment, it is broad and shallow.

Sarbarmati Basins :-

Sabarmati river rises in the Aravali hills and has a total length of 300 Km in which 120 Km runs into the Gulf of Khambhat region. The total drainage area of the river is 21,674 Km^2 which 48.44 percent (10,500 Km^2 in this area. Its main tributaries are the Sei, Wakul, Harnav, Hathmati and Watrak rivers.

Mahi Basin: Mahi river rises in the Vindhyas at an elevation of 500 metres and drains an area of 34,842 sq. Km^2 of which 10.9 percent (3800 Km^2) lies in the study area. Its length is 533 Km of which 100 Km is in this area. The principal tributaries are the Som, Anas and Panam rivers.

Narmada Basin : The river rises near Amarkantak in Madhya Pradesh at an elevation of 900 meter and has a total length of 1312 Km in which 180 Km lies in the study area. The total drainage area of the river is 98,796 Km^2 of which 9.08 percent or 8925 Km^2 in the study area. It has a number of falls in the head reaches.

Tapi Basin : Tapi river rises near Multai in the Betual district of Madhya Pradesh at an elevation of 730 Metres. The total length of the river is 724 Km of which 190 Km is in the study area. Its catchment area is 65,145 Km^2 of which 5.8 percent or 3800 Km^2 is in this region. The important tributaries joining at are Purna, Vaghur, Girna, Bari, Punjhra and Aner rivers.

River basin area of the other important river are as follows. Rangola river which flows eastward in Bhavnagar district having 1200 sq Km of basin area. Shetrunji which is also eastward river have a basin area of 1800 sq. Km in area. Dhadar Ambica which are the westward river occupy 3700 and 1700 sq. Km of river basin respectively.

Table No. 3.5

Surface and Ground Water Resource

Sr. No	River Basin	Annual precipitation (cms)	Total available Water resource		Utilisable water resource		Water per hect. of culturable land (cms)
			Annual Surface run off (ahm)	Annual ground water recharge(ahm)	Surface water (a hm)	Ground Water (a hm)	
1.	Tapi including Kim	78	1.97	0.61	1.46	0.406	58.40
2.	Narmada	121	4.01	1.24	2.96	0.710	89.00
3.	Mahi including Dhadar	83	1.18	0.35	0.87	0.253	68.20
4.	Sabarmati	76	0.37	0.27	0.27	0.065	41.40

Source: Second India Studies - Water, M.C Chaturvedi, p12

(iv) Ground water Resources :

Ground water may be defined as the subsurface water in soils and rocks that are fully saturated. Ground water is the earths largest accessible store of fresh water and excluding ice sheets and glaciers, have been estimated to account for 94 percent of all fresh water. Half of this water is held within 800 m of the ground surface (Price, 1985)

A geological formation comprising layers of rocks or unconsolidated deposits that contains sufficient saturated material to yield significant quantities of water is known as an aquifer (Lohman, 1972). Other formations that are much less permeable and can only transmit water at much lower rates tham the adjacent acquifers are commonly known as aquitards (Freeze and Cherry, 1979; Price 1985). Most of the major aquifers are composed of sedimentary deposits formed from the erosion and deposition of other rocks. In contrast, igneous and metamorphic rocks, formed under conditions of high temperatures and pressures, generally have few interconnected pore spaces and consequently have only low water bearing capacity. The form of an acquifer is

determined by the geological conditions. A common distinction, depending on the presence or absence of an overlying acquitard or confining layer, is made between confined and unconfined acquifers.

(v) Confined and Unconfined acquifers:

The upper boundary of the zone of saturation varies according to whether the groundwater is confined or unconfined. In the case of unconfined groundwater, this boundary is normally known as the water table, which is defined as the level where the purewater pressure is equal to atmospheric pressure (Lohman, 1972).

In the care of confined groundwater, the upper boundary of the water body is formed by an overlying less permeable bed. The distinction between unconfined and confined groundwater is often made because of hydralic differences between the flow of water under pressure.

(VI) Ground water situation in Khambhat region.

The hydrological properties of various rocks in the region are described in a summarised way, here under

Archaean and Proterozoic rocks –

These are found in extensive areas in Baroda and Kheda district. Because of their very poor porosity and permeability these rocks viz. gnesses, schists, phvuites quartzites and metamorphosed igneous intrusives do not form good acquifers. In only favourable localities where sufficient weathered zone occurs and/or fractured and jointed rocks occur, dug wells, dug cum bored wells and borewells are feasible.

Deccan trap are essentially basaltic lava flows consolidated with a general horizontal to near horizontal disposition, over a very wide area. From the ground water point of view these are promising. The thickness of traps is more than 1000 m in the Khambhat region.

Tertiary formation are exposed between Narmada and Tapti rivers in parts of Bharuch and Surat district. It is made of sandstone, shales and limestones with gravel exceeding 100 m in thickness. The water in these rocks is mostly brackish to saline, moderate discharges could be obtained from shallow tubewells.

Quaternary formations includes millolite limestones, the alluvium and aeolian deposits. Their thickness in the

GULF OF KHAMBHAT

GEOLOGY

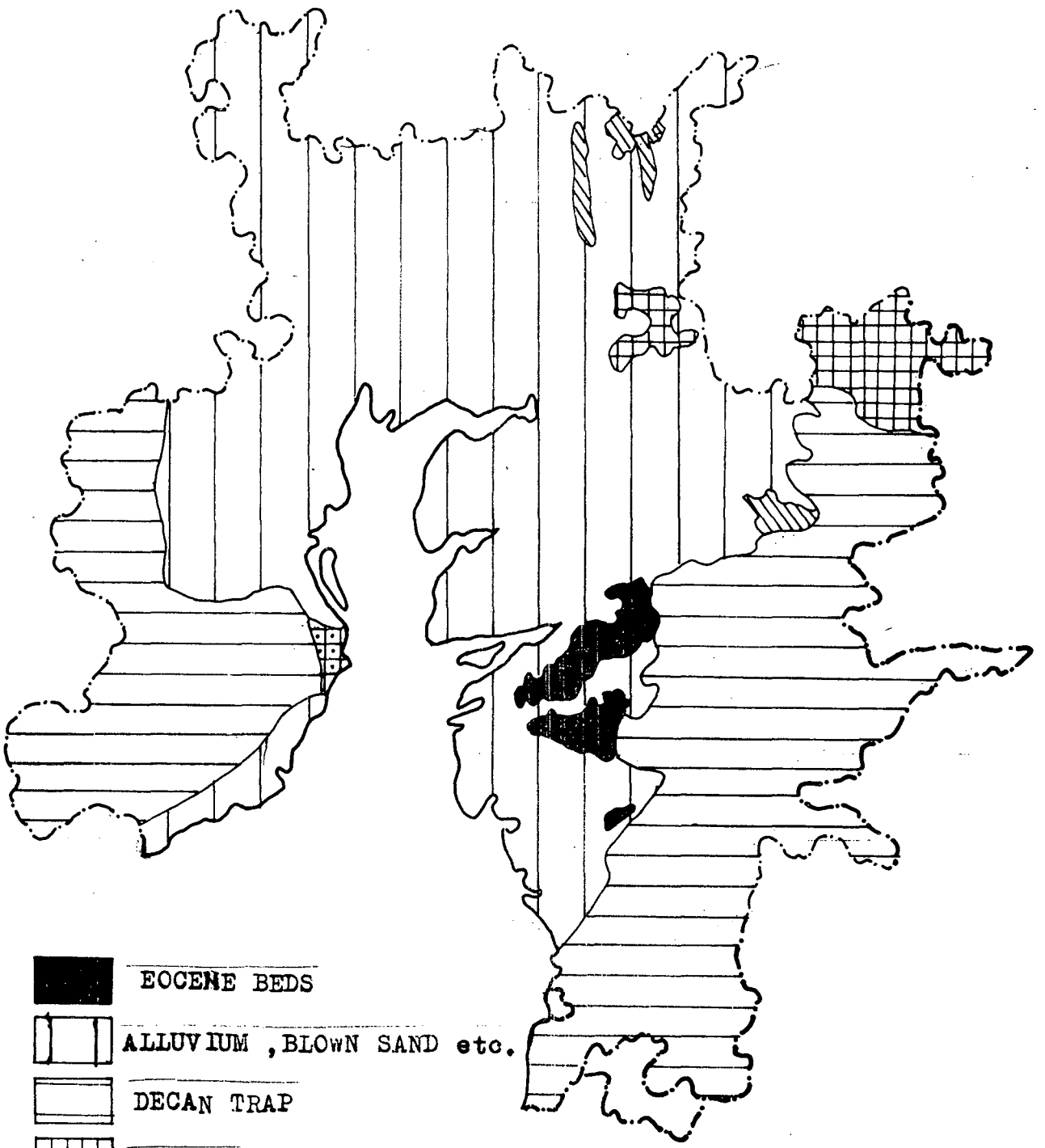

FIG. 3.6

Khambhat basin is estimated to be of the order of 700 m. In the southern part of the region the alluvium overlies mostly the basalts and the Tertiary srediments. Its thickness varies from a few metres near the rock outcrops to over 75 m in lower reaches. The quaternary sediments vary in character and composition in the Khambhat basin. These are predominantly composed of clay, silt and sand with Kankar. Towards the hilly tracts the proportion of grand, pebbles and boulders etc, increases. Such areas forming the piedmoint terrain extend from 10 to 20 km from the hills into the basin. Ground water in the alluvium occurs under water table conditions in the shallow depths. In deeper horizons it occurs under semi- confined to confined and flowing artesian conditions.

VII Assessment of present and ultimate requirements of ground water: (Appendix VI and VII)

The Ground Water Estimation Committee has recommended that 15 percent of the total ground water resources be kept reserved for drinking and industrial uses. These estimates of demand for drinking and industrial uses should be revised after every census. Districtwise Grand water potential is calculated in the Appex. VII.

The study area comprises 9316.51 MCM/Yr of total ground water resources. The highest percentage to total ground water resources in a region is in Surat district (21 percent), followed by Kheda (17.2%) and Bhavnagar (14.3%)

There are high due to nature of soil, rock strata, and drainage pattern of rivers. Lowest percentage is recorded 9 percent in Bharuch district.

Provision for domestic & industrial uses are calculated from the total ground water resources. It has been mentioned in the column number third of the Appendix no. VI, VII.

Utilisable ground water resource are being computated from the total ground water resource which is 85 percent. It is decribed in the column number four.

Gross draft and net draft are given in column number five and six of the (Appendix VI, VII).

Gross draft is calculated by looking into account the various indicators such as the rainfall and imfilteration of water into the soil, horse power of the pumps, number of wells and duration of pumping hours.

Net draft is calculated with the gross draft and it is fixed to 70% of the gross draft. It is indicating the

total quantity of water which is drafted from ground water table.

Balance is worked out from the utilisable groundwater resources minus net draft. It is given in the 8th column of the table.

Land of ground water development is computed in the percentage terms with the following formula :

$$\text{Level of ground water development} = \frac{\text{Net draft}}{\text{Utilisable ground Water resources}} \times 100$$

Net irrigation requirement is estimated by the groundwater commission in taking into account various parametrs for each district. It is varying from district to district. But it is fixed for all the talukas of the same district.

$$\text{Irrigation potential created in ha.} = \frac{\text{Net draft}}{\text{Net irrigation requirement (m)}}$$

$$\text{Ground Water balance} = \text{Utilisable ground water resources (ha. m/yr)} - \text{Net Draft (ha. m)}$$

$$\text{Balance irrigation potential from ground water ha.} = \frac{\text{Ground Water Balance}}{\text{Net irrigation requirement}}$$

GULF OF KHAMBHAT
AREA SUITABLE FOR DIFFERENT MODES OF GROUND-WATER DEVELOPMENT, 1986

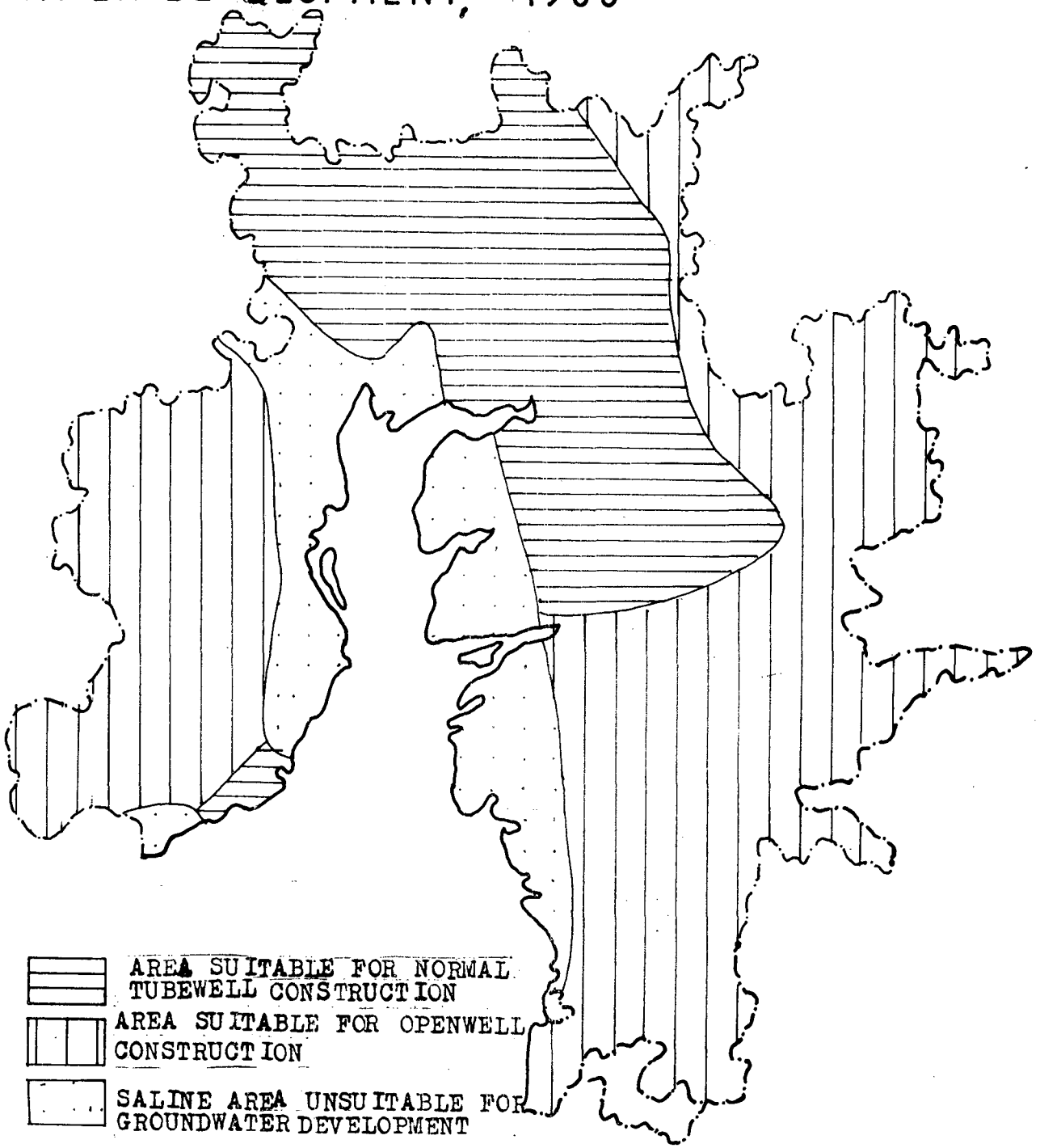

FIG. 3.7

Ultimate irrigation potential from ground water ha.	=	Irrigation potential created in ha.	+	Balance irrigation potential from ground water ha.

Level of ground water development.

The levels of ground water development for phreatic (confined) acquifers are calculated for each districts (Appendix VII). It is 17.62 percent for the Gulf of Khambhat region which is lower than the state average (30.81 percent). Among districts it varies from 37.06 percent in Bhavnagar district to 9.73 percent in Bharuch disrict. It basically depends on the utilisable ground water resources and quantity of net draft. Because net draft is high 418.92 percent in the Bhavnagar district,which has resulted in high degree of ground wate development.

