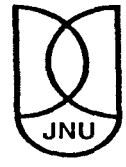
FOREST RESOURCES AND MANAGEMENT IN HIMACHAL PRADESH

Dissertation submitted to the School of Social Sciences, Jawaharlal Nehru University in partial fulfillment of the requirements for the award of the degree of

MASTER OF PHILOSOPHY

SUMEET SINGH



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CERTIFICATE

I, **Sumeet Singh**, certify that the dissertation entitled "**Forest Resources and Management in Himachal Pradesh**" submitted for the degree of **Master of Philosophy** is my bonafide work and may be placed before the examiners for evaluation.

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INTRODUCTION

Man-nature interaction has been going on since the dawn of civilization. The nature through its diverse resource base has been helping man in order to meet its basic needs. The character of this relationship between the two has undergone many changes, wherein earlier nature was dominant, but now with the advancement of technology man has been able to harness the natural resources in his own way. The role of natural resources for the development of a mountainous region is of great importance considering the environmental limitations and rugged topography with limited scope of industrial and agricultural development. The situation becomes more complex due to the steady population growth and the prevalent poverty in these regions. Thus the developmental activities undertaken need to be properly planned lest it might adversely effect the environment which is the store house of natural resources and upon which major part of population of the these regions depends for its sustenance.

The natural resources in the form of matter and energy are of vital significance for the successful survival of all types of life on planet earth in general, and for human beings in particular. In fact, all aspects of human society like social, cultural, political or economic depend upon resources. Therefore, the meaning, classification, assessment and evaluation, use and abuses, conservation and management of all types of resources natural or cultural, renewable or non renewable, are very significant for present day society.

Forest holds an important place among the natural resources since earliest times as this first provided food for people and later raw material for industries and household purposes. The use of forest for providing employment, fuel, grazing and for reclaiming cultivable land are only some of the benefits other than the indirect benefit to the environment of the region. Although its importance as a fuel resource has decreased over time, however, the importance of forest in Indian context is still very important as more than seventy percent of the population of India is rural and is directly or indirectly dependent on forest for daily life.

The significance of forest resources for a hilly and mountainous state like Himachal Pradesh is still greater as these provide a delicate balance for man-environment relationship in this state having fragile ecology. The Himalayan ecosystem is known for its uniqueness and diversity. The majestic Himalayas abound in unique flora and fauna and are store house of diverse range of species. Amongst it, the forest ecosystem, due to its fragility and biodiversity is important for the study.

Forest also performs multiple functions which have direct as well as indirect use to human beings. These can be categorized as natural and man imposed. Natural functions are protective and regulative services which are intangible and are related to "qualities". Man imposed functions are production of tangible goods, related to quantities and intangible socio-ecological services again related to qualities.

Protective and regulative services:

Forest have a beneficial influence on the climate as the trees act as pumps, sucking up the ground water from below and transmitting it as moisture to the air. This results in increased humidity and thus influences temperature. Forest also protect the soil from erosion on the hill slopes. These arrest the soil and break the force of runoff, thereby preventing the top layer of soil from being washed away by fast flowing rain water. These also conserve the fertility of land by enriching the soil with vegetal matter.

The vertical mass of trunks of trees also forms a protective barrier against the hot and cold winds for the habitations and agricultural fields. The vegetation increases evapo-transpiration and percolation and consequently decreases run-off. The reduced run-off prevents floods. The increased percolation results in conservation of water in sub surface resulting in the recharging of springs and aquifer.

Trees consume carbon dioxide from the atmosphere during the process of photosynthesis and release oxygen. Forests are therefore, the most effective mechanisms to maintain the carbon dioxide balance in the atmosphere, and by the release of oxygen they purify the air.

Material goods and productive functions:

The most important produce from forest is wood. The use of wood varies from domestic use to that in commerce, industry and communication. It also meets the fuel wood requirements of a large section of population in rural habitations.

Apart from wood, forest give various products such as fruits and seeds, leaves, barks and roots, gums and resin and grasses. These are used for purposes which range from food to medicines, from cordage to clothing, from oils to perfumes, from paints to dyes and from detergents to disinfectants.

Socio-ecological services:

Forest provides socio-ecological services which have grown in value terms with the advancement of civilization. The main services performed are the preservation of genetic diversity through a variety of plants and wildlife, creation of employment opportunities, recreation such as the eco-tourism which is gaining prominence in modern times.

Services and functions performed by forest for the humankinds benefit are many and varied. It is quite clear that forests are man's best friend. They perform their services with devotion without charging anything.

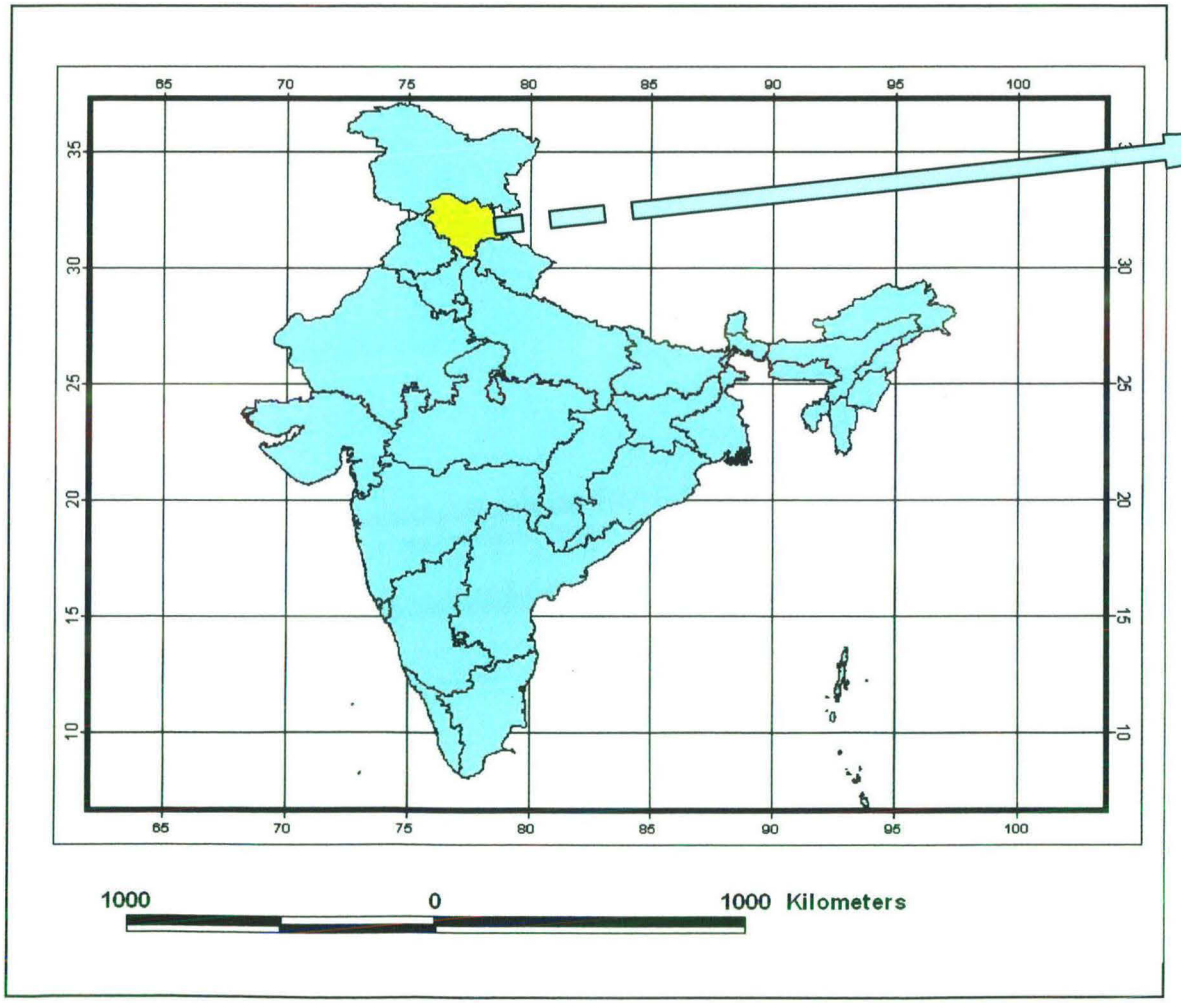
Environment as a factor can't be neglected while discussing the issue of development of Himachal Pradesh. The state has five parallel mountain ranges each having unique flora and fauna with certain combinations of physical factors. This has resulted in the diverse nature of forest resources and species which vary from the tropical, sub-tropical, temperate to alpine varieties. Thus it has a large biodiversity, preservation of which is of great importance. Rapid growth of human population in the state since independence has put a tremendous pressure on the forest land which is being cleared for agricultural and horticultural pursuits. Recently, boost in the horticultural activity has led to considerable clearing of forest for planting horticultural crops.

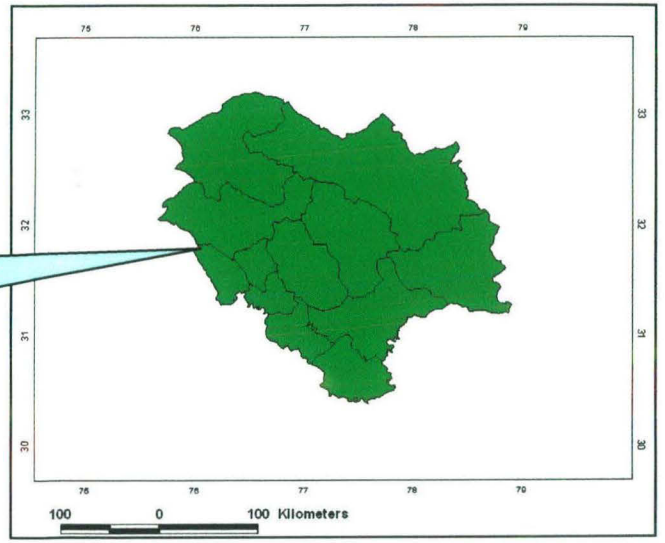
The importance of the above facts have been highlighted by Tucker (1999) who said, "both the government of India and independent resource planners now recognize that the Himalayas are both a unique source for the life of India and an extremely fragile ecosystem which must be managed both as a coordinate development system and as a high priority in its own right not just as an appendage to economic and political interest of North Indian

Map No 1.1

LOCATION MAP

HIMACHAL PRADESH





plains"[1]. Keeping these in mind and appreciating the various uses of forest, it has become important to manage the forest resources of Himachal Pradesh to sustain these over a long time and to establish equilibrium of man -environment relationship.

1.1 STUDY AREA

The Himalayas have been rightly called the greatest physical feature on the earth. This great chain of mountain rises transversely on the Asian land mass spanning a length of more than 2500km from "Nanga parbat" in the west to "Namcha Barwa" in the east.

It is a colossal crescent of varying width from 250 to 400 kms. This great chain of mountains has had tremendous impact on the geography, history and culture of India. This region is vast and varied agglomeration of complex eco- systems. It has an area of 5.3 lakh sq.km which constitutes, about a little more than one sixth of the total area of India.

The principle physical resources are the land, vegetation and water. Inaccessibility, remoteness, difficult topography and ruggedness of the terrain have imposed severe constraints on the employment and income opportunities for the hill people. Though on the whole, the density of population is low the pressure on agricultural land is intense because very little farmland is available. The whole region represents a steep climatic gradient varying from sub-tropical to arctic and altitudes ranging from 300m to 8000m. The landscape of the Himalayas is characterized by lofty mountains, innumerable snow clad peaks, glaciers, deep gorges and glens, roaring waterfalls, wide and narrow valleys and mountain plateaus.

Himachal Pradesh:

The state of Himachal Pradesh is a green pearl nestled in the western Himalayan mountain range. It extends from the perpetual snowy mountains separating it from china, Tibet in the north to Punjab plains in the south and west. It is situated between 30° 22' 40" and 33° 12' 40" north latitudes and 75° 47' 55" and 79° 04' 20" east longitudes. The elevation ranges from 350m in the foothills to 6975m in the high mountains.

The hilly and mountainous state known for its natural wealth, forests, meadows, rivers and valleys is endowed with rich cultural and religious heritage. The majestic array of perpetual lofty snow peaks presents a breath-taking panoramic view visible from far and

wide, whereas the lower hills and valleys appearing like ripples presents a sublime and delightful contrast. The four physiographic zones viz. Siwalik hills, lower Himalayas, higher Himalayas, and Tibetan Himalayas run almost parallel throughout the length of the state from east to west and are separated by deep gorges, glens and valleys.

Many important major rivers have their origin in the state, prominent among them being Ravi, Beas and Chenab. Satluj is the most important river of the state and has its origin in the adjoining Tibetan plateau. All these rivers drain Indus plain which is part of the vast Indo-Gangetic plains and sustain agriculture. The climate of Himachal Pradesh is subtropical in the lower part, temperate in the large middle portion and arctic in the high mountains covered perpetually with snow. The state has primarily an agrarian economy. Horticulture has come up as an important sector in the current land use planning in the state. Also it has become a tourist attraction because of its natural scenic beauty, flora and fauna.

1.2 LITERATURE REVIEW:

To get a broad understanding of the subject matter of the study, the relevant literature is collected. This helps a lot in forming a framework of the study which includes the objectives, research questions and the methodology. The literature related to the Himalayas is in plenty but that related to forest resources of Himachal Pradesh is comparatively limited. The relevant literature collected in the form of books and articles have been categorized keeping in mind various aspects related to the study.

Physical aspects:

Physical set up of a place has an important bearing on the vegetation and forest of an area. By this we mean terrain, climate, soil and processes related to these. All these influence the vegetative adaptations of tree species. This is especially true in case of Himalayan forest ecosystem as the vegetation varies both altitudinally and also according to soil and climate.

Chib[2] (1977) in his book talks about the state of Himachal Pradesh and discusses its physical and socio- cultural aspects. The second chapter in this book dealing with the Physical aspects is important for the present study. This chapter describes in detail the relief, geology and drainage pattern of the state. The third chapter on Climate dealing with seasons, temperature and rainfall and vegetation and soils is also useful.

Mukerji[3] (1990) in his article has analyzed the land use cover of the state of Himachal Pradesh with elevation as its basis. This spatial-altitudinal land use pattern is shown with respect to the zones. The altitudinal zones covering different districts are also drawn. The climatic aspects relating to temperature and rainfall are also discussed.

The article by Lal, Sah, Sharma, and Pal [4](1992) discusses in detail the physiography and geomorphologic aspects of Pauri garhwal. The valley forms, slope features, terraces and geology has been discussed in detail. On the basis of this the land use practices and its viability have been discussed. Singh[5] (1992) in his article has touched the theme of man-nature interaction in the Himalayas. He also describes the human response to the environmental constraints with special reference to the region of Ladakh.

A report[6] (1981) by Himachal Pradesh forest department describes the various ecological zones of Himachal Pradesh which are delineated according to the altitude. This report also mentions the climate, geology, flora, fauna and soil within each zone which provides us a good knowledge of diversity of species and the heterogeneity present within it.

Modern techniques of Remote Sensing and Geographic Information Systems have been applied to detect the land use / land cover changes in the ecologically sensitive catchment area of Tehri dam in Garhwal Himalaya in the article by Rantila, Rakshat, Jha, Gupta and Munshi[7] (2002). The article throws a great deal of light on the uses of Remote Sensing and Geographic Information Systems in the detection of land use changes and suggest suitable remedy for it. The book by Negi[8] (1993) gives us general information about the state of Himachal Pradesh and its various physical and cultural aspects. The fourth chapter on Geology is especially useful for getting the in-depth knowledge of structure of rocks in the state. The fifth chapter which deals with the natural vegetation and forest describes the principal forest regions and species of Himachal Pradesh.

Forest ecology:

The forest ecology of an area comprises of various species of vegetation available in the region, the complex interaction going on in between them in order to sustain itself. The vegetation species adapt themselves to the surrounding environment and thus preserve the ecology of the region.

A research report by Singh[9] (1999) gives in-depth detail about hill areas of India and the delicate man environment relationships developed therein. The noted scholar of hill regions has also given detailed case studies of some hill regions with particular emphasis of Socio–Cultural aspects on environment of Himalayan regions. His report is well documented and substantiated with diagrams and database. This study was especially useful for the current research work.

Singh[10] (1987) in his book has dealt in detail about the forest as a resource, taking Jammu and Kashmir State as a sample. The physical setting, types and distribution of forest, major and minor forest products and forest based industries has also been described. This book provides a store house of knowledge regarding the ecology and vegetation species of the state of Jammu and Kashmir. An article by Sahni[11] (1988) deals with the problem of erosion across the state of Himachal Pradesh. Its effect and extent on the degraded and wastelands are especially stressed considering the lack of tree cover on them. The effects of various soil processes upon the settlements established therein have also been discussed.

The article by Thakur[12] (1993) talks about the forest cover of Himachal Pradesh and net revenue accrued from it over a time series. The species composition and the volume of timber extracted are also elaborated upon. He also stresses the management of livestock especially cattle as it is the single largest grazing animal. The utilization of forest wealth in the initial years of development after independence is discussed in the article by Prarthi[13] (1971). The article stresses the importance of forest for the state of Himachal Pradesh and for the people living therein. The outturn of forest produce and revenue generated is also mentioned.

Chand's[14] (1996) article describes how agricultural diversification through horticultural development and off season crops was affecting the ecology and forest of Himachal Pradesh. The article takes a serious note of the fact that there is wide spread encroachment of forest areas for horticultural pursuits. Some positive and negative aspects of horticultural development have been described. The article carries preliminary primary survey and has ample empirical backing. The recent development of Horticulture in the state of Himachal Pradesh is discussed in the book by Azad, Swarup and Sikka[15] (1998). The second chapter which describes the land use pattern in the state and various agro-climatic zones is of much importance for the current study.

Forest stock and species of Mandi district and its spatial extent has been dealt in detail in the article by Singh and Rana[16] (1991). The various problems faced by the forest department in this region are also discussed and the various major and minor forest products being produced from the forest is also given. The cartographic maps showing vegetation distribution is also given.

Social and Cultural aspect:

Any aspect of resource management will be a sheer failure unless there is full cooperation and engagement of general mass of society. Thus people's involvement in forest conservation and protection is quite important.

The book by Tiwari[17] (1984) deals with the question as to why social forestry has become so important and how it can help in restoring the environmental balance and provide employment to the landless in a big way. It also stresses the fact that the rural people of the state are more or less dependent on forest resources for their daily tasks and thus people's participation is a must for the conservation of forests. Agriculture is the livelihood of majority of people of the mountains. The article by Singh[18] (1992) touches this theme and describes how the environment acts as a constraint in the agricultural development of Ladakh region in Trans Himalayas. The cropping pattern and growing seasons of Ladakh and its dependence on climatic factors is also mentioned.

Singh[19] (1990) in his article has tried to direct our attention to the process of urbanization in the state of Himachal Pradesh. Urbanization as a process started quite late in the state but has picked up recently. But still the urban population is very less and majority of the population is rural. He has tried to explain the growth and dynamics of different classes of towns in Himachal Pradesh. Religious composition of urban population and its change through time is also given.

The study of effects of socio-economic change on the ecology of Himachal Pradesh is analysed in the article by Gupta[20] (1990). Some historical accounts and post independence phase of changes due to development is also given. The economic prosperity from the development of horticulture and tourism and its impact on the ecology of the state is analysed. Kant[21] (1995) in his article tries to study the impact of economic development on the environment of Himachal Pradesh. The article also deals with the forests of Himachal

Pradesh and the problems faced by it. The various ecological zones and the main problems associated with it are also discussed. The government effort to tackle these problems is also mentioned.

The article by Raza and Singh[22] (1983) throws light on the aspects of development in the Himalayas. The process of development in the mountain regions should be undertaken carefully lest it might have an adverse impact on the environment. This article is quite useful to understand how the process of development can be quantified through the selection of various socio-economic indicators which would help in depicting the true picture. The weightages given to various indicators are also given. Bisotra[23] (2002) has touched the various aspects of demography like density, sex ratio, growth, migration etc in his article. He describes the various demographic indicators and the temporal changes therein. In another article by Kayastha[24] (1990) the problem of growing pressure of population on limited resources of Himachal Pradesh is highlighted. It points towards the increasing agricultural density in the state as a major cause of concern and provides with a simple model as a solution to some of its ills.

Forest policy, property rights and management:

For the better management and conservation of forest the government has enacted forest policies from time to time. These policies and the common property rights of rural villagers living in vicinity of forest often clash with each other leading to encroachment on forest land. Thus it is very important to strike a balance in these aspects.

Somanathan[25] (1991) talks about the core issue of deforestation in central Himalaya and how the property rights of villagers could help in decreasing it. The article stresses the fact that the rural people of the state have traditionally been using the forest resources since ancient times without harming the forest adversely. These rights of the people should be respected if proper management of forest is desired. Hallsworth[26] (1995) gives us an insight into the status of forest resource base and some management aspect's and people's rights regarding forest. This article presents the picture of forests of India and the various problems faced by it. The article says that one of the major causes of deforestation in India is the rampant poverty and illiteracy.

The article by Chhatre[27] (1996) examines the issue of forest bill and natural resource management bill and the ongoing debate between the two. It provides us the summary of both the bills and its positive and negative aspect.

The importance of common property resources in the lives of rural villagers is emphasized in an article by Berkes et al[28] (1998). It is a detailed study evolving village level survey and examination of land use pattern and the importance of common resources. These common property resources like the panchayat lands and shyamlat lands serve as the grazing lands for the villagers. But the main problem remains in the social set up in which higher castes get the large part of land and the lower castes are neglected. Also the influence of social hierarchy in the utilization of common resources is also discussed.

The article by Vasan[29] (2002) describes the historical evolution of the various practices of forest management in the state of Himachal Pradesh. The forests were looked after by the community as a whole in earlier time and were utilized collectively in a sustainable manner. The rights of common people and the various practices adopted by the people in this regard are also mentioned. The examples of various institutions involved in managing the forest resources are also given.

The chapter on forest management in the book by Negi[30] (1990) describes the various practices adopted to manage various tree species which are of economic importance and are being rapidly exploited in the Himalayas. It also gives us an insight into the various policies, objects, silviculture systems and working plans of the government.

Forest degradation:

Forest if not properly managed gets degraded over a period of time due to several factors and reasons. Most common causes of forest degradation are forest fires, illegal cutting, lopping, over grazing etc. Degradation of forest must be stopped so that forest ecosystem which gives human beings so much benefit can be conserved.

The article by Tucker[31] (1988) deals with the historical aspect of forest management in Thane district of Bombay. This article gives us insight into the various rights and privileges of people during early 19th century. The various practices of exploitation of forest resources are also mentioned. The politics associated with forestry is also described in it. Another article by Tucker[32] (1988) deals with the issue of deforestation in Assam and Kerala.

This throws light on the earlier policies of British which encouraged plantation crops like tea at the cost of depletion of forest resources. The problems of forest of Uttranchal are dealt in the article by Nanda[33] (1990). One of the major problems is the forest fires which has become an annual phenomena and vast tracts of *Pine* forest get affected due to it. The problem of lopping and grazing in the forest is also discussed. It also throws light on the aspects of deforestation and growing demand of wood.

The assessment of deforestation in isolated and hostile environment with the help of Remote Sensing and Geographic Information System has been done by Srivastava, Singh, Singh and Roy[34] (2002). The problem of deforestation in remote area is caused by various factors like fires, shifting agriculture and illegal felling and wildlife poaching. The article by Singh and Singh[35] (1994) deals in detail the situation of deforestation in Uttar Pradesh and how it has affected the delicate man-environment relationships. It is one of the major problems in state and every year a vast tract of forest land is affected by it and also the settlements surrounding it. The various roles and advantages of forest and its impact by felling on the environment have also been described.

The burning issue of forest fires of Uttranchal is dealt by Mukhopadhayay[36] (2001). The article stresses the fact that the main causes of the forest fires is the large number of *Pine* forest in the state which when combined with pre-monsoon heat causes rampant fires. The main causes and types of forest fires have also been discussed. Forest fire management through the application of Remote Sensing and Geographic Information System has been dealt by Shastry, Jhadhav and Thakkar[37](1998). The main indicators or factors which affect the fires is selected and based on the importance the relevant weightages are given to it. A forest fire risk map has also been prepared by incorporating the various indicators along with their weightages with the application of model builder in Geographic Information System software.

Forest and forestry:

Forest offer humans a variety of benefits both directly and indirectly. Thus forests are a man's best friend. But the indiscriminate use of forest resources due to greedy human nature has led to destruction of forest. The forestry sector and forest based industries have

been the major consumers of forest. Considering these facts, the sustainable use of forest is required so that coming generations can also make use of it.

Agarwala[38] (1988) talks about the forest in detail taking various aspects like extent, species and distribution etc. Some forest management concepts and policies have also been described. Sharma[39] (1978) has thrown some light on the available forest resources to support pulp and paper industry, ply-wood and match industries and also about the availability of fuel wood from our forests for the growing population. The book throws light on the dismal state of forestry sector in India and the various plans which supports the forestry projects. Tucker[40] (1993) presents a historical perspective of forest resources and its exploitation in western Himalaya. It throws light on the vast clearing of forest for the settlements, expansion of agriculture and construction of railway tracks by the British. The earlier policies of forest department are also mentioned in it.

In another article Tucker[41] (1991) focuses our attention on the decline of forest and pasture resources of Himachal Pradesh which are associated with the traditional livestock economy. The pre-independence British policies for grazing and herding are also mentioned. Tucker[42] (1993) in another article throws light on the earliest stages of management and utilization of forest resources of Himalaya by the British. The changing character of forest of Himalayas and some policies and enactments related to forest have also been discussed. A study conducted for Center for Science and Environment, New Delhi by Sodhi[43] (1995) provides an insight into the problems of grazing during ancient times. The British administration and its policies related to grazing rights of villagers have also been documented. Some case studies are also given to substantiate the issue.

Lal[44] (1989) presents a wealth of information in perspective forestry practices that would be appropriate in given circumstances taking into account both ecological needs and the economic imperatives. The article by Tewari[45] (1986) covers a wide spectrum of issues relating to forestry development with people oriented approach to benefit the poverty stricken rural masses, women and children. Various aspects of forest like energy resource, minor forest produce, industries, wildlife, environment has been dealt. Social forestry and rural development and its role for tribals have also been highlighted.

The book by Douglas, Hart, and Ranganathan[46] (1982) discusses the role of forest and tree crop in farming and offers detailed advice and information on various economic species,

the use of their products for food and raw materials, planting, techniques and suggestions and guidance for the layout and operation of schemes of forest farming. The article by Sinha[47] (2002) describes about the extensive *Pine* plantations in the Himalayas and its various harmful effects on the fragile Himalayan ecosystem. The importance of forest in the economy of Himachal Pradesh is highlighted in the article by Thakur[48] (1997). The outturn of major and minor forest produce and revenue generated out of sale of it is also discussed. The role of Himachal Pradesh Forest Corporation in the overall economic utilization of forest resources is also described.

The overview of above mentioned literature is quite helpful in throwing light on the study area and the problems of forest in Himachal Pradesh. With this knowledge in mind the framework of the present study is prepared which goes a long way in finding the root causes of the problems and finding solutions for it.

1.3 OBJECTIVES:

The study has the following objectives:

1. To analyze the physical environment of Himachal Pradesh in order to see its relationship with the forest resources.
2. To examine relevant Socio-Cultural aspects for assessing their role in changing forest cover.
3. To assess the Land use, forest cover, species composition and their temporal changes.
4. To study the major and minor forest products of the state of Himachal Pradesh.
5. To study the various management policies and institutions started by state government for conservation of forest resources in Himachal Pradesh.

1.4 RESEARCH QUESTIONS:

1. What is the land use pattern of Himachal Pradesh? Which factors govern the shift in the forest area of the state?
2. What are the various forest types and the species of trees found in the forest of Himachal Pradesh?
3. Has the dense forest cover declined in the state of Himachal Pradesh?

4. What is the trend in the growing stock and annual yield of commercially important species of trees in the state forest?

1.5 DATABASE:

To analyze the above mentioned objectives the relevant data supporting it is also needed. Thus the data used for meeting the objectives has been procured from secondary sources. These sources include:

1. Survey of India Toposheets on the scale 1:50,000 numbered 52H/3, 52H/4, 52H/7, 52H/8, 53E/1 and 53A/13.
2. State Statistical Abstract of Himachal Pradesh, 1999, Department of Economics and Statistics, Shimla.
3. Census of India, 1991, Series9, Himachal Pradesh, Part II-B, Primary Census Abstract, Directorate of census operations, Shimla.
4. Census of India, 2001, Series 3, Himachal Pradesh, Paper-2 of 2001, Provisional population totals, Rural-Urban distribution, Director of Census operations, Shimla.
5. Census of India, 2001, Series 3, Himachal Pradesh, Paper-1 of 2001, Provisional population totals, Directorate of census operations, Shimla.
6. Census of India, 1991, Series 9, Himachal Pradesh, Part XI, Census Atlas, Directorate of census operation, Shimla.
7. H.P Forest Statistics, 1986 and 2000, Forest department, Shimla, Himachal Pradesh.
8. Annual Season and Crop report, 1990-91 and 1999-2000, Commissioner (Revenue), Shimla, Himachal Pradesh.
9. Satellite imagery procured from National Remote Sensing Agency, Hyderabad on the scale 1:250,000 for the year 2002.
10. District planning map series, Kullu, National Atlas and Thematic Mapping Organization, Department of Science and Technology, New Delhi.
11. State of the Environment report- Himachal Pradesh, March 2000, State council for Science, Technology and Environment, Shimla.
12. Annual Administrative report, 1999-2000, Forest Department, Shimla, Himachal Pradesh.

As the data related to forest of Himachal Pradesh was not available, so the researcher made a field tour of Shimla in March 2004 to collect the forestry data at the district level. The relevant data was obtained from the forest department head office. It also gave him first hand information regarding the study area.

1.6 METHODOLOGY:

The study involved the usage of both cartographic and statistical techniques for the presentation and analysis of information. The cartographic maps comprised of climate maps depicting the temperature and rainfall, ecological zone map, drainage map, relative relief map and soil map which helps in the understanding of the physical environment of the state. Making of these maps involved extensive usage of Geographic Information System software Arc View 3.2a. Further the land use pattern and forest cover density maps of the districts have been shown with the help of proportionate circles involving the usage of Arc View 3.2a software. The data pertaining to the major and minor forest products has been shown with the bar diagrams.

A correlation analysis has been done between the land use classes of Forest area and the area under the classes of Net Area Sown, Non Agricultural Uses, Fallow Lands, Culturable Waste, Miscellaneous Tree Grove and Pasture and Grazing lands. This helps us to know the relationship between the various classes of land use. To study the extent of this relationship between Forest and other classes, a stepwise regression was done between the Forest class and other classes of land use. In stepwise regression the computer is programmed to introduce predictor variables one at a time in order to determine the sequence that makes the coefficient of determination (R^2) climb the fastest. It also lets us know that which of the dependent variables is the most important affecting the changes in the dependent variable. The final regression is the one that includes the predictor variable which tries to explain the shift in independent variable the maximum. The estimated relationship between the independent and dependent variables is given by:

$$Y = a + b\,x$$

Where $$b = \frac{\Sigma xy - \frac{\Sigma X \Sigma Y}{n}}{\Sigma x^2 - \frac{(\Sigma X)^2}{n}}$$ and $$a = \bar{y} - b\bar{x}$$

The coefficient of determination is found out which tells us the proportion of variation in Y as explained by X. A test of significance is also performed to show the validity of the regression model.

The statistical technique of coefficient of variation (C.V) has been applied to study the distribution of dense, open and forest blank areas within each district of Himachal Pradesh. To study the land use changes in the case study area of Upper Beas Basin, extensive use of Remote Sensing and G.I.S has been done. Several maps depicting the forest cover and tree species were also drawn with the help of Erdas Imagine 8.4 and Arc View 3.2a softwares.

The present study evolves the usage of various statistical and cartographic techniques. These techniques help a lot to substantiate the relevant information with statistical backing and validity. Thus with the help of these we analyse the information and arrive at a suitable conclusion.

1.7 ORGANIZATION OF MATERIAL:

The present study entails the use of various aspects related to the topic which has been organized in a suitable manner. The first chapter deals with the statement of the problem, introduction to the study area, objectives, database and methods of the study. Literature review has also been done to get some information related to the topic and also to make a framework for analysis.

The forest and vegetation wealth of a mountain state like Himachal Pradesh is directly dependent on the environmental parameters and indirectly on the socio-cultural aspects. The second chapter thus deals with the environmental setting of the study area which covers aspects of geology, physiography, drainage, climate, soils and relative relief. It also cover socio-cultural aspects like population growth, density, literacy, sex ratio, urbanization etc. as there is a delicate interaction between humans and forest ecosystem in the region.

The third chapter deals with the forest resources of Himachal Pradesh. This gives us an in depth information related to forest cover, type and species composition, area under reserved, protected and unclassed forest and the area under dense and open forest. Land use

cover and its changes have also been dealt. It also discusses the yield and standing volume of major commercial species of trees and production of major and minor forest produce.

Management of forest resources, forest policies, its historical aspects and management practices of forest department forms the fourth chapter of the study. The various problems of forest like forest fires, deforestation, encroachment and grazing etc will also be dealt in this chapter. An analysis of forest of Upper Beas Basin is also done with the help of satellite imagery. The study ends with the summary of conclusions in the form of chapter five.

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CHAPTER II

PHYSICAL ENVIRONMENT AND SOCIO-CULTURAL SETTING

The physical setting has a significant influence on the path of development of a region. The human response also varies in accordance with it. Hill/ mountain areas due to their topographic ruggedness have limited scope for agricultural and industrial development. This has led to a simple subsistence economy with some diversification towards horticultural activities. The environment plays a major role in the life of rural society in the mountains. Thus the study of the physical set up of the region assumes importance.

The environmental setting of a hilly and mountainous state of Himachal Pradesh is all the more important considering the fact that every aspect of human life be it social, political or economic is influenced by it either directly or indirectly. The topographic ruggedness and hostile climate are important aspects which determine the level of development and the relation between these two is precariously balanced. Environmental setting here denotes geology, physiography, drainage, soil and climate all of which are interrelated and have important implications for the society living therein. Thus, it becomes important to study the following:

- Geology which has an important bearing on the lithological structure of the region.
- Physiography upon which nature's force act and resultant landscape emerges.
- Drainage serves as the life line fulfilling the water requirements of the society and gives shape to physical landscape.
- Soils are largely the consequence of interplay of natural agents and determines agricultural pattern.
- Climate has a significant role in overall sculpturing of landscape and development of the society.

Being a part of Western Himalaya the state of Himachal Pradesh has a fragile environment which is ecologically vulnerable. The Himalayas appear to be strong and formidable, but environmentally they are weak, prone to destruction and the man-environment relationship is precariously balanced. Regarding this the International Mountain Society (I.M.S) has observed "The world's mountain regions may have the appearance of

being remote, durable and barely affected by the environmental ills that beset the more densely populated areas of our living space. This is not the case. What is worse, when mountain environments are degraded they often take longer to recover than many other types of environment. It is increasingly evident that their low priority on the world's environmental agenda can't be allowed to continue."(I.M.S, 1991)[1]. As elsewhere this statement holds true for Himalayas.

