LAND CLASSIFICATION IN THE HILL AREAS :
A STUDY OF WEST KHASI HILLS DISTRICT OF MEGHALAYA

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INTRODUCTION

1.1. The Concept of Land

As circumscribed by the earth, the area, what is considered to be land is finite and fixed. Peoples' need for food, clothing, shelter and energy come from the land, as do many of their needs for the amenities provided by fields, landscapes, and forests.

The term 'land' is too complex to be defined adequately. Given our anthropocentric viewpoint, however, the following definition developed by the Food and Agriculture Organisation (FAO) of the United Nations can be considered as adequate:

> "Land is an area of the earth's surface, the characteristics of which embrace all reasonably stable, or predictable, cyclic attributes of the biosphere vertically above and below this area including those of the atmosphere, the soil and the underlying geology, the hydrology, the plant and animal populations, and the results of past and present human activity, to the extent that these attributes exert a significant influence on present and future uses of the land by man."1

One consequence of this definition of land is that many, and perhaps all, water bodies on the surface of the earth have to be considered as land. Sometimes, water is treated as that part of the earth's surface which is left after land has been

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1 FAO (1976), in Vink, A.P.A. (1983); Landscape Ecology and Land Use, Longman Inc., New York, p. 11.

considered. But there are good reasons to consider fisheries and other uses of aquatic systems by man as kinds of land use which should be treated at par with the terrestrial land utilization types.

The complexity of land and its uses give an introduction to the nature of land and the problems of identifying and classifying it. To summarise, it is necessary to place the relationship of man and land resources in perspective by considering some important human concepts about land and its uses that have had much influence on the development of present attitude towards land.

The Judeo-Christian tradition in the Western World gave rise to the concept that people were created separately, after other living things, and were not a part of Nature. People were admonished to "be fruitful, and multiply, and replenish the earth, and subdue it."[2] The idea that the earth and all upon it were for people has become a deeply entrenched concept. Recently, the source of authority has shifted from God to the 'State' or 'Society'. In any case, the notion of the supremacy of human beings has been widely used to justify conquest and exploitation of natural resources as an 'unquestioned right of the humans'.[3]

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2 K. P. Davis (1976); Land Use, McGraw-Hill Book Company, New York, p. 7.

3 Ibid., p. 7.

The legal point that things affixed by nature or by human beings to the land, go with the land. Legally defined, permanent buildings and other structures and trees are a part of the land and are bought and sold with it, unless otherwise specified and agreed. Thus, when a person buys a house, the title deed specifically defines only the land area but not the structures or trees affixed to it.

Since the production of our basic needs (food, fibre and shelter) are linked with the wise use of the land, it is imperative that we must conserve this basic resource, and care for it so that we and our future generations may live on it.

1.2. Statement of the Problem

Land is the ultimate resource. Man being a terrestrial being, his habitation and all his activities, economic or social are land based. In earlier times, land management did not get due attention due to the fact that with low world population it was thought to be inexhaustible. But, in the twentieth century, with manifold increase in world population (currently estimated over 5,000 million) the situation has changed. It is not because of the food requirement alone, but due to urbanisation, industrialization and other developmental impetus that have put increased pressure on land. Although, there are still areas and countries where land is abundant, international migration from high density to low density areas have practically ceased.

There are no vast new lands waiting to be discovered and conquered. Therefore, every society has to manage to live and manage with the land they have.

Each year, the world has over 80 million[4] more people to feed but less good soil to grow crops. The destruction of our soil cover is a truly world wide phenomenon. It is beyond our (India) capacity to feed a population expected to increase by over a billion by the year A.D. 2000. Many nations are responding to preserve top soil which can take nature upto a thousand year to accumulate to a hoe's depth. When robbed of its protective vegetation, raging monsoons or strong winds can remove the top soil to expose bed rock in a matter of days. More often the process of destruction is less dramatic, a steady dwindling of fertility to a point where the land becomes useless to the farmer. Soil erosion is a natural process. The action of people is speeding up this process far beyond regenerating capacity of nature. In USA, annually 40 million hectares[5] are damaged beyond any practical repair; in India, one-third of the arable land is threatened with total loss of top soil. The consequences can extend far beyond the areas seriously affected. The 'desertification'[6] turns 6 million hectares into sand, and a further

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4 M.K. Tolba (1984); "Soil Erosion Threatens World Agriculture" Mazingira, Indian Edition, Vol. 8, No. 3, p. 7.

5 Ibid., p. 7.

6 Ibid.

21 million hectares are reduced to zero productivity. World wide, the livelihood of some 850 million people are threatened.

Historical evidences indicate that in the Eastern Mediterranean Region during Roman times, millions of hectares of land became desert;[7] in China, vast areas became eroded and abandoned and as recently as 1934, records indicate that the Yellow River carried silt washed down from cultivated lands equivalent to soil one metre deep, over 1,45,000 hectares. In Latin America, there are densely populated areas where the soil is very susceptible to erosion and losses have been so high as to place at least three countries there, among the low caloric areas of the world.

It has been said 'desert is the cradle of civilization'. The existence of the civilized man also indicates the existence of the desert! On a world wide scale, deserts are probably expanding faster today than ever before in the history of mankind. They are even faster than they did between 1914 and 1934. During this period more soil was lost to the world through erosion than in the whole of previous human history. That was the time when the dust bowl of North America was created. The top soil without cohesion, blew away and the land became desert.

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7 FAO (1977 and 78); "Soil Conservation for Developing Countries", in Soil Bulletin, No. 30, Paris.

The immediate causes of desertification in the developing countries are well known - overgrazing, indiscriminate felling of trees for fuel, waterlogging, salinzation and faulty agricultural practices etc. Too much is taken from the soil, too little is put back. This, in turn, is largely the result of the sharp increase in human population and the consequent pressure on land. It must be remembered however, that desertification is also taking place in developed countries, such as Australia, China, USSR, and USA. It is indeed, taking place throughout the world, but it is accelerating most rapidly in the developing (countries) world. Table 1.1 shows the degree and extent of the hazard of desertification in the developing world.

