C H A P T E R VII

ENVIRONMENTAL ASPECTS

GENERAL CONSIDERATIONS

SURFACE WATER

SUBSURFACE WATER

FLOODS

FORESTS

AGRICULTURE

DEVELOPMENTAL ACTIVITIES

GENERAL CONSIDERATIONS

Essentially comprising an economically undeveloped and socially backward area, the Rajpipla hills and its neighbourhood have vast developmental potentialities. In this chapter, the present author has briefly discussed the various geoenvironmental aspects of the study area and attempted to correlate the various phenomenon of nature with the problems of resource mobilisation and developmental activities.

The various geological and geomorphic factors, in conjunction with climatic factors, have operated together to finally result into the present day environmental conditions that control and govern the quality of life of the region investigated. A large part of the area is rocky and hilly. Then there are transitional uplands which on one side merge into coastal plains, while on the other give place to alluvial plains. In the evolution of these terrain types, the geology has played a dominant role, and it is interesting to observe that it still indirectly controls the human environment too. In the previous chapters the author has discussed the evolution of the landscape; here in the following lines he proposes to discuss the interaction between the terrain characteristics and the inhabitants that live on it. The entire description is however brief, rather qualitative and aims at establishing the relevance of the present study towards an appraisal of the impact which the events of the geological past could make on the present day life.

The present author has therefore selected following six environmental factors of the area for their appraisal :

1. Surface water
2. Subsurface water
3. Floods
4. Forests
5. Agriculture
6. Developmental activities.

SURFACE WATER

The behaviour and availability of surface water (mostly the rain water flowing along streams of various orders) are different in different parts. Though, the area receives relatively substantial rainfall, a large part of it, especially the trappean hills and the uplands do not have adequate year-round supply of surface water. Except for a few major rivers, most of the smaller ones are more or less ephemeral, and become dry during the winter and summer months. In the absence of natural or artificial storage facilities, most of the rainwater escapes to the sea or Narmada, leaving the various channels without water for the most part of the year. However, comparatively speaking, the availability of river water is much better in the alluvial plains to the north of Narmada; the worst areas being within the hilly terrain of the east at one end, and the esturaine mouths to the west. In the first case, there is no water, while in the second case the water is there but it is saline due to tidal contamination.

SUBSURFACE WATER

The behaviour of subsurface water supply is equally erratic and unsatisfactory in many parts of the area. The quality and quantity of groundwater supply show direct relationship to the geological conditions.

The occurrence and availability of groundwater in the trappean hilly areas is controlled by shear zones and joint planes, or in the weathered portion of the basalts. So it is observed that occasionally, one encounteres profuse groundwater supply at some place, while at other, no ground water in worthwhile quantity is available. In the trappean terrain, the groundwater occurs under unconfined condition, and generally speaking the recovery of water through wells or bores is quite less, except in some cases where the water has been able to accumulate in openings along major fractures/ weathered zones. The trappean hills of the study area, which show well defined plateau development at various levels, point to an interesting occurrence of ground water at shallow depths, in such spots where the hilly streams have, on impniging over a flat terrain, given rise to local flood plains. At many places restricted to the altitudes between 200 m to 100 m, such alluvial accumulations within the hilly terrain provide good sources of groundwater. Most of the villages in this part of the study areas, appear to have been located over such local alluvial zones.

In the uplands also, the groundwater behaviour is equally erratic. Wherever occur pockets or tracts of alluvium, the water supply through wells is adequate. But there are such areas also, which do not provide any groundwater.

It is observed that within the hilly terrain, and the uplands the groundwater is encountered at depths ranging from 6 to 15 m.

The groundwater in the alluvial terrain occurs under confined and unconfined conditions. The water levels in alluvial formation vary between 6 to 27 m below ground level. And as the alluvial aquifers are good, the plains are capable of transmitting and retaining large quantities of groundwater.

