CHAPTER - I

INTRODUCTION

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CHAPTER - I

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

GENERAL

The extensive alluvial tract of central Gujarat represents an area of well developed Quaternary terrain. The sector between the two rivers of Mahi and Narmada comprising a thick pile of sedimentary deposits manifests several interesting aspects of the Quaternary geological history like stratigraphic succession, depositional environments, climatic variations, sea level changes, neotectonic activities, etc. The related morphogenic processes have evolved the present landscape scenario. The terrain, is richly endowed with natural resources like land,soil,water,minerals etc. These resources along with suitable climatic conditions have provided a set of amicable geological environments for human living. Exploitation of the resources has brought economic prosperity to the people of the region. However, the exogenic and endogenic dynamical processes controlling the natural resource potential and accelerating activities of human interaction have rendered the terrain with a delicate environmental balance.

OBJECTIVE AND SCOPE

Purpose of the present investigation is to provide an integrated account of the geological evolution, terrain resources and related geo-environmental appraisal which comprise the follwoing main objectives :

i) A critical review of the structural evolution and detailed history of Quaternary geology of the area.

ii) Analysis of geomorphic set-up and its morphogenic processes.

iii) A detailed evaluation of terrain based resources : Land and Water.

iv) Appraisal of the geological environments and management strategy.

Scope of the study covers the following main aspects :

I Structure and Quaternary Geology.

i) Tectonic framework

ii) Structural evolution and Neotectonism

iii) Stratigraphy, sedimentation and depositional environments

iv) Paleoclimates and Sea Level changes

II Geomorphic Set-up and Morphogenesis.

i) Physiography

ii) Landforms

iii) Drainage system

iv) Morphogenesis

III Terrain Resources.

i) Land, Soil and Minerals

ii) Surface water and ground water

IV Geo-Environmental Management.

i) Parameters of geological environments

- Endogenic, Exogenic and Human induced

ii) Geo-environmental zoning

iii) Management strategy

AREA PROFILE

LOCATION OF STUDY AREA

Geopgraphic location of the study area is shown in Fig.1.1 physiographically, its northern and southern limits are marked by Mahi and Narmada rivers respectively. The western limit is determined by the Gulf of Khambhat, and in the east the area stretches upto the base of the rocky uplands. The area lies between the East Longitudes 72.30 to 73 43' North Latitudes 21.40' to 22. 53'. it is included in the Survey of India Topographic Sheets Nos. 46/B, C,F and G. Administratively, the area is shared by the districts of Vadodara and Bharuch. (Fig.I.2) In Vadodara district, it covers six talukas of Padra,

