CHAPTER – 2

ENVIRONMENTAL CHARACTERISTICS OF THE SAMPLE AREA: AN ANALYTICAL RETROSPECTION

"We know earth is round because of our predecessors' efforts and dynamicity."

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Geographical phenomena being elementary constituent perform a decisive role in the evolution and transformation of environment. These phenomena decide the nature and favourability of environment for the survival of man and his biome. It is apprehended that an analytical retrospection may reveal the existing realities of geographical constituents, their causes and direction of transformation. Transforming behaviour of environment indicates persisting processes which are liable to transform the nature of mutuality i.e. relative interdependence and balance between the different constituents. These perceptions guide to focus on environmental characteristics of the study area.

Environmental characteristics of the sample area have been outlined in the present chapter in terms of varying geographical phenomena i.e. the spatial and human attributes. Description and analysis of varying geographical phenomena is necessary in any environmental study as they are the constituent elements which regulate, transform and evolve the environment. Inferences of any research endeavour on environment cannot perhaps be complete without such an exercise. The entire analysis undertaken is based upon the various literary sources, toposheet analysis, field survey and secondary data analysis of 110 villages and primary data analysis of 30 villages.

2.1 LOCATIONAL CHARACTERISTICS:

Location of any space is a very decisive factor in the process of evolution of physical as well as human environment. The nature and evolution of geology, geomorphology, climatology, pedology, biosphere / eco–system, ethnography, society, culture, economy and agronomy of any space is primarily regulated by its location. Hence, location is the most significant factor that needs to be explained.

Eastern Panchmahals, the sample area, is a part of Panchmahals district (currently known as Dohad district) of Gujarat lying in the north – eastern and eastern margin of the district as well as the state. The following areas surround the region:–

(i) Dungarpur district of Rajasthan in the north,

(ii) Jhabua district of Madhya Pradesh in the East and South–east,

(iii) Vadodara district and Jambughoda taluka of Panchmahals in the South,

(iv) Halol taluka of Panchmahals in the South–west,

(v) Kalol and Godhara in the west, and Lunawada taluka of Panchmahals north–west.

Latitudinal and longitudinal extent of the area is between 22°30' North to 23°30' North latitudes and 73°30' East to 74°30' East longitude (Figure 2.1). The region covers 1/64800 grids of the globe, a distance of 4 minutes between meridians and 111 kms of latitudinal distance.

2.2 CLIMATIC CHARACTERISTICS:

The sample area lies on the northern most margin of the tropical region i.e. at the tropic of cancer and in the vicinity of subtropical or temperate zone, because of intermediary location between torrid and temperate zone and certain other reasons (mentioned below), exhibits a unique climate or weather conditions.

Although, under general climatic classification the area is considered under monsoon zone it exhibits arid conditions. The region lies within the effects of one of the three drought–prone zones, a rectangular tract which stretches from Ahmedabad to Kanpur, from Kanpur to Jullundhar and from Jullundhar to Kutch, characterized by low annual average rainfall ranging between 350 mm to 750 mm per year (Singh, 2003). However, according to Indira Hirway et al (2002), the total rainfall in the rainy season in Eastern Panchmahals is between 750 mm to 1150 mm. Based on the observations recorded at Dahod from 1931 to 1960 some of the generalized climatic characteristics can be derived as below–

(i) The annual mean daily maximum temperature is 32.5°C (24 years)

(ii) The annual mean daily minimum temperature is 19.9°C (24 years)

(iii) The Annual Mean Pressure is 972 mb (30 years)

(iv) Annual mean Relative humidity is 63% (30 years)

(v) Annual mean total rainfall is 788 mm (30 years)

(vi) Average number of rainy days is 39.9 (30 years)

(vii) Annual mean wind speed is 16.3 km/hour (21 years)