2.1 Geology:

The geology of Himachal Pradesh is complex lithologically, structurally, and tectonically. Being a part of the Himalayas, its geological structure is much the result of the Himalayan orogeny. Himalayas came into being due to the upliftment, folding, faulting of the sediments of the Tethys sea during Eocene, Miocene, and Pliocene periods. Structurally Himachal Pradesh falls into four sub-divisions viz Outer Siwaliks, Siwaliks, Central part and Eastern part.

While the outer Siwaliks are made of recent alluvium, the Siwaliks are made of tertiary rocks like sand stone, clays and conglomerates which came into existence during Pleistocene, Oligocene, Eocene, and Cretaceous periods. The deposits of this type are found in Una, parts of Bilaspur, Hamirpur, Solan and Kangra. "The Nahans are separated from the Eocene beds of the lesser Himalayas by the main boundary thrust which probably measures the whole length of the Himalaya right from Assam to Beas, demarcating the northern boundary of the Siwalik series."[2] Siwaliks assume the wildest nature in the Beas valley. Sirmaur series is separated from Siwaliks by a fault.

The central part of Himachal Pradesh extends from Chamba district in the north, to Shimla in the south and is formed by Jatog group of rocks which originated in the middle of the Proterozoic period. The area around Shimla is very complex geologically with rock structures such as shale, Diaban, Larji groups and Krol series. The Rampur- Banjar area has the Mandhati-Chandpur formation which is bordered by unclassified granites in the north eastern part extending between Kullu, eastern Shimla, Lahaul- Spiti and parts of Kinnaur district.[3] The Haimanta group of Cambro-Silurian period extends in a patch from North to South in between Lahaul –Spiti and Kinnaur districts. Rocks of this central zone belong mostly to granites and other crystalline groups and are mostly devoid of fossils as such.

The eastern part is composed of Triassic formation which is found in Kaza Tehsil of Lahaul-Spiti district. Rocks of Devonian period which are mostly quartzites are found in Manikaran, Magthal and Muh.[4] The western and north eastern part of Kinnaur district is composed of Haimanta and Unclassified granites of Cambro-silurian period of Blaini formation of Permo-Carboniferous period respectively. The south and south western Kinnaur and some parts of eastern Shimla districts have not been surveyed for geological structure.

It is clear from the above discussion that the geology of Himachal Pradesh is very complex. A large variation in lithology, structure and tectonicity is observed within the state. Great regional variation in lithology is also observed within the state. It was the result of the various mountain forming processes being observed during the Eocene, Miocene, and Pliocene periods.

2.2 Physiography:

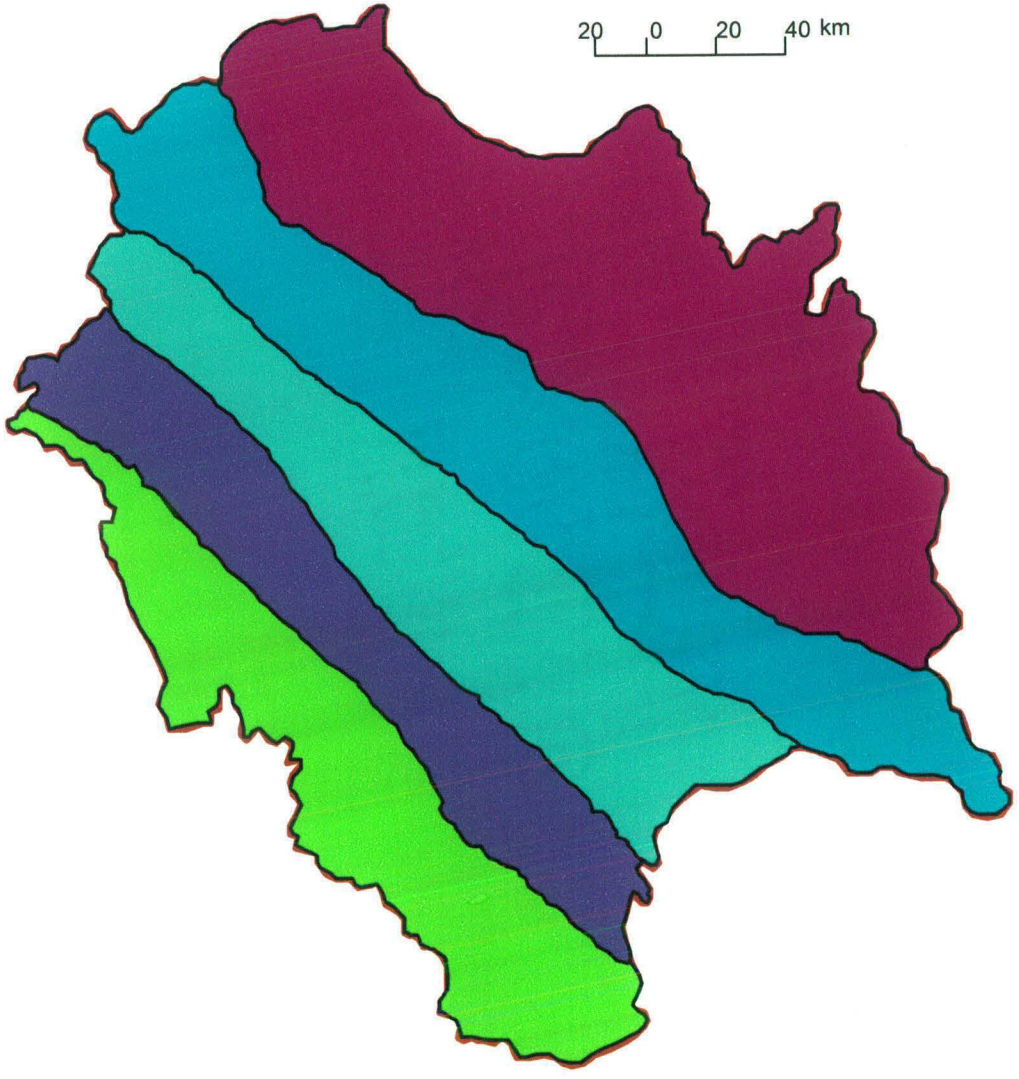
The state of Himachal Pradesh is a unique physiographic unit in the western Himalaya. It presents a rugged, undulating topography which is criss crossed with mountain ranges thus giving it complexity. Study of physiography becomes important as each physiographic zone has a unique physical, socio-cultural identity which is different from other zones.

The general elevation of the state varies from 261mts to 6791mts above mean sea level. There is an increase in altitude from west to east and south to north. Regarding the general elevation of the region it is said "with the exception of broad valleys in the districts of Kangra, Una, Solan and Sirmour which have lower elevation, the rest of the state is criss-crossed with lofty mountains, hills and narrow valleys and basins."[5] Snow clad peaks and glaciers are quite common at higher elevations. These are the sources of many rivers of Himachal Pradesh which are perennial in nature and have in turn been responsible for the creation of many beautiful gorges, canyons and valleys.

Himachal Pradesh has five important mountain ranges, almost parallel to each other with longitudinal valleys in between them. The Dhauladhar range stands over guard the Kangra valley while the Pir Panjal, the Great Himalayan range and the Zanskar mountains over look Chamba, Lahaul-spiti, Kullu and Kinnaur. The snow clad mountain peaks gives a delightful experience with chilly winds moderating the summer temperature. The Siwalik

Map No 2.1

HIMACHAL PRADESH
ECOLOGICAL ZONES



Kant.S, Development and the environment in an Indian Mountain State, Geographical Review of India, vol 57, No2, June 1992.

ranges form the outer boundary in the South-western side separating this land from the warm humid plains of Punjab.

The state of Himachal Pradesh can be delineated into vertical (altitudinal) and horizontal (regional) ecological zones supporting distinct flora, fauna, geology and climate.[6] The overall pattern of vegetation and wildlife in Himachal Pradesh is due to the complex interaction of variety of factors viz. altitude, climate, physiographic and biotic. These zones are quite flexible because of micro topographic variations affecting vegetation and migratory pattern of fauna. Himachal Pradesh can be broadly divided into the following eco-systems:[7]

Table 2.1

Ecological zones of Himachal Pradesh

S.no	Ecological Zones	Districts	Approximate elevation
1.	Outer Himalaya or Siwalik hills	Bilaspur,Una, Hamirpur	Upto 800 mts
2.	Lower Himalayas	Solan, Sirmaur, Kangra.	1100 to 2000 mts
3.	Lesser Himalayas	Shimla and Mandi	1200 to 2500 mts.
4.	Greater Himalayas	Chamba and Kullu	1500 to 3000 mts.
5.	Trans Himalayas	Kinnaur and Lahaul-Spiti	More than 3000 mts.

As given by Surya kant (1992) in 'Development and the environment in an Indian mountain state'. *Geographical review of India*, Vol57, No2, June.

1. Outer Himalayas or Siwalik Hills :

The Siwalik hills known by the name of 'Mainak parbat' in ancient time, lies between the lower Himalayas in the north and Punjab plains in the south. These have elevation varying from 60 mts to 1150 mts enclosing valleys and duns averaging 360m – 450m. The zone extends from Chamba to Siramaur along Siali-Hathidhar (Chamba), Solasing Kotidhar (Hamirpur), Panchmunda (Solan) and Dharti-Saindhar (Sirmour) hills. The duns are Jaswan, Kiarda, Nalagarh and Nurpur drained by the rivers Bata, Sirsa, Soan, Markanda and Ghaggar.

The Siwaliks are composed of highly unconsolidated deposits of soft sand-stone, shale and conglomerates and are very much prone to erosion.[8] Large scale deforestation has enhanced the process of erosion thereby leading to the development of Chos which are torrential and seasonal streams. This 16-40 km wide zone which includes low level areas represents 32% of the geographical area of Himachal Pradesh. Geologically this zone is further divided into three types[9]:

1) Lower Siwaliks – This contains Red sandstones, Purple Shales rich in vertebrate fossils. Example Nahan.
2) Middle Siwaliks - This zone has Sandstones, clays and Slates with Bonidae fossils. Example Dagshai-Sabathu.
3) Upper Siwaliks - It contains sandstone and clays with fossils. Example Krol.

2. Lower Himalayan zone:

This zone is a continuous belt having elevation varying from 1000 to 2000 m in the districts of Sirmaur, Shimla, Solan, Mandi, Kangra, Kullu, Chamba and Kinnaur. This also includes the tracts of the Kangra valley, Balh valley, Giri valley and Pabar valley having an elevation varying from 1000 to 1800 mts.

This belt includes the lesser Himalayan range of Dhauladhar extending from Dalhousie to Kangra, Mandi, Kullu and north of Shimla upto border with Uttranchal in east and is 60–90 km wide. This range is cut by the river Beas at Larji, Ravi along Chamba gorge and Satluj at Rampur.[10] The Mussorie ridge, Chaur or Panchamunda range, Shimla ridge, Nag Tibba, Jalori, Jalsu form part of Dhauladhar range averaging 3000- 4500mts. This zone constitutes 10% of the geographical area of Himachal Pradesh.

3. Lesser Himalayas :

Between the Greater Himalayas and Lower Himalayas lies the zone of lesser Himalayas with an average elevation of 2000 – 4000mts above sea level. Dhauladhar and Pir Panjal are the two important ranges within it having elevation of 3600m to 4500m and 4600mts respectively. Pir Panjal is the largest range in this zone and bifurcates from the Great Himalayan range near the bank of Satluj. The northern slope of the Dhauladhar range is set against the southern slope of Pir Panjal range. Pir Panjal serves as water divide between Chenab, Beas and Ravi.

These parallel ranges are divided by longitudinal valleys, the only exception being Kullu valley which run at right angle i.e. is transverse to the main layout. Geologically the rock structure of Lesser Himalayan range is constituted of Pre-cambrian and Cambrian age. The Giri and Gambhar rivers find their origin in this zone.

4. Greater Himalayas :

Just above the lesser Himalayan range is the zone of Greater Himalaya having an average elevation varying from 5000m to 6500m covering the north, north-eastern, and eastern portions of the state. Pir Panjal range joins the Great Himalayan range near Deo Tibba in Himachal Pradesh. Between these two ranges is situated the valley of Lahaul. This ecological zone is composed of crystalline rocks, granites and fossiliferrous rocks. Satluj river cuts across this range making deep gorges. Several rivers find their origin in this zone, these are Chenab, Ravi, Beas, Spiti, Baspa, Pabbar rivers which being snow fed are perennial in nature.

This zone of rugged terrain has also some mountain passes at high altitudes viz. Parangla (5548m), Kangla (5248m), Pin parbati (4802m), Kunzum (4551m) and Baralacha (4512m). To the east of Greater Himalaya in Himachal Pradesh, Zanskar range or Inner Himalaya is situated. The Zanskar range separates the basin of Tibet from Himachal Pradesh. The Tibet basin is associated with Satluj Basin of Himachal Pradesh through the passes of Sholarung and Gumrang. This zone has glaciers, moraines, hanging valleys and U- shaped valleys which provide sufficient evidence that the major part of Himachal Pradesh was once under the influence of glaciation[11].

5. Trans-Himalaya or Tethyan Himalayan Zone:

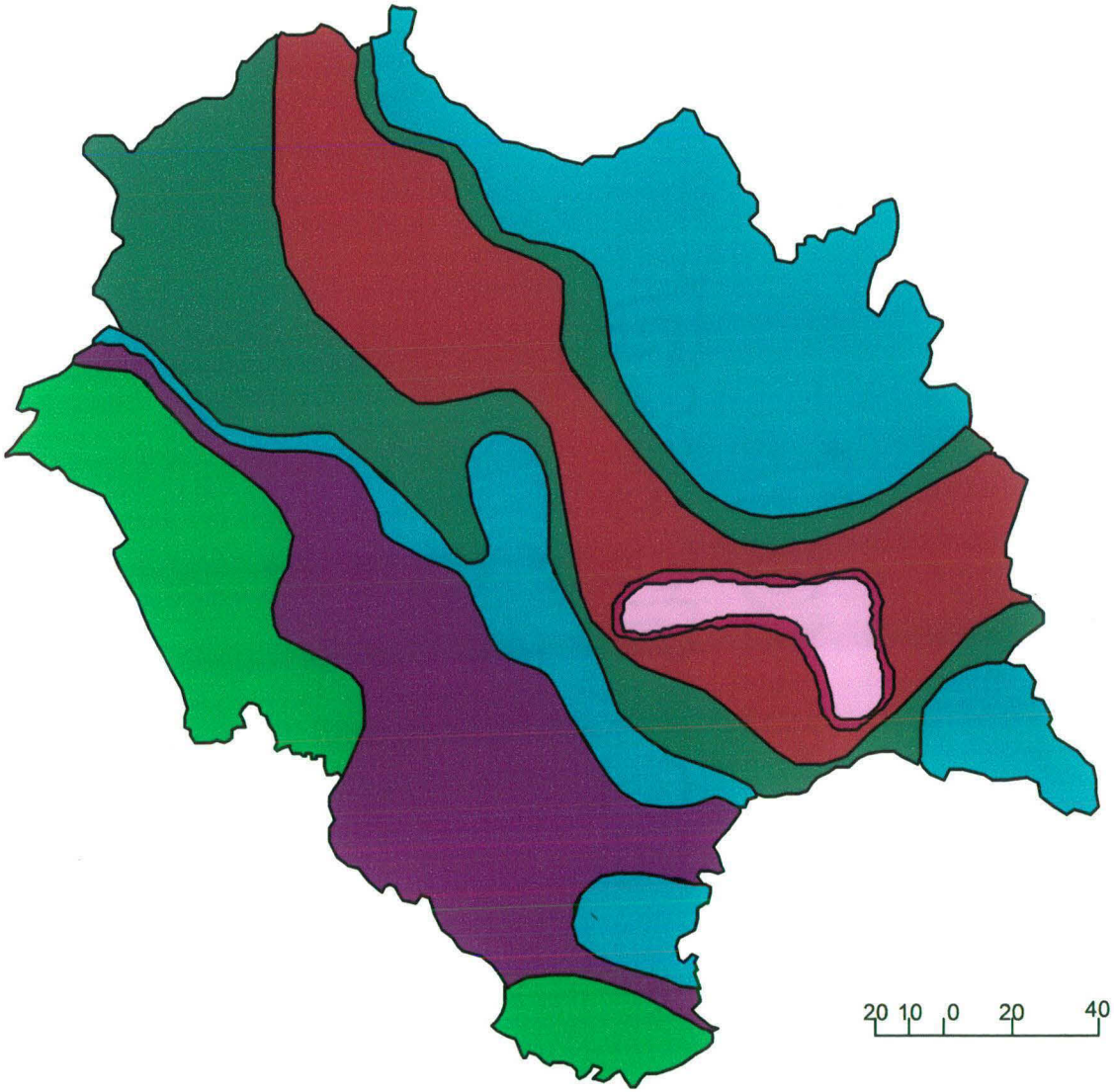
This ecological zone consists of Chandra, Bhaga, Spiti valleys of Lahaul-spiti and upper Kinnaur & Pangi area of Kinnaur district. The outer boundary of this zone is delimited by the Pir Panjal, Great Himalayan range and Zanskar range. One special characteristic of this region for which it is called cold desert region is the very scanty rainfall due to its location in the rain shadow region of the Himalayas. This region is especially famous for its majestic peaks and natural scenery.

The Zanskar mountains, beyond the Great Himalayan range forms the north eastern boundary of Himachal Pradesh separating Spiti and Kinnaur from Tibet. The general elevation varies from 3000-6500m and is cut across by Satluj at Shipkila. This zone has 35% of the geographical area of Himachal Pradesh. The Geology of this zone comprises of gneiss and schistose rocks (Rohtang), Slates, quartzite, phyllites, sandstone (Batal), slates, dolomite,

Map No 2.2

HIMACHAL PRADESH

RELATIVE RELIEF



Source: Census Atlas(1991),H.P, Series 9,Part XI, Census of India

shale, limestone (Takche), fossileferrous limestones, calcareous shales with rich fossils (Lipak, Hansa, Spiti).[12] It also presents complete sequence from pre-Cambrian to quaternary.

Relative relief depicts the nature of terrain of the region. It is defined as the difference in height between the highest and the lowest points in a unit area. More relative relief denotes a rugged, undulating terrain and less relative relief denotes relatively level land. Relative relief presents a general picture of the terrain and can be of help to understand the land use pattern and the various physical processes acting in the region.

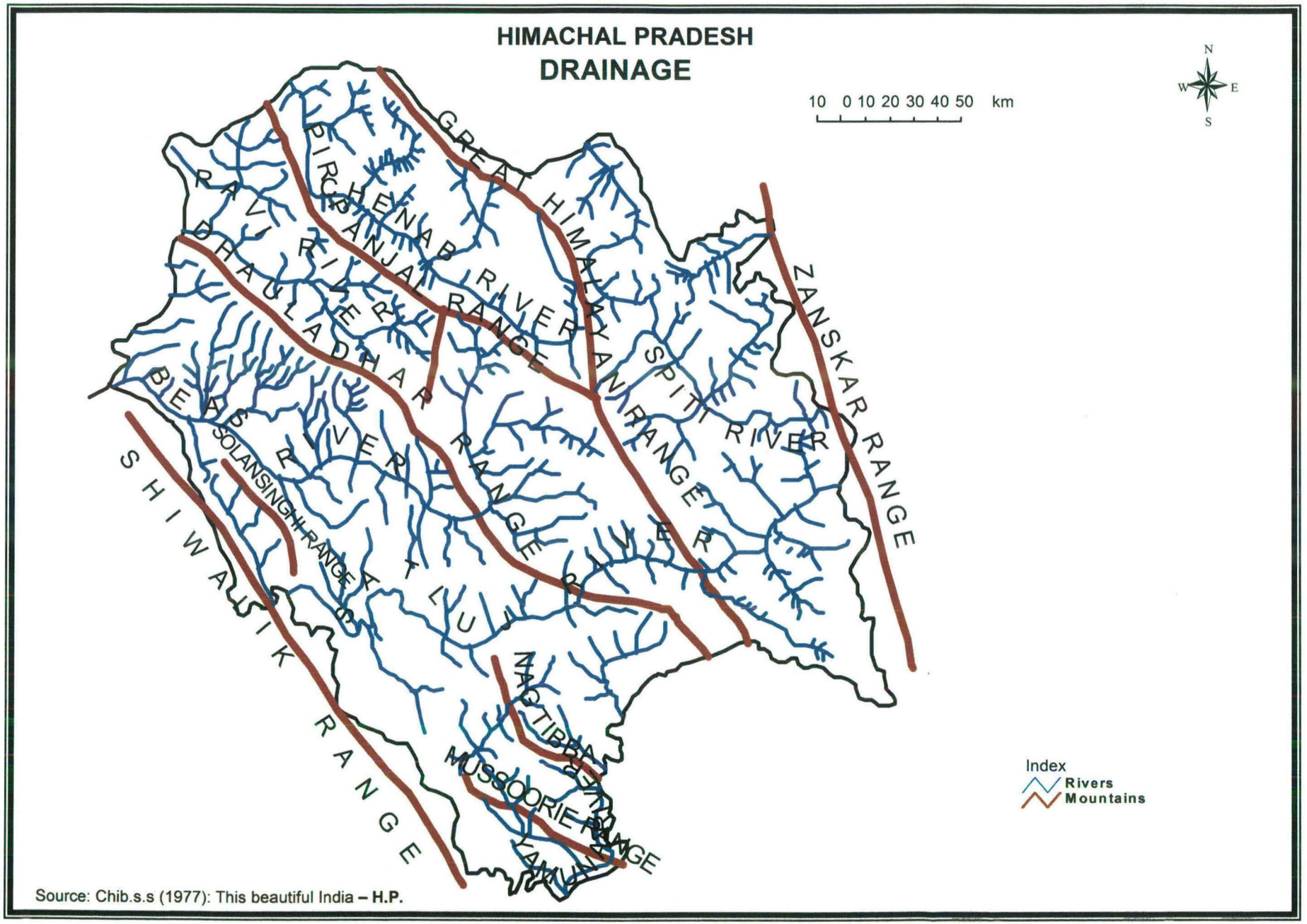
It is quite visible from the map of relative relief that the area bordering the Punjab have low relative relief and that there is a general trend of increase in relief from south to north excepting some areas in north in the Trans-Himalayan region.

The highest relative relief of more than 4100m is found in eastern part of state covering western Kinnaur, North-eastern Shimla and South-eastern Kullu. Just around this belt is a narrow belt with relief varying between 3400-4100m. Another belt of high relief 2700-3400m is running from north to south east covering north east Chamba, Bara-Banghal area of Kangra, western and south-western portions of Lahaul and spiti, eastern Shimla and parts of Kinnaur and Kullu districts. The north western part of the state has a relief varying between 2000-2700m. In the north, central and south-eastern part, relief ranges from 1300-2000mt. The lower relief in the range of 600-1300m is found in central and north western Kangra, eastern Hamirpur and Bilaspur district, large part of Mandi, entire Solan district, Central and Western Shimla District and central and North-western Sirmaur districts. The Southern and western parts of the state have a relief below 600mts.

To sum up the relative relief act as the major factor affecting the various physical processes in a region. The state of Himachal Pradesh has a relative relief varying from below 600 mts to more than 4100 mts. It is also seen that the area bordering the Punjab have low relative relief and that there is a general trend of increase in relief from south to north excepting some areas in north in the Trans-Himalayan region. Therefore, the areas with lower relative relief lying in southern part are more easily accessible and suitable for economic activities.

The above analysis shows that the state of Himachal Pradesh forms a part of western Himalaya. The physiography of the state comprises of lofty mountains, hills and narrow valleys and basins. Himachal Pradesh has five important mountain ranges, almost parallel to

Map No 2.3



Source: Chib.s.s (1977): This beautiful India – **H.P.**

each other with longitudinal valleys in between them and each physiographic zone has a unique physical, socio-cultural identity which is different from other zones.

2.3 Drainage:

Drainage of the region comprises of the various rivers and associated streams which flows through a region. The study of drainage network provides an idea about the topography, relief and hydrological features of the region. Settlements are also found to be located along the river valleys. Himachal Pradesh being deficient in organic fuel resources has a large potential in hydel power. Thus, it becomes important to study the drainage network in order to assess the role of natural environment and its impact on socio-cultural and economic aspects.

The state of Himachal Pradesh being a part of Himalayas has the distinction of providing waters to both Indus and Ganges basins. The monitoring of the environment in a mountainous region can be best done by studying the river basins and catchment areas which are the ideal units for planning and management. The table 2.2 shows that the state is drained by five major river systems with catchment area more than one percent and four minor river systems with less than one percent catchment area.

Table 2.2

Rivers, Catchment area -Himachal Pradesh

River	Area in Sq.Km	Area in percentage
Satluj	20,398	36.6
Beas	13,663	24.5
Chenab	7,850	14.2
Yamuna	5,872	10.6
Ravi	5,528	9.9
Indus	1,450	2.6
Markanda	360	0.6
Ganga	290	0.6
Ghaggar	262	0.5

Source: State of the environment report- Himachal Pradesh (2000).

1. The Satluj:

The Satluj river originates from the glaciers surrounding Mansarovar lake situated on Tibet highlands. It is the biggest river system of Himachal Pradesh having a catchment area of 20,398 sq.km. It enters India near Shipkila and is joined by river Spiti near Namagia. Its right bank tributaries are the Spiti, the Ropa, the Kasang, the Mulgoan, the Yul, the Wagner, the Throng and left bank ones are the Terung, the Gyanthing, the Baspa, the Duling and the Soldang. Bhakhra dam has been constructed on the river at a gorge near Bhakhra.

2. The Beas:

The Beas river originates from Beas *kund* near Rohtang pass in the Pir Panjal Range. It is the second largest river system of Himachal Pradesh with a catchment area of 13,663 sq.km. Some important tributaries of Beas are the Parbati, the Hurla, the Sainj, the Tirthan, the Uhl, the Suketi, the Luni, the Ama, the Banganga, the Manuni, the Guj and the Chaki. It has an orientation from North West to South and flows for a distance of 286 km in Himachal Pradesh. The northern and eastern tributaries of the Beas are snow fed and perennial, while the southern ones are seasonal.[13] The water of Beas and its tributaries are harnessed at Jogindernagar, Bassi, Pong and Pandoh.

3. The Chenab:

Also known by the name of Chandra-Bhaga, it has a catchment area of 7,850 sq.km. It is formed due to the confluence of two streams viz. Chandra and Bhaga at Tandi in Lahaul. It flows for about 122km in Himachal Pradesh before entering the state of Jammu and Kashmir. The river Chandra originates from a glacial lake called Chandra Tal in Lahaul. It passes through barren land with no habitation and its valley is a structural trough formed in the Great Himalayan and Pir Panjal Ranges.

4. The Yamuna:

The river Yamuna has it origin in Yamunotri glacier in Uttranchal and has a catchment area of 5,872 sq.km. Its main tributaries are Tons, the Pabbar, and the Giri. The river flows in a south-westerly direction upto a place Banog and turns westwards before it is

joined by the river Tons at a place Majiri Paharumala. It leaves the state near Tajewala headworks and enters Haryana.

5. The Ravi:

The Ravi river originates from the Baralacha area of Pir Panjal by joining two glacier fed streams Bhadal and Tantgari and have an catchment area of 5,528 sq.km. The important right bank tributaries are the Bud hill, the Tundah, the Burjiri, the Saho, the Siul and the left one is christened Nala. It has a length of 158 km in Himachal Pradesh and Chamba town is situated on its right bank.

Other than the above main rivers there are areas drained by Markanda (360 km^2), the Ghaggar (262 km^2) and tributaries of Ganga (290 km^2) and Indus (1,450 km^2). Most of the rivers of Himachal are perennial as these are snow fed and have their origins high in the Himalayan glaciers. Many of the rivers and its tributaries have been harnessed for big and micro hydroelectric projects but still it is way behind its optimal hydro electric potential and much need to be done.

To sum up the drainage of the state comprises of major rivers viz Satluj, Beas, Chenab, Ravi and Yamuna and minor rivers viz. Markanda and Ghaggar. Drainage has carved the broad, fertile valleys which support settlements and agriculture. The terraces formed by these rivers and its associated tributaries have been developed for agriculture and horticultural pursuits.

2.4 Soils:

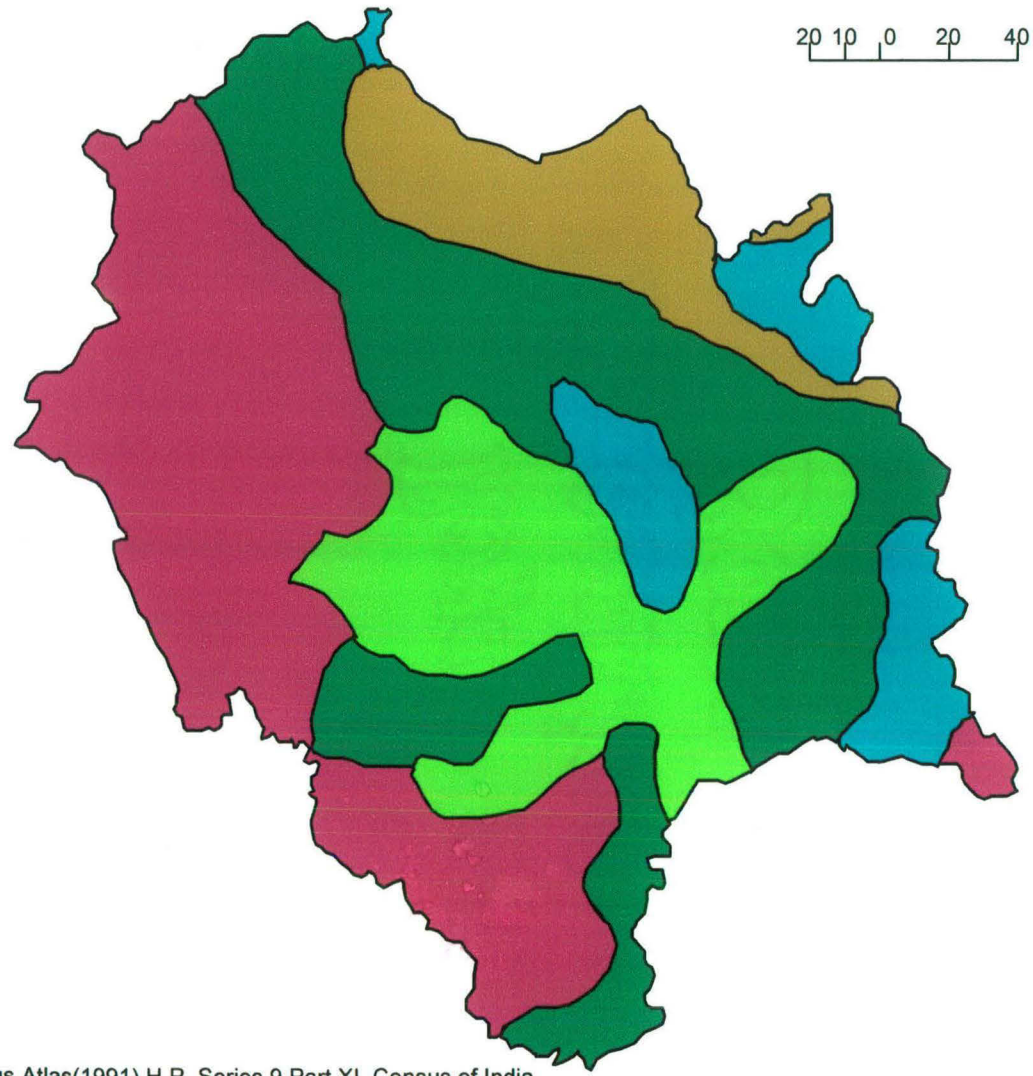
Soils are the direct outcome of the weathering of parent rock material. Himachal Pradesh being a part of the Himalayas has a skeletal type of soil with immature soil profile. On the whole, the soil is thin. But considerable depth occurs in the valleys or on some hill slopes. This results in the extensive agricultural practices in the valleys and on hill terraces. Study of soils will thus throw some light on the likely soil processes occurring therein and the pattern of agriculture and forests of the state.

Soils of Himachal Pradesh vary according to aspect, slope and climatic conditions. Soils of Himachal Pradesh have been grouped into five major types;[14]

Map No 2.4

HIMACHAL PRADESH

SOILS



Source: Census Atlas(1991),H.P, Series 9,Part XI, Census of India

a) Udalfs-Ochrepts
b) Othents-Ochrepts.
c) Ochrepts-Orthens-Ustalfs.
d) Udolls.
e) Glaciers and snow cap.

a) Udalfs-Ochrepts:

In this association the soils vary between high base status soils of humid regions and shallow black, brown and alluvial soils of northern region. These soils are found in north eastern part of Chamba, South Lahaul-Spiti, central part of Kinnaur district and central and eastern part of Shimla district, Eastern and Southern part of Sirmaur district, Eastern Bilaspur, Southern Mandi and Kullu districts, and northern tip of Solan district.

b) Orthents-Ochrepts:

These soil associations are recently formed soils having shallow black, brown and alluvial characteristics. These soils are found in the center part of the state in the districts of eastern Kangra and Hamirpur, Northern half of Mandi district, western and southern Kullu, north Shimla, Western Kinnaur district and south-eastern Lahaul and Spiti.

c) Ochrepts-Orthents-Ustalfs:

These soil associations are recent in origin and are shallow in nature with black, brown and alluvial soil components. Some recent sandy soils, red loamy, red sandy, and soils of arid region are also present. These soils are found in the north western and south western parts of state and also in south-eastern tip of Kinnaur district. It covers the districts of south western Chamba, Kangra, Solan, Hamirpur, north western Mandi, Una, Western Bilaspur, northern Sirmaur, and south western Shimla.

d) The Udolls:

These soil associations are similar in some features with the terai soil of the humid region. These are found in the north-eastern tip of Chamba district and northern part of Lahaul and Spiti district excepting the north-eastern tip.

e) The Glacier and snowcaps:

These soils are found in the high altitude regions of Himachal Pradesh. These regions include north-western, north-eastern and south-western parts of Lahaul and Spiti, eastern part and western tip of Kinnaur district, northern tip of Shimla district and eastern part of Kullu district.

The above analysis show soils of Himachal Pradesh to be less developed and skeletal in nature. This thin layer becomes a constraint on agricultural activities in many parts of Himachal Pradesh.