In case of India also, it has been noticed that the good soils have been degraded due to climatic factors, its improper management and misuse. Here, in India, deforestation is a major cause of land degradation. The extent of annual deforestation of rainforest in India is about 80,000 to 1,00,000 sq. km.[8] This scale of deforestation, not only makes ecological imbalance in our country but also causes the soil erosion and degradation. India's forest cover in relation to total landmass is 19.52 per cent[9] which is much below the minimum requirement of 33 per cent for maintenance of ecological and environmental balance.

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8 FAO (1977 and 78), op.cit.

9 The Sentinel, Guwahati, August 21, 1986.

Table 1.1: Degree and Extent of Desertification Hazards in the Developing World.

Degree of Desertification Hazards	Australia		Asia		Africa		Europe	
	Km^2	%	Km^2	%	Km^2	%	Km^2	%
Very High	332,300	4.3	485,840	1.2	1,857,070	6.1	51,290	0.5
High	3,120,040	40.5	6,848,890	17.3	5,032,000	16.1	218,380	2.1
Moderate	2,904,432	37.7	5,176,880	13.1	3,838,870	12.6	678,430	6.5
Extreme Desert already	-	-	2,156,220	5.4	6,550,520	21.6	-	-

Note: Percentage of the total land surface.

Source: J.K. Jain (ed. 1986). Combating Desertification in Developing Countries, Scientific Publishers, India.

The main casuality of this process of desertification is occurring in the hill areas of North East Region of India, where land is being degraded quickly by its faulty use pattern (for example, shifting cultivation, popularly known as 'jhum' cultivation). The region has about 4.94 per cent of closed forests[10] cover, but of these forests are secondary vegetation, the 10 years old bamboo shrubs developing after shifting cultivation.[11] It is estimated that about 5.5 thousand sq.km. of additional forests are cleared every year in the region, 50.0 per cent of which is primary forest due to slash and burn practices.[12] At this rate, all the primary vegetation would vanish from the region within a span of 25-30 years. This will distort not only the ecology in this region but also will degrade the soil fertility.

The pressure of population on the land resources and land based resources are increasing with a exponential rate of growth of population at 3.0 per cent per annum in the North Eastern Hill Region of India. In the absence of any significant manufacturing activities, nearly 85.0 per cent of the population are rural based and depend on agriculture. Being a hilly region,

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10 National Remote Sensing Agency, Hyderabad, 1983.

11 P.S. Ramakrishnan (1985); "Tribal Man in the Humid Tropics of the North-East India", Man in India, Vol. 65, No.1, pp. 1-32.

12 Ibid., pp. 1-32.

availability of flat land is limited and the agriculture is dominated by shifting cultivation. With a steady increase of the population, the pressure on cultivable land has gone up tremendously. This has resulted in complete occupation of valley lands permanently. The slopes and crest lands have been occupied under shifting cultivation, resulting in severe soil erosion, land degradation and is threatening the very means of sustenance of the people.

For understanding the extent of forest cover and deforestation, agricultural land use and soil quality, no adequate information base exist for this region, since there are no land records and no cadastral survey having been carried out. The present study, therefore, mainly aims at providing a base for the study of land classification of the West Khasi Hills District of Meghalaya, one of the most inaccessible, vulnerable and backward districts of the State.

1.3. Conceptualisation of the Problem

In a country (India) and in a region (North East India) where land is the chief resource for the people, land classification becomes fundamental to any attempt of rural and agricultural development. Land classification can be viewed from three theoretical approaches (Mabbutt, 1968):

i) The Genetic Approach

ii) The Landscape Approach, and

iii) The Parametric Approach.

(i) The Genetic Approach

This approach of land classification "attempts to arrive at distinctive land units by repeated subdivision on the basis of causal environmental factors ...."[13] The main theoretical support to this approach are:

(a) the similarity of widely separated areas and thus, the preditable characteristics,

(b) scope for a rational hierarchy, and

(c) promise of universality.

Essentially, this approach deals with the tangible, a priori (given) physical characteristics of the land, but by the same logic, precise divisions, specifically at lower level of the hierarchy is of limited use.

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13 Mabbutt further states, "Attempts to arrive at distinctive land units by repeated subdivision on the basis of causal environmental factors may be grouped as the genetic approach. This has its origins in the development of physical geography in the nineteenth century under the influence of botanists and geologists concerned with the genetic groupings of natural phenomena and the environmental controls of their associations and distributions."

"Reconciliation of this outlook with a primary aim of the geographer, namely the recognition of unity in diversity as shown in the distinctive character of portions of the earth's surface, led to the concept of genetically based 'natural' regions." J.A. Mabbutt (1968) in "Review of Concepts of Land Classification", in Stewart, G.A. (ed) 1968, Papers of the CSIRO Symposium, organised in cooperation with UNESCO, 26-31 August, 1968, Macmillan, Victoria, p.12.

(ii) The Landscape Approach

This is essentially a qualitative approach to land classification, based on the manifest differentiation of land at the micro-level through aerial photograph or satellite imageries, and then aggregation of the land units to higher levels[14] (Unstead, 1933). The landscape approach involves the recognition in the landscape of distinctive components with only a limited variation of those attributes important to land use. The most important factors in this approach is to identify the smallest

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14 J.F. Unstead (1933) further states, "Tired of fitting boundaries which did not exist around areas which did not matter, regional geographers abandoned the search for the elusive 'natural region' and sought real objects of study in distinctive parts of the observed environment. As a system of regional geography, the method is particularly associated with Unstead (1933), who aimed to show how the small regions so identified could be combined into areas of successively higher order ... "to a system of regions developed in this way the term 'synthetic' may be applied ... the process is one, not of division and subdivision of areas, but of combination of the smaller regions in order to arrive at the larger ones. By this means more accuracy is assured...."

"Unstead's primary units had to be small enough for detailed scientific investigation and at the same time be distinctive geographical entities. He proposed for them the term 'stow', identified by unity of relief, though with characteristic structure, hydrology, plant cover and land use. Nevertheless he recognized that the stow was made up of yet smaller components or 'features' of the status of minor land forms. His second order unit, the 'tract' consisted of a grouping of types of stow, and its unity might derive from one or all of relief, structure, and soils. Above the tract were levels of regional grouping expressive of characteristic relief type or climate". J.A. Mabbutt, op.cit., p. 15.

land units, the 'landfacets' (Bourne, 1931)[15] or 'facies' (Prokayev, 1962),[16] which distinctly manifest a complexity of physical, climatic, and environmental factors giving a particular character to the smallest land unit.