Towards west, i.e. along the coast or in the coastal alluvial terrain where the sea waves, tides and marine erosion largely affect the land, the conditions of the underground water is distinctly different. The dissolved salts increase towards the west, this may be due to the presence of inherent salts in the coastal marine deposits. This makes the groundwater salty. On account of the muddy nature of sediments the transmission of water also becomes small. The average water level fluctuates between 3 to 15 m. During or immediately after monsoon the wells in the coastal areas may contain fresh water but these in due course become saline. The water shortage, thus becomes very acute during summer. It is however, interesting to observe that right near the coastline, wherever longitudinal sand dunes occur, they contain fresh water at very shallow depths of a few meters only. Of course, this supply is limited and cannot be indiscriminately exploited.

FLOODS

The phenomenon of flooding provides an interesting picture of diversity and intensity. No doubt, the floods in the real sense could be attributed to the river Narmada only, the principal river of the study area, but the smaller tributary rivers as well as the low order streams of the hilly terrain also reveal several features of flooding which are of considerable local environmental significance. The various aspects of flooding in different categories of streams have been briefly described under three main categories :

1. Flooding of the hilly terrains.
2. Flooding of the smaller rivers.
3. Floods of Narmada.

1. Flooding of the hilly terrains

The hilly streams or Khadis with their narrow and deep valleys, do not show flooding on a large scale. Only during monsoons, when they cannot contain all the rain water, at such spots where they flow over flat ground (Plateaux) or near the confluence of two streams, their banks overflow and cause local floods of short duration. Floods are also common where these hilly streams appear over a flat terrain, either a lower plateau level or the foothill region. Local alluvial plains generated by such flood phenomenon within the hilly terrain, are locations for village settlements and agriculture.

2. Flooding of the smaller rivers

Most of the smaller rivers Heran, Devganga, Terav, Karjan and Amaravati, tributaries to the Narmada, are prone to floods only during very heavy rains. Sudden heavy down pours may cause overflowing of the banks at some places, but by and large, floods in these streams do not pose any environmental hazard on a big scale. On the other hand, flooding of these rivers

Plate VI 5 River Terav : Depositional feature, the river course is divided by bars - An accumulation of cobbles and pebbles of basalt, characterising a depositional phenomenon in river Terav. (Locality Near village Juna Mosda).

Plate VI 6 Karjan river course with gravelly bar/island (Locality : River Karjan near village Ajanvai).

Plate VI 7 Cliff on a high altitude basaltic hill overlooking Sankali khadi (Locality : Near village Fulsar).

Plate IV 8 River Karjan marked by a straight course, a waterfall (2-3 m) and rocky cliffy bank. (Locality : Near village Gopalia).

Plate VI 9   Confluence view of the rivers Terav and Karjan rocky bed, with alluvial terraced banks (Locality : Near villages Sada and Bej).

Plate VI 10   Terraced alluvial bank with a local flood plain of the river Men.

Plate VI 11 Alluvial cliffy bank on river Aswan, wide river course shows a meander curve, a gravelly island and the flood deposits.

Plate VI 12 A river Narmada near Garudeshwar : The banks show rocky terraces.

Plate VI 13 Muddy river mouth of Narmada, showing mud flats and bars.

Plate VI 14   Alluvial cliffy bank of Narmada river mouth.

Plate VII 1 A dissected alluvial terraced (flood plain) of the river Men.

annually contributes to considerable accumulation of fresh sediments, thereby augmenting to the alluvial deposits forming low level flood plains, that support good agriculture. (Plate VIII)

3. Floods in Narmada

The river Narmada, flowing almost in median part of the study area, is prone to frequent floods. Flood waters inundate its banks almost annually; some times the intensity of flooding is so great that vast areas are affected, especially on the southern banks. Data for the last few decades, show that, floods in Narmada used to occur at comparatively longer intervals but during the last two decades, the frequency of floods have increased and so has the magnitude of the floods. The flood frequency study for Narmada river at Bharuch, based on data of 73 years (1887 to 1959) indicate that a gauge level corresponding to a flood of 12.41 lakh cusecs had return period of 1 in 10 years. But after the high floods of 1961 and 1968, a re-evaluation of the phenomenon was made by studying data observed for 21 years (1948-1968) at Garudeshwar. The study has revealed that gauge level corresponding to 13.75 lakhs cusecs is prone to repeat at a frequency of 1 in 2 or 3 years. The study has also shown that floods are becoming more frequent.

