

Geoeecology of Kameng Himalaya

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Zahid Husain

What else could be a tribute to the UN '*International Year of Mountains 2002*' than a book on the environment and people of a part of the Great Himalaya Mountain. This book pertains to identification of vertical belts and assessment of ecosystem potentiality of Kameng Himalaya and analysis of the human response to it through the detailed studies of three villages—Yangse, Chhug and Senge Dzong located at 600 m, 1800 m, and 3000 m altitude, respectively. It deals with the shifting cultivation, settled cultivation, animal husbandry agropastoralism, transhumance, horticulture, hunting, gathering and fishing practised by the *adivasis*. The agricultural calendar, nutrition and health, trends of change etc. are also dealt with. Transhumance has been reported for the first time from this part of the Himalaya. Significantly it analyses the problems and prospects of change from shifting to settled cultivation and overall development of the mountain ecosystem keeping its pragmatic and aesthetic values in mind.

Presence of altitudinality is easily discernible through the geoecological controls on man, plants and animals in the study area and it shows that altitude is an impetus rather than impediment in the mountain development. The altitude of 2800 m seems to be the upper limit of the viable agriculture, and that of 1600 m for the wet rice cultivation. The inter-belt transfer of matter and energy, symbiotic exchange of products between the agriculturists and pastoralists, reciprocity, team work, role of socio-economic and political organisations and village council in the control and regulation of natural resources, division of work by age and sex are some of the strategies devised to get maximum results of their efforts made towards human adaptation to the mountain environment. For future development and management of environment the indigenous technology and strategy with 'modern' blend has to continue to maintain ecological balance. To achieve this the practise of 'no-tillage', 'hoe-culture', intensification of agriculture in the flat valley lands and utilisation of more than one belt is the only solution. These topics would definitely generate interest among the geographers, ecologists, anthropologists, social scientists, planners and technocrats in this book.

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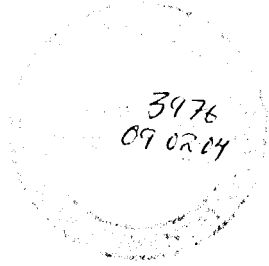
GEOECOLOGY OF KAMENG HIMALAYA

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CHAPTER ONE

Introduction

The earth is endowed with different types of environments, and the human beings are spread in almost all of them. The congenial environments have obviously attracted a large number of human populations. Whereas human population is thinly distributed in the uncongenial environments like—the hot and cold deserts, mountainous terrain and dense forests. Human life pursued in these uncongenial environments may seem difficult and challenging. Hence, human adaptation and response to such types of environment invite a curiosity. The present study relates to one such curiosity that of human adaptation to environment generally supposed to be uncongenial. It pertains to the rugged terrain and cold climate of the Kameng Himalaya Mountain Ecosystem covering an area of 11,642 sq km with altitude ranging from 150 m to 7090 m. The Monpa, Aka (Hrusso), Bangni, Miji (Sajalong or Dhammai), Sherdukpen, Khowa (Bugun) and Sulung (Puroik) *adivasi* inhabit the area. The author has studied from close quarters the Monpa and Aka human groups and their adaptation to environment of Kameng Himalaya at altitudes of 600 m, 1800 m and 3000 m.

It is invariably believed that human existence faces numerous environmental stresses in the mountain habitats. In the high mountains (particularly above 2500 m) unfavourable influences are felt due to rugged terrain, thin atmosphere, rarefied air, low oxygen, greater solar insolation, high intensity of ultra-violet radiation, aspect, aridity, chilly and violent winds, low temperature, snowfall and remoteness of the area. In fact, human occupancy of mountain ecosystem exhibits an amazing power

of adaptability of man. The present geocological research is more significant and fascinating too since it is concerned with a part of one of the highest mountain ranges, locally known as 'Kameng Himalaya'—a segment of the Eastern Himalaya.