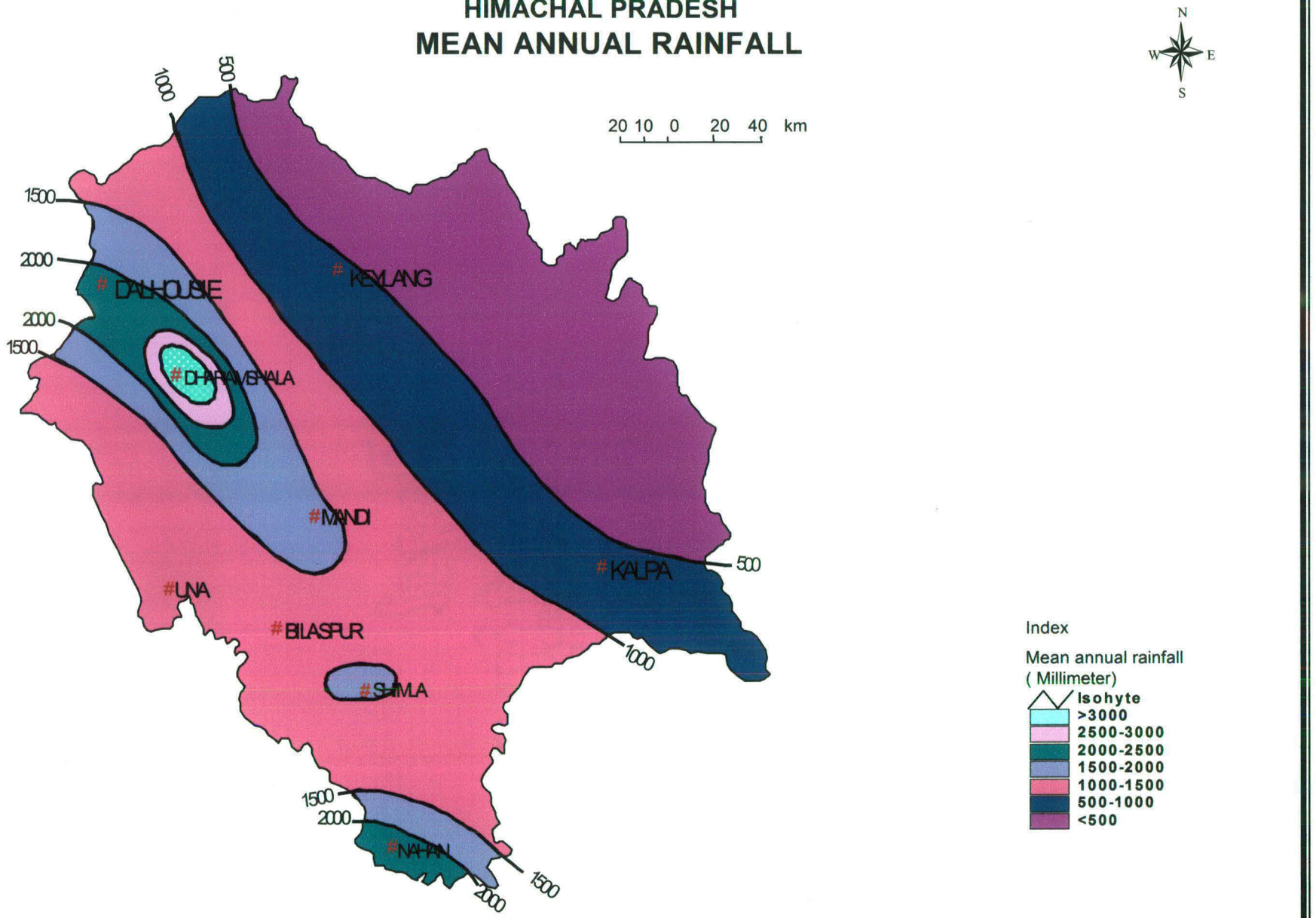
2.5 Climate:

Climate of the region has a general influence on the various physical processes and shapes the landscape of the region. Rainfall and temperature are the most important elements of climate. Himachal Pradesh is known for its pleasant climate. Large number of tourists comes to the hills of Himachal Pradesh to escape the scorching heat of the plains during summer months. It also experiences considerable variation in the distribution of rainfall and temperature due to varying aspect and altitude. Most part of the state exhibits the temperate climate which favors the growing of horticultural crops thus adding to economic prosperity of the people.

The state of Himachal Pradesh situated between the Greater Himalayas in the north and Punjab and Haryana plains in the south has a diverse climatic conditions ranging from hot and sub-humid tropical in the southern part, warm and temperate, cold and temperate in the middle part and cold and alpine and glacial in the northern and eastern high mountain parts. The climate of Lahaul and spiti and Kinnaur districts is of semi arid highland type. Such varied climatic conditions are due to the physical factors of altitude, physiographic configuration and aspect. The areas high in altitude have alpine and temperate climate compared to low altitude warm tropical and temperate areas. The aspect also influences climate as south facing slopes are sunny and rainier. The year is divided into three seasons- Cold season (October to February), Hot season (March to June) and Rainy season (July to September).

Map No 2.5

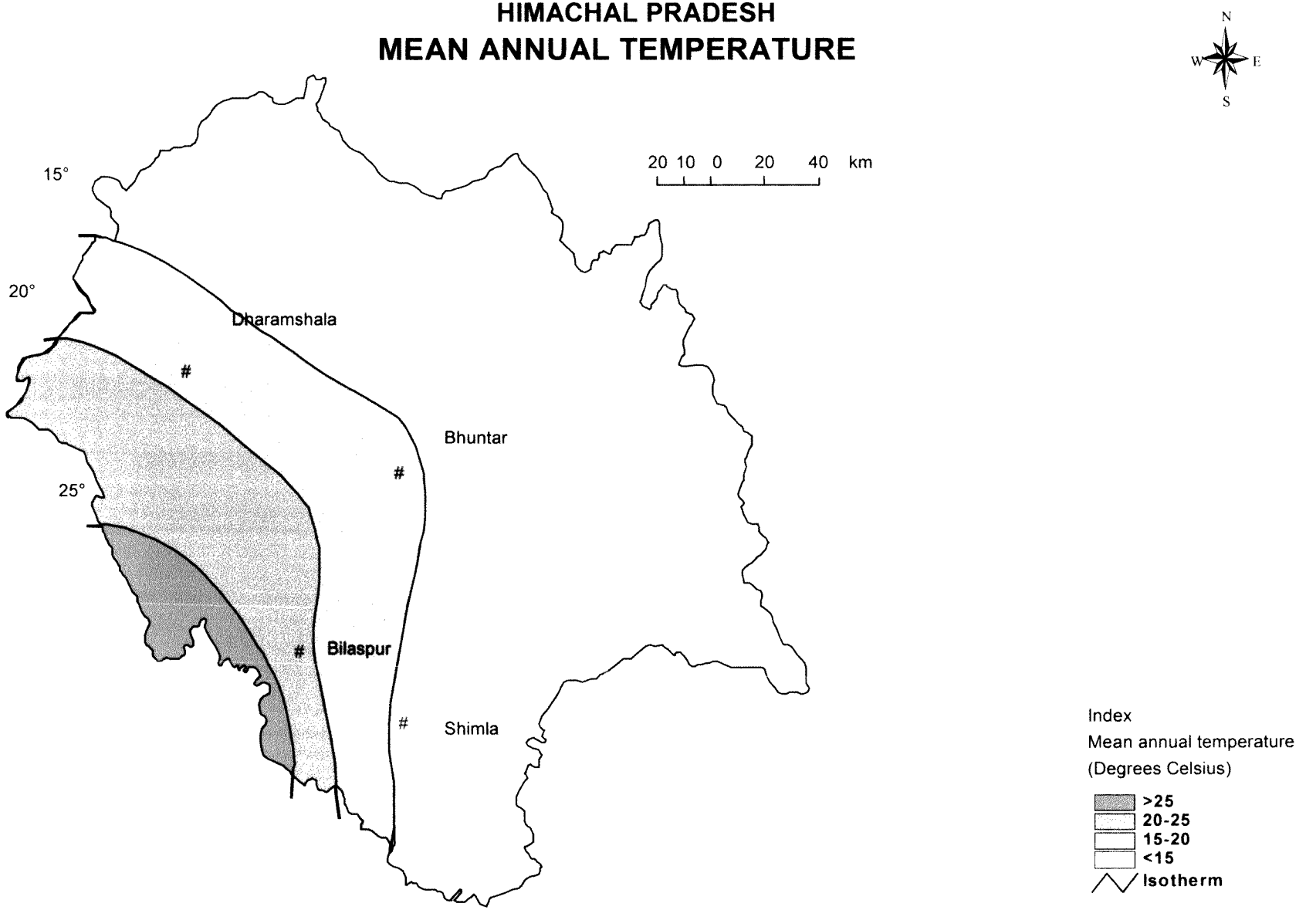
HIMACHAL PRADESH
MEAN ANNUAL RAINFALL



Source: Census Atlas(1991),H.P, Series 9,Part XI, Census of India

Map No 2.6

HIMACHAL PRADESH
MEAN ANNUAL TEMPERATURE



Source: Census Atlas(1991),H.P, Series 9,Part XI, Census of India

Maximum amount of rainfall comes from South West Monsoons starting from July till September. Some amount of rain occurs due to western disturbances during winters which are quite useful for Rabi crop. Generally the rainfall increases from the relatively plain areas to the hills. It shows a decreasing trend from south to north and from west to east. The distribution of rainfall is highly uneven from a low of 500mm in Lahaul and Spiti and Kinnaur to a high of 3400 mm at Dharmashala. The southern and south western parts of the state fall in the rainfall zone of 1500 to 2000mm. The central and North West part of the state have rainfall exceeding 2000mm and comprises of parts of Dalhousie, Dharmashala, Kangra, Palampur and Jogindernagar. The moisture laden monsoon winds bring much rainfall as there is sudden increase in elevation. Beyond it as one moves to Mandi, Kullu, Keylong, Rampur and Kalpa the annual rainfall decreases progressively. Most of the areas falling under Lahaul and Spiti and Kinnaur experiences less than 500mm rainfall and are thus semi arid cold deserts. These areas fall in the rain shadow zone of Great Himalayan Range.

The mean annual temperature varies with decreasing trend from western parts of the state towards north and eastern parts with the increase in elevation. The parts of southern and western portions of Una district, western parts of Bilaspur district and extreme south western portion of Solan district record maximum mean annual temperature of 25° Celsius. These areas consist of comparatively plain parts with low elevation and adjoin the plains of Punjab. The mean annual temperature ranges between 20° Celsius and 25° Celsius in the remaining parts of Una and Bilaspur districts, north western portion of Solan district, parts of Hamirpur district, south western parts of Kangra district and extreme western part of Mandi district. The eastern parts of Mandi district, parts of Kullu district, Kangra valley area and North eastern part of Solan districts have mean annual temperature varying between 15° Celsius and 20° Celsius. In the remaining parts of the state the mean annual temperature is less than 15° Celsius. Thus one can see a clear pattern of decrease of temperature from the south to the north in correspondence with the increase in the elevation. The highest temperature is recorded in the month of June.

To sum up, Himachal Pradesh has diverse climatic conditions. Southern parts are warmer but get more rain. Trans-Himalayan areas are very cold with arid conditions.

Socio- Cultural Setting of Himachal Pradesh

Himachal Pradesh is a part of the complex Himalayan ecosystem. It has an area of 55,673 sq.km which constitutes roughly one tenth or 9.4% of the total area of the Himalayan region. Depending on environmental conditions, the society has adapted itself by evolving different responses. Thus, it is of importance to study the Socio-Cultural setting of Himachal Pradesh considering the limited resource base and carrying capacity of the region. The distribution of population and its concentration is largely governed by the availability of agriculturally suitable land, which depends on gentle slopes and level tracts, moderate climate and irrigation facilities. All of these are rather limited in Himachal Pradesh. Thus, due to environmental constraints the agricultural resource base is highly restricted. The rapid growth of population in the past decades has led to increased pressure on limited resources affecting the environment adversely which has contributed to the recurrence of landslides, floods, deforestation, avalanches resulting in the loss of life and property

In this connection citing examples of adverse impact of humans on environment, it was said, "Changes in mountain vegetation and soils influence the water regimes in the low lands. Droughts, floods and siltation in the plains are not isolated from the watersheds in the mountains."[15] Various studies done by scholars have highlighted the fact that ecological disturbances due to growing population in the mountain areas like Himachal not only threaten these regions but can have catastrophic impact on the surrounding plains as well. It was estimated that "felling of tall trees has caused an annual increase of 20% in the number of avalanches."[16]

Every aspect of human life be it food habits, clothes, cropping pattern, land use, economic, social, and political aspects are influenced directly or indirectly by environment. Thus human beings have the capacity to influence and alter the environment to a great extent. In this context examples may be cited of the terraced nature of agriculture, growing of coarse cereals like millets, maize and bajra etc., development of horticultural crops like apple, pear, plum etc, predominance of sparse villages with low population and a few big towns etc. These are typical of a hilly state like Himachal Pradesh.

Thus in this respect the study of Socio-Cultural setting assumes prominence. This study includes the following aspects:

- Distribution and growth of population which let us know the spatial extent of settlements and the increase in population of the region and pressure on land.
- Sex ratio; an ideal indicator depicting the gender composition of the population as well as of migration.
- Literacy gives us an idea about the spread of education in the region and the level of awareness.
- Growth of urban population tells us the extent of urbanization which in turn gives us an idea about emergence of non primary economic activities.

Himachal Pradesh comprises of 12 districts, 52 sub divisions, 75 tehsils, 34 sub-tehsils, and 20,118 villages. There was only one town categorized as class I in the state of Himachal Pradesh which is Shimla. It is the state capital and also was the summer capital of the British India during colonial era. There was not a single town falling in the category of class II. All other towns of the state fall in the category of class III to class VI. Table 2.3 shows that the number of inhabited villages increased from 11,133 to 20,118 during the period 1951 to 2001. There was a sharp increase in the number of inhabited villages from 11,797 to 16,916 during the period 1961 to 1971. This was mainly because of the merger of Punjab hill areas with Himachal Pradesh under the reorganization of state act 1966. The period from 1991 to 2001 also saw an increase in the number of villages from 16,997 to 20,118. The increase in the number of villages is due to the completion of settlement operation in some of the remote districts of the state.

Table 2.3

No of villages, Himachal Pradesh- 1951-2001

Category	1951	1961	1971	1981	1991	2001
Villages	11,133	11,797	16,916	16,807	16,997	20,118

Source: Census of India, Himachal Pradesh, Provisional population totals, Paper I, series 3 of 2001.

To sum up we can say that the state of Himachal Pradesh has a rural character with a large number of villages. These villages are showing an increasing trend over the decades due to growth of population and completion of settlement operation.

2.6 Distribution of population:

The population of Himachal Pradesh is unevenly distributed as the environment plays an important determinant for the settlement of human population. Conducive environment in the districts bordering the plains of Punjab favours dense population and hostile environment of the Trans-Himalayan districts of Lahaul and Spiti and Kinnaur have sparse population. The population of Himachal Pradesh has steadily increased from 1951 when it was 983367 persons to 6077248 persons in 2001. The population of the state constitutes 0.59 percent of Indian population and the state ranked 21st among all states in 2001.

It is found from table 2.4 that Kangra was the most populous district with 22.02% of population in 2001 and 23.14% in 1981. It was followed by Mandi with 14.8% population in 2001 and 15.06% in 1981. Both these districts have a favorable climate and are agriculturally developed leading to large population concentrations. Shimla was third in this respect with 11.88% population in 2001 and 11.94% in 1981. Shimla being the administrative capital of the state is also showing heavy concentration of population. It was the summer capital of India during British times and also earliest horticultural development was seen in this district. About half of the population of the state is concentrated in the districts of Kangra, Mandi and Shimla. Each of the districts of Solan, Chamba, Sirmaur, Una, Hamirpur, Kullu and Bilaspur has from 5% to 8% of the population of the state.

Table 2.4
District-wise population -1981-2001

District	1981	% of total	1991	% of total	2001	% of total
Kangra	990758	23.14	1174072	22.71	1338536	22.02
Mandi	644827	15.06	776372	15.01	900987	14.82
Shimla	510932	11.94	617404	11.94	721745	11.88
Chamba	311147	7.27	393286	7.61	460499	7.58
Solan	303280	7.08	382268	7.39	499380	8.22
Sirmaur	306952	7.17	379695	7.34	458351	7.54
Una	317422	7.41	378269	7.32	447967	7.37
Hamirpur	317751	7.42	369128	7.14	412009	6.78
Kullu	238734	5.58	302432	5.85	379865	6.25
Bilaspur	247368	5.78	295387	5.71	340735	5.61
Kinnaur	59547	1.39	71270	1.38	83950**	1.38**
Lahaul-Spiti	32100	0.75	31294	0.60	33224	0.55

**Based on Projected population.

Source: Census of India 2001, H.P, Series 3, Provisional population totals, Paper I of 2001.

The least populated districts of Himachal Pradesh are Kinnaur with 1.38% population in 2001 and 1.39% in 1981 and Lahaul-spiti with 0.55% in 2001 and 0.75% in 1981. It is because of the inhospitable terrain and relative isolation that these districts have low proportion of population. It can be seen from the table no 2.4, that except the districts of Chamba, Solan, Sirmaur and Kullu which have shown a increase in the percentage of population out of total population over the decades 1981 to 2001 the rest of the districts have shown a decrease during the corresponding time period.

Density of population differs spatially and temporally according to physical environment, level of economic development and cultural and historical factors. The table 2.5 showing density reveals highest density in Hamirpur district with 369 persons per sq.km in 2001 compared to 284 persons per sq.km in 1981. This was followed by Bilaspur and Una having nearly equal density of 292 persons per sq.km and 291 persons per sq.km respectively for 2001 and 212 persons per sq.km & 206 persons per sq.km in 1981. These districts have comparatively level land, intensive agriculture, better industrial development and connectivity which have led to such high densities.

These are followed by Solan, Kangra and Mandi districts with densities of 258 persons per sq.km, 233 persons per sq.km and 228 persons per sq.km respectively in 2001 and 157 persons per sq.km, 173 persons per sq.km and 163 persons per sq.km in 1981. Here also the main reasons for high densities are most probably the industrial development of Solan and fertile valleys and agricultural lands of Kangra and Mandi. Kangra has the largest Net sown area among all districts. Sirmaur is next with a density of 162 persons per sq.km in 2001 followed by Shimla with 141 persons per sq.km. Other districts have density below 100 persons per sq.km. These districts include Chamba, Kullu, Kinnaur and Lahaul-Spiti with densities of 71 persons per sq.km, 69 persons per sq.km, 13 persons per sq.km and 2 persons per sq.km respectively in 2001. These had densities of 48 persons per sq.km, 43 persons per sq.km, 9 persons per sq.km and 2 persons per sq.km respectively in 1981. All these districts are relatively isolated having poor connectivity, rugged terrain and adverse climate which act as negative factors for population concentration.

Table 2.5

Population Density - 1981-2001

Districts	1981	1991	2001
Kangra	173	205	233
Mandi	163	197	228
Shimla	100	120	141
Chamba	48	60	71
Solan	157	197	258
Sirmaur	109	134	162
Una	206	246	291
Hamirpur	284	330	369
Kullu	43	55	69
Bilaspur	212	253	292
Kinnaur	9	11	13*
Lahaul & spiti	2	2	2

* On the basis of projected population.

Source: Census of India 2001 H.P, Series 3, Provisional population tables, Paper 1 of 2001.

With the exception of Lahaul and Spiti all the districts have shown an increase in density over the period 1981-2001. Lahaul and Spiti had stable density of 2 per sq.km. The maximum increase of 101 persons per sq.km during the decades 1981-2001 was seen in Solan followed by Una, Hamirpur and Bilaspur which had an increase of 85, 85 and 80 persons per sq.km respectively. Thus it can be seen that climate and topography plays an important role in the densities of population in various districts. Favorable environment promotes higher densities of population and vise versa. Besides, Solan has also experienced large scale industrialization in the recent decades.

2.7 Growth of population:

Growth rate of population is an important aspect especially in a state like Himachal Pradesh which has limited carrying capacity. The table 2.6 shows that only two districts viz. Solan and Lahul-Spiti have shown an increase in growth rate from 26.02 percent to 30.64 percent and -2.51 percent to 6.17% percent respectively during 1981-91 and 1991-2001. All the other districts have shown decrease in growth rate. In case of Solan the likely reason is the rapid industrial and agricultural development leading to more economic opportunities to sustain more population. In case of Lahaul and Spiti various government policies coupled

with development of horticulture and economic prosperity there have culminated in a positive growth rate by checking out migration on one hand and encouraging in-migration on the other.

Table 2.6

Growth of Population 1981-91 and 1991-2001

Districts	% decadal growth rate (81-91)	% decadal growth rate (91-01)
Kangra	18.50	14.01
Mandi	20.40	16.05
Shimla	20.84	16.90
Chamba	26.40	17.09
Solan	26.02	30.64
Sirmaur	23.72	20.72
Una	19.17	18.43
Hamirpur	16.17	11.62
Kullu	26.68	25.60
Bilaspur	19.41	15.35
Kinnaur	19.69	17.79*
Lahaul & spiti	-2.51	6.17

* On the basis of projected population.

Source: Census of India 2001 H.P, Series 3, Provisional population tables, Paper 1 of 2001

The highest growth rate was recorded for Solan district of 26.02% in 81-91 and 30.64% in 90-01. It was followed by Kullu having 26.68% and 25.60% growth rate respectively. Sirmaur comes next with growth rate of 20.7% in 2001 down from 23.72% in 81-91. The main reasons for the high growth rate in the districts of Solan and Sirmaur is the rapid industrial development and connectivity whereas Kullu has broad fertile valleys and horticultural development. Una with 18.43% growth rate was followed by Kinnuar and Chamba with 17.79% and 17.09% growth rate respectively in 1991-2001. The lowest growth rate was for the district of Lahaul-Spiti of 6.17% in 1991-2001 as compared to -2.51 percent in 1981-91. The negative growth may be due to out migration from the district in search of jobs especially government jobs and other economic pursuits. But as the economic avenues increased due to growth of tourism and horticulture, the population growth rate for decade 91-01 showed a positive trend.

The largest decrease in growth rate was witnessed in the case of Chamba district from 26.4% to 17.09% for the decades 81-91 and 91-01 respectively. This is followed by Hamirpur from 16.17 to 11.62 respectively. The least decline in growth rate was seen in Una of 0.74% followed by Kullu 1.08% for the decades 81-91 and 91-01. Rest of the districts showed a decrease of four to five percent over corresponding time frame.

To sum up the population of the state of Himachal Pradesh is unevenly distributed. The environmental and socio-economic factors are the determining factors which affect the distribution of population. The population of the state has in general shown an increase over the decades, but the decadal growth rate across most of the districts has shown a decline. The population density of all the districts of Himachal Pradesh has shown an increase over the year which is a cause of concern.

2.8 Sex ratio:

The human population of a region comprises of males and females. For a balanced composition of population the male-female ratio should nearly be equal. Sex ratio is one of the most important indicator for assessing the gender composition of a region. The high sex ratio denotes gender equality and more progressive nature of society. It also has a bearing on migration. It has been noticed that backward areas suffering from male selective out migration tend to show very high sex ratio.

Table 2.7
Sex Ratio -1981-2001.

Districts	1981	1991	2001
Chamba	936	949	961
Kangra	1016	1024	1027
Hamirpur	1149	1105	1102
Una	1028	1017	997
Bilaspur	1002	1002	992
Mandi	999	1012	1014
Kullu	918	920	928
Lahul and spiti	767	817	804
Shimla	878	894	898
Solan	929	909	853
Sirmaur	874	897	901
Kinnaur	885	856	851*

* On the basis of projected population.

Source: Census of India 2001, H.P, Series 3, Provisional population totals, Paper 1 of 2001.

Table 2.7 shows highest sex ratio in the district of Hamirpur which was 1102 females per thousand males in 2001 as compared to 1149 females per thousand males for 1981. It was followed by Kangra and Mandi with the sex ratios of 1027 females per thousand males and 1014 females per thousand males respectively for 2001 and 1016 females per thousand males and 999 females per thousand males for 1981. All these districts had a positive sex ratio for the year 2001 i.e. more females per 1000 males. The main reason for this is that a large number of male populations are being employed outside leading to male selective out migration. Una and Bilaspur with sex ratios of 997 females per thousand males and 992 females per thousand males in 2001 were having positive sex ratio of 1017 females per thousand males and 1002 females per thousand males in 1991. The decline in sex ratio could be because of in migration of males as a result of rising demand for skilled and unskilled workers due to industrial development in the region. Chamba, followed by Kullu and Sirmaur have the sex ratios of 961 females per thousand males, 928 females per thousand males, 901 females per thousand males respectively in 2001 and 936 females per thousand males, 918 females per thousand males and 874 females per thousand males in 1981. Other districts of Shimla, Solan, Kinnaur and Lahaul-Spiti had sex ratio below 900. Shimla had 898 females per thousand males in 2001 as compared to 878 females per thousand males in 1981, followed by Solan, Kinnaur and Lahaul and spiti with 853, 851 and 804 females per thousand males respectively for 2001 and 929, 885 and 767 females per thousand males in 1981. Shimla being an urban center and administrative capital has led to the male selective in migration for economic pursuits. Industrial development of Solan was an incentive for in migration of male workers. In case of Kinnaur and Lahaul and Spiti, the declines in sex ratio were due to male selective out-migration and inter district female marriages.

It is seen that sex ratio has declined in the districts of Hamirpur, Una, Bilaspur, Solan and Kinnaur during 1981 to 2001. Among these the steepest decline was observed in Solan district with decrease of 76 females per thousand males during this period, followed by Hamirpur, Kinnaur, Una and Bilaspur with decrease of 47, 34, 31 and 10 females per thousand males respectively. The most likely reasons for the decline in sex ratio are the recent urbanization coupled with industrial development leading to male selective immigration. Kinnaur may be the exception in this regard, where the decline could be due to the developmental works like road construction, dams etc which also led to male selective in-

migration. Other districts showed an increase in the sex ratio. Lahaul and spiti showed maximum increase of 37 females per thousand males over 1981-2001 period followed by Sirmaur with 27 and Chamba with 25 females per thousand males in the same period. In case of Lahaul & spiti the government policies and efforts along with high literacy has its effect on increase in sex ratio. Mandi was the only district which consistently showed increased sex ratio over the years from unfavorable 999 in 1981 to favorable sex ratio of 1013 and 1014 in 1991 and 2001 respectively.

2.9 Literacy:

Literacy is an important indicator of Socio-Cultural development of a region. The state of Himachal Pradesh has made tremendous progress in the field of literacy during the last two decades increasing its literacy from 51.18% in 1981 to 77.13% in 2001.

Table 2.8

Literacy -1981-2001

Districts	1981	1991	2001
Chamba	32.15	44.70	63.73
Kangra	59.20	70.57	80.68
Lahaul and spiti	36.57	56.82	73.17
Kullu	41.05	54.82	73.36
Mandi	49.00	62.74	75.86
Hamirpur	63.77	74.88	83.16
Una	59.75	70.91	81.09
Bilaspur	53.80	67.17	78.80
Solan	49.39	63.30	77.16
Sirmaur	38.59	51.62	70.85
Shimla	50.60	64.61	79.68
Kinnaur	43.55	58.36	N.A

Source: Census of India 2001, series 3, Paper 2, Provisional population totals, H.P

Table 2.8 shows that Hamirpur is the most literate district having literacy rate of 83.16% in 2001 as compared to 63.77% in 1981, followed closely by Una and Kangra with literacy rates of 81.09% and 80.68% respectively in 2001 and 59.75% and 59.20% in 1981. Shimla with literacy rate of 79.68% in 2001 comes next followed by Bilaspur, Solan and Mandi having literacy rates of 78.80%, 77.16% and 75.86% in 2001 and 53.80%, 49.39% and 49.00% respectively in 1981. All these districts are comparatively more urbanized and have high levels of economic development along with good educational institutions which

may be the reason for high literacy. The districts of Kullu, Lahaul and spiti and Sirmaur have literacy rates of 73.36%, 73.17% and 70.85% respectively in 2001 and 41.05%, 36.57% and 38.59% in 1981. These districts are relatively more rural in character with bad connectivity and thus don't provide an incentive for education. The least literate district in 2001 was Chamba with literacy rate of 63.73 % which improved quite a lot from 32.15% in 1981. The data of Kinnaur for 2001 was not available and its rate was 58.36% in 1991 and 43.55% in 1981.

It becomes clear from the above discussion that literacy in Himachal Pradesh is quite high with the exception of Chamba and Kinnaur. All the districts have shown improvements over the previous decades. Maximum increase of literacy during 1981 to 2001 was seen in case of Lahaul and Spiti district with an increase of +36.6 percent, followed by Kullu, Sirmaur and Chamba with +32.3 percent, +32.3 percent and +31.6 percent increase respectively. Government policies and promotion of education at the village level coupled with construction of primary schools even in remote corners of the state are responsible for the improvement of literacy. Thus it shows that Himachal Pradesh is quite progressive in the case of literacy.

2.10 Growth of Urban Population:

Post independence the level of urbanization in the state of Himachal Pradesh has picked up but is still very low as compared to other states. Urban centers are generally area of high population growth in developing countries. It is because of the better economic opportunities and infrastructure which act as magnets for immigration from the rural areas.

Table 2.9

Urban population in different class Towns -1981-2001

Size class	No of U.A's / Town			Percent of population in each size class			Percent decadal growth	
U.A/town/city	1981	1991	2001	1981	1991	2001	1981-91	1991-01
Class I	-	1	1	-	24.57	24.31	51.17	31.01
Class II	1	-	-	22.40	-	-	-	-
Class III	2	4	6	12.54	19.42	25.87	113.43	76.45
Class IV	5	7	7	22.08	21.73	19.06	35.61	16.14
Class V	9	9	16	19.83	14.90	19.10	3.56	69.77
Class VI	29	34	26	23.15	19.38	11.66	15.34	-20.30

Source: Census of India 2001, series 3, Paper 1, Provisional population totals, H.P

It becomes clear from the table 2.9 that still majority of the towns of Himachal Pradesh falls in the category of class V and class VI. The number of towns falling under Class VI decreased from 29 in 1981 to 26 in 2001 where as that of class V increased from 9 to 16 in the corresponding period. The towns under class III and IV also increased from 2 & 5 in 1981 to 6 & 7 in 2001 respectively. There was not a single town categorized as class II in the year 2001. There was only one town categorized as class I in 2001.

If we look at the share of urban population in each size class, we find that largest urban population was found in the class III towns with 25.87% of total urban population in 2001 which was much less at 12.54% in 1981.The towns in class III are basically industrial centers which attracts the people from other places. These include Solan, Baddi, and Nahan etc. It was followed by class I town with 24.31% urban population in 2001. Shimla was the only town categorized as class I. It is the administrative capital of the state which has better social, economic and educational facilities and thus attracts a large number of people. The share of urban population for class V and class IV was nearly equal in 2001 at 19.10% & 19.06% respectively which was 19.83% & 22.08% in 1981. The least proportion of urban population was seen in class VI towns with 11.66% share in 2001 as compared to share of 23.15% in 1981. Majority of the towns in this class are Nagar panchayats. This shows the dispersed nature of urban population in many low size class towns in Himachal Pradesh.

Analyzing the percent decadal growth for different classes of towns we find that it was highest for class III towns which was 76.45% in 1991-01 as compared to 113.43% in 81-91. Class III towns are mostly urban and industrial centers which attracts people from rural areas and also it has the largest urban population among various classes. It was followed by class V towns with 69.77% growth in 91-01 which was a huge increase from 81-91 when the growth rate was only 3.56%. The huge increase in growth rate may be attributed to a large increase in the number of class V towns. The growth rate of class I town was 31.01% in 91-01 which showed a decline from 51.17% in 81-91, followed by class IV whose growth rate also fell from 35.61% in 81-91 to 16.14% in 91-01. The apparent decrease in growth rate may be due to decrease in the percent urban population over the years. The negative growth rate of -20.30% was seen in the case of class VI towns in 91-01 whose growth rate was 15.34% in 81-91. The negative growth rate may be due to out migration of people from class VI towns to other towns in search of better economic opportunities resulting in decrease of

urban population and number of towns. Thus the present trend shows that urban population will most likely be concentrated in the classes of III and V in the near future.

After the analysis of environmental and socio-cultural aspects of the state of Himachal Pradesh it is evident that still environment plays a significant role in the overall demographic set up and development of the region. Himachal Pradesh is a mountain state with sparse population. The distribution of population is uneven and shows the effect of environment. The overall literacy rate is high. The population on the whole is mostly rural with few urban towns.

This chapter broadly highlights the physical environment and the socio- cultural setting of Himachal Pradesh which will be quite helpful for setting a framework for vegetation studies in later chapters and its main problems. It also directs our attention to the fact that planned and systematic development of the state of Himachal Pradesh is very important considering the fact that it is the source of many perennial rivers of north India. The various aspects of the Socio-Cultural and physical environment which have been studied in the present chapter will be of much help to assess the land use cover of the state. The natural resources can be utilized for the development of state but it should not be at the cost of the environmental degradation. The forest resource of Himachal Pradesh which is a mix of hardwood and softwood tree species is an ideal resource for development of state in sustainable manner in the near future.

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CHAPTER III

LAND USE AND FOREST RESOURCES

Forests are renewable resources and play a dynamic role in life, economy and habitat of human beings. The word forest is derived from a Latin word 'fores' meaning outside, the reference being to a village boundary or fence and it must have included all uncultivated and uninhabited land. In general a forest is defined as the area under diverse vegetation species which is maintained due to certain benefits which it provides. It is the source of some basic human needs like fuel, fodder, timber, medicinal herbs, raw material for industries and many other products required in almost every walk of life. Forests indirectly control floods and droughts, check soil erosion, landslides and desertification, maintain temperature and increase rainfall and humidity. Ecologically a forest is a plant community predominantly of trees and other woody vegetation, usually with closed canopy. The study of forest resources of Himachal Pradesh thus can not be neglected owing to the many benefits that it provides to the environment and rural society of the state.

Himachal Pradesh has a diversified and rich flora owing to the great variations in altitude and climate. While the conifers extend towards the higher slopes, the valley bottoms have Broad-leaved deciduous trees. Different forest types generally follow definite altitudinal zonation except where micro-climatic changes due to change in aspect, rock and soil bring about vegetation inversion viz. forest types which otherwise occur at higher elevation sometimes are seen in the lower zones and vice versa[1]. Generally thick forest cover is confined to inaccessible and remote areas or areas having low population density.

The competition for land to be put into various uses has led to the encroachment within the forest areas. The situation is more complex in the state of Himachal Pradesh which has limited land suitable for agriculture, settlements and non-agricultural uses owing to which the fringe areas of forest are often being encroached by the villagers. Thus to get a broad understanding of area under forest and its dynamics it would be of much importance to study the land use pattern of the state of Himachal Pradesh. The changes in the various classes of land use would depict the true picture of the interaction between man and nature and its influence on the forest cover of the state.

3.1 Land use:

The core requirement of human beings and their settlements is the land and almost all activities of humans are associated with and are dependent on land. The land use pattern depicts the socio-economic and cultural complexion of a region. The word 'Land' here denotes not only the surface of the soil but also all those resources which are the gifts of nature. Thus 'Land' includes not only the visible soil surface, but also includes flora, fauna, air, sunshine, precipitation and underground resources[2]. An irrational use of land not only leads to its wastage and degradation but also lowers the efficiency of other resources. Moreover it is not only the extent of geographical area which determines the land use efficiency but also the rational and judicious use of the limited land available.

The rationale behind the land use classification is to divide the available land into certain categories keeping in mind certain characteristics which can be of some utility to fulfill human needs. This will help us immensely to identify basic land-use problems and thus formulate a strategy for future planning at the governmental level. Land use classification is thus the systematic arrangement of various types of available land on the basis of certain defined characteristics, mainly to identify and understand their fundamental utility[3].