During the last twenty years the heavy floods that occured in the years 1961, 1968, 1970 and 1973, are significant for very largescale damage. Generally all the heavy floods have occurred in the months of August and September in the crop ripening season or months.

In the plains of Narmada or Bharuch and Ankleshwar, the safe carrying capacity of floods of the river Narmada (down stream of Garudeshwar) is about 7.5 lakh cusecs. And when discharge increases beyond 7.5 lakh cusecs, the low lying areas of the Bharuch city and villages situated along the banks of the Narmada in its lower reaches are affected by floods. This corresponds to a gauge level of RL 94 m at Garudeshwar and RL 29 m or 30 m at Bharuch railway bridge. Progressively more and more villages get affected in addition to the city of Bharuch, with the floods of larger and larger magnitudes. When flood discharge reaches about 12 lakh cusecs at Bharuch, it affects about 55 villages which are along the bank of Narmada. Such a flood would rise upto a level of 34 m at Bharuch railway bridge, when it syncronises with high tides and an area of about 200sq.km is inundated along the banks of the river and its tributaries at this stage. In 1968 with a flood of 20.5 lakh cusecs, in 1970 with a flood of 24.5 lakh cusecs and in 1973 with a flood of 21.65 lakh cusecs, areas 373 sq.km, 492 sq.km and 296 sq.km respectively inundated were along the banks of the river and its tributaries, downstream of Garudeshwar.

The flood-hazards of Narmada have considerably increased during the last two decades and the causes for the high frequency of devastating floods needs a detailed scrutiny. It appears that climatic changes in recent years marking heavier annual rainfall in the catchment areas of the main river as well as those of its various tributaries, are an important factor. Secondly, the rapid depletion of vegetal cover and forests in the upstream portions, have contributed to larger influx of water. By the time the flood waters arrive at the lower reaches of Narmada, the volume of flood water, heavily laden with sediments, assumes dangerous proportions. It is not unlikely that the environmental imbalance caused by silting up of the river mouth, is also an important contributing factor, choking up the exit might be augmenting to the impounding of flood waters, raising the level to threatening heights.

FORESTS

Almost 20% of the total study area comes under forests. Most of the hilly terrain as well as some parts of the uplands, have moderate to sparse forest covers. The eastern rugged trappen hilly terrain, north and south of Narmada shows relatively dense vegetation of sub-tropical moist climate. Panwad, Kawant, Ambadungar, Kajalmata, Vadgam and Limdi hills, to the north of

Narmada show a dry deciduous vegetation normally covering high altitude hills and the undulating grounds of the ridges and hills. To the south of Narmada the forests are confined to the Dhamanmal Dungar and other dungars between the rivers Narmada, Terav, Karjan and Devganga, Mal-samot plateau and other hills of the south and south-east of the river Terav and east of the river Karjan. Even the western trappean hills south and west of Narmada and Karjan are under forests.

The forests of the study area fall within the jurisdiction of Gujarat Forest Department and are administered as under :

	Division		Range	Areal Extent
1.	Chhota Udaipur	-	Kawant	230.00 sq.km
			Naswadi	60.00 sq.km
2.	Rajpipla	-	Gora	188.00 sq.km
			Rajpipla	278.00 sq.km
			Dedipada (East)	287.00 sq.km
			Dediapada (West)	300.00 sq.km
3.	Vankal	-	Netrang	220.00 sq.km
			Vankal	250.00 sq.km
			Sagbara	177.00 sq.km
				1990.00 sq.km (20% of the study area)

Teak is the most valuable (in proportion 15%) tree of the forests. Its associates are as under :

a) Overwood - Sadad, Shisham, Hed, Kakad, Modad, Biyo, Tanach, Khair, Hino, Bondaro, Kumbhi, Bedo, Garmada, Kevlu, Madmahudo, Nagval etc.

b) Underwood - Gota, Dhedak, Mag, Kudi, Parabor, Al, Ghatbor etc.

c) Shrubs and Herbs - Madhuri, Kanta Seriu, Atedi, Kudio, Karav, Bhindi, Jinidhamni, Vedehi, Gogdu, Jungli Kel, and many others.

d) Climbers - Chanothi, Kuvach, Asanvel, Avol, Jal, Palasvel, Malkangau, Toranvel etc.

e) Bamboo - Mauvel Vans.

f) Grasses - Gargadi, Bhatdu, Zinzvo, Baru, Sukli, Vijal, Dab etc.

