Chapter 3

Terrain Characteristic

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TERRAIN CHARACTERISTICS

The Gujarat State is characterised by a variety of terrains attributed to various surficial and sub-surficial processes coupled with distinct geoclimatic domains. Geomorphology of the different parts of Gujarat has been studied in detail by the various workers viz. Merh, (1987), Islam, (1986), Nayak and Sahai, (1983), Nayak et. al. (1988), Babu, (1977), Agrawal et. al. (1988, 1996), Sant and Karanth, (1993), Alavi (1990).

Geomorphologically the Gujarat may be divided into four units viz. (I) Rocky upland, (II) Pediment Plains, (III) Alluvium Plains, and (IV) Coastal Plains and Ranns.

Cambay basin as a whole and study area in particular constitutes a part of Alluvium and Coastal Plains. The study area constitute a part of inter-stream area shared by the rivers Sabarmati in west, Watrak and Shedhi in the north, Mahi in east and south and Gulf of Cambay in the southwest. The study area is characterized by a gentle to flat topography, meager natural drainage, comparatively heavy soils and semi-arid climate. A critical account on the geomorphic characteristics of the study area and its surrounding environs is discussed as under-

PHYSIOGRAPHY

Entire study area and its surrounding is characterised by a comparatively low gradient and featureless terrain. The study area lies at an elevation ranging between 65 m and 8 m AMSL. It displays gentle slope to southwest, i.e. towards Gulf of Cambay with an average gradient of 1:1600. Southwestern region of the study area is characterised by extremely flat terrain and subjected to annual inundation during monsoon. This terrain is locally referred as Bhal Area.

LANDFORM FEATURES

Mahi Irrigation command and its surrounding area harbours a variety of erosional, depositional, residual and tectonic features. The detail study of this area has been carried out by Agrawal et. al. (1996) who has divided the area into three units viz. (1) Aravalli Folded

Erosional Unit, (2) Pediment / Piedmont Unit, and (3) Alluvial Plain; based on Physiography, slope and landform features (Fig 3.1). A critical appraisal of their work is given as under.

1. **ARAVALLI FOLDED EROSIONAL UNIT:**

This unit constitutes major catchment areas for the rivers bounding the study area. it is characterised by a typical rocky and hilly terrain of Pre-Cambrian and Mesozoic rocks with an altitude ranging between 150-350 m AMSL. This unit has been traversed by the rivers like, Watrak, Eru and tributaries of the Majham, Meshwa and Mahi. All these channels show SSW to SW direction of flow and have developed structurally controlled parallel drainage system.

2. **THE PEDIMENT/PIEDMONT ZONE:**

A narrow strip opening wide on approaching south is bounded between Aravalli Folded Erosional Unit and Alluvial Plains. This unit sprawls within the elevations ranging between 65 m and 150 m. A considerable area under this unit is occupied by the bad land ravines, specially along the stream channels of Watrak, Sabarmati and Mahi rivers around Kapadvanj, Himmatnagar and Vasad respectively. These badland patches are characterised by a deep entrenchment / incision, to the order of 10-25 m. This unit also reflects strong influence of structurally controlled parallel drainage system trending SSW-SW. So far other landforms are concern the river terraces of 25-30 m height and the inselbergs are the most conspicuous landforms found in the upstream parts of Sabarmati River.

3. **THE ALLUVIAL PLAIN:**

This unit encompasses the vast area of command (the study area) and is characterised by flat surface within the elevations ranging between 65 and 13 m AMSL. The unit represents agradational surface formed as a result of fluvial deposition by the major rivers and their tributaries. The rivers show sinuous courses.