Despite so-called unfavourable environment of the mountain ecosystems, these have become salubrious human habitats. Many a times in the world, unique cultures have grown and came out solid even in the adverse environmental conditions of mountains. The mountain ecosystems have perhaps imparted to these cultures their distinctiveness whereby they display great verve, vigour and vitality. This is borne out from the archaeological findings and from the prevalence of great civilisations in higher plateaus and mountains such as in the Tibet, Peru, Bolivia, Mexico, Abyssinia, Yemen, Mesopotamia, Alps and Himalaya. In the view of famous human geographer and ecologist Blache (1950:34) 'high plateaus were even preferred as the locus of American civilisations'. Probably the remoteness, security and ability of man to cope with such environments are the reasons responsible for formation of such unique cultures.

About ten million persons live permanently between 3600 to 4000 m altitude in the world. The mountain ecosystems of the world have about 12 per cent of its total population and area. The Tibetans live up to 4500 m, the Kashmiris up to 3000 m and the people in the Andes up to 5500 m (Weiner, 1977). In the Central and Eastern Himalaya people live up to 4000 m. Such a great extent of human habitation in the extreme climatic and rugged terrain of the world attracts the researcher to investigate the patterns and processes of human adaptation and responses to biophysical potentialities of the mountain ecosystems. Further, within the mountains variations in the patterns and processes of human response occur in correspondence with altitudinal changes, which make the investigation more interesting and worthwhile. Moreover, in the mountain ecosystems various sets (mild or extreme) of the climatic scale can be seen under the influence of altitude and topography, which produce astonishing contrast in micro climatic regime, biophysical diversity, and human response and occupation.

The study of a mountain ecosystem along with its *adivasi* population is of great ecological relevance since here nature of

man-environment relation is delicate and intimate. Importance of the study can therefore be seen in the following background. Firstly, it is actually furrowing in the virgin land as no such work has been done previously in this area. Secondly, the area is inhabited by the *adivasi* who require utmost attention of the scientists for an overall development. Thirdly, the study area is strategically important. Fourthly, the present study covers a part of the Great Himalaya Mountain, which plays a crucial role in the ecology of the Indian sub-continent. Lastly, the study pertains to that part of the Himalaya where natural environment and ecological balance are not disturbed yet (unlike other mountains which have become fragile ecosystems due to excessive and unscientific utilisation of their resources).

The present study entitled "*GEOECOLOGY OF KAMENG HIMALAYA*" is an attempt to investigate broadly the natural potentialities and constraints of the ecosystem and man's attempt to harness and overcome these in order to maintain his existence. It also identifies and analyses the vertical life zones and human response to them. It is believed that the biophysical properties vary at different altitudinal belts, and there are corresponding changes in human response to it. The entire process is a matter of man-environment geoecological relationship along the vertical gradients (life zones) of the area. Therefore, the study also explores in depth the following objectives:

- i) to study ecosystem potentiality at various altitudinal belts and human response to it,
- ii) to ascertain altitudinality,
- iii) to find out environmental stresses on and natural hazards to life, and
- iv) to ascertain present geoecological relationship for prospective effects on the environment and proposed changes in land use and resources, so as to prognosticate the trends of human response and ecological balance.

Theoretical Background

Generally it is seen that 'altitude' has its positive role to play in the mountain geoecology where exist different means and modes of movement of people, livestock and goods. Even