Since 1968 a programme of intensive bamboo cultivation in the forest areas has been taken up. It is however a sad thing to observe that in the course of last two/three decades, the forests are being rapidly destroyed. Density of trees or vegetation has gone down and it still faces decreaseing trend. Teak is the highly affected species; either it has totally disappeared from patches or is existing in a degraded state. There are many factors, natural and human causing damage to vegetation and effects the forests and its growth.

i. Drought

The monsoon seasonal rain is most erratic, irregular and unreliable, either no rain for many days, or heavy rain in few days, these adversely affect the vegetation.

ii. Floods

The seasonal local floods sometimes heavy cause much damages to the trees, especially those located along the banks of rivers, khadis and nalas; such trees are largely uprooted during the floods. Since last 30 years and especially in the last decade, the frequency and magnitude of floods have increased and these floods have caused much damages to forests.

iii. Human Activity

Cattle grazing, illicit cutting, fire and encroachment for cultivation etc. are the man-made biotic influences causing damage to the forests. As per the available data and information from the Forest Department, the total illicit cultivation was over 34.51 sq.km in 1961 and is going up rapidly. Ofcourse in recent years special efforts are now being made to regenerate forests.

AGRICULTURE

The study area shows an uneven distribution of agricultural land. The areas to the north of Narmada river comprises about 60% of cultivable land, which consists of river alluvium and is more fertile than that of the south of Narmada. The area south of Narmada and west of Karjan consists of 70% cultivable land; except the trappean hilly terrain, rest supports reasonably good agriculture. The eastern and south eastern trappean rugged terrain, east of Karjan being mostly rocky consists hardly of 40% cultivable land. (Plate VII 2)

The crops grown in the area are paddy, groundnut, bajri, tobacco, maize, Rabi-jowar, wheat, and tur, while with the help of irrigation cotton, paddy and jowar crops are grown in the areas where irrigation water is available. In the rocky or hilly soils the crops grown are maize, groundnut, cotton, paddy, jowar, wheat and pulses. In loamy alluvium soil the cultivated crops are bajri, jowar, wheat, cotton, and groundnut and other staple food crops like Kodra, Jowar, Banto, Bawto, Lung and vegetables. The crop pattern and agricultural production of the area largely depends on rain. Though the study area receives fairly good rain, the rainfall is erratic and most irregular causing frequent floods and drought in the area, and because of these, the crop

Plate VII 2 Paddy field within the Karjan river bed (Locality : Dediapada upland, near village Gopalia).

