CHAPTER - I

HISTORICAL AND GEOGRAPHICAL BACKGROUND OF THE STUDY AREA

INTRODUCTION

The dichotomy of environmental determinism versus possibilism has been the key instrument in defining the supremacy of man over natural environment and vice versa in the erstwhile mountain kingdom of Sikkim. The present study is a pioneer in analysing history in relation to significant aspects of accessibility, marginality, ecological niche (natural factors) and human settlement with reference to social structure, its mal- adjustment, cultural heritage like customs, traditions and diplomatic revolution etc. (man made factors) Hence, an attempt has been made to synthesize both factors with their spatial location in the historical perspective while adapting in natural environment. There exists a regional disparity in the history, which provides a heterogeneous picture. Hence analysis of historical evidence is important because the interrelationship between human beings and natural environment is as old as the emergence of mankind in the earth.

The past is key to the present, present cannot run independently if we ignore the past therefore analysis on any phenomenon can be carried out in the light of history as every segment of the world has been inhabited long before the dawn of recorded history. Hence it represents the past events with its relation to present developmental scenario of a particular place.

In this chapter, an attempt has been made to analyze the historical overview of Sikkim with regards to its people of multi-ethnic communities found at present in Sikkim. All such aspects have been dealt with in relation to environment in one hand and tourism development and its impact on the other.

1.1 NAMGYAL DYNASTY OF SIKKIM

Sikkim was a kingdom ruled by Namgyal dynasty till 1975 (Table 1.1)), ever since Sikkim became the 22nd state of Indian Union; it retained and uphold the same status till today. The ancient history of Sikkim is not well documented; myth, legend and stories are the base through which writers have made history.

During 13th century, Khye-Bumsa came to Sikkim to seek blessing from Thekong-Thek, Khye-Bumsa in return was blessed with three sons, as a result brotherly relationship grew up. Later the two chieftains signed a treaty of brotherhood at a place, which is known as Kabi.

Name of Kings	Period ruled
PhuntshogNamgyal	1642 – 1670 ·
Tensung Namgyal	1670 - 1700
Chakdor Namgyal	1700 – 1717
Gyurmed Namgyal	1717 – 1733
Phuntshok Namgyal	1733 – 1780
Tenzing Namgyal	1780 – 1793
Tsngphud Namgyal	1793 – 1864
Sidkeong Namgyal	1864 – 1874
Thutob Namgyal	1874 – 1914
Sidkeong Tulku	1914(Feb to Dec)
Tashi Namgyal	1914 1962
Palden Thendup Namgyal	1962 - 1975

TABLE 1.1 CHRONOLOGICAL ERA OF NAMGYAL DYNASTY

On 16th may 1975, Sikkim merged with India and became 22nd state of Indian union. After 1975 rapid developmental activity started to give present prosperous Sikkim (Das, 1995). The traceable history of Sikkim begins from17th century onwards, wherein Namgyal dynasty ruled Sikkim for nearly four century. Till 1975, Sikkim remained as an inaccessible country in the remote corner of Eastern Himalayas. The slow pace of development resulted slow pace in environment degradation as well. The primitive people in Sikkim

were hunter and gatherer, they bank upon jungle for their livelihood and hence environmental degradation was taking place. The process of cultivation started, clearing of forest cover took place and agriculture cultivation started in the valley and slopes of Sikkim Himalayas. After the later half of 19th century, massive development activity along with massive ecological destruction is witnessed in the study area.

1.2 CULTURAL ADJUSTMENT

Human adjustment of different races in Sikkim from the beginning has brought about uniqueness in cultural set-up; therefore to study its historical background is a matter of vast source of information. Basically the Lepchas, the Bhutias and the Nepalese are main races to contribute to the history of Sikkim. The three communities are affiliated to Hindu, Buddhist and Christian, however Hindu population is in majority. It may be mentioned that nature worshippers are still found in the villages. The belief on Jhankri Dhami still persists among the people. Besides, animal sacrifice is seen among the Lepcha, Manfar, Gurung, Tamang, Rai, Limbu, Chettri etc. During dasai, goats and ducks are sacrificed in the houses of Chhetris, Limboos and Rais. Kul pitri puja is also performed as the rituals of Khambu, Limbu, Chhetris etc. Hence the above communities can be categorized into nature worshipper. Before rushing any patient to hospital, these communities perform ritual formalities; it is a firm belief that doctors never cure illness due to laag lagan. While interacting with a *jhankri and bijuwa*, it is understood that they don't believe in doctors rather they themselves guarantee for the cure of illness. Jhar phuk and its belief are deeply rooted into the minds of Sikkimese people. As reported by some jhankris at Mangley, while performing and chanting mantras they call river, forest, mountain, wind etc and spiritually request for the cure of disease. The statements show how close are they with the nature.