Land use in the Himalayas:

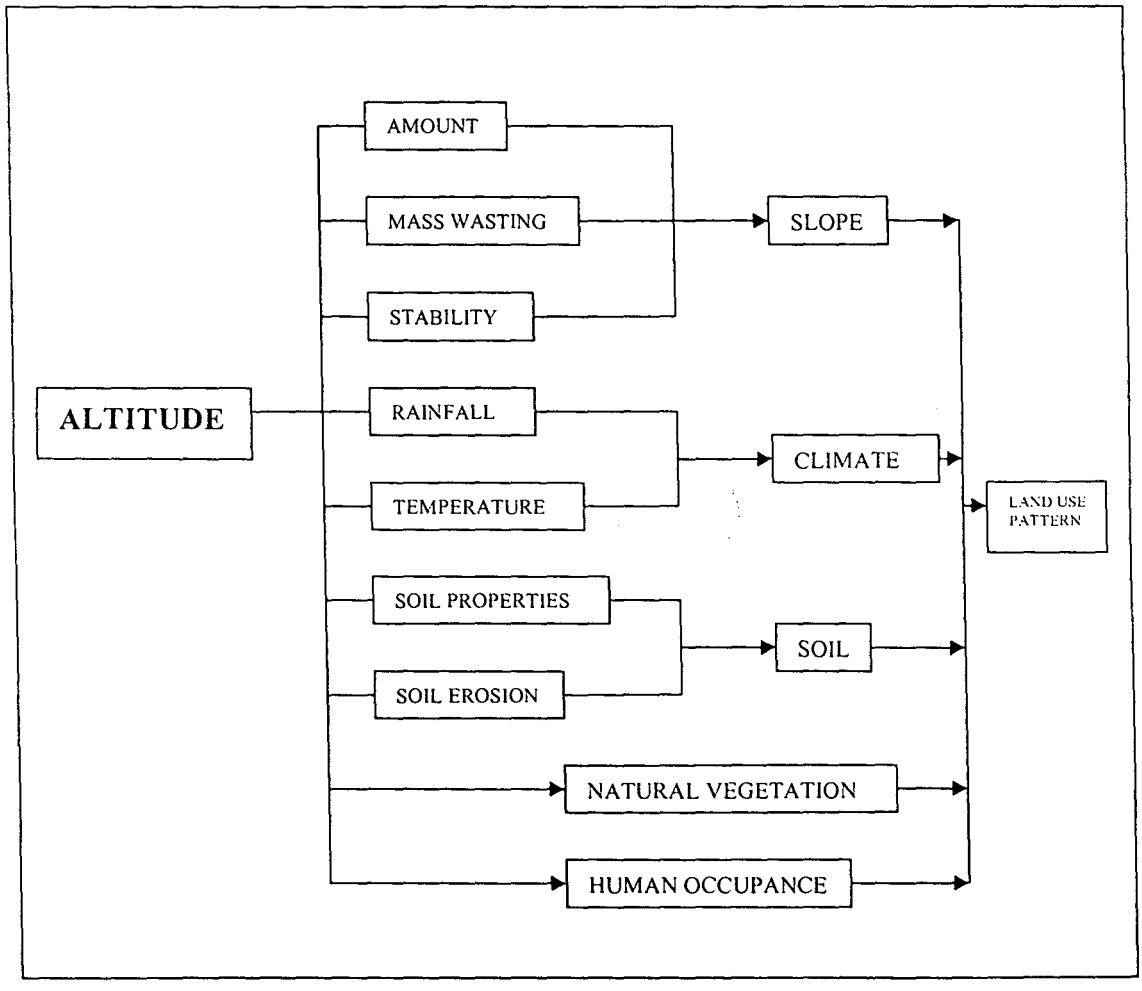
Land use cover in mountains show a marked contrast from the plains in that they have a sequence of zones which are dependent on altitudes and each zone has a predominance of particular element and a specific combination of components. However it must be kept in mind that although elevation is a major determinant in land use pattern of Himachal Pradesh, the importance of natural and cultural determinants which vary across altitudinal zones is also important and should not be neglected. This can be understood from a model of altitudinal zonation of principal land use component[4].

Model 3.1 shows that the altitude has a dominating influence on the climate, soil, slope, natural vegetation and human occupancy which are major determining factors while studying the land use pattern of a mountainous region. The pattern of land use in the state of Himachal Pradesh is not regionally autonomous and experience shifts in the components and

location due to the influence of the neighboring North Indian plains and foot hill zones[5]. Growing urbanization, tourism and horticultural developments are also some of the important influences which have resulted in the changes in the land use pattern of Himachal Pradesh. The concept of land use in the case of Himalayas has thus been termed as "Spatial altitudinal" rather than "Spatial horizontal" which is the case in plains, Himachal Pradesh being no exception to it.

Model No 3.1

Altitudinal zonation of principal land use components of Himachal Pradesh

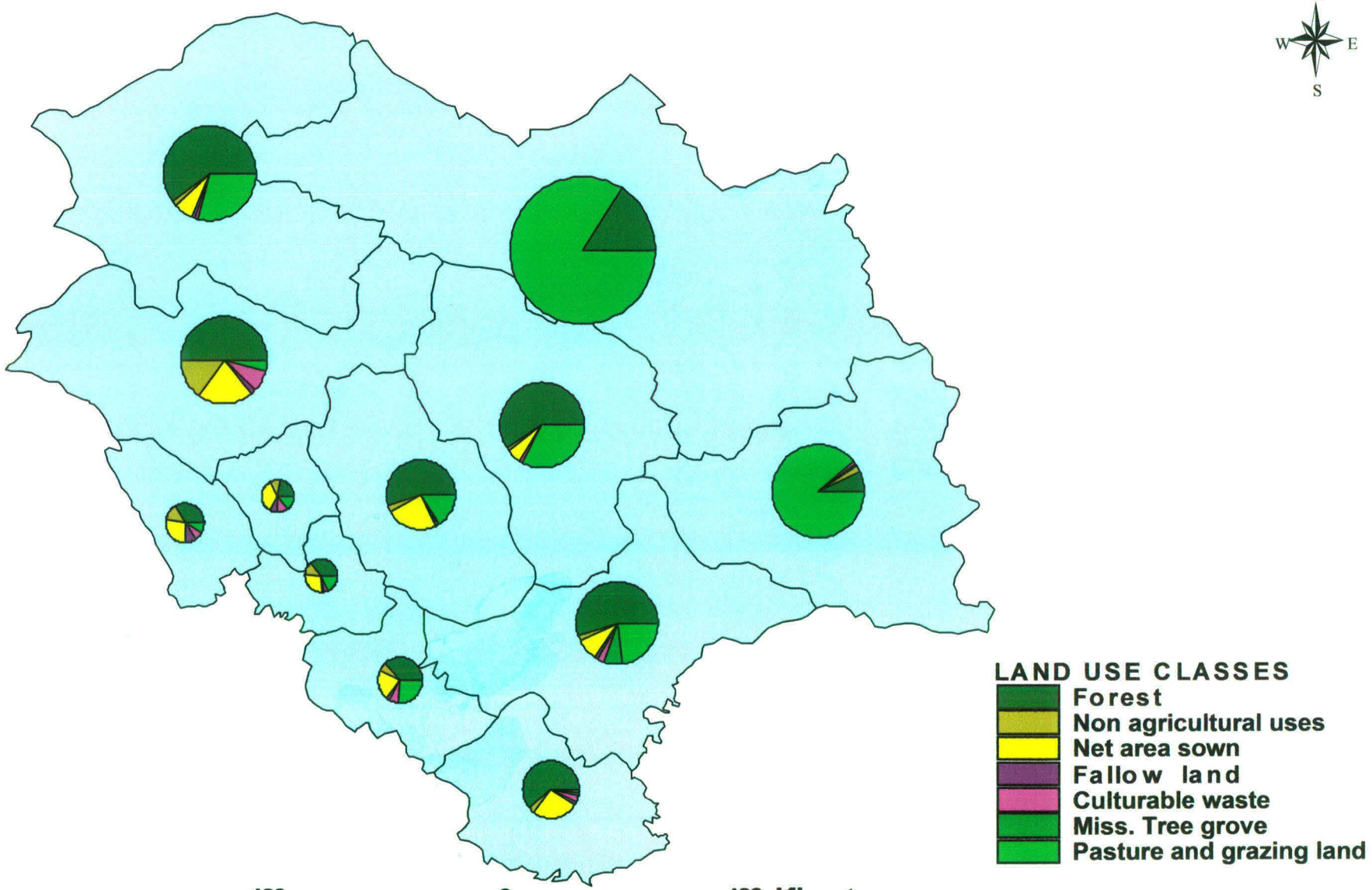


Source: Mukerji.A.B: Altitudinal zonation of the principal land use components in the western Himalayas (Himachal Pradesh)[1]

[1] Mukerji.A.B (1990): "Altitudinal zonation of the principal land use components in the Western Himalayas (Himachal Pradesh)", in Geography of the Mountains, Contribution to Indian Geography XII, (edited by Tejvir Singh), Heritage Publications, New Delhi.

Map No 3.2

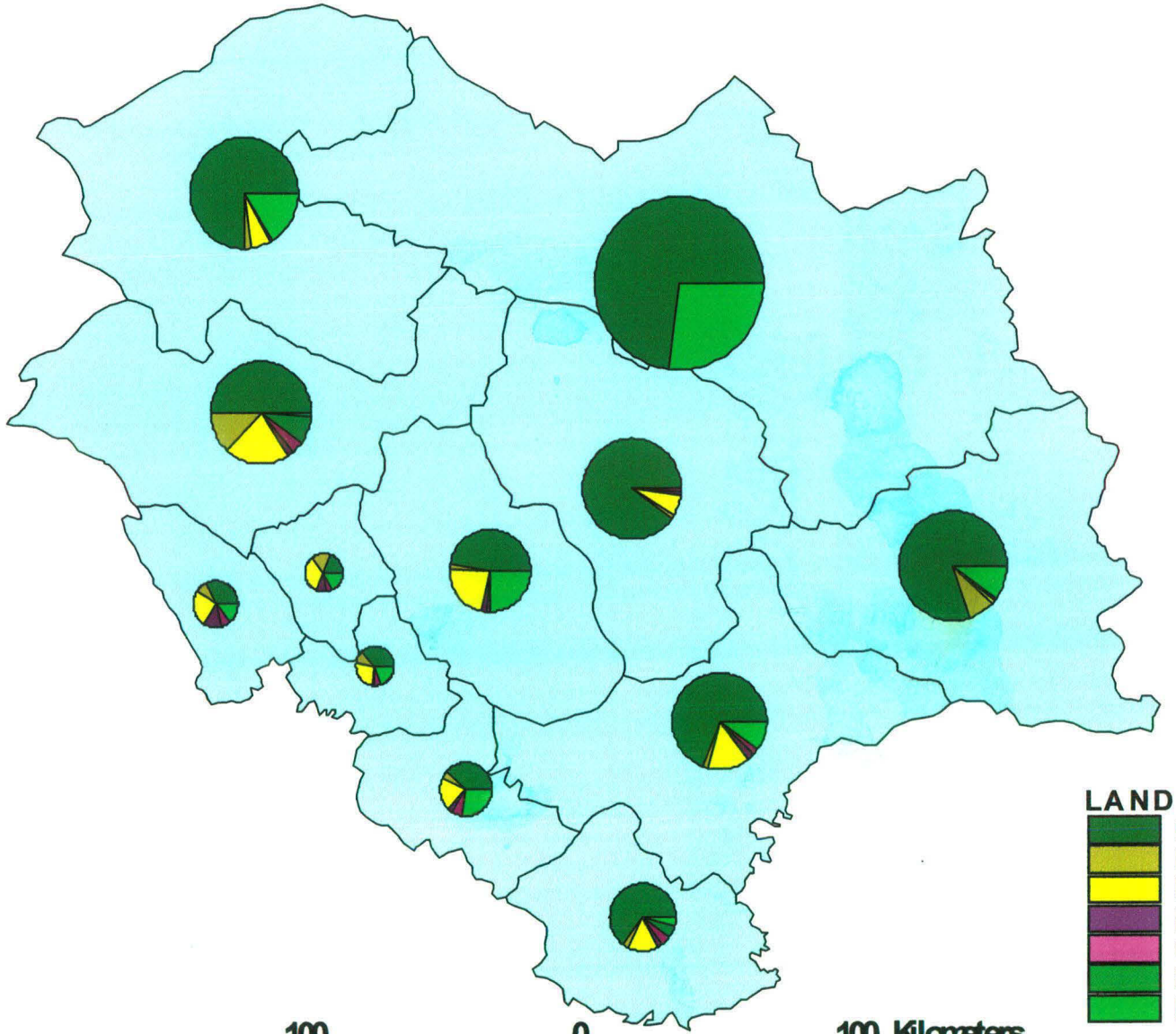
LAND UTILISATION OF HIMACHAL PRADESH 1984-85



Source: H.P Forest statistics, 1986

Map No 3.3

LAND UTILISATION OF HIMACHAL PRADESH 1997-98



Source: H.P Forest statistics, 2000

After having a broad understanding of the concept of land use and its importance, it would now be appropriate to analyse the land use data of Himachal Pradesh at the district level and see shifts therein. The years 1984-85 and 1997-98 have been taken as the representative years for the analysis.

Analysis of the district-wise land use pattern and shifts (1984-85 AND 1997-98):

Himachal Pradesh Forest Department recognizes seven land use classes viz. Forest, Land put to Non-Agricultural Uses, Net Area Sown, Fallow Lands, Culturable Wastes, Land under Miscellaneous Tree Crop not included in cultivation and Pastures and other Grazing land. The area under Current Fallow and Fallow Lands other than Current Fallows are combined and put under the category of Fallow Lands. Like wise the area under Barren and Unculturable land is included in the Pasture and other Grazing land class. Map 3.2 and 3.3 shows the land use pattern of Himachal Pradesh. With this understanding of the various classes of land use the analysis of shifts in these classes across different districts of Himachal Pradesh is as follows:

1. Forest:

The category of forest include all actually forested area of land, classed or administered as forest under any legal enactment dealing with forests, weather state owned or private. If any portion of forest land is not actually wooded, but is put to some agricultural use, that portion is included under the appropriate heading of cultivated or uncultivated lands. This rule however doesn't apply in the case of state owned forest.

The largest increase in the share of area under forest is in the district of Kinnaur followed by Lahaul-Spiti, Kullu, Chamba and Shimla. The share of forest in Kinnaur for the year 1984-85 was 6.72 percent which increased to 79.56 percent in 1997-98. Likewise the increase in share of forest area in Lahaul-Spiti was from 16.10 percent in 1984-85 to 73.23 percent in 1997-98. Such massive increase in area is unexplainable considering the climatic conditions, except that the area under Pasture and Grazing lands was shifted to this category. It may also be kept in mind that the share for year 1997-98 perhaps is of assessed land and not of total geographical area. It has been seen that in large barren districts like Lahaul-Spiti

and Kinnaur, at times assessed area is taken which corresponds to total village area. Therefore, the sudden increase may be attributed to definitional change. Similar is the case with the districts of Kullu, Chamba and Shimla which also saw an increase in area under forest. The forest area of Kullu increased from 58.64 percent of total area in 1984-85 to 90.06 percent in 1997-98. Chamba witnessed an increase in forest area of 990 sq.km area and Shimla 699 sq.km during the corresponding period. Bilaspur, Solan and Sirmaur also showed an improvement in the forest area.

Mandi district has shown the largest decline in forest area. It was 55.44 percent of total area in 1984-85 which came down to 47.09 percent in 1997-98. It was followed by Una, Hamirpur and Kangra districts. The decline in the case of Una was from 33.77 percent to 31.62 percent in 1997-98 while it was from 22.27 percent to 19.59 percent in case of Hamirpur. Kangra witnessed a slight decline of 18 sq.km of forest during the corresponding period. The main reason for decline in case of Mandi may be the increase in horticultural activity coupled with increase in illegal felling of trees. Una, Hamirpur and Kangra have witnessed an increase in industrial and infrastructural development which may be the cause of the decline.

2. Land put to Non-Agricultural Uses:

All the land occupied by built up areas like buildings, roads, railways or covered with water for example rivers, canals, water reservoirs and also other areas put to uses other than agriculture are grouped under this class. The largest increase in area under this category is in the district of Kinnaur where it went up from 1.56 percent of total area in 1984-85 to 7.99 percent in 1997-98. This could possibly be because of the building of various hydel projects and dams across the Satluj river and some other streams. Hamirpur showed an increase in area under this class from 11 percent to 15.65 percent in 1997-98. Lahaul-Spiti also showed an increase of 32 sq.km area under this category during the corresponding period. The likely reason for this was the various developmental activities being initiated by the government like the construction of roads etc. In the case of Kullu district which showed an increase of 17 sq.km, the most likely reason could be the various river valley projects and reservoirs being built there.

All other districts showed a decrease in area under Non-Agricultural Use during the period 1984-85 and 1997-98. The decline in the district of Kangra was from 14.86 percent to 13.12 percent in 1997-98 while Una witnessed a decrease in area from 12.92 percent in 1984-85 to 7.79 percent in 1997-98. Mandi, Bilaspur, Sirmaur, Chamba, Shimla and Solan also witnessed a decline in the area of Non-Agricultural Uses during the corresponding period. The decline in area under this category is unexplainable and this shows that the area under this category is not being recorded properly. This is so because the area once put to Non-Agricultural Use will not generally and easily be converted into other categories[6].

3. Net Area Sown:

Land with crops and orchards come under this category. Most of the districts have shown a decline in the Net Area Sown during the period 1984-85 and 1997-98. The most conspicuous decline was seen in the case of Sirmaur where its share out of total area went down from 26.34 percent in 1984-85 to 14.94 percent in 1997-98. This could be explained by the shift of land during this period from this class to the class of land under miscellaneous tree crops. Large plantations were raised in order to meet the requirement of fuel wood and other industrial needs. Sirmaur is followed by Solan, Mandi, Kangra, Una, Hamirpur, Bilaspur and Chamba in that order. All these districts also show a decline in Net Area Sown. The slight decline in Net Area Sown in such a large number of districts of Himachal Pradesh may be due to environmental factors and more intensive nature of farming.

Only four districts had witnessed an increase in area under this category during the period 1984-85 and 1997-98. These were Shimla, Kullu, Kinnaur and Lahaul-Spiti. The largest and most prominent increase in area under this category was seen in the case of Shimla district where its share increased from 8.63 percent in 1984-85 to 13.86 percent in 1997-98. Here such a large increase may be attributable to spurt in horticultural activities leading to setting up of fruit orchards. Kullu, Kinnaur and Lahaul-Spiti witnessed a minor increase during this period.

4. Fallow lands:

Under this category come the lands which are temporarily out of cultivation for a period of not less than one year but not more than five years. The cropped areas which are

kept fallow for the current year also come under this category. The reasons for keeping once cultivated lands as fallow may be many such as poverty of cultivators, inadequate supply of water or silting of canals and rivers or unremunerative nature of farming etc. Land is also kept fallow to rejuvenate fertility as soil with constant use tends to become deficient in nutrients.

The largest increase in share of Fallow land was in Una district where it went up from 8.70 percent in 1984-85 to 12.79 percent in 1997-98. This could possibly be because of adverse climate and lack of availability of water due to failure of monsoon during the year 1997-98. Shimla, Mandi and Solan also showed a slight increase of area under this category. The increase in area was 100 sq.km, 35 sq.km and 14 sq.km respectively for the corresponding year. Kullu, Bilaspur, Hamirpur had a marginal increase in area of fallow lands during this period.

The districts of Kangra, Lahaul-Spiti, Chamba, Sirmaur and Kinnaur showed a decline in area of Fallow lands during the period 1984-85 to 1997-98. Kangra had the largest decline among the districts where the area under this category came down from 2.23 percent in 1984-85 to 1.57 percent in 1997-98. The decline in area of fallow lands in all these districts may be attributed to good agricultural development during the recent years. Kangra and Sirmaur have one of the highest cropping intensity within the state of Himachal Pradesh. In Lahaul-Spiti and Kinnaur efforts are being put to grow various crops on experimental basis.

5. Culturable Waste:

All lands suitable for cultivation weather uncultivated or not or taken up for cultivation once but not cultivated during the current year and the last five years or more in succession for one reason or another are included in this category. This category is also called 'Banjar kadim' in revenue terminology and may be either fallow or covered with shrubs and jungles which are not put to any use.

Most of the districts are showing an increase in area under this category during the period 1984-85 and 1997-98. The largest increase in share was seen in the case of Bilaspur district where it increased from 3.86 percent in 1984-85 to 4.97 percent in 1997-98.

Following it were the districts of Sirmaur, Kinnuar, Chamba, Kullu, Lahaul-Spiti, Solan and Mandi in that order. The increase in area seen in these districts was not much.

Only four districts had shown a decrease in area under the class of Culturable Waste during the period 1984-85 and 1997-98. These were Kangra, Hamirpur, Shimla and Una. The share of Hamirpur declined from 11.45 percent in 1984-85 to 5.09 percent in 1997-98 while Kangra witnessed a decline from 8.31 percent to 4.37 percent. One of the reasons for such decline could be the large plantations which were raised in these lands to meet the fuel wood requirements. Shimla and Una showed a decline of 40 sq.km and 2 sq.km respectively during the corresponding period. The reason for such minor decrease of the area under this category is because this type of land is a type of reserve with the farmers which can be brought under cultivation depending upon the pressing demand for cultivation and also the existence of suitable conditions of climate, as well as availability of finances[7].

6. Land under Miscellaneous Tree crops not included in cultivation:

Under this category come all the cultivable lands not included under 'Net Area Sown' but which are put to some other agricultural uses. Land under *Casurina* trees, *Thatching grasses*, *Bamboo bushes* and other tree groves for fuel which are not included under orchards are classed under this category.

Except the districts of Kangra, Shimla and Sirmaur the rest of the districts are having slight or minor change of area under this category during the period 1984-85 and 1997-98. Kangra witnessed an increase in share of this category from 0.02 percent to 9.46 percent during the period 1984-85 and 1997-98. Most likely reason could be the reclamation of lands from Culturable Waste and Pasture and Grazing lands by raising plantations for fuel wood requirements. Sirmaur also increased its area under this category from 1.06 percent to 6.41 percent during the corresponding period. The demand of industrial wood and fuel wood requirements has led to increase in the plantations. A large decrease in area occurred in case of Shimla. It share went down from 6.82 percent in 1984-85 to 0.33 percent in 1997-98. In this case the reason may be the increase in the orchard farmlands which were started in suitable locations.

7. Pastures and other Grazing lands:

This category includes all the grazing lands weather they are permanent pastures and meadows or seasonal transhumance grazing grounds. Common village pastures, meadows and Shyamlat lands are also included in it. The Barren and Unculturable lands are also within it. The lands like mountains, deserts, marshes etc which can't be cultivated due to natural contingences are also included.

The data in this category is highly unreliable as there is a marked shift of area from this category towards other categories. Lahaul-Spiti witnessed a large decline of area under this category from 83.25 percent in 1984-85 to 26.1 percent in 1997-98. In Kinnaur's case this decline was from 89.69 percent to 9.87 percent during the corresponding period. Kullu also saw a decline from 33.22 percent to 1.07 percent during the same period of time. Similarly Chamba, Shimla and Kangra also witnessed a decline in area under this category. In all these cases the decreased area was most probably put under the category of forest. This redistribution of area was due to change in the definition of forest by the forest department according to which alpine pastures and meadows were included under the category of forest.

Mandi showed the maximum increase of area under this category from 15.89 percent in 1984-85 to 25.44 percent in 1997-98. It was followed by Sirmaur, Hamirpur, Una, Bilaspur and Solan districts. In case of Mandi the degradation of forest due to over grazing and illegal felling most probably has led to the increase in the area of Pastures and Grazing lands. The rest of the districts also showed a minor increase in area under this category.

In order to know the nature of relationship between the forest class and other classes of land use a correlation was performed between the forests with other classes for the year 1997-98. Table 3.1 shows that the category of Net Area Sown, Fallow Lands, Culturable Waste and Land put to Non-Agricultural Uses are negatively correlated with the Forest area. This means that any increase in any of these categories will show a decrease in the forest land and vice-versa. The correlation coefficient is -0.927 between the classes of forest and Net Area Sown which is significant at one percent level of significance.

The correlation coefficient between Forest and Culturable Waste is -0.800 which again is significant at one percent level of significance. The coefficient of correlation between Forest and Fallow Land and between Forest and Land put to Non-Agricultural Uses are -0.705 and -0.683 respectively at five percent level of significance. The rest of the two classes of land use viz. Miscellaneous Tree Groves and Pasture and Grazing land had a

negative relationship with correlation coefficients of -0.038 and -0.429 respectively but it is insignificant for the present sample.

Table3.1

Correlation between Forest and other land use classes for the year 1997-98

	N_A_uses	N.S.A	Fallow_L	C_waste	M_T_Grove	P_G_land
Forest	-.683*	-.927**	-.705*	-.800**	-.038	-.429
Sig(2-tailed)	.014	.000	.010	.002	.906	.164

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Correlation in general depicts the relationship between one or more variables. In order to know the extent of influence of independent variables on the dependent variable the statistical technique of regression is much more useful. A step wise regression has been worked out here to know the influence the determining factors cumulatively. In the present context the dependent variable is the Forest and independent variables are the classes of Net Area Sown, Land put to Non-Agricultural Uses, Fallow Lands and Culturable Wastes. The classes of Pasture and Grazing lands and Miscellaneous Tree Groves have been excluded as the correlation analysis of these land use classes with forest class was statistically insignificant. The relationship between dependent variable (Y) and independent variable (X) can be explained by a simple linear equation:

$Y = a + bX$

From the model summary table (Appendix) in regression analysis, the coefficient of determination (R^2) tells us the proportion of variation of Y (dependent variable) as explained by X (independent variable). The value of adjusted R^2 for Net Area Sown is 0.846 which means 84.6 percent of the total variation in the Forest (Y) is being explained by Net Area Sown (X_1) alone. With the addition of Culturable Waste class (X2) the explanatory percentage increases slightly to 85.4 percent. This shows a minor increase in explanatory

percentage of forest with the addition of Culturable Waste class. With the addition of classes of Non-Agricultural Use (X3) and Fallow Lands (X4) the explanatory percentage decreases to 84.7 and 83.0 percent. Since the explanatory capacity of these independent variables decreases these have been removed from the regression model. This shows that Net Area Sown is the most important determining factor in the shift of forest areas which alone explains nearly 85 percent of variation in the area of forest.

From the table of coefficients (Appendix) the significance level of each of the determinants X1 & X2 can be known by the t –values. The null hypothesis here is that ß=0. If the $|t| < 2$, the null hypothesis is accepted and the coefficient is insignificant. If the $|t| > 2$, then the null hypothesis is rejected and the model is significant. The t- value for Net Area Sown alone is -7.837 which is highly significant. When the variable Culturable Waste is added, the t value becomes -4.271 & -1.254 respectively. It shows that only the class of Net Area Sown is statistically significant considering the fact that modulus t-value of it is more that two. The Culturable Waste class is statistically insignificant for this regression model as the modulus t-value of it is less than two. Thus the null hypothesis is rejected. Hence, Net Area Sown is the most important class affecting forest area.

The regression equation explaining the relationship between the dependent variable i.e. Forests (Y) and independent variable (X1) is as follows:

$Y = 87.365 + (-1.942)\ (X1)$

Where Y = Forest area

X1 = Net Area Sown

The equation shows the relation between Forest and Net Area Sown. These relations are further supported by the correlations being performed earlier.

The above analysis of land use pattern shows that the maximum land area was under Forest out of all the land use classes. Further the correlation and regression analysis shows that the changes in forest area are determined to a large extent by the Net Area Sown. Rest of the classes viz. Pasture and Grazing lands, Non-Agricultural Uses, Culturable Waste, Miscellaneous Tree Groves and Fallow Lands being statistically insignificant for the present study. A large share of area under forest presents quite a rosy picture of flourishing forest of Himachal Pradesh, but this is not the true picture as the area under pasture and grazing lands

is also included within the forest area which can be easily seen from the case of Lahaul-Spiti and Kinnaur both of which are cold desert regions.

The actual forest cover of Himachal Pradesh is 22.5% of total geographical area of the state which is still far behind the ideal cover of sixty six percent as envisioned by the National forest policy. Thus to get a clear picture of area under forests and forest cover an study of the forest area and cover and also the various legal classifications would be of much help.

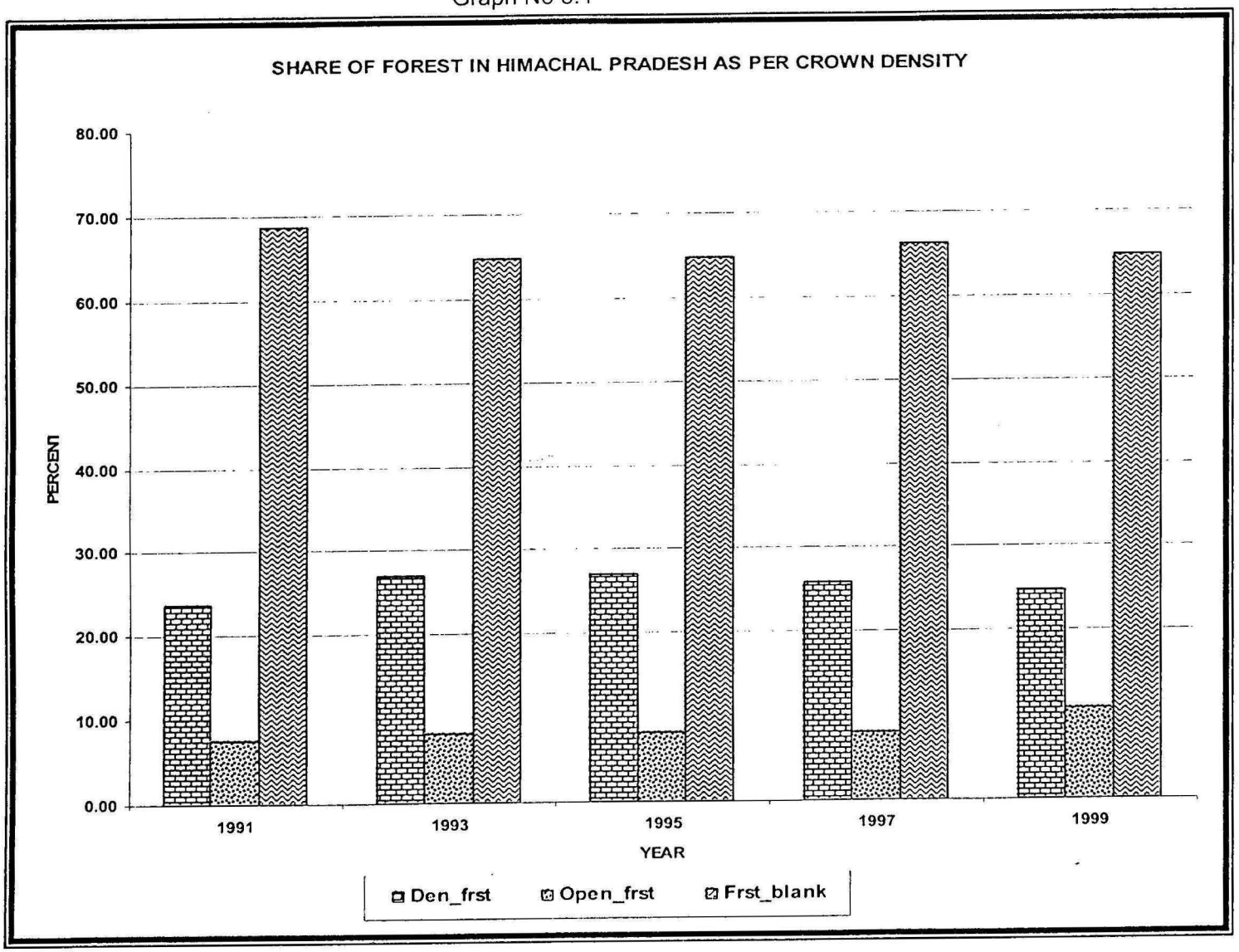
3.2 Forest cover and classification:

The extent of forest cover on the land surface governs many important ecological processes. Forest protects settlements located in the valley bottoms from landslides in a hill state like Himachal Pradesh. It also saves soil from being eroded and moderates the water flow. The national forest policy lays down that forest should cover two thirds of the geographical area. But in reality the well wooded area with good canopy cover and density is much less in the state.

State of Environment Report (2000), Himachal Pradesh says, "nearly 16,376 sq.km or 29.41 percent of the so called forest area is under alpine pastures and perpetual snow cover. This leaves only 21,215 sq.km or 38.11 percent of the geographical area under forest cover of some sorts"[8]. According to the State forest report (1997) published by the Forest survey of India, the actual forest area in the state occupies only 12,521 sq.km i.e. 22.5 percent of the geographical area of the state while the recorded forest area is 35,407 sq.km, which is 63.60 percent of the geographical area of the state. A recent study of forest cover assessment of Himachal Pradesh by using satellite imagery of IRS 1C/1D Wifs data showed actual forest area to be merely 17.15 percent as against 22.5 percent reported by the Forest survey of India[9].

Thus it can be seen that data on the forest cover of Himachal Pradesh often varies and is misleading. The area under alpine pastures and snow cover is also included under forest by the forest department. The assessment of forest cover was earlier done by manual surveys in which the inaccessible areas were not surveyed and thus total area under forest was not estimated correctly. But now with the help of Remote sensing and Satellite imagery, even the remotest areas are being mapped and forest cover is estimated with greater accuracy and less

Graph No 3.4


SHARE OF FOREST IN HIMACHAL PRADESH AS PER CROWN DENSITY
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
PERCENT
1991
1993
1995
1997
1999
YEAR
Den_frst
Open_frst
Frst_blank

probability of errors. This gives us a much clearer picture of the forest cover and as the technology in this field improves the more accurate information will be available.

3.2.1 Density distribution of forests:

It is clear that area under forest does not mean that all the area within it will be under vegetation. It will also include alpine pastures, snow covered area and unculturable, barren lands. Thus the study of density of forest assumes importance. By density here we mean tree canopy or crown cover density. According to density, the forests are of three types:

- Dense forest: These include the forest where crown cover density is above forty percent.
- Open forest: These cover the forest having crown density more than ten percent but less than forty percent.
- Forest blank: These are those forest areas where the crown cover density is less that ten percent. Here the vegetation is very sparse and is more or less composed of shrubs, bushes and scrublands.

Table 3.2

Forest Cover Crown density - Himachal Pradesh, 1991-99

Year	Dense forest	Open forest	Forest blank
1991	23.71	7.63	68.66
1993	27.01	8.29	64.69
1995	26.93	8.27	64.80
1997	25.85	8.01	66.15
1999	24.63	10.70	64.67

Source: Himachal forests (2002), a booklet by Forest department, H.P.

The above table 3.2 shows that the dense forest area in Himachal Pradesh initially increased till the mid nineties but declined subsequently. It was 23.71 percent of the total forest area of Himachal Pradesh in 1991 which increased to 27.01 percent in 1993 and then declined to 24.63 percent in 1999. Open forest is showing an increasing trend during this

period. It was 7.63 percent in 1991 which increased to 10.70 percent in 1999. The area under the forest blank was the maximum out of these three categories. It was showing an inconsistent trend with 68.66 percent share in 1991 which came down to 64.80 percent in 1995 and increased to 66.15 percent in 1997. Its share out of total forest area for the year 1999 again decreased to 64.67 percent.

In order to assess the distribution of dense forest, open forest and forest blank in districts of Himachal Pradesh, a coefficient of variation (C.V) was calculated for 1991 and 1999 which is show in tables 3.3 and 3.4. C.V for the category of forest blank was 130.78 percent in 1991. It means that there is high inconsistency in the distribution of forest blank area among various districts. To elaborate further it implies that some districts have high share of forest blank area out of the total area under this category. For example Lahaul-Spiti has 36.24 percent and Kinnaur 22.37 percent share out of the total forest blank area. This is due to the cold desert climatic conditions prevalent in these districts. On the other hand some districts have very low share out of total area under this category. Una has 0.63 percent and Hamirpur 0.13 percent forest blank area. High level of development and population density has led to less area under this category.

