Chapter III

TERRAIN CHARACTERISTIC

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INTRODUCTION

Geomorphological characteristics of the South Gujarat area present unique picture interms of their diversity in physiography, landforms, drainage and landuse pattern. Infect it provides a 'Key Hole View' of the geomorphic fabric of entire Gujarat State.

The South Gujarat area is bounded by the rivers Tapi in north and Damanganga in south. The eastern boundary delimits the Trappean highlands and on western side the coast line of Arabian Sea. The diversity in geomorphic characteristics of this area is attributed to the factors related to viz. litho-tectonic framework, geomorphic processes, climate and the neotectonism.

PHYSIOGRAPHY

Taking into account the altimetric variations, the South Gujarat reflects a very high order of relief variation. Beginning from almost at the mean sea level, the positive height of the area touches almost 1000 m. mark, within an average lateral distance of 90 -100 km.

Physiographically the South Gujarat terrain can be divided into 4 zones, viz.

Zone I - Trappean Highlands (100 - 1000 m AMSL)

Zone II - Trappean Pediments (50 - 100 m)

Zone III - Alluvium Plain (10 - 50 m)

Zone IV - Coastal Plain (0 - 10 m)

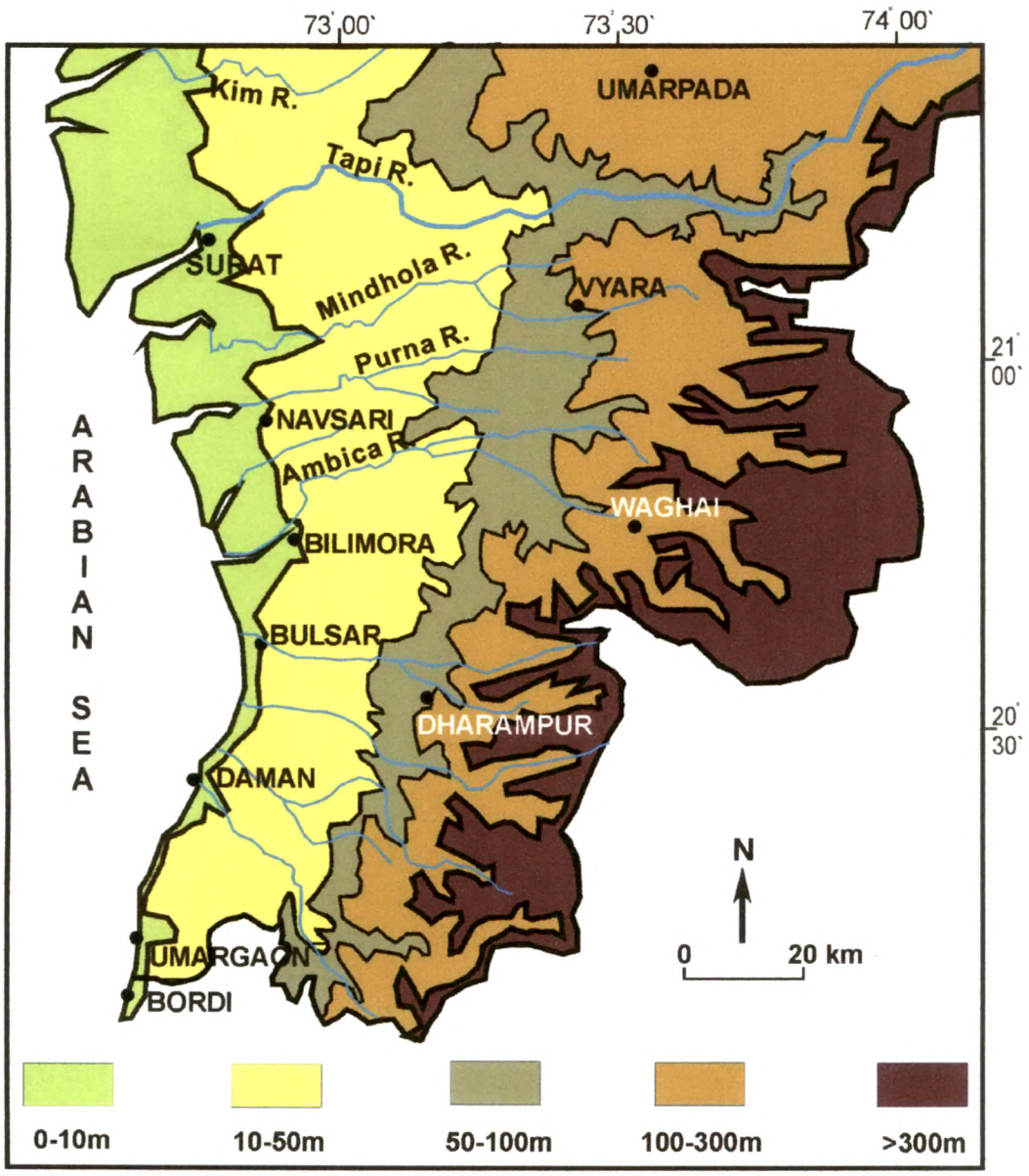

Fig. 3.1 Altimetric Zones of South Gujarat.

i) **Trappean Highlands**: The Trappean Highlands (Fig. 3.1) constitute the northernmost extension of the Western Ghats Escarpments, the Sahayadri

range and form a high plateau running parallel to the West coast of Gujarat. The topography is highly irregular, marked by chains of hills and narrow intermountain valleys. The area display general slope towards west. However, the entire range owing to its increasing heights due south displays steep plunge towards north. The mountain chain apart from N-S extending plateau features is dissected by large number of E-W and NE-SW trending regional dyke ridges. Owing to intense residual and mechanical weathering, the plateau surfaces have been enriched with a good thickness of soils. The slopes are characterized by deep red soils, while on the planation surfaces black cotton soils have developed. The landscape is dominated by a thick canopy of a typical deciduous forest.

ii) **Trappean Pediments**: This is a transitional zone between Alluvial Plain on one side and Trappean Highlands on other side. In general this area fall within the altitudes 50 and 100 m. Area is characterized by low relief and rolling topography. This zone is partly covered by the rocky outcrops i.e. dyke ridges and a substantial thickness of colluvial material, depositing a broad fan morphology and the triangular facets. The pediment zone is widest in northern parts of the area and tends to narrow down southerly.