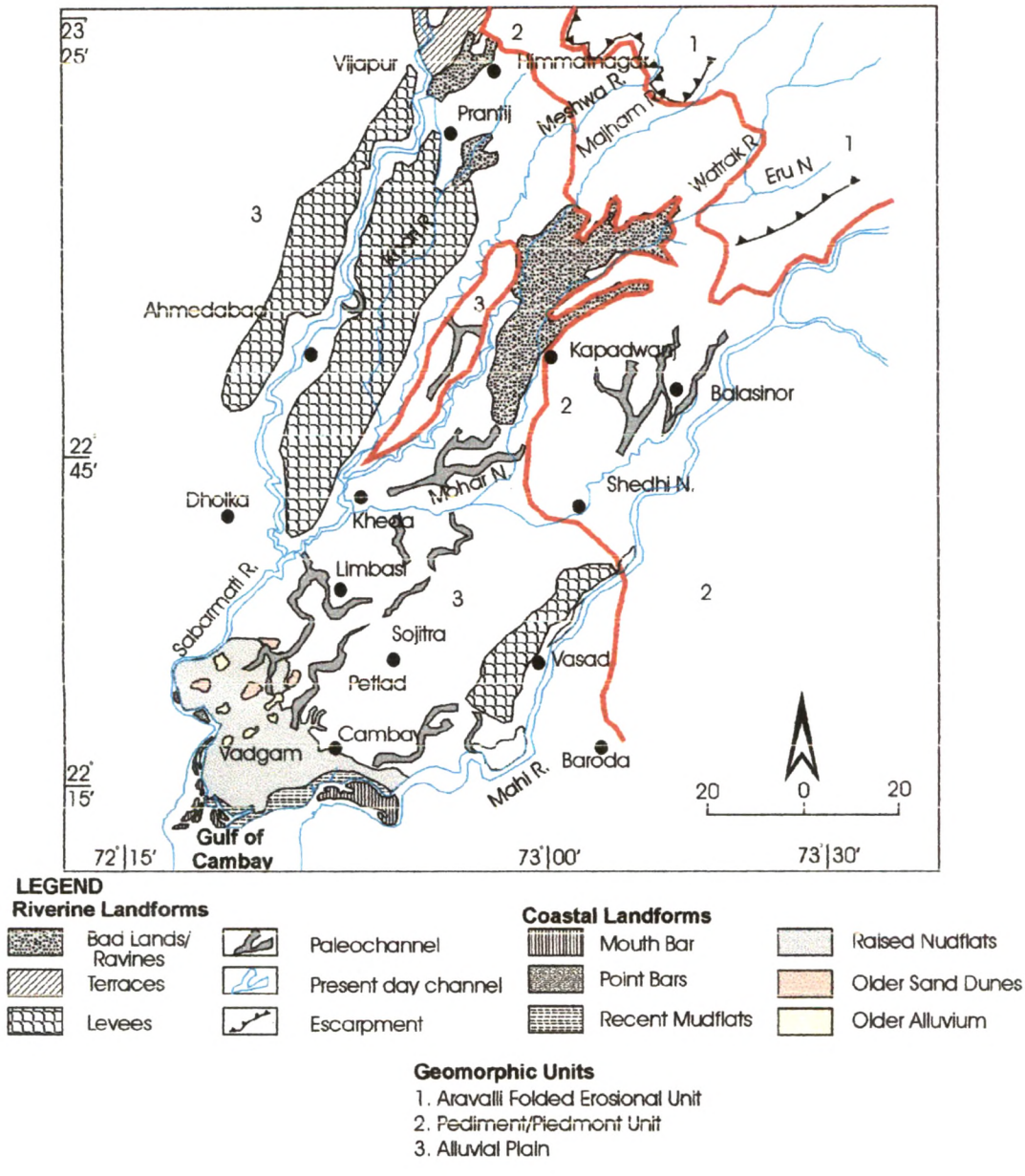

Fig. 3.1 Geomorphological and Landform Attributes in Parts of Sabarmati-Mahi Interstream Area.

Vast alluvium tracks along the Gulf of Cambay, popularly known as Bhal Region is the manifestation of eustatic changes during late Quaternary period (Merh, 1996). This terrain which has been identified as vast gradient less feature is affected by a prolonged inundation during monsoon period and severely affected by salt encrustations. The Bhal region is characterised by a variety of landform features of fluvial, fluvio-marine and aeolian

origin viz. Terraces, Relict Alluvium and Channel Bars, Estuaries, Tidal flats, raised mudflats, sandy ridges and Eolian Stabilized sandy ridges, present day dunes (Islam, 1986, Nayak et. al. 1985).

DRAINAGE SYSTEM

Study of drainage system of any area constitutes a vital input for the problems related to water resources evaluation. Majority of waters received during monsoon period are channelized and distributed by this single attribute, the drainage. As it has already been eluded that the command/study area is bounded by the drainage system of the Sabarmati-Watrak-Shedhi and Mahi Rivers. Hence it becomes imperative to critically review the role played by these rivers in an overall evolution of the area and their influence on surface and water resources distribution.