1.3 HISTORY OF CONSERVATION

The first ever steps towards preservation of environment appeared in 1954,by banning the construction of building within 15.2m from the roadside

Fig-1.1: GEOMORPHOLOGY



(forest notification No.2375/54, Archives). In 1970, yet another notification was issued by imposing restriction on export and import of Lycopodium from Sikkim. (Notification No.1744/forest, Archives)

1.4 PHYSIOGRAPHY

The magnificent breathtaking and range of snow-clad "Kanchandzonga" offers Sikkim a unique paradise on earth. The whole landscape offers a sweeping panorama of mountain ridges, sky and emerald lakes, sculptured in the towering folds of rock strata. Amphitheatre is an artistic impression of Sikkim, as high ridges on the north and west griddle the state from east and west respectively. The variation in relief ranging from 250m to 8595m makes Sikkim a contiguous part of the Lesser and Greater Himalayan zone. Steep hills and steep deep valleys characterize the whole physiography of Sikkim Himalayas. The mountain slopes from north-south direction with well-carved interlocking spurs_and water divides form deep and silent vallevs.

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TABLE 1.2: TOPOGRAPHY VARIATIONS ACCORDING TO ELEVATION

Type of land	Level of elevation (in meter)
Lower hills	270 1500
Mid hills	1500 - 2000
Higher hills	2000 – 3900
Alpine zone	3900 with vegetation
Show bound land	Very high mountain without vegetation and with perpetual snow cover upto 8580m

Source: Statistical profile 2004-05

The present morphology is the result of existing geological condition where north, west and eastern region comprise of hard gneissic rocks, southern and central lowland is mainly composed of soft and erodable rocks. The geomorphologic setting of study area shows (Fig 1.1) contrasts physical

Fig-1.2: SPOT HEIGHT



features. The topographic variation (Table 1.2) shows classification of hills ranging from 270 meter to 8580 meters (Figure 1.3) featuring similar contours.

1.4.1 Classification of terrain

Physical feature of the study area is also categorized according to varying degree of slope, vegetation and geology. The major types are summits & ridge, escarpments, very steep slopes (> 50%), steep slopes (30 – 50%), moderately steep slopes (15 – 30%), narrow valleys (< 15%) cliffs and precipitous slopes zone of glacial drift, perpetual snow (Das *et all*, 1996)

1.4.2 Peaks

The landform features developed in various terrains are snow-capped mountain, snow covered peaks & hills, V-shaped valleys, gorges rapids, canyons, waterfalls etc. The natural beauty of Sikkim is exhibited by the kaleidoscopic view of glaciated peaks. Northern peaks are Lhonak ,Sentinel, Chorten Nyma,Khora Khang,Khora Tso Gna Khang,Mt. Talung at 7375.80m Eastern peaks are Mt. Masunyange at 5882.35m, Lamaongden at 5902.46m, and Paunhri at 6705.27m Western peaks are Mt. Kanchendzonga, at 8581.53m, Mt. Kabru at 7380.37m, Mt.Siniolchu at 6888.14m,Mt.simvo at 6850.35m,Mt. Pandim at 6735.75, Mt. Kokthang at 6145.07m, Rathong at 6735.75m. Besides Tent, Nepal, Langbo and Pyramid peak significant in their scenic beauty. The spot height (Fig 1.2) of important places exhibit contrasting altitudinal variation.

1.4.3 The sacred peaks

The people of Sikkim have been nature lover therefore Government has notified few peaks as sacred peaks. The expedition to mount Kanchendzonga the guardian deity of Sikkim was held in the year 1955 and 1977 respectively. The mountaineers were told to stand 1.82m below the

Fig-1.3 CONTOUR



summit. At present, Government of Sikkim has banned on expedition to Mt. Kanchendzonga. The commemoration of 50th years of assent to Kanchendzonga was observed in Gangtok on 17-18th September 2005. (*Now*, 19-9-2005).

