CHAPTER - 9

SUMMARY AND CONCLUSION
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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-
cess and technology to manage reclamation 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 in-depth 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° 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 region, 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 casualties 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 Sub-division. 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 implications, 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 microscale 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.