

**GEOGRAPHY AND DEVELOPMENT  
OF HILL AREAS**

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The book relates to the unique geography of the unique land-segment of India, represented by Arunachal Pradesh or the Land of Rising Sun. Arunachal Pradesh is a State which has been least explored and exposed. Its geography has remained least comprehended. Its potentials and plan projects have, accordingly, remained least recognised and ill-effectively executed.

The present book represents a modest attempt to fill the void felt in academic and planning circles. The contents of the book provide a geographic comprehension of Arunachal Pradesh on the one hand and expose its potentials and weaknesses confronting the developmental prospects on the other. The book has been designed and the subject matter has been so discussed that it may attract not only specialists, the students, the professorate, the policy makers, and the planners but also all those who keenly look forward to know the land and people of this extraordinarily beautiful state of India.

Rs. 170

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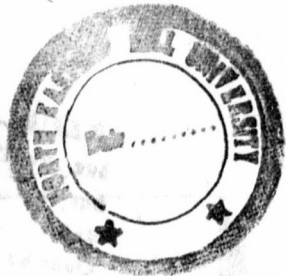
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# GEOGRAPHY AND DEVELOPMENT OF HILL AREAS

(A Case Study of Arunachal Pradesh)



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To  
**Poonam Bharati**  
 &  
**Shashi Shukla**

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## PREFACE

The Earth happens to have simultaneously the global composite and segmented geography. The composite geography of the Earth reflects the wholeness of the features of the elements composing the physical and cultural landscapes. The segmented geography signifies the distinctiveness of the elements of physico-economic and socio-cultural environment at lower areal scale. The idea of segmented geography is related to the concept of regional classification of the earth's surface on the basis of the distinct conditions of homogeneity with reference to territorial limit. The segmented parts of the earth are defined to represent geographic regions. Each region inherit and develop a distinct geography of its own. The purpose of regional geography has been to acquaint with the nature and pattern of distribution of the physical, economic and socio-cultural elements. We find a good discourse of regional geography for many parts of the globe. We have, however, still some parts of the earth's surface which lack discourse on their internal geography. Arunachal Pradesh conforms to represent such a region. The age long locational isolation of the area and seclusion of the inhabitants of the area have kept its geography contained within.

The objective of the present book has been two-fold. It is to provide a discourse on the general geography of Arunachal Pradesh and it is next to prepare an analytical frame for the geographic elements of the region. In other words the book attempts to create an awareness of the geographic qualities of the region on the one hand and to inculcate the geographic comprehension on the other. The awareness to physical, economic and socio-cultural elements help in establishing the right geographical identity of the Arunachal Pradesh. People are supposed to know the state through its identities in terms of locational, bio-physical, economic and socio-cultural distinctiveness only.

The composition of the First Part of the book including three chapters, viz. (1) Aspects of Physical Geography (2) Aspects of Economic Geography, and (3) Aspects of Socio-cultural Geography intends to explore the general geography of Arunachal Pradesh in terms of the nature and pattern of distribution of various geographic elements—natural as well as human. The inclusion of these three chapters is intended to serve the basic needs of curriculum of geography teaching both at school and college level. The contents of these chapters constitute the topical statements of the nature and pattern of distribution of essential elements of regional geography. This will serve also the purpose of general readers who might develop some urge to know the land and people of Arunachal Pradesh—primarily a geographic *terra incognita*.

Geography in its current perspectives, has, however, not remained a mere topical statements of the objects and activities on the parts of the Earth. It has emerged to hold relevance to developmental issues at all levels of economic sector and geographic area. The various elements of geography make the basic resource of development. Various processes and trends of development are inescapably tied with the geographic quality of the land. It is felt, therefore, that all developmental activities must be formulated and executed after adequate comprehension of the geographic base and scope acquired through analytical frame. It is felt more in case of Arunachal Pradesh where geographic elements dominate to deter developmental activities. Part Two containing seven chapters intends to assess the elements of ordained bio-physical environment and the spheres of sustained human activities. The analytical frame of the comprehension has been prepared in the light of the interplay of the nature and degree of bio-physical dictates and human response to such dictates—the two fundamental components of all developmental activities.

The contents of the chapters included in Part Two are intended to equip policy makers, all developmental agencies and institutions with the knowledge and comprehension of the possibilities, potentialities and propensities to grow. Only a rational analysis of the nature of resources available and stresses deterring the developmental activities is expected to sustain the tempo and pace and direction of development already initiated in Arunachal Pradesh.

The book is intended, therefore, to be a reference volume for all those concerned with ushering a new phase of transformation in the region.

The book is thus supposed to meet the need of academic exercises and practical plan formulation for Arunachal Pradesh. We wish the book to be a part of developmental activities in the region.