(iii) The Parametric Approach

The approach attempts land classification based on selected quantifiable attributes of land and thus amenable to statistical manipulations and more precise classes. As Mabbutt refers, "being quantitative, it allows comparisons between and affords greater consistency within land evaluation projects...."[17]

All the above three approaches to land classification have their advantages as well as limitations. Adoption of any

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15 Bourne defines the fundamental components of 'landfacets' as the 'site'. He further stated that "an area which, for all practical purposes, provides throughout its extent similar conditions as to climate, physiography, geology, soil, and edaphic factors in general". J.A. Mabbutt, op.cit. p. 17.

16 Prokayev further suggested, "that the definition of the facies should be based on the character and thickness of surface deposits, the redistribution of moisture and of heat within it as controlled by local relief, and corresponding properties of soil and vegetation cover and of animal life," in J.A. Mabbutt, op.cit., p. 17.

17 Mabbutt states that "one may define the parametric approach as the division and classification of land on the basis of selected attribute values. For instance, a hypsometric map demonstrates a classification of land based on elevation, with class limits at chosen contours. Employment of the parametric approach ranges from general purpose surveys considering many attributes, to classification for special purposes and on a narrower basis, and also includes the stiffening of more qualitative systems through the infusion of parametric ingredients". J.A. Mabbutt, op.cit., p. 19.

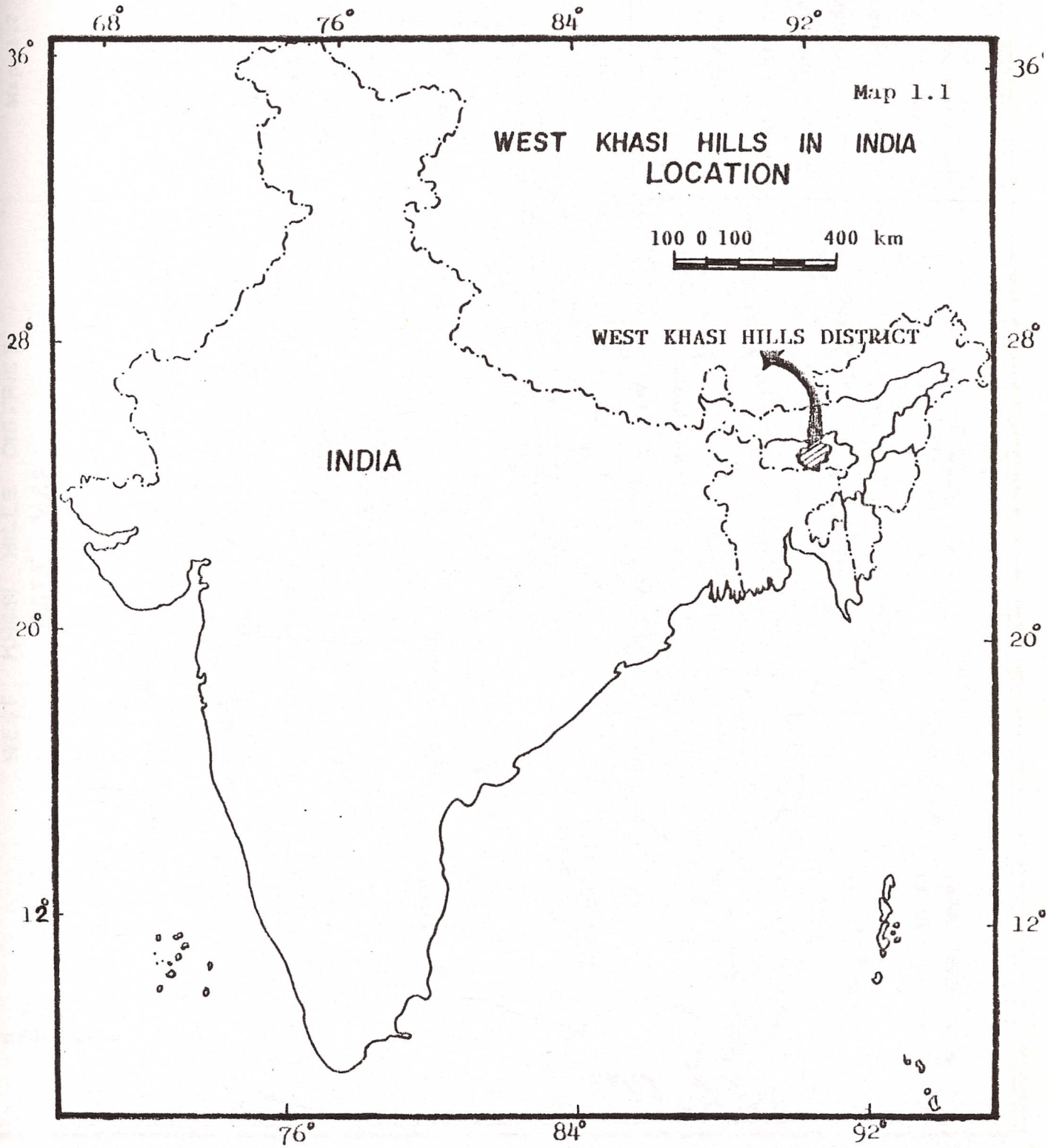
one or rejection of the other has specific problems. In the present study, an attempt has been made to use all the three approaches in combination (and synthesis) for different sections and requirements of the study. Moreover, an additional approach has been developed due to the specific demands of the study. This approach may be called the 'normative approach'. A detailed discussion on this approach has been dealt with in Chapter 3, i.e. Methodology.