iii) **Alluvium plains**: This zone is characterized by a wide planation surface between moderate - steeply sloping pediment zone in the east and a narrow coastal plain strip in the west. Alluvium plain predominantly comprises an admixture of gravel, sand, silt and clays, deposited under riverine environment. The deposition of these non-indurated sediments with an aggregate thickness of 10 -200 m. is attributed to tectono-eustatic factors (Vashi and Ganapathi, 1982). From north to south the width of the alluvium plain tend to decrease southward. The lateral disposition of this zone strongly guided by the Trappean basement, which is on approaching to Par river mouth almost, appears near the shoreline. The alluvium further south is restricted as narrow flood plain deposits and of very limited thickness. The alluvium plains are drained by a well-knitted westerly flowing drainage system.

iv) **Coastal Plain**: Abutting with the alluvium plains in east, the coastal plain (02 - 20 km wide) is distinguished by an extensive flat terrain, with the features like sandy beaches, bars, spits, barrier ridges, dune ridges, creeks and mud flats. The coastal plain is made up of unconsolidated sediments of marine, fluvial and aeolian origin (Jottun et al, 1982). Late Quaternary sea-level fluctuations have given rise to more than one generation of coastal features (Merh, 1986). Vegetation cover is scanty, often marked by prosopis sp., palms and poor mangrove vegetation.

Plate 2 A View of Stabilised Coastal Onshore Dunal Ridge with Luxurious Vegetation (Loc. Daman).

LANDFORM FEATURES

Landforms shape the quantity and quality of economic activities. They play a significant role on land use variation, extent of cultivation, mechanisation, accessibility and irrigation and indirectly effect the change in soils and erosional patterns (Porwal, 1997). Howard (1967) has defined a landform as "any element of the landscape, characterised by a distinctive surface expression, internal structure or both and sufficiently conspicuous to be included in a physiographic description".

The South Gujarat region characterizes a very interesting geomorphological set up. Though appearing simple outlook, it has evolved through very complex geological-cum-geomorphic processes. South Gujarat area is riddled with a variety of landform features, manifested under numerous exogenetic processes. The study of available literature (Vashi and Ganapathi, 1982; Jottun et al, 1982; Mukharjee, 1985; Vashi et al, 1988; Alavi, 1990; Rai, 1991; Alavi and Merh, 1991 and Deota, 1991), topographical maps and satellite imageries has revealed that these landforms exhibit distinct affinity to the physiographic zones.