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## CHAPTER ONE

# ASPECTS OF PHYSICAL GEOGRAPHY

Physical elements form the reference point of all kinds of regional knowledge. The characteristic features of all such elements combine to compose the physical geography of a particular appreciably large area. The quality of unison to produce some degree of homogeneity spatial perspective to earn distinction within and to differentiate a region from another one. It appears, naturally therefore, imperative to comprehend the geography of a region first in terms of the nature and the extent of various physical elements providing distinctive and lasting look to the region. The natural elements of physical geography of any region include commonly, apart from rational issues, the nature of geo-structural make-up geomorphological surfaces, climatic situations, vegetal cover and soil formation to constitute the terranean, sub-terra-  
nean, aerial and vegetal environment of the region.

Arunachal Pradesh adorns a distinct physical geography of its own. It has remained, however, basically one of the least explored parts of India. Geographical studies of Arunachal Pradesh as a separate geographical division have consequentially have miserably lacked so far. A beginning is thought imperative and an attempt follows.

### Geographic Identification

The territory of Arunachal Pradesh is identified in terms of its geographic location, regional location, shape and size over the map of India. By geographic location we mean the extent bounds with reference to latitudes and longitudes. Arunachal Pradesh extends geographically between 26°30' N and 29°30' N Latitudes and between 91°30' E and 97°30' E longitudes. This decides its site within the limit of three degrees of latitudinal and six degrees of longitudinal spread. Within its geographic bounds Arunachal Pradesh happens to be overbound by virtue of its shape. It ac-

quires for the most part the normal geometric shape of a rectangle with a SW-NE layout but for the south-east tract tugged to deform its shape.

By regional location we mean the relative position of ground coverage with reference to contiguous territorial tracts with which boundaries of the particular area coincide. Arunachal Pradesh delineates a perfectly land-locked territory. Its approximately exceeding 2500 km long boundaries coincide with the international borders in the west of Bhutan, in the north of Tibet, in the north-east of Sinkiang China and in the east of Burma, and the Indian state borders in the south-east of Nagaland and in the south of Assam. Regionally it lies to form the north-eastern section of India can be approached by N.F. Railway section running almost parallel with its southern boundary. Marmuti is the nearest railway station to provide access to the capital town Itanagar. Murkongse-lak is the easternmost railway station to provide access to another major town Pasighat. Besides these two Shilapather railway station in between provides approach to another important town Along to serve inter-regional links of Arunachal Pradesh. The accessibility within is served by point to point links of major places usually district headquarters. Arunachal Pradesh finds, therefore, its opening into Assam valley for approachability. The geographical territory of Arunachal Pradesh covers an area of about 8.4 square Km which comes to be about 2.5 percent share of the total area of Indian territory to which it has its parentage.

### **Geology and Structure**

Geo-structural characteristics make the build of ground. The land is formed by geological formations and structural trends, the regional geological and structural history at larger regional scale. The geo-structural make-up of Arunachal Pradesh can be correlated with the geological history mainly of the Himalayas and of the Patkai. For simple comprehension it is supposed that the part of Eastern Himalayas—almost whole of Arunachal Pradesh except the district of Tirap—is formed of tertiary alluviums with occasional Archean basement. The part of the Patkai coinciding with Tirap district has the surface build of Disang, Baruil, Tipam and Dihing series of tertiary sediments.

The almost *terra incognita* part of the land particularly with respect to geological and geographical knowledge, Arunachal

Pradesh has failed to expose its specific geological and structural features. The characteristics of its geology and structure may, however, be understood with reference to Himalayan geology. Arunachal Pradesh has been mapped to reveal its geo-structural characters in part. The known features may be correlated with four major general geo-structural units as proposed by A. Gansser in his study of Geology of Himalaya.

1. *The Sub-Himalaya Unit*: This is represented by the southernmost frontier zone. This zone has the geological formations of Tertiary period. It has the presence of recent alluvium, older alluvium and traces of siwalik deposits.
2. *The Lower Himalaya Unit*: The formations of this unit include sedentary and metamorphic rocks belonging to Mesozoic and Palaeozoic ages. Rocks of Miri formation, Genwana formation and Bomdila formation with Abor volcanoes etc. are found mainly between well recognized the main Boundary fault and the main central Thrust.
3. *The Higher Himalaya Unit*: This lies to the Main Central Thrust. The land here consists of the crystalline thrust sheet in the basement.
4. *The Higher Himalaya Unit*: This part is formed by the crystalline thrust. The crystalline basement is, however, covered by the tethys sediments.

The geological formations belong, therefore, to both younger and older ages. The geological formations of Arunachal Pradesh have marked generalised characteristics of SW-NE structural trend. Forming a part of Himalayan orogeny the geo-structural build has made whole Arunachal Pradesh prone to occasional or even frequent seismic activity. This phenomenon indicates that the region is continuously set to respond to the process of evolution associated with Alpine orogeny. The region awaits the events of wide geological explorations to expose the sequences of complex geological formations ranging from younger to older ages and the ground lie out composed to simple anticlinal and synclinal structures and complex fault, thrust and everthrust as well.