LOCATION MAP

FIG - 1-1

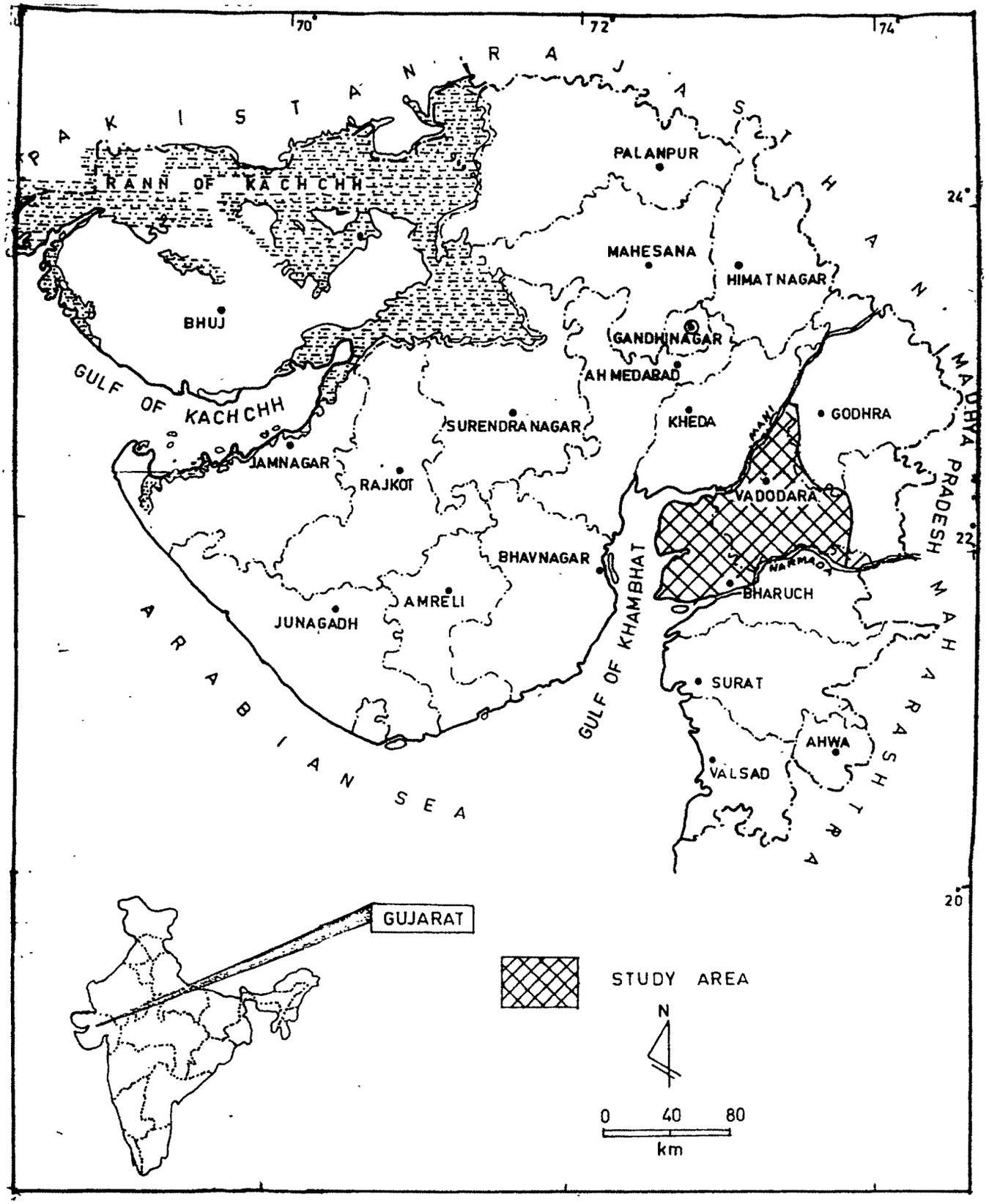