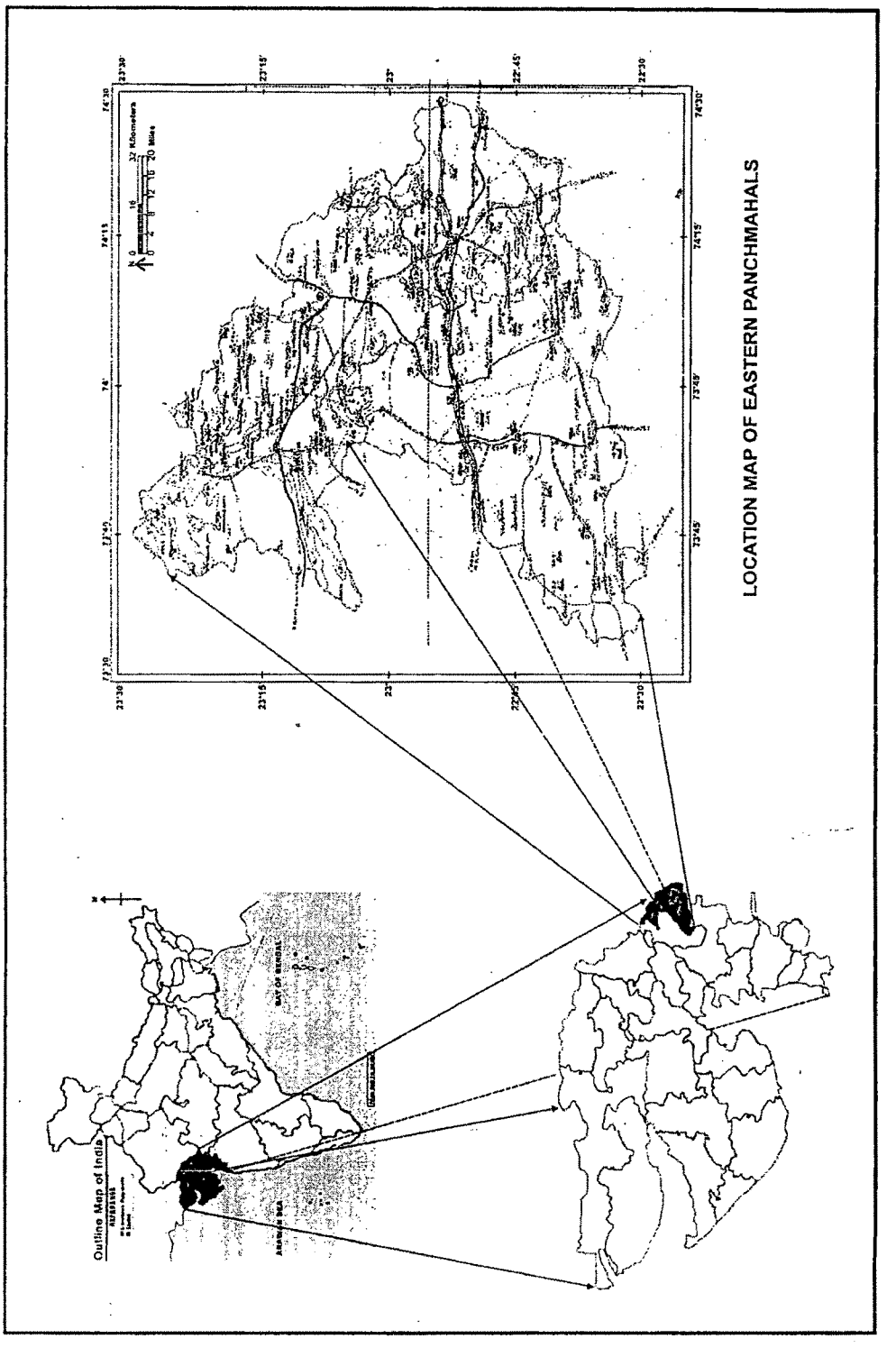

Figure 2.1: Location Map of Eastern Panchmahals

Some of the striking features of the area which affect its weather and climate are–

(i) The undulating terrain characterized by high and low lands with barren rocky surface or no vegetational cover also lays impact on the weather or climate of the region. Such terrain decreases the albedo and increases the atmospheric temperature during the day. Secondly, the varying slopes though receive insolation obliquely but the reflected terrestrial rays being directed towards the low lying surfaces combine to the reflected terrestrial rays (long waves) of low land and hence increase the atmospheric temperature (Trewartha, 1980).

(ii) Less rainfall might be due to the decreased vegetational cover and no obstructing element (highlands not having enough altitude and being aligned) to stop and gather the advancing clouds or moisture laden monsoon winds. The other reason could be the dynamism i.e. high velocity of the winds carrying rain potentials, due to which they might be moving forward without or shedding their moisture. So, the absence of physical or atmospheric frontogenesis might be one probable cause for less rainfall (Trewartha, 1980; Singh, S, 2003).

(iii) Evidentially, in July the region lies within the isobars of 999 mb and 1002 mb (pressure gradient is 3 mb and very steep). The pressure gradient or barometric slope being steep or abrupt, wind from the region tends to rush towards the low pressure zone or eye formed by 999 mb isobar (in Arabian land) in the north–west. This phenomenon probably creates friction or divergence with monsoon but is not much effective in neutralizing the dynamism of monsoon and leaves the zone without precipitation. It is notable that the friction caused due to the divergent force might be slightly helpful in causing the rain in the northward region (along with other favourable conditions) (Singh, S., 2003; Trewartha, 1980).

In the month of January the area lies between the isobars of 1020 mb but 1017 mb but pressure gradient being moderate, wind blows moderately from land to sea. Climate of the region is well summarized in a report published by Government of Gujarat, "Climatically, three seasons can be demarcated viz. summer (March to June), monsoon (July to September) and winter (November to February). In the arid North – and North East areas, temperature can be extreme, dipping to 1° C in winter and shooting to 45° C in summer".

2.3 GEOLOGY:

The origin, structure and stratification of the rocks are the resultant product of varying sequential geomorphic and geological processes over time and conditions such as climate.

Eastern Panchmahals extends over eastern highlands of Vindhyan ranges which stretches between Narmada in the south and Mahi River in the north, is a well defined sub–zone of the mainland Gujarat. The region is characterized by the formations of Pre–Cambrian crystallines, sedimentary rocks of cretaceous period. Evidentially, significant alterations have taken after the deposition of Pre–Cambrian Vindhayan rocks followed by upliftment in the end of Palaeozoic era during Upper Carboniferous. The redistribution of land and sea and consequential mountain building movement in the north–eastern parts of Gujarat within which Eastern hilly region of Panchmahals lies, was the controlled effect of tectonic movements of Delhi, Aravalli and Satpura trends. Because of tectonic movements the area might have experienced an extensive lateral compression, being located in between the effective and submerging zone of these three tectonic trends. Besides this, the region also, might have experienced the upliftment or subsidence in the Mesozoic and Cenozoic and sedimentation in the Cretaceous period caused due to the faults of Cambay and Narmada and their tectonic activities (Merh, 1995).

Above all, the rocks of Precambrian over lain by younger rocks of Zurassic, Cretaceous tertiary and quaternary formations show a considerable diversity caused due to considerably varying environmental conditions. Another interesting feature is the temporal, regional and structural uniformity in respect of process and evolution. The availability of similar rocks in varying regions indicate their lost natural or environmental uniformity. The rocks of the region are primarily of Pre–Cambrian formations (7 million years B.P.). The rocks of former category include phyllites, states, schists, quartzites, gneisses and granites and later include basalt with inter–trappean clays, similar to Deccan trap formations of cretaceous period (Gazetteer of Panchmahals, March, 1995).

2.4 GEOMORPHOLOGY:

The geological history, nature of terrain and landforms reveal the active role of endogenetic (diastrophic and sudden forces) and exogenetic forces and related geomorphic processes in the evolution of contemporary geology as well as landforms or topography. The factors influencing the geomorphology of the region are varying

climate, breaking and drifting of landmasses, transgression or regression of sea, glacial and interglacial periods, vertical and horizontal movements, faulting and fissure eruptions etc.

The origin, evolution and nature of landforms present on the surface clearly depict the impact of varying agents and forces with the varying environment. The uneven topography and the exposed rocks represent the action of temporally varying agents such as endogenetic, fluvial, aeolin and climatic.