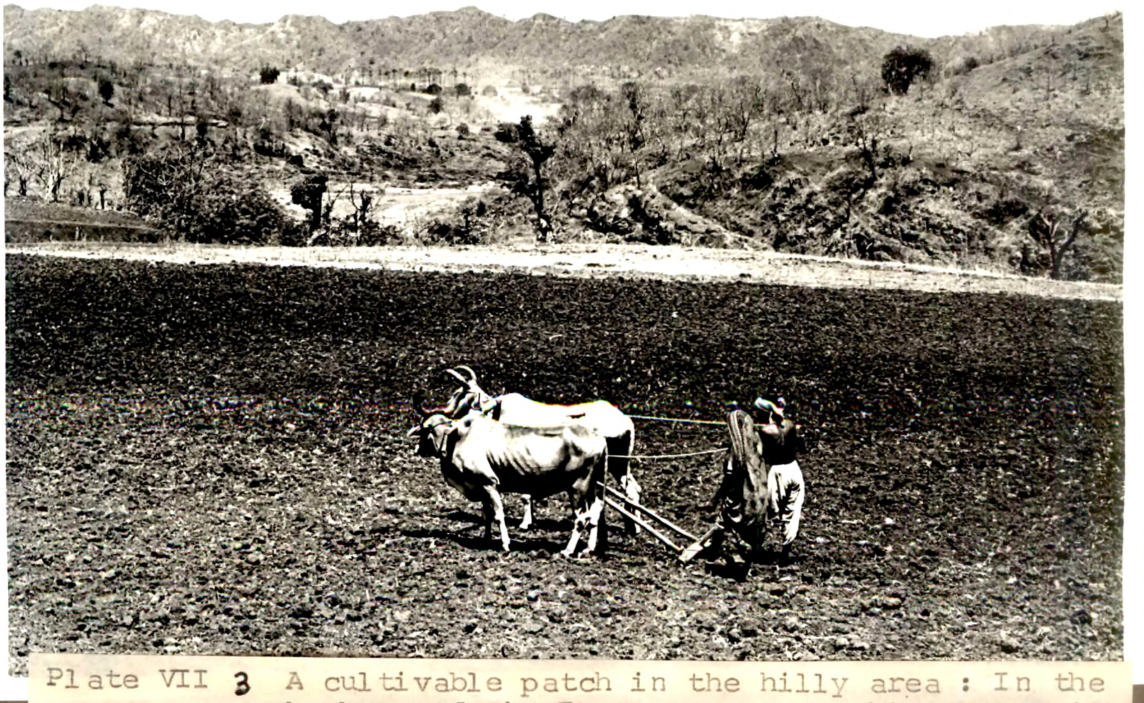

Plate VII 3 A cultivable patch in the hilly area : In the background the Eastern trappean hilly terrain (Locality : The confluence of rivers Terav and Karjan, near village Bej).

yield is very uncertain and unpredictable. Though the rivers like Heran, Aswan, Men, Narmada, Devganga, Terav, Karjan, Kim and Amaravati are perennial, but the winter and summer water levels of these rivers are so low that Karjan, Heran and Narmada river waters are used at some places by lift irrigation. The entire study area has hardly 5 to 8% land under irrigation; the main sources of supply being well, tube well, tank and river water lifted by pumps. The uncertainity and the scarcity of rain are the main hazardous factors. Provision of water and irrigation facilities in the area can improve the crop yield, crop production and agriculture and by these even living and economy of the people can also be improved in the area.

DEVELOPMENTAL ACTIVITIES

In the last few decades, the area has been receiving considerable attention of the State Government in respect of its overall development. Broadly, these activities,which have direct impact on the prevailing environment, could be categorised as under :

1. Agriculture
2. Forest regeneration
3. Mining activities.
4. Engineering projects.

In view of the various developmental activities, listed above, a large number of new roads have either come up or are being planned. With an increased network of roads, the different parts of the area tends to provide faster means of communication, and thereby accelerating the pace of development.

1. Agriculture

Agriculture is the main activity of the people; more than 70% people farm the 60% cultivable land of the study area. The lower parts of hills, uplands and alluvial plains are the areas of agriculture. Uncertainity of rainfall, scarcity of water or floods and old traditional methods of farming are the factors, because of which crop harvest and agricultural production is not sufficient. However, the alluvial plains have better conditions; some areas are under cash crops and commercial farming. The uplands have cultivation of various crops with subsistence farming. While in the eastern hilly terrain; largely occupied by tribal people, a very interesting change is observed; the tribals are now coming out of their traditional practice of shifting agriculture and migratory living, and are now settling in villages taking up sedentary agriculture and subsistence farming. The government incentive schemes and agriculture improvement programmes are providing

Plate VII 4 Thick forest showing bamboo cultivation (Locality : Near village Juna Mosda).

various facilities and services by way of loans and subsidies. Even minor irrigation projects (check dams) have improved the agriculture on the uplands by providing stored water. Major irrigation and power projects, regeneration of forests, redistribution of cultivable land and transformation of some wasteland to cultivable land, as well as other plans and programmes of government are bound to show good progress. (Plate VII 3).

The need of forests has been realised not only from the point of view of availability of good teakwood, but also from the considerations of other forest produces like bamboo, firewood etc. which provide dependable sources of livelihood to the local population. With the increasing energy crisis faced by the country, there has been now a greater awareness towards biomass (forests etc) as a relevant alternative source. (Plate VII 4).