### *Relief*

The relief of a region shapes the form of its land. The build of the land determines the relief of an area. Arunachal Pradesh

possesses a young and conspicuous relief forming the part of the great physiographic division of the Himalaya. Arunachal Pradesh signifies essentially a mountain topography at large. It corresponds to identify the physical division of Eastern Himalaya and the part of the Arunachal. Relief variations are, however, observed all along the physical span of the territory. Such variations create the geographic forms of the region. These variations find expression in the presence of the sequences of mountain ranges along with occurrences of low hills, high mountains, intermontane plateaus and basins.

Arunachal Pradesh presents an intricate and inhospitable surface. The general relief has the instances of a range variation of elevation between a few hundred metres and above 7000 metres. It has, thus, the occurrence of foothill topography on the one hand and the lofty mountain topography on the other. Any authentic scheme of physical division of Arunachal Pradesh on the basis of relief is still lacking. This is due to imperfect and inadequate geo-structural mapping of the area. Attempts have been made to divide the part of the Eastern Himalaya by some geologists. One of such attempts has divided the region adopting nomenclature associated with the tribes inhabiting the sub-area.

1. *The Aka Hills*: This section lies between the Dhansiri and the Dikrai rivers.
2. *The Daphla Hills*: This section lies between the Bhaineli on the west and the Rangunad on the east.
3. *The Miri Hills*: This section lies to the north of the Lakhimpur district of Assam.
4. *The Abor Hills*: This section lies between the Siom on the west and the Dibang on the east.
5. *The Mishmi Hills*: This section lies between the Dibang and the Dihang.

This five-fold division does not, however, reflect any physiographic comprehension. The physiographic divisions of Arunachal Pradesh has also been tried in terms of the well recognised three-fold divisions of Himalayan ranges. Accordingly the surface of Arunachal Pradesh has been physically divided to comprise of:

1. *The Siwalik and the Foothills*: This physical division coincides with the sub-Himalayan geo-structural unit lying in

the Southern frontier strip of Arunachal Pradesh. The zone is narrow in the west and gradually opens wider in the east. It may be delineated by 200 metre contour. The 200 metre contour tends to run along latitudinal valley along Southern border and to project northward along longitudinal valleys of Simen, Kameng, Subansiri, Siang and Dibang. This area presents relatively flat topography and gradually descends down to merge with the northern section of Brahmaputra valley in Assam.

2. *The Lesser Himalayas:* The Siwaliks attain sudden rise from the plains and merges into lesser Himalayas range northward. The Sub-Himalayan section in Arunachal Pradesh is comparatively lower in altitude than in other areas. Narrow sections of surfaces having elevation between 200 metres and 800 metres may be found along river valleys.
3. *The Great Himalayas:* This physical division dominates the surface configuration of Arunachal Pradesh. Even a very generalised portrayal of physical map of the area will exhibit the astonishing number of ridges and mountain peaks. Mountain ridges appear to extend inward from the northern border like snake's body. Mountain peaks reaching an elevation of above 6000 metres are not uncommon. Gorichen (7300 metres), Kangto (7090 metres), Namcha Barwa (7756 metres), Kulangri (7544 metres), Chomo Lhari (7344 metres) and others are some of the many conspicuous mountain peaks of great elevations.

The physical characteristics of the eastern Arunachal Pradesh and of Southeast Patkai section are featured by relief ranging between 2000 metres and 5000 metres. The mountainous and hilly surface characteristics are occasionally intercepted by locations of intermontane plateau and basins. The Apatani plateau and the Taroan basin forms specific examples. The Taroan basin is the largest basin and is surrounded by high mountain ranges with elevations between 3000 metres and 5000 metres. The Mishmi Hills section contains lofty ranges of the Purvanchal and encloses many basins. The general physical form of Arunachal Pradesh is dominated by hills and mountains with associated features the presence of ridges,

peaks, intermontane plateaus, basins and steep slope gradients.

### *Drainage*

Drainage forms a major physiographic element of a region. It refers to the pattern of rivers and streams which constitutes the surface run-off. Arunachal Pradesh has proved a natural home for the development of dense drainage system. A large number of major rivers along with their numerous tributaries drain the region. Major rivers and their tributaries are interposed between defined mountain ridge. In general major rivers form dendritic drainage pattern with trunk in the south and branching tributaries in the north, particularly in case of mainland of Eastern Himalaya section. In southeastern section of Purvanchal major rivers open their mouths in the west and in Tirap district the dendritic nature of drainage pattern becomes less obvious.

Drainage system of Arunachal Pradesh forms a part of larger Brahmaputra River system. Major rivers have so much of dominant physiographic stay that most of the districts of Arunachal Pradesh have been named after the major river draining the particular area. Brief introduction of major river systems of the region seems reasonable.

