CHAPTER

VI

RIVERS AND PONDS

GENERAL

RIVERS

PONDS

CHAPTER - VI

RIVERS AND PONDS

GENERAL

Coastal areas are always unique in the sense that though they are so close to the sea, they are characterised by a variety of fresh water regimes, which form an integral and important component of coastal environment. The rivers that flow across the coastal plains not only play a significant role in controlling the nature and quantity of coastal and offshore sediments but also provide sources of potable water. River mouths comprise an integral part of a coastal landscape. No study of coastal environment can be complete in the absence of an evaluation of the coastal drainage system, nature of rivers, their effectiveness as agents of transport and deposition, and role played by them in sweet water availability in the coastal areas. Closely related to the aspect of drainage, is that of surface accumulations of fresh water in the form of natural as well as man-made ponds. These rain-fed water bodies are an integral part of the coastal environment and are very important source of sweet water to the local population.

The present author in this chapter has endeavoured to provide a general view of the surface water supply of the Gulf coast emphasizing on the drainage characteristics as well as the nature and the role played by surface accumulations of rain water. He has dealt with following aspects of the fluvial and pluvial regimes:

(1) The overall drainage of the Gulf and its surrounding areas.

(2) The nature and characteristics of the rivers and streams in different coastal segments.

(3) Ponds as a surface storage.

RIVERS

OVERALL DRAINAGE SET UP

The Gulf coast environment has been significantly influenced by the rivers that flow into the Gulf. The evolution of the Gulf during Quaternary times is also related to the role played by various rivers that flow into it. The drainage characteristics of the coast, in turn reveal a close relationship that has existed between structural lineaments, tectonic uplifts and subsidence and sea level changes. The regional fluvial setup within which the rivers of the Gulf, have operated is therefore of vital importance.

The rivers and streams that flow into the Gulf can broadly be classified into two main categories:

A. Rivers like Sabarmati, Mahi, Narmada and Tapi which originate far away from the Gulf, drain several hundred kilometers of geologically diverse terrains before meeting the Gulf.

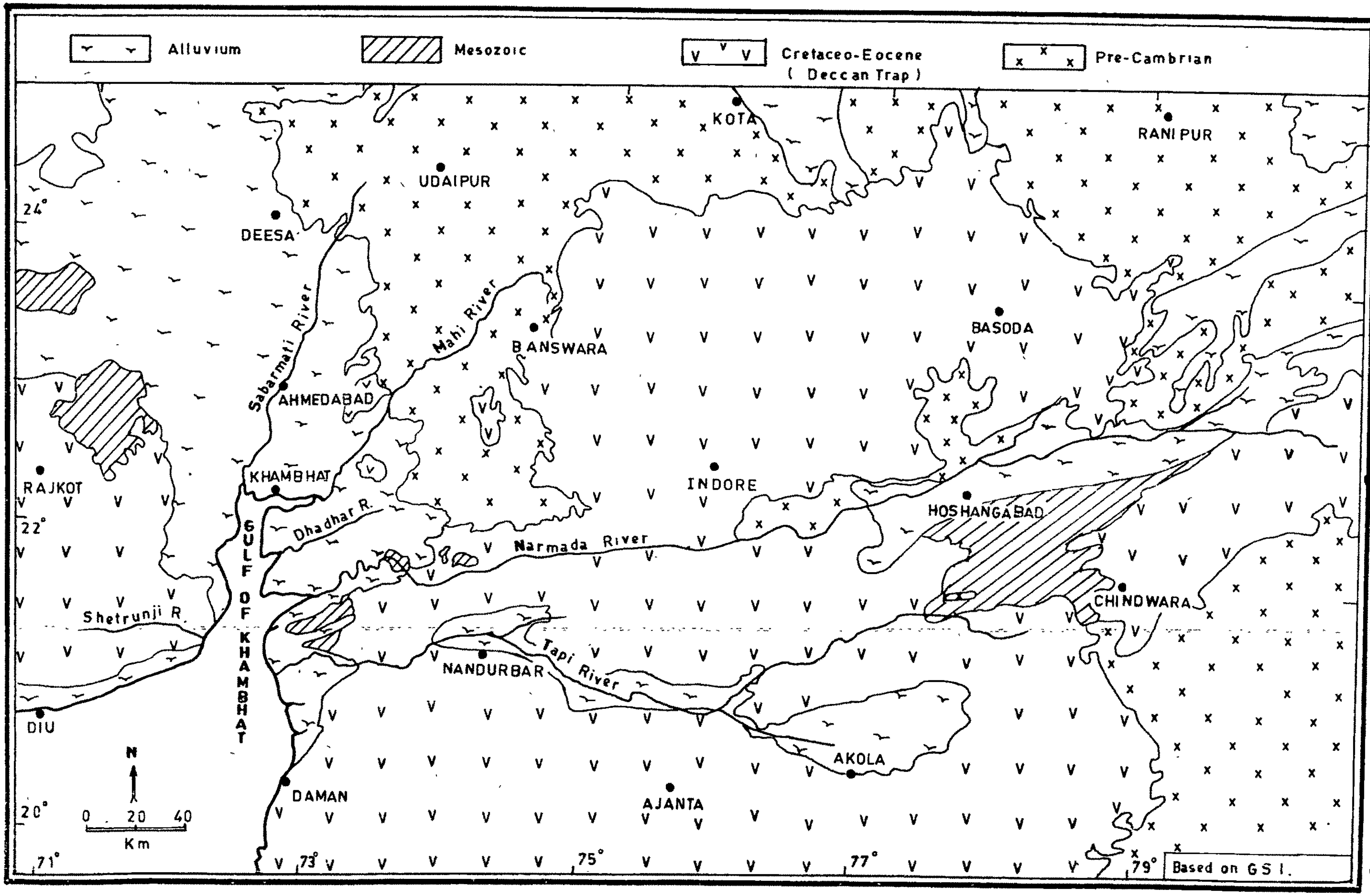
B. Relatively smaller rivers of Saurashtra like Shetrunji, Bhogavo and of Mainland like Dhadhar, Kim and Mindhola, which have nearby provenances and smaller catchment areas.