C.V for the category of forest blank increased to 144.077 percent in 1999. It indicates further clustering and concentration of area under this category to fewer districts. The share of Lahaul-Spiti went up to 41.71 percent and that of Kullu to 12.46 percent. On the other hand the share of Bilaspur, Solan and Una came down to 0.81 percent, 0.99 percent and 0.29 percent respectively. This was primarily due to government plantations and afforestation programmes.

C.V for the category of dense forest was also very high at 93.74 percent in 1991. It shows high variation of the distribution of dense forest area among the various districts of Himachal Pradesh. The share of just three districts namely Shimla, Kullu and Chamba was 21.56 percent, 20.39 percent and 18.24 percent respectively. If taken together their share comes out to be nearly sixty percent of the total dense forest of the state. These districts have a large inaccessible area under forest with rugged terrain which has dense forest. On the other

hand Lahaul-Spiti, Bilaspur, Hamirpur, Solan and Una have share of dense forest amounting to nil, 1.13 percent, 1.75 percent, 1.84 percent and 1.96 percent respectively. Severe cold arid climate in case of Lahaul-Spiti and developmental activities in the case of other districts resulting in deforestation are responsible for such low share. The districts of Mandi, Kangra, Sirmaur and Kinnaur has a share of dense forest amounting to 9.42 percent, 9.07 percent, 8.30 percent and 6.34 percent respectively in 1991.

The C.V for the category of dense forest came down to 89.69 percent in the year 1999 which although still very high is less as compared to the year 1991. This shows that the dense forests are slowly starting to spread to all the districts. This is further proved as the share of Shimla, Kullu and Chamba came down to 19.82 percent, 17.88 percent and 17.38 percent respectively for the year 1999 while the Share of Lahaul-Spiti and Solan increased to 0.37 percent and 3 percent respectively. This was possible due to the government efforts.

Table 3.3

Dense, Open and Forest Blank – District wise 1991

Districts	%T_Dense	%T_Open	%T_Frst_Blank
Bilaspur	1.13	2.27	1.01
Chamba	18.24	13.66	11.13
Hamirpur	1.75	2.09	0.13
Kangra	9.07	21.78	5.27
Kinnaur	6.34	2.37	22.37
Kullu	20.39	4.57	11.49
Lahaul-Spiti	0.00	0.59	36.24
Mandi	9.42	16.10	3.01
Shimla	21.56	10.42	4.75
Sirmaur	8.30	9.72	2.73
Solan	1.84	8.75	1.23
Una	1.96	7.67	0.63
Mean	8.33	8.33	8.33
S.D	7.81	6.48	10.89
C.V	93.74	77.77	130.78

Source: State of the environment report (2000), H.P

Table 3.4

Dense, Open and Forest Blank – District wise 1999

Districts	%T_Dense	%T_Open	%T_Frst_Blank
Bilaspur	0.71	4.29	0.81
Chamba	17.38	18.07	10.93
Hamirpur	1.02	2.40	0.13
Kangra	14.67	7.60	5.03
Kinnaur	4.78	5.38	18.57
Kullu	17.88	8.66	12.46
Lahaul-Spiti	0.37	2.93	41.71
Mandi	10.77	14.06	1.34
Shimla	19.82	14.69	4.68
Sirmaur	8.14	9.24	3.07
Solan	3.00	5.50	0.99
Una	1.45	7.19	0.29
Mean	8.33	8.33	8.33
S.D	7.47	4.94	12.006
C.V	89.69	59.27	144.08

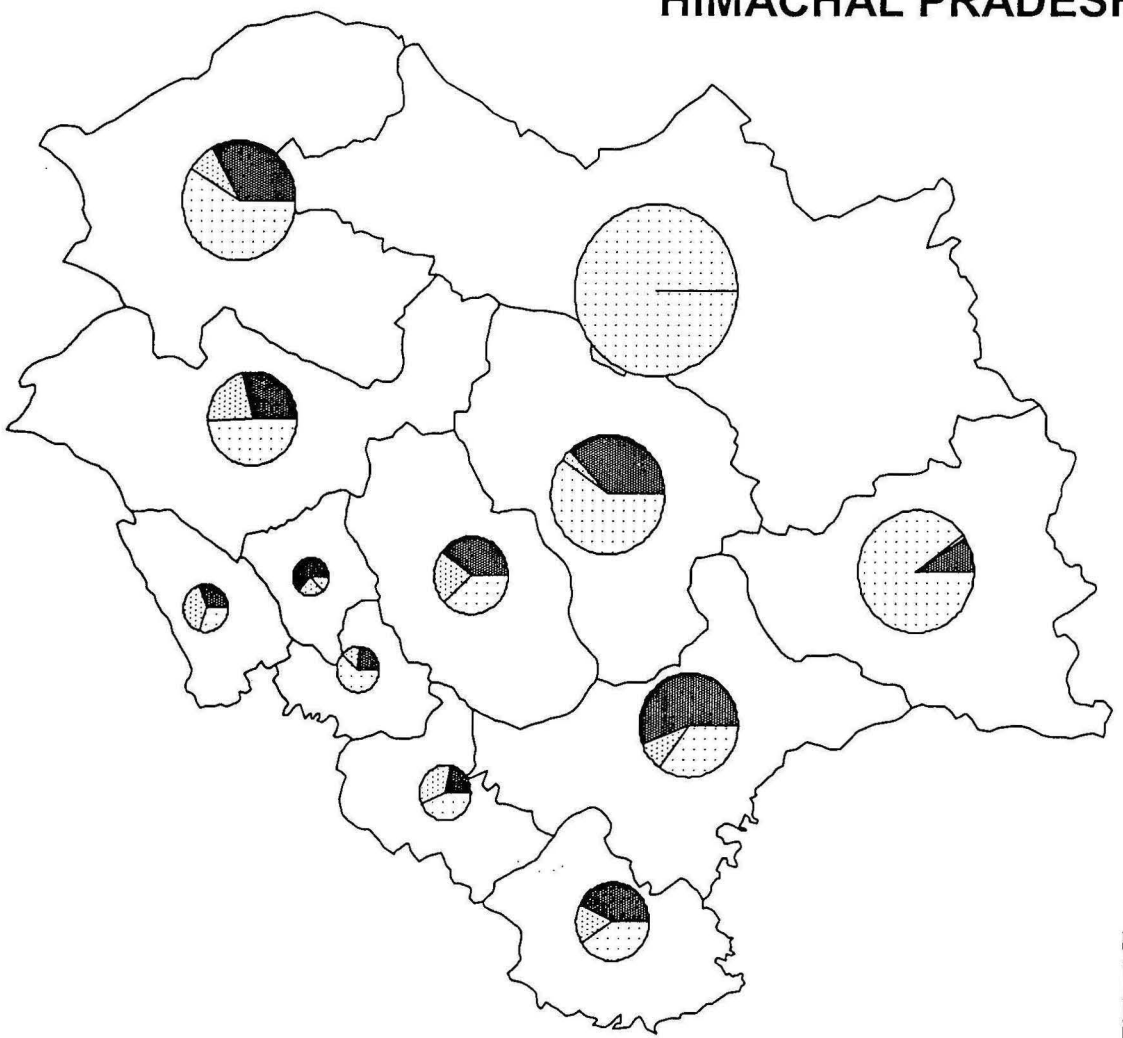
Source:http://Himachal.nic.in

Open forest also had a high C.V of 77.77 percent for the year 1991 but was less as compared to other two categories viz. dense and forest blank. This shows more uniform distribution of open forest among the various districts of Himachal Pradesh. The share of Kangra and Mandi was 21.78 percent and 16.10 percent respectively while the share of Lahaul-Spiti and Hamirpur was 0.59 percent and 2.09 percent respectively. The low share of Lahaul-Spiti was due to environmental factors and in case of Hamirpur due to developmental factors. The C.V of open forest came down further to 59.26 percent in the year1999

Map No 3.5

FOREST COVER DENSITY 1991

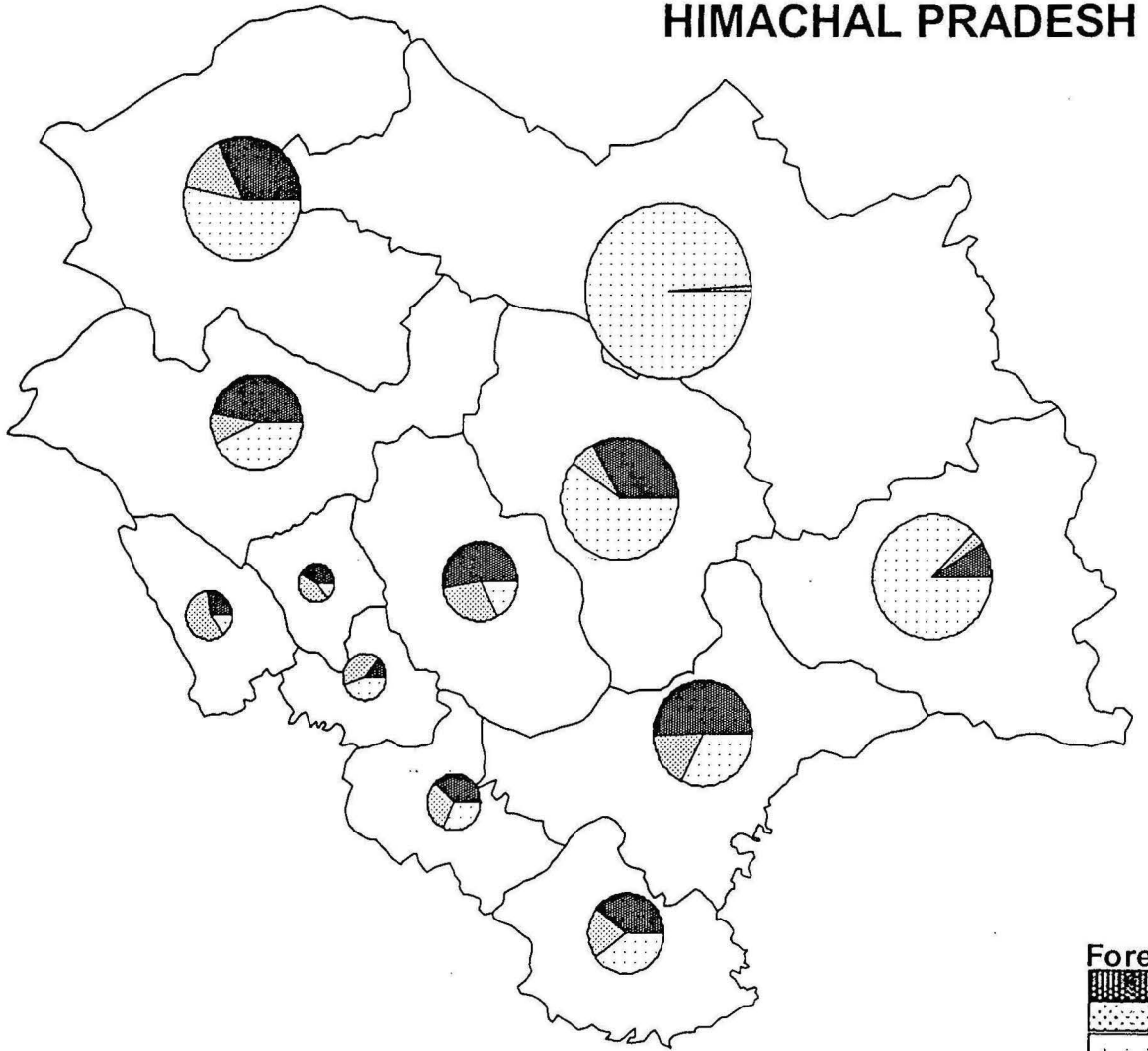
HIMACHAL PRADESH



Source:http//himachal.nic.in

Map NO 3.6

FOREST COVER DENSITY 1999
HIMACHAL PRADESH



Source:http//himachal.nic.in

indicating the more uniform distribution of open forest area among various districts of Himachal Pradesh as compared to 1991. This is supported by the fact that share of Kangra and Mandi went down to 7.60 percent and 14.06 percent respectively, while the share of Shimla and Chamba increased to 14.69 percent and 18.07 percent respectively for the year 1999.

The above analysis shows that open forest area is the most uniformly distributed across the districts of Himachal Pradesh, where as forest blank is showing the maximum variation. The category of dense forest is falling in between these two. But one thing comes out quite clear is that all these taken together are showing a high variation across the various districts which shows the clustered nature of distribution of forests of Himachal Pradesh.

Share of different forest density classes out of total forest area within each district of Himachal Pradesh:

It would not be out of place here to study the share of dense forest, open forest and forest blank out of the total forest area with in each district of Himachal Pradesh. The years 1991 and 1999 have been taken as the representative year for the analysis which are show in map 3.5 and 3.6.

Dense Forest:

It becomes clear from the map 3.5 that share of dense forest for the year 1991 is high in the districts of Hamirpur, Shimla, Kullu, Mandi and Sirmaur which was 62.65 percent, 55.73 percent, 36.98 percent, 40.38 percent and 42.95 percent respectively out of the total forest area within each district. With the exception of Hamirpur the large share of dense forest could be explained due to isolated, inaccessible large forest areas within these districts. Leaving Mandi all the districts viz. Hamirpur, Shimla, Kullu and Sirmaur have shown a decline in the share of dense forest area out of total forest area. This shows that forests are being cut in these districts. The share of dense forest in Mandi increased to 52.80 percent in 1999. This is primarily due to massive reforestation programmes and check on illegal felling being undertaken with in the district[10].

The share of dense forest for the year 1991 is less in the districts of Lahaul-Spiti and Kinnaur. It was virtually nil in case of Lahaul-Spiti and 8.82 percent for Kinnaur district.

This low share of dense forest out of total forest area in these districts was mainly attributable to the environmental factors. However the condition of Lahaul-Spiti improved slightly in 1999, when its share of dense forest became 0.34 percent out of total forest area. But the opposite happened in Kinnaur where the share of dense forest declined slightly to 8.56 percent which is a cause of concern.

Open forest:

Open forest are more common in relatively more plain areas of Himachal Pradesh. The share of open forest in the year 1991 was high in the districts of Una, Solan and Hamirpur where it was 39.50 percent, 34.29 percent and 24.10 percent respectively out of the total forest area within each districts. With the exception of Solan, the other two districts viz. Una with 58.52 percent and Hamirpur with 43.38 percent share in 1999 have shown an increase in the share of open forest. These are plain areas with lot of developmental activities going on thus major part of forest area is open. The decrease in the share of open forest of Solan was due to extraction of timber for various industries.

In the year 1991, the lowest share of open forest was seen in the districts of Lahaul-Spiti and Kinnaur which was 0.18 percent and 1.06 percent respectively out of total forest area of these districts. Rugged terrain and environmental factors inhibit the dense growth of vegetation. However their share increased slightly to 1.14 percent and 4.18 percent respectively for the year 1999. This was on account of government efforts to reforest suitable lands. The share of rest of the districts varies between ten to thirty percent of the total forest area.

Forest blank:

Forest blank is generally barren and uncultivable lands where some sparse vegetation or bushes are found growing. Alpine pastures and grazing lands and snow bound areas are also included in it. The share of forest blank for the year 1991 was the highest for the districts of Lahaul-Spiti and Kinnaur which was 99.82 percent and 90.12 percent respectively out of total forest area. The rugged, stony terrain, high relief and cold desert climatic conditions has hampered the vegetative growth leading to such a large share of forest blank in these

districts. Their share decreased slightly in the year 1999 to 98.52 percent and 87.23 percent respectively.

The lowest share of forest blank out of total forest area during the year 1991 was in the districts of Hamirpur and Una which was 13.25 percent and 29.08 percent respectively. This is obvious since these are relatively plain areas and have less barren land. The share of Hamirpur increased slightly to 14.16 percent and that of Una declined to 14.37 percent during the year 1999. In Una district some parts of forest blank has been reforested with newer varieties of plants. The share of rest of the districts varies between thirty and eighty percent which is quite normal for a hilly and mountainous state like Himachal Pradesh.

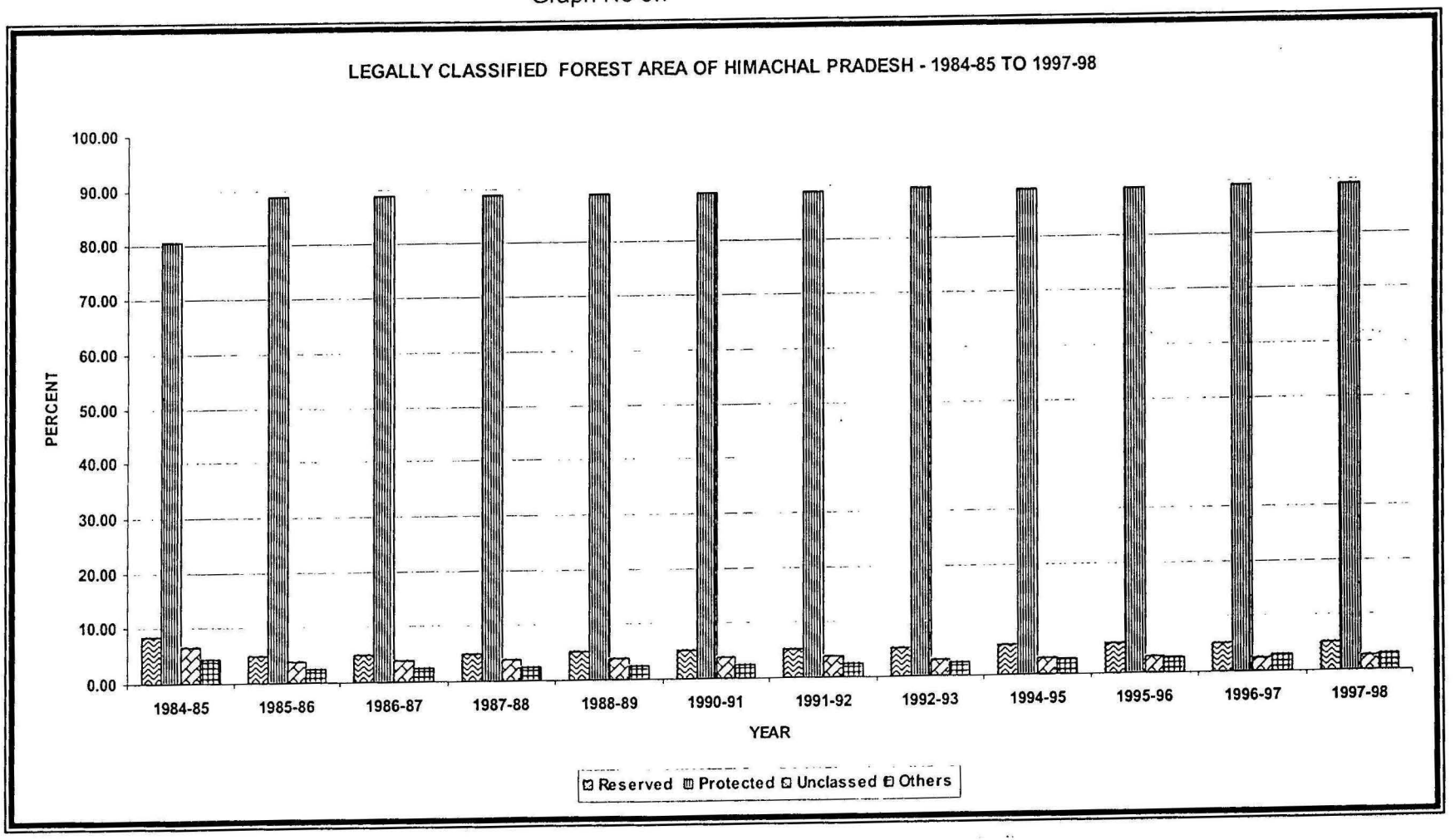
The above analysis shows that in most of the districts of Himachal Pradesh the share of dense forest is declining over a period of time. On the contrary the share of Open forest is showing an increase during the same period. The decrease in share of dense forest is a cause of concern which needs immediate attention and reversal. One way to check the further decrease in the dense forest area is to convert it into reserved forest. It would here be interesting to study the distribution of forest of Himachal Pradesh based on legal status.

3.2.2 Forest based on Legal status:

For the purpose of better management and conservation of forest, the Himachal Pradesh forest department has broadly classified the forest of Himachal Pradesh. The broad legal classes as given by forest department are:

- Reserved forest: Reserved forest is one which is permanently dedicated either to production of timber or other forest produce. Right of grazing is seldom allowed. It is owned and operated by the government.
- Protected forest: In protected forest some rights like grazing, herding, wood collection etc are allowed subject to a few mild restrictions. Though owned by the government, it may be used by private individuals to meet their needs of wood and grazing.
- Unclassed forest: The unclassed forests are those which are under the general control of the forest department and are allowed to be used by the general public. These are largely barren areas, snow bound alpine pastures and are unproductive and unprofitable lands.

Graph No 3.7


LEGALLY CLASSIFIED FOREST AREA OF HIMACHAL PRADESH - 1984-85 TO 1997-98
PERCENT
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1984-85
1985-86
1986-87
1987-88
1988-89
1990-91
1991-92
1992-93
1994-95
1995-96
1996-97
1997-98
YEAR
Reserved
Protected
Unclassed
Others

- Other forests: This category includes forest areas along road strips, railway strips, area under section 38. IFA, area under L.P.A and H.P pvt forest act, cantonment and municipal forest[11].

From the table 3.5 showing the forest area of Himachal Pradesh based on legal classes during the period 1985-86 to 1997-98 it is seen that the maximum forest area is under the protected forest. More than eighty five percent of forest of Himachal Pradesh is protected forest and there is very little variation among its area during the concerned period. The reserved forest with a share of around five percent follows it. It was showing an increasing trend till 1994-95 when it became 5.36 percent of total forest area and then showed a slight decline to 5.12 percent. In absolute terms it has remained same at 1896 sq.km but due to fluctuations in the total forest area, its share has shown a change.

Table 3.5

Reserved, Protected, Unclassed and other forests

Himachal Pradesh (1985-86 to 1997-98)

Year	Reserved	Protected	Unclassed	Others
1985-86	5.03	88.74	3.72	2.51
1986-87	5.03	88.78	3.78	2.41
1987-88	5.03	88.82	3.73	2.41
1990-91	5.04	88.72	3.82	2.42
1991-92	5.04	88.72	3.72	2.52
1992-93	5.04	88.72	3.72	2.52
1993-94	5.12	89.49	2.92	2.47
1994-95	5.36	88.89	3.06	2.69
1995-96	5.35	88.79	3.06	2.80
1996-97	5.13	89.24	2.51	3.12
1997-98	5.12	89.18	2.68	3.02

Source: State of environment report (2000), H.P

The unclassed and other forest category forms the rest five percent of the share of forest area of Himachal Pradesh. The share of unclassed forest is showing a decreasing trend while the share of other forests showed a slight increase during the concerned period.

From the above analysis it is known that the area under reserved forest is very less in Himachal Pradesh. The forest under the reserved category is the healthiest and dense because there is limited outside interference and grazing is not allowed. Although the absolute area under reserved category is stable but its share is declining with the passage of time. The share of protected forest is also decreasing while that of unclassed forest is increasing. To keep the forests of Himachal Pradesh greener and to conserve it more area should be put under the reserved forest category. This will help immensely in better management and protection of forest of Himachal Pradesh.

The forest resources of Himachal Pradesh have a great influence on the daily life of people of state and on the environment. The trees of economic importance are numerous and are utilized for various purposes. In this context the knowledge of the various forest types and composition of species will help us to get a broader idea of the various species which can be of use and utility for the prosperity of the state.

3.3 Forest types and composition:

Himachal Pradesh has rich and diverse natural vegetation which covers roughly one fourth of the total geographical area of the state. The richness and diversity of the flora can be gauged from the fact that, out of the total forty five thousand species found in the country as many as three thousand two hundred ninety five species (7.32%) are found in the state. More than ninety five percent of the species are endemic to Himachal Pradesh and characteristic of western Himalaya flora, while about five percent or one hundred fifty species are exotic, introduced over the last one hundred fifty years.[12] The enumeration of different plant species in the state is as under:

1. Flowering plants: 3120 species.
2. Conifers: 12 species.
3. Pteridophytes: 124 species.
4. Orchids: 38 species.

The spatial extent of vegetation is from the foothills to the snowline being denser in remote and inaccessible areas. This includes the tropical scrub and bamboo forest in the lower hills to the alpine meadows in the upper Himalayan ranges. The entire range of west Himalayan flora can be found in the state which includes the tropical, sub tropical and temperate vegetation based on the altitude and climate. Since climate is the major controlling factor over plant growth, one can find the different vegetation in different climatic types. Above all the density of vegetation may also vary within one climatic type due to difference in soil, amount of sunshine, slope of land, drainage and interference by man. Also the altitudinal stratification sometimes gets disrupted due to micro climatic changes brought out by above mentioned factors.

Various scholars have classified the forest types of Himachal Pradesh. The classification done by Champion and Seth, 1968 and Negi, 1990 is the best recognized and respected[13]. The classification done by them is based on scientific line and is of great value for studying the forest types of Himachal Pradesh. The following forest types are found in different parts of Himachal Pradesh:

1. Moist Sal Forest:

Sal forests are found only in the Paonta or Kiarda dun valley of south-eastern Himachal Pradesh. There is also an isolated patch of Sal near Kangra. Paonta valley is considered the north-western limit of Sal. These forests are found on the moist north facing slopes of the Siwalik Hills and south facing slopes of the Nahan ridge.

a) Moist Siwalik Sal forest: This is found in the Siwalik hills of Paonta valley having heavy rain. In summers, the temperature may go up to forty degrees. The main species found in this forest are *Adina cordifolia, Anogeissus latifolia, Bridelia retusa, Garuga pinnata, Aegle marmelos, Butea monosperma, Mallotus philippensis, Randia dumetorum.*

b) Moist bhabar Sal forest: This again is found in the Siwalik foothills of Paonta valley having medium to good quality Sal forest. The main species are *Adina cordifolia, Kydia calycina, Shorea robusta, Terminalia tomentosa, Terminalia bellerica.*

2) Dry Sal Forest:

Such forests are found on the relatively dry and exposed slopes of Siwalik Hills. The trees are sparse and open in nature due to increasing population pressure. Regeneration is difficult as there is heavy loss of soil during the monsoon season. These forests extend to an elevation of about 1000 meters. The principal species found are *Acacia catechu, Dalbergia sissoo, Diospyros tomentosa, Shorea robusta, Terminalia tomentosa, Cassia fistula, Emblica officinalis, Colebrookia oppositifolia.*

3) Dry Mixed Deciduous Forest:

This forest type is found in the drier parts of the lower Himalayan foothills and is composed of poor quality trees of various species. The average annual rainfall varies from 100 to 150 cms. The soil is usually shallow and at times severely eroded. Such forests are found in the Siwalik and lower hills of Kangra, Hamirpur, Una, Bilaspur, Solan, Sirmaur and Mandi districts. The main species are *Acacia catechu, Aegle marmelos, Anogeissus latifolia, Ehretia laevis, Feronia limonia, Flacourtia indica, Kydia calycina, Lannea coromandelica.*

4) Dry Bamboo Brakes:

Bamboo brakes occur in isolated patches in the Siwalik Hills and Himalayan foothills of Solan, Bilaspur, Hamirpur, Una and Mandi districts. The main species is the common bamboo or *Dendrocalamus strictus.*

5) Riverine or Khair-Sissoo Forest:

This is a dry deciduous forest having Khair (Acacia catechu) and Sisham (Dalbergia sissoo) as the main species. As the name suggest it is found along rivers and streams in the lower Himalayan ranges of Nurpur, Una, Hamirpur and Bilaspur areas. Such forests are also found in dry and exposed localities where these are open and less dense. There are three variations within these forests which are (a) mixed, Khair-sissoo forest; (b) pure Sissoo forest with occasional trees of Khair; and (c) pure Khair forest with occasional trees of Sissoo. In the older forests fairly dense, deciduous, shrubby under-growth is found. The main species found in these forests are *Acacia catechu, Dalbergia sissoo, Tamarix dioica, Tiliacora acuminate, Holoptelea integrifolia and Zizyphus mauratiana.*

6) Chir Pine Forest:

This forest type is found extensively in the lower and middle hills of the state. It is further divided into two types:

a) Lower or Siwalik chir pine forest: It is found above an elevation of 500mts on the hill tops and both slopes of Siwalik Hills in the districts of Sirmaur, Solan, Bilaspur, Mandi, Una, Hamirpur and Kangra. The forest is of pure Chir Pine with deciduous species occurring in moist and shady depressions. The middle and lower storey are virtually absent with grass covering the forest floor. The main species under it are *Pinus roxburghii, Acacia catechu, Albizzia chinensis, Emblica officinalis, Mallotus philippensis, Carissa opaca, Colebrookia sp., Dodonea viscose and Flacourtia indica.*

b) Upper or Himalayan Chir Pine forest: This is more or less pure forest of Chir Pine with individual trees attaining a height of up to twenty to twenty five meters. It is extensively developed in the lower and middle Himalaya and lower hills of the higher Himalayas. The trees of this type are best developed in areas of Kangra, Bilaspur, Mandi, Solan and Sirmaur districts with elevation below 2000 mts. They also occur in the inner dry Satluj valley north of Rampur. The main species under this forest type are *Pinus roxburghii, Coriaria nepalensis, Crataegus crenulata, Ficus roxburghii, Lyonia ovalifolia, Myrica sapida, Quercus leucotricophora, Rhododendron arboretum, Syzygium cumini, Aechmanthera tomentosa and Rubus ellipticus.*

7) Olea scrub:

These are low scrub forests found on the dry, south facing slopes of the Siwaliks and lower Himalaya along the border of Himachal Pradesh with Punjab and Haryana. Thorny species are more dominant on hot, dry exposed slopes which suffer erosion during monsoons. As the name suggests, *Olea cuspidata* is the principal species.

8) Ban Oak Forest:

Being a part of lower temperate forests of western Himalaya these forests are the lowermost Oak forest. These forests are found in the upper hills of the lower Himalaya and lower hills of the middle and higher Himalaya having an altitudinal range from 1700mts to

2200 mts. Ban Oak forests attain their best development on moist sites and on shales, slates, phyllites and basic igneous rocks. The tree of this forest yields a good quality fodder, wood for burning and making agricultural implements. Such forests are found in the districts of Chamba, Kangra, Kullu, Shimla, Solan and Sirmaur districts. The main species found are *Carpinus viminea, Lyonia ovalifolia, Quercus leucotricophora, Quercus himalayana, Rhododendron arboreum, Toona serrata, Betula alnoides, Euonymus pendulus, Ilex dipyrena and Litsea umbrosa.*

9) Moru Oak Forest:

These forests are found usually above the Ban Oak forest between an elevation of 2200 and 2400 mts. The forests under this category forms one of the best temperate broad-leaved forests with individual trees attaining the height of more than 20 mts. Cooler, temperate tract found in the districts of Chamba, Kullu, Shimla, Kinnaur and Sirmaur has well developed forests of this type. The main species found are *Abies pindrow, Acer caesium, Betula alnoides, Carpinus viminea, Quercus himalayana, Quercus leucotricophora, Euonymus pendulus, Eurya acuminata, Lyonia ovalifolia, Pyrus lanata, Toona ciliate and Taxus baccata.*

10) Moist Deodar Forest:

Extensive patches of almost pure forest of Deodar (Cedrus deodara) are found in the lower temperate zone of the state. These are found in the altitudinal range of 1800 to 2500 mts with the best development seen on the moist slopes between 2000 to 2300 mts.

Occasionally trees of blue pine, fir and spruce may be seen in the upper reaches while chir pine trees are found in the lower limits. Broad leaved trees like oaks, Chestnut and Rhododendron occur in moist shady depressions. Individual trees of Deodar may attain a height of forty meters and its branches are whorled. In winters occasional snow is seen in the forest area and temperature remains below freezing point. These forests are extensive and found commonly in the districts of Chamba, Kullu, Shimla, Solan, Mandi and Sirmaur. The main species found are *Abies pindrow, Cedrus deodara, Picea smithiana, Pinus wallichiana, Quercus himalayana, Quercus leucotricophora, Rhododendron arboreum, Berberis lycrium,*

Deutizia staminea, Lonicera angustifolia, Rosa macrophylla, Clematis Montana and Vitis himalayana.

11) Temperate Mixed Coniferous Forest:

As the name suggests this forest type has a mixture of temperate coniferous trees like deodar, blue pine, fir and spruce and is the most attractive forests of the western Himalayas. The altitudinal range of this forest type is from 2400 to 3000 mts or even higher in certain localities. In the moist, shady depression may be found the broad leaved trees such as chest nut, walnut and Oaks. Open grassy meadows are found in the upper limits of this forest type. Individual trees may attain a height of forty meters with thick growth of climbers underneath. Precipitation is mostly in the form of snow. These forests are found in the districts of Chamba, Kullu, Shimla, Sirmaur and Kinnaur districts. The main species are *Abies pindrow, Cedrus deodara, Picea smithiana, Pinus wallichiana, Acer acuminatum, Acer caesium, Acer pictum, Betula alnoides, Euonymus lacerus, Quercus himalayana, Quercus leucotricophora, Quercus semecarpifolia* and *Taxus baccata.*

12) Temperate Moist Mixed Deciduous Forest :

Such forests occur in the altitudinal zones of 1800 mts to 2750 mts. This is a mixed deciduous high forest with individual trees attaining a height of more than twenty meters. It occurs in moist, shady depression and along rivers and streams. Extensive tracts of this forest are found in the districts of Chamba, Kullu, Shimla, Kinnaur and Sirmaur district. The main tree species found are *Acer caesium, Acer pictum, Acer villosum, Aesculus indica, Betula alnoides, Carpinus viminea, Celtis australis, Fraxinus micrantha, Juglans regia, Prunus cornuta, Pyrus lanata, Ulnus wallichiana, Arundinaria sp., Cornus macrophylla, Corylus colurna, Euonymus tingens, Lyonia ovalifolia, Taxus baccata and Rhododendron arboreum.*

13) Temperate Secondary Scrub:

These forests are found in the lower temperate belt of Himachal Pradesh and are a secondary scrub forest. Under these come the low scrub forests consisting of small sized evergreen trees and shrubs. The growth of these shrubs is year round but its luxuriant spread is seen during the monsoon season. The main species found are *Berberis lyceum,*

Cotoneaster bacillaris, Crateagus crenulata, Indigofera gerardiana, Prinsepia utilis, Pyrus pashia, Rosa macrophylla and Spiracea canescens.