1. *The Siang River System:* River Siang constitutes the part of River Brahmaputra. It provides entry of Tsangpo—the source flow line of Brahmaputra in Tibet having its origin at Tamchok Khambab Chorten in the Chemayungdung glacier. It enters the northern border of Arunachal Pradesh near Namcha Barwa mountain peak (7755 metres). It flows southward through the full length span of old Siang District. Shimang, Yamne, Siku, Sibia, Ringong, Sigang, Nidyang and Siyum are the major tributaries of the River Siang. The river Siang drains out ultimately into the River Brahmaputra in Assam. The river Diahang, as the River Siang is known by other name has a capacity of flow discharge of about 200000 cubic metres of water.
2. *The Dibang River System:* The Dibang River system drains the territorial confines of Dibang district—the part of the Eastern Himalayas east of Dibang River system. The drainage pattern of the Dibang River system resembles perfectly with elendritic pattern. The almost north-south

flowing Dibang receive a number of important tributaries from west and east having north-east and north-east flow directions. Yangyapchu, Andra, Elan, Ahi from the West and Dri, Tangan, Ithun etc. from the east are major tributaries. River Dibang is considered to discharge some 628000 cubic metres of water to the Brahmaputra.

3. *The Subansiri River System:* The identity of Subansiri district is associated with the River Subansiri. The dendritic nature of drainage pattern is not so densely developed in case of the Subansiri River system as in case of the Dihang and the Dibang. River Subansiri receives tributaries both from the north and south of the main Himalayan Range. Tsari Chu, Yu Me Chu, Siken, Sinyum, Syee are important tributaries. The main river separates the Abor Hills from the Miri Hills. It is supposed to have a long course in the Himalayan and flows through a series of gorges and rapids. The Siyum forms the major course of the River Subansiri which is joined by another important tributary the Karela in its lower reaches.
4. *The Kameng River System:* The Kameng River system drains the land of Kameng district in the western part of Arunachal Pradesh. Flowing from the north it is joined by the river Bicham at Palazi where the main river descends down southward after a westerly flow and follows again a course of westward flow to enter the plain of Assam with southeastward bend to drain out into the Brahmaputra. It discharges some 25900 cubic metres of water to the Brahmaputra. Bicham has major tributaries in Dakhri Bru Bishumchu and Diyang Nala. Yenga River is also an important tributary of Bicham.
5. *The Naming River System:* In the extreme northwest part of Arunachal Pradesh the River Tawang flows from north-east to southwest direction. In its lower reaches another tributary Nyamjangchu joins it from the north. This river as also the Kameng has not developed so dense dendritic pattern of drainage as in case of River Siang and the Dibang in the eastern section of the Eastern Himalayan part of Arunachal Pradesh.
6. *The Lohit River System:* The River Lohit differs in its flow

direction and location. This forms the part of the physiographic character of the Purvanchal. The River Lohit drains the area between Assam and Burma. It has a water discharge capacity of about 60,000 cubic metres. It joins the Noa Dihing flowing through the northern section of Tirap district and taking a northward turn to enter Lohit district near Jaipur in Assam plain to follow the main course of the Brahmaputra. Namdapha joins Noa Dihing from north. Namphuk River in Tirap district flows almost parallel to Noa Dihing or Diyum. Hetzu, Digaru, Tidding are important tributaries of the Lohit. In its middle and upper reaches the River Lohit is respectively known as Tellu and Krawnaan.

7. *The Tirap River System:* Having its origin in southwest border section of Tirap district the River Tirap flows northeast to meet Burhi Dihing in the Assam plain. Parallel to Tirap flows the course of the Namchik River.
8. *The Tisa River System:* In the western part of Tirap district the River Tisa forms a distinct river system. It originates in Southern part and flows directly northward to join Disan River in the Assam plain. It has Tishing and Tawai as its major tributaries at western flanks.

There are, however, some of the broadly generalised river systems of Arunachal Pradesh. Any attempt to develop precise river regimes will add many more systems at mesa and micro regional levels. The general impressions about the drainage system of Arunachal Pradesh reveal that the eastern block of the main Eastern Himalayan section of the state has developed moores pronouncedly the denser dendritic pattern of drainage system with tendency to perfect north-south flow of major rivers. The western block of the Eastern Himalayan section and the southeasterly part of Arunachal section have in contrast tendency of east-west flow and development of less denser pattern of dendritic drainage, rivers are perennial in nature.

### **Climate**

Climate conforms to be a very significant element of physical geography of any region. It denotes an average composite condi-

tion produced by the effects of various meteorological elements like, temperature, humidity, rainfall, wind and atmospheric phenomena of cloudiness, thunders, hails, duststorm, squall, fog and frost. These elements directly affect the life and activities of the inhabitants of a region.