entire culture with its resource utilisation technology and strategy varies from level to level. According to Guillet (1983) under the organismic interaction in mountain environments role of vertical control is an important aspect of investigation. The various patterns are integrated by human efforts, their strategies of resource utilisation and also by their overall ability of finer adjustments to varied environments at different altitudinal belts. Guillet also mentioned that John V. Murra and his followers consider altitude an impetus to cultural ecology of mountains (rather than an impediment). Many researchers have identified verticality in the Central Andes (e.g., Orlove, 1977; Brush, 1977; Forman, 1978; Masuda, 1981; Lehmann, 1982). Troll (1968) and Rhoades and Thompson (1975) observed its applicability in the Alpine environments and described the peculiar adaptive strategy known as *Alpwirtschaft* or 'mixed mountain agriculture' system based on agropastoral transhumance. In case of the Himalaya, altitudinality has been discussed by Pant (1935), von-Furer Haimendorf (1964), Negi (1970, 1972), Shrestha (1972), Hasan (1972), Sharma (1973), Akhtar (1974), Kawakita (1974), Dhillon (1975), Jest (1975), Jalal (1976), Pathak (1984), Mukerji (1985) and others. In the MAB programme of the UNESCO (1973) presence of altitudinality is accepted in the mountains. However, Rhoades and Thompson (1975) and Troll (1968) in the Andes, and Goldstein and Messerschmidt (1980) in the northern slopes of Nepal Himalaya have emphasised on significance of latitudinality instead of altitudinality. While introduction of the important factor of accessibility to advance the traditional zonation models of the mountains has been proposed by Allan (1986). The microenvironments of the multi-zoned mountain ecosystems 'present overwhelmingly structured restrictions and opportunities to human adaptation' (Fricke, 1989:133), altogether influenced by the altitude.

To harness the opportunities and cope with restrictions resulting from the altitudinally governed microenvironments of the multi-zone, the mountain dwellers of the world have widely employed unique technology and strategy. This includes mixed agriculture with particular crops suited to specific belt, animal husbandry, transhumance, effective management of natural and human resources and a deep understanding of the biophysical environment, particularly of the weather pattern

and its influence on man and his domesticated plants and animals. The environmental constraints on production give rise to vertical control. Altitudinal stresses in the common form of climate and soil fertility are found on production strategies in different vertical production zones. Types of domesticated plants and animals are gathered from the biotic diversity of the vertical belts. Agriculture remains viable up to certain altitude, then upwards pastoralism predominates, that too up to certain altitude where grasses cease to exist, but with due consideration of seasonal migration of herds of man and livestock. While vertical production zones do vary discontinuously, there is a tendency for productivity to vary inversely with altitude. Higher the ecological zone lower the productivity (Orlove, 1977; Guillet, 1981 etc.). Role of altitudinality can also be seen in allowing certain biophysical processes above particular height which may include snowfall, frosting, growing of temperate fruits and alpine meadows and so on (of course all of these are not negative roles).

The *functional-ecological-systems* analytical approaches have been adopted to explain human adaptation to Kameng Himalaya Mountain Ecosystem. The *functional* approach attempts to analyse phenomena in terms of the role they play within a particular organisation. It forms base of the ecological explanation and is more prominent in ecosystem concept. A functional-ecological-systems thinking is important in geographical explanation. Wrigley (1965) has pointed out that how the approach of Blache and Brunhes comes very close to the functionalism in its form, while Barrows' human ecology exerted some influence. In fact, Hartshorne's 'interrelationships within areas' has distinctively functional-ecological ring to it. Many geographers today think that this approach provides an important basis for geographical explanation (Stoddart, 1965, 1967; Brookfield, 1964; cf. Harvey, 1979:81). Ecological explanation focuses 'process' of man-environment interactions rather than 'form' and 'content'. Basically, geographers believe in spatial approach, while the ecologist on structural and functional approach. On the basis of such characteristics Philbrick (1957) pleaded for greater use of functional-ecological analysis in geography. Ackerman (1963) mentioned that the functioning of systems that includes multiple numbers of variables,

especially life systems and social systems, is overriding problem in science.