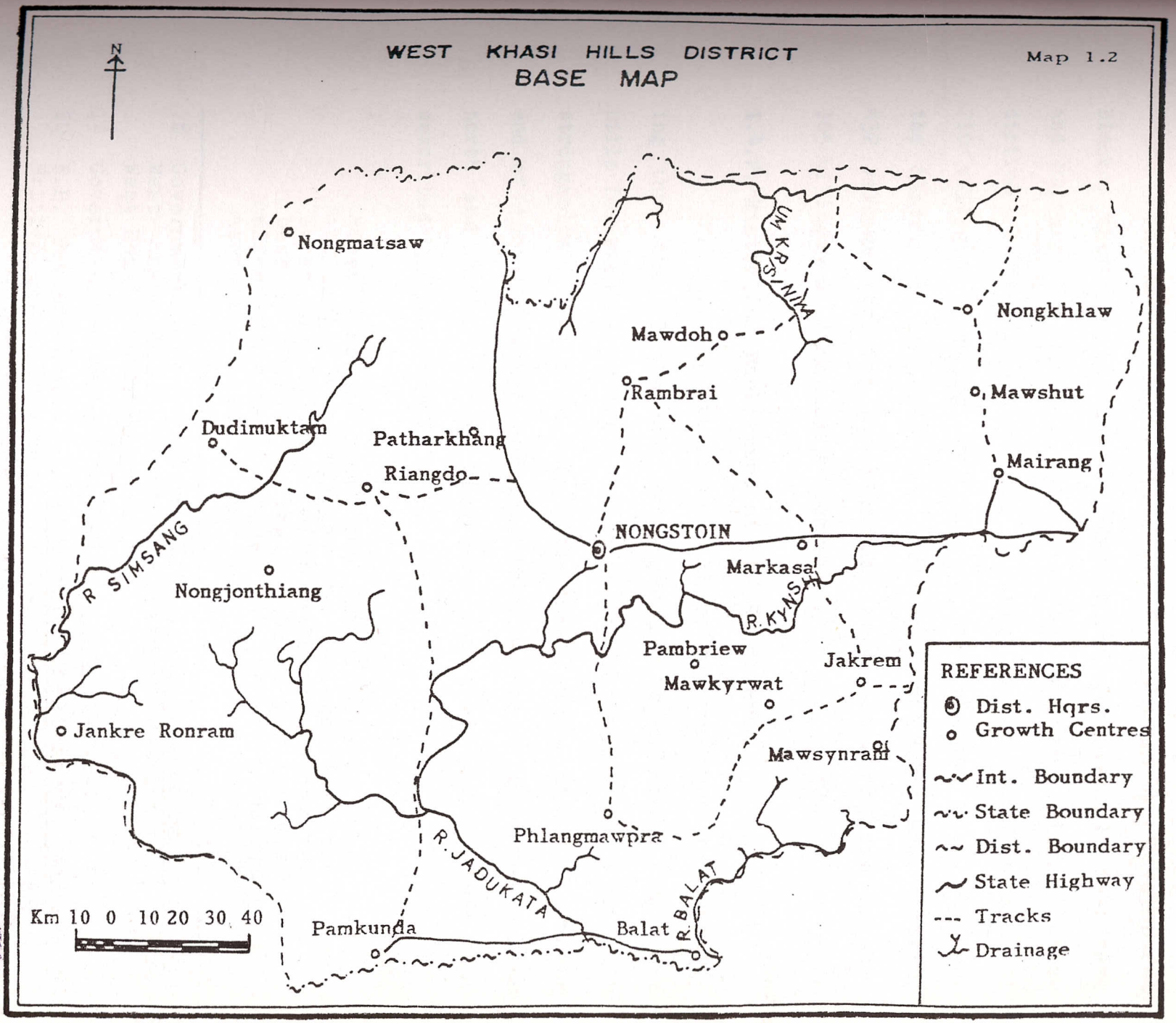
1.4. Study Area

For the present analysis, the study area chosen, is a district of the State of Meghalaya, i.e. West Khasi Hills District.

1.4.1. Location

The West Khasi Hills district is situated in the central part of the State of Meghalaya. The district lies between 25°51' North Latitude and 90°45' East to 91°52' East Longitude covering an area of 5,247 sq.km. occupying about 24.0 per cent of the total geographical area of the State. The district headquarters is located at Nongstoin, at a distance of 96 km from Shillong, the capital of the State. The district is bounded by Kamrup district of Assam to the North, East Garo Hills and West Garo Hills districts of Meghalaya to the West and Bangladesh to South. Map 1.1 and 1.2 show the location and the base map of the West Khasi Hills district of Meghalaya, respectively.


68°
76°
84°
92°
36°
28°
20°
12°
Map 1.1
WEST KHASI HILLS IN INDIA
LOCATION
100 0 100 400 km
WEST KHASI HILLS DISTRICT
INDIA



In the district, there are four Community Development Blocks; they are, Nongstoin, Mawshynrut (Sonapahar), Mawkyrwat and Mairang C.D. Blocks. They provide the operational jurisdiction of the district. The district had a total number of 710 villages[18] having some of the most backward villages of the State. In 1975-76, the Government of Meghalaya declared 432 villages of the district as 'most backward' and another 105 villages as 'specially backward'.[19]

1.4.2. Historical Background of the Study Area

On ethnological grounds there are reasons for supporting that the Khasis and Syntengs have been living in these hills for many centuries. Due to the isolation in their mountain strongholds, little is known of their early history. At the end of the eighteenth century, they harried the plains on the north and south of the District, and their raids were thus described by Pemberton in 1835:

> "They descended into the plains both of Assam and Sylhet, and ravaged the villages fire and sword the villages which stretched along the base of this lofty region. Night was the time almost invariably chosen for these murderous assaults, when neither sex nor age spared."20

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18 Government of Meghalaya (1981); Socio-Economic Review, West Khasi Hills District, District Statistical Office, West Khasi Hills, Nongstoin.