14) Kharsu Oak Forest:

These forests are found in the upper temperate tract of Himachal Pradesh between an elevation of 2500 mts and 3300 mts. Here dense, high level oak forest is found especially in the moist, shady depressions. The individual trees have fully developed crowns and may attain a height of up to 20 mts. Temperate or sub -arctic conditions prevail in the region with winters being very cold and temperatures below freezing point. The Kharsu Oak forest succeeds the Moru Oak forest and toward still higher elevation gives way to mixed sub-alpine forests. Such forests are found in the districts of Chamba, Kullu, Shimla and Kinnaur. The main species are *Acer caesium, Betula alnoides, Celtis australis, Quercus himalayana, Arundinaria jaunsarensis, Betula utilis, Prunus padus, Rhododendron arboreum, Rhododendron barbatum, Cotoneaster sp., Ribes glaciale, Rosa macrophylla, Rosa Sericea and Sarcococca saligna.*

15) Oak- Fir Forest:

These forests are a mixture of conifer and broad leaved trees and are found in the upper temperate belt of the state. The trees of Oak-Fir forest are found between an elevation from 2600 mts to 3400 mts in the districts of Kullu, Shimla and Kinnaur. The principle species are *Abies pindrow, Picea smithiana, Pinus wallichiana, Acer caesium, Betula alnoides, Quercus himalayana, Quercus semecarpifolia, Indigofera gerardiana and Rosa macrophylla.*

16) Cypress Forest:

Cypress forests are found in the lower and upper temperate belts of the state having an elevation of 1800 mts and 2800 mts. These are open forests consisting of scattered trees growing on steep, rocky tracts of limestone, dolomite and marble. Some broad leaved tree species occur in the moist, shady depressions. Individual trees may attain a height of up to 22 mts. Such forests are best developed in the districts of Chamba, Kullu, Shimla and Kinnaur. The principle species found are *Cedrus deodara, Cupressus torulosa, Aesculus indica,*

Juglans regia, Pyrus pashia, Abelia triflora, Berberis sp., Cotoneaster bacillaris and Prinsepia utilis.

17) Alder Forest:

Such forests are found along the streams and rivers of the temperate belt having an elevation up to 3000 mts. This is an almost pure forest of Alder (Alnus nitida) where the individual trees may attain a height of up to 20 mts. These forests are well developed in the high altitude water courses of Ravi, Beas, Satluj and Pabar rivers having freshly laid down alluvium. The ground flora is not well developed as the soil is poor in organic matter content. The main species are *Alnus nitida, Celtis australis, Populus ciliata, Ulnus villosa, Cretaegus crenulata and Sarcococca sp.*

18) Blue Pine Forest:

Blue Pine forests are found above an elevation of 2100 mts in the lower temperate belt of the state and are more or less pure forests of Blue Pine (Pinus wallichiana). There is scant undergrowth and the forest floor is covered with a fairly thick layer of needles. Here pine trees are often mixed with other coniferous and broad- leaved species. Individual trees may attain a height of more than 30 mts and are often found to be growing on almost bare rock with a negligible soil cover. The two habitats in which one can find blue pine forests are:

a) Moist temperate zone above an elevation of about 2100 mts, usually on cooler slopes; and
b) Above an elevation of about 2000 mts along rivers and streams on the freshly laid alluvium.

The forests of such type are found in the districts of Chamba, Kullu, Mandi, Shimla and Kinnaur. The main species are *Abies pindrow, Cedrus doedara, Picea smithiana, Pinus wallichiana, Quercus himalayana, Quercus leucotricophora, Rhododendron arboreum, Berberis sp., Desmodium tilaefolium, Indigofera gerardiana and Rosa macrophylla.*

19) Dry Mixed Forest:

Such forests are found in the dry, inner valleys of the higher Himalaya and Trans-Himalaya between an elevation of 2000 mts and 2400 mts. As the name suggests these forests contain a mixture of coniferous and broad-leaved trees and are open in nature due to the dry climate prevalent there. These are dry regions and the bulk of the annual precipitation is in the form of snow. These forests are best developed in the districts of Lahaul and Spiti, Kullu, Chamba and Kinnaur. The main species found are *Acer pentapomicium, Cedrus deodara, Celtis australis, Pinus gerardiana, Fraxinus sp., Olea cuspidate, Rhus succedanea, Zanthoxylum alatum, Abelia triflora, Artemisia maritime, Artemisia vulgaris, Daphne oleoides, Rosa webbiana and Roylea calycina.*

20) Dry Temperate Coniferous Forest:

Under it are found more or less pure coniferous forests in the temperate zone of the dry areas of the inner and Trans-Himalaya. Within it are two sub- types:

a) Neoza or Chilgoza Pine forest: Almost pure forest of Chilgoza pine are found exclusively in the two areas of Himachal Pradesh viz. Bharmaur area of Chamba district and Central and northern parts of Kinnaur district. The main species are *Cedrus deodara, Pinns gerardiana, Fraxinus xanthoxyloides, Artemisia maritima, Daphne oleoides, Ephedera gerardiana and Rubus nivens.*

b) Dry Deodar forest: Under it are found more or less pure forest of Deodar with occasional trees of Chilgoza pine, blue pine and some broad leaved species. Individual trees are of relatively low height. Such forests are found in the dry zones of Shimla, Lahul- Spiti, Chamba and Kinnaur between an elevation of 2000 and 3200 mts. Main species found are *Cedrus deodara, Pinus gerardiana, Corylus colurna, Desmodium sp., Rubus nivens, Abelia triflora and Artemisia martima.*

21) High level Dry Blue Pine Forest:

Such forests are found in the upper tracts of inner dry valleys and trans-Himalaya between an elevation of 3000 and 3600 mts. Some broad- leaved trees and other conifers may be associated with blue Pine and are found in moist depressions. Under harsh conditions, trees of such forest are of relatively low stature compared to their counterparts in the moist

temperate zone. The principle species are *Abies spectabilis, Cedrus deodara, Pinus wallichiana, Betula utilis, Rhododendron sp., Juniperus communis and Juniperus macropoda.*

22) Dry Juniper Forest:

Dry Juniper forests are found in the inner dry valleys of cold deserts of Lahaul-spit and Kinnaur districts within an altitudinal range of 2700 mts to 4300 mts. This is an open evergreen forest and the soil here is loose and poor in organic matter content. The main species are *Fraxinus sp., Juniperus communis, Juniperus macropoda, Ribes grossularia, Rosa sericea and Rosa webbiana.*

23) Sub-Alpine Birch-Fir Forest:

These forests are found in the middle and higher Himalaya above an elevation of 3000 mts. The trees here are stunted with low spreading crowns. Such forests are well developed in the parts of Chamba, Shimla and Kinnaur districts. The principle species found are *Abies spectabilis, Betula utilis, Quercus semecarpifolia, Rhododendron campanulatum, Sorbus foliolosa, Cotoneaster acuminata, Lonicera webbiana, Ribes glaciale and Ribes rubrum.*

24) Birch-Rhododendron Scrub Forest:

Such forests are found in the moist slopes of Dhauladhar range and Higher Himalayas. These are alpine, low evergreen forests and the trees here are stunted and slightly curved at the base due to the pressure of snow. Dense undergrowth may be found in the moist, shady depression. These forests mark the upper limit of tree growth and may extend to the snowline or give way to the moist alpine scrub. The main species are *Betula utilis, Berberis sp., Lonicera parviflora, Polygonum sp., Rhododendron lepidotum, Sorbus foliolosa and Viburnum nervosum.*

25) Decidious Alpine Scrub:

Deciduous Alpine Scrub forest is found in the alpine zone of higher Himalayas comprising the districts of Chamba, Kullu, Kinnaur and Shimla above an elevation of 3500

mts. This is a low deciduous scrub forest in which individual scrubs usually do not attain a height of more than 1.5 mts. Some of the main species forming a part of it are *Berberis sp., Betula utilis, Corylus stracheyi, Lonicera parviflora, Primula denticulata, Primula stuartii, Rhododendron campanulatum, Rhododendron lepidotum, Ribes glaciale, Ribes rubrum, Syringea emodi and Viburnum nervosum.*

26) Dwarf Rhododendron Scrub:

These scrub forests are found immediately below the snowline in the Dhauladhar range and the Higher Himalaya and Rhododendron is the predominant species here. They do not attain the shape of a tree and are stunted and bushy. Such forest succeeds the sub-alpine forest at lower elevations and merges with the line of perpetual snow at higher elevation. This forest is found in the districts of Chamba, Kangra, Kullu, Lahaul-spiti, Kinnaur and Shimla. The principle species comprising such forests are *Betula utilis, Lonicera obovata, Rhododendron anthopogon, Rhododendron campanulatum, Rhododendron lepidotum, Sorbus foliolosa and Syringea emodi.*

27) Dry Alpine Scrub:

Such forests are found in the dry alpine inner valleys of the higher Himalaya and the cold desert of the Trans-Himalaya. These are further categorized into two sub types:

a) Dry scrub: This scrub forest is commonly found in the regions of Lahaul, Spiti and Pooh. Vegetation is denser along the streams and shady depressions. The soil is poor and rocky with low humus content. The main species forming a part of it are *Arenaria sp., Artemisia maritima, Artemisia sacorum, Caragana sp., Draba gracillina, Eurotia ceratoides, Juniperus communis, Juniperus wallichiana, Kobressia duthei, Myricaria sp., Potentila fruticossa, Primula stuartii, Saxifera imbricata, Sedum crassipes and Sedum crenulatum.*

b) Dwarf juniper scrub: This forest is found in the cold deserts of Trans- Himalaya viz. Lahaul, Spiti and Pooh with the dominance of scrubs of *Juniper*. The scrubs are characterized by dwarf Juniper verities.

After discussing the forest types and its composition it is known that there is a great diversity of forest species in Himachal Pradesh. The species found range from the Alpine varieties to

sub-tropical varieties to temperate varieties. This large range of species is attributable to the altitude of Himachal Pradesh which varies from a low of 600 mts to a high of 6000mts. Himachal Pradesh being endowed with such a diverse vegetation produces a large range of forest products which are consumed locally or is exported to other states.

3.4 Forest resources:

Forest constitutes one of the major natural, renewable resources of Himachal Pradesh. The forest resources play a vital role in the economic development and ecological maintenance of the state. They serve the people in many tangible ways and their economic value increases as the science and technology find new ways to utilize its products. The importance of forest resources is highlighted by Singh (1987) in his book when he says, "The forests may well be considered as the wealth of man deposited with nature's bank. The wise thing on the part of man is to withdraw the periodic bank interest on this wealth in the form of yearly increment in the volume of these forests rather than draw the principle amount i.e. the total volume existing at a particular time"[14].

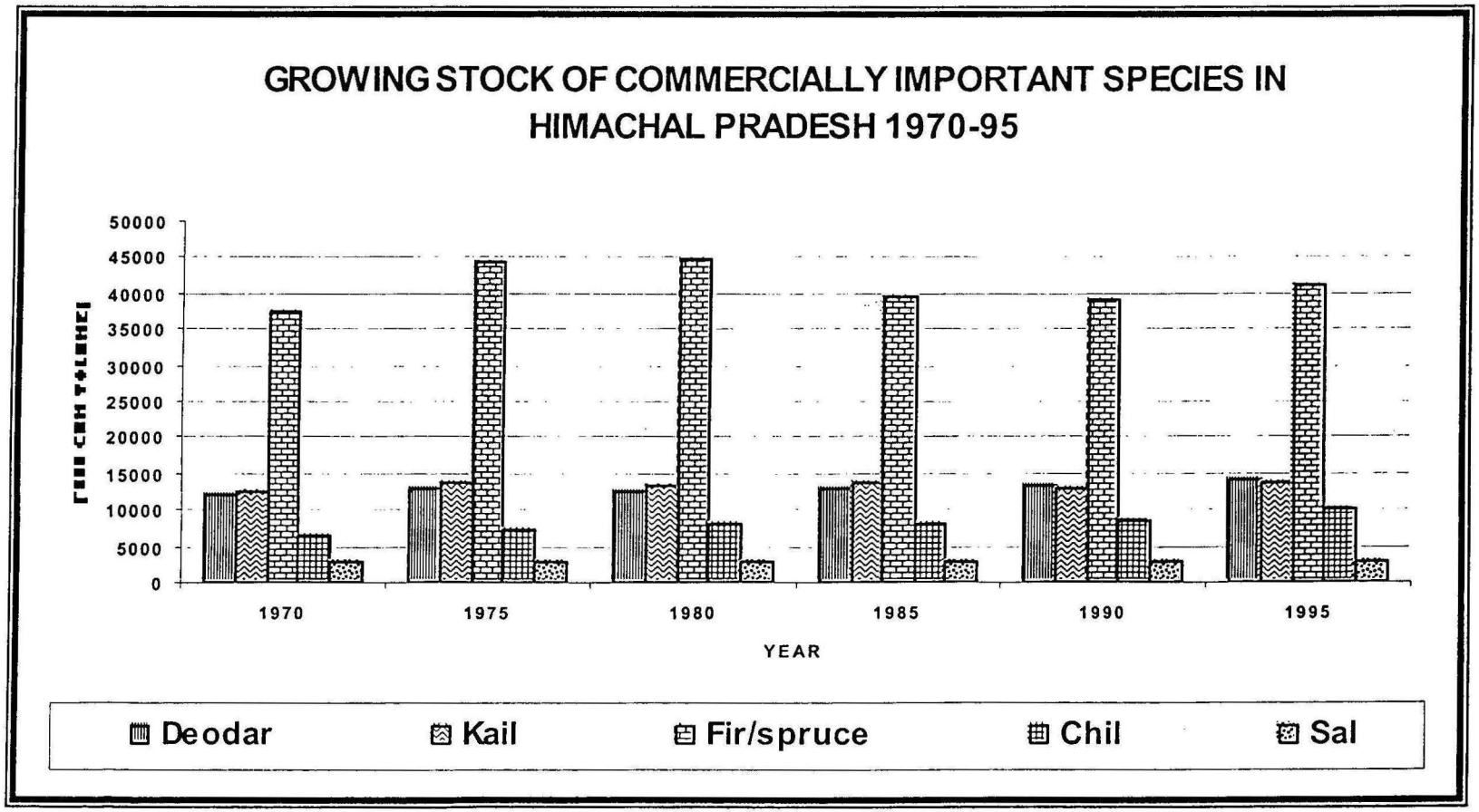
The forest wealth of the state has been of great utility for rural community of Himachal Pradesh. Apart from the source of revenue to the government, forest provides valuable wood for the construction of houses, agricultural implements and daily domestic uses. They also provide many more things out of which resin, medicinal herbs, drugs, lac, oils etc are important. Accordingly the forest products of Himachal Pradesh are classified into two categories:

1. Major Forest produce
2. Minor Forest produce.

3.4.1 Major forest produce:

Major forest produce consists of wood of coniferous and non-coniferous trees to be extracted as timber, fuel wood and charcoal. The forest of Himachal Pradesh are dominant with soft wood trees which include Deodar, Pine, Fir, Spruce, Kail, Chil, Sal etc. These soft wood trees are light, strong, fairly durable and easy to work and as such are very useful for constructional purposes. They also provide raw material for the forest based industries.

Graph No 3.8


GROWING STOCK OF COMMERCIALLY IMPORTANT SPECIES IN HIMACHAL PRADESH 1970-95
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1970
1975
1980
1985
1990
1995
YEAR
Deodar
Kail
Fir/spruce
Chil
Sal

The growing stock of commercially important species of Himachal Pradesh during the years 1970 and 1995 is given in the table 3.6.

Table 3.6

Growing Stock ('000 cum standing volume)

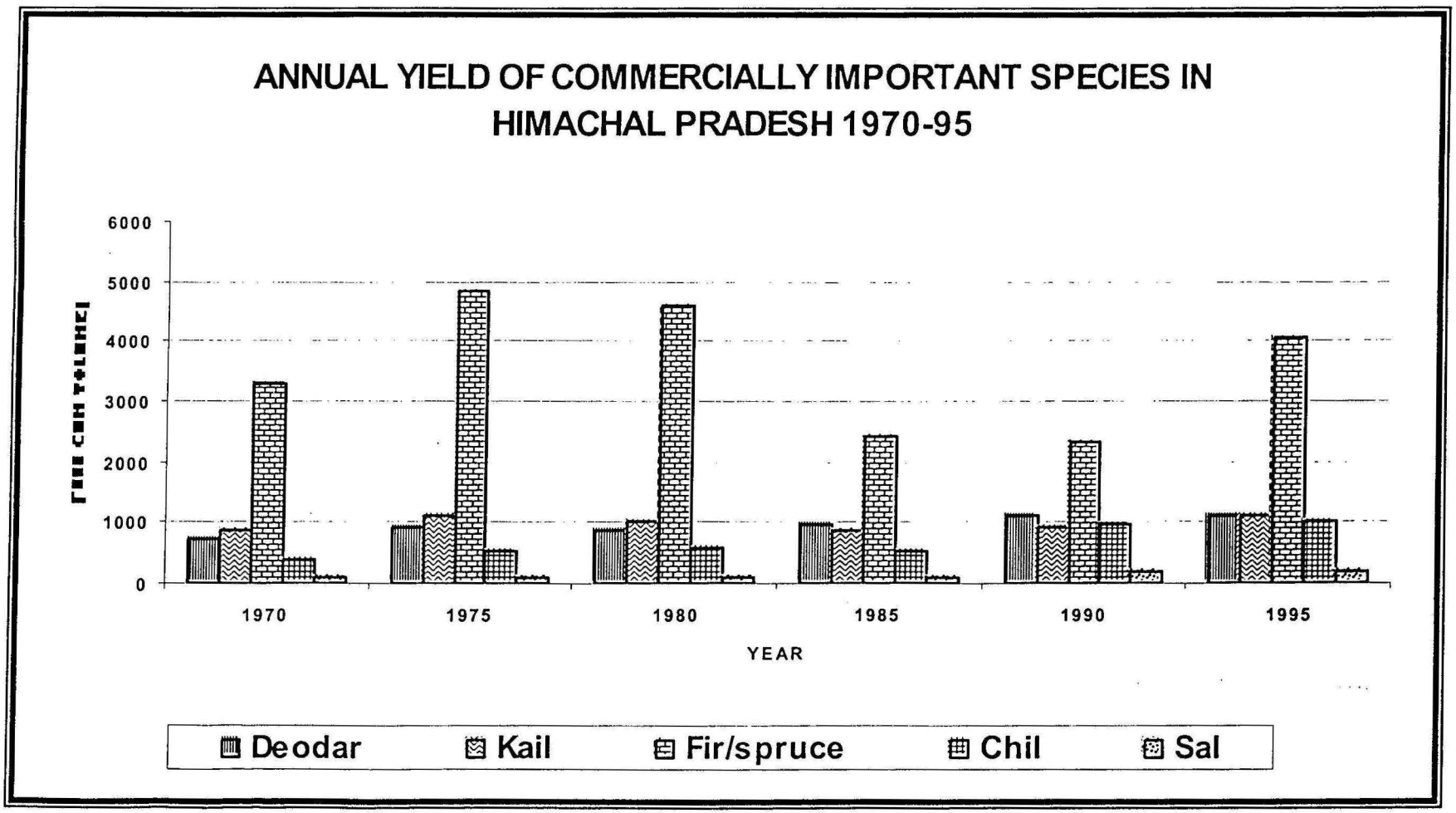
Species					
Year	Deodar	Kail	Fir/Spruce	Chil	Sal
1970	11920	12585	37370	6520	3011
1975	12859	13753	44220	7295	3011
1980	12393	13386	44726	8006	3011
1985	12716	13710	39691	7982	3011
1990	13288	12996	39026	8644	2563
1995	14215	13616	41012	10053	2563

Source: State of the environment report (2000), H.P

Table 3.6 shows that the growing stock of nearly all the commercially important species has increased during the period 1970 to 1995. In case of Deodar it increased from 1.19 crore cum in 1970 to 1.42 crore cum in 1995. The sharp increase in growing stock in the nineties was due to the ban on the felling of trees by the Himachal Pradesh government. The growing stock of Kail also increased from 1.25 crore cum to 1.36 crore cum during the corresponding period. This can be explained by the fact that Kail timber extracted during the same period came down from 1.44 lakh cum to 63.68 thousand cum.

The growing stock of Fir/Spruce was 3.73 crore cum in 1970 which increased further to 4.47 crore cum in 1980 but declined in the year 1995 to 4.10 crore cum. This could be explained by the increase in the removal of Fir/Spruce timber during this period. The growing stock of Chil species increased consistently during the period 1970 to 1995 with the exception of 1985 when it declined to 79.82 lakh cum. This is most probably due to a large increase in the removal of Chil timber during the period 1980-85. The Chil timber extracted went up from 83.02 thousand cum to 1.24 lakh cum during the corresponding period. There was no change in growing stock of Sal upto the year 1985 when it was 30.11 lakh cum. But in the nineties its growing stock declined to 25.63 lakh cum. This was the result of increase

Graph No 3.9


ANNUAL YIELD OF COMMERCIALLY IMPORTANT SPECIES IN HIMACHAL PRADESH 1970-95
6000
5000
4000
3000
2000
1000
0
1970
1975
1980
1985
1990
1995
YEAR
Deodar
Kail
Fir/spruce
Chil
Sal

in the removal of Sal timber from 8.78 thousand cum to 16.32 thousand cum during the corresponding period.

Prescribed annual yield of commercially important species in Himachal Pradesh 1970-95:

By yield we mean the total volume of wood which can be extracted from a species with scientific techniques. The table 3.7 presents the prescribed annual yield of some important commercial species of Himachal Pradesh during the period 1970- 95. The yield of Deodar increased consistently from 1970 when it was 75 thousand cum to 1.1 lakh cum in 1995. The only exception was the year 1980 when it declined to 89 thousand cum. It was because the yield is dependent on the growing stock and as the growing stock of Deodar declined from 1.28 crore cum to 1.23 crore cum during 1975 to 1980 thus its yield also declined.

Table 3.7

Prescribed Annual Yield ('000 cum standing volume)

	Species				
Year	Deodar	Kail	Fir/Spruce	Chil	Sal
1970	750	850	3290	410	110
1975	920	1110	4830	530	110
1980	890	1040	4620	570	110
1985	950	880	2400	520	110
1990	1100	940	2300	960	190
1995	1100	1122	4083	1011	190

Source: State of the environment report (2000), H.P

The yield of Kail is not showing a consistent trend but still increased from 85 thousand cum to 1.12 lakh cum in 1995. This can be explained by the wide changes in the growing stock of Kail species. Similar was the case with Fir/Spruce. Its yield increased from

3.29 lakh cum to 4.08 lakh cum in 1995. In between these there is a wide fluctuation which is attributable to changes in the growing stock.

The yield of Chil increased consistently from 41 thousand cum to 1.01 lakh cum during the period 1970 to 1995. The only exception was in the year 1985 when it declined to 52 thousand cum. The reason could be the decline in the growing stock of Chil. The yield of Sal increased during the period from 11 thousand cum to 19 thousand cum. This is quite unusual as the growing stock of Sal declined during the period. One reason for it could be the error in the tabulation of data.

Table 3.8 showing total timber removed from the state of Himachal Pradesh since 1950-51 to 1999-00 shows that the timber extraction peaked during the decade 1980-90 and then declined during the decade 1990-00. It was 4.46 million cum during the decade 1950-60 which reached a high of 5.62 million cum during 1980-90 and decreased to 3.57 million cum during the decade 1990-00.

Table3.8

Total timber extracted

Decade	Volume removed (m3)
1950-60	4464921
1960-70	4607744
1970-80	4933085
1980-90	5623844
1990-2000	3573632

Source: H.P.Forest statistics 2000, Forest department, H.P

During the seventies and eighties unsystematic and heavy felling was done especially in the high level Fir and Spruce forests to meet the wood requirements for apple packing cases[15]. But the regeneration of felled areas did not keep pace and large chunks of felled areas got degraded. The state government placed a complete ban on the use of valuable Fir and Spruce for the purpose and alternative packing cases of Eucalyptus and corrugated cartons was made available. Due to this ban the timber removed during the decade of nineties has shown a decline.

The extraction of timber in the state of Himachal Pradesh is done by various agencies. The table 3.9 shows that the main agency of government for the economic and scientific extraction of timber is the Himachal Pradesh State Forest Corporation. It came into existence on 25th March1974 and is a wholly government owned company registered under the companies Act, 1955. In the year 1999-2000, the corporation extracted timber of Deodar, Kail, Fir/Spruce, Chil and Sal amounting to 1.96 lakh cum. The timber extracted to be given to rights holders was 94.31 thousand cum. At present nearly 1.5 lakh cum of standing volume of timber are granted annually to the local people for house construction as per their rights recorded in various forest settlements. This is done at very nominal rates, which is only 1/4000 of the market value estimated at about Rs 60 crore[16]. The category of other agencies includes the timber extracted by saw millers and wood based industries. The total extraction of timber for the year 1999-2000 by these was 7.094 thousand cum.

Table3.9

Timber extracted by various agencies (Standing volume m3).

Name of the agency	Deodar	Kail	Fir/Sprue	Chil	Sal	Total
H.P.S.F.C	12102	34974	62604	80902	5803	196385
Right holders	42036	23428	8524	18499	1821	94308
Other agencies	121	153	173	6647	0	7094
Total	54259	58555	71301	106048	7624	

Source: State of environment report (2000), H.P.

If we look at the species from which timber is extracted by these agencies we find that Chil with a volume of 1.06 lakh cum of wood was the highest, followed by Fir/Spruce with a volume of 71.3 thousand cum. Kail and Deodar had nearly equal extracted volume of timber which was 58.55 thousand cum and 54.25 thousand cum respectively. The least amount of timber extracted was from Sal species which was 7.62 thousand cum.

To sum up the major forest product derived from the forest of Himachal Pradesh is the timber which is utilized in a number of ways. The forest of the state abounds in the coniferous, soft wood species which have great utility and economic importance. Though the

total timber extracted has shown a decline during the nineties but the growing stock and annual yield of major commercial species have shown an increase during this period. Himachal Pradesh state forest corporation acts as a nodal agency which extracts the timber in a scientific manner and has a major share in the total timber extracted.

3.4.2 Minor Forest Produce:

Minor forest products include all products which are obtained from the forest other than wood and thus comprise products of vegetable and animal origin. Some of the important minor forest products are resin, bamboos, grasses, oils and medicinal herbs.

Resin:

Resin is obtained mainly from Chir Pine trees which grow extensively in the Himachal forests. Crude resin consists of two principal constituents; a liquid known as oil of turpentine (25%) and a solid resin (75%). After the process of distillation, they are separated. Turpentine is used mainly as a solvent for paints and varnish, synthetic camphor, pine oil, disinfectants, pharmaceutical preparations, wax, boot polish and industrial perfumes. Resin is an important raw material for several industries which include paper, paint, varnish, soap, rubber, water proofing, linoleum, oils, greases, adhesive tape, phenyl, plastic etc.

There are two resin and turpentine oil factories in the public sector at Bilaspur and Nahan. The table 3.10 shows the production of resin, rosin and turpentine oil for the year 1999-00 to 2003-04.

Table3.10

Production of Resin, Rosin and Turpentine oil in Himachal Pradesh in 1999-04

Year	Resin extracted	Rosin (qtls)	Turpentine oil(Lac lts)
1999-00	72081	97570	27.11
2000-01	73358	79948	22.32
2001-02	73540	69494	19.59
2002-03	84944	73224	20.33
2003-04	84228	23918	8.05

Source: H.P.State Forest Corporation, Head office, Shimla, H.P

The production of resin has shown an increasing trend except in 2003-04 when it showed a slight decline. It was 72.08 thousand quintals in 1999-00 and went up to 84.23 thousand quintals in 2003-04. Rosin's production declined from 97.57 thousand quintals in 1999-00 to 23.91 thousand quintals in 2003-04. This steep fall in production was due to lack of market demand. As turpentine oils production depends on the rosin production thus its production also declined from 27.11 lakh liters in 1999-00 to 8.05 lakh liters in 2003-04.

Bamboo and Bhabbar grass:

Bamboo belongs to grass family but grows like a tree. It is tall, woody and perennial. It may attain a size of as much as thirty meters. Bamboo is called the poor mans timber as it provides cheap material for roofing, walling, flooring, matting, basketry, cordage, cart hoods and a host of other things. Young, tender leaves are eaten; the seed is collected and eaten as grain. However the most significant use of the bamboo is for making pulp for the production of paper and news print. The quantity of Bamboo extracted during the year 1984-85 was 3.76 thousand tonnes while for the year 1999-00 the data was not available. Bhabbar grasses are used as a cordage, matting and as an important raw material for manufacturing paper. Its production was 671 tonnes for 1999-00 from a high of 2114 tonnes in 1984-85. The decline was due to lack of demand from paper industries which took up other sources as the raw material for paper making.

Medicinal Herbs:

Ancient literature mentions the existence of a large variety of medicinal herbs and plants some of which are found in abundance in Himachal Pradesh. The collection of medicinal herbs is done by the local villagers who are permitted to extract the minor forest produce under "Bartandari" (Rights system). These villagers though technically untrained are adept in identifying, locating and collecting most of the traditional crude drugs and aromatic materials from plants growing in the forests areas.

Kuth (*Saussurea lappa*) was introduced in Lahaul region in early forties making the state the largest grower of the important drug. Similarly Posh kar (*Inula racemosa*) and caraway (*Carum carui*) has been successfully cultivated in the region. Some important crude drugs grown in the state are Kutaki (*Picrorhiza Kurrooa*), Choorah (*Anglua glauca*), Som

(*Ephedra gerardiana*), Kermala (*Artemisia maritime*), Mushkbala (*Valeriana jata mansi*), Banafsha(*viola spp*), Pashanbheda (*Bergenia ligulata*), Bahera (*Terminalia telerica*) and Brahmi (*Taxus buccatta*). Anirit Haritaki, a longer sized forest variety of *Terminalia chebula* much prized for its therapeutic value and commanding a very high market price comes exclusively from Himachal Pradesh.

About 150 species of plants are attributed to be having some medicinal value. Some of these are *Dioscorea deltoidea* rhizomes, *Angelica glauca* roots, *Berberis spp* root and bark, *Embilica officinalis* fruit, *Cinnamomum tamala* leaf, *Picrorhiza Kurrooa* root, *Viola* flowers, *Terminalia chebula* fruit, *Terminalia belerica* fruit, *Valeriana jata mansi* roots, *Heracleum candicans* roots, *Artemisia maritime* herb, *Ephedra* stems, *Podophyllum e modi* root etc. Some important medicinal herbs are:

Taxus Baccata:

It is locally called "Brahmi" or "Rakhal". The tree is ever green and is of moderate height ranging from five to ten meters. It is found as an under story in the Fir forest at an altitude ranging between 2000 to 3500 meters in the districts of Shimla, Kinnaur, Kullu and Mandi. Its leaves are also used as a substitute for tea leaves in the high hill regions of the state. The bark and leaves are used as a raw material for dying of leather. At present the leaves are being used to extract Di-acetyl Baccatin (D.A.B) an alkaloid for the treatment of cancer disease.

Berberis:

It is locally known as "Kash mal". It is an evergreen thorny shrub of three to five meters height. It is found upto height of 2600 meters in the districts of Sirmaur, Shimla, Solan, Hamirpur, Mandi, Kullu and Kangra. An extract "Berberine" is extracted from their root which is used in the medicines.

Dhoop:

It is a perennial herb without an ariel stem, found in the Himalayas at an altitude of 10,000 to 14,000 feet. Its roots are aromatic and woody and are used as incense in the

temples and religious ceremonies. It is considered to be stimulant and given in fever after child birth.

Katha:

Katha is extracted from the heartwood of *Acacia Catechu*. This tree is found in Kangra, Hamirpur, Bilaspur and parts of Solan, Mandi and Nahan districts. There is one modern Katha factory in private sector in Una district. Katha industry is seasonal with employment generation potential.

Dr.Y.S.Parmar University of horticulture and forestry, Nauni, Solan has developed the technology to cultivate exotic species like *Glaucium flavum, Solanum laciniatum, Rosmarinus officinalis, Glycyrrhiza globra, Salvia selarea, S. bisor, Matricaria chamomilla* and indigenous drugs like *Withania somnifera, Mimosa pudica, Dioscorea deltoidea and Digitalis lanata*[17].

Table 3.11 pertaining to extraction of medicinal herbs shows that although the total quantity of medicinal herbs extracted decreased slightly from 1514 tonnes in 1984-85 to 1401.5 tonnes in 1999-00 but important thing is that a lot more newer herbs were extracted during 1999-00. These include *Chukri/ Reward china, T/Patters, Dorighas, Brahmi,Thuth, Bankakri, Birch/ Bhoj patra, Kakar singi, Chora, Baryan, Mithi patties and Bhutkesi*. The largest quantity extracted during 1999-00 was of *Dorighas* which was 142.3 tonnes, followed by *Musk bala/ Nihani* 93.9 tonnes and *Dhoop* which was 78 tonnes.

Table3.11

Outturn of Minor Forest Produce form state forest 1984-85 & 1999-00

Forest produce	1984-85	1999-00
Bamboo	3760	D.N.A
Bhabbar grass	2114	671
Medicinal herbs		
a.Dhoop	446.8	78
b.Muskbala/Nihani	145.8	93.9
c.Chukri/Rewardchini	0	40.9
d.T/Patters	0	27.4
e.Dorighas	0	142.3
f.Brahmi	0	6.3
g.Kaur/Karu	244.4	4.6
h.Guchhie	26.7	10.6
i.Tej-patra	80.2	45.9
j.Thuth	0	13.6
k.Bankakri	0	0.9
l.Kuth/Diascorea	116	14.2
m.Birch/Bhoj patra	0	15.6
n.Banafsha	201	0.5
o.Kakarsingi	0	2.4
p.Chora	0	43
q.Baryan	0	3
r.Mithi patties	0	16.9
s.Bhutkesi	0	5.9
t.Others	452	835.6
Total	12947	10797.5

Source: H.P.Forest statistics, 1986, 2000

The others category in the table includes herbs such as *Salam panja, Salib misri, Rewand chini, Yogispada, Pushkar mool, Ratnjot, Somlata, Kabab chini, Jeevaka, Chirayata.* Its extraction increased from 452 tonnes to 835.6 tonnes during the corresponding period. The rest of the herbs extracted were less than fifty tonnes and their production has decreased over the years according to market demand.

Marketing of medicinal herbs:

The collection and trade of medicinal herbs is disorganized and the state has no market or Mandi for its sale or purchase. Village people collect the herbs and sell these to local shop keepers in return for items of domestic needs. In turn these village shopkeepers act as agents / distributors of parties from Delhi, Amritsar, Saharanpur, Bombay and Dehradun. There are three situations of market flow:

- The pharmaceutical and drug industries directly contact the locals for collection.
- The contract is given through local dealers or through bigger commission agents.
- Small dealers engage the local people for meeting market needs of small drug units for which the supplies are traded through market as described above.

Kapoor (1997) found that ninety percent of raw material in Kullu and Lahaul-Spiti districts is traded through the Amritsar market[18]. The market rate of raw material fluctuates and the whole industry works on market demands. Several species of drug plants like *Dioscoria, Jurinea, Orghis, Aconitum, Polygonatum, Angelica, Nardostachys, Valeriana, Arnebia* and even *Breberis aristata* face the threat of extinction. Right holders collect medicinal herbs and plants free of charge and sell them at high prices to the traders. In a bid to maximize earnings, the exploitation of these herbs is merciless.

To conclude, the forests of Himachal Pradesh are in a state of flux as the share of dense forest is decreasing and that of open forest is increasing. Also the distribution of dense forest is not so uniform as compared to the open forest. This is a cause of concern considering the great utility of this resource as major and minor forest products which provides employment and economic sustainability for the rural people of Himachal Pradesh. Another thing of worry is the declining trend of reserved forest during the decade of nineties.

Himachal Pradesh has a great variety of forest types and vegetation species which is of great economic and ecological value. Thus proper management of forest of Himachal Pradesh is required considering the many benefits it provides to the rural society of Himachal Pradesh.