Taluka wise study of confined acquifers reveals that the levels of ground water development ranges from 53.95% in Bhavnagar taluka to 3.20% in the Vagra taluka of Bharuch district.

The study of unconfined aquifers is given in the Appendix VI. This includes both the district and taluka

wise study. It reveals that irrigation potential created in ha is highest in Bhavnagar district 32.3 percent and lowest in Bharuch district 3.9%. It is because half ofthe district of Bhavnagar falls in the scarcity area. Thus more water should be drafted from the ground water resources to meet the drinking and other requirements.

While the ultimate irrigation potential from ground water is maximum in Surat district (21.6%) and lowest in Bharuch district (7.3%). This shows the maximum limit of ground water which can be exploited.

Talukawise study has also been done on the same line. Net irrigation requirement is a fixed value for all taluka of a same district. Ultimate irrigation potential from ground water is calculated for all the coastal talukas of the study region. This value is the sum of irrigation potential created and balance irrigation potential from ground water. This value is highest in Navsari taluka 73528 ha. and lowest in Hansot taluka (3724 ha.). These value are also shown in map.

Last column of the table is highlighting the additional number of wells feasible for 100 percent level of ground water development.

GULF OF KHAMBHAT
coastal taluka irrigation
1983-84

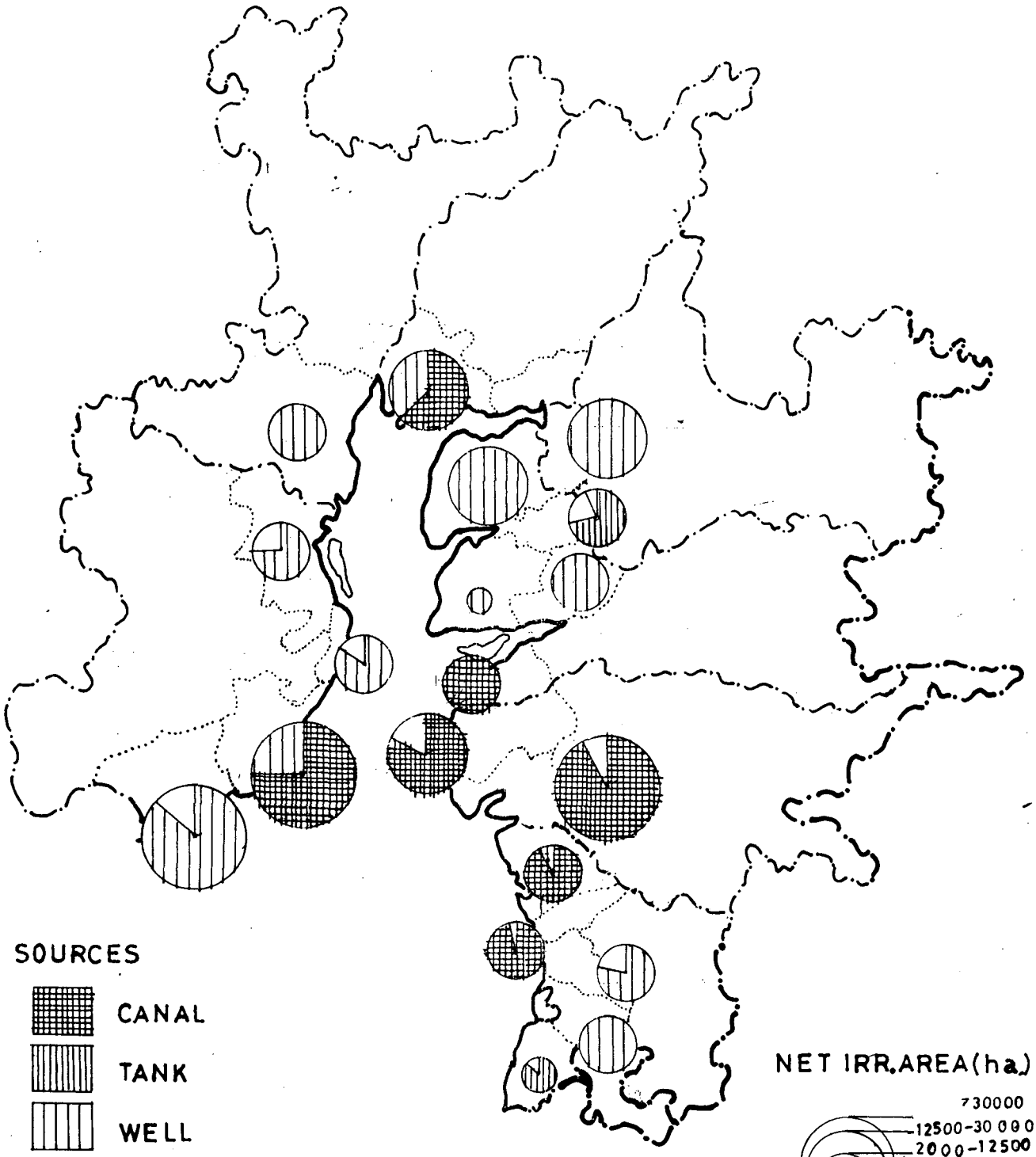

FIG. 3.8

Based on the resource estimates, large ground water potential is still available for development in the state of Gujarat. The growth rate of ground water development for irrigation has considerably reduced in the last few years, which is broadly due to high increase in the capital costs of the ground water abstraction structures. Although the ground water irrigation is less expensive and less time consuming, it is felt that a farmer utilising the facility of flow irrigation gets water at a heavily subsidised rate. Ground water irrigation also needs to be subscribed if the national objective of harnessing the entire ground water resource is to be achieved by 2005 A.D.

3.8 Irrigation

The economy of any region is largely based on agriculture. Thus the development of agriculture plays a pivotal role in economy. It is therefore, necessary to have improved and efficient agriculture. Secondly, the standing crops are also required to be protected from the uneven and at times inadequate rainfall. This can be done by extending irrigation facilities which would provide the farmers with assured and timely supply of water. Irrigation water is the

primary and major input necessary to increase the agricultural productivity, at least so far as it has the potential to increase the cropping intensity.

Proportion of gross area irrigated to gross area shown varies from district to district (Appendix VIII). While this percentage is higher in the gulf of Khambhat region (25.83%) to states average (25%). It is highest in the Kheda district (49.33%), followed by Bhavnagar district (27.09%), and Vadodara district (25.34%). It is lowest in Bharuch district (9.57%).

The major source of irrigation is wells (including tubewells) which contributed 67.8% of the total area under irrigation in the year 1983-84, which was lower than the state average 79.2%. Districtwise analysis of area irrigated by different source of irrigation reveals that canal irrigation is significant in Ahmedabad, Valsad, Bharuch, Surat and Bhavnagar district where it varies from 40 percent to 33 percent. But even the prime importance is given to wells irrigation. It is highest in Vadodara district (92.8%), followed by Kheda (65.5%) and lowest 52.5 percent in Valsad district.

The share of tank irrigation and other source is low as 4.1

and .34% respectively in the study area. Talukawise study of irrigation by source is given in appendix VIII. This study reveals some important features.

Some costal taluka of the region is 100 percent irrigated by the well i.e. Dhandhuka (Ahemdabad district), Jam Busar (Bharuch district) and Padra (Vadodara district). These areas are rich in groundwater resources and wells irrigation are more economical than other source of irrigation. It also high hights availability of high water lable. This area is drained by Bhadar, Mahi and Dhudhar rivers. Percentage of wells irrigation is lowest in Navsari (1 percent), Charasi (3 percent), and Olpad (7 percent).

Canal irrigation per hectare to net irrigated area is highest in the Charasi and Navsari talukas with 96 percent each to net irrigated area. These talukas are irrigated with Tapi and Ambica rivers respectively. It is followed by Olpad (91 percent), Talaja (75 percent), Khambhat (69 percent) and Gandevi talukas (52 percent).

Tank irrigation is prominent in Amod talukas where its share to net irrigated area is 65 percent. This area is drained by the river Dhadhar followed by Pardi talukas which is drained by river Par.

The appendix VIII also reveals that percentage of not irrigated to net sown area is highest in Olpad talukas (70.25 percent) to lowest in Vagra taluka (.07 percent). It is depends on the condition of land, drainage pattern and land use pattern, which varies from taluka to taluka.

Gujarat is one of the State with limited water resources. Basinwise studies have revealed that only 21.6 maft. of water can eventually be harnessed in the state the ultimate irrigation potential of 53.05 lakh hectares available in the state through major, medium and minor irrigation including groundwater resources. The irrigation potential of 28.80 lakh hectares (54 percent) has been harnessed so far, whereas the harnessing of groundwater resources is as much as 89 percent of the ultimate potential. The harnessing of surface water resources is only of the order of 36 percent of the ultimate potential. With a erratic pattern of rainfall and due to resultant uncertaintees in agricultural production, the need far an integrated approach towards land and water has been felt. The entire approach to the soil and water conservation programme has now been changed to watershed approach in order to reap the benefits of erosion contral and water conservation.

3.9 Marine Resources

No one can deny the fact that certain mineral reserves on land are getting depleted. Demand and competition for these resources are on an upward spiral as more and more countries industrialise. Due to these conditions, man is being forced to look toward the sea where mineral resources have been virtually untapped. Marine resources is defined as all types of "water use" resources under and on the seabed in the water itself and on the water's surface (Calberg 1982). The coastal zone areas and seas have traditionally been used for fishing and shipping.

During recent years the marine environment and its natural resources have attracted other interests. Conflicts between different types of utilisation have become apparent and have increased the need for knowledge about the marine environment as well as planning for the use of sea areas.

The coastal zone plays a key role in marine life. Photosynthesis is greater here than in the open sea. It is here that several animal species have their reproduction and growth areas, including those that normally live in the open sea. But above all it is in the coastal zone that there is an increasing interest concerning the utilisation of marine resources.

Table No. 3.6
Districtwise information of crafts and tackles, 1982 Census

Sr. No.	Name of District	Mechanised Boats	Non Mechanised Boats	Total Boats	% of total	Total Nets	% of total
	Total Gujarat	3926	6641	10567	-	512800	-
1.	AOhmedabad	2	-	2	.04	491	.17
2.	Bhrauch	-	1095	1095	24.96	73930	25.90
3.	Bhavnagar	2	32	34	.77	4630	1.62
4.	Kheda	-	2	2	.04	2872	.87
5.	Surat	-	864	864	19.07	119531	41.9
6.	Vadodara	-	339	339	7.7	12811	4.49
7.	Valsad	910	1140	2050	46.7	71140	24.93
		914	3472	4386	100	285405	100
		(23.3)	(52.3)	(41.5)		(55.6)	

Source: Bureau of Economics and Statistics, Government of Gujarat, 1985.

Resources are of two basic types: the renewable and non renewable and could be further classified with specific reference to the nature of a resource. Both renewable and non renewable resources are available in large quantities in the ocean. Presently most of the fish catch come from off Asia, the production level being 73.4 million metric tonnes. It is well known that hydro-carbons by for the most valuable found in very substantial quantiy, under the bed of the sea. As and 20 percent of the worlds petroleum products come from sea and may reach 50 percent by the year 2000 A.D., waves and current, besides other like thermal difference, salinity gradient etc could become immense source of energy. This will also be useful for the multipurpose economic development of the poor, tropical and sub tropical countries, which is lacking hydrocarbon deposit, provided appropriate technology is available to them.

Sea floor mineral deposits include all unconsolidated sediments lying on the floor. Present commercial production comprises of sands, gravels, corals, limeshells and relatively small quantities of tin, titanium and iron. Potential sea floor mineral resources are, however, immense and comprises of both oozes and clays, phosphorites and

magnese nodules, and the newly discovered polymetallic sulphides and cobolt crusts.

Resources of the Indian coasts can be classified under two broad heads;

(A) Living Resources

(B) Non- living Resources

A Living Resources: The upper most layer of 100 m of the sea is the zone of maximum importance to man kind for the exploitation of natural living resources. This is the zone where most of photosynthesis occurs. It forms about 1.8 percent of the world ocean. Presently 50 percent of the worlds fish catch is obtained from this zone. The region occuping this zone are either fairly close to the coast or in very fertile areas of the coastal and offshore upwelling regions (Qasim S.Z,1983). With the 200 mile exclusive economic zone India has jurisdiction over the living resources in approximately 5,87,600 nautical miles of the Indian Ocean. Some important resources are fish, sea weeds, mangroves, coral reefs and mariculture etc.

3.10 Fisheries

Fishes occupy nearly every available acquatic habitat. Fish are a vital source of food, especially in countries like Japan, Norway, Sweden etc. Fish are rich in animal proteins. In addition to use as human food, large quantities of fish and shell fish are used in the maunfacture of by products.

Fish whale and other marine animal oils have a large number of industrial uses. They are used in the treating of leather and in the manufacture of soap, paint, printing ink, linoleum, oil cloth, lubricants and greases and many other products.

Gujarat is a major maritime state of India with a long coastline and accounts for about 1600 km or 25 percent of countrys total coastline. It produces 15 percent of the total marine fish production of the country. In addition, the state has excellent resources for developing inland fishries. These resources include village ponds, major rivers, several major, medium and minor irrigation dams / check dams /reservoir estuarine areas, low lying saline marshy lands and man grone swamps. These afford excellent scope for inland fish capture and culture fisheries, estuarine fish culture and breakish water fish farming.

The Gulf of Khambhat region contributes the 32.16% or 525 K.M of the total coastline of the state. Districtwise information of crafts and tackles (1982) highlighting (TableNo. 3.6) that the region comprises 23.3. percent mechanised and 52.3 percent of non-mechanised boats of the state. It is highest in Valsad district which sharing 46.7 percent of the total region. The region also occupies 55.6 percent of the total nets of the state. It is highest in Surat (119531) followed by Bhaurch district (73930). These infrastructural facilities indicates the development of fisheries in these region.

According to the fishing department survey Appendix IX Gulf of Khambhat region covers 56 out of 100 fishing talukas of the state. This area occupies 36 percent of marine fishing village, 87% of freshwater fishing villages and 93 percent estuarine fishing village of the state. Marine fishing villages are highest in Valsad district which constitute 45.6 percent of the region. Surat account for 42 percent of the fresh water villages in this region while Bharuch ranks tap (44.7%) in estuarine villages in the region.

Population engaged in fishing and related occupation is given in appendix X. This indicates the talukawise

population of coast of the region. Three talukas namely Umbergaon, Valsad and Navrasi constitute more than 50% of the total fishing population of the region.

The main objectves of fisheries development in the current plan is in the marine sector to increased production, organisation of intensive assessment surveys and optimum exploitation of marine resources.

Marine Fish : Gujarat, with a long coastline, has rich marine fish resources. Most of the present fishing is confined to near shore water upto about 50 m depth. The coastal belt of Gujarat provides a large number of tidal rocks and low laying potential resources. Most important commercial varities of fish includes Bomfrets, Bombay duck, Dhoma, Indian Sahnon, Hika, Goldara, Mullet, Labsters, Seer, Fish Perch, Prawn, Silver bar, eel etc.

The Gujarat fisheries Aquatic Science Research Station and Okha has undertaken various research projects to contribute to the increase of fish production of rear pearl, oysters, window pane oysters, see weed culture and to develop exportable and commercial varities from various marine fish products.

There are three agencies which have pioneered surveys on

fisheries resources. These are the Deep Sea fishing Organisation, the integrated Fisheries Project (Nanda J.N, 1983). The FAO have estimated that Indian ocean surface fishery has potential yield of skipjack of around 3,00,000 tonnes per annum.

Inland Fisheries : The river systems of Narmada, Tapi, Mahi, Sabarmati, Ambica, Par, Damanganga, Dhadhar, Bhadar, Shetrunji and perenmal village tank and along with other small rivers and sweet water swamps form rich potential resources for development of inland fisheries. The important species of inland fish catch are catfish, hika, mullets, catla, sohu, mrigal, pranens, herings, perches etc.