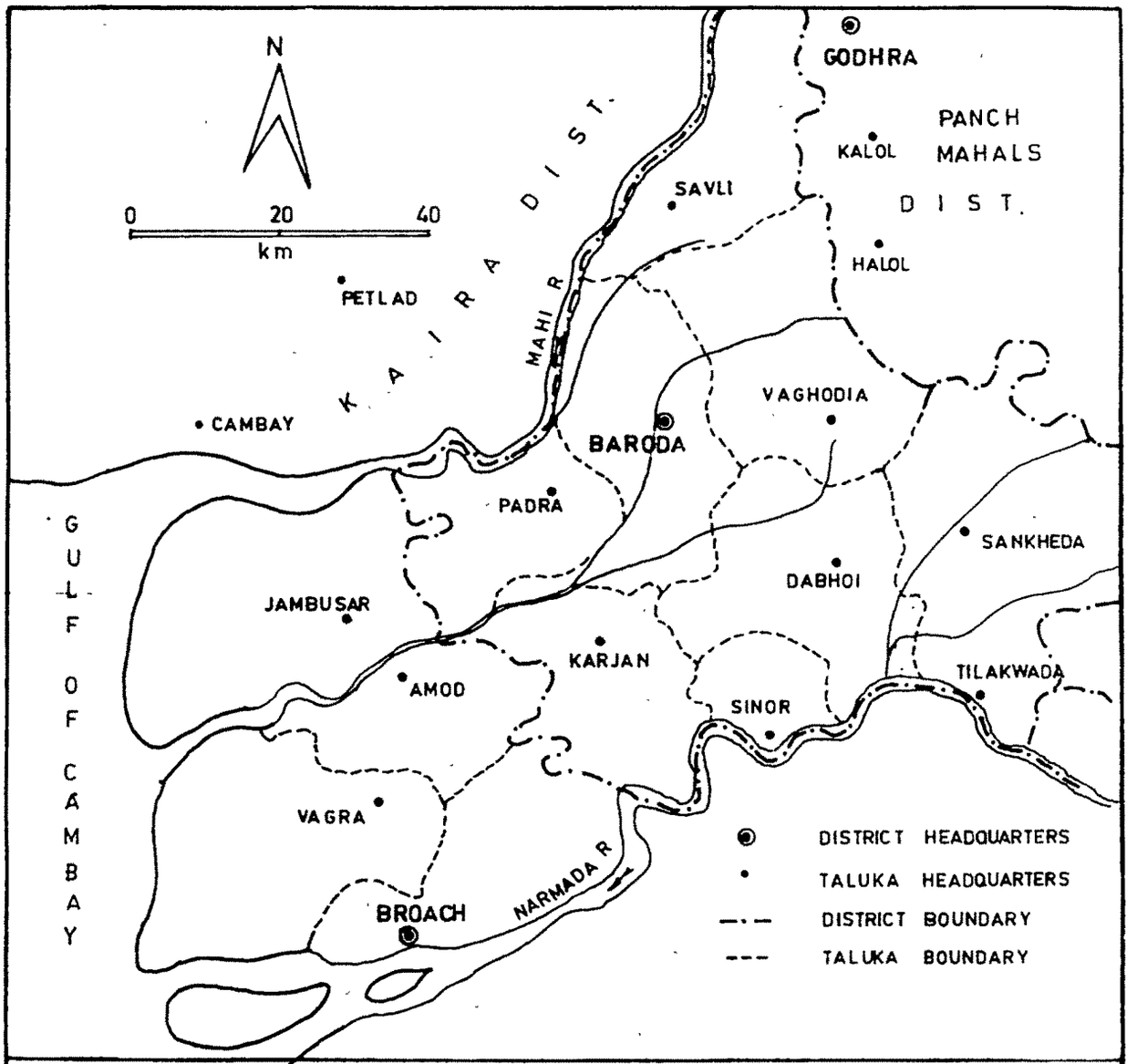