The geomorphic processes in the region have mainly influenced by the varying actions or factors in the varying geological stages, such as Archean and Precambrian orogeny; Cretaceous-tectonism, eruptions, marine transgression and initiation of regression; Tertiary marine regression, tectonic movements, erosion, exposition of rocks and sedimentation; and Quaternary (pliestocene and recent) lowering of temperature, glaciation of northern hemisphere upto lower temperature margin and sedimentation. It is also derived that endogenetic and aggradational processes were more active before tertiary and since tertiary exogenetic or degradational processes in the region have become more active (Merh, 1995).

Presently the landforms are primarily effected and evolved by aeolin geomorphic process (wind erosion) and secondarily by the fluvial process (rainwater drained by ephemeral streams) due to climatic changes. Anthropogenic actions are third prime cause which is exponentially and drastically becoming active and then effecting the nature of topography as an assisting tool during varying seasons. The transformation of topography in turn is transforming the environment or eco–system (field observation).

2.5 PHYSIOGRAPHY:

Topographically Eastern Panchmahals is a homogeneous region. The topography is characterised by undulating dissected terrain composed of successive low or high, abrupt or moderate rugged stony ridges and hills separated by numerous ephemeral water courses (Figure 2.2). The two distinct physiographic features emerging from the interpretation of topographic sheets are–

(1) Highlands or uplands

(2) Inclined lowlands

But, it would not be a logical classification because of two reasons. Firstly, the lowlands do not form a continuous region as they are separated by the central uplifted part i.e. highlands or uplands. Secondly, though both the inclined lowlands on either sides i.e. east or west of the central highlands or uplands are on to the leeward side, if we consider the stretch of southern highlands from west to east. But

the consideration of central highlands or uplands as well locate the eastern inclined lowland in the rigorous leeward zone as it is effected by the uplifted parts in the south as well as west. So, considering these logics the region is classified into following physiographic divisions–

1. Southern Highlands (stretching from western margin of Devgadh Baria to the eastern margin of Dohad)
2. Central Highlands or Uplands (stretching perpendicularly from the central part of southern highlands upto the northern most margin of Santrampur)
3. Western Inclined Lowlands (on to the west of central highlands)
4. Eastern Inclined Lowlands to the east of central highlands (interpreted from the Topographical Sheets).

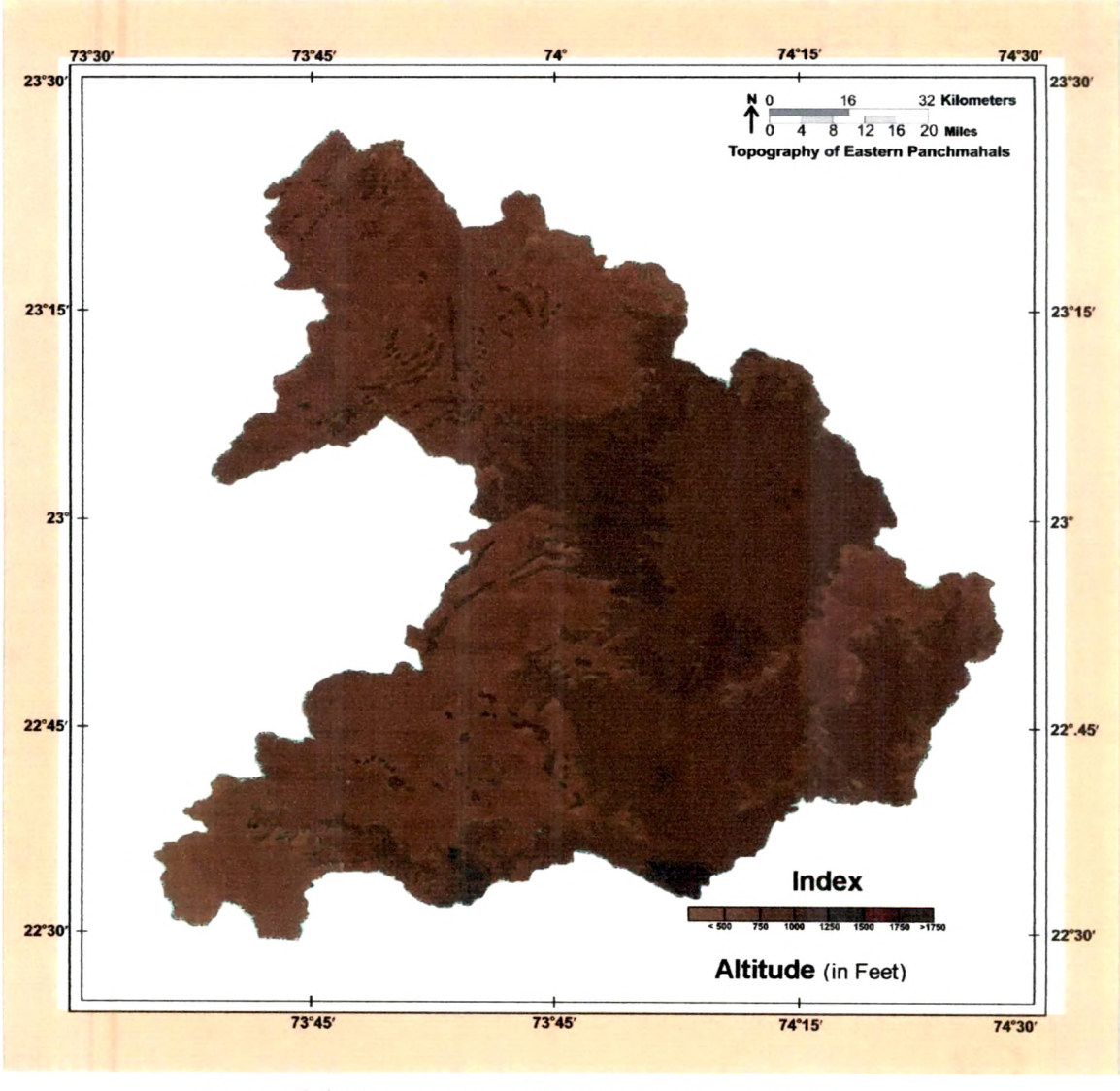

Figure 2.2: Topography of Eastern Panchmahals

1. Southern Highlands:

This sub–region is comprised of a series of hills on the southern frontier stretching from south–western margin to the south–eastern margin and forms a divide between Narmada and Mahi. The series of hills are the extreme western outskirts of the Vindhyan Range and also the base for the central, perpendicularly rising highlands or uplands from the Ratanmal hills. Most of the region lies between the altitude of 150 metres (500 feet) and 525 metres (1750 feet). Ratanmal hill possess the highest peak of about 617.7 metres (2059 feet) of altitude in the southern highland region as well as in the whole Eastern Panchmahals. The closeness of the contours reflects steep or abrupt slope. The general slope is north–westward and westward in the western part and north–eastward and northward in the eastern part.