Ernst Haeckel first of all used the term '*Ecology*' in its modern sense in 1866 in quest of formulation of a biological scheme of zoological sciences. The term ecology is derived from '*oekologie*', which has the Greek root—*oikos*, meaning 'household' or 'living place' or 'habitation'. Haeckel (1866) defined ecology 'as the body of knowledge concerning the economy of nature—the investigation of the total relations of animal to its inorganic and organic environment....' Popularity of the term ecology has led to its misuse as synonym for environment. The scope of ecology is broadened by defining it as 'the study of energy flow... material cycle in biosphere... structure and function of nature' (Odum, 1975:1-4). Now ecology is viewed in terms of the study of totality of man and environment, and a link between natural and social sciences. Castri (1981) opined that it is a science of converging disciplines to form a common trunk of ecology. The natural laws, which influence survival and abundance of organism in the form of ecological balance, are studied in its totality and all possible details.

Geography and Ecology

Interrelationship between man and environment has been focal point of geographical inquiry. In this connection dichotomy of "determinism" and "possibilism" was an unfortunate development. Actually both 'represent the opposite poles of a total spectrum which includes every possible position' (Lewthwaite, 1966). The poles are not opposite but continuum of an environment. The ecological concept discards this naive controversy and looks from holistic point of view man-environment relations as mutual, reciprocal and symbiotic to find out internal coherence and ecological balance between the two.

The geographer has traditionally been closely concerned in many ways with the subject matter of ecology as geography is basically devoted to analyse the relationship between inorganic control and organic response (Davis, 1961). The concept of ecology gave greater insight into the man-environment interaction and geography was redefined in ecological terms (Barrows, 1923) to search professional identity (Ackerman, 1963) and

rectify the traditional man-environment school of geographical thought (Simmons, 1973). The crude ecological spirit implicitly found its place in early geographical studies, for example, in the works of Buffon and Humboldt. Therefore, by virtue of inter-disciplinary approach the science of geography claims to be more nearer to modern ecology and thus it must lead in ecological studies (Gerasimow, 1983). Explanation of any geographical phenomenon in context of spatial relations or spatiality, multiple connections with environment (mass of complex actions, reactions and interactions) and equilibrium in this complex is actualist by definition and it is basically ecological (Sorre, 1971). The 'accurate description' of geography is analogous to ecological investigation of 'all possible interactions' between organism and environment; and 'rational description' comes nearer to concept of 'ecosystem' as a functional whole. Chorley and Haggett (1971) considered geography and ecology as study of distribution, organization and morphology of phenomena on the surface of the earth. The fundamental contribution of ecology is setting limits to human activities and by following ecological viewpoint, the geographers will get rid of naive determinism (Eyre, 1964). This point is later elaborated in geoecology.

Human Ecology

When the concept of plant and animal ecology is applied on the study of man and his activities in relation to biophysical environment, it is called 'human ecology'. Since most of the social sciences are already involved in the study of man-environment relations, the evolving ecological ideas of biological sciences permeated into it by the early twentieth century to deal with man, society and their environment (see Barrows, 1923; Mckenzie, 1926; Park, 1936; Quinn, 1939 and others). Attempts were made to restate fundamentals of human activity in biotic terms and from about 1910 'human ecology' was used for the study of man and environment, not in a deterministic sense, but for man's place in the 'web of life' or the 'economy of nature' (Stoddart, 1966).

As one of the pioneer social or human ecologists Mukerjee (1926) defined 'social (or human) ecology as synoptic study of

the balance of plant, animal and human activities, which are systems of correlated working parts in the organization of the region (ecosystem)'. The methods of plant and animal ecology are of great help in scientific study of the spatial, occupational and temporal relationships of human beings with their biophysical environment. The problems of mobility, competition, symbiosis, segregation, balance, optimal population, dominance and succession as they are applicable in plant and animal ecology are also applicable in human ecology. Interactions among man, plant and animal govern food supply and nutritional level and character of man's socio-economic patterns (Mukerjee, 1968). The complex of human ecological interrelations among man, plant, animal and their physical environment ought to be studied in a single framework, and ecosystem rightly provides this framework. In the mid 1960s human ecology was reviewed and revitalised with the concept of ecosystem by Stoddart (1967) who translated it into systems analysis. Most of the recent human ecological studies focus on man's place in wider ecosystem (Gregory, 1981). Thus, in the words of Sutton and Harmon (1973) "human ecology is study of ecosystems, as they specifically affect and are affected by human beings".