All these rivers characteristically follow well defined tectonic lineaments, and except for the smaller rivers of Saurashtra, rest are all perennial and bring a lot of water and sediments.

The major rivers of category A comprise the main source of water. They are also instrumental in bringing sediments from distant areas. Figure VI.1 shows the starting points of these rivers and also gives an idea of the geology of the provenance and of the terrain drained by them. The Gulf sediments to some extent reflect this diversity of the source rocks. In Table 6.1 the author has summarized the relevant information about the four major rivers.

Smaller rivers and streams originate within the limits of the Gujarat state and either they follow tectonic features or are slope controlled. Shetrunji and Kalubhar rivers of Saurashtra follow fault planes, while the Bhogavo-Omkar river appears to flow in the slope direction. On the Mainland side, the rivers like Dhadhar and Kim originate in the eastern rocky highlands and flow down the gradient. Whether they are controlled by any structural features is not known. But these rivers, while flowing over the alluvial plains show well marked entrenched meandering, pointing to their rejuvenation subsequent to the development

FIG. VI.1.



GEOLOGY OF THE AREA DRAINED BY THE DIFFERENT RIVERS MEETING THE GULF OF KHAMBHAT

TABLE 6.1. MAJOR RIVERS OF THE GULF OF KHAMBHAT

Name	Total length (km)	Catchment area (km^2)	Annual Runoff (Mm^3) Max	Mini.	Mean	Catchment provenance	Remark
Sabarmati	300	21,674	4000	530	1271	Basement Gneisses, Precambrian metamorphics and metasedimentaries and Quaternary alluvium	-
Mahi	533	34,842	24,000	500	11,800	Basement Gneisses, Precambrian metamorphics and metasedimentaries, Deccan Traps and Quaternary alluvium.	-
Narmada	1312	98,796	-	-	40,705	Basement Gneisses, Precambrian metamorphics and metasedimentaries, Mesozoic sedimentaries, Deccan Traps and Quaternary Alluvium.	Annual Sediment Transport (Bed load) 502 m^3/sq.km. of catchment
Tapi	724	65,145	-	-	17,982	Deccan Traps and Quaternary alluviums.	Annual Sediment Transport (Bed load) 1,094 m^3/sq. km of catchment.

of meanders. This phenomenon is attributed to strandline regression and/or neotectonism by Patel et al.(1985).