2. Central Highlands or Uplands:

Central Highlands or Uplands extend perpendicularly northward from the centre southern highlands i.e. Ratanmal hills. Central highlands form the divide between Mahi, Panam and Anas river basins. Altitude of the region varies from 234 metres to 365 metres. The general slope is north westward and westward on the west and north–eastward and eastward on the east. The slope gradient is steep to moderate on either sides but less than the southern highlands. The flat top of the uplifted land gives it a shape of a table land. It is equally dissected as the southern highlands.

3. The Western Inclined Lowland:

The western lowland lying on the west of Central Highlands has a gradual inclination towards the west finally merging with the course of Mahi River. It is a highly dissected topography comprised of numerous streams of varying order interspersed with numerous isolated hills or ridges. Devgadh Baria of the lowland as well as the region as a whole forms the south–western margin and has an elevation ranging between 213.36 to 243.84 metres which is higher than the western adjoining land. The highest isolated peak of 374.7 metres is in this section. It is derived from the direction of flow of streams that–

- The land is inclined westward and north westward from the central highlands or uplands.
- Though general slope is either westward or north westward, the dissected topography is aligned in east–west south–east or north–west directive

depending on the direction of flow of the streams. These disruptions however, do not change the general slope of the region.

- This lowland region is evidently interspersed with eroded remnants of big massive boulders of granites.

4. Eastern Inclined Lowland:

The lowland lying east of Central Highlands or upland region is inclined towards the north–east. The appearance of land is similar to the Western Inclined Lowland but in opposite directions. This land along with Western Inclined Lowland seems to be establishing isostatic balance on the either side of the central uplifted region. This land also exhibits a dissected topography with comparatively less isolated hills and streams but comparatively higher average altitude than its western counter part. The general slope is north–eastward but at some places the monotony breaks due to the uplifted elongated lands. Most of the hills have more than 300 metres (1000 feet) of attitude.

2.6 DRAINAGE PATTERN:

Drainage pattern of any region is influenced by the characteristics of topography i.e. structure or resistance of rocks, slope of terrain and supply of water. Topography of Eastern Panchmahals provides an ideal condition for the flow of rain water in the form of streams along the low lying regions, following the general slope, between the uplifted lands (Figure 2.3). The surface run off is high and immediate as rocks are resistant and impervious and the soil layer through which water percolates is very thin hence most of the streams become waterless very quickly. The rain water which is prime and only source of water supply accumulate in the low lying basins from all the directions. The current of flow in streams is evident only during rainy season. In other seasons they become cut off streams with intermittently accumulated water in deep basins like a pool or small lakes. It is so because streams are rainfed and so ephemeral in nature (field survey).

The drainage pattern is so complex due to the varying nature of rocks, topography and supply of water. On the basis of various evidences two basic kinds of drainage patters can be identified–

1. Trellis Drainage Pattern – This kind of drainage pattern is clearly visible in many parts of the region. Rivers like, Goma, Panam, Karad, Hadap, and Machhan in the western lowland and Kali–I, Khan, Kali–II and Anas in the