FIG-I-2 **ADMINISTRATIVE MAP OF THE STUDY AREA**



BARODA DISTRICT	
TALUKA	AREA km^2
BARODA	670·0
PADRA	534·6
KARJAN	601·9
SINOR	292·5
SAVLI	792·0
DABHOI	632·6
	3523·6

BROACH DISTRICT	
TALUKA	AREA km^2
JAMBUSAR	1097·4
AMOD	464·9
VAGRA	883·5
BROACH	665 5
	3111·3

Vadodara, Savli, Karjan, Dabhoi and Sinor, while in Bharuch District it covers four talukas of Jambusar, Vagra, Amod and Bharuch. The estern part lies in the Baroda District while its western part lies in the Bharuch district. The Mahi river in the north forms the boundary between Baroda and Kaira districts. While the Narmada in the south-east separates Baroda from Bharuch. The area has approximate rectangular shape with E-W length about 100 km and N-S width about 60 km. It covers approximately 6,000 sq. km.

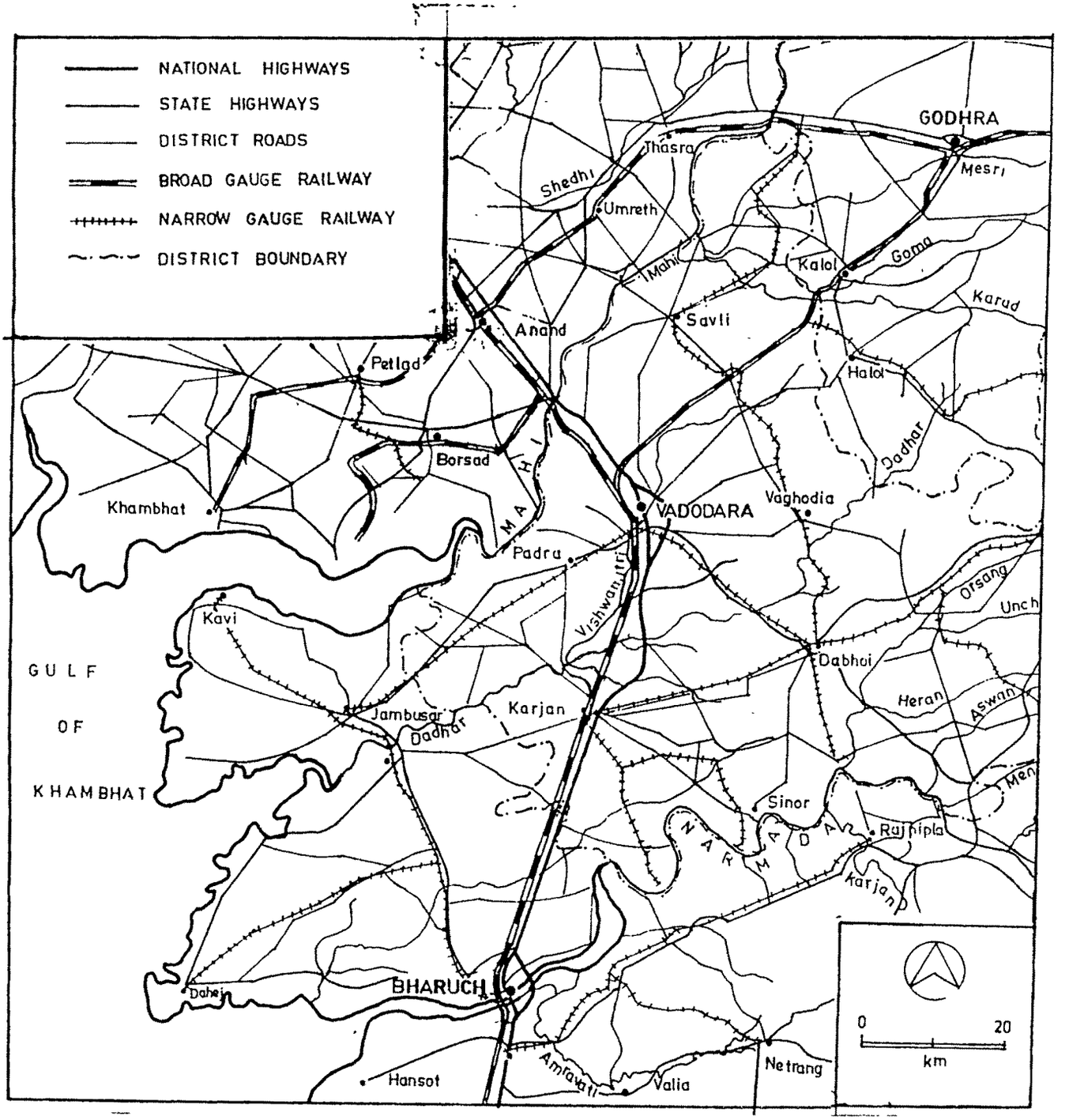
COMMUNICATION

A map showing the communication links is given in Fig.I.3. The flat terrain has facilitated a close network of criss-cross communication routes. Almost all the town and villages are well connected with the road transport. The national highway No.8 and Delhi-Bombay broad guage railway line passes through the area. The State Transport bus service cover almost all the habitation centres. Vadodara has got a domestic airport connecting major cities of the country.