The mouths of various major rivers are replete with estuarine mudflats and mouth bars, and their funnel shaped morphology points to their evolution under a fluctuating strandline. Their present day configuration is typically suggestive of submergence and drowning of coastaline on account of rise in sea level during the last transgression (Flandrian). The effects of sea-level changes on the coastal geomorphology have already been briefly described in the previous chapter.

Another important and striking feature related to the impact of sea level changes on the drainage is seen in the Bhal area along the NNW-SSE low lying wasteland upto Nal Sarovar and beyond. This saline tract represents an old tidal flat related to the sea which was higher by a few meters. A large number of east flowing smaller streams originating from Saurashtra side are seen disappearing into this wasteland. This abrupt truncation of drainage is an excellent example of a higher strandline which subsequently regressed to its present position leaving behind extensive mudflats. The small number of streams that straggle across the wasteland of Bhal and meet the tidal channels of today are obviously the few remnants which survived (Fig.VI.2).

The effect of sea level changes in the Mainland rivers is also seen in the development of 10 to 15 m high alluvial cliffs and terraces near the mouths of the rivers Mahi, Dhadhar and Narmada.

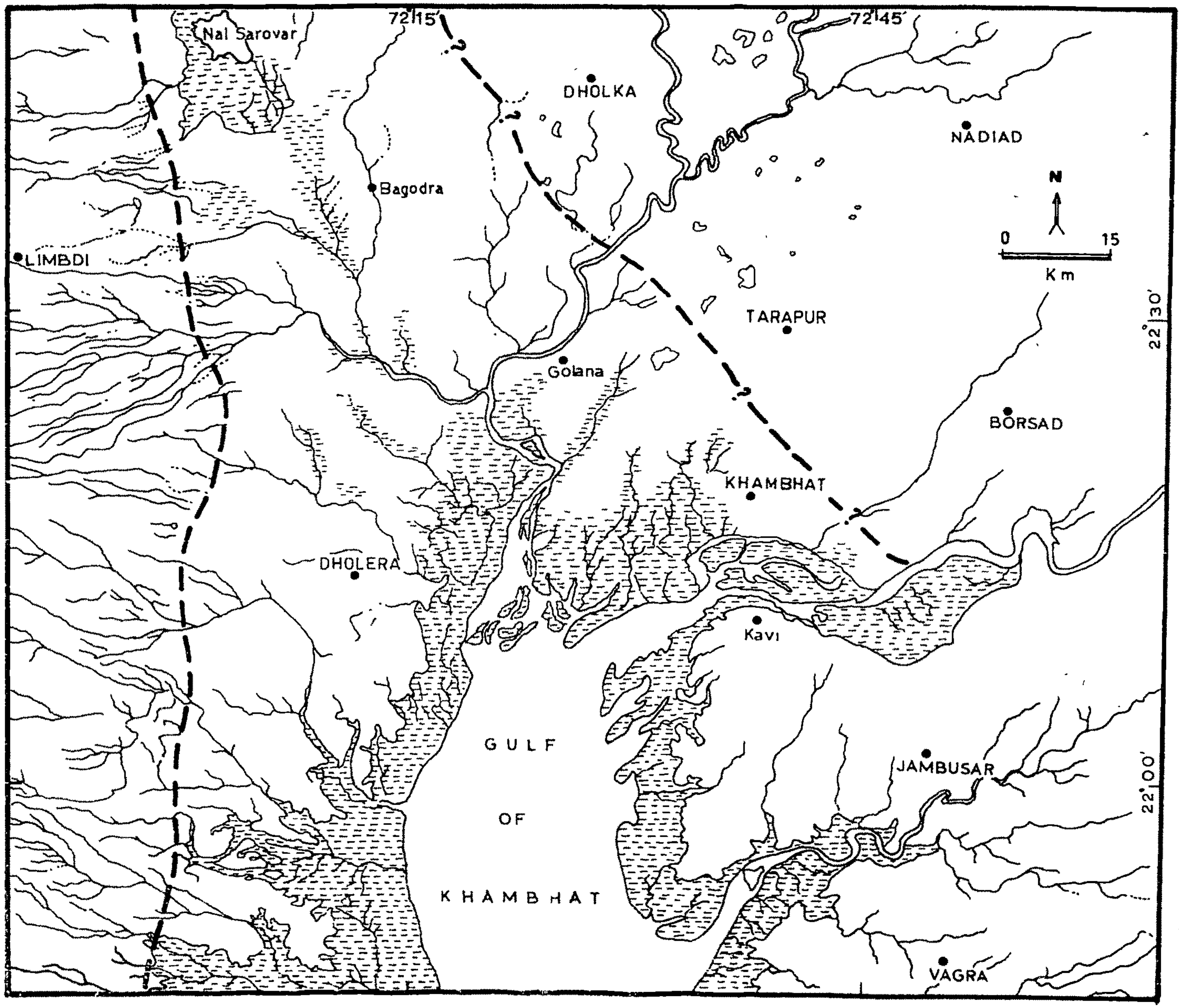
CHARACTERISTICS OF THE COASTAL DRAINAGE

The various categories of streams in different parts of the coast not only comprise channels for rain water to flow into the Gulf but also act as conduits for recharging the groundwater. The salient features of the rivers and streams (Fig.VI.3) of the area around the Gulf coast have been briefly described segmentwise as below:

Area between Methla and Bhavnagar Creek

In contrast to the rest of the Gulf coast, this part is rocky and exhibits a distinctive drainage pattern. Bound between the two fault-controlled major streams, Shetrunji and Kalubhar (Ganapathi, 1981), the terrain comprising Deccan Trap, laterite, Tertiary and Quaternary rocks, is characterised by a number of slope controlled consequent and subsequent streams which together regionally show a radial drainage, with each individual stream showing a dendritic pattern. The northward running streams comprise various