Climate of Arunachal Pradesh may be comprehended through the knowledge of the division of the year into four major seasons.

1. *The Pre-Monsoon Season:* This season spreads over the time duration between March and May. The chief characteristics of the season are noticed in the events of frequent cloud cover, thunderstorms and heavy downpour. More than 10 percent of the total year's rainfall is received during this season.
2. *The Southwest Monsoon Season:* The periodic stay of this season is between June and September. The season is characterised by rain, water, clouds, thunderstorms, lightning and other phenomenon of rainy season. The season produces hot, humid and wet climatic conditions. July is supposed to be the month of heaviest rain. Arunachal Pradesh receives normally above 70 percent of its annual rainfall during this season.
3. *The Post-Monsoon Season:* October and November are supposed climatically to be transitional seasons. Climatic conditions start shifting from rainy abundance to cold severity. This rejuvenates the whole biotic setup of the region and the occupational activities take motion.
4. *The Winter Season:* This marks the prevalence of cold conditions in Arunachal Pradesh. Temperature drops down to about 10°C in the plains and even to below 0°C at higher altitudes. Katabatic winds storm the places at valley openings. Temperature is occasionally brought down to 5°C even in plains on account of cyclonic rains associated with severe cold.

The knowledge of rainfall behaviour in terms of amount and periodic distribution is considered the best reflection of the climate of a geographic region. Rainfall is basically the outcome of composite influence of temperature, humidity and wind.

Table 1.1 gives an idea of the extent and monthly distribution of rainfall at subregional scales.

TABLE - 1.1

## Temporal and Spatial distribution of rainfall (in cm.)

Months	Kameng E + W + Tawang	Subansiri U + L	Siang E + W	Lohit + Dibang	Tirap + Changlang
	(1)	(2)	(3)	(4)	(5)
January	3.26	5.69	7.86	5.48	5.64
February	3.01	8.32	14.38	19.19	18.00
March	2.15	9.74	18.41	31.29	20.96
April	6.73	11.73	21.97	43.79	23.55
May	14.28	30.81	39.93	44.43	36.39
June	31.90	29.63	59.50	36.15	48.76
July	26.08	43.44	73.56	39.87	56.87
August	20.10	27.04	40.86	17.95	46.13
September	17.29	28.29	77.05	24.44	31.95
October	12.39	12.50	8.79	17.40	11.80
November	1.42	1.89	2.59	0.65	1.71
December	Nil	0.08	0.10	Nil	Nil
Total	138.61	209.16	374.97	280.55	301.46

The knowledge of the consistency of rainfall becomes another important issue of climatic study. This can be obtained by a record of annual average rainfall during a past few years in terms of spatial distribution. Arunachal Pradesh presents a good deal of consistency in this regard. This becomes obvious from the Table 1.2.

The composite effects of meteorological elements determine the climatic comfort scale at sub-regional level. Climatic conditions may be equable and extremes with respect to comfort or discomfort felt under the situations produced by the nature and extent of meteorological elements. Attempts have been made to divide climate of a region in terms of prevalent situations in spatial frame. Arunachal Pradesh may be divided into major climatic zones of:

(i) *The Hot-Humid Sub-Tropical Climatic Zone*

This zone constitutes the southern plains of foothills. It pro-

TABLE 1.2  
Tempo-spatial Distribution of Average Rainfall in cm

Districts	1976	1977	1978	1979	1980	1981	1982	1983
West Kameng	80.0	84.5	90.5	92.5	84.5	96.0	78.27	86.03
East Kameng	179.5	233.5	179.0	372.5	478.5	377.43	N.A.	N.A.
Lower Subansiri	209.4	202.3	171.6	187.6	366.5	223.6	249.12	N.A.
Upper Subansiri	159.0	118.0	179.5	123.0	190.7	143.5	N.A.	N.A.
West Siang	255.5	334.2	194.7	252.0	256.0	279.0	N.A.	N.A.
East Siang	500.0	552.0	572.0	N.A.	427.35	447.2	419.16	N.A.
Dibang Valley	321.7	418.7	N.A.	343.8	338.6	334.7	373.00	383.73
Lohit	256.7	380.3	274.0	268.9	282.6	220.6	253.69	226.05
Tirap	254.5	279.1	210.3	110.3	356.3	255.5	488.03	N.A.

vides relatively an equable climatic conditions.

(ii) *The Cooler or Micro-Thermal Climatic Zone*

This zone coincides with the areas of interior hills and mountains. Here climatic conditions show greater degree of variations. Relative fall in temperature associated with severeness of cold characterises this zone.

(iii) *The Himadri or Alpine Type Climatic Zone*

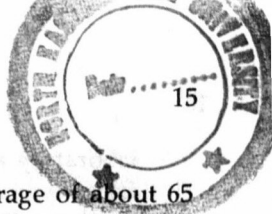
This zone is represented by mid-altitudinal to high altitudinal locations. Climatic conditions are characterised by extreme fall of temperature, perpetual snow cover and replacement of rainfall by snow at greater elevations.