CLIMATE

The area is characterised by a general semi-arid climate. The year can be divided into four seasons. Mid-November to March are cold months of winter season minimum temperature ranges from 20° to 5° C. It is followed by summer with gradual rise in temperature resulting in an uncomfortable weather due to hot winds and low humidity till the middle of June. The maximum day

Fig: I-3 COMMUNICATION MAP OF THE STUDY AREA



temperature during this season at times reaches upto 45° C. The period form June to September is the South west monsoon season where July is the rainiest month. This is followed by a short season of retreating monsoon from October to November characterised by a secondary high in temperature.

The relative humidity during the S-W monsoon is relatively high, generally exceeding 70%. While in the rest of the year, the air is dry. The winds are generally high during the late summer and early part of the monsoon. The winds blow mostly from SW direction during the period from May to September. During the post-monsoon and early winter months they blow from NNE. In the latter half of the cold season and the first months of summer, the winds direction are SW and NW.

FLORA :

The vegetation of the area could be distinctively categorised by coastal type and inland forms. The most common species are, Avicenia marina, Salicornia brachiata, Acanthus ilicifolius Buiginers conjugates, Sueda nudiflora, Prosopis spisigera Argemone mexicana, Xanthium strumarian, Echinops procera, Ipomoca pescaprae. Psilostachys Seriaca, Calotropis procera, Zizyphus Jujuba, Zizyphus nummularia, Cyperus arenarius, Hyphaenae indica, Aerva Ianata, Butea monosperma, Phoenix Sylvestris, Borassus flaballifer, Acacia senegal, Azadiracta indica, Manilkara, Wexandra, Acacia nilotica, Suaeda fruticosa, Portulaea oleracea.

The inland area comprising black cotton and sandy loam soils support a variety of crops like cotton (Gossypiam herbacium), groundnut (Arachis hypogea), oil seeds (Sesamam indicam), tobacco including normal cearals and pulses like millet, tur, beans etc. The common fruit crops are mango (Mangifera indica), guava (Pasidium gujava), Chickoo (Alcharas sapota) and banana. The saline soils towards coastal area have very poor agricultural productivity and form a pasturaal land

The area being almost flat and mainly under cultivation, forest is not so common and due to rapid growth of human population and industrial developmental activities during last few decades there is a considerable change in habitation pattern.

The common types of trees are found in the area include (Banian Tree), Mitragyna Parvifolia(Kadamb, Acacia catecha(Khair) Manikara Laxandra(Rayan), Sapindus Laurifolius(Aritha), Melia azedarach(Limbda), Terminalia bellerioa(Bahida), Acacia arabica(Babul), Wrightia tinctoria,(Indrajav), Butea frondosa (Khakharo), Dalbergia paniculata (Patrali), Tamarindu s indicus(Amli), Cassia fistula(Garmala), Phoenix Sylvestris(Tad), Pongamia pinnata (Karjan), Cassia auriculata(Al) Ficus glomerata(Umro).

FAUNA

The common fauna in the area consists mainly of fox (Valpes benogalensis) wild cat (Felis chaus), Wolf (Canis lupus), Tree

shrew (Anathana ellioti), House rat (Rattus), Mole rat (Bandicatta indica), Titehri (Vancellus indicus), Krait(Bungaurus coerleus), Rhesus macaque (Macaca Mulatta), Saur (Sas Scrofa), Pegeon (Columba Livia), Cobra (Naja naja), Viper (Vipera russelli), Cow,Buffalo, Donkey, Oxe, hooses, goat ect.