Emphasising importance of ecological concept in human studies Mukerjee (1938) said that from Frederick La Play to Patrick Geddes has come the valuable insight that the organism (man, folk), function (work, occupation) and environment (place, region, nature) cannot be treated separately. Entire assemblage of things should be taken as single harmonious functional entity i.e., as an ecosystem. In the writings of Arthur Geddes this approach is concomitantly present and he stressed on 'landscape ecology'. "The ecologists... have taught us that most things that are found together work together" (Geddes, 1982:1).

Definition and scope of 'geography' and 'human ecology' often seem to be interchangeable. 'This geographical usage of 'ecology' has a specialised subsidiary in which 'environment' is equated with 'climate', so that study of man and environment comes to mean man and climate' (Bates, 1953:701). Huntington and Shaw (1959) considered climate as supreme influencing factor on man's mode of life.

Geocology

In human ecological studies when focus is placed on limiting geoenvironmental factors, it is termed as 'geocology' in the strict sense. Carl Troll (1968) mainly used the term 'geocology' in the study of major mountain areas of Tropical America. Such studies have been done in Eurasia (Troll, 1972; Rathens, Troll and Uhlig, 1973) and in the Colorado Front Range it was examined by Ives (1980). The major contribution of geocological research has been discovery of a vertical pattern of environmental and human diversity in the mountains. The interaction of altitude, climate and soil fertility is seen as upper limits on agriculture and pastoralism. Similarly, within the range of agriculture interaction takes place between the geocological factors and upper limits on types of crops (Troll, 1968; Uhlig, 1976, 1978; Webber, 1979; Joshi, 1986). In the same way, some other geoenvironmental factors can also be identified which may show their restraining potentiality. In this strict sense, actually the term geocology is more applicable to the ecological study of the extreme climatic zones, e.g., cold climate of the high altitude or latitude, and hot climate of the arid zones (deserts). It seems to be most suitable to mountain ecology because constraints on life forms are more pronounced here than in any other ecosystem. Moreover, altitudinality produces gradients in human adaptation to mountains, which can be explained in geocological terms.

In fact, the term 'geocology' owes its origin to the term 'geoenvironment' whose roots lie in the term 'landscape ecology'—a term introduced by the German geographer-ecologist Carl Troll (1968). That's why the credit of coining the term 'geocology' goes to Carl Troll, who later used it in many studies on mountain ecology. The term 'geoenvironment' means the physical landscape or terrain or land form based environment. It means that part of the natural environment, which is created by the earth, i.e., by its features, characteristics and properties. Geoenvironment is the base on which the rest of the physical environment rests, and together (i.e., both physical and biological) they influence the human beings and their activities. And in course of the utilisation of the biophysical environment man also influences it. Therefore, geocology studies both natural

and cultural ecosystems in relation to the earth- i.e., called *geo* in Greek.

The Greek word *geo* is used as a prefixed in many compounds, it usually implies a relationship with the Earth as a whole (Clark, 1985:241). There are number of terms in currency in many sciences where *geo* is prefixed, e.g., geoarchaeology, geobotany, geochemistry, geoenvironment etc. Almost all of them carry the main idea of relationship with the earth. Further it means the application of the method and concepts of geosciences in the research in a particular discipline to find out its relationship with the earth, as Butzer (1993) has described in case of geo-archaeology. In the same way the term geoecology implies that ecological study where the skills, tools and concepts of the earth sciences have been adopted to analyse the dynamic interrelationship between an organism and its geoenvironment. In case of human ecology the central organism is the man, and the term geoecology can be appropriately used here.