The alluvium and coastal plains together shares large number of erosional and depositional landform features, developed under fluvial marine and aeolian processes (Fig. 3.2). Landforms associated with the pediment zone and trappean highlands have been predominantly developed under mechanical erosion as well as the tectonism. As descriptive account on the specific landforms and their genesis goes beyond the scope of this study, author has provided a summary of all the available landforms along with processes and physiographic zones in Table 3.1.

Table 3.1 Summary of South Gujarat Landforms.

Geomorphic Processes	Types of Landforms	Physiographic Zone
Marine	Sea cliffs, Beaches, Wave cut platforms	Coastal plain
Fluvial	Alluvial plain, Flood plain, Point bars, Channel bars, River terraces, Cliffs	Alluvium plain
Fluvio-marine	Mud flats, Mouth bars	Coastal plain
Aeolian	Sand dunes	Coastal plain
Mechanical (erosional)	Cuesta, Mesa, Plateau, Valleys	Trappean highlands
Tectonic	Escarpment, Fall, Cascades, Rapids, Knick point, Ravines	Trappean highlands, Pediment zone, Alluvium zone

DRAINAGE SYSTEM

South Gujarat terrain is characterised by a well-knitted westerly flowing drainage system. The major rivers, which drain the area from north to south, are viz. Tapi, Mindhola, Purna, Ambica, Auranga, Par and Damanganga. The existing drainage exhibits their origin from rugged terrains of the Trappean Highlands except Tapi, which originate far enough from northern Maharshtra.