Climatic zonation and the behavioural display of meteorological elements over different periods of the years have shown essential connection with the physiographic character of Arunachal Pradesh. Extreme conditions in more or less belted arrangement from south to north intend to be intensified in all the geo-structural, physical and climatic divisions.

### Vegetation

Natural vegetation in Arunachal Pradesh resembles forest cover. Forests have found natural home in Arunachal Pradesh where the physical and climatic conditions have adequate environment to sustain forest growth. The types of forest have developed indirect response with prevailing topographical and climatic situations at sub-regional levels in Arunachal Pradesh. Following types of forest have been identified:

- (1) *The Sub-Tropical Evergreen Forests:* This type of forest is found in lower reaches of the state. The occurrences of forests of this type is found at various altitudinal locations up to 900 metres and between 900 and 1800 metres. Sub-tropical trees and grass lands characterise the forest cover in this area.
- (2) *The Temperate Evergreen Forests:* Areas of mid-range altitude are occupied by forest species of this type. Altitudinal location of these forests is generally at an elevation ranging between 1800 and 3500 metres.
- (3) *The Sub-Alpine and Alpine Type of Forests:* The elevations above 3500 metres are normally covered by species of Sub-



## *Aspects of Physical Geography*

### Alpine and Alpine forest.

Forests of Arunachal Pradesh have a coverage of about 65 percent of the geographical area of the state. They are rich in species. Non-coniferous species of trees are mostly found. Coniferous species are found in a few pockets of higher elevations. Hollong, Hollock and Mekai are the most important non-coniferous species. Blue Pine, Chir, Fir, Tsuga and Kail are the coniferous species. Besides there are various medicinal plants. Minor forest resources include cane, bamboo, agarwood and mishmiteting. Forests of Arunachal Pradesh also provide suitable habitats for a variety of multi-coloured birds and wild animals. Forest resources form large potentials for development and maintenance of ecological equilibrium in the state. A beginning of forest resource utilization has been initiated and the forest management has naturally been a major issue of state.

Forests of Arunachal Pradesh fall under two classes—Reserved forests and unclassified forests. The proportion of forest coverage under the Reserved class has gone up to above 5 percent. Apart from forest areas under these classes some areas are put under protected forest. By virtue of the extent of area coverage, per capita share of forest area upto as high as more than 8 hectares. Arunachal Pradesh hold a very significant position with respect to forest economy and its contribution to the total economy of the region. Forest management has naturally become a major concern in this area. Forest department has undertaken many schemes which have been grouped under:

- (1) *Plantation and Conservation Schemes:* (a) Artificial plantation, (b) Afforestation, (c) Aided Natural Regeneration, (d) Recreation forestry, (e) Supplemental Crop Plantation, (f) Social forestry, (g) Plantation of quick growing species, (h) Cultural operation, and (i) Rehabilitation of degraded Jhumland.

- (2) *Research and Survey Schemes*

(a) *Forest Research:* Under the scheme, studies on silviculture as well as price improvement, meteorological and mensuration aspects are undertaken. The significant achievement of the scheme during last 2 years had been to undertake research work on nursery technique and development of project for seed testing, tree improvement and geneticist

laboratory facilities with a total expenditure of Rs. 33.27 lakhs.

(b) *Working Plans*: To facilitate systematic survey of existing stock of forest, field survey and stock mapping are done for preparation of working plan for future felling/working of forest in a scientific manner.

Survey and enumeration of 747 sq. km. were the main achievements during these two years with a total expenditure of Rs. 24.51 lakhs.

(c) *Resource Survey*: Survey of forest resources in a scientific manner for preparation of various project reports for the industries comes under the purview of the scheme. During 1984-85 and 1985-86 a total of 500 sq. km. of forest areas were surveyed with an expenditure of Rs. 11.67 lakhs.

(d) *Forest Consolidation*: Under the scheme, demarcation of 269 km. boundary and fireline cutting of 445 km. mainly along the RS areas as consolidation measures were undertaken during 1984-86 with an expenditure of Rs. 6.83 lakhs.

#### *Mechanised Logging and Marketing of Timber including Departmentalisation of Timber Operation*

The scheme envisages marking of mature trees for extraction and layout of timber coupes and marketing of timber including supply of Railway sleeper and timber to Railways and other agencies. The following achievements were made during last 2 years with financial implication of Rs. 37.69 lakhs.

(i)	Marking of Timber	2303 Lakh cum
(ii)	Purchase of Jeep	2 Nos.
(iii)	Purchase of motor cycle	14 Nos.
(iv)	Construction of check gates	40 Nos.
(v)	Estt of Timber Depot	35 Nos.