1.4.4 Passes

The state of Sikkim is characterized by high mountain passes and narrow glacier outlets. The mountains remain under the perpetual snow cover through out the year. The eastern and northern regions in Sikkim have high mountain passes. However it is to be noted that the Nathula Pass in East Sikkim is a famous trade route between India and China. Besides, other passes are Sasayla, Kongrala, Nakula, Chortem Nymala etc.

1.4.5 Ranges

The morphology of physical landscape exhibit well defined ranges which demarcates the international natural boundary between the nations. Such ranges are located in the high altitude and inaccessible rugged terrain of the Sikkim Himalayas. The ranges in such hostile climatic condition often act as a barrier and save the country from external aggration. Owing to its inaccessibility, these ranges are well preserved and its pristine beauty remains virgin. The important ranges lying at the frontier of Sikkim include Singalila range, which separates Sikkim from Nepal in the western edge of Sikkim Himalayas, secondly Chola range demarcates Sikkim from Tibet and Bhutan in the eastern edge and finally Pangolia range, separates Sikkim and Bhutan. All these ranges remain under perpetual snow cover and hence the crests (Fig.1.3) of the ridges vary seasonally. These entire passes constitute unexploited alpine tourist destination in Sikkim.

1.4.6 Glaciers

The glaciated region of Sikkim virtually falls towards the upper part of Tista-basin. The roof of Sikkim Himalayas is covered by glacier. Glaciers are the sources of water which drains almost the whole of Sikkim Himalayas.

Important glaciers above 5000m remains under perpetual snow cover; such glaciers are formed along the highly elevated region of West, North and East Sikkim. Due to north-south slope, the melted glacier descends down towards southern slopes forming important glacial features such as Cirques, Moraines, etc.

1.4.6.1 *Glacier complex*

Owing to suitable latitudinal and altitudinal extent, the glacial movement and avalanche are common geomorphic features in the upper parts of Sikkim Himalayas. The contiguous ice and snow cover has given rise to the formation of various glacial complexes. The formation of glacier complex has been found in eight major places. Their origin (Table 1.3) and flow vary in accordance with relief and altitude.

The glacial lake outburst was noticed on 25th September 2005, claiming lives of four mountaineers scaling to Yummo Peak at 6867.41m in north Sikkim (Now daily 28-9-2005).

The Yumthang glacier complex comprises of twelve number of glaciers where as Relli complex has just three complexes. The melting and receding of glaciers have been recorded in Sikkim Himalayas. During the movement of glacier, mass wasting and debris, the topsoils are carried away under the force of gravity. The plants of medical importance are washed away and the stunted growth of vegetation prevails all over the region. The event of (GLO) glacial lake outburst is witnessed in the higher altitudes (Lama, 2001). Therefore in Sikkim Himalayas, especially in the higher altitude eco-fragile area, the landforms are naked and delicate ecological balance is maintained. The tourism activity often takes tourists to such places for adventure tourism. As a result, negative impact on environment is experienced all over the regions.

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No. of Glacier			
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9			
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TABLE 1.3: GLACIAL COMPLEXES

Source: Jeyaram, K.Murthy, Shrinivasan, Radhakrishnan 1998.

1.4.6.2 Important Glaciers

The important glaciers are Zemu, Lhonak, Hidden, Tista Khangse, Chungsang, Langbo, Rathong etc. All above-mentioned glaciers are the major sources of water; streams are originated from the glaciated topography to form the major river system in Sikkim. It is self explanatory that most of the glaciers have their origin in Northern Sikkim. It is to mention that northern Sikkim is the house of biodiversity in Sikkim. Therefore, in northern region, eco- tourism must be developed in harmony with nature.

1.5 LAKES

Due to constant glacial activity and high altitudinal vegetation cover, the lakes are found abundant in the Sikkim Himalayas. There are more than 150 water bodies, which are classified as lakes. (Roy, Thapa, 1996) The glacial activists are the source of water feeding such lakes; accumulated water bodies are often named as *Chho, Tso or Pokhari* in Lepcha, Bhutia and Nepali language respectively.

1.5.1 Classification

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The lakes found in Sikkim Himalayas are classified according to their altitude, across the length and breadth of Sikkim's geographical area. According to place of origin, three groups are classified. (Prasad & Sundriyal, 1984); (Rawat, Naitham, 1986); (Roy & Thapa 1996) as High altitudinal lakes, Mid altitudinal lakes and Low altitudinal lakes.