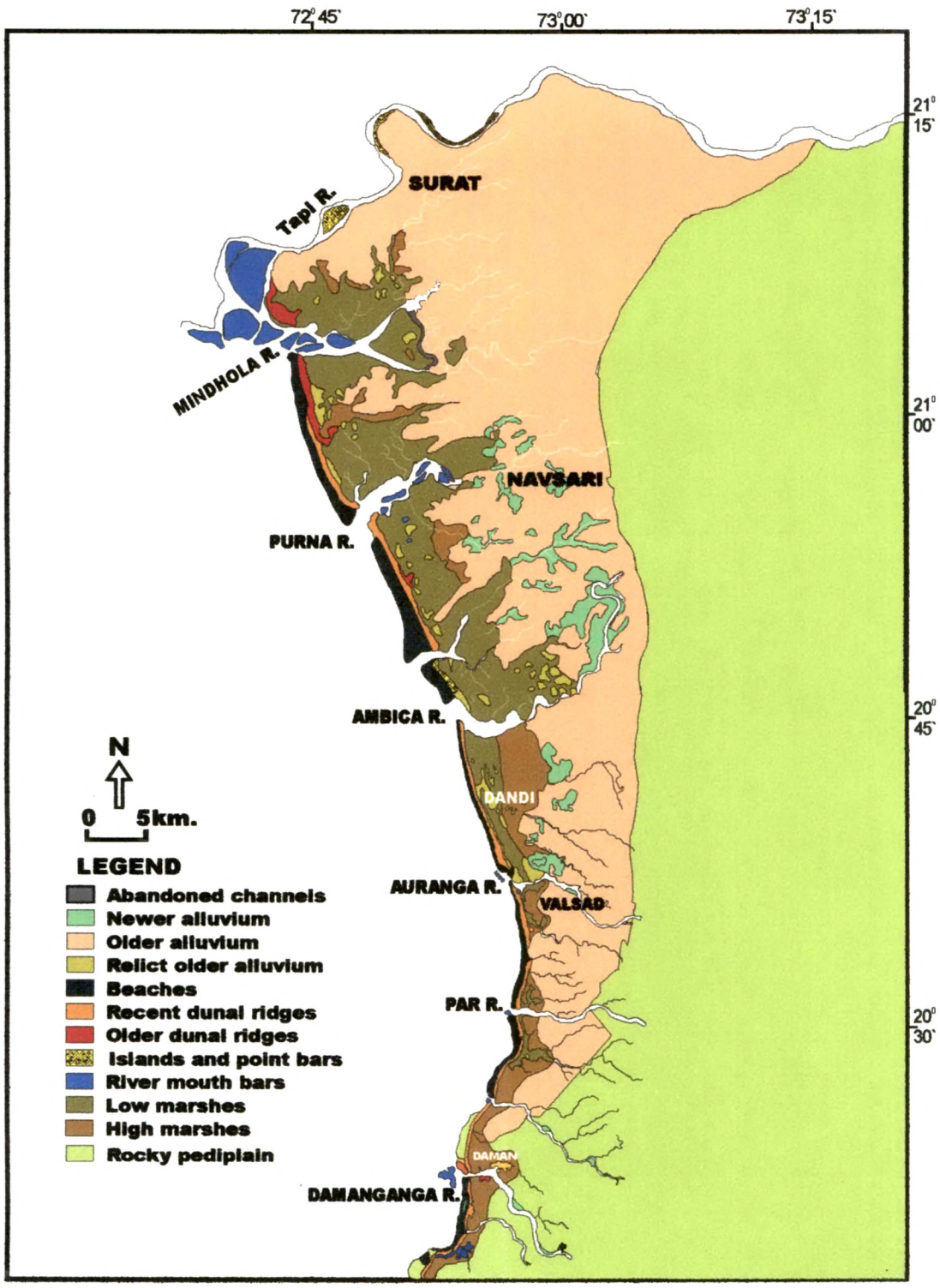

Fig. 3.2 Landform Characteristics of South Gujarat.

Drainage being mainly controlled by the numerous joints and fractures therefore, an overall drainage reflects a characteristic dendritic and rectangular drainage patterns which is typical of trappean terrain. In the higher elevations, quite a few low order streams are slope controlled, but this is restricted to steeply sloping area only. On the other hand, low order streams flowing on plateaus or gently sloping ground, by and large follow joints and fractures. Once the rivers enter in the alluvial plain owing to sudden drop in velocity the headword portions of the stream flow rapidly while their courses over gradient less plains are sluggish. Presence of large scale meandering loops in upper reaches particularly the rivers Purna, Ambica and Auranga are attributed to dyke controls.