19 Government of Meghalaya (1981), op.cit., p.2.

20 R.B. Pemberton (1835); Report on the Eastern Frontier of British India, Calcutta, p. 221.

In 1826, the Europeans first visited in the Khasi Hills. Among the Europeans, David Scott first entered into the District with the help of local chiefs for the construction of a road through their territory from Assam into Sylhet. The construction work could not be finished due to the threats of the Bengali Chaprasi, who declared that the hills were to be brought under taxation. The tribes suddenly rose and massacred two European Officers, Lt. Bedingfield and Burlton, near Nongkhlaw, with about 60 of their native followers. Military operations were commenced, but were protracted through several reasons, and it was not till 1833 that last of the Khasi Chiefs tendered his submission. Engagements were then entered into with the heads of the various Khasi States. Government abstained from imposing any taxation upon their subjects and their independence was recognised. Since, that date the history of the Khasi states has been one of peaceful development, checked only by the great earthquake of 1897.

Originally, Cherrapunji was selected as the Headquarters of the hills, but due to the excessive rainfall the then District Officer had to move to Shillong in 1864 and Shillong was declared the headquarters of the administration when Assam was formed into a separate province ten years later.

1.4.3. The State of Meghalaya

The State was created by the North-Eastern Areas (Reorganisation) Act 1971, which gave it the status of a full-fledged

State with effect from January 21, 1972. Prior to 1970, the areas now constituting the State of Meghalaya formed part of the state of Assam. The State of Meghalaya was declared as an autonomous State of Meghalaya within the State of Assam on January 12, 1970. Initially, the State had only two districts namely, United Khasi and Jaintia Hills District and the Garo Hills District. In 1972, the erstwhile United Khasi and Jaintia Hills district was bifurcated into two districts namely, Jaintia Hills District with headquarters at Jowai and Khasi Hills district with headquarters at Shillong. Thereafter in 1976, Khasi Hills District and Garo Hills District were bifurcated to form two ditricts each, viz. East Khasi Hills district with headquarters at Shillong, West Khasi Hills district with headquarters at Nongstoin, East Garo Hills district with headquarters at Williamnagar and West Garo Hills district with headquarters at Tura.

1.5. Objectives

1. Since, the study is of taxonomic type, the overall aim is land classification of the West Khasi Hills district of Meghalaya which is one of the most backward district of the State, with the aim of providing a basis for environmental management as well as the agricultural management of land. There are three bases of land classification which has been attempted here:

(a) Land classification on the basis of the genetic characteristics and landscape characteristics;

(b) Land classification on the basis of land potential with a parametric approach; and

(c) Land classification on the basis of policy objectives, specifically the environmental management policy in view.

2. The other important objective is also the detailed land classification of the catchment area of Um Sohdkhiew and Umthied (two tributaries of the river Kynshi) which will provide indepth study since land classification at the level of the district can be considered as too broad a level only.

1.6. Hypotheses and Research Questions

As mentioned earlier, the study is essentially of taxonomic character and therefore, exploratory in nature. The major tasks, therefore, will be to explore the pattern and nature of land classes in their horizontal and generic levels, whether on the basis of existing situation of land as has emerged over the long interaction of man and nature or from the point of view of policy intervention in the situation. Therefore, no major hypothesis has been planned to be investigated. However, a number of secondary hypotheses have emerged during the study. These hypotheses can be outlined in the following manner:

(1) that soil fertility declines with slope. This is indicative of erosion of top soil from higher slope zones and deposition in the valleys.

(2) that land potentiality declines with altitude and slope. Thus, the valley and gentle slopes are suitable for agricultural occupance and intensification of cultivation.

(3) that vulnerability of land arises out of intensification of land use on slopes, deforestation and reduction in the shifting cultivation cycle.

(4) that land degradation is a consequent stage of non-management of vulnerable land and not isolated land units.

(5) that deforestation is an accelerating process. This needs occupational shift and management of land.

(6) that vulnerability and degradation of land arises out of improper or under-utilization of the existing valley land. If, the potentiality of valley land is fully exploited in the district the pressure on slopes and forests can be considerably reduced.

Moreover, a number of information on varied aspects of the land quality, land potential and the pattern of land classes have been systematically studied and summarised in the relevant chapters of the thesis.

1.7. Justification of the Present Study

The understanding, management and preservation of the vital resource i.e., 'land' is of the greatest importance to

man now. More so, is the case of the developing countries, because of the overwhelming dependence of their population on land and soil resources. The North East Region of India is especially dependent on land resources, since nearly 90.0 per cent or more of the population still depend on agriculture or land related activities. The problem becomes even more acute in the case of the large tracts of areas inhabited by tribal population, principally the hill district of the West Khasi Hills of Meghalaya. The general level of backwardness in this district is even more striking. Unfortunately, the land resource which is the chief means of livelihood of the people is the least managed along scientific principles; rather it is subjected to fast ecological degradations due to the age old practices of shifting cultivation and rising population pressure.

In India, few studies have been attempted on land classification. Most of the studies on 'land' for the purposes of classification have been based on two approaches. Firstly, land classification has been attempted on the basis of potentiality and capability of land. The criteria for the assessment of land potentiality and capability are either soil quality or the production capacity of the soil. Secondly, many of the studies on land classification have been carried out by land use related studies. Such land use related studies can be classified into two classes: (a) agricultural land use, and (b) general land use. A detailed discussion on these approaches

of classification especially for India, have been dealt with in Chapter 2 of the thesis.

Unfortunately, not much information nor sustained studies have been attempted on the West Khasi Hills district, particularly on land and soil quality to understand the problems related to land classification in the district. Being part of the non-land record, non-cadastral surveyed areas of the country, most of the information compiled by different official sources are at best informed guesses. Therefore, the present study can be considered as a pioneering work of its kind, especially in the North East Region of India, so also to the country.

SUMMARY AND CONCLUSION

9.1. Summary

Despite the two hundred years of industrial civilization and its consequent prosperity (or even, poverty) land remains the single most important resource base for mankind. As an offshoot of the industrial phenomenon two philosophical outlooks of man affected the land resources significantly. The first outlook pertains to the supremacy of man over nature with the help of his greater understanding of the natural laws and its inevitable use in technological advancement. The second relates to the inexhaustibility of resource and specifically, the 'land' resource. As a result, with manifold increase in world population and the growing cleavage between the rich and the poor nations, the stress on increased exploitation of land either for food production or demand on housing and settlements and other built up structures and mining and industries has led to shrinkage of availability of land. Moreover, stricter control over international migration does not allow redistribution of population from the over populated to the under populated areas of the world. The single most reason for the alarming situation in land degradation has resulted from over exploitation and under management of crop lands in the developing nations and deforestation in the largest possible scale, although the problem to some extent remains in the developing world. The developing countries have resour-

ces and technology to manage reclaim and restore the degraded land if they desire. On the other hand, the developing nations neither have resources nor a large population allows them to neglect the meagre land resource which forms the basis of their sustenance. Therefore, management, preservation and regeneration of land resource remains one of the chief challenges before the developing countries if a sustainable and minimal standard of living is to be provided to their population.