FIG VI.2



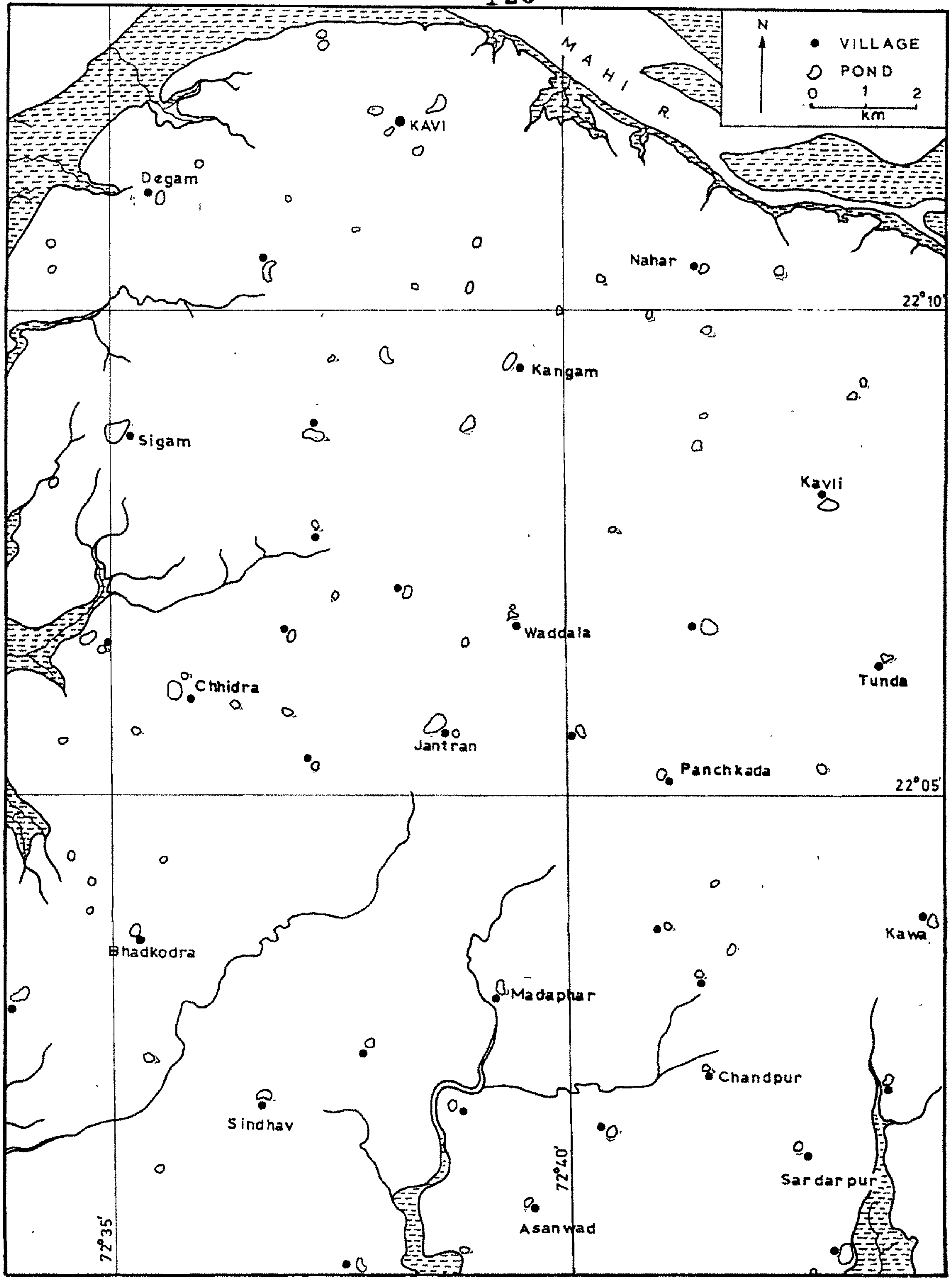
DRAINAGE IN RELATION TO LAST HIGHER STRANDLINE

Plate VI.1. Dug wells on the periphery of the pond at Elao.

Plate VI.2. Dug wells on the periphery of the pond at Veluk.

Beyond Mahi, towards Bhal, except for a few old channels now converted into ponds, most of the water bodies belong to the other category of ponds which comprise man-made depressions manually dug for storing direct precipitation. No natural topographic advantage is availed of, and the storage is dependent on the slight depressions in the flatness of terrain and the relative impervious nature of sediments that inhibit downward percolation. Ponds of this category (Fig.VI.5) are ~~very~~ common on the Mainland coast (north of Narmada) and in the saline areas of Bhal and Dholera. In size, these are not very large, generally circular or oval never exceeding 500 m in diameter and only a 4 to 5 metres deep. By age old experience, the local inhabitants have aquainted themselves with the art of digging ponds upto appropriate depths because on going deeper, saline water is encountered which contaminates the pond water. On a very limited scale, these ponds tend to push the saline water table by a metre of two, building up a reasonably thick sweet water column at least in and around the ponds. As a result, when these ponds get dry during summer months, the beds of the dried ponds yield limited supplies of sweet water on digging small 1 m diameter, and 2 m deep pits in pond beds. Thus, the role played by these ponds is twofold. For a part of the year, they provide stored water but for the remaining summer months, they act as sub-surface reservoirs of sweet water.

FIG VI-5



NATURE OF PONDS IN MAHI-DHADHAR PART OF MAHI-NARMADA COASTAL SEGMENT (Mostly dug ponds)