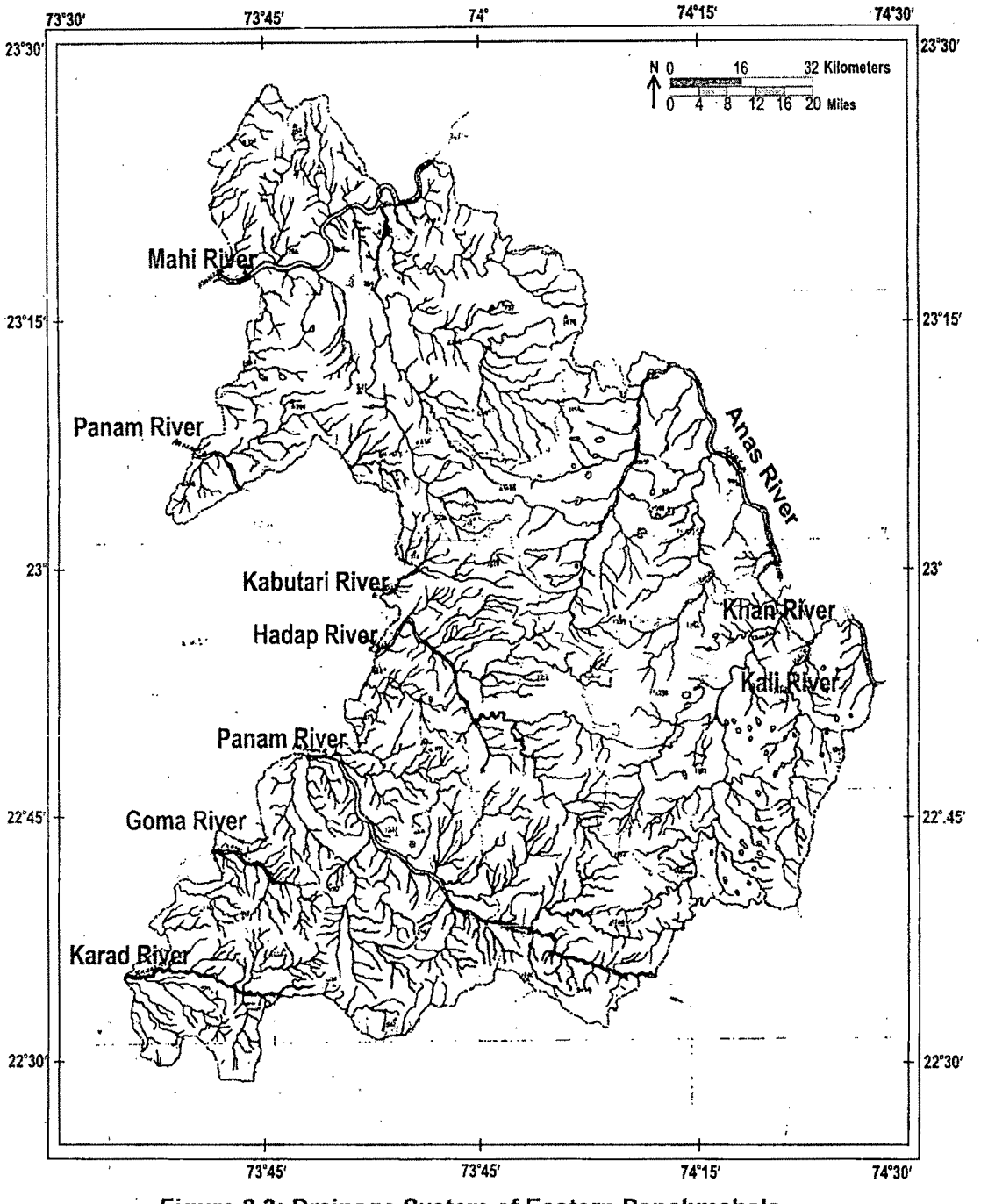

Figure 2.3: Drainage System of Eastern Panchmahals

Eastern lowland depict trellis drainage pattern. But at some places the pattern is disturbed only because of the differences in the structure. For example in some low lying plains on the two inclined low lands due to the granitic uplifted surface dendritic pattern develops. The trellis pattern is formed as the streams completely follow the slope. Any deviation in their form is because of change in slope. It is notable that at some places the

deviations are visible because of the joints of rocks. One significant feature of this pattern is that the number and length of obsequent streams is comparatively less than resequent streams. And, streams of all the order i.e. consequent, subsequent, resequent or obsequent have the tendency to adjust with slope and structure of rocks. Other notable features are:

a. short interval between tributaries reflect the rugged topography,
b. short length and numerousity of streams of lower order and meanders in the upper course and lower course clearly depict the tendency of streams to adjust with the varying rocks structures and slopes

2. Radial Drainage Pattern – There are two uplifted parts or nodes, one in the central part of Southern Highlands of and the other to the north Ratanmal hills. Around these nodes of upliftment, streams develop radially. The streams emerging radially from southern node are River Khan and its tributaries, Hadap, and tributaries of River Panam and from the northern node the tributaries of Khan, Kali–II, river Anas and tributaries of Hadap. All of these radially originating streams are rainfed. North of these nodes lies on elongated uplifted part like a table land. Around this table land various streams also originate from the top or top margins and flow radially. This mesmerism is solved or cleared with the explanation that mode of occurrence or origin might be radial but the pattern that develops is trellis.

There are numerous streams of varying length and width which form the drainage pattern, transport the water and contribute in the evolution of the topography. Places of origin of some of the main streams and their tributaries are given below.

River Mahi which originates from Malwa Hills is the longest and the main stream but its flow in the region is very short and confined to northern Santrampur where it flows through the villages of Khedapa, Rath, Kadana, Vaghdungari, Ghodiyar, Mumpur, Nadhra, Salia, Mal, Thakorma Nadhra and Antalwada and thereafter enters Lunawada Taluka. Kadana Irrigation Project on river Mahi has been constructed near Kadana village in the Eastern Panchmahals. River Panam originating in Madhya Pradesh, Machhan originating in Sutharvasa village of Jhalod, Anas, at the confluence of Suki and Chibota streams, originating in Santrampur are the main tributaries or subsequents of River Mahi and form its whole drainage basin. Though all the above mentioned streams are the tributaries of the River Mahi none except river Machhan joins it within the study region. Excluding Mahi, River Panam is the most significant river in the Western Inclined Lowland region. It would not be wrong to consider it as an antecedent stream as it has maintained its course and

graded itself to its initial course in the Ratanmal Hills. The upliftment in the southern part of Eastern Panchmahals might have affected its flow for a certain period but its flow and efficiency to erode must have enabled it to grade the original basin and maintain its flow. Panam enters the central part of Southern Highlands near Limadia village of Limkheda, from south–east and after its long course it leaves the region from Bathwada Village of Devgadh Baria and enters Godhra taluka. During its course the main tributaries which it are river Ujal and Hadap which originate at village Sadabia of Devgadh Baria and Kantu of Limkheda respectively.

Anas is another important river of the region which flows along the eastern margin of the region and Eastern Inclined Lowland region. Anas originates in the Malwa hills and flows northward. Before meeting Mahi, various subsequents or sub–streams join it. Some of the important subsequents or tributaries of the river are Kali II, Khan and Kali I which orginate respectively in villages of Rabdal, Bhe and Lari Bujarg of Dohad. Some other significant rivers of the region are Karad and Goma originating in villages of Bara and Kantu of Devgadh Baria in the westerd part of Southern Highlands and Khatlaer and its tributaries, Suki and Chibota in the North–Western Inclined Lowland, originating in the villages of Surpur in Santrampur and Vansia in Jhalod.

On the whole it is concluded that the drainage pattern is physiographically well developed but are ravenous in nature as most of the streams being rain–fed are either intermittent or ephemeral. Also, the streams are not efficient to meet the demand because of less rain, inclination of the surface towards east, north and west, and impervious rocks. It is notable that all the subsequent or sub streams of the region discharge their water into Anas, Mahi and Panam which almost encircle the study region leaving small portions in the north and south west.