Keeping in the view of potentiality of resources available for inland fish culture, arions production oriented and employment generation programes have been formulated. These includes intensifying survey of brakish water with scientific approach in fish culture establishing more fish seed, production farms, nurseries and improving village tanks, ponds and reserviors for augmenting fish production.

Table No. 3.8
Districtwise Production of Inland Fish

(in tonnes)

Sr. No.	District Name	1978-79	1979-80	1980-81	1988-89
	Gujarat State	15651	16343	17331	22314.8
1.	Ahmedabad	305 (2.06)	2388 (15.5)	3473 (21.0)	983 (5.8)
2.	Bharuch	8976 (60.8)	8896 (57.7)	9686 (58.6)	11148 (66.5)
3.	Bhavnagar	2 (.01)	-	-	35 (.2)
4.	Kheda	386 (2.6)	356 (2.3)	588 (3.5)	1629 (9.7)
5.	Surat	830 (5.6)	1056 (6.8)	914 (5.5)	1493 (8.9)
6.	Vadodara	4133 (27.9)	2597 (16.8)	1628 (9.8)	1168.6 (6.9)
7.	Valsad	134 (.9)	135 (.87)	230 (1.4)	293 (1.7)
		14766	15428	16519	16749.6
		(100)	(100)	(100)	(100)
		94.34	94.40	95.31	75.06

Table No. 3.7

Total Fish Production in Gulf of Khambhat Region

in tonnes

Year	Inland	Marine	Total	% Growth Rate	% to total state prod.
1978-79	14766	5624	20390	-	52
1979-80	15428	7383	22811	11.8	10.2
1980-81	16519	10011	26530	16.3	11.23
1988-89	16749	25534	42283	59.37	9.69

Gujarat Fisheries 1978-79 to 1988-89, Commissiones of Fisheries, Government of Gujarat, Gandhinagar.

Production Trends : Gulf of Khambhat region has contributed to 52 percent of total fist production of the state in year 1978-79 (Table no. 3.7). It is having decreasing trend over period of time. The percentage has declined to 10.20 percent in the year 1979-80, 11.23 percent in the year 1980-81 and 9.69 percent in the year 1988-89

Growth of fish production of the study region is highest 16.3 percent per annum in the year 1979-80 to 1980-81. It is merely 59.37 percent during the period 1980-81 to 1988-89. Thus the growth rate also trend to be on decreasing trend.

TABLE NO. 3.9

.Districtwise Marine Fish Landing in Gulf of Khambhat Region

1978 - 79 to 1988 - 89

Sr. No.	District Name	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1986-87	1987-88	1988-89
	Gujarat State	22997	206749	218872	220607	192669	223290	315938	327560	414075
1.	Ahmedabad	-	-	-	-	-	-	-	-	-
2.	Bhrauch	1694 (30)	1158 (15.7)	1701 (17)	1293 (11.3)	1105 (8.9)	2592 (15.2)	1425.8 (8.6)	1879 (7.4)	1912 (7.4)
3.	Bhavnagar	424 (7.5)	822 (11.1)	1249 (12.5)	760 (6.6)	1155 (9.3)	1824 (10.7)	737.3 (4.4)	1203 (4.7)	1250 (4.9)
4.	Kheda	280 (4.9)	251 (3.4)	343 (3.4)	366 (3.2)	1108 (8.9)	1824 (10.7)	993.6 (6.0)	843 (3.3)	2315 (9.0)
5.	Surat	844 (15)	797 (10.8)	1212 (12.1)	1334 (11.6)	1127 (9.1)	1255 (7.4)	1857.8 (11.3)	1008 (3.9)	1531 (5.9)
6.	Vadodara	-	-	-	-	-	-	-	-	-
7.	Valsad	2382 (42.3)	4355 (59)	5506 (55)	7695 (67.2)	7847 (63.6)	9542 (56.0)	11444.8 (69.5)	20554 (80.6)	18526 (72.5)
	Total	5624 (100)	7383 (100)	10011 (100)	11448 (100)	12342 (100)	17037 (100)	16459.3 (100)	25487 (100)	25534 (100)
		24.4	3.57	4.57	5.18	6.40	7.62	5.2	7.78	6.16

Gujarat Fisheries 1978-79 to 1988-89, Commissioner of Fisheries, Government of Gujarat, Gandhi Nagar.

Production of Inland fish is given table no 3.8 . The region constitute around 90 percent of the state production during teh period 1978-79 to 1980-81. But in the year 1988-89 it constitute only 75 percent of the state production. It was due to the sudden decline in the production of Ahmedabad district. Bharuch was leading in fish production during 1988-89 with 66.5 percent to the total production in the region followed by Kheda (9.7%), Surat (8.9%) and Vadodara (6.9%).

Marine fish landing (Table no. 3.9) constitute 5 to 7 percent of the state production in the region during the period 1986-87 to 1988-89. Valsad was dominating in the marine fish productilon with its share 69.5 to 80.6 percent in the same period. The region is having increasing trend from year 1986 to 1989. During the period 1986-87 to 1987-88 it achieved 54 percent of per annum growth rate while in 1987-88 to 1988-89 the growth rate was only .18 percent per annum. In the year 1986-87 maximum landing was in Valsad (69 percent) followed by Surat (11.3%) and Bharuch (8.6%). But during 1988-89 situatilon has changed. Valsad remains the same position with 72.5% of the total production of the region but Kheda with 9.0% was second and finally Bharuch 7.4 percent.

Brakish Water Fish Farming : As per the report of the national Commission on agriculture Gujarat has about 3.67 lakh hectares of coastal fallow lands which has varying degrees of potential for brakish water fisheries. The state ranks second only to W. Bengal in vastness of the area. The survey indicated 132 sites in the state. The state initially took up the work of establishment of some pilot scale brackish water fish farms. The farms envisaged were under three different agr-climatic conditions. These are located at Mundra, Talaja and Navsari talukas in the state. Some other survey ,was done by MPEDA Cochin and CICEF Bangalore with the intention of setting up a regional pilot scale farms. The potential area available is about 5000 ha. and the area where micro survey is done is 1300 ha. The area which is saline-land can be develop as Brakish-water fish culture and may be feasible in future with availability of fresh water through irrigation canals.

3.11 Marine Energy

The ocean is a store of energy due to solar influx. The ocean which covers about 71 percent of earths surface acts as a natural collector of solar energy. Thus, the oceans has an enormous potential to supply energy in many different ways.

The major advantages of oceanic energy is that it is renewable and continous through out the year, pollutionfree and has minimum health hazards. For remote islands ocean energy will be the most important form of alternative energy since it comes from the immediate vicinity.

Various forms of oceanic energy:-

The forms is which the ocean energy could be tapped are: Ocean Thermal Energy, Wave Energy, Tidal Energy, Salinity gradient energy, Offshore wind energy, energy from marine currents and energy from marine bio-mass:

i Ocean Thermal Energy Conversion : It is the most important form of oceanic energy for a country like India having a long coast line of tropical waters. The principle behind OTEC is quite simple. It utilise the temperature difference existing between warm surface of sea water around 28 c and the cold deep sea water of around 5' to 7' c, which is available at depth of 800 to 1000 m in tropical waters.

India is having more than 3 lakh sq. kilometres of tropical water in the exclusive economic zone (EEZ) where sufficient temperature gradient exists throughout the year. The OTEC plant locations are around Laksh

deep, Andaman and Nicobar islands. The total OTEC potential around India is estimated to be more than 50,000 MW which is about 150% of our total installed power generating capacity. The urgent thrust is develop OTEC technology indivenously.

ii . Wave Energy : The incessant motion of sea surface in the form of wind - waves constitute a source of energy which is continually being replenished. About 1.5 percent of the incoming energy from sun is converted to wind energy. Part of the energy from th winds is transferred to sea surface resulting in the generation of waves. This energy is carried to coastlines throughout the world where it is dissipated as the waves break. If this energy can be tapped and used economically it can provide a sizeable portion of world energy needs.

The Indian coast of around 6000 Km in length have the wave energy potential in aproximately 60,000 M.W. But the wave energy potential along the Indian coasts is not as high as in the northern latitude countries. Therefore a wave energy system purely to generate electricity from the waves may not be commercially viable in the near future.

iii Tidal Energy : Tidal power development has gone through long stages of development and two tidal power stations have been in operation for more than a decade. First is Rance plant in France and second is at Kislaya Luba /in USSR. A tidal range of 3 to 4 meter in considered viable for installing a tidal power plant. The total tidal resources of the oceans have been estimted at 3 x 106 megawatts, of which only 2 percent is suitable for harnessing.

There are quite a few sites in India suitable for tidal power development but all these sites are clustered in two or three areas only. According to the study conducted in 1975 by an UN experts, Mr E. Wilson indicated a theoretical possibility of installing very large tidal power station in the Gulf of Khambhat, Kutch and smaller power stations in Sunderbans area. Installed capacities of about 7300 MW, 1000 MW and 15 MW, in the Gulf of Khambhat, Gulf of Kutch and Sunderban areas respectively are possible. The corresponding estimated costs (1975) are Rs. 1925 crores, Rs 600 Crores and Rs. 15 Crores respectively. The Gulf of Khambhat scheme may require a barrage of 40 m height and about 30 Km long. The 7300 MW plant at

Gulf of Khambhat, if installed, will be able to contribute about 20% of India's installed power capacitiy. Realising the great potential, Gujarat state electricity board and Department of Energy, Government of India have jointly taken up a detailed project study in collaboration with Electricity de France, the pioneer who built the Rance plant. An important wind generator has been installed for the first time in India to operate a light a light house at Kanai Greek (Gujarat) with a power output of 300 watts.

iv The energy from salinity Gradient is represented by the osmotic pressure difference between the sea - water and the fresh water which is very high. In India , Sunderbans and other deltaic and esturine points are potential places for generation of energy from the salinity gradient in near future.

v The magnets hydro-dynamic generator (MHD), uses geotropic currents and long strip that is wound with a flat wise, the following current produces an eletric current produces an electric current of 5 m ho/m.

vi Marine Biomass while wet, undergoes anceroebic decomposition, there by producing gaseous mixture of

co2 and ch4 with the possibility of using residues as an excellent fertiliser. Two main marine biomass energy resources being (1) the gaint sps Macrocystic Pysipera and (2) Garcitaria Hilvaniae.

vii Geothermal energy is associated with riftzones and volcanic activity, but currently it appears that only in coastal and insular situations would be tapping of such energy be warranted economically.

3.12 **Mineral Resources :**

The ocean has been repeatedly labelled as the 'last frontier' and claims have been made that metals can be hanked from the sea at 50-70 percent of the most of launching. The sea ores are often highly concentrated. Maganese rich nodules have been hailed as a bonanza that would help the economy of developing countries.

Mineral exploration will undoubtedly be influenced by recent development in the plate tectonic theory. Three types of environment are areas of major igneous activity: 1. spreading plate boundaries 2. Subduction zones and 3. hot - spot of rising mantle rock are deposits have been shown to be associated with each of these zones.

Mineral deposits of economical interest are quite different from the surrounding sea - floor materials : this allows their spotting and identification, for example on density, seismic velocity, magnetism, electricl and thermal conductivity, indeed polarisation and chemicalproperties.

Marine resources can divided into three main categories 1. Minerals from the continental scheme 2. Minerals from Deep Sea Floor and 3. Minerals from Sea Water.

Minerals from the continental shelves and slopes :

The most important minerals extracted from the continental shelves and slopes are petroleum and natural gas. Due to the even increasing demand for oil as a fuel and power source, off shore drilling has rapidly increased from an almost negligible amount in 1945 to five "million barrels daily in 1969 which accounted for sixteen percent of the world's total production and should be double to reach a third of that production by 1980." (Cowan R.C 1970). The most modern concept of offshore in late 1940's and early 1950's. It is noted that the production of petroleum and natural gas is not confined to the shelf and slope areas but in the deep sea floors as well. Excluding petroleum and natural gas the total production of all other minerals extracted from all

aspects of the seas in relativelly minor (Nelson, 1968). Sand and gravel is found throughout the world in the continental shelf areas. It is dredged heavily in the more populated coastal areas mainly because of its value as a building materials and low cost. Phosphorite, chrefly used in the manufacture of chemical fertilisers, is found in abunbance in several areas of the continental sheves throughout the world. Gluconite is a hydrated potasium, iron, aluminium selicate and is relatively unimportant economically but is unique as it is found exclusively in marine shelf areas. Some other minerals mined from the continental shelves are tin, gold, diamond and barium sulphate.

ii Minerals from the Deep Sea Floor : There are two minerals economically important enough to be mined from the deep sea floor. They are maganese modules and phosphorite moudles. Methods for mining the seabed are primary the senote controlled unmanned deep sea crawler and the deep sea drug dredge.

iii Minerals from Sea Water : There are three minerals mined commercially from sea water, common salt bromine and magnesium along with some of its compounds.

3.13 Resourse Regions :

The resource regionalisation may help in planning for balanced growth in the region with marked disparity in levels of develpments (Sen Gupta 1967). The concept of regionlisation for economic utilisation of resources in India is recent. A survey of these efforts is presented by Sunderban (1980). A critical analysis of regionalisation experiments carried out after independence is presented by Pal and Learmonth (1964). In the evolution of this concept, a transition from physioeconomic regionalisation to resource particularly energy resources regionlisation is becoming promient (Sengupta & Sdasynk 1968). Homogeneous natural similasities ar used as criteria to identify "physio - economic regions". One of the first works of then nature is of Rao (1949) in which he stressed that regionalisation is a dynamic concept which aims at the optimum utilisation of regional resources. In 1964 he with Bhatt proposed a new regional frame work for resource development in India. The report prepared by Nath (1965) for the planning commission in worth mentioning in this respect. Inspite of these attemps, the states still are officially used planning regions. Therefore, their resource potentials and development trends are being intensively innestigated.

The credit of application of the concept and principle of integrated economic regionalisation in India is to sengupta (1962 & Sengupta and Sdaryuk 1968). The basic principle of economic planning is an effort to bring about the fullest development of natural resources through production specialisation in regions for which they are specially suited. To discover such regions evalution of resource indownments of natural regions is necessary. The size of these micro units vary according to the size and distributional pattern of natural resources.