POPULATION

As per 1981 Census, population of the 10 Talukas of the two districts was 36,22,020. Of which the rural population is 60.6% and urban population is 39.4%. The decennial growth rate is 29.19%. This is higher than the average rate of 27.67% for the state as whole. It has been observed that the urban centres have registered higher growth rate which is mainly due to rural migration towards industrial growth centres. The population density in rural area is 181 per sq.km. as against the urban density of 3,902 sq km Average population density for the area is 272 per sq km.

ECONOMIC ASPECTS

The area is inhabited by a population with a wide variation in the socio-economic condition. In fact, the geological environments ranging from hostile to amicable, have controlled the economic status of the people. The inhomogeneity of natural resources have influenced the living standard. The people living in extreme coastal zone have hard mean of earning in comparision to the fertile central zone. The people in the coastal zone

mainly earn their living from fishing and very light agriculture. Similarly the people in the eastern Piedmont areas depend on low yielding agriculture, The central zone provides remunerative agricultural produce, and there are several industrial centres providing other alternative and supplementary means of earning. As a result, there is higher population concentration in the central part. An average person of the area enjoys a reasonably good socio-economic status in comparision to an average status of the state at large.

GEOLOGICAL ASPECTS

GEOLOGY AND STRUCTURE

The Quaternary deposits of central Gujarat area generally described as Gujarat Alluvium and the study area lies at its southern part. The Quaternary geological history of the area is interesting and equally complex because the sedimentation has taken place under compound influence of unstable structural basin and fluctuating sea levels and climatic variations. Its basement is formed of Tertiary, Decan Traps, Mesozoics and Precambrians.

The early Quaternaries (Pleistocene) of the area comprise sediment older alluvium (Narmada Alluvium) are characterised by 2nd and 3rd glacial advent during mid-Pleistocene comprising interbedded, clayey and sandy layers. The late Quaternaries comprises Recent and sub recent deposits i.e. newer alluvium including river sand-gravel, coastal and estuarine mud, beach sand, blown sand, modern soils, etc. The sedimentation has taken

place under the tectonically active basin which formed a part of the Cambay graben. From the time of late Triassic to Recent, a series of tectonic events have contributed in evolving the present structural pattern. The marine clay horizons in the stratigraphic column and the specific geomorphic landforms along the coastal zone mark the fluctuations of sea levels during different phases of depositional environments and palaeo-climatic changes.

GEOMORPHOLOGY

The area in general forms a lowlying levelled land. The major part is in the elevation range of 10 to 40 m. The fringe zones towards the coast is below 10 m; Physiographically, the terrain could be divided into three units as:

i) Coastal Lowland below 13 m,

ii) Central Alluvial Plains between 13m and 45m and

iii) Eastern peidmont Zone between 45 to 60 m.

The general slope of the area is towards WSW. The Mahi and Narmada rivers are the prominent physiographic features. However, the major drainage of the area is carried by the Dhadhar river flowing almost in the central part.

The landforms of the area show their development under subaerial exogenic processes characterised by semi-arid to humid climate with moderate to high rainfalls. The coastal landforms comprise mudflats, river mouth bars, beach sands, relict mudflats and alluvial plains, etc. The Central alluvial landforms comprise

flood plains, natural levee, point bars, buried channels, river terrace, gullies, cliffs, scarps, etc. The eastern peidmont zone is characterised by undulating topography reflecting bedrock configuration. The regional trends of the broad landform pattern show strong influence of endogenic activities related to the tectonic movements within the platforms and are indicated by the structures of various orders. The drainage pattern reflect the structural framework.

TERRAIN RESOURCES

The terrain resources like land, soil, water and minerals have rich potential. About 77% of land is available for cultivation while uncultivable waste land shares about 10% and the rest 13% is under other uses. In general, the terrain show a high rate of capability for variety of landuse.

Soils of the study area broadly fall under three major groups, viz. Black soils, alluvial sandy loam and saline - alkaline coastal soils. Genetically,they belong to three major orders as Vertisols, Inceptisols and Entisols.