The Forest department of the Gujarat State has embarked upon an ambitious programme of regenerating forests. Not only strict measures are being taken to minimise the distruction caused by man, but also all available areas are brought under forestation. The eastern and southeastern hilly portions (S. of Narmada) of the study area, have been exclusively reserved for regenerating forests.

3. Mining Activities

From the point of view of mining activities, the area had remained fairly neglected, except for the age old surface digging for agate at Jhagadia, and local quarrying for road metal and building stones. But in recent years, the discovery of fluorite deposits at Ambadungar (Kadipani) near Kawant, and a lignite beds near Jhagadia, have considerably augmented to the mining activities. The Fluorite Project of the Gujarat Mineral Development Corporation (G.M.D.C.) at Kadipani is one of the major opencast mining sites, with attached beneficiation plant. The lignite deposits of Jhagàdia are in the process of being developed, again by the G.M.D.C.

4. Engineering projects

Within the confines of the study area, quite a few developmental Civil Engineering Projects have been located. Two of them are quite big, viz. the Narmada and Karjan Projects.

1. Narmada River Project

The harnessing of Narmada river is a prestigeous national multi-purpose project of Gujarat. It was initiated in 1959 and is still in progress.

The main dam is located at Navagam (21°-50' N latitude and 73°-45' E longitude) in the Bharuch district, the site village Navagam is upstream of the City Bharuch. To control floods, protect the land and forests, to prevent soil erosion and to generate hydroelectric power are the main purposes. The construction of 138.68 m high dam will provide big reservoir in the trappean hilly terrain; this reservoir will be about 210 km long (towards upstream) and is 2 km wide, with a submergence of 370 sq.km. A large part of the reservoir to the east lies beyond the study area. The estimated hydro power generation capability at three different stages is as under :

First stage	571 MW
Second stage	262 MW
Third stage	104 MW

This large scale irrigation cum hydroelectric project of Narmada will provide irrigation facilities to the region north of Narmada, ofcourse a very small part of the study area will have the benefit of Narmada Irrigation waters. The main canal suppose to be 445 km long would extend to the north across parts of central and north Gujarat.

2. <u>The Karjan Irrigation Project</u>

The river Karjan the perennial tributary of Narmada is being harnessed by constructing a dam with a reservoir.

The Karjan irrigation project engisages construction of a 102 m high and 1215 m long earth dam with masonary spillway, across the river Karjan near Jitgadh and Zampa villages (21°-49' N : 73°-32' E latitude and longitude), about 8 km, S, SE of Rajpipla town. This project will provide water irrigation and hydropower to those areas of the Bharuch district, which are not covered by Ukai (Tapi river) project. The project will evolve a reservoir in the trappean hilly terrain that will submerge some areas of Nandod and Dediapada talukas. The catchment areas of rivers Terav and Karjan will feed the reservoir. Irrigation will be provided to Dediapada and Netrang uplands and even to the eastern part of the coastal plains.

3. Heran River Project

The Heran River Project is located in the terrain north of Narmada. A rubble masonry weir dam across the river Heran at the village Rajwasana (22°-07' N : 73°-45' E latitude and longitude) of Jabugam taluka, Vadodara district is mostly for irrigation. The height of the weir is5 m above the foundation and its length is 182 m. The project has an irrigation potential of 2100 hectares. No water storage is envisaged, and this weir scheme depends on rainfall and on the river runoff.

4. Check Dams

Within the limits of the study area, lies three very small constructions of local significance in the form of check dams, constructed within the uplands. These dams are essentially meant for storage of water and groundwater recharge in a hilly terrain. The stored water provides small scale irrigation facilities to the parts of Dediapada and Netrang uplands. Following are the check dams;

1. Check dam on river Kim near village Daulatpura (21°-34' N latitude :N73°-17' E longitude), provides irrigation water for agriculture.

2. Check dam near village Chopadvav (21°-30' N latitude, 73°-45' E longitude, in Saghbara taluka), this provides water for irrigation.

3. Check dam near villages Kup and Temroliya (21°-36' N latitude : 73°-26' E longitude in Valia taluka), for fresh water fishing.