As already indicated, extension of activities of the forest department towards management of Arunachal Reserve Forests and placement of 848.34 sq. km. of reserved forest and village forests under the Arunachal Pradesh Forest Corporation for intensification of management on commercial footing are the recent ventures. Achievements made under "Govt's management of ARF and corporations management of some Reserved Forest" during 1984-85 and 1985-86 are given below:

(i) *Anchal Reserve Forests*: As a follow-up measure towards implementation of the "Anchal Reserve Forests Act" a total of 256.08 sq. km. were brought under the management of Anchal Reserve Forests upto the end of 1985-86.

(ii) *Forest Corporation*: During 1984-85 and 1985-86 a total of Rs. 100 lakhs was paid by the Govt. to the Forest Corporation towards equity share. Earlier Rs. 170 lakhs have been provided to the corporation which took up management of 700.92 sq. km. reserved forest and 147.42 sq. km. of village forest in Tirap District for intensive management of the area. Besides exploitation of timber and its sales on commercial footing, the corporation raised plantation and undertook construction of roads and building and allied plantation oriented works. The significant achievement of the Arunachal Pradesh Forest Corporation during 1984-85 and 1985-86 are briefly as under:

(a) Raising of artificial plantation	242 hectares
(b) Aided natural regeneration	2065.5 hectares
(c) Construction of road	23.185 km.
(d) Total expenditure on road	Rs. 4.63 lakhs
(e) Total expenditure on plantation	Rs. 47.22 lakhs
(f) Total expenditure on buildings	Rs. 10.22 lakhs
(g) Revenue from major forest products	Rs. 207.55 lakhs
(h) Revenue from minor forest products	Rs. 21.29 lakhs

In the field of cash crop production, the Corporation raised plantation of the following species upto the end of 1985-86:

(a) Coffee Plantation	502.40 hectares
(b) Cardamom Plantation	134.65 hectares
(c) Tea Plantation	113.10 hectares

The Corporation has already started harvesting of appreciable quantity of both coffee and tea during the recent years. The annual output of both coffee and tea is now around 600 quintals and 3000 quintals respectively.

Achievements made under "Intensification of direction, administration and training oriented" schemes are highlighted below:-

*Direction and Administration*: Under the scheme, a total expenditure of Rs. 24.05 lakhs was incurred mainly towards payment of salary during 1984-85 to 1985-86 to facilitate smooth functioning of

the Department.

*Education and Training:* The scheme aims at imparting training to the employees for improvement of efficiency. During last two years a total expenditure of Rs. 5.79 lakhs was incurred for imparting training to 230 trainees in the departmental Forest Training School and also towards sponsoring of 17 selected trainees to different institutions.

A wing of the forestry management is dedicated to wildlife conservation in the Union Territory. As already indicated, the coverage of this wing had multiplied during the recent years and the achievement made under these schemes are as follows:

#### *Conservation of Wildlife*

The objective of the scheme is to preserve the rich heritage of the Union Territory and to emphasise preservation of fauna, the wildlife, in the Union Territory. The scheme also envisages constitution and development of wildlife sanctuaries and National Parks in the Union Territory. The following achievements were made upto the end of 1984-85 and 1985-86 under the scheme.

	Accounting unit	Position at the end of	
		1984-85	1985-86
(i) Establishment of Wildlife Sanctuary	Nos.	4	4
(ii) Establishment of National Parks	Nos.	1	1
(iii) Zoological Park & Mini Zoos	Nos.	5	5
(iv) Watch Tower	Nos.	9	11
(v) Hornbill house	Nos.	2	2
(vi) Tourist House	Nos.	1	1
(vii) Area covered under (i) & (ii) above	sq. km.	3281.57	3281.57

Achievements made during 1984-85 and 1985-86 under "Infrastructure Development" oriented schemes are given as under:

*Forest Communication:* Communication is the life line of any developmental process. Forest roads constructed so far mainly cover the foothill area. More forest roads are necessary to make head way for exploitation and management of forest in the inaccessible areas. During the last two years a total of 8.19 km. forest road was

constructed and a total length of 46 km. was improved with a total expenditure of Rs. 26.69 lakhs. Latest reconciled figures reveal that a net length of 1022.99 km. forest road exists at the end of 1985-86.

*Building:* Under the scheme 182 numbers of buildings, both residential and non-residential, were constructed to facilitate provision of residential accommodation to the employees and for non-residential accommodation during last 2 years. In earlier years 1550 buildings of all specifications were constructed by the department. The extent of expenditure made during 1984-85 and 1985-86 under the scheme was Rs. 137.86 lakhs.

The department implemented as many as four "Centrally sponsored schemes" during 1984-85 and 1985-86. Schemewise details are given as under:

*Social Forestry including Fuel Wood Plantation:* Under this scheme raising of a total of 3247 hectares plantation as well as free distribution of 3.75 lakh seedlings to the villagers from 1979-80 to the end of 1985-86 may be attributed as the main achievement. The total financial implication is Rs. 65.74 lakh during the entire period.