2.7 NATURAL RESOURCES:

Ground Water:

The groundwater potentiality depends upon the supply of water especially through rain, composition and structure of rocks, nature of topography and vegetation. The most significant and prime factor is the quantity of rain. The quantity or supply of water through precipitation or rain is meager in the study region. The adverse environmental conditions such as location, topography, geology and vegetative cover leads to less rainfall and thence less immediate storage of water through percolation. It is worth mentioning that the Eastern Panchmahals is characterized by hilly and inclined surface and occupied by Archean metasediments represented by basalt, quartizites, phyllites, schists and Deccan lava Cretaceous

period which do not provide an ideal environment for water percolation and thence adversely affects the ground water potential. Besides this the decreasing vegetational cover further aggravates the problem by increasing the rate of surface run off and decreasing the rainfall by disturbing the energy cycle and rate of percolation. The underlying aquifers or phreatic zones might be saturated by percolation through joints or creeks, subterranean reversible action or recession of water accumulated in the low lying valleys or basins towards the uplifted region but probably due to adverse conditions for the distribution of harnessed water, the actual ground water storage pool is difficult to access. The availability of water (at un–specified depth) between the cavities or joints through seepage from river basins or other sources act as mesmerism but certainly proves to be a drop of relief. Also, probably the availability of wide impermeable rocks or acquicludes between the aquifers is another great problem in the detection of actual and uniform ground water table.

Mineral Resources:

The geological structure of the region is similar to the resource rich Damodar Valley region. The availability of quartzite and sandstone of the Vindhyan type in Damodar Valley as well as in the Eastern Panchmahals region which is close to the effective zone of Vindhyan range or probably the northward off–shoot of the same, signifies the probability of rich reserves of resource. The marine transgression and regression to its west and north and shrinking of Tethys to its north also indicates its close affinity to marine system and thence resource richness. The efforts initiated towards exploitation of mineral resources in the region might prove to be very significant with the detection of miraculous reserves beneath it (Merh, 1995; Krishnan, 1982).

Several studies have proved that the region has vast potentiality of mineral resources. The incessant quarrying of building material like granite in Devgadh Baria, Dahod and Jhalod, States in Jhalod, sandstones, and hard and compactly composed quartzites throughout the region, specifically in Devgadh Baria, Jhalod and Dohad, is carried on since very long. Some other useful rocks containing minerals are siliceous limestone, calcareous sandstone, calcareous tufa, calcites, clay containing silica oxide and aluminum oxide in large proportion, feldspar in granite, sand containing silica and mica, quartz containing copper, graphite in biotite and amphibole quartz schists, manganese along the joints of quartzites and phylliles and milky quartz suitable for glass manufacturing in phyllites, schists and quartzites (Gazetteer of Panchmahals, Report of Planning Division, Government of Gujarat).

Soil:

The process and nature of soil formation, composition and structure is dependent upon the various environmental conditions such as nature of the rock, topography, vegetation, climate, geomorphic process and the agents or forces of denudation. The dissected, rugged undulating topography and the regionally varying characteristics of soil within the region explain and verify the process of denudation, transportation and accumulation of sediments forming soil. The long geo–climatic history associated with biological evolution must have had significant influence on the process of soil formation. The Pleistocene glaciations to the north and then probably the origin of snow fed incessant or perennial streams, due to the melting of ice, might have become active agents of denudation, transportation and accumulation of sediments. This is certainly evident from the dissected undulating topography. The region being inclined remained overlain with thin layer of soil but contributed a lot in developing the plains located off the east and west margins of the region. The increased temperature might have led to the extinction of ice–masses and the streams fed by them. The streams got converted into intermittent or ephemeral streams and rain water became the prime source of water for such streams. The changing climate might have brought and placed the region under the category of intensive draught prone areas of India. The climate being fluctuating between arid to semi–arid with decreasing annual rainfall, the agents of denudation also might have changed. The streams or running water became passive and wind action active agent. The rate of denudation decreased and the nature of transportation and deposition varied characteristically. The inclined surface accompanied by blowing action of wind and flowing action of intermittent or ephemeral streams led to the meager deposition of sediments in the Eastern or Western Inclined Lowlands and vast deposition to the far–off eastern and western and north eastern and north–western margins of the region (Singh, 2003; Holmes, 1994; Merh, op.cit; Bloom, 1978).

Some of the significant features related to the soil of the region are–

(i) The composition and texture of soil varies in different parts of the region because of the varying intensity of weathering and erosion with varying geology, slope and geomorphic actions. The varying colour of soils signifies the varying composition. The soil varies from light to dark colours, ranging from light cream reddish brown, grayish to blackish. The texture too varies from coarse grained to fine grained sediments intermixed with gravels or rock particles or pieces – i.e. ranging from rock pieces or gravels, coarse sand, fine sand, clay to silt. The variation in

composition and texture depicts variation in the mode of formation caused due to the various environmental factors mentioned above. It is notable that the variation in composition signifies the varying mineral constituents and then the fertility of soil. The marginal lowland on either side of the Central Highland or Upland region and areas along the streams are deposited with fine textured soil. Besides this, the Eastern part is mainly overlain with grayish black, black or reddish brown or dark coloured soils whereas the Western Lowland is overlain mainly with light coloured, or redish brown soils.

(ii) The thin layer of soil ranging from few centimeters to few metres shows less deposition of sediment within the region.

(iii) The thin layer of soil over the resistant rocks for example, granite, depict the unstable condition, such as less durable consolidation, improper illuviation or elluviation due to less developed soil horizons on inclined surfaces. The illuviation or elluviation or capillary action is not sufficiently active because of the inclined surface or resistant bed–rock. The inclined surface mobilizes or activates lateral action along the declining slope instead of vertical action necessary for vertical recycling of nutrients to rejuvenate soil fertility. Also the resistant bed–rock beneath shallow soil restricts porosity of the soil.

(iv) The decreasing vegetational cover action along with increased human with the alteration climatic conditions is leading to the decreasing supply of hummus which makes soil viscose and fertile.

(v) The moisture or water retentive nature of soil is hazardous where the bed rock is resistant or inclined. The water or moisture in such conditions act as lubricant and leads to the downward mass–movement. The excessive rain might prove to be hazardous with rapid flow or mass–movement due to the active sliding action for the population inhabiting the upper slopes but could be fruitful for the inhabitants of low–lands located at the destination of deposition.