In the present dissertation, an attempt has been made to study a backward, tribal district, West Khasi Hills of the State of Meghalaya in relation to land classification of the district keeping in mind the environmental processes and identifying various land units (facets) for management, preservation, conservation and regeneration of land both from the point of view of agriculture and forestry which happen to be the chief occupations of the people in the district. The study is primarily taxonomic with normative implications. The main approaches to land classification can be outlined in the following manner.

1. There are three bases of land classification which has been attempted here:

(a) Land classification on the basis of the genetic characteristics and landscape characteristics;

(b) Land Classification on the basis of the land potential with a parametric approach; and

(c) Land Classification on the basis of policy objectives, specifically the environmental management policy in view.

2. The other important approach is also the detailed land classification of the combined catchment area of Um Sohdkhiew and Umthied (two tributaries of the river Kynshi) which will provide indepth insight into the problem since, land classification at the level of the district can be considered as too broad a level.

The main findings of the study are summarised below:

In Chapter 1 of the dissertation, the problem and scope of the study, the hypotheses and the research issues have been outlined. The summary of the relevant literature available for the study and the details of methodology, data base and data analysis-methods and techniques have been discussed in the Chapter 2 and 3, respectively. Chapter 4 provides the general information on population (growth, density, work force etc.), settlement distribution, settlements under shifting cultivation and the economy, mainly agriculture and forestry.

In the first part of the Chapter 5, attempt has been made to identify the macro-regions (ecological zones) in the

West Khasi Hills district. There are ten macro-regions (ecological zones) which have been identified on the basis of genetic approach using the environmental factors like - geology, relief, slope, drainage, climate and vegetation. The regional variations among the environmental factors are significant in the district and they are responsible for the existing landforms. A detailed discussion has been made for these environmental factors which have been used for the demarcation of macro-regions and at the same time, the characteristics of each and every macro-region have been discussed.

In the second part, a discussion has been made to identify the 'land facets' (micro-regions) in the district on the basis of landscape approach. As stated earlier, 'land facet' is a nomenclature given to small land units with homogeneous environmental (or geographical) characteristics. Such characteristics may be the geology, the slope, the predominant soil type or vegetation cover. But, in the present situation of a plateau area, the major control characteristics in determining the facet is found to be the 'slope'. Of course, other characteristics have been assessed too. Considering slope as the main controlling characteristic in determining the land facet, five types of land facets have been identified in the district. They are:

(i) Valley (flat) land - $< 2^{\circ}$ slope

(ii)	Gentle slope	- 2° - 10° slope
(iii)	Medium slope	- 10° - 20° slope
(iv)	Steep slope	- 20° + slope
(v)	Crest land	- Generally mildly undulating.

The entire district has been divided into detailed land facets. There are altogether 189 land facets in the district and they have been outlined in the relevant tables and maps. About 40.0 per cent geographical area of the district is classified as medium slopes (where slopes vary from 10° to 20° slope). The valley (flat) lands, gentle slopes, steep slopes and crest lands occupy 16.58 per cent, 19.63 per cent, 18.87 per cent and 5.72 per cent, respectively. Macro-region-wise, Jadukata river valley (7) has the largest valley (flat) lands, accounting for 31.82 per cent area of the rgion, followed by Nongstoin-Markasa (3) and Balat-Pamkunda (6) macro-regions.

An analysis of evaluation of land potential by use of rating index based on detailed sampling of soils (382) covering the entire district has been attempted in the Chapter 6 of the dissertation. It has been ascertained that out of the three groups of soil characteristics, namely - the physical, the chemical and the site characteristics, soils in the valley (1.67) and gentle slopes (1.61) (< 10° slope) are found to be

most favourable in potential, while the crest lands (1.56) and steep slopes (1.47) (> 20° slope) are the least favourable soils. The physical characteristics, are not as favourable to the valley (1.13) than the gentle slopes (1.16) although the textures of finer (clay), the colours deeper (Deep Brown) and the structures strong. From the availability of chemical nutrients, valley soils are the best with high NPK status and availability of deeper formations of humus and therefore, the presence of organic carbon. However, the pH status of the entire district is highly acidic and therefore, it hampers the process of nutrients transfer (cations exchange) from soil to plants.

There is also a 'gradation' of soil properties from valley bottom facets to crest lands so far as site characteristics are concerned.

When interpreted macro-region-wise (the ten macro-regions), it is noticed that the soil rating status of six macro-regions namely, Riangdo and Nongumdang (8), Mairang (2), Nongstoin (3), Nongkhlaw and Mawdoh (10), Rambrai (1) and Balat and Pamkunda (6) are relatively good. It may be pointed out that these areas contain relatively more of valley and gentle slope areas. Moreover, the percentages of good and very good qualities of soils are relatively higher in these macro-regions. For example, Riangdo and Nongumdang (8)

macro-region has got the highest percentage in very good quality soils, followed by Nongkhlaw and Mawdoh (10), Mairang (2) and Nongstoin (3).

Of all the environmental problems facing the country, the problems of deforestation has received the maximum importance from the point of view of soil erosion and land degradation. As it is mentioned earlier, one of the main casualities of the process of desertification is the hill areas of North East Region of India, where land is being degraded quickly by its faulty use pattern. With the increase in population (3 per cent per annum) and without any significant availability of other avenues of employment, there is a consistent pressure on land and land based resources, particularly, in the West Khasi Hills district of Meghalaya. This has resulted in complete occupation of valley lands permanently and the slopes and crest lands have been occupied by shifting cultivation, resulting in severe soil erosion and land degradation.