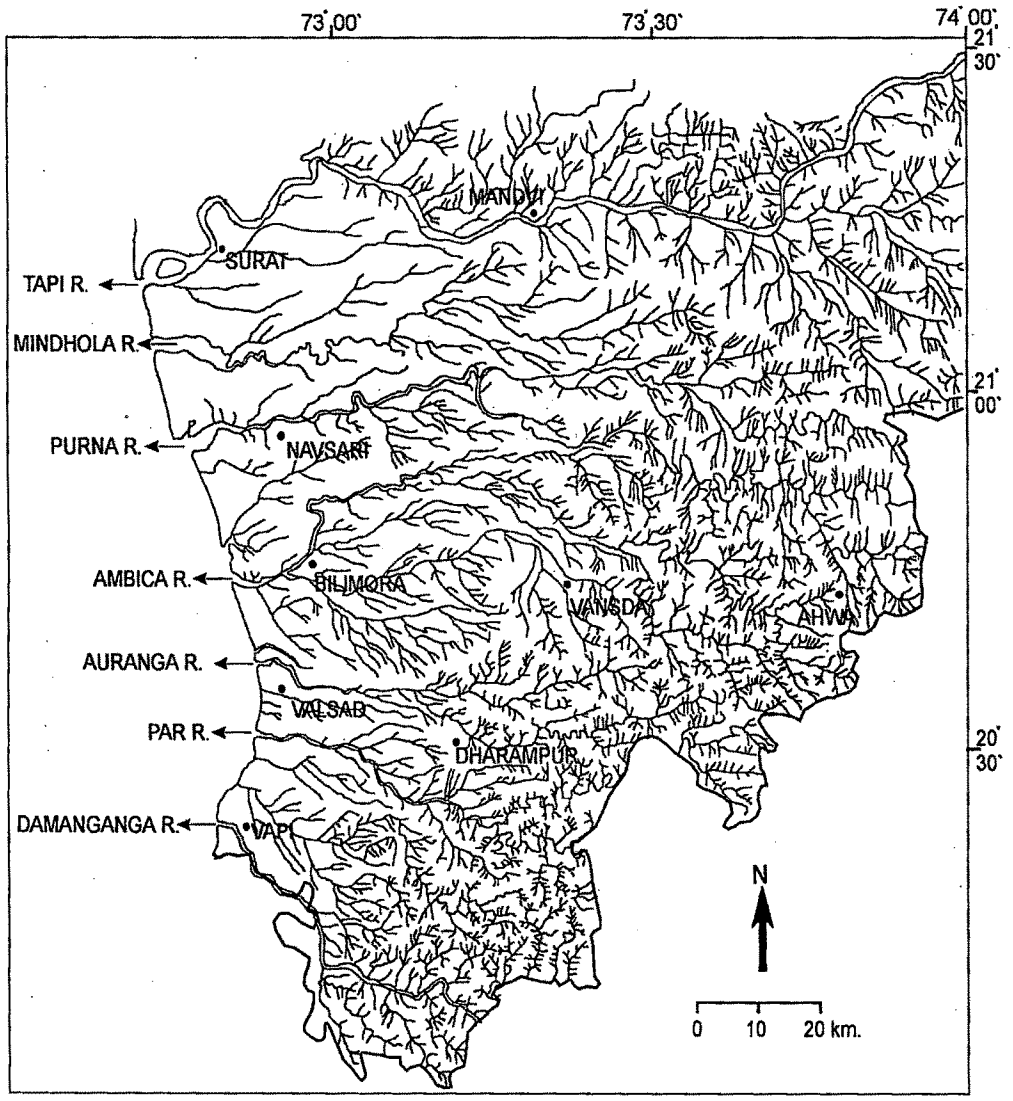

Fig. 3.3 Drainage Systems of South Gujarat.

The drainage map of the area (Fig. 3.3) clearly indicates a consistent parallelism in the major trunk streams, indicating deceptive controls exercised by the regional fracture pattern. All the river courses are guided by ENE-WSW fractures, which have been considered by the various workers viz. Biswas, 1987; Powar, 1987 and Alavi, 1990 as the basement fractures. In the deep seismic profile of Kaila, 1981, also these fractures/faults are clearly witnessed.

The river courses in its lower reaches shows marked shift in their flow. The rivers namely Damanganga, Par and Auranga abruptly change their courses to north while the rivers Ambica, Purna to south, this phenomena of abrupt shift in their course can be attributed to differential movements among the faults/fractures controlled blocks. Deep entrenchment, ravine lands, presence of enumerable paleochannels and meander loops are also attributed to the shifting of river channels, under the block movements.

Alavi (1990) carried out a detailed study on the drainage characteristics of the South Gujarat. According to him "the drainage characteristic of the area ideally reflect the tectonic features". Entire drainage system is representing an interplay of ENE-WSW (basement), NW-SE & NE-SW (conjugate) and N-S trending fracture systems; thereby providing a strong evidence of a morphotectonic control. The area provides a good example of drainage diversity and its close relationship with various factors of landscape evolution.

LAND-USE PATTERN

Term land use refers to man's activities on land (Clawson and Stewart, 1965). Study of land use pattern of any area gives an insight on qualitative and quantitative scenarios of land, in terms of its resources, utilisation and development. Systematic monitoring and assessment of land and its various resources utilisation not only reflects socio-economic condition of the area, but also serves an important tool in predicting the degenerating state of land as well as the land management strategies. Developmental activities considerably influence the landuse pattern. The South Gujarat terrain has not remained exceptional to this very fact. Owing to everlasting urbanisation, growing population and the inception of canal irrigation; the landuse pattern in South Gujarat has witnessed considerable change.

Although not much information on the landuse pattern, prior to the commissioning of Kakrapar canal irrigation i.e. 1953-54 is available; only 9,476 hectare land used to be covered under different sources of irrigation. Now, almost 2,04,080 hectare land is covered under the canal irrigation. The earliest account on the landuse pattern in Kakrapar command area dates back to 1971 (Dist. Census Hand Book). Then decadal scenarios for the years 1981, 1991 have been prepared by the Government agencies (Table 3.2).

Mistry and Purohit (1982) studied the environmental impact of Ukai-Kakrapar Project using data from conventional sources. According to these workers the CCA under Kakrapar canals which has originally estimated at 227540 ha has been reassessed to 204080 ha. The various land use categories worked out by these workers comprises:

Area under surface irrigated crop in any one season	124692 ha.
Area under well irrigation	20000 ha.
Orchards	5305 ha.
Cultivable waste	19850 ha.
Current fallow	4695 ha.
Grass land	6788 ha.
Coastal land	2000 ha.
Total	204080ha

Latter Sahai et al (1983) studied the impact of canal irrigation on the ecology of the Ukai-Kakrapar Command area with special reference to land degradation due to waterlogging/salinity as well as changes in the cropping pattern using remote sensing techniques. They further categorised the command area, using Anderson Classification (1976). According to these workers the landuse categories in this command fall under Level I and II classification of Anderson shows in Fig. 3.4.
The land use pattern scenarios for the year 1971, 1981 and 1991 (Table 3.2) shows considerable shift in various categories viz.