1.5.1.1 High altitudinal lakes

These types of water bodies are found above 2600m heights in the areas lying in higher altitude of North and East Sikkim. These are snow fed and remain under snow cover during winter season. Most of these lakes are situated in the remote areas and carry no names. The dimension of the lakes (Appendix I) varies from 10-100 meters and the depth varies from place to place.

1.5.1.2 Mid altitudinal lakes

The lakes located upto the height of 2000 m. are categorized under mid altitudinal lakes. In summer some lakes remain dry due to the lowering of water table and high rate of evaporation. Such lakes are *setey pokhari and Kal pokhari* (Roy, Thapa, 1998). Whereas, some lake (Appendix II) are so virgin that even it remains nameless till date.

1.5.1.3 Low altitudinal lakes

The lakes are found in low-lying river valleys (Table 1.4) but remain dry in most of the season, the rainwater is the major source of water for lakes. Such lakes are given cemented surface with a view to develop water sports for tourists. (Roy & Thapa, 1998).

Lakes	District	Importance
Martam Pokhori	East	Domestic use
Nagi Lower Lake	South	Domestic, religious
Nagi Upper Lake	South	Domestic use.
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FABLE 1.4: LOW	ALTITUDINAL	LAKES
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Source-Roy, Thapa, (1998).

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The matter of concern for low altitudinal lakes is the characteristics of seasonality in the supply of water and lake pollution by animal grazing and human interference. Hence environment of these lakes are degraded to a great extent. While visiting Aritar Lake it was noticed that visitors throw

eatable waste in the surrounding and noise pollution cause migration of birds and living organisms.

West District	North District	East District	South District
Lam Pokhari	Gurudongmar	Bidang Chu	Yangang
Khechuperi	Chholamu	Changu	Rabong
Laxmi Pokhari	Sima Chok	Menmecho	
Majur Pokhari	Panch Pokhari	Aritar	
Dud Pokhari			
Samiti Lake Pokhari			
Ram-Laxman Pokhari			

TABLE 1.5: LAKES -AS TOURIST DESTINATIONS IN SIKKIM

Source: Statistical Profile, 2004-05 and field visit 2004.

1.5.2 Lake as a tourist destination

Of all the lakes in Sikkim, Changu, Memencho, and Gurudongmar are the mostly visited lakes by the tourists of domestic and international nature (Table 1.5). The basic features of lake in Sikkim are absence of water sports. However, whitewater sports are gaining importance in Sikkim day by day. Aritar is the only lake in Sikkim, which provides boating facility. Such lakes being located at low altitude are ecologically degraded due to pollution from human and animal interference, remnants of plants and animals etc. of the total number of tourist visiting Sikkim, 75% of them visit Tsango lake due to its prime location, natural beauty and its proximity from the capital town of Gangtok.

1.6 HOT SPRINGS

The hot spring in Sikkim gained significant importance since the dawn of Sikkim's history. Hot water of spring is medicine for the cure of various skin diseases. Among the local population, hot springs are known as 'Tatopani'. Hot water having sulfurous odor when gushes out from the inner earth to the crust, it forms hot spring. During winter such places gain tremendous local tourists. Of all the hot springs (Table 1.6) Ralong, Borong and Yumthang are popular in terms of visitors.

Name of Hot Spring	District
Phurchachu at Khadosangphug	West/South
Yumthang	North [,]
Borong (Ranglop Tshachhu)	South
Raiong	South
Yuma Samdongtshachhu	. North
Tholung Kangtshachhu	North
Shagyong Phedok	North
Takrumtshachhu	North
Gangyab Chhutshen	West
Zee Tshachhu	North
Source: Notification 70/ HOME /2001	· · · · ·

	TABLE	1.6:	IMPOR	ΤΑΝΤ	HOT	SPRINGS
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There has been a plan for the development of hot spring for the tourist purpose, in such scenario; there remain every possibility of degradation. The area in and around the hot spring is polluted, during tourist gathering. Littering, open defecation and soil pollution are common in such sites.

1!7 SACRED CAVES

The caves are the typical geomorphic landforms found in Sikkim. Such caves are associated with myth and it bears significance in terms of history and religion of Sikkim.