On a regional scene these rivers manifests a parallel drainage pattern with almost NNE-SSW trend. But locally their abrupt shifts are fault controlled. All these rivers are originating in the rocky uplands of Pre-Cambrian Mesozoic rocks and show strong influence of structural control. The moment these rivers enter into plains; they seem to carve out variety of landform features attributed to the factors related to Neotectonism, eustatic changes and climatic vicissitudes. The geomorphic and drainage evolution of the Sabarmati-Mahi interstream area has been studied in detail by the workers viz. Gadekar et. al., 1981; Nayak et. al., 1985; Sant & Karanth, 1993; Agrawal et. al. 1996. These rivers show strong sinuosity and meandering patterns. Various fluvial features viz. Ox-bow lakes, terraces, point bars, palaeochannels, palaeo-delta, bar islands etc. can be ubiquitously seen on the satellite imageries.

The study carried out by Gadekar et. al. (1981) has suggested that the Mahi river had passed through at least three stages of geomorphic evolution. This he corroborated on delineation of four system of palaeochannels viz. Dabhasa, Bhadran and Tarapur-Dabka; within the time framework of palaeochannels 1& 2 (Upper Pleistocene-Holocene), palaeochannel 3 (1868-1891 A. D.) and palaeochannel 4 (1972-73 A. D.). He further opined that the present day course in its lower reaches is controlled by NW-SE and NE-SW fault systems near Cambay and Dabka respectively.

Agrawal et. al. (1996) have studied the palaeochannels and palaeodeltaic lobes of Mahi and Watrak Rivers and designated these palaeochannels as Proto-Mahi and Proto-Watrak rivers; dissoluting their loads in the Gulf of Cambay. The palaeo-delta lobes of these rivers appear to coalesce between Kheda and Dakor (Fig. 3.2). Also the occurrence of wide estuary at the Mahi river mouth further suggests that an arms of sea extended northward at least upto south of Limbasi-Sojitra-Petlad area and receded southwest due to delta progradation during Holocene period. Large numbers of ponds in the study area, which are having elongated shapes, are nothing but the remnants of palaeo-channels of the earlier drainage system; now, constitutes a vital depository surface water accumulations. It is interesting to observe that as far as command/study area is concern practically no active drainage exists within the command (Fig. 3.3). Almost absence of active drainage may be attributed to highly porous and permeable soil-subsoil stratum and almost flat gradient topography. An ideal conditions for water infiltration to the groundwater regime.