Resource Regions of the Gulf of Khambhat region.:

The delineation of resource regions within the Khambhat region is based on attributed of resources and their present exploitation patterns. Procedure is illustrated elsewhere (Sharma 1975, pp 324). It is started with the demarcation of land units. It is because the land is the basic resource and the nature of terrain plays crucial role in framing the set up extra territorial factors bearing an resources and it has deep effects on their utilisation. Accordingly, the region has been divided into landform units, considering structure, lithology and bold geomohphic character. From these land form units, super - imposing on maps of resource endowments and use pattern, resource regions have been carried out. in

GULF OF KHAMBHAT

RESOURCE REGIONS

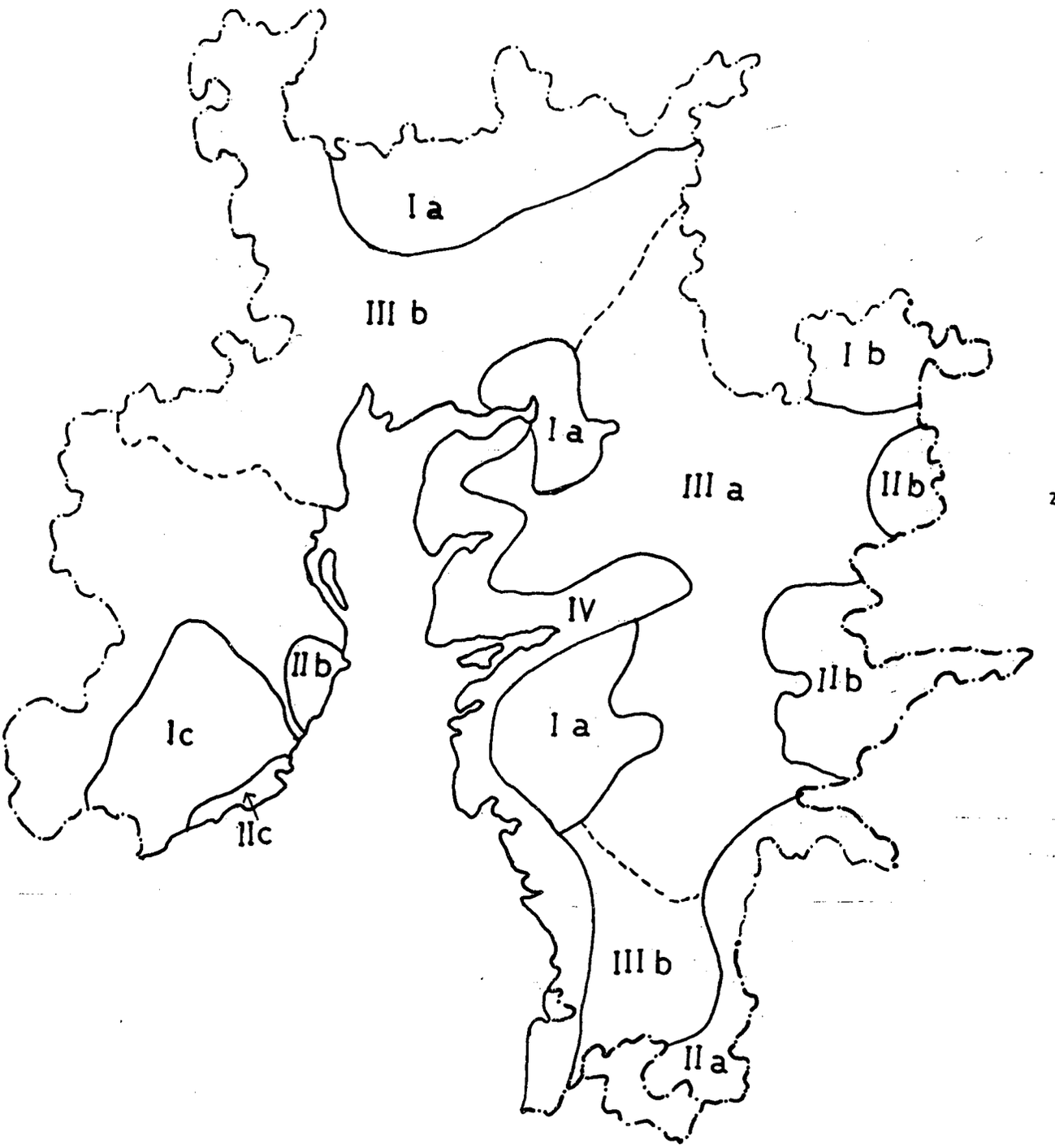

FIG. 3.9

framing of these regions population distribution, crop combination, agricultural efficiency and possibility of agricultural expansion are specially noted. the Khambhat region is thus divided into four macro resource region and nine mass resource regions as follows:

I. Mineral based Industrial Region

   a. Petro - chemical Industrial Region
   b. Electricals and Machine Industrial Region.
   c. Calcite and Moulding sand based industrial region.

II. Forest Regions.

   a. Moist deciduous
   b. Dry Moist deciduous
   c. Mangroves

III. Agriculture and Agro - based industrial region.

   a. Cotton Textile region (black soil region)
   b. food grain region (alluvial soil region)
   c. Oil seed industrial region
      (dry land farming region)

IV. Coastal Marine Resource Region.

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UTILISATION PATTERN AND GROWING PRESSURE AND IDENTIFICATION OF FRAGILE REGION

India and many other third world countries are now passing through the phase of population explosion. It is being argued that this situation has arisen because economic development in these countries has failed to maintains pace with the population growth. The thrust of this argument is that since rapid growth of population causes poverty and proves to be a barrier to development. These countries should take care of their population growth if they seriously wish to solve their poverty problem and put their economy on the path of economic development.

Recent studies contends that since independence, India has sucessfully managed to avert faminies (Sen. Amartya, 1982) with the rapid growing population, the other resources are not increasing with the same pace which has resulted heavy pressure on the resources. This has also resulted in growing unemployment, low standard of living, declining land - man ratio and low rate of capital formation. The fast growing population is also affecting the present cropping pattern, availability of food grains, process of deforestation with the heavy pressure on arable land, decrease in land holding and finally rapid growth of urban population and pollution

problem. "Indian population problem is manageable up to the year 2001 even under the highest projections of population growth and income." (Parikh K.S, 1976)

4.1 Population Growth

Appendix II is showing the decadal population growth at the district level. The growth of total population of the state increased from 2.68% to 2.93% per annum in the period 1951-61 to 1961-71. It declined to 2.70 percent per annum in the period 1971-81. The rural population is declining over the period of time, it was 2.94% (1951 to 61) to 2.23% (1971-81). But the urban population is increasing very rapidly which is evident from the decadal growth of 20.07% in 1951-61 to 41.00% in the period 1961-71 and 41.42% during 1971-81. It indicates the rapid process of industrialisation and urbanisation in the state.

Districtwise growth trend of population reveals that the decadal growth during the period 1951-61 was highest in the Ahmedabad district (32.55%) while lowest in Valsad district (21.38%). High rate of population growth was due to immigration plus natural increase of population in Ahmedabad district. During the period 1961-71 in decadal growth

Ahmedabad maintained its first position with 36.62% growth. Lowest was recorded in the Kheda district with 23.96%. One important feature of this growth was that the highest point to point increase with the previous decade was recorded in Surat district (40 percent).

In the last decade 1971-81 highest decadal growth was in the Surat district (39.53%) while lowest in the Bharuch district (16.84 %). It reflects the rapid development of industries in the district.

4.2 Decadal Variation in the Rural - Urban population

Districtwise ayalysis of the rural - urban growth reveals that, Gujarat is the highly urbanised state in India, which is followed by Maharastra and TamilNadu. Decadal growth of urbanisation during 1951-61 was maximum in the Valsad district (47.20%) and lowest was in Bharuch district (3.72%). During next decade (1961-71) highest decadal growth was recorded in Surat district (67.15%). It was 148 percent increase over the previous decade. Followed by Vadodara district which was having 51.75% decadal urban growth. Lowest growth was marked 27.43% in Kheda district. Between 1971-81 decade the position of urban growth was same as in

GULF OF KHAMBHAT
DIST & COASTAL TALUKAS
POPULATION- DECADAL GROWTH, 1971-81

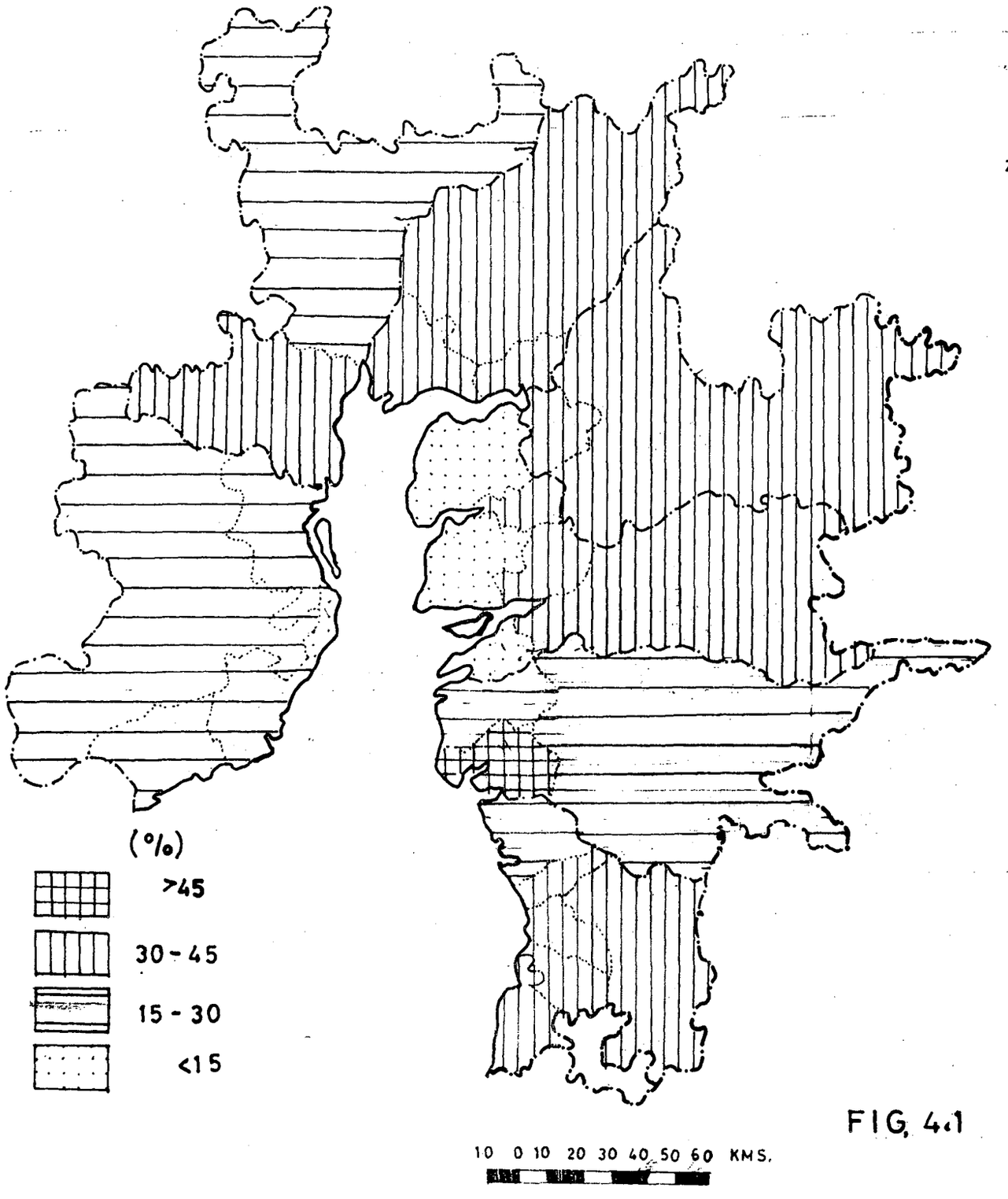

FIG. 4.1

(1961-71) with (76.89%) and minimum was in Kheda (23.99%). Kheda district showed the declining trend in the urban growth. The decline of decadal urban growth was maximum in Bharuch district 43.22%.

Rural population growth indicates declining trend in all the district of the region except Bhavnagar and Valsad. Highest decline over 1951-81 was recorded in Ahmedabad district (48.88%) which was followed by Bharuch (47.6%). These districts are highly urbanised and out-migration from the rural areas resulted in declined rural growth.

4.3 Land-Man Ratio

It is asserted that the pressure of population on land has been steadily increasing and with it land-man ratio is becoming increasingly adverse. Since independence though the country has recorded a rate of population growth which is unprecedented for the sub-continent, and the density of population has reached a level which would have looked quite alarming in the early decades of the current century, yet the country has not only succeeded in breaking the low level equilibrium trap but has also made some advance on the path of development.

The growing pressure of population on land has also resulted in sub- division and fragmention of holding. On these fragmented holdings, it is contended that there is not much scope for raising the farm procductivity, The presence of disguised unemployment is also often mentioned to reainforce the argument that further increase in population will put additional burden on agricultural land which is now finding increasingly difficult to sustain. Even though various evidences of development from other densely populated countries further confirms that there is no negative correlation between density of population and under development. But still it is treated as one of the indicator. The density of population per sq. km is shown in Appendix I.

District wise analysis for the period 1961-81 is highlighting that density is increasing in all district. Highest increase in land-man ratio was in Bhavnagar district during the period 1961-71 from 13 to 126 persons per $Km.^2$ in percentage terms 1076.6 percent over 1961. Highest density per Km^2. was in Ahmedabad district 248 person (1961), 334 person (1971) and 445 person (1981). Even though there is no trend for less

density district but Bharuch has retained its lowest position in 1971 and 1981.

However, population growth should always be seen in relation to development of productive forces. In an economy where productive forces remain arrested due to retrogressive socio-economic relations, favourable land - man ratio will be of little help.

4.4 Land Holding

Operational holding is the basic unit of decision making on agriculture and it is useful for any effectice strategy for agricultural development. It is defined as all land which is wholly or partly used for agricultural production and is operated as a one technical unit by one person alone or jointly with others without regard to title, legal form, size or location.

Average size holding (Table no. 4.1) indicates mean size of land holding in hectares. As population is growing rapidly, it pressurises the land resources which results in decreasing the average size of holdings. Table reveals that over the period of time the average size of holding is decreasing,

which is highlighting heavy pressure of population on land. Average size of holding in the Gujarat has decreased from 4.11 hectares in 1970-71 to 3.45 hectare in 1980-81 . This reduction in terms of percentage is 16.05%. Districtwise analysis shows that average size of holding was maximum 6.73 hectares for Bhavnagar in 1970-71 while lowest recorded was 1.89 hectare in Kheda district. There was not much variation recorded in Bhavnagar during 1976-77 and 1980-81, but reduction in the average size holding from 1970-71 to 1980-81 was 30.6% or from 6.73 hectares to 4.67 hectares . Small average size of holding was recorded in Valsad district. There is a direct relation in average size of holding and the population. But some other factors are also contributing in this for example lalws of inheritance, decline of joints family system, farmers indebtness, psychological attachment to land, and practice of crop sharing.

4.5 Agricultural Production Trends and Food Availability

The cropping pattern of Gujarat reveals certain special features (Appendix XII). The major food crops of Gujarat are bajri, jowar, rice and wheat. Cotton, groundnut and tobbaco are major non - food commercial crops. State occupies around

50 percent area as cultivated area to total reporting areas. The non-food commercial crops claim on an average around 40 percent of the total cropped area.

State total food grain production was very low in the period 1960-61 as compared to 1970-71 and 1984-85,and it was 18,58,500 tons, 48,44,100 tons, 52,57,100 tons respectively. Thus the quantum increased was made in 1970-71, which resulted in 160.64% increase over 1960-61 production and 8.5% increase over 1970-71 production. This increase of production was also due to the expansion of areas under crops in 1970-71. This picture is also seen at the district wise analysis (Appendix XII). Total food grain production increased four fold in Ahmedabad district during 1960-61 to 1970-71, while three fold in Bhavnagar district in the same period. During the period 1984-85 highest growth in the total food grains production was achieved in Bharuch district. It was 65.4 percent over the period 1970-71. It was due to increase of area under the food grain production (68.24%). Bhavnagar district was second in the production increase with 41.5 percent.

Per capita food availability is a macro level indicator which reflect the presure of population on the resources. It is

not giving any clear cut picture. At the state level per capita avaliability was 90.07 Kg. in 1960-61, which increased to 181.44Kg in 1970-71 but it declined to 154.23 Kg in 1984-85. It increased during 1970-71 because of the extension of area under foodgrain production while decreased in 1984-85 due to reduction of land under food crops.

At the district level per capita foof availability was highest 199.80 Kg in Surat district in 1960-61. Food deficient distri

was Ahmedabad during this period which was only 32.25 Kg. This picture has changed in the period 1970-71 and Kheda district was on rank one in the Khambhat region, availability was 186.30 Kg in this district during 1970-71, which was above the state average. Even though Ahmedabad has improved its position during 1970-71 (95.30 Kg) but still had lowest per capita food availability. It is due to incerease in area under food crops plus increase in the yield per hectare. During the period 1984-85, the position of Kheda is maintained with 188.42 kg per capita food availability, followed by Bharuch 172.92 kg. Ahmedabad still maintained its lowest position with 76.21 kg, which declined from the previous average. It is due to decrease in the area under food crops. All this picture is reflecting in the figure no.

4.6 Land Utilisation

The pattern of land-use of a country or a region at any particular time is determined by the physical, economic and institutional framework taken together. The existing land-use pattern has been evolved as a result of action and interaction of various factors, such as the physical characteristics of land, the institutional framework, the structure of other resources (capital, labour etc) available, and the location of the region in relation to other aspects of economic development, eg. those relation to transport as well as to industry and trade. The present pattern can, therefore, be considered to be in some sort of static harmony and adjustment with the other main characteristics of the economy in the region. A close study of the present land-use patterns and the trends during recent years will help to suggest the scope for planned shifts in the patterns.