In the present study meaning and scope of the geoecology term has been enlarged. It includes interaction between man and geoenvironmental factors that already have a prominent place in geographical studies. A step further, the author suggests that combination of two disciplines—geography and ecology give rise to 'geoecology', meaning simply a 'geographical ecology'. The motive behind this blending is to study scientifically and logically the natural geographical phenomena in terms of geoecological interaction resulting from relationship between man and geoenvironmental factors. All possible interactions between man and environment, which a disciple of geography can find out and explain, come under geoecological research. The scope of geography seeks its liaison with ecology only when the former takes into consideration the concept of interaction necessary for maintaining the balance in ecosystem to allow certain activities in a particular environment only to a permissible limit or extent. In fact, this is the role or function performed by 'geoecology'.

Systems Analysis and Ecosystem

Explanation of a phenomenon as a part of a set of 'functional-whole' comes under systems analysis, which is best exemplified

in 'ecosystem' approach'. The history of systems thinking in geography is very much bound up with the functional approach, with the organismic analogy, with the concept of regions as a complex interrelated wholes, and with the ecological approach to geography' (Harvey, 1979:467). Ecosystem is the basic functional-areal-environmental system consisting of self-regulating complex-whole of mutually interacting, interdependent and integrated organisms (community) and their non-living environment, each influencing the properties and functions of one another and both necessary for maintenance of life (Odum, 1975).

Arthur Tansley (1935) for both biome and its habitat coined the term *ecosystem*. The interaction between the two is responsible for maintenance of equilibrium in a mature ecosystem (Tansley, 1935, 1946). In German and Russian literature '*biogeocoenosis*' is the equivalent term to ecosystem, whereas '*anthropogeocoenosis*' (Alexeev, 1986) is analogous to man-made ecosystem. Yermolaev (1975) viewed the entire biosphere as the largest possible ecosystem. Cole (1958) suggested the term 'ecosphere' for whole terrestrial ecosystem meaning as the sum total of life, environment and resources of the earth.

Stoddart (1965) recommended adoption of ecosystem concept in geographical investigation because of four characteristics of ecosystem viz., *monistic, structured, function and as general open system* obeying laws of thermodynamics. Influence of Stoddart's ecosystem concept on geography is seminal rather than definite. In order to have more scientific and better-balanced view of man in his environment, the analysis of systems was seen by many as providing the necessary 'intellectual rigour' (Ackerman, 1963; Stoddart, 1965 and others). The book '*Ecology of Man: An Ecosystem Approach*' edited by Smith (1972) is the basic textbook in this field. Fosberg (1963) did a commendable work on the island ecosystem. Mention may be made about an edited book entitled '*Subsistence and Survival: Rural Ecology in the Pacific*' (Bayliss—Smith and Feachem, 1977) for its multidisciplinary work to unravel complexity of influence of ecosystem on man and vice-versa.

Significance of the basic concept of geography—"areal differentiation" lies in revealing connectivity or "information" flow in a system. Ackerman (1963) compared systems analysis

with: (i) Humboldt's assertion on 'comprehension of world phenomena' as the highest and eternal purpose of all research (1845:68), (ii) Hartshorne's purpose of geography as "scientific description of the earth as the world of man" (1959:172), (iii) Barrows' definition of geography as human ecology (1923), and (iv) Platt's definition of geography in 1930s and 1940s "as the science of regional process and patterns of dynamic space relations" and his concept of 'areal functional organization' (1957:190, and 1959). These thoughts and concepts have close affinity with the functioning and organisation of modern day concept of ecosystem.

It is worth mentioning that the functional-ecological-systems analytical approaches are inter-connected and even cannot be separated from basic cause-and-effect analysis. The gap between spatial approach of geographers and the structural and functional approach of the ecologists is filled up by the concept of '*landscape ecology*' or '*holon*'. The concept of *holon* has recently been given by Naveh and Lieberman (1984). M. Schultz wrote about it in the introduction of their book that 'in fact, it is this concept of wholes which connects the ideas of the geographer-ecologist founded with such theories as general systems and cybernetics, on the one hand, and on the other, with such applications as landscape appraisal, land use planning and conservation'. Landscape is basically a concern of the geographers and it is seen as the man's role in changing the face of the earth (Thomas, 1956), man-environment systems (Ackerman, 1963), and perception (Lowenthal, 1967; cf. English and Mayfield 1973:7). Manipulation and modification of natural ecosystems into man-made ecosystems are points of interest of a geocologist.