TABLE 1.7: THE MAJOR CAVES IN SIKKIM AND THEIR LOCATION						
Name of Cave	Locatión					
Sharchhogbayphug at Sangmo,	South Sikkim.					
Khadosangphug at Sanganath,	South Sikkim					
Dechenphug above Nampung,	West Sikkim					
Lharinyingphug via Kongri-Labdang,	West Sikkim					
Phagmorong,	West Sikkim					
Tragthungrong,	West Sikkim.					

Source-Statistical Profile, 2004

The caves (Table 1.7) have spiritual importance to the people of Sikkim. Such caves have also become the place of tourist importance. Therefore the process of degradation of caves environment is obvious.

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Fig-1.4-DRAINAGE



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1.8 DRAINAGE SYSTEM

The drainage system can be categorized into water bodies including lakes, streams, rivers and ponds. However, river forms major drainage system in Sikkim. The glaciers and its complexes have been the permanent source of water for the people living in the lower altitudes. The details of rivers in Sikkim are mentioned at Appendix III.

The major rivers in the state are Tista and Rangit (Fig 1.4) The river Tista and its tributaries drain major portion of the state. The river Tista has its source at the glaciated Chholamu lake in North Sikkim. The glaciers such as; Lonak, Zemu, Rathong with the tributaries such as Zemu Chu, Lachung, Lachen Dikchu, Rangpo, Rongi Chu produce distinct drainage system. The river Rangit is fed by Rathong Chu which has its source at Rathong glacier.Other tributaries of river Rangit are Rumbi, Kalej, Reshi Rothak, Rammam and Manpur Khola. The Rangit river finally merges with the Tista as a tributary.

Left Bank Tributaries	Right Bank Tributaries			
Chhombo Chu	Zemu (Lachen Chu)			
Lhasa Chu	Rangyong Chu			
Kelep Chu	Rangphap Chu			
Gyumthang Chu	Rangit Chu			
Burum				
Gey				
Tarum				
Rabom				
Lachung	Do not have right bank tributarion			
Ong	Do not have right bank tributaries			
Chakung				
Dikchu				
Rongni				
Rangpo				

TABLE 1.8: TRIBUTARIES OF TISTA RIVER

Source: Choudhury1998

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1.8.1 Tributaries of river Tista

Tista River is the longest and flows from its origin at Cholamu to Rangpo. During the course of its flow, she cuts through deep gorges and canyons. From the steep slope of North Sikkim, it flows with high speed and velocity. In the youthful stage of Tista River, erosional activity is prominent, however, work of river decreases with decrease in altitude. Many other rivers (Choudhary, 98) feed the main river from (Table 1.8) left and right bank.

1.9 CLIMATE:

The prevailing climatic condition of Sikkim varies from region to region, due to variations in topography, soil and uneven vegetation cover. Average annual rainfall ranges from 1300 mm to 4300mm.The maximum summer temperature varies from 21°-37 ° C and the minimum winter temperature varies from 13°-23 ° C. Overall climate varies generally from sub-tropical to alpine, depending upon the elevation. Rainfall is heavy and well distributed from May to September. There are two zones which have been classified as maximum rainfall receiving zone and low rainfall receiving zone.

- 1. The maximum rainfall receiving zone include; Mangan, Ravangla, Damthang, Rayong, Ralang and Gangtok.
- 2. The rain fed areas are Hilley-Varshey and region include Namchi, Jorethang and Melli.

1.9.1 Classification

The climate of Sikkim according to Choudary is broadly divided into the following types

A-Sub-Tropical Humid (lying below 1500m)

The summer temperature is 35° C while the winter temperature is 6° C. The average annual rainfall varies from 1500mm to 3500mm. Tadong (1500m) in East Sikkim receives maximum (3000mm) rainfall whereas, Namchi (1500m) in South Sikkim receives only (1550mm) rainfall. Mangan located at 1310m in North Sikkim receives 3200mm, while Dentam at 1372m in West Sikkim receives only 2300mm rainfall. The night shower is prevalent

in the rainy summer. This season remains for nearly six months from April-September.

B-Semi temperate (lying between 1500-2000m)

The annual average temperature ranges from 8° C in winter to 26° C in summer. This belt is characterized by heavy monsoon rain during June, July and August with the mean annual rainfall of 2400mm. The Station Gangtok records minimum temperature of 2° C and mean maximum temperature of 26° C.

C-Temperate (lying between 2000 to 3000m)

The annual temperature ranges from 0[°] C in winter to 15[°] C in summer. Places like Lachen and Lachung in North Sikkim receives 1700mm average annual rainfall. In the areas lying in Lachung and Lichen belt in North Sikkim, the average annual 1700mm rainfall is recorded.