(i) Area under forest

Forest have important protective as well as productive functions. They not only suppy timbers, fuel, fodder and variety of other products but also have a moderating influence against floods and erasion and help to maintain

soil fertility. A number of industries also depends on forests for supply of raw materials. Development of forestry is also essential for raising the income of the tribal people. Forest area of Gujarat is unevenly distributed, due to variations in climate and soil conditions. The forest growth also varies from scrubs in the North and North-Western parts of the State to luxuriant and valuable forests in the South Gujarat.

With the increasing population the demand for forest products are also increasing which results in over exploitation of these resources. It has resulted in deforestation. As per the National Forest policy of 1952 lays down that the proportion of land to be kept permanently under forest should be 33 percent of the total land area. Gujarat state had only 5.1 percent of the area under forest during the period 1960-61. It increased to 8.4 percent in 1970-71 and 10 percent in 1983-84. Thus the forest coverage of the state is far behind the national average. One significant factor is that even though forest area is very low but forest coverage is showing increasing trend. In the various plan afforestation programmes has been launched which has helped in increasing area under forest. But as far as the quality of forest is concerned, it is very poor. Around 10 percent forest is under the private ownership.

Districtwise analysis is indicating the mixed reaction. In some districts the area under forest is decreasing while in other it is increasing. The area under forest was higher than the state average during the period 1960-61 in Bhaurch (13.3%) and Surat district including Valsad (11.8%). In remaining district forest covers are less than the state average.

In the decade of 70's the forest area of the state increased by 64.70 percent from the previous decade. It was due to various efforts of the government including afforestation programmes. The proportion of forest area in the following districts is higher than the state average as in Valsad (26.6 percent), Surat (19.8 percent) and Bhaurch district (18.2 percent) while below the state average in Vadodara (7.2 percent), Bhavnagar (3.0 percent), Kheda (2.3 percent) and Ahmedabad (.19 percent) during 1970-71. In terms of point to point highest increase was in Bhavnagar, by 172.72 percent, and in Surat district it was 67 percent.

During the period 1983-84 forest area of the state increased by 19 percent, and had 10 percent of the total area under forest. At the district level highest increase was in Vadodara district by 47.22 percent over 1970-71 period. This

period showed some mixed reaction. Bhavnagar, Vadodara, Bharuch and Ahmedabad districts recorded increasing trend of forest coverage. While decreasing trend is evident in Kheda (by 34.78 percent), Valsad (by 9.02 percent) and Surat (by 8.08 percent) district over 1970-71 forest area.

In sum following conclusion can be made :

- Quality of forest has decreased over the four decades.
- Highly urbanised and industrial districts are having very meagre forest area. Because of the heavy pressure of population on forest resource plus area put on other human needs.
- Valsad and Surat district where the forest area was very high has shown declining trands. It reflects the process of deforestration with the population increase and increase of forest product demand as well as area put under other human need.
- Last but not least government efforts for afforestation can not be over looked. With these efforts forest coverage has increase two fold 1960-61.

(ii) **Land not Available for Agriculture**

This category includes the area under forest, barren and incultivable land, land put to non agricultural use,

cultivable waste and permanent pasture and other grazing land indicates the area which is not available for agriculture. It is positively correlated with increase in urbanisation and industrialisation and has resulted shrink in the arable or area available for agriculture. Around 45% of the total area in the state comes under this category. All the district in this category has been less than the state average since 1961. Thus it indicate that the region is agriculturally rich. Surat is the only district where its percentage has increased by 25% over 1960-61

(iii) **Net Area Sown (NSA)**

This term denotes the net area sown under crops and orchards, counting areas sown more than once in the same year, only once. The percentage of net area sown to total geographical ara of the state has decreased from 52.4%(1960-61) to 51.1% (1983-84). In the same manner area under non agricultural use has increased. This shift is due to heavy pressure of population to other purposes e.g. roads, construction, industries, dams etc.

All the district of the Khambhat region are having N.S.A. more than the state average since 1961. Highest net area

sown has been in Kheda district which ranges from 77.6% to 76.2% during the period 1960-61 to 1983-84. It is followed by Ahmedabad and Vadodara district, where its average is around 70% over this period. Lowest area under this category is found in Bharuch and Valsad district. It is due to the high percentage of area under forest cover.

These shift in the land-use patterns were mainly in response to the increasing demand for foodgrains and agricultural raw materials. The demand was partly met through the extension of the area under cultivation and partly through intensive cultivation.

Table No. 4.1

Districtwise Average Size of Holding

(in hectares)

S.No	District	1970-71	1976-77	1980-81
	Gujarat State	4.11	3.71	3.45
1.	Ahmedabad	5.00	4.61	4.36
2.	Kheda	1.89	1.81	1.71
3.	Bhavnagar	6.73	5.45	4.67
4.	Vadodara	3.04	2.75	2.63
5.	Bharuch	3.69	3.44	3.19
6.	Surat	2.98	2.78	2.54
7.	Valsad	1.90	1.75	1.67

Source : Directorate of Agriculture, Gujarat State.

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OCEANIC ORIENTATION AND FUTURE DEVELOPMENT

5.0 Oceans are vital to human existence with their promise of mineral wealth, food supply, production of off shore gas and oil and as a medium of international transportation, communications and commeerce. They provide security in depth to nations and influence climate and rainfall. They are the international commons. Since many nations border the oceans, all of them have rights and responsibilities, future development lies in international goodwill and international cooperation. As wolfgang Friedman(1971) has said there is no alternative to conscious and planned regulation of life on the sea- the surface as well as on the oceanic bed. The forces of collaborative international order are overtaking national political and economic pulls."

5.1 When the economic resources of the sea were restricted mainly to fish catches, the need was felt for conservation and avoidance of conflict, between nation, giving rise to regulation of the freedom to fishing. By 1969, most countries had announced a 12 - mile territorial sea. Some countries declared unilateral rights over 200 miles of sea from their

coastline. Offshore oil and gas came to be discovered and exploited. Rich metallic nodules were found strewn on the floor of the deep sea and there was growing apprehansion that some countries might cover such resources. There was also fear of interference by coastal countries, island states and countries controlling straits between wide oceans. Thus as diverse needs had to be met, the United Nations convened the law of the Sea Conference for envolving an international framework for future control and development of marine resources. A treaty acceptable to most countries emerged after prolonged consideration over several years. The treaty expresses a widespread consensus among nations. It provides that the territorial sea will extend to 2 nautical miles, there will be an exclusive economic zone (EEZ) extending upto 200 nautical miles, and the riches below the sea bottom pertaining to the continental shelf will belong to the nearest coastal state.

The first rights on the fish wealth of the EEZ will rest with the coastal state. Any fish in excess of the requirements of the coastal state will be made accessible to the countries of the region in the first instance and to other fishing fleets in general, possibly under a licensing and quota system. The coastal state alone will have the right to create structures,

carry out mariculture and mine the sea bottom in the EEZ as well as under the nearby continental shelf. FAO have formulated the programme to assist coastal states in the management and development of marine resources in the EEZ.

The fish, mineral and other resources of the deep sea are acknowledge to the part of the international common. Deep sea mining will be carried out under the authority of an International Deep Sea Authority and the International Deep Sea Enterprises which have been envisaged in the treaty.

5.2 The Coastal Zone

The 1970s witnessed the birth of a new object of enquiry : the coastal zone. The strip of land and sea that has been the spatial setting of the modern world system, has only recently been identified by planners and scientists as a spatial area which requires special study and treatment. Coastal waters, which represent only 10 percent of the total sea area in our planet, provide 99 percent of the total fish production and there are still enourmous possibilities for further exploitation. The area extending towards the sea, beyond the mean low tide line, is often called offshore; its extent is a functions of the wave action and the depth of

water. The area extending beyond the mean high tide line inshore is known as the backshore or dry - sand area. Its inland extent is usually defined by the presence of negetation or a change in the phyriography of the land.

The Federal Coastal Zone Management Act of 1972 in the US defines the coastal zone as the "coastal waters (including the land therein and there under) and adjucent shore lands (including the water therein and there under) strongly influenced by each other".

Using various criteria (morphological, land use, ecological or economic), one can identify a series of different zones. Obviously the width of the coastal zone varies from one area to another, depending on the spatial extent over which the criteria, applied is most applicable.

5.3 Gujarat Coast

Gujarat is a major martine state in India with a long coastline and accounts for about 25 percent of countrys coastline. It has rich in marine fish recources. The state has a large continental shelf of 1.65 lakhs sq Kms of fishable potential (seashore,offshore and deep sea fishing areas). Apart from this large potential source, the coastal

belt also provides a large number of tidal creeks and low lying potential resources of about 3.68 lakhs hectares for tapping and launching mariculture, brakish water and quaculture programmes. The Peninsular water offers the facility of sustenance and growth of varied marine wealth.

Oceanic orientation of the Gulf of Khambhat can be analysed with various indicators such as concentration of population, growth patterns, density of population, food grain production, occupational structure of the population, land use pattern, source of irrigation and marine production in the coastal talukas of the region.

5.4 Total Population in Coastal Talukas :

The coastal zone of the Gulf of Khambhat region,which comprises nineteen taluka of the seven district. These taluka contribute 12.40 percent of the total population of the state in the period 1961 and 27.90 percent of the total districts population in the region (Table no. 2.1)

1971 census reveals that the population in the coastal taluka to total state population has increased to 13.03 percent and in the case of district population its share has declined marginally (26.62 percent).

In the 1981 population in coastal taluka has again increased to 13.53 percent and 27.31 percent to the state population and districts population respectively.

Thus this analysis clearly highlight the oceanic orientation in the sphere of population share.

5.5 Rural - Urban Population

Coastal talukas in Gulf of Khambhat contributes 8.35 percent and 11.46 percent of total rural and total urban population of the state during 1961. The share of the coastal taluka to total district population in the region is 22.84 percent and 27.25 percent respectively for rural and urban population.

These proportion to the state population has increasedin 1971 by 36.76% to rural and 49.73 percent in urban population. But in the ccase of total districts population the position were not changed significantly. During the 1981 census the share of coastal population to state population has declined (to 11.42 percent) in case of rural population and increased (to 19.06 percent) in urban population (appendix III)

The development of ports and interregional trade has

accounted for much of the urban growth along coastal areas. As cooley (1984) "first explained, the economics of transfer create a comparative advantage for the growth of urban centres." As trade expands so do urban areas (smith A 1937). This expansions often occurs along the coastline due to topographic and physiographic features. Industrial development has been particularly attracted to coastal areas for two major reason: access to transport facilities and vast quantities of water.

5.6 Population Growth Pattern :

Talukawise study (Appendix III) of the coastal areas reveals that during the period 1961-1971 maximum growth in total population was achieved inn chorasi taluka of Surat district with 41.84 percent and negative growth was achieved in Ghogha taluka of Bhavnagar district with (-) 3.42 percent. The decadal variation during 1971 to 1981 period was highest with 68.38 percent in Chorasi taluka (Bhavnagar). It was due to rapid growth of urbanisation in this area. Variation ,was minimum in Vagra taluka (Bharuch) with only 0.69 percent,it was due to cent percent rural population.

Rural - urban decadal variation indicates some important features. During the period 1961-71 negative rural growth

GULF OF KHAMBHAT

COASTAL TALUKA

POPULATION (RURAL-URBAN) 1981.

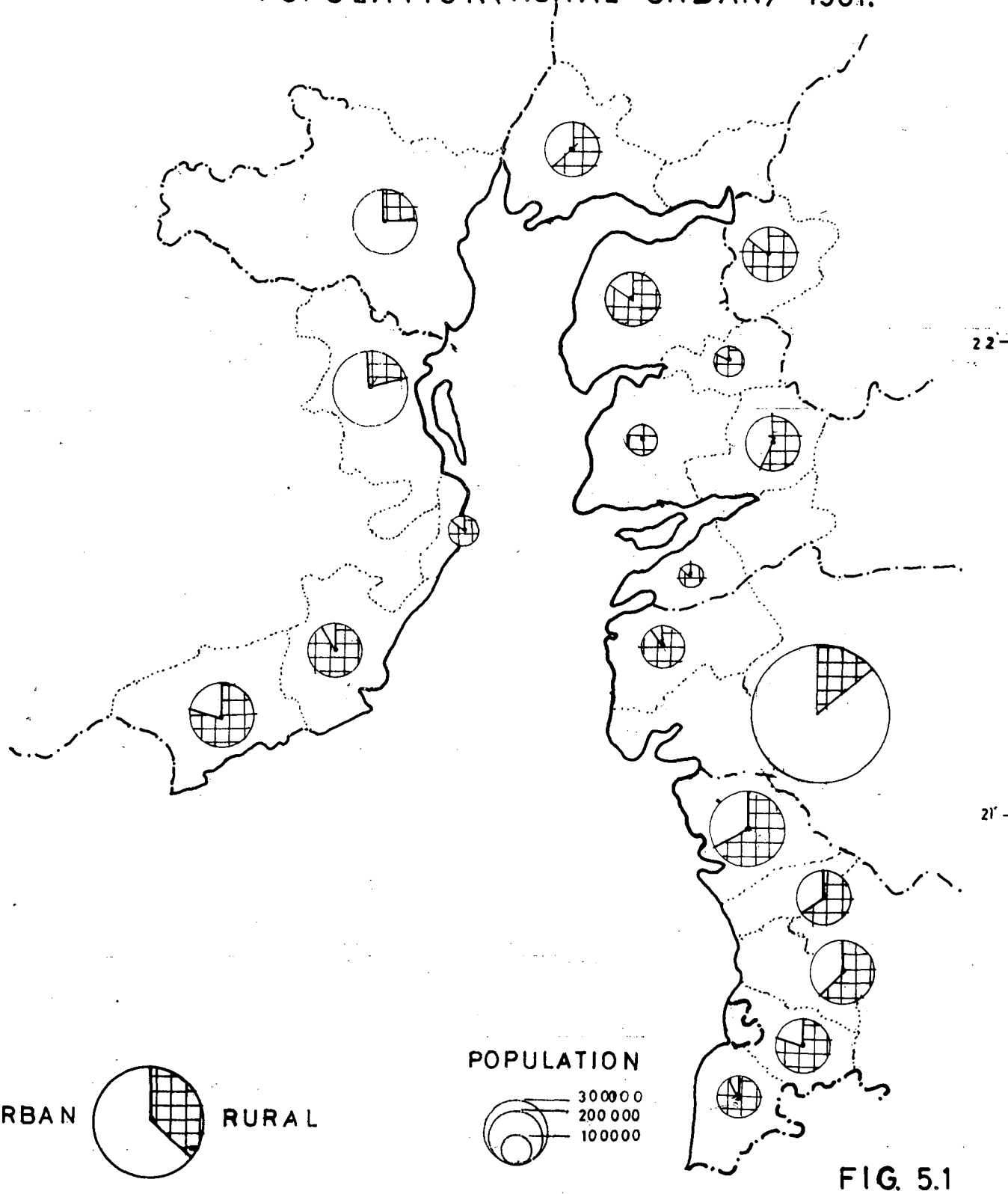

FIG. 5.1

was recorded in Ghogha (Bhavnagar) with (-) 6.16 percent while maximum was Talaja (Bhavnagar) with 34.47 percent. In the decade 1971-81 highest growth was achieved in Mahwa taluka (Bhavnagar) with 34.69 percent and lowest in Vagra taluka of Bharuch district (.69) percent. Urban growth during 1961-71 decade was ranging from (-) 6.16 percent (Ghogha) to 34.47 percent (Talaja). But during the period 1971-81 spectacular growth was achieved in Khambhat taluka (Kheda) with 344.80 percent. While the negative growth rate was recorded in Hansot taluka of Bharuch with (-) .79 percent.

5.7 Density of Population

It implias the average number of persons living per sq. Km. It indicates the man - land ratio. High density of population can be supported with the availability of natural resources and the extent of the use of technology to exploit the resources. Density of population in the coastal taluka is given in appendix I. It reveals that during the 1961 the density was highest in chorasi taluka (793 person) in Surat district, which is highly urbanised. While the lowest density of population was recorded in Dhanduka 58 person and

Vagra 66 person per Km, these taluka had more rural population.