(vi) The ped–formation in the dry conditions especially during summer is not only because of water loss from the less viscose soil but also due to the active sliding force and restricting frictional force along the declining slope. Actually the sliding action caused during the rainy season is accompanied by the expansion of soil molecules due to their water absorbing and retentive nature. Also the amount of rain does not reach beyond the elasticity of soil. So, mass movement and ped–formation do not take

place. But with the increasing temperature the water or moisture content evaporates because of which the molecules of soil contracts around various nuclei leaving behind the gaps or cracks in columnar form. The gaps or cracks caused between the peds get filled with water and leads to the expansion of the soil molecules during the rainy season. Peds are general features in the region because of recessive surface tension along the slopes under excessive temperature conditions.

(vii) The eluviation (the downwashing of clay and other fine particles and nutrients) or leaching (the removal of materials or nutrients through solution from upper layer) assisted by lateral and gradual seepage of water along the slope and resistant, impervious bed–rocks, drains off or transports the rich nutrients to the lower regions.

Because of the above characteristic causasive factors the region is endowed with the soil varying in character and fertility. The inclined surfaces have thin layer of less porous soil where as lowlands have relatively deeper, darker and more fertile soil. The heterogeneity of soil is quite evident with the availability of wide variety of soils such as entisols, inceptisols, and vertisols. But entisols and inceptisols are the two major kinds of soils. Entisols develop over traps, granite, gneiss, quartzite and alluvium. They are light grey, grayish brown and reddish brown in colour and have depth ranging between few centimeters to a few metres. Soil horizons from A to C, weak structured and textured from sandy clay, loam to clay. The soil is calcareous and alkaline in nature. Inceptisol is another variety formed over baslaltic, granitic, gneissic and alluvial parent rocks and occur on gentle to moderate and steep pediments, in sloping isolated plateaus, valley bottoms and moderately sloping interfluves. These are dark grey to light grey, reddish brown, yellowish red and dark reddish brown in colour. Like Entisols, inceptisols are also formed in semi–arid conditions and humid conditions. These are calcareous, neutral to alkaline in nature, structurally sub–angular and blocky having A to C horizons but thin layered and texturally silt loam to clay (Merh, op. cit; Krishnan, op. cit; Gazetteer of Panchmahals, Government of Gujarat Planning Division, 1992).

2.8 EXPLOITATIONAL UNITS OF SPACE:

Nature of space is defined through human interaction with space over time. Increase of population leads to the increase in the demand of varied resources. An agrarian economy based on primary activities the exploitation of space for crop cultivation and utilization of forest resources. However, with diversification of

economy, utilization of available space not only gives rise to several functional spaces, but also introduces alterations into the pattern of space utilization. For example, an increase in one functional space leads to decrease in others. Such variations are still operative in the tribal hilly environment and create the necessity to analyze each functional unit separately.

2.8.1 Cultivable Space:

Cultivable space is comprised of

(i) irrigated,

(ii) unirrigated, and

(iii) culturable waste land.

a. Irrigated Space:

Irrigated cultivable area is constantly increasing with the increasing effort to develop irrigation facilities. The average decennial proportionate increase in the irrigated area is around 1.33 only i.e. 3.04% of total area and 4.48% of cultivable area is irrigated. In other words, the percentage of irrigated area to the total area is 32.88 and to the total cultivable land is 22.29. As is revealed from the earlier discussion undulating nature of the terrain and poor water retentive capacity of the soil in the region restricts the scope of increase in the area under irrigation.

b. Unirrigated Space:

The trend of increase or decrease in the total unirrigated area is directly related to the reclamation of culturable waste or uncultivable land for the purpose of cultivation. Some of the facts revealed are –

i. The proportionate decennial increase is 1.01.

ii. 55% of the total area is unirrigated.

iii. 1.81 proportion of the total area is unirrigated.

iv. 81% of the total cultivable area is unirrigated.

Unirrigated cultivable land is totally dependent on rainfall and in the region a very high proportion of the cultivable land is unirrigated. The rainfall being erratic in nature, it would not be wrong to conclude that the overal productivity and economy of the region is also erratic and that the life of people in hilly this environment is almost completely dependent upon the mercy of rain.

c. Culturable Waste Land:

Land available for cultivation but yet not cultivated for five or more years is known as culturable wasteland. Such land being unexploited allow the growth of wild plants, shrubs or herbs etc. The presence of culturable waste land is an indicator of inefficient technology. Information on culturable wasteland reveal that –

i. 14.03% of the total cultivable area is culturable waste.

ii. 9.51% of the total area is culturable waste.

iii. The proportionate decennial increase is 0.9317.

iv. The rate of proportionate decrease i.e. 1.659 is relatively higher than the increase. The decreasing trend is a symbol of some betterment of tribal agrarian economy.

2.8.2 Barren and Uncultivable Land:

Land which is economically not suitable for cultivation could be called as uncultivable land. Uncultivable land restricts human (cultivators) tendencies and opportunities and dictates its deterministic rule. Some of the salient features of the region are –

1. land is highly undulating, dissected and overlain with resistant rocks.
2. approximately 19% of the total area is uncultivable.
3. the proportion of uncultivable area to the total area is 5.262 compared to the proportionate decrease of 1.176.

2.8.3 Forest Area:

Tribal space has experienced a dwindling trend in the extent of forest cover. Traditionally, the space was characterized by rich forest resource coverage but currently the coverage is insufficient to sustain the requirements of tribal economy though it is showing a sign of gradual growth in its extent. Some of the salient features are –

1. 12.19% of area is under forest in the total area.
2. The proportionate decennial growth in the forest area is 1.62.
3. The average proportion of forest to the total area is 8.20.

The growing trend is a positive symbol in gaining impetus towards balanced eco-system and sustainable development.

2.9 POPULATION:

Hilly environment of the sample area is pre–dominantly inhabited by the tribes. Any space inhabited by more than 50% of the population characterized as tribes could be called a tribal space. The tribal space under study reveals the following salient features.