The area has got vast surface water potential. The total drainage area of the three rivers of Mahi, Narmada and Dhadhar have aggregate average annual discharge of 49,895 Mm^3 at mean rainfall of 1100 mm. Groundwater potential of the area is also quite rich It occurs under water table conditions in shallow depths and in deeper horizon under semi-confined and confined

aquifers. In general, the groundwater flow is from ENE to WSW. Quality of water progressively deteriora es as traced towards west. Average annual gross recharge from various sources amounts to 980 Mm^3/yr and present level of utilisation is at 29% only. The occurrence of groundwater in terms of the quantity and quality clearly reflects its governing conditions related to Quarternary history of sedimentation under fluctuating sea levels.

An interesting array of mineral resources like salt, sand, gravel, brick-earth, clay, and Kankar, etc. are widely distributed and occur in large quantities. Broad tidal range of the sea water and brine bearing shallow coastal aquifers have provided ideal conditions for salt manufacture. The natural aggregate like sand and gravel are available in abundant quantity and of good quality from the river courses of Mahi, Narmada and Dhadhar. The earth suitable for the manufacture of high strength bricks is also amply available from the northern parts of area.

GEO-ENVIRONMENTS

The operating geo-dynamic parameters (endogenic and exogenic) define the geo-environmental status of the area. The hazardous geological environmental parameters include seismicity, floods, erosions, deposition, inundation, storms etc. Accordingly the area could be divided into four broad zones :

i) Central Alluvium

ii) Revine land

iii) Coastal saline land

iv) Eastern Upland

The human interaction parameters include agricultural practices, industry, communication, habitation etc. The present management practices of the terrain resources indicate an overall deteriorating trend of the environment.

METHODOLOGY AND APPROACH

The scope of the problem being of multidisciplinary, the methodology and approach adopted include the following main aspects :

I Data Base.

1. Maps

   - Survey of India Topographic sheets (1 : 1m, 1 : 250,000, 1 : 50,000)
   - Satellite imagry, 1:250,000 scale colour prints (30m resoultion)
   - Other administrative maps

2. Literature and Information.

   - Published works
   - Institutional reports (Govt., Semi-Govt, and others)
   - Personal communications

3. Field and Laboratory.

   - Observations of geological and structural features
   - Identification of geomorphic features

- Collection of samples : geological formations, soils, water, minerals, photographs of features of specific interest
- Map processing and analysis

  A map showing field investigation for the study area is given in Fig. I.4.

II Data Processing and Evaluation.

1. Review of published literature for geological and structural studies, supporting with personal field observations.
2. Quantitative and qualitative interpretation of maps and imagery and field checks for identification of geomorphic features and terrain charactheristics.
3. Compilation of statistical data and analysis about exploitation of natural resources and review of resource genesis.

III Formulation of Concepts and Models.

1. Dynamics of Quaternary processes controlling morphogensis of present geomorphic setting and future trends of landform modifications.
2. Terrain capability environments of resource genesis and exploitation practices.
3. Geo-environmental zoning and appropriate strategy for management.