Human Response and Adaptation

Study of adaptation of an organism to biophysical environment comes mainly under the purview of ecology. Human adaptation to environment is a process involving technology and strategy employed by man for harnessing the biophysical resources of an ecosystem (i.e., ecosystem potentiality), not only for subsistence and survival but also for his future growth. Study of human adaptation in its totality (including cultural,

behavioural, biological and physical adaptation) is a multi-disciplinary subject. In geography and human ecology, primarily the behavioural and to some extent technological responses are taken into account. The complexity of human responses to a variety of natural environments and various points of investigation related with it are concern of the cultural geographer, which demands his immediate attention to find out 'common constraints placed on all cultures by the spatial context of their existence' (English and Mayfield, 1973: 541).

Human adaptation is considered as adjustment of activities of man to changing environment. 'Adaptation results in an economy of effort which once attained, assures to every individual, at minimum cost, the quiet regular exercise of its functions' (Blache, 1950). In fact, adaptation is also a biological concept (alike ecology) defined as 'the good fit of organisms to their environment' (Gould and Lewontin, 1979:592) and in case of man it is supported by his biological and cultural traits. Thus, Bose (1929) also included culture under the adaptive mechanism. The biological functioning of a population in a given environment includes 'population's health, ability to feed itself adequately, functional capability in its physical environment and reproductive performance' (Baker, 1984:2). Every organism acquires a particular set of 'adaptive mechanism' for its existence. Adaptation is dynamic and it also includes resilience by which the organism adjusts with environmental changes (sudden or gradual) without disturbing the ecological balance. Every organism carves out an 'ecological niche' to ensure its successful occupancy and survival.

Growth of human adaptation is spiral in form. In the evolution of it, role of the trio comprising of opportunity, protection and necessity can also be seen with an additional factor of time. In the process of adaptation, organisms face both restrictive (passive, negative) and permissive (positive, constructive) factors of environment. Climatic influence on the domesticated crops and animals, shelter, cloth and health is so profound that invariably adaptation to environment means to climate itself. Bates (1953) has divided climate in two categories—first 'ecoclimate' or the climate of habitat, and the second 'microclimate' or the climate surrounding the individual

organism. Such division is relevant in study of montane geocology. However proficient and advance, speaking technically, might have become human groups in mountain ecosystem (or in any other uncongenial environment) but negative roles of certain adverse physical conditions like altitudinal limits, rugged terrain and harshness of climate can not be denied in their process of adaptation.

Cultural Geography

Through genetics and culture, the adaptive mechanism passes on to the next generation. The human being could disperse in so wide and varied environments of the world because of being warm-blooded mammal, ability to digest wide range of food and cultural kit (Barnouw, 1978). Therefore, the pattern and process of human adaptation are related with culture of a human group and culture is taken as part of human endowment. Hence, sometimes it is called 'cultural adaptation'. This places the adaptation study also in the realm of 'cultural geography'. It is the analysis of the cultural landscape by geographers, which reveals succession of human response and environmental change. 'Cultural history' deals with sequence of events, and the cultural geography is concerned with the process implied in a sequence of events (Wagner and Mikesell, 1971). Forde (1956) has emphasised on study of broad patterns of economic life in relation to physical and social environment. Devenan (1983:405) pointed out that 'with our current interest in environmental changes and natural hazards, we may need to be reminded by Sauer that "culture is the agent" (1925:46) and is not passive, that the habitat is revalued and reinterpreted with every change in habit (1941:7), that there is no 'necessary adaptation' (1925:51) and that environment itself is often a cultural artefact'.