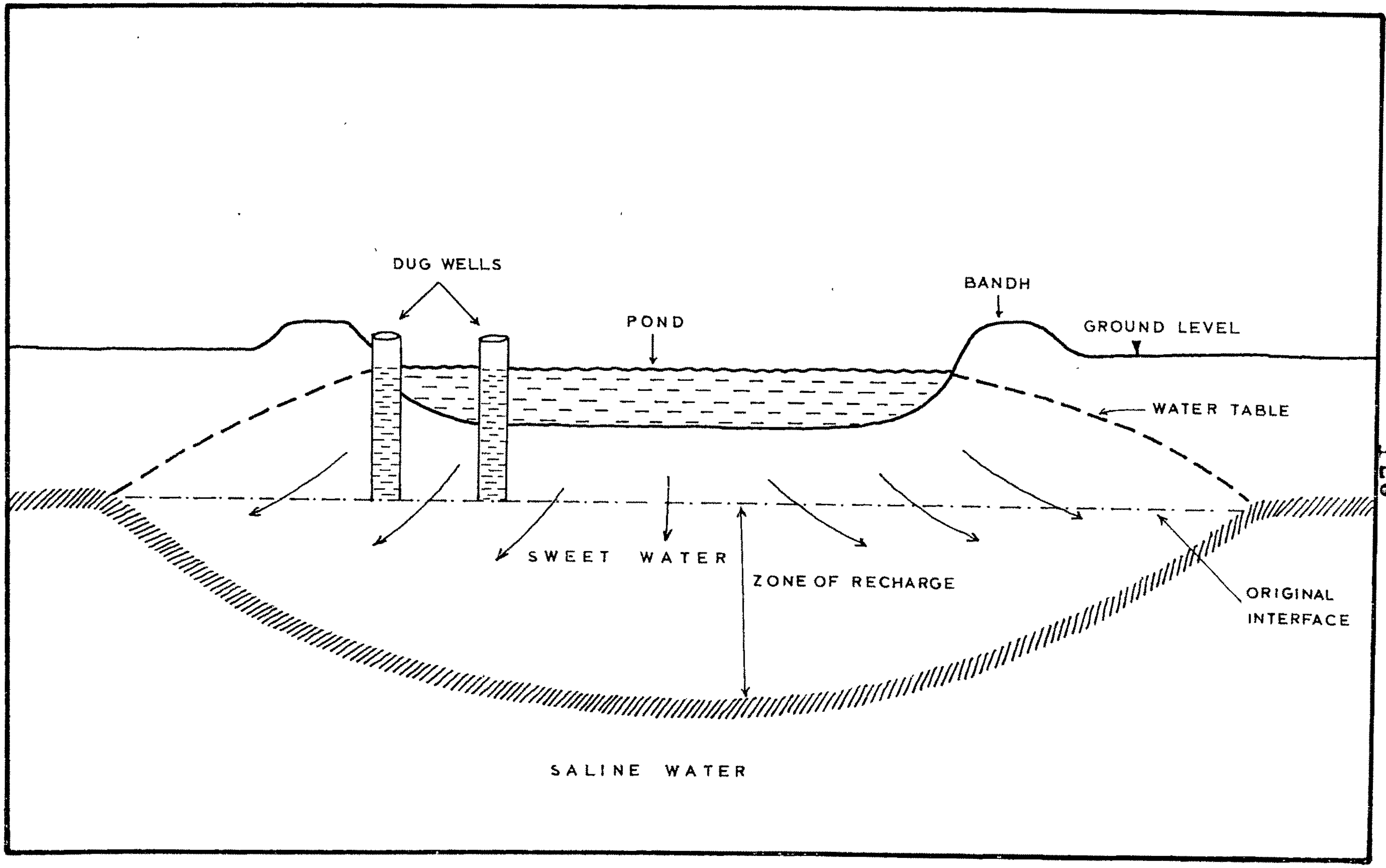
ROLE OF PONDS

The major input of water in these ponds is through the precipitation. As it has been discussed earlier, these ponds serve dual purpose. All over the coast the area is affected by the salinity, and the ponds are the only source of fresh water supply, but side by side the subsurface infiltration of water through these ponds facilitates the recharge to the underlying shallow and thin fresh water phreatic aquifers.

The recharge process by means of ponds builds a subsurface mound of sweet water whose lateral extension is much more than its height, but of very limited thickness (Fig VI.6). These fresh water mounds supress the upcoming of the saline water by maintaining the delicate interface between sweet and saline water below the floating fresh water mound. These groundwater mounds which are very much protected from the evapotranspiration losses, increases the days of fresh water supply.

No doubt, the sweet water supply from these ponds is inadequate, but a proper management comprising increasing the numbers of such ponds and prevention of vertical seepage and evapotranspiration, could substantially improve the water supply position through ponds in saline areas of Bhal and Dholera coasts.

FIG. VI 6



SCHEMATIC DIAGRAM SHOWING SWEETWATER MOUND CREATED BY SURFACE STORAGE