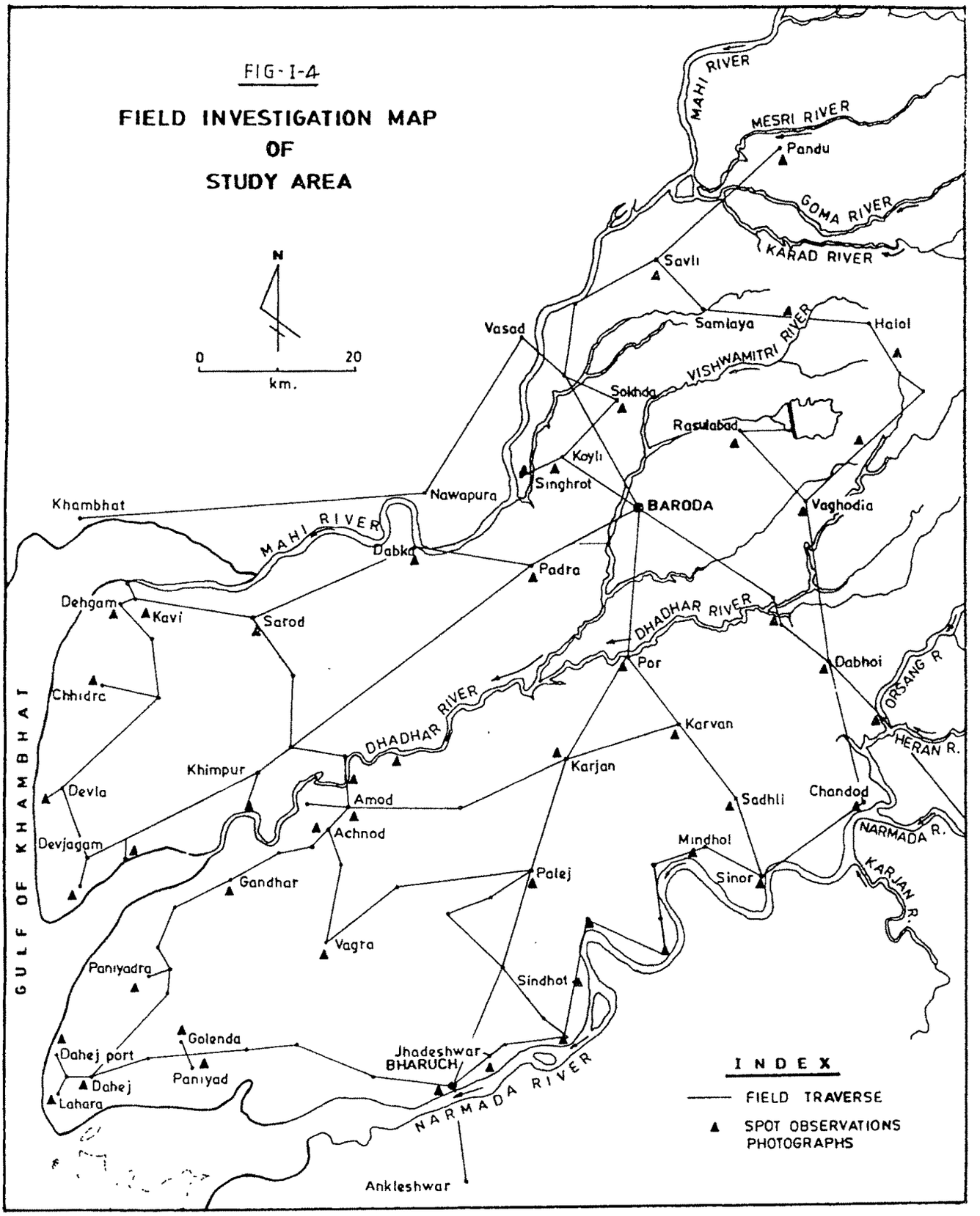


FIG-I-4
FIELD INVESTIGATION MAP
OF
STUDY AREA
N
0
20
km.
MAHI RIVER
MESRI RIVER
Pandu
GOMA RIVER
KARAD RIVER
Savli
Samlaya
Halol
Vasad
VISHWAMITRI RIVER
Sokhda
Rasulabad
Kayli
Singhrot
Nawapura
Khambhat
BARODA
Vaghodia
MAHI RIVER
Dabka
Padra
Dehgam
Kavi
Sarod
DHADHAR RIVER
Por
Dabhoi
ORSANG R
Chhidra
DHADHAR RIVER
Karvan
HERAN R.
Khimpur
Karjan
Devla
Amod
Sadhli
Chandod
Devjagam
Achnod
NARMADA R.
Mindhol
Palej
Sinor
KARJAN R.
Gandhar
Vagra
Paniyadra
Sindhot
Golenda
Dahej port
Jhadeshwar
BHARUCH
Paniyad
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