Keeping in view the above, a normative basis of land classification (Map 7.14) has been attempted for environmental and agricultural management of the district in three categories; land classified as environmentally 'safe', 'vulnerable' and 'degraded'. More than 70.0 per cent of the land area of the district is classified as vulnerable lands. The vulnerability of land arises out of intensification of landuse on slopes,

deforestation and reduction in shifting cultivation cycle (< 5 years). It may be mentioned here that the north and north-western parts of the district are the most vulnerable due to shifting cultivation on hills and slopes. The safe and the degraded areas of the district are 15.10 per cent and 13.10 per cent, respectively. The environmentally safe areas are mostly the valley and therefore, relatively plain areas where wet paddies and potatoes are grown. Since, land is scarce in the district and there is a scope of great improvements in the rate of crop yield, it is possible to intensify the cultivation practices. The degraded land includes the areas of the eroded rock slopes of the hills and spurs, degraded forests and the grass lands. As mentioned earlier, that due to the acceleration in deforestation and intensification of activities on slopes (over 15-20 degrees and above), the process of land degradation also will accelerate to 3-4 per cent per year. This would mean that within the next 20-25 years a major part of the district will constitute of degraded land only. As indicated in the Map 7.14, degraded areas occur on the both sides of the valleys of the central highland which is densely populated and intensely cultivated. Therefore, these areas require special management techniques as stated earlier, like - (i) civil works for areas prone to landslides, (ii) regeneration of forests, and (iii) protection measures.

Lastly, an attempt has been made to study the micro-

level land classification of the combined area of two small river basins of the district, with the aim of providing basis for environmental as well as agricultural management of land.

The study has been attempted on the basis of landscape approach to micro-level land classification by using aerial photographs pertaining to the combined basin. From the Map 8.17 it is clear that the concentration of settlements at Mairang village is the highest (872), which accounts for more than 65.0 per cent of the total population of the combined basin. Moreover, the density of population is 135 persons per sq.km. (Census 1981) which is more than four times that of the district. This may be due to the fact that the area of the combined basin is small and intensively used for agriculture. Mairang village has got the highest population due to the fact that Mairang is the headquarters of Mairang Subdivision. Moreover, Mairang is almost a valley (flat) area with intensive commercial cropping of potatoes and has good transport and communication with Shillong, the capital of Meghalaya. The classification of average slope zones in the combined basin shows that more than 50.0 per cent area has slopes less than 10°. About 22.0 per cent area has slopes of 10°-20° and another 16.0 per cent area has slopes more than 20° slopes in the combined basin. As a result of the availability of valley and gentle slopes, a large part of the combined basin has been put for permanent agriculture,

like - wet paddy cultivation. The situation of forest cover in the combined basin is rather in a pathetic condition due to the indiscriminate felling of forests and the occupation of hill slopes. The total forest cover in the combined basin is 22.0 per cent which accounts for 11.5 sq.km. of the total area of the basin. Out of which 82.6 per cent and 17.40 per cent come under degraded and moderately degraded forests, respectively.

The agriculture is the main occupation in the combined basin. About 41.0 per cent area of the combined basin has been utilized for different types of agriculture of which permanent cultivation (mostly wet paddy) occupies 23.0 per cent, followed by terrace cultivation (10.0 per cent) and hill slope/top cultivation (8.0 per cent). Rice, maize, potatoes, vegetables, chillies etc. are grown in gardens, particularly the higher slopes as subsidiary food crops. A considerable area is also devoted to high land paddy. It could be mentioned that the cropping pattern in the combined basin is determined more by the topography and rainfall than by any other factor.

Keeping in view the above, an attempt has been made to identify the small land units (land facets) with homogeneous environmental (or geographical) characteristics in the combined basin. A total of 64 land facets have been identified of which

43.27 per cent area falls under flat and valley land facets, followed by gentle slopes (17.31 per cent), medium slopes (15.38 per cent), steep slopes (13.46 per cent) and crest lands (10.58 per cent). On the basis of the attributes mentioned above the Map 8.22 (Chapter 8) provides the micro-level land classification for the combined basin from the environmental and agricultural planning point of view. At the micro-level, such normative classes have already been stated to be of three types: (a) the relatively 'safe', (b) the 'vulnerable', and (c) the 'degraded' land. More than 44.0 per cent area of the combined basin has been identified as relatively 'safe' area and therefore, intensification of crop practices would help the farmers to get better return and thus, taking off the pressure for bringing in additional land under cultivation. The vulnerable tracts of land constitute about 37.0 per cent area of the combined basin. This vulnerability occurs due to the human intervention and also the occurrence of steep slopes. In the vulnerable areas the strategy will have to be protection and conservation. Measures like bunding, terracing, afforestation on the slopes etc. might be necessary. The degraded land constitutes about 19.0 per cent area of the combined basin which includes the degraded forests and grasslands, the eroded rock slopes of the hills and plateaus and spurs. As stated earlier, that continuously over the years, 1-2 per cent more areas are being added to the degraded land

for the district but in case of the combined basin, the process of land degradation (due to population pressure, indiscriminate felling of trees and intensification of agriculture) will be much higher than the district. Therefore, in the degraded land strategy will have to be regeneration of forests and protection measures from soil erosion and land degradation.

9.2. Conclusion

On the basis of the aforesaid study, several implications of general and specific nature arise which require consideration from academicians, policy makers and administrators.

1. Land degradation and desertification which is assuming serious proportions in the developing nations specifically in high density, land dependent, agricultural countries like India, need earnest, immediate and appropriate management and conservation measures if a sustenable and tangible path to development is to be sought. In recent years, the concern of the Government of India on issues of environment, ecological balance, forest policies, and waste land management and regeneration through establishment of various bodies enactment of federal laws and large investments on these sectors like, social forestry, Ganga Action Plan, Waste Land Board, and Hill Area Plans are pioneering efforts compared to other similarly placed developing nations.