*Operation Soilwatch:* Since 1979-80 and upto the end of 1985-86 a total of 1349 hectares of afforestation and 383 hectares of Terracing were done with a total expenditure of Rs. 65.37 lakhs.

*Pilot Project on Control of Shifting Cultivation:* Preceded by a project with an outlay of Rs. 10.70 lakhs to develop 200 hectares of land for permanent settlement of 100 local families, another new project was launched during 1985-86 covering an area of 20 hectares with a total expenditure of Rs. 0.86 lakhs.

*Project Tiger, Namdhapa:* Under this scheme a total expenditure of Rs. 57.13 lakhs was incurred from 1983-84 to 1985-86 to develop the Namdhapa National Park.

The above schemes are 100 percent Centrally sponsored.

During these two years the Forest Department as well as the Forest Corporation incurred expenditure on the following three most important fields of activities towards development of infrastructure and raising of plantation.

(Figures in Rs. Lakhs)

Activities	Forest Department		Forest Corporation	
	1984-85	1985-86	1984-85	1985-86
(a) Road	8.85	17.84	2.24	2.39
(b) Building	59.34	78.52	1.74	8.48
(c) Plantation, afforestation and allied works	182.98	156.78	24.51	22.71
Total	261.17	253.14	28.49	33.58

The above figures if compared with the total two years' plan expenditure figures of Rs. 837.54 lakhs of the Forest Department reveal that while, on an average 19.65 percent of total plan expenditure was incurred towards development of infrastructure 40.57 percent was invested towards raising of plantation alone by the Department. The Forest Department alone invested 60.21 percent of its total plan expenditure against the above three important aspects. Expenditure incurred by the Forest Corporation towards development of these aspects may be attributed to additional contribution to forestry development.

Following statistics provide a visual impression of the spatial distribution of forests in Arunachal Pradesh (Table 1.3).

It is, however, not only the physical coverage of forests that held significance but also its economic utilization making it an element of economic geography.

### Soils

Soils form a very important physical element for all practical purposes. It is not easy to know the types of soils of Arunachal Pradesh with reference to well established soil types or classes. The difficult terrain and drainage have deterred any such attempt. A generalised comprehension of the nature of soils may be obtained in terms of their altitudinal locational classification. A three-fold classification is accepted convenient.

- (1) *Soils of the Hills*: These soils are deficient in organic content.
- (2) *Soils in the valleys and the Mid Altitudinal sections*:

These soils are relatively rich in organic contents are occasionally represented by clayey alluvinous.

TABLE 1.3  
Spatial Distribution of Forest Area, 1983-84 (Area in sq. km.)

Districts	Total forest area	Reserve forest area	Anchal Forest Area	Protected Forest Area	Others/State forests	Remarks
West Kameng	7000	2091.08	4.56	6.75	4035.66	Forest Area figures except those of Reserve forests and protected forests are provisional in absence of final survey.
East Kameng	-	851.95	-	-	-	
Lower Subansiri	10200	1634.87	-	-	8565.13	
Upper Subansiri	-	-	-	-	-	
West Siang	16000	238.28	-	-	15370.43	
East Siang	-	391.29	-	-	-	
Dibang valley	15140	797.46	-	-	10294.03	
Lohit	-	3935.17	113.34	-	-	
Tirap	3200	2656.16	133.18	1.04	409.62	
Total	51540	12606.26	251.08	7.79	38674.87	

- (3) *Soils of Foothills:* Diluvial loams and sandy loams are represented best in foothill sections of Arunachal Pradesh. The textural quality of soils of foothills conforms of with sedimentary surface because they have been brought down from mid and high altitudinal sections of the region.
- (4) *Jhum Land Soils:* Associated mainly with man's activity somewhat altogether different type of soils are found in areas of Jhuming. This shows degradation of quality.

The quality of soils and qualitative changes in sub-regional perspective are connected with the parent materials and the processes involved in the formation of soils. The occurrences of high rainfall and heavy surface run-off have caused the formation of high acidic soils in Arunachal Pradesh in general. Heterogeneity of basic rocks and sedimentary formation of soils have produced great variation in terms of the nature and composition of soils found even within some general class. It is, however, the nature of parent materials and the mechanico-chemical processes that determine the nature of soils in spatial location context. Arunachal Pradesh is obviously least studied and comprehensive survey work is needed to know the soil type classes.

A comprehension of different physical elements constituting the physical geography of Arunachal Pradesh has been considered to form key to its geographic study as a whole. The physical geography has inescapable influence over the economic and socio-cultural geography of the region. It will be observed that the aspects of other geography have to respond to physical elements without fail.

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- **Kashmir: Ecology and Environment**—S. K. Chadha (Ed.), Rs. 170
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