D-Alpine snow forest (lying between 3000 to4000m)

At this belt precipitation takes the form of silt and snow. Tsomgo (Changu) at the altitude of 3840m in East Sikkim receives 2900mm rainfall, whereas, Yumthang in North Sikkim with 3673m altitude receives merely 1400mm precipitation. Further, Thangu at 3812m receives just 800mm of precipitation. During December – February temperature remains very cold with snowfall in most of the higher belts. The higher altitude areas remain without settlements due to harsh climatic condition.

E- Alpine meadow or tundra (lying above 4000m)

It includes snow covered peaks and ridges of high altitude belt. During winter precipitation occurs in the form of snowfall. The stunted growth of vegetation with bare settlement is common in such region. Due to frozen temperature, no permanent settlement is found in this belt.

F- Artic (above 6000m)

The region is characterized by no vegetation and plant life. The entire zone remains under perpetual snow, to name few are Mt. Kanchendzonga, Kabru, Tulung, Tent, Pyramid, Jonsang, Siniolchu peaks etc.

1.9.2 Weather phenomena

The day to day weather condition prevailing over two important stations at the vicinity of Gangtok have been discussed with a view to understand the local physical climatic condition. (Table 1 9) Taking Gangtok as on of the station, it reveals that 21.8° C is recorded as the highest temperature in the month of July and the lowest is recorded in the month of January with 5.8 degree centigrade.

Year 2003	Temperature 0 ⁰		03 Temperature 0 ⁰ Rainfall Relative Humidity		Humidity	Evaporation		D.P			
Month	Gan	gtok	Tad	ong	(mr	ກ)	0	6	(mi	n)	(0°C)
	Min.	Max.	Min.	Max.	Gangtok	Tadong	Gangtok	Tadong	Gangtok	Tadong	Gangtok
January	5.8	13.1	7.2	16.5	1.5	1.3	79.0	83.0	1.2	2.8	2.9
February	6.6	13.5	8.4	17.7	6.2	5.0	88.0	86.0	1.1	2.6	5.6
March	9.1	15.9	11.0	21.0	4.3	5.9	84.0	83.0	1.4	2.8	7.9
April	13.0	20.3	14.9	25.0	17.0	15.3	84.0	82.0	1.5	2.9	12.0
May	14.0	21.3	15.9	26.3	20.0	16.0	84.0	70.0	1.5	3.2	13.3
Jurie	16,9	21.7	19.1	26.6	21.9	19.3	95,0	85.0	1.4	2.8	17.4
July	17.7	21.8	20.0	26.3	19.0	17.9	96.0	89.0	1.4	2.8	18.0
August	18.0	23.0	20.2	27.9	14.7	11.7	96,0	79.0	1.6	2.9	18.3
Septembe	17.1	21.3	19,4	26.4	13.4	12.0	96.0	82.0	1.5	2.9	17.5
October	14.0	21.0	16.3	24.6	7.2	9.3	93,0	78.0	1.8	3.2	13.8
November	10.0	16.1	12.1	20.7	0.6	4.4	90.0	76.0	1.4	3.1	9,7
December	7.0	14.7	8.6	17.5	2.2	1.6	78.0	67.0	1.5	3.0	4.8

TABLE 1.9: WEATHER RECORDED IN VARIOUS STATION IN GANGTOK (2003)

Source: Department of Meteorology, Govt. of India, Baluakhani, Gangtok

The rainfall in the same month is recorded 21.9 mm. This indicates that the temperature and rainfall are maximum in the month of June-July. The continuous rain and temperature may lead to expansion and contraction of landform and the weak zones may invite landslide, sinking and subsidence. Hence all these factors may lead to various intensity of environmental degradation in the locality

1.10 VEGETATION

Sikkim is a house of natural vegetation with diversified botanical resource. She harbours over 6000 plants species across diverse geographical conditions. The floral diversity comprises of over 300 species of trees, bamboos, orchids, rhododendrons medicinal plants etc.

The major factors controlling vegetation are:

- Climatic conditions such as rainfall, temperature, soil, humidity and moisture.
- Relief including steepness of slope, terrain etc.
- Geology such as rock structure, morphology, rock formation and property of porosity, permeability, softness and hardness.
- Latitudinal and altitudinal variation.
- Soil fertility, erodibility and its chemical composition.
- Porosity, permeability and soil nutrient.