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CHAPTER IV

FOREST MANAGEMENT IN HIMACHAL PRADESH

Forest plays a vital role in the western Himalayan ecosystem by conserving the integrity of the upper watersheds of five major rivers viz. Chenab, Ravi, Beas, Satluj and Yamuna. This helps in sustaining the agro-pastoral livelihood of hill people, and in balancing the economy of this small hill state. Apart from these, there are many indirect benefits from forest to people, which makes it all the more important to conserve and manage the forest of Himachal Pradesh.

All these benefits from forest and its resources can continue to flow towards the rural society of Himachal Pradesh for the present and in future, only if the forest resources are managed on the principles of sustainability. The sustainable management of forest necessitates setting up of elaborate forest management system. According to the F.A.O (1991) forest management is defined as dealing with, "... the overall administrative, economic, legal, social, technical and scientific aspects involved with the handling of conservation and use of forest"[1]. It implies various degrees of deliberate human interventions, ranging from action aimed at safeguarding and maintaining the forest ecosystem and its functions, to favoring socially or economically valuable species or groups of species for the improved production of goods and environmental services.

Forests in the state seem to have suffered a great amount of degradation due to number of factors. While the natural factors include snow, wind, insects and pathogens, it is the factors like increasing number of both human and cattle population which cause the most damage. In the initial years after independence, large tracts of forest were cleared for agriculture under the "Grow more food campaign" and also under the scheme for allotment of land to the landless launched in the mid seventies[2].

In the later years the various developmental activities like construction of dams, reservoirs, roads and urban expansion also consumed a lot of forest areas. Forest land was allotted rather liberally for the developmental activities till the 'Forest Conservation act of 1980' halted such transfer of forest areas for non-forestry uses. In spite of all these policies

there are still some problems which ail the forest resources in the state. Some of the salient problems affecting the forest and its management are discussed below.

Fuel wood:

According to 2001 census, more than ninety percent of the total population of the state is rural. They depend on forest for meeting their needs of fuel for cooking and heating in winter months. Annual fuelwood requirements of eight lakh families living in the villages are estimated at 3.2 million tonnes[3]. The way in which fuel-wood is procured by the rural population from forest is also highly damaging. Although the right holder and resident population of a village are allowed to collect only dry and fallen woods and twigs, or to lop lower branches of permissible tree species, but in reality even young trees are cut and badly lopped. This severely impairs the regeneration and productive capacity of the trees and development of a forest.

In the year 1999-2000 the total quantity of wood extracted as fire wood and charcoal was 1073 tonnes and 74 tonnes, respectively. Total quantity of timber extracted for various purposes was 3.12 lakh cum. Forest in the vicinity of villages are especially the most badly affected. The greatest pressure is seen on the *Ban oak* trees as these are lopped for fuel wood and also for fodder in the mistaken belief that it is a good feed, whereas in reality it comes very low in the ranking among fodder trees. As a result, the areas surrounding the villages have become devoid of vegetation and are susceptible to rapid erosion and landslides.

Grazing:

About ninety percent of the state forest area, excluding the areas under regeneration and plantations, are open for grazing. The practice of growing green fodder for livestock is virtually non-existent. Stall-feeding practices are not common among the rural populace of Himachal Pradesh. As a result, most rural households are dependent on grazing in the forest areas for the upkeep of their cattle and livestock. This continuous grazing throughout the year diminishes productivity and gives rise to inferior grasses and unpalatable bushes like *Lantana and Ageratum* species[4].

As a result of open grazing, young seedlings are damaged and trampled, thus reforested plantation affected. Even the alpine pastures are deteriorating due to intense

grazing pressure created by migratory grazing, also called transhumance. The Gujjars and other pastoral migrants indulge in heavy lopping of trees. Grazing for domestic livestock is totally unrestricted in the state which encourages the rural population to keep a large number of cattle. As the human population increases so does the number of households and with it there is also an increase in the number of livestock. The livestock resources in the state have grown consistently over the years, thereby putting more pressure on forest resources. The total livestock was 4.99 lakh in the year 1982 which increased further to 5.1 lakh by 1992.

Grazing is one of the principal recognized rights of people of villages reported in settlement reports. This has become an obstacle in the formulation of a sound and rational grazing policy. The recommendations of the state grazing advisory committee to freeze the cattle population of the state at 1971 level has remained confined to papers only and the livestock population is increasing as stated above[5]. Merely notifying an area for closure to grazing is not sufficient and proper heavy barricades and fencing should be erected to counter this problem. Unless a scientific animal husbandry policy is adopted in the state, there can't be successful forestry. A proper coordination and support between the departments of forest and animal husbandry is needed to overcome this acute problem.

Timber distribution rights:

Through the forest settlement records of the colonial era, people of the villages have been accorded right for timber at minimal rates for construction. The ratio between these concessional rates and market rates is 1:4000 to 5000. Due to the division of families, the numbers of right holders have multiplied, thus putting more pressure on prime forest. Already almost half of the annual yield from the forests goes for timber distribution rights. Moreover, as the trees are marked to the individual right holder, it gives an easy access to the forest areas and provides a temptation for illicit felling. More over, some of the best trees marked for timber distribution could have been the potential seed bearers. Thus it affects the growth of new trees and natural regeneration.

Encroachment in forest areas:

The problem of encroachment of forest areas is alarming in the undemarcated protected forests which are without boundary pillars. These areas adjoining private lands are

more prone to encroachment. The forest officials face many problems while surveying and demarcation of these forest areas. It takes a long time to vacate these encroached lands and to get ejectment orders from the revenue courts as the procedure is extremely cumbersome.

At present there are about seven thousand encroachment cases pending involving about 1.7 thousand hectares of forest areas[6]. The fate of the village common lands, panchayat lands and shayamlat lands is also similar. Although orders for transfer from the revenue department to the forest department have been issued, these orders have remained unimplemented as most of these tracts have either been allotted to the landless or have already been encroached upon.

Forest fires:

Fires cause immense damage to the forest ecosystem. While most fires in the state are ground fires which damage the ground vegetation, but sometimes these fires spread to the areas under regeneration and adversely affect the management particularly in *Chir* forest. Crown fires are more damaging, affecting hundreds of hectares of forest land. Quantification of damage is difficult, yet some of the common damage is destruction of regenerated and young plants, drying up of trees, retardation of increment, burning of pine needles and humus. Fires thus expose soil to the vagaries of wind and rain leading to soil erosion and affecting the ground water recharge. Biodiversity is severely affected both above and below in the areas of forest fires.

Forest fires cause a lot of damage to the forest resources, and the wildlife therein. Each year, hundreds of hectares of forest land get burned up especially in the *Chir* zone mostly due to negligence of the villagers. Forest fires are also very common in the high altitude *Blue Pine* forest during November and early December when weather is dry and winter rains are delayed. The forest area burnt in the year 1983-84 was accounted for 960 hectares which further increased to 8128 hectares in the year 1998-99.

In the light of the above facts and figures on forest it becomes imperative for the forest department of the state to manage the forest resources in a more scientific and co-operative manner. It must although be kept in mind that the whole practice of management of forests in Himachal Pradesh has its roots in the colonial era. Therefore, an understanding of the historical development of forest management is very essential.

4.1 History of forest management:

History of forest management in the state can be divided into two phases viz. era of princely states and British era. Forest management now over 150 years old, was started in mid 19th century by the Britishers. These efforts towards the management of forest are again at the threshold of change since 1990's. At the center stage again is the concept of 'Forest-people' symbiosis in the management of forests.

Era of Princely hill states:

Not much is known about forest conservation and management prior to the initiation of regular forest management practices by the British. During the Mughal period, forests were not preserved, although the Mughal emperors had set up 'Shikar reserves' for the purposes of hunting[7]. The Muslim invasions led several small rulers to migrate to remote hills of the Himalayas where they overpowered the small tribal chieftains to establish their own states. These rulers of hilly states did not comprehend the value of forest wealth as it was available in plenty. Forests were destroyed only sometimes during wars, or at times for cultivation purposes.

British era:

The mountains of Himachal Pradesh supported a complex interaction between subsistence agriculture and transhumant grazing long before the British arrived in this state. The British gained control of the Punjab hills in 1849 which comprises the present area of Himachal Pradesh. They allowed few rajas to administer their princely state under British supervision but took certain areas like Kangra valley and areas in the higher Himalayas under their direct control.

Lord Dalhousie, the then Governor General of India, recognized the need to ensure forest conservancy in the area and took direct steps for forest conservation. He appointed Captain Longden for this job who carried out the exploration work during 1852-53 and submitted his report. Thus the earliest systematic attempt for the extraction of timber was made from the forests of Chenab Valley. For this purpose Captain Longden raised a small plantation of 1500 to 2000 Deodar plants on the banks of river Chenab during 1853.

The first priority of the British at that time was to stabilize and extend agriculture; and the second, to exploit and sustain the mountain forests. Thus they codified land tenure system for the purpose of assigning rights of ownership and use to tilled, grazed and forested land as a basis for revenue collection. Barnes, the officer who conducted the 1854 land settlement of Kangra district, first surveyed and recorded the ownership of arable land. He granted the landholders of village collective ownership of large grazing and forest areas which later became the village forest land.

The period of 1850's and 1860's witnessed a sudden increase in felling of commercially important species which resulted in increased pressure on forest resources. In the Deodar and Kail belt, there was a huge demand for timber after 1850, first as a building material for the towns of Punjab, and by the 1860's as sleepers for the great railway network being constructed in the plains[8]. Felling of deodar trees was carried out in Chenab valley for construction of Sialkot cantonment. The British government gave out its orders for timber to private contractors, but their work was so crude and wasteful that this system was abandoned after few years.

Uncontrolled felling by private contractors, coupled with extensive grazing in the forest led to the first modern crisis of forest and pasture management in the state. The settlement and revenue department was entirely inadequate to deal with these issues. When the colonial forest department was established in 1864, with an aim of scientific forestry, it became necessary to enumerate and specify all rights in the forest that now were the property of the British state. This was undertaken through a process called forest settlement, where forest officers attempted to record existing rights of the people in forests and legalize them under colonial law[9]. The main objective of this exercise was the appropriation of forests for the commercial use of the British government.

Hence the first national forest law for British India was passed in 1865 and the Indian Forest Services was established under German foresters who were imported to implement it[10]. The main purpose behind this was to improve long-term forest management and guarantee future watershed stability, timber stocks and subsistence supplies of fuel wood and fodder. This was the first attempt to give the then government indisputable power to regulate most forests and pastures which the earlier land settlements had failed to provide.

The forest settlement being undertaken were based on inquiries into existing rights of local people but in most regions, local rights, particularly valuable timber rights, were ignored in the settlements. In this context, the 1878 Forest Act was annexationist in purpose and denied most local rights. As soon as the 1878 law was introduced frequent reports came in that villagers were massively evading the fee payment system which regulated their use of government forest and that forest guards hired by the British were functioning as little else but rural police, who were in competition with the officers of the revenue department[11].

In 1883, the forest settlements of Kangra, Kullu, Shahpur Kandi and Muree were initiated and finally sanctioned in 1897. There were major changes in the definition and entitlement of right holders, prices of trees and treatment of rights with respect to new settlers. The forest settlements of Chamba were completed in 1879-1882. In 1888, the Punjab government promulgated the forest conservancy rules which provided for the formation of reserved, demarcated and undemarcated forests[12].Under these rules, all the princely states completed their forest settlements which included the states of Jubbal (1915), Rawingarh and Dhadi (1900-01), Tharoach (1895), Dhami (1890), Bhajji (1923-24), Koti (1890), Keonthal (1902), Theog (1911), Madan (1894), Ghund (1890), Khanetti (1934), Kuthar (1893), Mailog (1891), Beja (1911), Bhagal (1905-08), Mandi (1915), Suket (1923-26), Bilaspur (1912), Nahan (1930), Nalagarh (1888), Chamba (1878-84), Bushair (1870-1911), Sutluj valley (1884-1921), Kullu & Lahaul (1883-96), Kangra (1879-1897) and Cholta and Bara Bhangal (1901)[13].

The early twentieth century:

Until the onset of World War I, forest use and management in the western Himalayas had witnessed few dramatic changes. The forest department's fund and energy was largely exhausted in the task of implementing the laws regarding reserved forest. A lot of work was done by the department which included surveying of timber and forest boundary; building paths, access roads and foresters' huts etc. A large number of disputes regarding the rights of villagers' access to reserved forests had to be resolved in which forest and revenue department had conflicting interests[14]. Time and again forest authorities had to negotiate at length with the private owners to consolidate government holdings in forests which had been fragmented into many small holdings over the years.

All this was done while simultaneously maintaining the annual supply of timber for railway sleepers, construction, trade and fuel and urban market places. By the early twentieth century many second generation sleepers for railway tracks were required as the original tracks had deteriorated[15]. The next major breakthrough in the exploitation of forest resources came with the improvement in the methods of processing *Chir pine* resin from lower hills. All this demand of forest resources guaranteed the forest department of the necessary funds to finance its functioning and management of forest.

Some of the funds of the forest department was invested in the old *Sal* forest which became north India's first modern forest plantation. The relative ease of regenerating *Sal* forest as compared to the Deodar led the forest department to afforest ten thousand acres of forest land in Punjab hills in 1914[16]. The urban population of the hills was also increasing steadily and thus brought with it growing demand for building timber, charcoal and fuel wood. The onset of World War I brought sudden and unprecedented demand of timber for military purposes. The understaffed forest department worked overtime to provide the timber without reforesting the trees. The labour force of the hill regions was also in short supply due to their recruitment in the Indian army.

At the end of the war the relations between the hill people and forest department were severely strained. Shortly afterwards, Mahatma Gandhi initiated a nation wide non-cooperation movement in which the hill people also participated and turned their protest and anger on the restrictive forest laws and policies which most directly touched their lives. From 1921 onwards the issue of forest use became highly politicized and the ecological sustainability of the western Himalayas more seriously talked about.

The study of history of forest management reveals that the first attempt to manage the forest of Himachal Pradesh was started by the British. They took control of the hill areas which comprise of the present Himachal Pradesh and started the process of forest settlement to record the rights of local people. This was done basically to gain control of forest land and to restrict the rights of the local people. Their main aim was to exploit the forest wealth of the state by extracting a large quantity of timber for various purposes. Later seeing the massive deforestation they set up the forest department to afforest some forest areas.

4.2 Forest management in Post independence era:

After independence and attaining the statehood, the responsibility of forest management went into the hands of forest department of Himachal Pradesh. The forest department was quick to realize that without the co-operation and support of the general rural mass of the state, the management of the forests of Himachal Pradesh was not possible. Thus the forest department started various forest management institutions which tried to co-operate with the rural village masses for the proper management of forests. Some of the important institutions having community participation are:

1. The Rakha system and the Forest guard.
2. Kangra co-operative society / Kangra forest co-operative.
3. Joint forest management.
4. Sanjhi Van Yojna.

All these are discussed briefly to throw the light regarding their functioning and the role of the forest department in it to make these institutions successful.

1. The Rakha system and the Forest guard:

The Rakha is a villager who is employed to guard local forests and for monitoring forest offences. The Rakha system was prevalent since ancient times and later it was institutionalized by the forest department. This system in many regions of Himachal Pradesh can be seen as a nascent form of Joint Forest Management since forest guard acts as a link between state forest department and local people.

2. Kangra co-operative society / Kangra forest co-operative:

Forest co-operatives in Kangra district of Himachal Pradesh is a unique experiment of forest management in the post independence era. The idea of forming village co-operatives to manage forest in Kangra district was suggested in a Forest officer's conference in 1935[17]. The resolution to this effect was proposed by H.M.Glover and seconded by A.P.F. Hamilton. In 1937, the Punjab government appointed a commission of enquiry popularly called as the Garbett Commission to consider the problems faced by the people living near the forest, and to identify the means to seek their co-operation in forest management. The recommendations

of this commission finally led to the formation of Kangra forest co-operative societies in 1940[18].

The Kangra Forest society rules were approved and the Village Forest Co-operative Society (VFCS) was formally registered in November 1941. The unit for the co-operatives was at the Mauza level, and a society could be formed if more than three- fourth of the cultivators of the mauza agreed to form a co-operative. The entire forest area, irrespective of its legal classification, as well as private lands was treated as one forest block and was managed by the co-operative societies. By 1944-45, forty co-operative societies were established covering an area of 43,749 acres[19].The main income of these co-operatives was thorough the revenue generated from the sale of forest produce. The government also gave a grant-in-aid of upto Rs 50,000 to be distributed to all the societies.

The forest department's role was confined to making working plans and monitoring the implementation of these plans. The Kangra co-operative societies continued to function with full legal recognition till 1973 after which the registration of these societies was not renewed and the grants-in-aid was stopped. The negative aspect of these societies was that the landless and lower caste villagers, migrants and women were excluded from these societies.

3. Joint Forest Management:

It is relatively recent concept that has its foundations in social forestry practice. Most of the funding under this programme has been directed towards tree plantation on private lands and wood lots/ forests on common and government land. It was started in the state of Himachal Pradesh in 1994 and its geographical extent was limited to the districts of Kullu and Mandi. This was started as a research project entitled 'Policy, rights and local forest management: The case study of Himachal Pradesh' funded by the Department of International Development (DFID) under its rural development forestry network programme. Under this programme, the Joint Forest Management in the districts of Kullu and Mandi has been restricted to small village plantations, nurseries and on farm tree planting.

There has been little interest in conventional forms of Joint Forest Management in Kullu where forest and local rights are extensive. Still there are some interesting local initiatives emerging to protect natural forest of Kullu. These initiatives in the form of village

level organizations include Mahila mandals (women's groups), Yuvak mandals (Youth groups), and Village development committees (V.D.C) and Forest protection committees (F.P.C).

a) Mahila mandals:

These are registered under the societies and co-operatives act and have a formal structure of operation. These Mahila mandals have been most effective in terms of forest protection. In Kullu district over 150 mahila mandals have been established representing the interests of the whole villages[20]. The action taken by these mandals varies according to local problems.

b) Yuvak mandals:

Their activity includes planting and protecting small areas of forest but mainly they are evolved in welfare type of work like helping poor villagers with house construction etc. Membership varies from 20-40 and is mostly made up of young men. The meetings are generally held once a month.

c) Village development committees:

These committees were set up under the World Bank's umbrella social forestry project. The committee has a statutory composition of one women (a representative from local mahila mandal), representatives from scheduled caste, the panchayat leader, forest guard, members of the gram sabha[21]. The village development council is the body which decides as to which land is to be allocated for social forestry plantations and who is to carry out plantation and protect it. The committee approaches the panchayat for a resolution to allow areas of undemarcated forest to be used for plantations. One of the major problems with these committees has been lack of representation of local forest users[22].

d) Forest protection committees:

It is the initiative of the local villagers close to the forest areas to protect forest. This is an effort to enforce protection of a forest area against other villagers who degrade the forest. In some areas of Kullu where there is a large amount of illicit felling of trees and

smuggling, many forest protection committees have been formed to try and stop such activities. According to local villagers there is a need for legislative support to strengthen their control in such matters.

The role of forest department in the joint forest management is to create enthusiasm and participation through participatory exercises, research local needs, prepare working plans, maintain registers and accounts, provide employment, infrastructure and other benefits and monitor all aspects of function of Joint Forest Management.

4. Sanjhi Van yojna:

Until recently, the Joint Forest Management in Himachal Pradesh was confined to donor agency sponsored pilot activities. But in 1998, the government of Himachal Pradesh introduced its own Joint Forest Management programme called 'Sanjhi Van Yojna'. There are now 364 village forest institutions under the Sanjhi Van Yojna and a further 153 under the D.F.I.D funded project in Kullu and Mandi[23]. This programme is functioning in the entire state of Himachal Pradesh. Under it protected forest are included and wherever reserved forest are degraded they are also included. The membership of the general body comprises of one male and one female from each household in the village selected by the forest department. The executive body membership is elected from general body. The village forest development committees are formed wherever the forest department decides to implement the scheme. Role of forest department is the same as Joint Forest Management scheme initiated earlier in the nineties by donor agencies.

Thus the government of Himachal Pradesh has set up a uniform platform of forest management in the form of 'Sanjhi van yojna' throughout the state. This scheme envisages the full co-operation of rural village masses in the management of forest resources of the state as they are totally dependent on these resources. The forest department acts only as a monitoring body in functioning of such schemes. Thus more open and full co-operation and understanding is maintained between the forest department and rural village masses. It will go a long way to sustain, protect and maintain the forest resources which will help in the general upliftment and betterment of the people of the state.

From the above discussion it becomes clear that the government and the forest department have realized that the success of the various programmes for the conservation and

management of forests is not possible without the active involvement of the people of the state. Thus the emphasis of the government in the decade of nineties has been towards Joint Forest Management programmes. The Joint Forest Management programme called 'Sanjhi Van Yojna' is the right step in this direction.

The various programmes and institutions for forest management and the efforts of the forest department of Himachal Pradesh will be effective only when proper policies and legislations are enacted supporting the cause of people and forest of the state. For this purpose the state government has brought out several acts and legislations which act as a supporting base for the working of the forest department.

4.3 Forest policy and legislation:

Formulation of forest settlement during the last part of the nineteenth century was the first attempt in establishing a formal institutional framework for the administration of forest lands and resources of Himachal Pradesh. These legal settlements made at the end of the nineteenth century and in the first two decades of twentieth century still provide the basic institutional framework for administering the forest resources by the forest department. However, over a period of time, the state government has slowly regulated public access to government land and forest, through the forest and revenue departments.

The forest settlements formulated during the colonial era formalized the rights of the local people and villagers. Since then many new laws have been enacted but rules and regulations affecting the use of forest resources by local people have remained unchanged. It must be kept in mind that the number of people holding these rights is on an increase, and the demands made on forest resources by honoring these rights have also increased enormously. Institutional and legal environment by which these rights are honored has become more complex and complicated over a period of time. In the backdrop of this perspective, there is an immediate need to create public awareness, and to enact certain legislative measures; to preserve and protect forest resources from unscrupulous elements.

The government of the state has strengthened the legislation regarding these through the enactment of various acts and rules from time to time. These legislative and administrative steps were considered necessary to curb the problem of unauthorized, illegal removal from forests and of organized timber smuggling from the state. Due to the consistent

efforts of the state government and forest department, the forest offences are now not heard too often. The system of the contractor agency for timber extraction has been done away with; which was the root cause of illegal felling and timber smuggling. Presently the job of scientific forest harvesting and resin tapping and production is nationalized and is entrusted to Himachal Pradesh Forest Corporation, set up in the year 1974.

The legal provisions and guidelines for control, use and management of forest of Himachal Pradesh have developed over a period of time. These include several acts, rules and settlement reports, notification and government orders some of which have their colonial origin. At different times, legal instruments were introduced to deal with administrative exigencies. While the Indian forest act of 1927 remains an all pervasive act for the constitution, management and protection of forests, various other laws, acts and rules enacted by the state of Himachal Pradesh having bearing on are as under:

Himachal Pradesh river rules, 1971

These rules have been enacted to regulate and control the transit of timber on the rivers of the state. For landing, floating and rafting any timber in a river, the permission of the divisional forest officer is required.

Forest produce transit (land routes) rules, 1978

These rules were enacted to regulate the movement of forest produce by land routes into, from and within the territorial limits of the state. This act was amended in the year 1994.

Mandi and Chamba minor forest produce extraction and export act of 1937

This act was enacted to regulate the collection of herbs of utility and their export.

Wildlife (Protection) act, 1972 as amended in 1990

Under this act there is a provision of setting up of protected areas, national parks and sanctuaries. This act also involves regulation of activities in these areas for the protection and conservation of both flora and fauna.

Himachal Pradesh land preservation act, 1978

In view of the hilly terrain of the state, the felling and sale of trees in private areas is regulated under a ten year felling programme. Notwithstanding the provision, lot of damage was done to the government forests under the garb of private area felling. This was the result of ill defined boundaries between the government forests and private lands.

Himachal Pradesh forest produce (Regulation of trade) act, 1994

Under the act, working or harvesting forest in private areas has been nationalized and this is to be done only through the state forest corporation.

The Himachal Pradesh resin and resin products (Regulation of trade) act 1981

Through this act, the trade in resin produced from private areas under forests has been nationalized and resin has to be sold only to the state forest corporation.

The forest conservation act 1970 as amended in 1988

This act enacted by the central government provides that no forest land can be transferred for non-forestry use without the prior approval of the government of India. It also provides for punishment and penalties to offenders who do not obey this act. This act has been a deterrent against liberal transfer of forest land of Himachal Pradesh for so called developmental purposes.

Indian forest (H.P second amendment) act 1911

This act has assumed considerable importance, as under it the forest officers are now empowered to confiscate vehicles involved in any offence related to forest resources of Himachal Pradesh.

Under the government notification of 1952, all government wastelands have been declared as protected forests and large areas brought under the undemarcated protected category[24]. There remains a controversy about its legal validity.

State Forest Policy 1980

The forests and its resources of the state have been governed by the national forest policy, as enunciated from time to time i.e. 1855, 1894 and after independence in 1952. In 1980, the state government promulgated its own forest policy within the framework of the national forest policy. This was essential considering the unique forestry situations and problems faced within the state. The policy guidelines contained in this state forest policy are still valid and cover almost all the facets of forestry[25].

Salient features of the state forest policy 1980

- The forest policy is to become an integral part of the land management policy. The policy envisages earmarking the available land resources to meet and balance the conflicting demands of different segments of society on land.
- Transfer of all areas acquired by the government under the land ceiling act, 1972 and the village common land act 1974, bearing forests or having a potential for being brought under the tree cover, to the forest department.
- Crash afforestation programmes are to be formulated to increase the area under plantations and density of forest cover, in areas already notified as forests.
- Felling of trees for timber is to be carried out strictly in accordance with the prescription of the sanctioned working plans of the forest department. All felling including those for meeting the requirement of rights holders and for packing cases are to be accounted for and justified against the prescribed yield. Fresh felling will be permitted only when regeneration of the areas felled, has been secured.
- The process of demarcation of all undemarcated and unclassed forest and the completion of forest settlements to be completed.
- The rationalization of timber distribution rights for bonafide domestic use. The right holder's rate of timber to be placed on a sliding scale meaning there by that there will be higher rates for those who are better placed. Timber for new houses to be given once in life time only and for repairs, this will be once in ten years.
- The alienation of forest land for agricultural uses to cease.
- The making of master plans for the management of watershed areas of Himachal Pradesh.

- To strengthen the wildlife-wing of the forest department.
- To start forestry programmes for meeting the requirements of the people and encourage people's participation.
- To encourage the use of fuel saving devices like the Bio-gas chuhla etc.
- To strengthen the Indian Forest act further, to stop the unauthorized removals and transport of timber.
- To stop all the hidden subsidies which affect the revenue to be collected from the forests.
- The incidences of forest grazing to be checked by formulating programmes for the improvement of cattle and pasture land.
- The nationalization of sale of timber from private land by incorporating the Himachal Pradesh Forest Corporation.
- To encourage eco-tourism so that employment and environmental consciousness is generated among the common people.
- To set up an effective monitoring and evaluation unit with in the forest department of Himachal Pradesh. This will help in formulating the future strategies and plans for forest management in the state of Himachal Pradesh.
- To create more facilities for carrying out applied forestry research.

From the given facts as above it becomes clear that the legal provisions and guidelines for control, use and management of forests of Himachal Pradesh have developed over a long period of time. These include several acts, rules and settlement reports, notification and government orders, some of which have their colonial origin. At different times, legal instruments were introduced to deal with administrative exigencies. The state forest policy 1980 has several features taking care of the various aspects of management of forest. The proper implementation of this policy will go a long way in managing and conserving the forest in a more scientific manner.

The management of forest of Himachal Pradesh can be undertaken in a better way by adopting the modern techniques of Remote Sensing and Geographic Information Systems. The integrated approach of both these will help the forest department to manage the forest in a better way.

4.4 Remote Sensing and G.I.S as modern tools for Forest management:

With the advancement of Remote Sensing technology in the eighties and the development of I.R.S series of satellites by Indian Space Research Organization, the management and monitoring of forest resources within the country has undergone a major change. The conventional methods of information gathering and analysis were not able to cope with requirements of forest resource monitoring and management as these are unreliable, time consuming, labour intensive, subjective and expensive.

The dynamic temporal changes in the case of forest fires, deforestation, density distribution and species composition can only be reliably mapped and analysed through satellite image information. Thus Remote Sensing and Geographic Information System tools alone permit a complete automation and integrated analysis of forest resources, free from bias and error.

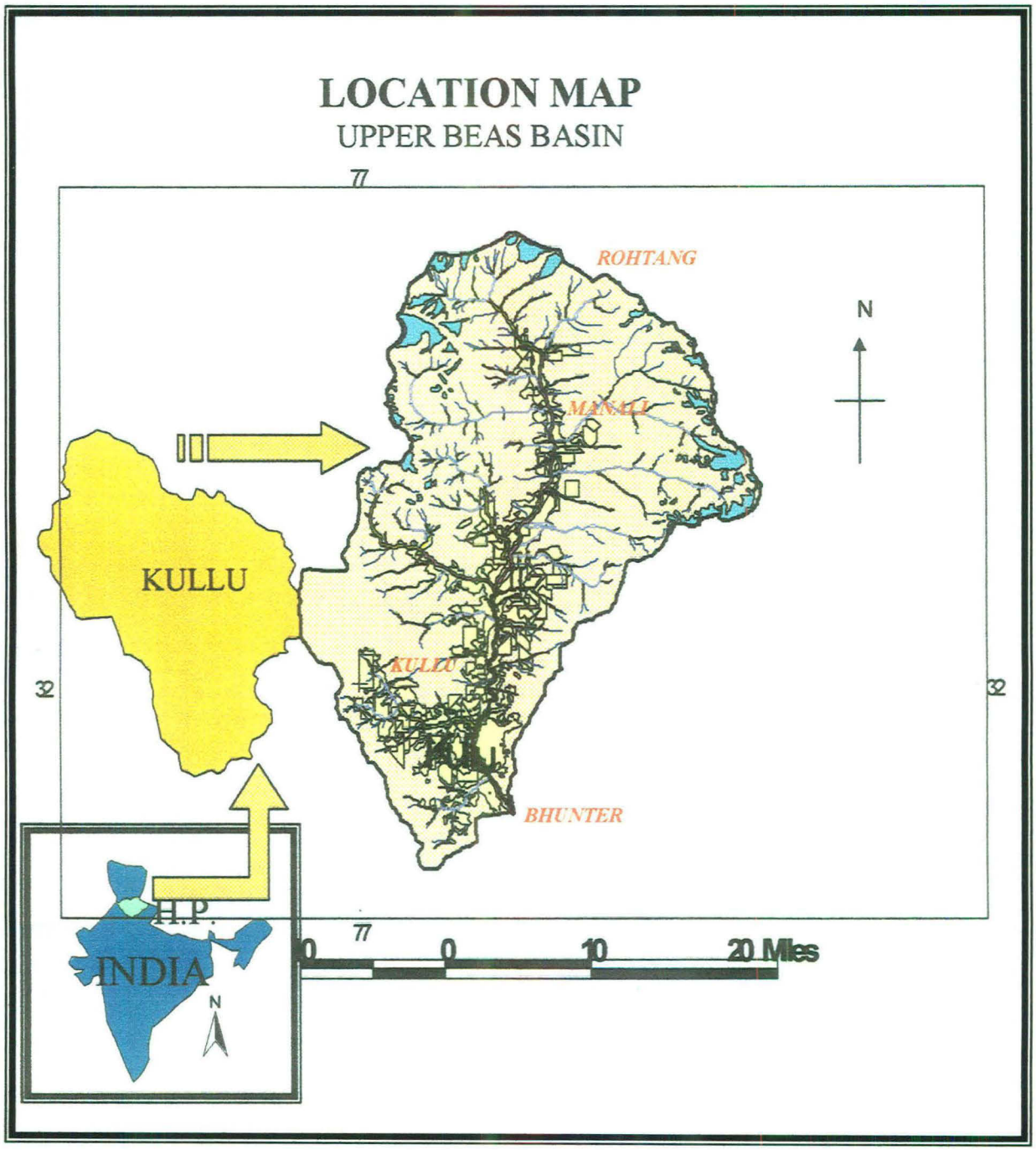
An attempt has been made here to study the forests of the Upper Beas Basin using the I.R.S 1C LISS-III image. The image processing software ERDAS IMAGINE 8.4 and G.I.S Software Arc view 3.2a have been used extensively for the analysis. Maps have been prepared to help us study of forest resources of the Upper Beas Basin.

A case study of forests of Upper Beas Basin:

The present sample area study deals with the forests of the Upper Beas Basin. The Beas river originates from the Pir Panjal range near the Rohtang Pass. Its source, the Beas *Kund,* is situated at a height of over 3960 meters above the sea level. The course of the Beas river throughout the valley unfolds a fascinating panorama with numerous gushing cataracts, gorges and precipitous cliffs. The mountain slopes covered with trees of various species, towering above the tier of Deodar on the lower rocky slopes presents a picturesque scene. The Upper Beas Basin has an abundance of forest wealth which includes many coniferous species. Some of the important species found here are Chir Pine, Deodar, Kail, Spruce and Fir.

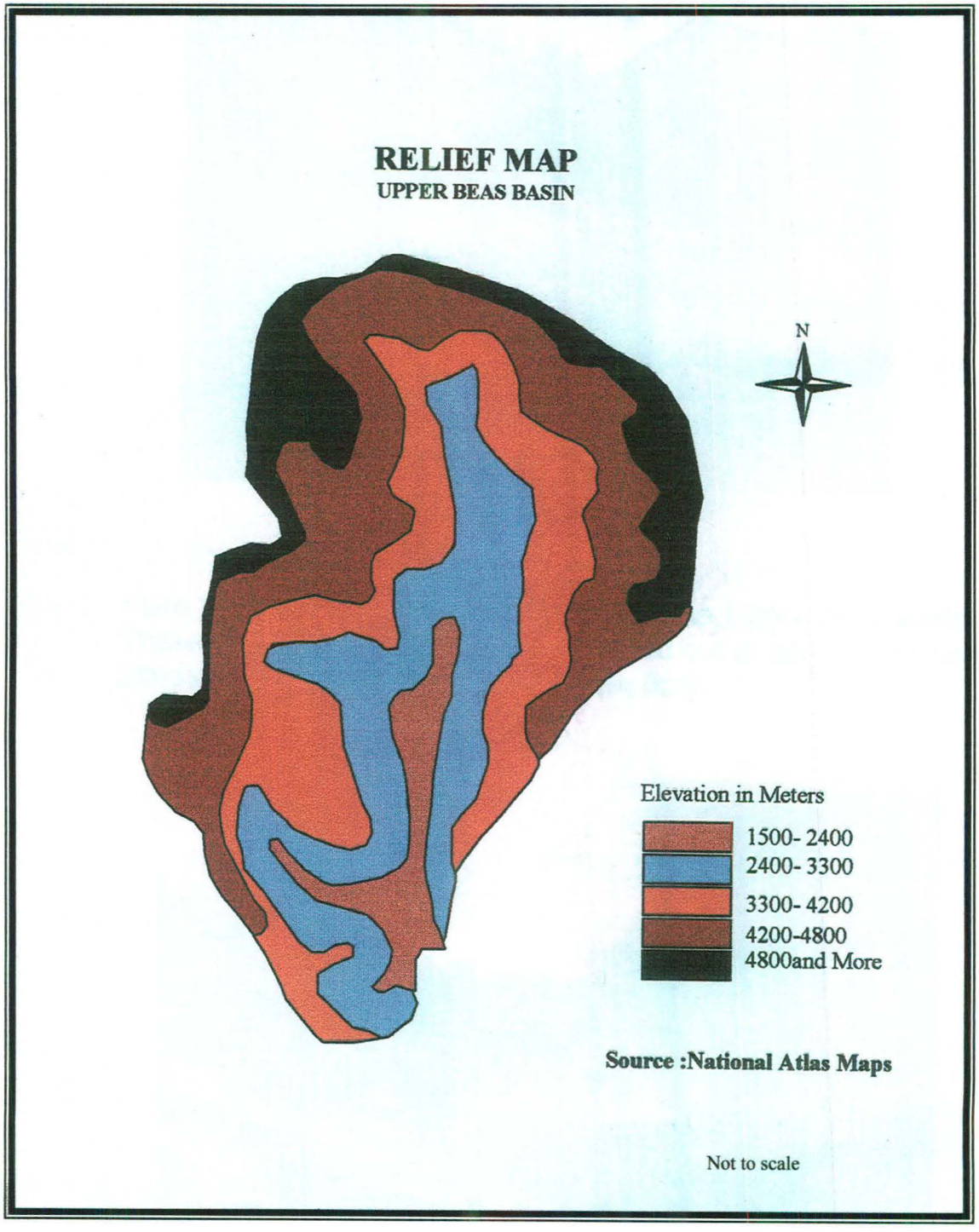
The study of forests of basin would be interesting as the region has vast area under forests which are considered to be of good quality and as well as density. The numerous

Map No 4.1



Source: Singh.I (2003): Climate change and Landscape evolution in Upper Beas Basin, Himachal Pradesh, An unpublished M.Phil Dissertation, C.S.R.D, J.N.U, New Delhi

Map No 4.2



Source: Singh.I (2003): Climate change and Landscape evolution in Upper Beas Basin, Himachal Pradesh An unpublished M.Phil Dissertation, C.S.R.D, J.N.U, New Delhi

species of coniferous trees also abound in the region. Rapid horticultural development has also necessitated the need to study the forest of Upper Beas Basin.