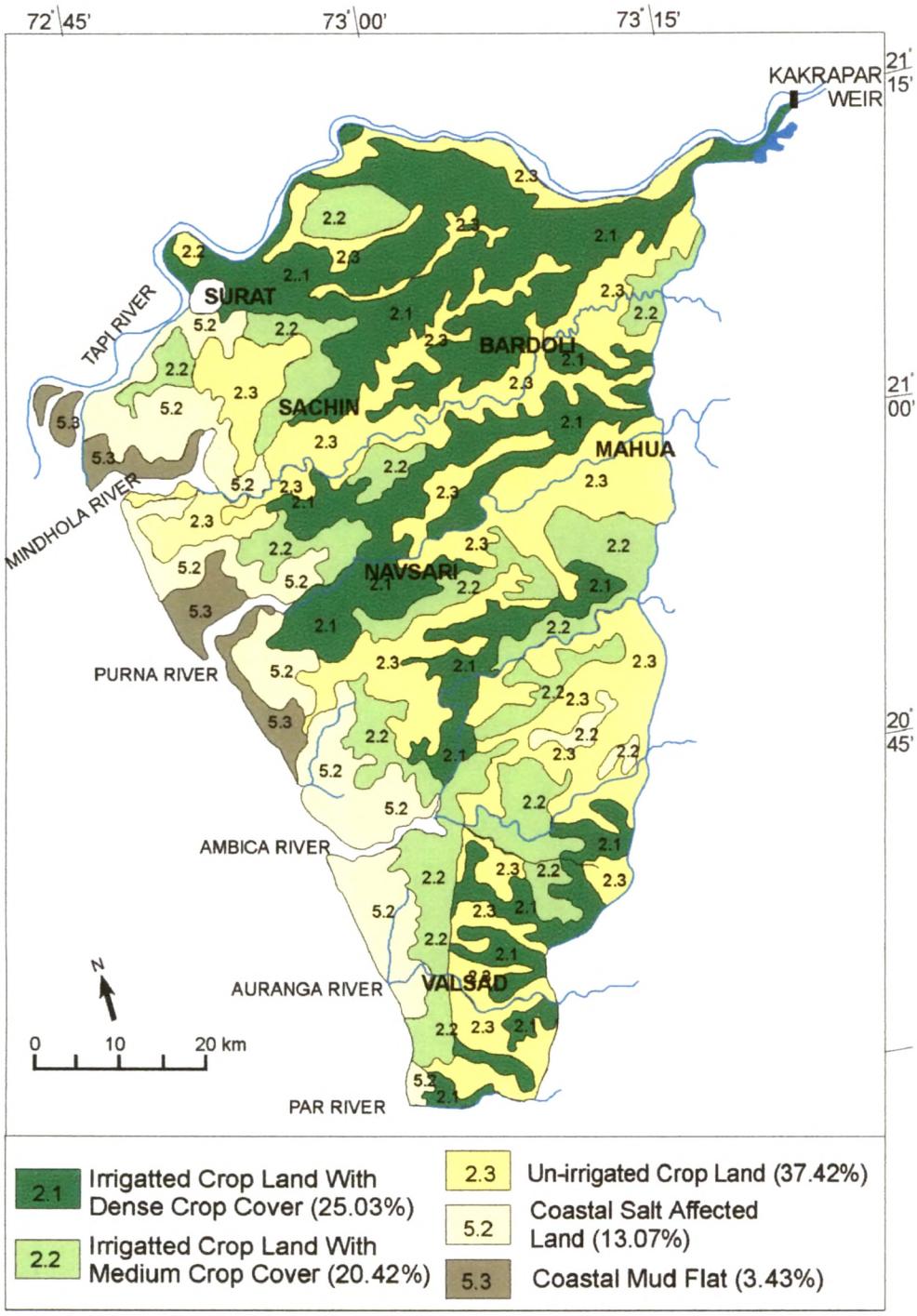

Fig. 3.4 Landuse Pattern of Kakrapar Left Bank Canal Command Area (after Sahai et al, 1983).

i) **Forest Area**: Forest land have a tree-crown areal density of 10 percent or more, are stocked with trees capable of producing timber or other wood products, and exert an influence on the climate or water regime (Anderson

et al, 1976). Table 3.2 indicates that the forestland is decreased by 1.4 percent from 1971 to 1991.