Some of the salient features derived from the secondary data are

1. More than 87% of the total population is tribal.
2. Average decennial increase of tribal population between 1971 and 1991 is 1.39 compared to the 1.36 proportionate growths in the total population.

This indicates an alarming increase in the laggards' population and needs to be immediately combated. In failure of combating the growth rate of laggards then all developmental efforts or infusion of infrastructures would be insufficient and better realities would be beyond imagination and control.

2.10 LITERATE POPULATION:

Some of the salient features of literate population in the tribal space are–

1. While around 19 (18.51) percent of the total population is literate, only around 15 (15.66) percent of the tribes return themselves as such.
2. Proportionate mean decennial growth in the tribal literates is 2.02.
3. 14.38% of male and 4.12% of female tribes is literate (Primary Data).
4. The proportionate mean decennial increase in the male and female tribal literate population is 1.85 and 2.95 respectively.

The above features clearly indicate that a big chunk of tribes remain illiterate. Either they remain devoid of education or do-not make any effort to get it. This is another alarming fact which cannot be undermined. Overlooking this big illiterate mass would certainly decimate any kind of developmental effort. There is certainly a need to combat the mass illiteracy by enhancing the facilities and programmes.

2.11 FUNCTIONAL POPULATION:

Functional structure of the population decides the economy, level of development and more specifically the standard of living of the population of any space. Salient features of functional population:

1. 35.26% of tribal population is classified as main workers (1971–91).
2. Mean Proportionate decennial growth rate of tribal main worker is 1.214, tribal male main worker is 1.288 and female main worker is 1.107 (1971–91).
3. From the total main workers, 83.96% of total main worker, 87.23% of total male and 73.88% of female main workers are cultivators (1971–91).
4. In an agrarian economy dominated by tribes, only 29.6% of total tribal population are cultivators against 35.26% of total tribal main-workers including cultivators. This indicates that only 5.65% of tribes are engaged in activities other than cultivation. This also indicates that about 65% of the total tribes do not perform any action i.e are idle. Lastly, the above fact directs that 65% of idle mass is dependent upon 35% of the working class for their sustenance. If this non-working idle population is not combated it will pave the way for epidemical conditions similar to that of last decades of nineteenth century and early decades of twentieth century.
5. Mean decennial proportionate growth rate of total tribal cultivators, male and female tribal cultivators are 1.108, 1.22 and 0.886 respectively.

Conclusion:

A retrospection of the geographical environment of the sample area was undertaken by analyzing the spatial and human attributes. Description and analyzes of these geographical phenomena were necessary for the environmental study of the area as they are the constituent elements which regulate the nature. transformation and evolution, specifically, of the regulatory processes or functions of the environment. An analyses over–looking these cannot lead to immaculate conclusions or inferences.

The analytical retrospection of the geographical environment comprises description of location, climate, geology, geomorphology, physiography, drainage pattern, natural resource exploitational units of space and population.

The sample area is located at the northern margin of tropical zone and in the vicinity of sub–tropical region. It exhibits arid climatic conditions and is one of the drought prone zones of India. The geology of the region reveals the effect of a series

of geological actions and formations in many eras, caused due to redistribution of land and sea, tectonism etc. Similarly, geomorphology of the region is the resultant of varying temporal actions such as tectonism, transgression and regression, weathering, erosion, sedimentation, glaciation and climatic variations. The impact of climate, geology and geomorphology is evidentially visible in the evolution of contemporary topography and physiographic variations and drainage system. The topography is characterized by undulating dissected terrain composed of successive rugged ridges of moderate elevation separated by numerous ephemeral water courses and low lands. The physiographic divisions are classified as – southern highlands, central highlands or upland, western inclined low land, eastern inclined low land, and northern land of isolated ridges and hills. Undulating, inclined land and resistant surface is comprised of many ephemeral streams. Nature of the surface leads to the high surface run–off and development of trellis and radial drainage patterns. Similarly, the location, topography, geology, and vegetation are not ideal for sufficient rainfall and water storage through percolation but the probability of inaccessible reservoirs cannot be denied.

The geological structure similar to many resource rich regions of the Indian subcontinent indicates the probability of significant mineral reserves in the region. In an agrarian economy soil is the most potent resource upon which the life of people and economy is dependent. But, the composition of soil do not display uniformly well developed horizons throughout the region. Resistant bed rocks, inclined surfaces, and arid climate favour mass movement, unconsolidation, ped–formation and erosion. Exploitational units of space such as irrigated and unirrigated cultivable land, culturable waste land, uncultivable land and forest certify and reflect the nature of environment and economy. Growing population and thence demand is the cause for temporal variation in the proportion of different exploitational units. Such temporal variations are responsible for the transformation in the environment.

The area is evidentially tribal in nature as around 87 per cent of the population has been enumerated as Scheduled Tribe. Aggregate literate population is about 19 per cent whereas literate proportion in the tribal population is around 16 per cent. Only 32.26 per cent of the population is listed under the main worker category of which 84 per cent are cultivators.

Explications given about the environmental characteristics of the sample area reveal some of the existing realities, their causes and probable nature of transforming environment. Existing realities of the significant characteristics like location, climate geology, geomorphology, physiography and drainage pattern reflect inter–causasive relation between them in space–time continuum. The physical and basic

constituents of environment depict evidences of simultaneous synergic impact on each other. Uniformity and continuity in the transformation implies continuity of various regulatory forces and process and continuity in transformation. Ever transforming behaviour of environment indicates transformation in resource potential and human life multifariously. Past evidences of structural and characteristic variations imply variation in the climate, geological structure, geomorphological processes, hydrological cycle, resource reserves, bio–diversity, etc. The past and existing erratic environment with diminishing potentialities i.e. supply from environment and increase in consumption is an indication of growing imbalance and diminishing sustainability.

The area characterised by undulating–rocky terrain, semi–arid climate deteriorating forest resources, water scarcity, poverty, low literacy, low infrastructure, less developed soil and underdevelopment do not provide an ideal condition for cultivation and growth of other primary activities in tribal rural economy.