1.10.1 Classification

According to Singh and Chauhan (1998) vegetation are classified into four major types. Each type differs in climatic and physiographic variations.

a-Tropical forests

The vegetation found upto 900m above main sea level are categorized as tropical forest, it constitute mainly of tropical moist deciduous to semievergreen species with the predominant sal cover. The valley of Tista and Rangit extending upto the border of West Bengal is known for such vegetation.

b<u>-Sub-tropical</u> forest

These forests occur at the elevation ranging from 800 to 1500m, along the Tista and Rangeet catchment areas. Ferns and fern allies of Orchid characterize forest cover in this belt.

c-Temperate forest

The forest lying between altitude ranging from 1500 to 3500 m are classified as temperate forest, Lachen and Lachung exhibit such vegetation. Temperate forest can be further divided into broad leaved and coniferous forest.

d-Alpine vegetation

The altitude of this region ranges from 3500 to 5000m where species of rhododendron, berberies, cotoneasfer etc. are dominant. At the higher altitude

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zone of Tsangu, Lachen, Lachung areas, alpine type vegetation with stunted bushes are found. Plants of medicinal value such as Aconilum hetrophyllum etc. are common in Zemu valley along Lachen-Lachung belt. The areas towards Chholamu and Lhonek valley are dominated by the species from Tibetan highland.

Thus Sikkim is richly endowed with natural flora and fauna. The natural vegetation consisting of evergreen trees, grasses, and bushes extends upto 4000m MSL only. At elevations above 5000m MSL hardly any vegetation is found.

1.11 SOIL

Soil is geographically defined as "the naturally occurring unconsolidated upper layer of the ground consisting of weathered rock which supplies minerals particles, together with humus, the most common medium for plant growth". The five major factors affecting the formation of soil are: i) Climate, ii) Relief, iii) Parent materials, iv) Vegetation, and v) Time. Distinct soil type in Sikkim is found in the steep hills, deep valleys, terraces, scarps rides, cliff, and different glacial zones.

1.11.1 Classification

The soil type varies with varying altitude. According to report prepared by National Bureau of Soil Survey and land use Planning Nagpur, major soil type in Sikkim are identified as (Das, *et all*, 1996).

The geographical area of Sikkim has been categorized into five major divisions. The relationship between these physiographic units and soil are elaborated as under.

1.11.1.1 Soil of summits and ridges

The factor affecting soil on summit and ridges are climatic and angle and degree of slope. Further micro level classification has been done as per the slope. *Ridge with above 30[%] slopes*: Soils at this slope is characterized by fine loamy with loamy surface having the property of moderate erosion well

developed in deep and excessively drained areas. The total area occupied by such soil is 11435ha, which amounts to 1.61% of the total geographical area. suitable crop cultivation includes paddy, maize etc. However, major portion of the area is pre-dominantly covered by forest. Soil acidity and erosion are the two major problems associated with such soils.

- A. Ridges with 15 30[%] Slopes: Soils are drained deep with loamy surface. Rich in humus such soils are acidic in nature. They are classified as Hapludolls and Umbric Dystrochrepts. The total area covered by this soil is 15388 ha amounting to 2.17% of the total geographical area. Paddy and millet are the suitable crops in this type of soil. Major problems associated with such soil include erosion and surface stoniness.
- B. Ridges with below 15[%] Slope: Well-drained soil with deep and fine loamy surface with the property of moderate erosion falls within this slope. Soil profile development is slight and hence classified as Cumulic Haplumbrepts and Pachic Haplumbrepts. Total area under such soil is 1974 ha, which spread over 0.28% of total area. Temperate forest is common and paddy cultivation occurs in such areas. Soil erosion is the main problem of this zone.

1.11.1.2 Soils on side slopes and hills

Such soils are well developed along the slope of a hilly terrain. Formation of soil on side slopes is greatly influenced by steepness of slopes. Most of the area remains under perpetual snow covered and snowfall is common. Temperature varies from 7.8°C – 17°C and rainfall varies from 821mm at Thangu to 1652mm at Lachen in North Sikkim. The other slopes receive 2197mm rainfall at Damthang and 3494.5mm rainfall at Gangtok.

1.11.1.3 Soils on valleys

Common in moderately steep slope ranging between 15-30%, slope, characterised by mild summer and cold winter in the northern region. Annual rainfall received at Rangpo station is 2500mm.