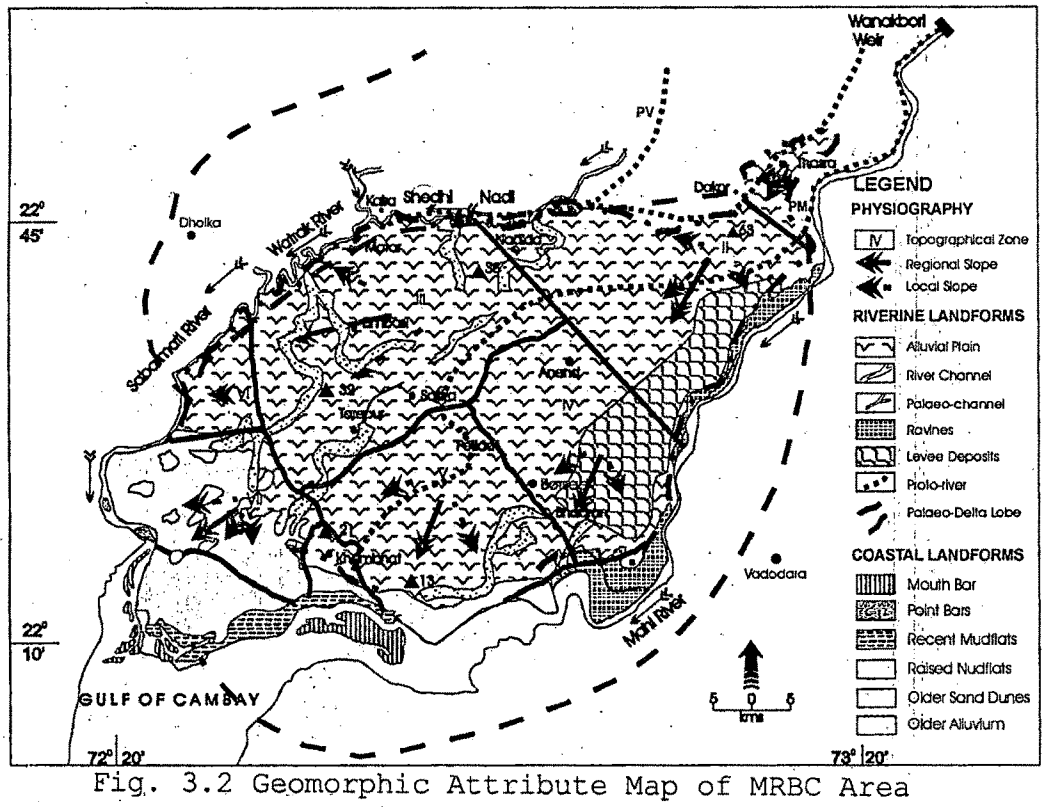

Fig. 3.2 Geomorphic Attribute Map of MRBC Area

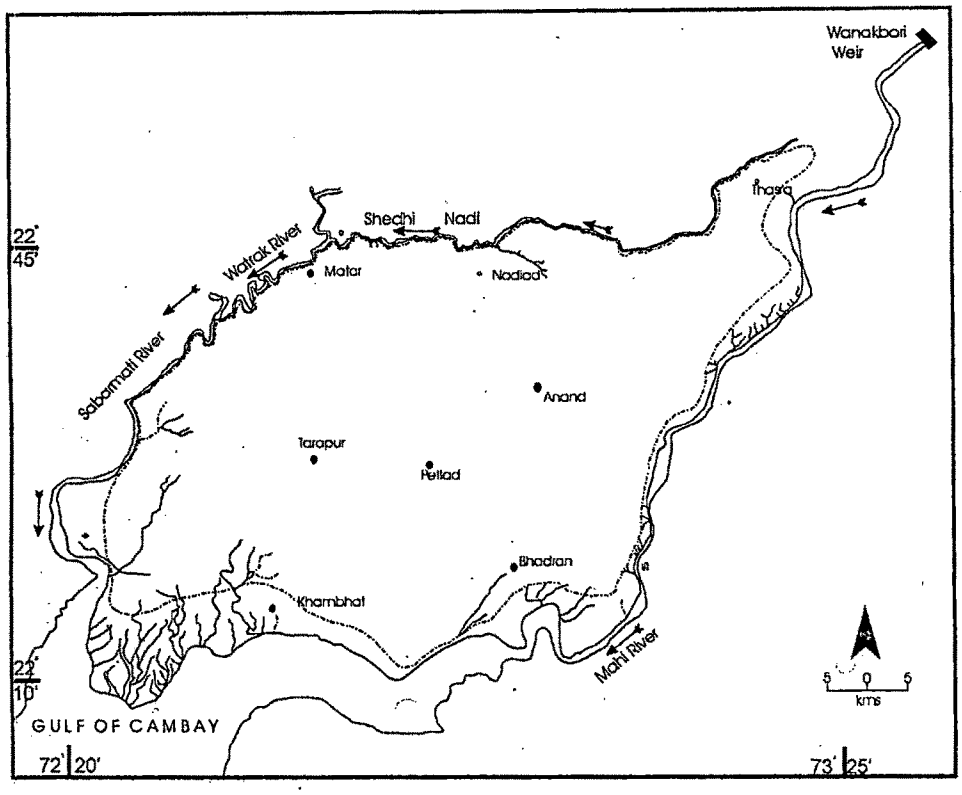

Fig. 3.3 Drainage Map of MRBC Area

LANDUSE PATTERN

The entire command area (3,15,790 ha) being an alluvial plain has a gentle to flat gradient and ample availability of the surface and groundwater, major part is utilized for the agricultural practices. The coastal areas around Cambay town, characterised by the mudflat are used for the salt pans. The area also has the wasteland in the form the ravines but it is restricted near the river channel of the Mahi, which again falls out side the command area. The availability of the plenty of the surface water in the form of Canal network and the exiting natural tank lead to utilization of land for agricultural practices in both kharif and rabi season. An overall landuse pattern in the command area is given in Table 3.1

The I. A. R. I. workers have categorised the study area in to seven topographical zones, based on local slopes and their directions (Fig. 3.2).

Table 3.1 Land Use Pattern in Study Area.

Land Use	Area in ha	
Gross Command Area (GCA)	3,15,790	100 %
Culturable Area (CA)	2,45,685	77.80% of GCA
Culturable Command Area	2,12,694	86.60 % of CA
Unculturable Area	70,105	22.20% of GCA
Culturable Waste Area	21,790	6.90 % of GCA
Double Cropped Area	87,562	29.80% of NCA
Net Command Area (NCA)	2,93,832	

Based on the above terrain characteristics, it would be noteworthy to conclude that the study area is ideally displays the homogeneity in terms of lack of drainage and gradient, more or less a solitary landuse pattern, geological material characteristics etc. thereby; a uniform hydrogeological setup. The influence of such terrain characteristics on the water regimes of the study area has been dealt in subsequent chapters.