However, the question of land conservation, regeneration and management cannot be approached but from a holistic

point of view. In the Indian situation, though land has always remained, historically, in short supply and intensively used for centuries academic efforts, specifically, from geographers have been at best patchy and segmented. Comprehensive classificatory studies on the potentials of land for potential agricultural or other uses have not been adequately studied. In this respect the current study is a first attempt to study various land classes, their potentials and problems from the point of view of management policies for the West Khasi Hills district of Meghalaya which is undoubtedly one of the most backward district of the country and is threatened with severe land degradation.

2. As discussed earlier, the genetic and landscape approaches to land classification are essentially taxonomic in character which for the geographer provides the essential base of understanding the manifest reality. In a situation, where land is neither cadastrally surveyed and therefore, no detailed maps being available, the two tier classification provides a basis for understanding the nature and characteristics of land units of various levels systematically. It also provides insight into the micro causal factors which differentiate one land unit from the other. It is significant that the micro-ecological controls like - slope, natural vegetation, moisture availability and the soil potentials determine the potentials for use of the land to which it can be brought

into. It is these micro variations rather than the commonality of their characteristics which are of interest to us.

3. The parametric approach based on a large number of field samples of soils, profiles and nature of the site characteristics provide insight into the positivist potential of land. Among the five classes of micro-land units (land facets) the valley lands and the gentler slopes which traditionally have been first to be occupied and intensely used are potentially the best for agricultural purposes. However, the medium slopes, the steep slopes and the crest lands have been also occupied whether under permanent slope fields, terraces or under shifting cultivation practices and are the least suitable and highly vulnerable to land degradation. In the district, the potential of the valley and the gentle slopes have not been fully exploited neither in coverage nor through improved crop culture nor in management. Out of the total geographical area of 5,247 sq.km. the valley and the gentle slopes cover nearly 37.0 per cent i.e., 1941 sq.km. or 194,100 hectares. However, the net sown area of the district is less than 4.0 per cent of the total geographical area. The potential land for agriculture i.e., 194,100 hectares provide a per capita availability of land in the district to the extent of 1.2 hectares which prima facie seems adequate from the point of view of food and other needs of the population. Therefore, there seems no justification for occupation of low potential

and highly vulnerable lands as stated for purpose of agriculture or associated usages. Moreover, the medium, steep slopes and crest lands can be put to forestry and horticulture which in long run not only yield higher returns but also help in stabilisation of slopes and therefore, conservation of soils. A number of other scientific studies as cited earlier (Chapter 2) corroborate similar findings and have a suggested appropriate policies for crop plant and management for the hill areas of the region.

4. The study based on an approach of land classification for environmental management of land identifies three broad normative classes of land such as the 'safe', the 'vulnerable' and the 'degraded' lands. This helps us in locating these classes of land in the district, their areal extension, the causal factors and, thus, the necessary policy implications appropriate to those classes of land. For example, the safe class of land can be put to further intensification under suitable crop plants or if not occupied to be brought under exploitation. The vulnerable class of lands are to be protected and conserved either through lessening of intensification of use, terracing, bunding, planting of horticulture plants, reduction in areas under shifting cultivations, reducing deforestation and programmes of afforestation. The degraded lands need specific measures of protection, conservation, and regeneration until their ecology becomes stabilized.

The micro-level study of the combined basin of two rivers such as Um Sohdkhiew and Umthied provide similar implicatons, but being located in a high population density area the nature of exploitation of land is at a higher degree and a large part of the agricultural land is put to commercial crop culture like - potato cultivation. This has resulted in making the entire basin area highly deforested and therefore, vulnerable to land degradation. Thus, in such micro-scale appropriate management measures require immediate attention.

The present study is essentially of taxonomic character and therefore, exploratory in nature. The principal aims, therefore, were to explore the pattern and nature of land classes in their horizontal and generic levels on the basis of existing situation of land. Therefore, no major hypothesis has been planned to be investigated. However, a number of secondary hypothesis have emerged during study (in Chapter 1).

The findings of the Chapter 6 of the dissertation provide that the soils of valley (flat) land and gentle slopes are relatively better in potential than the medium, steep slopes and crest lands. On the other hand, land potentiality declines with altitude and slope. Therefore, the results satisfy the first two hypotheses of the dissertation. Chapter 7

provides that the vulnerability of land arises out of intensification of land use on slopes, deforestation and reduction in the shifting cultivation cycle (< 5 years). The pressure of population of cultivable land has gone up tremendously which has been resulted in occupation of valley land permanently. The slopes and crest lands have been occupied by shifting cultivation, resulting in severe soil erosion and land degradation in the district. This supports the validity of the hypotheses third and fourth.

A micro-level land classification has been attempted in Chapter 8 of the dissertation which provides normative classes of land for environmental and agricultural management of land in a combined river basin. The study indicates that vulnerability and degradation of land arises out of improper or under utilization of existing valley land of the combined river basin. Moreover, the process of deforestation could be minimized if there is any occupational shift and management of land in the district.

9.3. The major limitations of the study are:

i) The present study deals with the land classification based on genetic, landscape and parametric approaches. No study has so far been attempted in this line in India and particularly, for North East Region. The available studies attempted in

this line in India on land classification have been based on land use and land capability classification only. Due to the lack of comparable study for Indian situation, the present study is hampered in improving the methodology.

ii) The district lacks in reliable data and information i.e., secondary information on different aspects of land, existing land use pattern including the extent of shifting cultivation etc. This restrict the study to largely primary and map based data available.

iii) As in rest of the tribal and hill regions of North East, there has been no systematic surveying of land of West Khasi Hills. Since, land is not cadastrally measured, non-availability of detailed maps is a major limitations to which the study was to cope with.

9.4. Suggestions for Further Study

There is a necessity of further detailed studies on land use practices and land classification of the district. The main hurdles before any researcher in this area is the lack of measurement of land (cadastral surveys) which is now high time to be carried out. The greater utilization of aerial photographs at micro-level preferably scale lower than 1:25,000

should be available to the researchers. Moreover, efforts should be made by the concerned authorities to conduct extensive field survey in connection with land classification for the planning purpose. Moreover, in situations like the present one, greater field based approach is the need for the hour, which shall remain of immense challenge to researchers, if fruitful and relevant research is to be carried out on these remote and inaccessible regions of the country.