Further classifications of valley soils are as under:

a-*Thermic soil temperature regime*: Mainly found along the bank of river Tista, the soil is acidic and rich in humus. Total of 0.77% of area is covered by this soil covering total geographical land of 5448 ha.

b-Mesic soil temperature regime: Along the bank of river Tista and its tributaries in northern part, it covers the geographical area of 3225 ha. occupying 0.45% of the total land area.

Soil Degradation	Degree	of degradation	'000 Ha)	Total
Туре	Moderate	Strong	Extreme	Area (%)
Water Erosion				
Loss of top soil	151.7	81.6	12.3	245.6
	(21.4).	(11.5).	(1.7).	(34.6).
Terrain deformation		7.7		7.7
		(1.1).		(1.1).
Total area	151.7	89.3	12.3	253.3
	(21.4).	(12.6).	(1.7).	(35.7).
Stable Terrain				
Under natural conditions				196.1
				(27.6).
Rock-outcrops and cliff				81.6
				(11.5).
Land with no degradation problems				88.2
				(12.4).
Misc. area (Ice cap)				90.4
				(12.7).

TABLE 1.10: STATUS OF SOIL DEGRADATION

Source-Das, Sarkar, Sehgal 1998 (bracket figures indicate values in percentage)

1.11.1.4 Soil on cliffs and precipitous slopes

Such soils are classified into two types

a-*Thermic soil temperature regime*. It covers an area of 16692 ha. and shares over 2.35% of total geographical area. Land under this soil is permanently left fallow.

b-Mesic soil temperature regime. It is mainly confined to periglacial region of North Sikkim. It covers an area of 69874 ha. and spread over 9.85% total area.

1.11.1.5 Soils on glacial drifts/moraines/stones

These soils cover an area of 25468 ha. and share 3.59% of total geographical area. Soil comprises of maraines and boulders. Forest with luxuriant vegetative growth is common. (Das *et all*, 1996)

1.11.2 Severity of degradation

The severity of degradation is expressed by the combination of the degree and relative extent of the type of degradation process. There are (Table 1.10 & 1.11) low, medium, high and very high severity class of soil degradation in Sikkim occupying 14.2, 7.5, and 162.9, 69.6 thousand hectare of area respectively.

Soil Degradation	Severity class(in '000 Ha)				Total
Туре	Low	Medium	High	Very High	area (%)
Water erosion	14.2	7.5	162.9	61.0	245.6
	(2.0),	(1.1).	(22.9).	(8.6).	().34.6
Terrain deformation				7.7	7.7
				(1.1).	(1.1).
Total area	14.2	7.5	162.9	69.6	253.3
	(2.0).	(1.1).	(22.9).	(9,7).	(35.7).

TABLE 1.11: STATUS AND SERVERITY OF SOIL DEGRADATION

Source: Das, Sarkar, Sehgal 1998 (Figure in bracket indicate percentage)

CONCLUSION

Historically, state is as old as 1642, when first ever Phuntsog Namgyal was consecrated as King to rule over Sikkim. After it became Indian state, real developmental activities were carried out at a faster rate. The Himalayan state is endowed by mountains, lakes, ranges, caves, passes, rivers, glaciers, with diverse climate, vegetation and soil. The beauty of Sikkim Himalayas lies in high altitude eco-fragile geographical regions. Owing to tourist visit in such fragile areas, mountain eco system seems to have been damaged to a great extent. The lakes are the source of water used in domestic purpose human interferences and animal grazing is rampant. Lakes are transformed into recreation and water sports. Cementisation and concretisation process is

Historical and Geographical background

growing in the name of infrastructure development. Concrete footpaths surround the Khecheopalri Lake as a result of lakes drying up slowly. Water table is lowering and lakes are drying up imperceptibly. Broadly, lakes are under constant threat and environment degradation is perceptible to common man. The rapid growth of tourism in lake area has further threatened the ecological base of the State.

The relief, climate, vegetation, soil and other geographic features such as cave, pass, glaciers and hot springs are the major places of tourist interest. It can be summarized that all the resources are tourism products in Sikkim Himalayas. Hence development of such region needs proper planning and management.

This chapter will help the reader to analyze various geographical and historical facts of the study area. The next chapter will throw light on how people strike balance with nature and what are the diverse economic activities performed in such condition.

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