Environmental Perception, Resource Appraisal and Utilisation

Environmental perception, preferences and decision-making of a human group are controlled by their cultural heritage, which influence human response in the form of adoption of

innovations and different land uses. The culture itself has environmental impact on it. Sonnenfeld (1972) has given a behavioural classification of environment as geographical, operational, perceptual and behavioural. It encourages the human geographer to view the environment in a more discriminating and precise way and its application in cross-cultural behavioural research can be fruitful (English and Mayfield, 1973). It is also useful in dealing with sharp spatial order existing as a result of altitudinality in the mountain ecosystems inhabited by the *adivasi* having different cultural kit and resource utilisation.

The total flow of material from its place in nature through its period of contact with man and its disposal can be termed 'resource process' (Firey, 1960). Man plays a role of varying dominance in these resource processes, such a view is generally termed as ecological. In every ecological system there are natural limits to the total amount of living matter that can be supported by it, and ecology tells whether in the long run a particular process is possible or not (Simmons, 1971).

Resources do not mean a thing or a substance but a function, which a thing or substance may perform or an operation in which it may take part. Human being plays vital role in recognition and utilisation of resources and it is inseparable from human wants and capabilities, which are not only influenced by culture but by human organisations and institutions. This idea of resource utilisation has been put forward by Zimmermann (1951) in his 'functional or operational theory of resources'. The same has also been employed by the investigator to analyse geocology of Kameng Himalaya.

Methodology

i) Selection of the Problem

While doing fieldwork in Arunachal Himalaya, the investigator was amazed to see the power of adaptability of the local inhabitants to the environment by utilising immediate biophysical resources for their sustenance in climatically harsh and physiographically rugged terrain. Changes in adaptive strategy were also noticed with variation of elevation. The

agropastoral transhumance economy in higher altitude, horticultural potentiality of middle belt and agricultural advantages of lower altitude were matters of attraction for the investigator, which led to selection of the present problem.

ii) Fieldwork

For the purpose of detailed field investigation three sample villages at 3000 m (high), 1800 m (middle) and 600 m (lower) altitude were selected in a single river valley—the Bichom. The Monpa people are occupant of the upper two villages, whereas the Aka (Hrusso) people are living in the lower village.

iii) Collection of Data, Mapping and Analysis

Primary data for this study was collected from each of the three selected villages with the help of two types of schedules, first for the village and second for the households. Secondary information/data was culled from district statistical handbooks and census reports. The data collected so, was processed, compiled and tabulated later on for each village and the region as a whole. This helped in preparation of tables, charts, diagrams and maps.

Base map for the study area was obtained from the Survey of India Map of NorthEast India on 1:1 million scale and Atlases. The investigator himself prepared sketches of the three villages. Boundaries of various types of land use in a village were drawn on the basis of the detailed survey of the village, particularly of agricultural land use by the investigator. Soil samples from various fields were collected and analysed (Appendix I). With the help of abney's level, angles of slope were measured. Altimeter was used in the field to mark altitudinal limits for particular crop and over all land use. This all was necessary for preparation of so-called sketches of the sample villages, because in this part of the country even the cadastral did not take place, and as such, no maps are available. For the location of sample villages at different altitude, survey of the entire Kameng Mountain Ecosystem was done with the help of the Toposheets and satellite imagery. The maximum-minimum temperatures and weather conditions recorded during the stay in the sample villages are given in the

Appendices II, III and IV. About 90 per cent of this data can be taken granted as reliable. With the help of tables drawn after compilation and tabulation of primary and secondary data, and also with the help of maps, charts, diagrams thus prepared, detailed analysis of various phenomena related with: man-environment interaction, strategy and technology employed by man to harness ecosystem potentiality (biophysical resources), vertical life zones, altitudinality, environmental controls, geoecology, ecological balance and future trends of land use, was done to arrive at certain conclusions, stated in the last chapter.