Table 3.2 Landuse Pattern of Kakrapar Left Bank Canal Command Area.

(Total area is 451202.9)

Year	Forest	Irrigated	Unirrigated	Culturable waste	Area not available for cultivation
1971	30681.8 (6.8%)	41961.87 (9.3)	280197 (62.1)	35645.03 (7.9)	62717.2 (13.9)
1981	29328.19 (6.5)	93399 (20.7)	236430.3 (52.4)	33840.22 (7.5)	58205.17 (12.9)
1991	24364.96 (5.4)	141677.7 (31.4)	176420.3 (39.1)	38352.25 (8.5)	70387.65 (15.6)

(Source: District Census, Gujarat State)

ii) **Cultivable land**: Cultivable or agricultural land may be defined as land used primarily for production of food and fibber. This includes irrigated as well as unirrigated land. Cultivable land covers about 70.5% of the total area out of which 31.4% area is irrigated while 39% area falls under unirrigated area. Twenty years land use data under this category clearly suggests that the unirrigated area has reduced from 62.2% to the 39.1% while, irrigated area shows considerable increase from 9.3% to 31.4%.

iii) **Culturable wasteland**: These are the lands, which are neither productive nor useful for growing food, and fibber. These lands may be made useful only after giving primary and secondary treatment. This category also shows marginal increase from 7.9% in 1971 to 8.5% in 1991. This increase may be attributed to the waterlogging and increase in soil salinity due to excess irrigation in the area.

iv) **Area not available for cultivation**: Land which is not available for the cultivation and being utilized as residential area, lakes, ponds, roads etc are fall under this category. The data shows almost 1.7% increase in this category. This may be attributed to growing urbanization at the cost of encroaching the land used under other categories.

A time progression graph showing change in land use pattern for all the categories in Kakrapar Left Bank Canal Command Area is given in Fig 3.5.

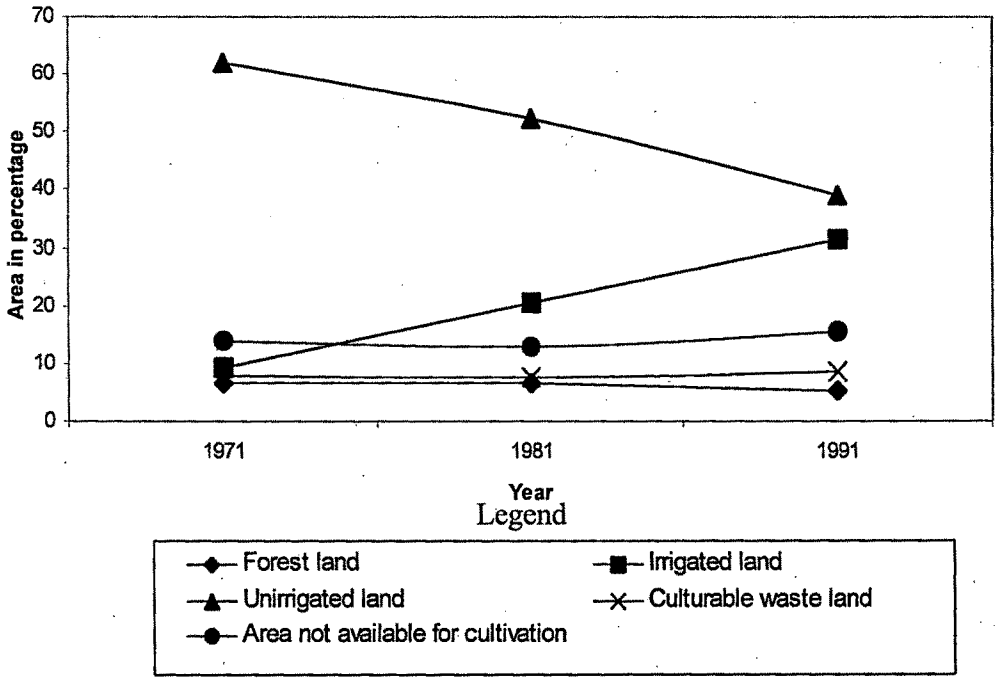

Fig. 3.5 Decadal Change in Landuse Pattern, KLBC Area.