1971 population census was indicating also the same trend. High density was concentrated in Charosi taluka (1108 person) while dispersed population were in Dhanduka (67 person) and Vagra (74 person) taluka.

In the decade 1981 trends in density of population were more or less same. On the upper side Chorasi taluka recorded 1839 person per Km^2. But in lower side position was changed as Vagra recorded lowest density of population 74 person and Dhanduka taluka 80 person.

It is evident that the density of population is high with processes urbanisation and low were more population is engaged in rural activities.

5.8 Coastal Area :

Coastal Area of coastal taluka are calculated with respective district. Valsad district was comprises 44.00 percent of te total geograpical area as coastal area, followed by Bharuch 38 percent, Bhavnagar 35.16 percent, Ahmedabad 30.00 percent,

Surat, Kheda wit 16.5 percent and Vadodara district with 6.8 percent area. Thus the district which are having more percentage under coastal area ae having more oceanic 7 marine orientation.

5.9 Occupation Structure

Broadly speaking various occupàtions can be classified into three categories, vig. primary, secondary and tertiary. There is a close relationship between development of an economy on the one hand, and occupations structure on the òther. Economic progress is generally associated with certain district, necessary and predictable changes in occupational structure (clark 1940)

Agriculture and allied activities such as animal husbandry, fishery, poultry farming, lumbering, etc. are considered primary occupations. Manufacturing industries, small-scale and cottage industries and mining are included in the secondar' sector. Trade, transport, communication, banking, insurance etc. are included in the tertiary sector.

Work participation ratio is calculated by total main workers to total population. Talukawise study on this indicator is

given on Apendx. IV . It shows the working population or availability of labour power. During 1961 working population was highest in Khambhat taluka (66.91 percent) while lowest in Bhavnagar taluka (30.00 percent), it has continued in 1971 and 1981.

Occupational structure of the working population is classified into three sectors namely primary, secondary and tertiary sector. This comparison is only possible for 1961 and 1971 and not possible for 1981 because of inadequate data at taluka level. Appendix IV reveals that during the period 1961 working population engaged in primary sector was highest in Vagra taluka (93.1percent) and lowest in Chorasi taluka (22.3 percent). These positions were remain the same during the period 1971 but it has reduced byte3-4 percent. Thus it indicates that population has been shifted in favour of secondary and tertiary sector, even though pace was low. In the case of secondary sectors high working force was engaged in Chorasi taluka 43.2 percent during 1961 and it has increased by 17.12 percent (50.6 percent) in the 1971. Lowest working force engaged in secondary sector was in Vagra taluka 2.1 percent (1961) which raised to 3.7 percent (1971). In the tertiary sector too Vagra taluka recorded lowest

GULF OF KHAMBHAT

COASTAL TALUKA

OCCUPATIONAL STRUCTURE, 1971.

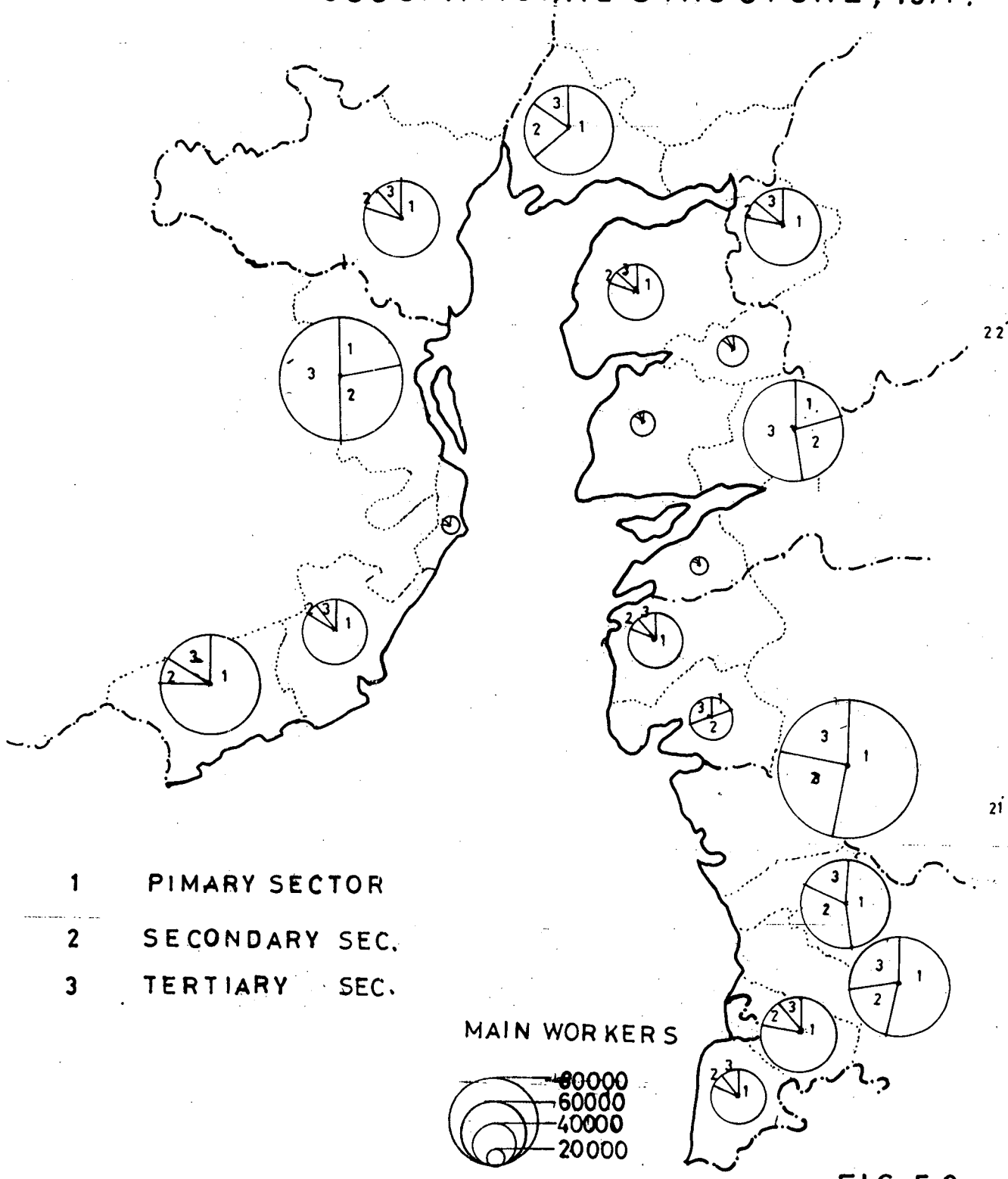

FIG 5.2

percentage of working population 4.7 percent and 6.6 percent in 1961 and 1971 respectively. But working force engaged in tertiary sector was highest in Bhavnagar taluka 46.0 percent and 50.5 percent during 1961 and 1971 respectively. This taluka was highly advanced in service sector economy due to number of industrialised estates.

In crux the shift in the working population from primary sector to secondary and tertiary sector was a well known phenomenon except in few taluka. Working force in primary sectors during 1961-1971 period were showing upward trend in the following taluka namely Ghogaha (by 49.2 percent) Bharuch (by 38.0 percent), Dhanduka (by 21 percent), Talaja (by 20 percent) and marginal increased in Amod, Jam Busar, Mahuva, Chorasi, Pardi and Umbergaon taluka. Although working force in secondary sector was on increasing trend which is also good for the economy but for taluka shows deteriorating trend, during 1961-1971 period e.g. Dhanduka (44 %),Mahuva, Talaja and Ghogha decreased by 30 to 40 percent. Tertiary sector was reflecting increase trend in 1961-1971 period with few taluka had decreasing trend.

Thus we can say that working population is more baised towards primary sector which clearly indicating the population is more oceanic orientation in all the coastal

talukas. Except Chorasi and Bhavnagar taluka the working of population in primary sector is very high around 60-70 percent. These work force is mainly associated fisheries and other marine activities because most of the coastal land is saline and less fertile.

5.10 Land Use Pattern in Coastal Taluka

Land is very important natural resources. It is not only required for agriculture but all for factories and other purposes. Although there is no direct relationship between oceanic orientation and land use pattern but still we can draw some conclusion on the basis of land-use pattern. The land covered under barren and unculturable lands are generally unsuitable for agricultural use either because of the bad soil and topography or because of their inaccessibility. The saline lands of the study area is also included in this category. The percentage of barren and uncultivable land to total geographical area of each taluka is calculated in Appendix XI . Bhavnagar taluka comprises 51.8 percent of the total area under barren and uncultivable land in 1982-83, followed by Dhanduka (17.6%), Khambhat (17.4%), and Gandevi (16.1%) (Appendix XI) Barren

and uncultivable land can be developed for fisheries, salt and other marine activities or have to be developed.

5.11 Coverage of fishing taluka, village and Towns

The Gulf of Khambhat coast region comprises 55% of the total fishing tlukas of the state (Appendix IV). It covers 36 % of total marine fishing villages of the state and 28.6% of the marine fishing town of the state. Thus this region is having very significant role in the marine fisheries.

5.12 Fishing population talukawise

Appendix X reveals that the fishing population comprises of 1,06,918 number in the region. Three taluka namely Umbergaon, Valsad and Navsari contributing more than 50 percent of the fishing population of the region. Thus it indicates high percentage of people engaged in fishing and other activities.

Persons engaged in fishing and related occupation is maximum in Valsad taluka (23.8%), followed by Navsari (16.4%) and Umbergaon (11.7%). These three taluka constitute more than 50 percent of the person engaged in fishing and related

occupation of the region. Thus these talukas are having highly oceanic orientation in economic activities.

5.13 Future development

There is rising world demand for food and metals and crude. The national policy of each country has to work for high sustain able levels of marine production and bio-mass. Every effort has to be made for offshoare exploration and extraction of oil. Exploitation of maganese nodules within the framework, set by an international sea-bed authority ;is an important policy goal. India has been granted the pioneer investigator status and this should assist her further efforts in deep sea mining and metallurgy of nodules.

Besides conservations and exploitations of marine resources, national aims at generating empheyment, diversifying professional sklills, raising nutritional levels and encouraging exports. In seeking these objectives, co-operation with other developing countries and specially with the countries of the region as well as with developed countries and the agencies of the UN have to be constantly kept in view.

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PROBLEMS AND STRATEGIES

Each coastal zone has its own economic system and environmental system. "But each system is also linked to other through the flow of natural resources and waste material between them". (Lee.A,1973) At each stage of economic activity either resources are taken out of the environment or waste is returned to it: hence the existence of a multiplicity of links between the economic-environmental system. The nature, magnitude and location of the flows of resources and waste which passes through these links changes overtime in response to changes within the economic system.

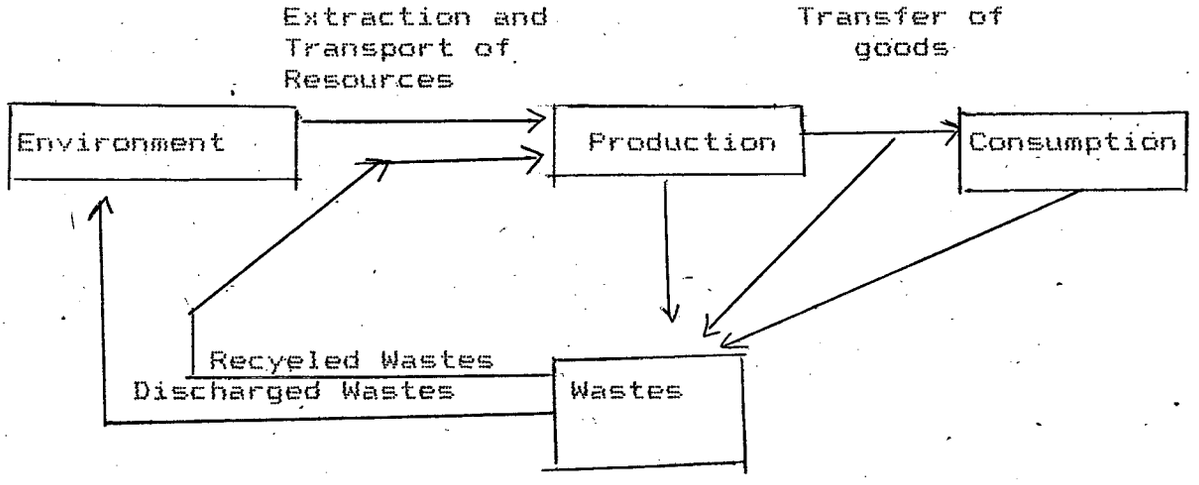

Fig.: 6.1 Relationship between economic and environmental systems.

The coastal zone is one particular type of area where the interactions between economic and environmental system are of special interest and concern:

(i) The coastal zone is one of the rich and diverse environment which has a very wide range of potential uses but a number of these may be in conflict with other uses.

(ii) With the facilities for deep water transport water supply or effluent disposal, these zones provides very attractive locations for large scale, heavy industrial activities. These are likely to experience intense forms of land use conflict.

(iii) The strengthening of environmental controls has often progressed more rapidly at inland location then in coastal zones.

Since the coastal zone is not a closed economy or a self - contained environmental system, its environmental condition is affected both by economic activities located within the zone and by the environmental effects of certain activities located beyond its boundaries.

Problems :

Gulf of Khambhat region has got the maritime and continental location. It exhibits a variety of climates representing transition between the heavy rainfall area of Konkan and arid Rajasthan. There occurs irratic and uneven rainfall over the time. Drought is an usual phenomenon. Coastal taluka in Bhavnagar, Ahmedabad, Kheda, Vadodara and Surat is declared as drought prone area.

Except Kheda the remaining districts have very low percentage of area under irrigation. All the districts highly rely upon wells and tubewells as source of irrigation. Thus it tends to over - exploitation of ground water resources. Recharging of ground water resources is controlled by hydrological setting. Thus the thrust for the construction of surface water irrigation project. But most of the surface irrigation is being tapped except Narmada. Coastal areas are saline and unsuitable for ground water development, while northern part of Ahmedabad district is over developed in ground water. Remaining part is suitable for open well and tubewell construction.

Study area occupies small percentage of area under forest

coverage as against the norms of National forest Policy. Apart from this forest area is unevenly distributed and mainly concentrated in Valsad and Surat district. But one striking feature is that the coverage under forest is increasing with various afforestation programmes.

Population has been increasing very rapidly during the last four decades. It is resulting in heavy pressure on various resources especially land resources. This can be reflected from decreasing average size of holding since 1960-61. Process of urbanisation is recorded high in Ahmedabad , Surat and Vadodara districts which has created many problems like pollution, slums, housing, overcrowding etc. Highly urbanised talukas are Dhanduka, Bhavnagar and Chorasi. All the districts are showing high dependency on the working population. Population is mainly occured in primary sector except two talukas (Chorasi and Bhavnagar) where it is engaged in secondary and tertiary sector.

This region occupies a signifant position in dairy development but inadequancy of fodder arises many times, effecting the milk production.

Problem of Pollution :

As human population has grown phenomenally the magnitude and semification of pollution have also increased. As a consequence, the environment has been adversely affected leading to impairment of health and ruination of the aesthetic state of the land scape in several parts of India. Pollution is manifest in the expanding dumps of garbage and waste, the intracable ramification of effluents in water and the thickening canopy of smoke, dust and gases in the atmosphere. The rapidly increasing urbanisation and advancement in industrialisation in particular, around the maritime states, results in the convenient disposal of various kinds of waste in large quantities to the coastal marine zones.

The principle source of water pollution are (i) discharge of domestic and municipal sewage, (ii) effluents from industries, (iii) use of agriculture chemicals such as fertilisers pesticides and insecticides, and 9iv) accident or/and deliberate release of oil and ocean water. Then there is natural pollution of groundwater due to salts and minerals derived from rocks and soils.

There are about 8000 water polluting industries in the state, in which around 80 percent of the industries are located in the Gulf of Khambhat and adjoining areas. Disposal of effluents from these industrial estates are creating problem in number of rivers such as Kalak, Damanganga, Sabarmati etc. The disposal of domestic effluents grave this problem. Petrochemical complex area near Vadodara housing major water pollution industries such as IPPCL, GSFC, Gujarat Refinery, GACL, Heavy Water Project etc. The other inviting attention is Jetpur where about 1400 small scale dyeing and printing units are located and created water pollution problem of river Bhadar. Mindola river is polluting by some paper and sugar mills located nearby. "About 6 MLD of industrial waste water is discharged without proper treatment in the fresh water zone of river Kolak. The river flow decreases considerably during the dry season thus created severe pollution conditions in summer season". (Zingde etc 1980).

Pollution Control :

Various programmes and project have been taken by the Gujarat Government and Gujarat Pollution Control Board such as: (i) GEM project : This programme is undertaken by the Central Pollution Control Board with the World Health Organisation

(WHO) sponsored Global Environmental Monitoring Project (GEM). Project covers the assesment of the major rivers namely Narmada, Tapi, Mahi and Sabarmati.

(ii) 'MINAR' Project : The 11 rivers were selected under Monitoring of Indian National Aquatic Resources System project. This programme will help in formulating the plans and policies regarding control of water pollution.

(iii) Global and marine Pollution Survey: This survey was jointly done by the Central Pollution Control Board and National Institute of Oceanography (NIO).

(iv) Board Effluent Channel: This channel is the first of its kind in India. All the industrial units located in Baroda petrochemicals Complex area discharge the effluent into 'Baroda Effluent Channel'. This has stopped the pollution of river Mini and Mahi. At present, only the effluent from the industrial estate at Nandesari is going to river Mahi through river Mini. Efforts are under way to treat and divert this effluent into Baroda Effluent Channel.

Finally the difficulty faced is the lack of consistent and reliable data on coastal environment and related inland areas. The coastal management is essentially concerned with conflicts of interest and usages, information on the

distribution and quality of a wide range of environmental resources. So that threatened resources can be identified and evaluated and potential areas of conflict delimited. In addition, data from repeated surveys are needed to monitor in environmental conditions and resources.

Strategies

Coastal zone has many potential uses but, as the pressure of demand from particular uses grows, it becomes increasingly clear that all uses cannot be met simultaneously.

The best use of coastal zone is not to be determined according to the size of the benefits to be derived from particular uses or by the size of the costs associated with those uses, but by the balance between those benefits and costs.

Since the coastal zone is not a closed system the planning process must take account of the benefits and costs of uses originating from outside the zone. This implies integrating planning over an area wider than the individual zone: it also rises the wider distributional issue of payment for outside uses of coastal zone facilities.

Watershed Management

The need for an integrated approach towards land and water has been felt. The entire approach to the soil and water conservation programme has now been changed to watershed approach. With this approach not only agricultural production can be augmented but also resolve the varied problems like flood control, gully control, land reclamation and improvement of pastures and forest.

Drought Control

It should be involved a package programme of various long term strategy.

1. Restoration of ecological balance
2. Development and management of irrigation resources
3. Soil and moisture conservation and afforestation
4. Restructuring of cropping patterns and pasture Development
5. Changes in agronomic practices
6. Livestock development
7. Provision of drinking water supply
8. Assistance to small and marginal farmers

Management of Marine Living Resources

There is need to organise fish product development along with an effort to expand the internal as well as the external market. The catch can be expanded by efficient managerial skills for -mechanised fishing, including elementary processing and freezing on board the vessels. There is urgent need for training, strengthening of national and regional research, technology and institutions for engaging in physical as well as biological oceanography.

Change agents are required in fishing villages for enthusing the people towards efficient methods of fishing, aquaculture and diversification. Political support is necessary for legal protection to fishing aquaculture and ecosystem preservation and for planned and integrated utilisation of eco subsystems.

Herculean task ahead of us

For ensuring better quality of life we must carefully husband our renewable resources of soil, water, plant and animal life. Every exploitation of these is reflected in soil,

erosion, siltation, floods, deforestation, which leads to destructioin of forests and wild life of the country.

We have to have massive efforts to conserve our land resources through scientific land use, soil conservation of moisture, stopping excessive irrigation, conservation of marine eco system, etc. Similarly, in the case of the forests and wild life, conservation rather than resource exploitation should be emphasised. In case of general environmental pollution something is being done to contained air, water and land pollution much is yet to be done. Similarly we will have to do a lot about noise pollution as well as racliation pollution which too are threatening our existence.

Conservation is now more essential for survival than ever before. Harmony with nature, reducing our demands to the level of the revival capacity of nature and the stops that would help restoration of health of land and water resources are all essential steps is a permanent economy and hence that has to be secured with all efforts. Environmental Protection and forest conservation will have to be the backbone of all development programmes and all disciplines have to work in mission to achive the goal of an enviornmentally sound

the country. In this herculean task all of us have to join a
nd
create a peoples movement aiming at a better tomorrow and a more glorious, healthier future promising a better quality of life.

APPENDIX - I

DISTRICT AND COASTAL TALUKAWISE POPULATION (RURAL-URBAN)

	1961					1971					1981				
	Area km^2	Population density (per sq km^2)	Population			Area km^2	Population density (per sq km^2)	Population			Area km^2	Population density per sq km^2	Population		
			Total	Rural	Urban			Total	Rural	Urban			Total	Rural	Urban
AT STATE															
MEDABAD	8918	248	2210199	866620	1343579	8707	334	2910307	964 93	1945814	8707	445	3875794	1094716	2781078
) Dhanduka	2676	58	154809	122810	31999	2718	67	181166	143931	37235	2683	80	213748	169205	44543
AURCH	7731	115	891969	758171	133798	9045	123	1109601	916587	193014	9032	143	1296451	1054942	241509
i)Bhanseh	653	276	180750	107111	73639	665	336	223537	124924	98613	640	414	265093	144509	120584
i)Hansat	398	92	36688	36688	-	398	113	45231	37595	7636	399	126	50245	42670	7575
v) Vagra	797	66	53108	53108	-	883	74	65037	65037	-	883	74	65487	65487	-
v)Amod	463	122	56660	56660	-	464	148	68664	58139	10525	468	171	79934	67879	12055
i)Jam Busar	1099	104	114867	96421	18446	1097	128	140355	116104	24251	1097	144	158316	129947	28369
EDA	2917	678	1977540	1593769	383771	7194	341	2451387	1962357	489030	7194	419	3015027	2408672	606355
ii)Khambhat	1133	152	172013	120722	51291	1194	185	221139	159042	62097	211	1248	263373	187154	276219
AVNAGAR	9260	13	1119435	767006	352429	11155	126	1405285	955671	449614	11155	168	1879340	1253766	625574
iii)Mahuva	1220	123	149497	116675	32373	1219	161	196075	154487	41588	1220	216	264155	208083	56072
i)Talaja	865	120	103573	96506	7067	869	157	136906	126881	10025	870	210	182541	167802	14739
)Ghogha	576	88	50709	45237	5472	437	112	48976	42449	6527	437	145	63481	54677	8804
i)Bhavnagar	922	250	230900	54427	176473	1462	204	298746	66250	232496	1463	276	407032	90187	316845
OODARA	7803	196	1527326	1129832	397494	7788	254	1980065	1376860	603205	7794	328	2558092	1007565	950527
ii)Padra	525	265	134630	121891	17269	534	320	171308	147079	24229	534.6	377	201610	170908	30702
AT	12628	194	2451624	1909429	542195	7745	231	1786924	1184272	602652	7657	326	2493211	1427172	1066039
iii)Olpad	653	122	79444	79444	-	687	143	96407	92112	6295	676	198	134048	120134	13914
iv)Chorasi	574	793	455303	137784	317519	562	1106	645827	152836	493001	592	1839	1087482	157236	930246
SAD	-	-	-	-	-	5238	273	1428742	1172326	256416	5244	338	1774136	1385274	388862
vi)Navsari	738	306	225720	162530	63190	735	376	276425	196324	80101	740	486	359797	224704	135093
vii)Gandevi	368	354	130304	94124	36180	284	561	159483	113327	46156	282	674	190049	120643	69406
viii)Valsad	-	-	-	-	-	509	438	223084	155521	67563	500	555	278033	175221	102872
viii)Pardi	446	293	130898	109133	21765	428	380	162465	131705	30760	426	483	205538	163452	42086
ix)Umbergaon	371	259	95973	89399	6574	361	323	116866	109098	7768	362	397	143727	132859	10868

Source: Census of India, Series5, Gujrat 1981.

Appendix II

Decadal Growth of Population

		1951 to1961	1961 to 1971	1971 to 1981	Population 1961	1971	1981
Gujrat State	Total	26.88	29.39	27.67	20633350	26697475	34085789
	Rural	29.42	25.36	22.31	-	-	-
	Urban	20.07	41.00	41.42	-	-	-
1.Bhavnagar	Total	26.40	25.54	33.73	1119435	1405285	1879340
	Rural	27.43	24.60	31.19	-	-	-
	Urban	24.23	27.58	39.14	-	-	-
2.Ahmedabad	Total	32.55	36.62	33.17	2130272	2910307	3875794
	Rural	26.41	22.60	13.50	-	-	-
	Urban	36.42	44.82	42.9	-	-	-
3.Kheda	Total	22.64	23.96	22.90	1977540	2451387	3015027
	Rural	37.76	23.13	22.74	-	-	-
	Urban	15.75	27.43	23.99	-	-	-
4.Vadodara	Total	26.02	29.64	29.19	1527326	1980065	2556092
	Rural	23.52	21.86	16.76	-	-	-
	Urban	33.74	51.75	57.58	-	-	-
5.Bharuch	Total	24.31	24.40	16.84	891969	1109601	1296451
	Rural	28.82	20.89	15.09	-	-	-
	Urban	3.72	44.26	25.13	-	-	-
6.Surat	Total	25.72	36.01	39.53	1313823	1786924	2493211
	Rural	25.26	24.23	20.51	-	-	-
	Urban	26.98	67.15	76.89	-	-	-
7.Valsad	Total	21.38	25.57	24.17	1137801	1428742	1774136
	Rural	17.47	22.61	18.16	-	-	-
	Urban	47.20	41.66	51.65	-	-	-

Source: Census of India , Series 5, Gujrat State 1981

Appendix III

Percentage of Rural-Urban Population and Decadal Growth

	1961		1971		1981		Decadal Growth					
	Percentage to Total Population		Percentage to Total Population		Percentage to Total Population		1971	1961 - 1971		1971 - 1981		
	Rural	Urban	Rural	Urban	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
1. AHMEDABAD	39.2	60.8	33.2	66.8	28.2	71.8	-	-	-	-	-	-
(i) DHANDhuka	79.3	20.7	79.4	20.6	26.3	73.7	17.02	17.20	16.36	17.98	17.56	19.6
2. BHARVCH	84.9	15.1	82.6	17.4	81.3	18.7	-	-	-	-	-	-
(ii) Bharvch	59.3	40.7	55.9	44.1	54.5	45.5	23.67	16.63	33.91	18.59	15.68	22.22
(iii) Hansat	100	-	83.1	16.9	84.9	15.1	23.28	2.47	-	11.08	13.50	(-).79
(iv) Vagra	100	-	100	-	100	-	22.46	22.46	-	.69	.69	-
(v) Amod	100	-	84.7	15.3	84.9	15.1	21.18	2.61	-	16.4	16.7	14.5
(vi) Jam Busar	83.9	16.1	82.7	17.3	82.0	18.0	22.19	20.4	31.47	12.79	11.92	16.98
3. KHEDA	80.6	19.4	80.0	20.0	79.8	20.1	-	-	-	-	-	-
(vii) Khambhat	70.2	29.8	71.9	20.1	71.0	29.0	28.55	31.7	21.06	19.10	17.67	344.8
4. BHAVNAGAR	68.5	31.5	68.0	32.0	66.7	33.3	-	-	-	-	-	-
(viii) Mahuva	78.0	22.0	78.8	21.2	78.8	21.2	31.15	32.40	28.46	34.72	34.69	34.82
(ix) Talaja	93.2	6.8	92.7	7.3	91.9	8.1	32.18	34.47	41.86	33.33	32.25	47.02
(x) Ghogha	89.2	10.8	86.7	13.3	86.1	13.9	(-)3.42	(-)6.16	31.74	29.62	28.88	34.88
(xi) Bhavnagar	23.6	76.4	22.2	77.8	22.1	77.9	29.88	21.72	31.74	36.24	36.13	36.28
5. VADODARA	73.9	26.1	69.5	30.5	39.4	60.6	-	-	-	-	-	-
(xii) Padra	87.5	22.5	85.8	14.2	84.8	15.2	23.10	20.66	40.30	17.68	16.20	26.71
6. SURAT	77.8	22.2	66.2	33.8	57.2	42.8	-	-	-	-	-	-
(xiii) Olpad	100	-	93.6	6.4	89.6	10.4	23.87	15.94	-	36.21	30.42	121.0
(xiv) Charasi	30.3	69.7	23.6	76.4	14.4	85.6	41.84	10.91	55.26	68.38	2.88	88.69
7. VALSAD	-	-	82.0	18.0	78.1	21.9	-	-	-	-	-	-
(xv) Navsari	72.0	28.0	71.0	29.0	62.5	37.5	22.46	20.79	26.76	30.22	14.25	68.65
(xvi) Gandevi	72.2	27.8	71.0	29.0	63.5	36.5	22.39	20.40	27.57	19.69	6.45	50.37
(xvii) Valsad	-	-	69.7	30.3	63.0	37.0	-	-	-	24.63	12.67	36.82
(xviii) Pardi	83.4	16.6	81.0	19.0	79.5	20.5	24.11	20.68	41.32	26.51	24.10	36.82
(xix) Umbergaon	93.2	6.8	93.3	6.7	92.4	7.6	21.76	22.0	18.16	22.98	21.77	39.9

Source: Census of India, Series 5, Gujrat State, 1981.

Appendix IV

Sectoral Distribution of Main Workers

	I			II			III			Percentage of Main Workers to Total Population		
	Primary Sector			Secondary Sector			Tertiary Sector					
	1961	1971	1981	1961	1971	1981	1961	1971	1981	1961	1971	1981
GUJRAT STATE	69.3	67.6	62.48	13.9	13.9	17.23	16.7	18.5	20.29	41.00	31.46	32.22
1. AHMEDABAD	34.1	31.2	26.93	35.7	33.8	36.30	30.2	34.9	36.78	34.42	29.52	29.97
(i) Dhanduka	65.2	79.5	-	13.4	7.5	-	21.3	12.9	-	36.76	30.97	34.60
2. BHARUCH	82.1	79.9	72.83	6.1	7.7	11.80	11.8	12.4	15.37	45.60	35.30	37.2
(ii) Bharvch	40.6	56.3	-	8.4	15.9	-	16.6	27.7	-	39.60	32.55	33.95
(iii) Hansat	85.3	85.0	-	5.7	6.3	-	9.0	8.5	-	51.86	36.80	38.35
(iv) Vagra	93.1	89.7	-	2.1	3.7	-	4.7	6.6	-	54.46	36.19	34.60
(v) Amod	81.9	85.2	-	6.8	5,9	-	11.3	8.8	-	47.13	36.72	38.72
(vi) Jam Busar	79.4	81.8	-	6.6	6.7	-	13.9	11.4	-	39.82	31.68	31.35
3. KHEDA	72.7	73.3	69.82	11.8	10.4	12.56	15.5	16.2	17.30	34.59	29.17	30.70
(vii) Khambhat	62.8	62.9	-	20.2	20.6	-	17.0	16.5	-	66.91	29.62	31.15
4. BHAVNAGAR	62.4	65.1	64.09	15.7	12.8	15.68	21.2	21.9	20.02	38.76	29.55	32.37
(viii) Mahuva	71.3	74.7	-	12.4	8.7	-	16.3	16.6	-	40.97	31.00	34.00
(ix) Talaja	68.4	82.5	-	12.4	6.1	-	19.1	11.4	-	42.50	31.50	35.5
(x) Ghogha	54.5	80.1	-	12.7	7.2	-	32.7	12.7	-	45.70	31.60	35.5
(xi) Bhavnagar	25.1	21.4	-	28.6	28.0	-	46.0	50.5	-	30.00	26.07	28.4
5. VADODARA	76.6	66.0	60.30	10.3	14.3	17.77	18.0	19.6	22.04	38.40	32.06	33.36
(xii) Padra	82.1	79.5	-	6.5	8.3	-	11.4	12.1	-	36.60	31.15	33.2
6. SURAT	73.4	61.6	53.55	12.6	23.4	29.30	13.9	14.9	17.15	44.40	37.19	39.66
(xiii) Olpad	83.4	77.3	-	7.4	10.7	-	9.1	11.9	-	41.60	32.72	40.00
(xiv) Charasi	22.3	17.9	-	43.2	50.6	-	34.5	31.3	-	34.30	32.75	34.63
7. VALSAD	-	72.9	63.48	-	13.5	20.39	-	13.9	16.13	-	35.45	36.38
(xv) Navsari	62.2	53.4	-	80.2	25.4	-	13.6	21.2	-	37.4	33.3	36.2
(xvi) Gandevi	50.9	46.9	-	25.9	30.7	-	23.2	22.3	-	36.66	31.02	33.19
(xvii) Valsad	60.5	51.9	-	13.2	19.6	-	26.2	28.4	-	-	29.54	32.5
(xviii) Pardi	79.4	78.2	-	6.2	9.6	-	14.3	12.0	-	52.5	37.3	35.8
(xix) Umbergaon	82.9	83.4	-	5.8	6.9	-	11.2	9.6	-	49.5	37.9	46.9

Source: Census of India, Series, 5, Gujrat State, 1981

Appendix V

Distribution of Live stock 1983-1984

	Total cattle	Total Buffaloes	Total Sheeps	Total Goats	Total Live stock	Total Poultry
Gujrat State	6994643	4443898	2357258	3299352	17465842	3572066
1.Ahmedabad	272074 (3.89)	248916 (5.6)	26541 (1.12)	88378 (2.68)	669940 (.38)	789690 (2.2)
2.Bharvch	246364 (3.52)	130037 (2.93)	7066 (.30)	131224 (3.98)	523122 (2.99)	163607 (4.58)
3.Bhavnagar	436555 (6.24)	249155 (5.6)	352917 (14.97)	222032 (6.73)	1275953 (7.30)	32219 (.90)
4.Kheda	274433 (3.92)	583372 (13.13)	18174 (.77)	93247 (2.83)	1002062 (5.73)	353676 (9.9)
5.Surat	340481 (4.86)	189195 (4.26)	5153 (.22)	140443 (4.26)	680739 (3.89)	659113 (18.45)
6.Vadodara	369507	249949	3757	187555 (5.68)	824196 (4.71)	275084 (7.70)
7. Valsad	360052 (5.15)	125008 (2.81)	9704 (.41)	138257 (4.2)	636587 (3.64)	785149 (21.98)
Total	2299466 (32%	1775632 (39.96)	423312 (17.96)	1001136 (30.34)	5009653 (28.68)	2347814 (65.72)

Figure in brackets showing percentages

Source: Statistical Abstract o. Gujarat State 1985 and 1986.

APPENDIX(VI)

Irrigational Potential in Coastal Talukas of Gulf of Khambhat Region (1984)

(Unconfined Aquifer)

	Utilised ground water resources (ha. m/yr)	Net irrigation requirement	Net draft (ha.m.	Irrigation potential created in Col 4/ Col 3)	Ground water balance (ha.m)	Balance irrigation potential from ground water ha. (Col 6/Col 3)	Ultimate irrigation potential from ground water ha. (Col 5 + Col 7)	Additional number of wells feasible 100% level of ground water development
1	2	3	4	5	6	7	8	9
Total for Gujarat								
1. Ahmedabad Distt	106602	.357	24649	69044	81953	229560	298604	47016
i. Dhandhuka	15801	.357	2120	5938	13681	38322	44260	9087
2. Bharuch Distt	7143	.5	6946	13892	64467	128934	142826	45797
ii. Bharuch	3362	.5	871	1742	2491	4982	6724	1384
iii. Hansat	1862	.5	224	448	1638	3276	3724	910
iv. Vagra	6219	.5	199	398	6020	12040	12438	3344
v. Amod	3632	.5	1106	2212	2526	5052	7264	1403
vi. Jam Busar	6862	.5	491	982	6371	12742	13724	3539
3. Kheda Distt	136219	.421	21577	51251	114642	272309	323560	66345
vii. Khambhat	5903	.421	977	2321	4926	11701	14022	2737
4. Bhavnagar Distt.	113026	.366	41892	114459	71134	194355	308814	58315
viii. Mahuva	15576	.366	6716	18350	8860	24208	42558	6994
ix. Taluja	20225	.366	4804	13126	15421	32134	55260	12782
x. Ghogha	4554	.366	2262	6180	2292	6262	12442	1784
xi. Bhavnagar	5807	.366	3133	8560	2674	7306	15866	2148
5. Vadodara Distt	100850	.494	14635	29625	86215	174524	204149	58487
xii. Padra	7942	.494	1380	2794	6562	13283	16077	3646
6. Surat Distt	166616	.395	16241	41116	150375	380696	421812	103355
(xiii. Olpad	17524	.395	762	1929	16762	42435	44364	9312
xiv. Charasi	14044	.395	4228	10704	9816	24851	35555	5453
7. Valsad Distt	97170	.392	13624	34755	83546	213128	247883	60517
xv. Mavsari	28823	.392	2532	6459	26291	67069	73528	15285
xvi. Gandevi	6087	.392	1804	4603	4283	10926	15529	2642
xvii Valsad	13552	.392	1962	5005	11590	29566	34571	8939
xviii. Pardi	5724	.392	1858	4740	3866	9862	14602	3222
xix. Umbergaon	4688	.392	832	2122	3856	9837	11959	3213

Appendix VII

Groundwater Potential of Coastal Talupa of Gulf of Khamphat Region confined Acquifers 1984.

	1	2	3	4	5	6
	Total Ground water resources in MCM/Yr	Utilisation G.W. resources in MCM/Yr	Gross G.W. Draft in MCM/Yr	Net Draft in MCM/Yr (70% of total draft)	G.W. Balance in MCM/Yr	Level of G.W. water dev. in %
1. Ahmedabad	1254.15	1066	352.13	246.49	819.53	23.12
(i) Dhandhuka	186.84	158.81	30.28	21.0	137.61	13.25
2. Bharuch	840.16	714.13	99.2	69.46	644.67	9.73
(ii) Bharuch	39.55	33.62	12.44	8.71	24.91	25.91
(iii) Hansot	21.91	18.62	3.20	2.24	16.38	15.03
(iv) Vagra	73.16	62.19	2.84	1.99	60.20	3.20
(v) Amod	42.74	36.32	15.80	11.06	25.26	30.45
(vi) Jam Busar	80.73	68.62	7.01	4.91	68.71	7.16
3. Kheda	1602.58	1362.19	308.27	215.77	1146.42	15.84
(vii) Khamphat	69.45	59.03	14.96	9.77	49.26	16.55
4. Bhavnagar	1329.76	1130.26	598.47	418.92	711.34	37.00
(viii) Mahuva	183.25	155.76	95.94	67.16	88.60	43.12
(ix) Talaja	237.95	202.25	68.63	48.04	154.21	23.75
(x) Ghogha	53.58	45.54	42.32	22.64	22.92	49.67
(xi) Bhavnagar	68.32	58.07	44.76	31.33	26.76	53.93
5. Vadodara	1186.47	1008.5	209.07	146.39	862.15	14.51
(xii) Padra	93.44	79.42	19.71	13.80	65.62	17.37
6. Surat	1906.21	1666.16	232.03	162.43	1503.75	9.75
(xiii) Olpad	206.17	175.24	10.89	7.62	167.62	4.35
(xiv) Chorasi	169.22	140.44	60.40	42.28	98.16	30.10
7. Valsad (Bulsar)	1143.18	971.70	194.63	136.24	835.46	14.02
(xv) Navsari	339.10	288.23	36.18	25.53	262.90	8.78
(xvi) Gandevi	71.61	60.87	25.77	18.04	42.83	29.63
(xvii) Valsad	159.43	135.52	28.02	19.62	115.90	14.48
(xviii) Pardi	67.34	57.24	26.54	18.58	38.66	32.46
(xix) Umbergaon	55.15	46.88	11.88	8.32	38.56	17.75

Source: Report of the Group on the estination of Groundwater Resources.
Irrigation Potential from Groundwater in Gujrat State April 1984.

Appendix VIII

AREA IRRIGATED BY SOURCES OF(1983-84)

(Hectares)

	Government Canals	Tanks	Wells	Other sources	Net irrigated	Percentage of net irrigated to NSA
1.Ahmedabad Distt.						
(i)Dhandhuka	-	-	12319	-	12319	7
2.Bharvch Distt.	-	-	-	-	-	9.48
(ii)Bharvch	-	-	6315	212	6527	0.72
(iii)Hansat	9866	40	-	-	9906	42.38
(iv)Vagra	-	-	30	-	33	0.07
(v)Amod	-	7781	3934	230	11945	39.27
(vi)Jam Busar	-	-	790	-	790	1.17
3.Kheda Distt						
(vii)Khambhat	17878	100	7586	412	25976	29.0
4.Bhavnagar Distt.	-	-	-	-	-	33.7
(viii)Mahuva	5509	-	34598	-	40107	41.67
(ix)Talaja	29080	-	9943	-	39023	62.68
(x)Ghogha	1250	-	6291	-	7541	28.78
(xi)Bhavnagar	1050	621	4850	-	6521	26.70
5.Vadodara Distt.						
(xii)Padra	-	-	22040	-	22040	52.64
6.Surat Distt.						
(xiii)Olpad	25407	528	1909	-	27844	70.25
(xiv)Charasi	70854	307	2062	-	72323	31.30
7.Valsad Distt.						
(xv)Navsari	10393	256	110	-	10759	31.18
(xvi)Gandevi	4255	381	3495	-	8151	41.83
(xvii)Valsad	1360	105	5170	-	6635	16.70
(xviii)Pardi	-	1665	5433	100	7198	19.84
(xix)Umbergaon	-	60	1477	247	1784	6.96

Source: Statistical Abstract of Districts , 1986-1987

Appendix X

Coastal Taluba wise fishing population and workers ,1982 census

District/Taluba	Total fishing population		Persons engaged in fishing andrelated oceuption	
	Person	./. to total	Person	./. to total
(i)Dhandhuka	-	-	-	-
(ii)Bharvch	8700	8.13	4475	8.9
(iii)Hansat	1419	1.33	739	1.48
(iv)Vagra	1478	1.38	710	1.40
(v)Amod	621	0.58	267	0.53
(vi)Jam Busar	2841	2.65	1320	2.6
(vii)Khambhat	1517	1.4	833	1.7
(viii)Mahuva	401	0.37	247	0.49
(ix)Talaja	361	0.33	185	0.37
(x)Ghogha	569	0.53	300	0.60
(xi)Bhavnagar	545	0.50	297	0.59
(xii)Padra	946	0.88	428	0.86
(xiii)Olpad	2141	2.0	935	1.88
(xiv)Charasi	9315	8.7	4181	8.4
(xv)Navsari	14848	13.8	8156	16.4
(xvi)Gandevi	9557	8.9	4869	9.8
(xvii)Valsad	21771	20.4	11842	23.8
(xviii)Pardi	7728	7.2	4218	8.5
(xix)Umbergaon	22160	20.7	5814	11.7
	106918	100	49816	100

District Statistics Abstract, Bureau of Economics and Statistics, Govt. of Gujrat 1985.

Appendix XI

Distribution Land Utilisation

(In Percentage)

District	Year	Total Reporting Area	Forest	Barren and uncultivable land	Land put to non agriculture use	Cultivable Waste	Permanent pasture & other grazing land	Land under tree crop	current follow	Other follow	Net Area Sown	Area not available for agriculture (4+5+6+7+8) 13	Area available for agriculture (9+10+11+12) 14
1	2	3	4	5	6	7	8	9	10	11	12		
Gujrat State	1960-61	100	5.1	25.5	2.2	4.3	5.8	0.23	1.9	2.4	52.4	44.0	56.0
	70-71	100	8.4	16.4	4.1	10.4	5.0	0.07	1.8	0.02	51.6	46.5	53.5
	83-84	100	10.0	13.9	5.7	10.5	4.5	0.02	3.8	0.0	51.1	44.7	55.3
1. Bhavnagar	1960-61	100	1.1	9.5	2.4	4.1	11.2	-	2.2	2.4	67.0	29	71.0
	70-71	100	3.0	11.0	4.1	3.4	7.5	-	3.7	5.1	60.0	31.2	68.8
	83-84	100	3.2	10.4	7.3	3.8	7.19	-	4.38	0.45	63.28	31.89	68.11
2. Ahmedabad	1960-61	100	-	19.6	0.78	3.4	1.2	-	2.9	1.8	70.3	25	75.0
	70-71	100	0.19	9.98	7.2	3.3	4.03	-	1.9	2.3	71.5	24.3	75.7
	83-84	100	1.3	8.5	7.4	2.8	3.9	-	6.1	0.7	69.2	24.0	76.0
3. Kheda	1960-61	100	1.7	3.6	10.6	0.74	4.0	-	0.94	0.77	77.6	20.69	79.31
	70-71	100	2.3	4.3	11.4	0.55	3.9	-	1.8	0.25	75.2	22.75	77.25
	83-84	100	1.5	4.5	12.4	0.35	3.97	-	1.0	0.05	76.2	22.75	77.25
4. Vadodara	1960-61	100	7.2	5.0	5.2	2.6	8.4	0.33	0.64	0.54	69.8	28.73	71.27
	70-71	100	7.2	3.3	5.2	6.0	6.7	0.05	0.87	0.32	70.2	28.56	71.44
	83-84	100	10.6	3.5	8.5	1.6	4.2	-	2.1	-	69.4	28.50	71.50
5. Bharuch	1960-61	100	13.3	22.5	0.03	2.1	3.7	0.01	0.25	0.59	57.6	41.55	58.45
	70-71	100	18.2	0.40	10.8	5.9	3.1	0.01	1.12	2.2	58.0	38.67	61.33
	83-84	100	18.6	2.8	12.6	5.7	3.1	-	2.9	-	54.1	43.00	57.00
6. Surat	1960-61	100	11.8	9.2	1.9	5.0	5.0	0.34	0.86	0.01	64.4	34.39	65.61
	70-71	100	19.8	10.2	3.8	2.3	4.1	0.46	0.85	1.7	56.0	40.99	59.01
	83-84	100	18.2	7.8	10.6	2.9	3.1	0.53	4.8	-	51.8	42.87	57.13
7. Valsad	1960-61	100	-	-	-	-	-	-	-	-	-	-	-
	70-71	100	26.6	4.1	2.3	3.6	3.4	-	1.8	1.2	56.7	40.3	59.7
	83-84	100	24.2	2.3	7.1	4.7	1.5	-	2.8	-	57.0	40.2	59.8

Appendix XII

Total food grain production and Per Capita food availiolitiy

Distinct	Total food grains. Area outturn. (00 hectares)	(00 tonnes)
Gujrat State		
1960-61	46323	18585
70-71	55827	48441
84-85	47468	52571
1. Bhavnagar		
1960-61	2870	792
70-71	3053	2136
84-85	2429	3024
2. Ahmedabad		
1960-61	2415	687
70-71	3803	2773
84-85	3190	2954
3. Kheda		
1960-61	2896	1765
70-71	3861	4566
84-85	3590	5681
4. Vadodara		
1960-61	2222	1240
70-71	2215	1968
84-85	2790	2707
5. Bharvch		
1960-61	1566	568
70-71	1707	1355
84-85	2872	2241
6. Surat		
1960-61	3768	2626
70-71	2371	1984
84-85	2108	2685
7. Valsad		
1960-61	-	-
70-71	1683	1783
84-85	1435	2355

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