Location:

The Upper Beas basin lies between 31° 50' N to 32° 42' N and 76° 56' E to 77° 39' E in Kullu district of Himachal Pradesh. This area is covered by the Survey of India toposheets numbered 52 H/3, 52 H/4, 52 H/7, 52 H/8, 53 E/1 and 53 A/13. The general elevation of Upper Beas basin ranges from 1120 m at Bhuntar to more than 5000 m at higher reaches. It is bound by the Pir Panjal range in the north and water divide of Parvati river in east and of Ravi river basin in the west. The southern extent of the study area is limited to Bhuntar town.

Before going in for the detailed study of the forests of Upper Beas Basin it is imperative to have a general understanding of the physical set up of the region. Thus the aspects of physiography, relief, slope, soil, drainage and rainfall conditions have been briefly dealt with.

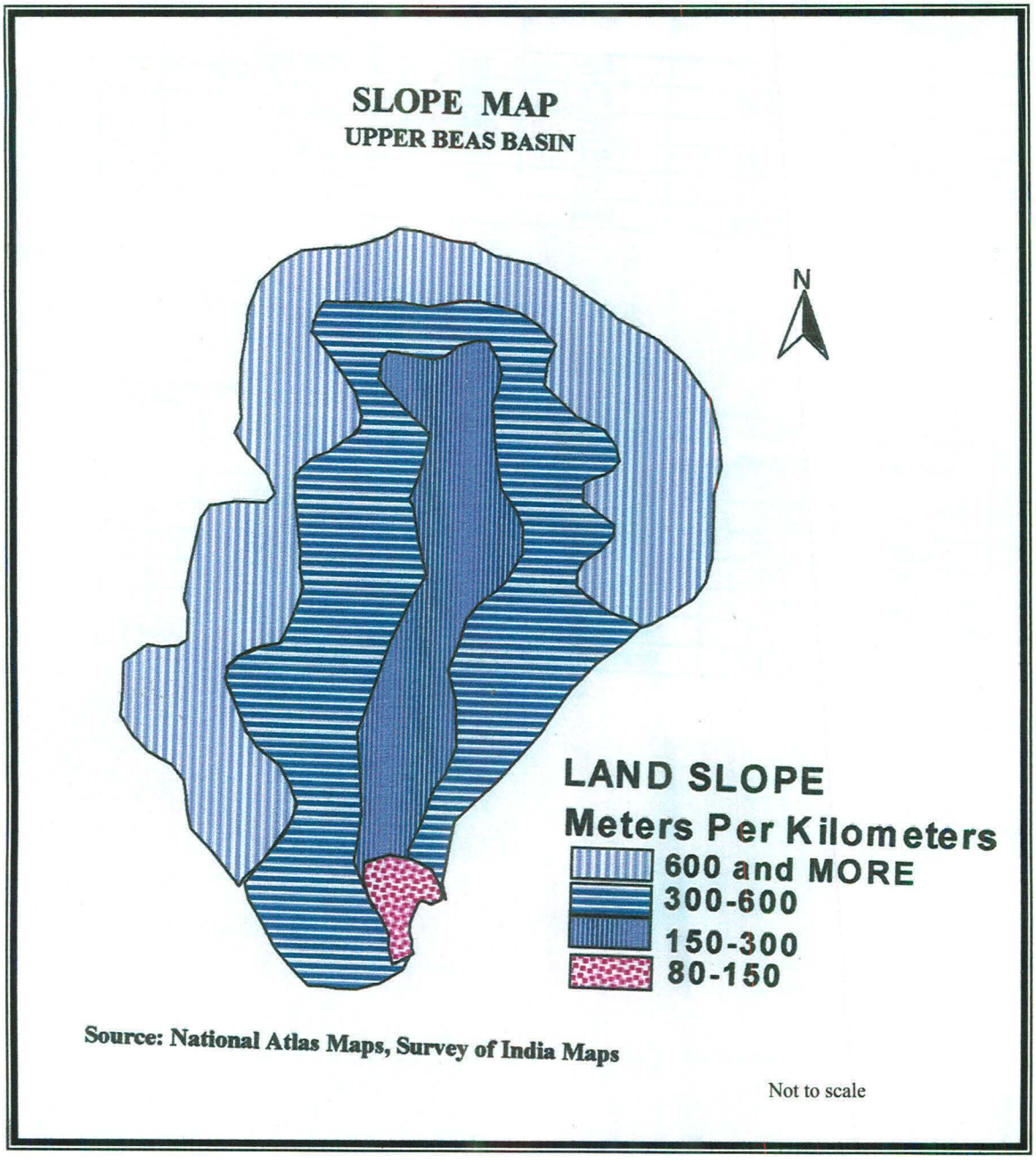
Physiography:

The Upper Beas Basin has a rugged and undulating topography characterized by numerous ranges and valleys. Its north and north western part is bound by high peaks with heights in excess of 4500 meters. Some of these are Beas Kunde Ri Dhar (5345 m), Hanuman Tibba (5932 m), Goh Kincha (5085 m), Shid Dhar (5209 m) and Inder Kila (4941 m). The Gohru peak (4600m) forms the eastern frontier of the basin. The Upper Beas Basin is bounded by many mountain passes which act as the main arteries of communication between the remote parts of the region. Some of the major passes are Rohtang Pass (3998m), Taintu ka jot (4996m), Hamta jot (4268m), Thanod pass (4080 m) and Haishin jot (4942 m).

Relief:

The relief denotes the general elevation of the region which helps us to understand the nature of topography. The general elevation of the basin ranges from 1500 m to more than 4800 m. The elevation range of 1500 to 2400m is found in the lower valley areas down stream the Beas river. This zone is surrounded by the area having elevation range of 2400m to 3300m. Vast tracts of coniferous trees are found in this zone. Rest of the area of the basin

Map No 4.3



Source: Singh.I (2003): Climate change and Landscape evolution in Upper Beas Basin, Himachal Pradesh. An unpublished M.Phil Dissertation, C.S.R.D, J.N.U, New Delhi

has an elevation above 3300 m. Here coniferous trees and alpine vegetation is found which are sparse in nature.

Slope:

Slope is defined as the angular inclination of terrain between hill tops and valley bottoms. The slope characteristics of a region are determined by endogenetic and exogenetic factors. The initial slope of a basin area gets transformed by the processes of erosion and denudation. The map showing the slope of the Upper Beas Basin depicts the change in elevation per unit kilometer. The least slope is found in the southern part of the basin which is in the range of 80 to 150 meters per kilometer. The area surrounding the Beas valley has a slope in the range of 150 to 300 meters per kilometer. This is the most suitable area for horticultural development. The slope increases further to 300 to 600 meters per kilometer around this zone which is mainly covered with dense forest. The rest of the area of the basin has a slope of above 600 meters per kilometer where largely alpine vegetation, barren lands and glaciers are found.

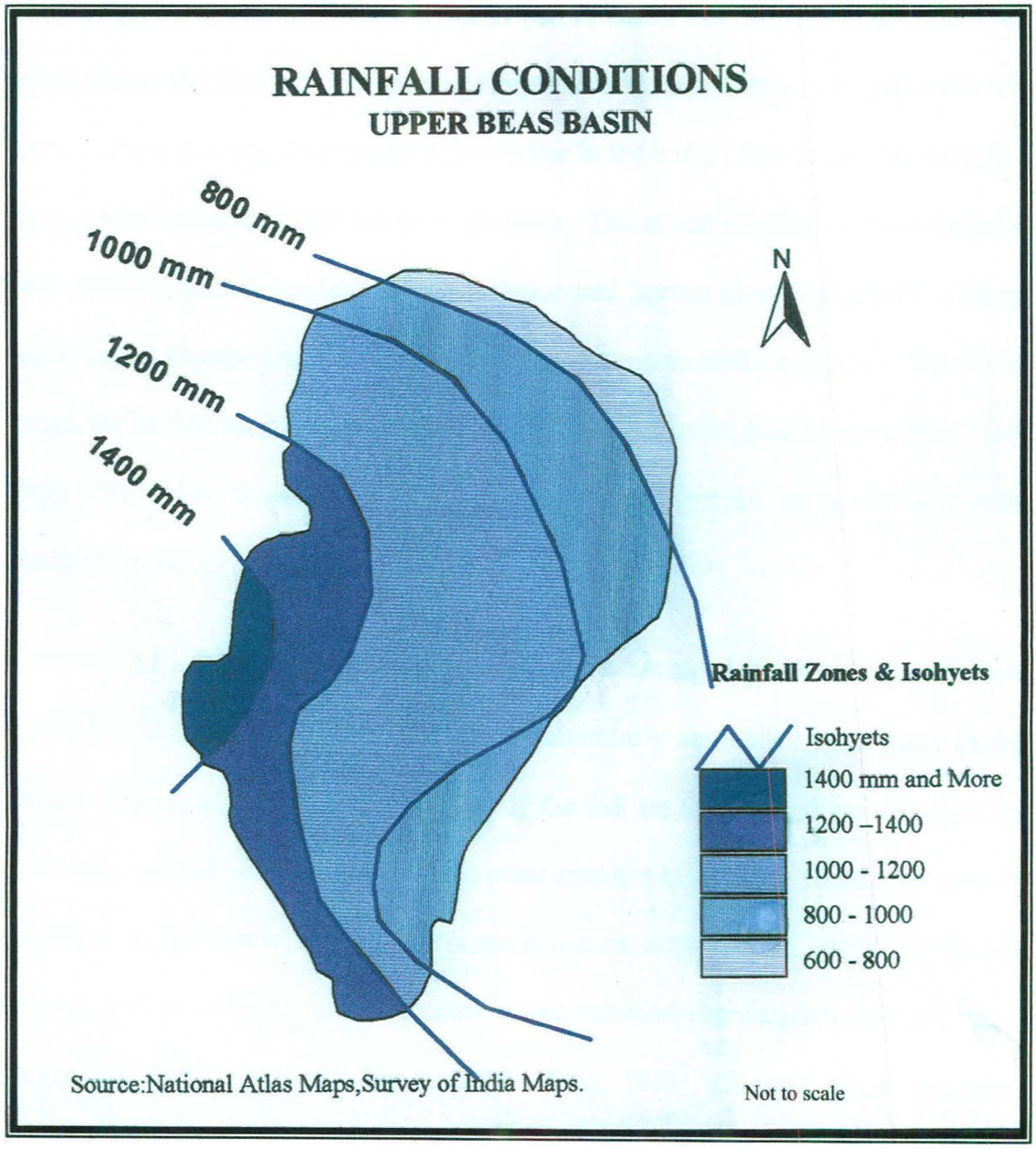
Soils:

The depth of the soil in the basin varies from shallow to moderately deep. They have a pale yellowish brown to dark brown colour and sandy to silty clay loam and clay texture. Both calcareous and non-calcareous formations are prevalent. The main classes of soil found in the basin are Fsamments, Fluvents, Ochrapts and Udalfs. The soils of Beas basin and its valleys with medium texture and thick hydro-moranic surface characteristics contribute comparatively less to the silt yield of the catchment[26]. These soils are rich in organic matter and have well developed crumb structure. These soils undergo less erosion due to their inherent characteristics and dense vegetation found in the basin area.

Drainage:

The drainage network consisting of rivers and streams act upon the physical landscape and develops beautiful valleys and gorges. From its place of origin, the Beas river has a north to south transverse flow through the middle Himalayan ranges. The river is a small stream upto a place called Marhi below Rohtang pass, which is fed by the glaciers of

Map No 4.4



Source: Singh.I (2003): Climate change and Landscape evolution in Upper Beas Basin, Himachal Pradesh, An unpublished M.Phil Dissertation, C.S.R.D, J.N.U. New Delhi

surrounding Pir Panjal range. The course of the Beas river becomes wide and gentle in gradient from Manali town downstream. The streams of the Beas basin show concurrent flow characteristics. Major streams associated with the Beas river are the Solang nala, Sarai nala, Rawla gohru nala, Halindi nala, Manalsu nala, Sanjoin nala, Phojal nala, Sarbari khad, Chhaki nala etc. All these streams are perennial, being fed by the melt waters of the surrounding glaciers.

Climate:

The climate of the basin is temperate with variation in elevations from south to north. Hence a marked difference in temperature is found in the Beas Basin. There are large annual variations in temperature with the maximum temperature in June and minimum in January. The climatic zones also vary across the length of basin from north to south. The alpine climate is found near Rohtang Pass and above it. Below this zone is the sub-alpine climate which is followed by temperate zone further south.

The average annual rainfall map is depicted by isohyets which are the lines joining the places having the equal amount of rainfall. The rainfall shows an increasing trend from North, North east to West and South west of the basin area. The maximum area falls under the zone of 1000 to 1200 mm rainfall. July and August are the months having maximum relative humidity, and in June it is the least. The Upper Beas Basin also receives rainfall from western disturbances in winters during the period of November and March. The higher reaches of the Basin area receives precipitation in the form of snow fall in winters.

The understanding of the physical set up of the Beas Basin will help us to get a general idea about the nature of forests and land use practices therein. The land use of a region is generally the utilization of land resource which in turn is dependent on the environmental factors. The dominance of environmental factors in land use increases considerably in the Upper Beas Basin considering the high relief and mountainous character of the region.

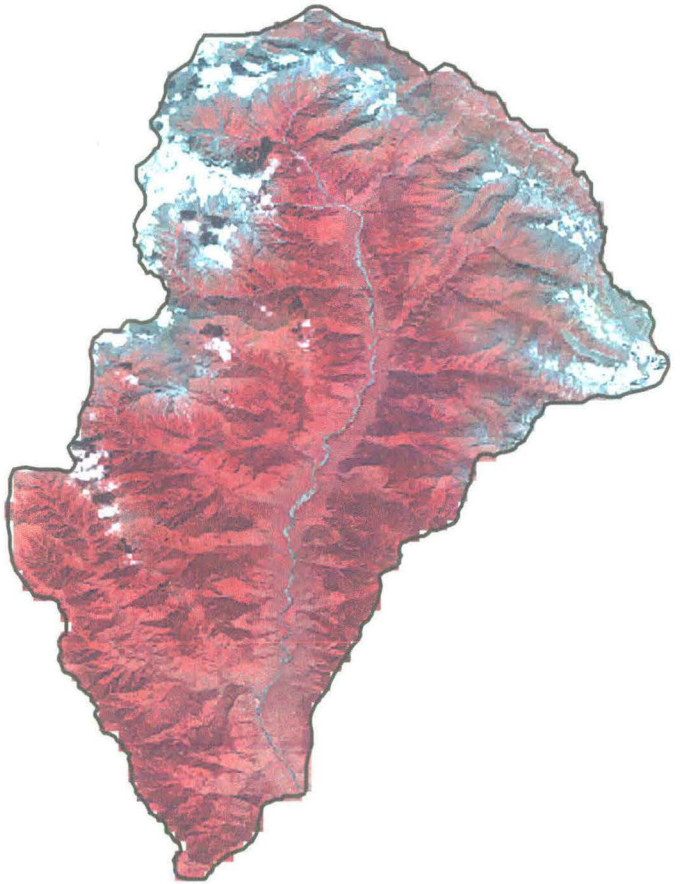
Land use in Upper Beas basin:

Land use profile of a region presents a broader picture of various uses to which the land resource have been brought under by the human society living therein. In the mountains,

Map No 4.5

SATELLITE IMAGE

UPPER BEAS BASIN



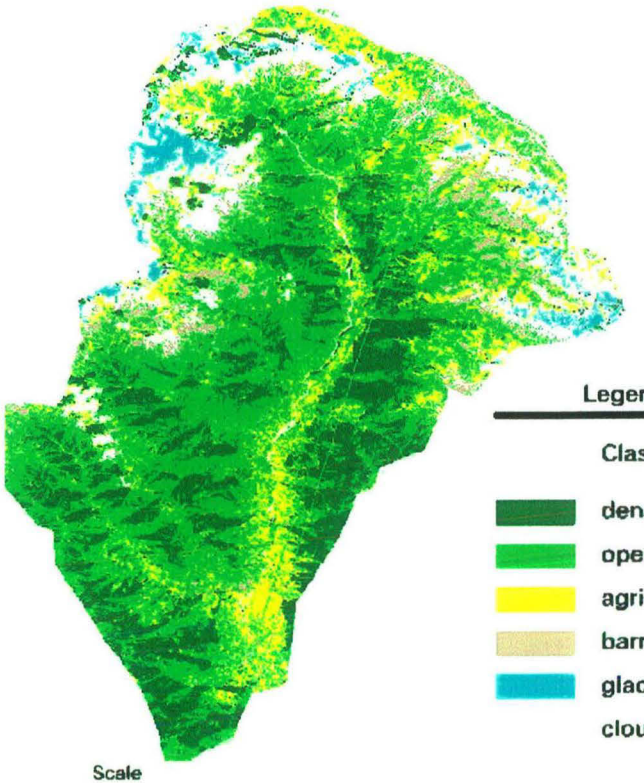
10 0 10 20 Kilometers

Source: I.R.S- 1C LISS III

Map No 4.6

LAND USE CLASSIFICATION

UPPER BEAS BASIN



Legend

Class_Names

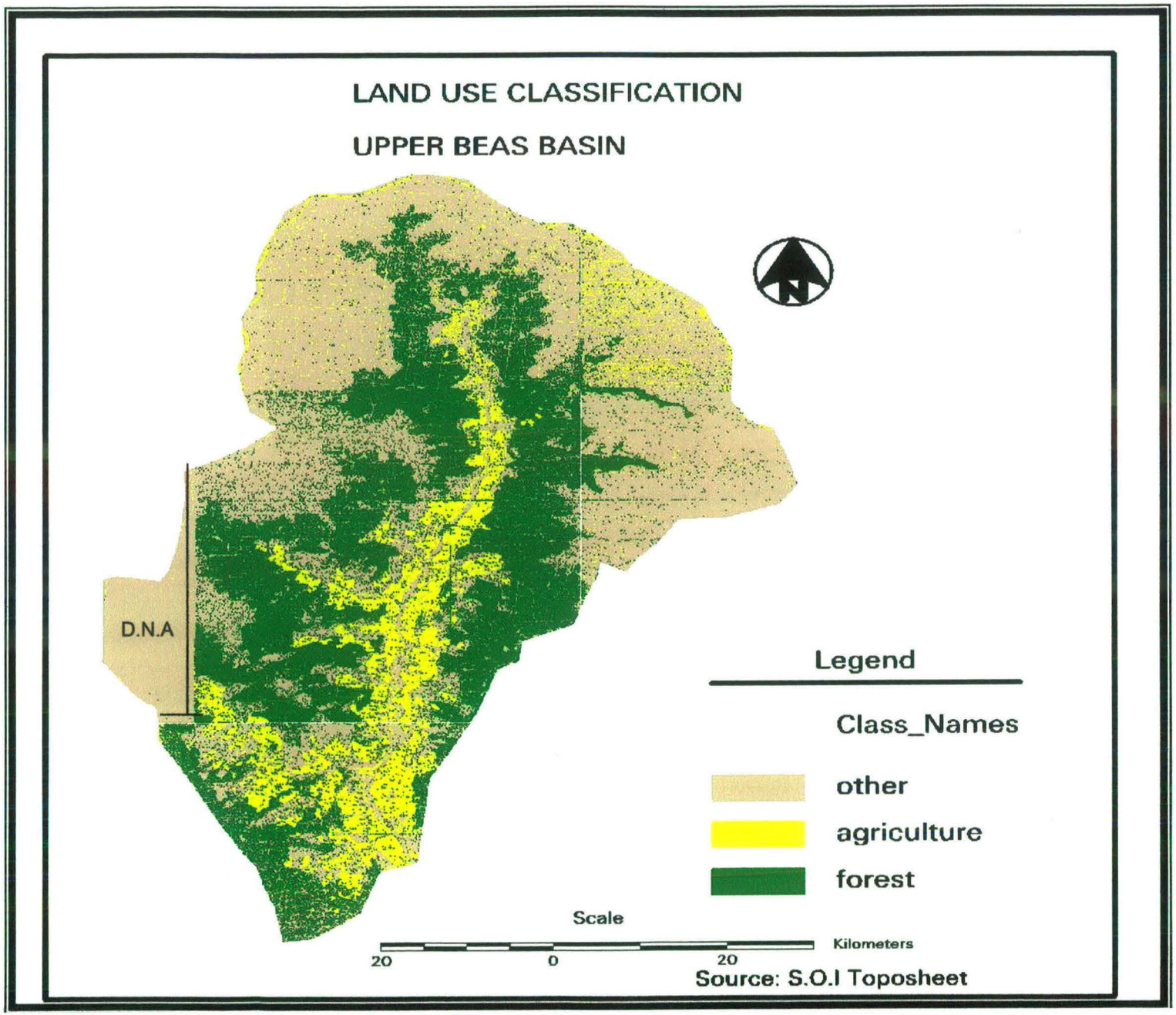
- dense forest
- open forest
- agriculture
- barren land
- glacier
- clouds

Scale

20 0 20 40 Kilometers

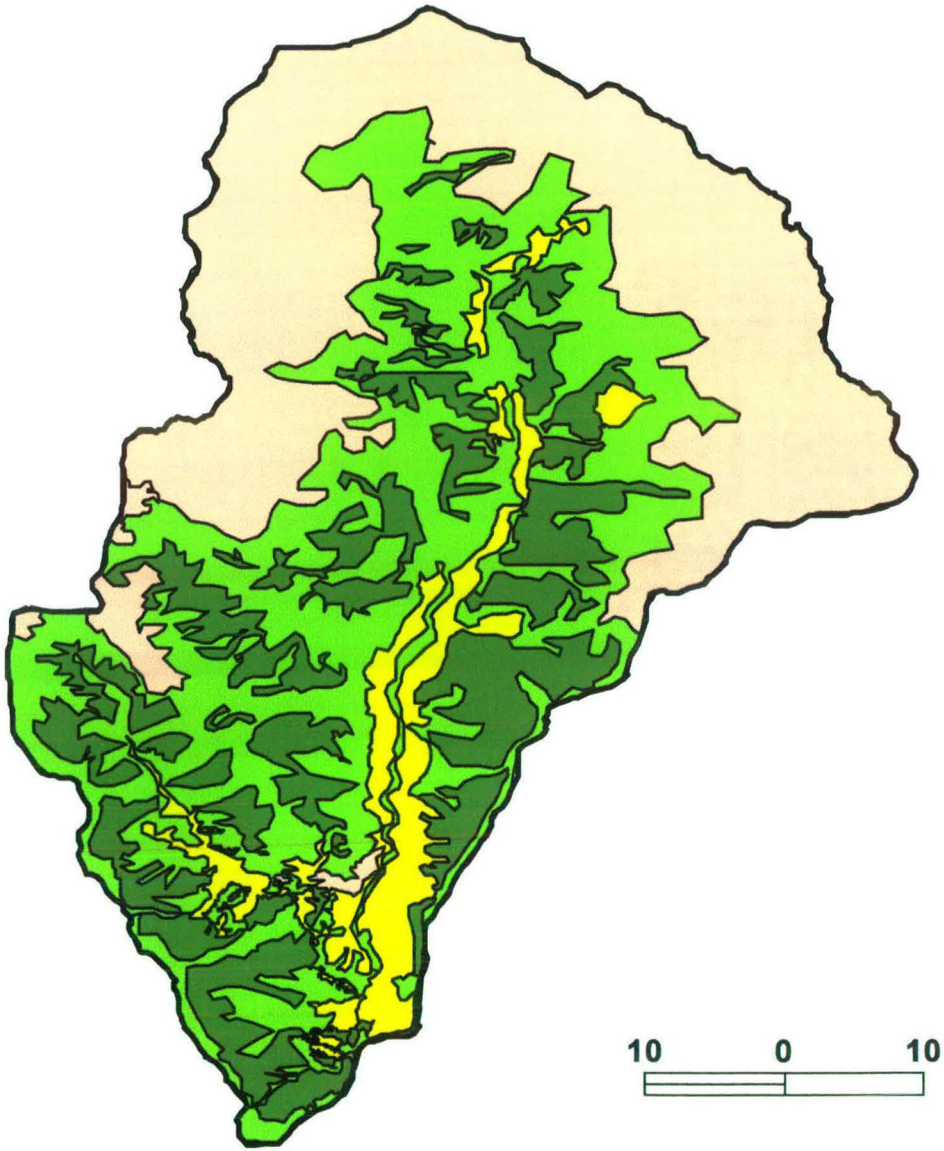
SOURCE:IRS-IC LISS-III SATELLITE IMAGE

Map No 4.7


LAND USE CLASSIFICATION
UPPER BEAS BASIN
D.N.A
Legend
Class_Names
other
agriculture
forest
Scale
20
0
20
Kilometers
Source: S.O.I Toposheet

Map No 4.8

LAND USE CLASSIFICATION
UPPER BEAS BASIN



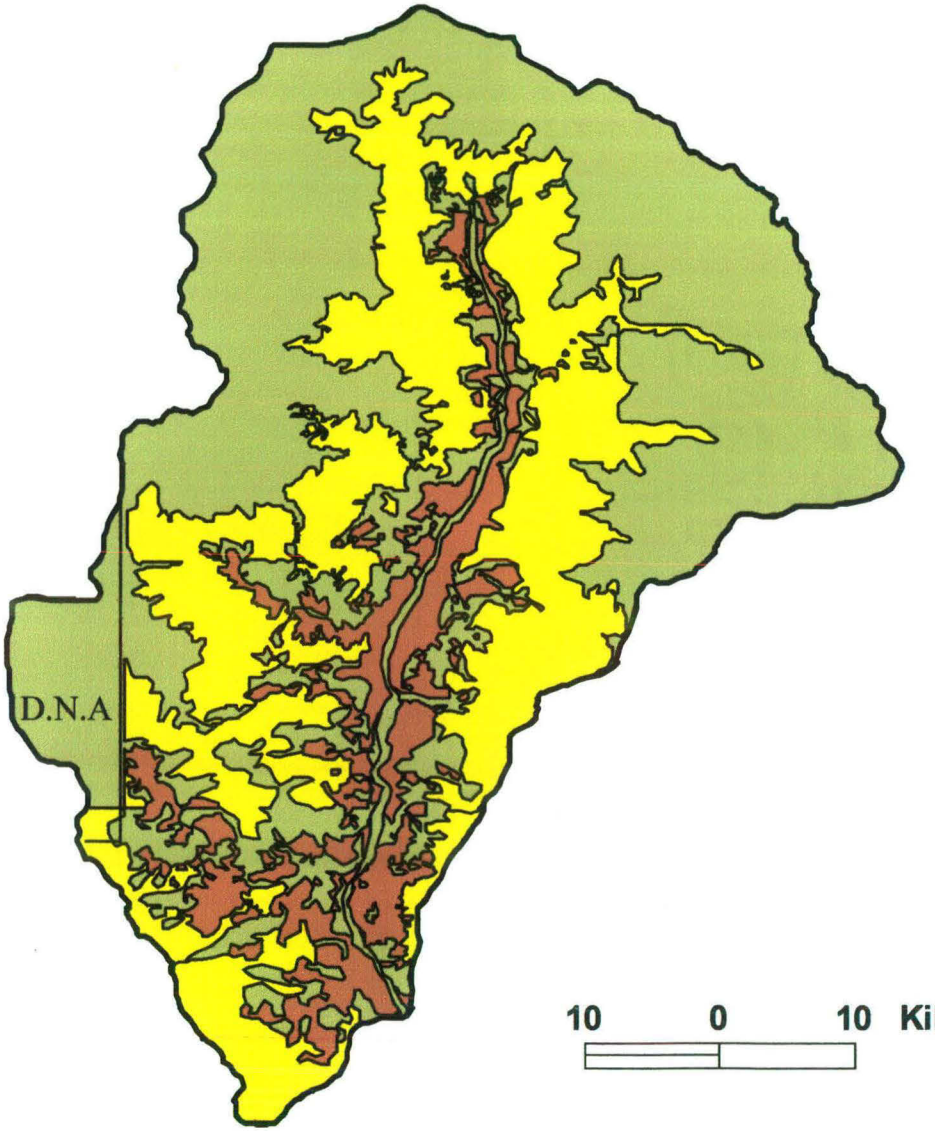
INDEX
- agriculture
- dense forest
- open forest
- other

10 0 10 Kilometers

Source: I.R.S LISS III Imagery

Map No 4.9

LAND USE CLASSIFICATION
UPPER BEAS BASIN



N
W E
S

INDEX

- agriculture
- forest
- other

10 0 10 Kilometers

Source: S.O.I Toposheet

like in present case study region of the Upper Beas Basin, the most important land use class is the forest. Thus by delineating the broader classes of land use, area under forest can also be identified.

The present study involves the delineation of broader classes of agriculture, forest and others. In the others category, the barren, uncultivable land and glaciers are included. For the analysis of changes in the land use the representative years taken are 1969 and 2002. The toposheets of 1969 covering the Upper Beas Basin numbering 52H/3, 52H/4, 52H/7, 52H/8, 53E/1 and 53A/13 are taken. A satellite image of I.R.S 1C LISS-III sensor taken in the year 2002 is also used for the analysis.

For the delineation of land use classes, supervised classification is performed with the help of ERDAS IMAGINE 8.4 software. The area under each class has also been computed. The related maps have been prepared with the help of Arc view 3.2a software. The computed value for the area under different land use classes is given below:

Table4.1

Land use in the Upper Beas Basin.

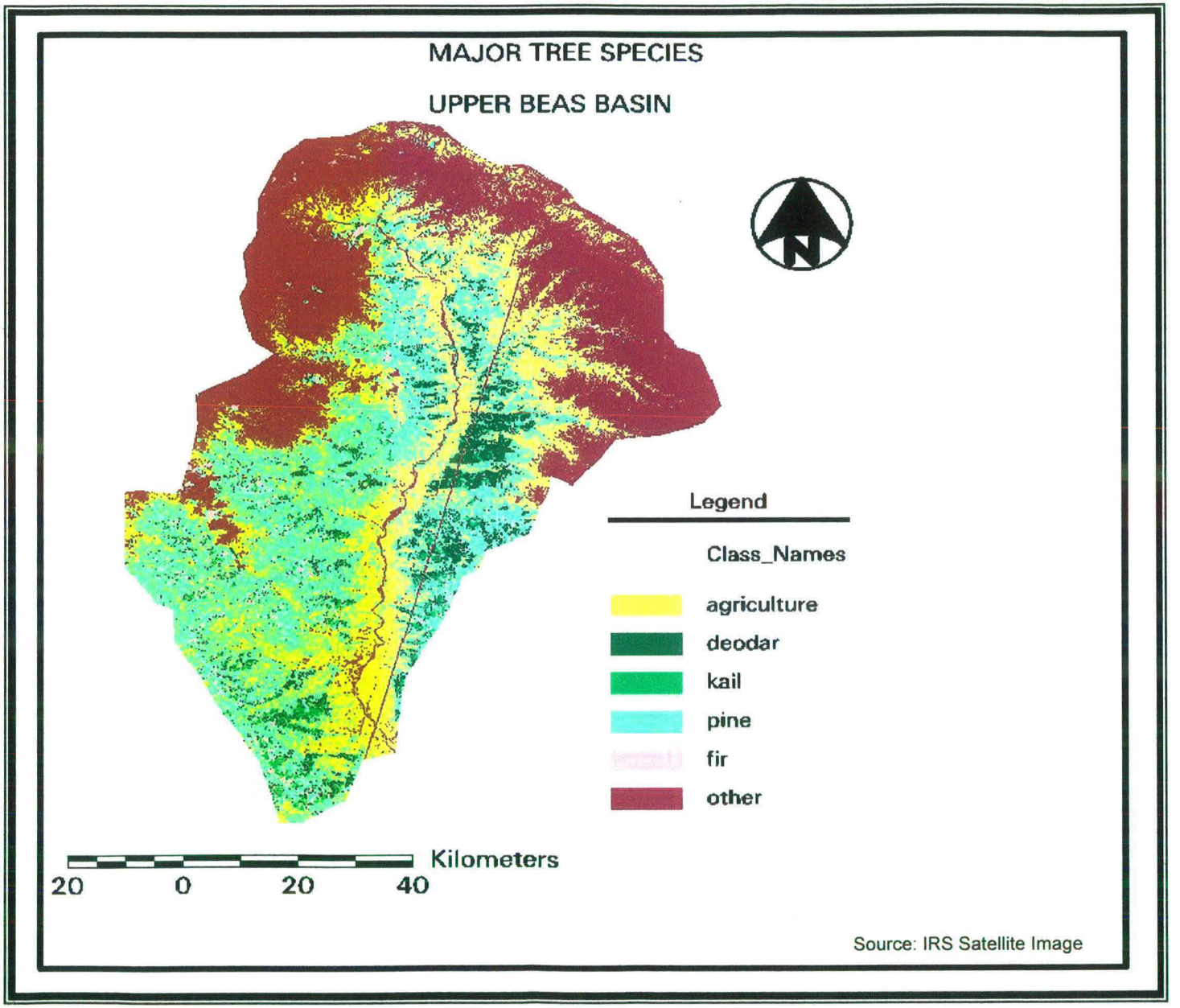
Land use classes	1969	2002
Agriculture	10.82%	7.58%
Forest	33.31%	57.25%
Other	55.87%	35.17%

Source: I.R.S 1C-LISS III image (2002) and Survey of India toposheet (1969).

Table 4.1 shows that there has been a decline in area under agriculture from 10.82 percent to 7.58 percent during the period 1969 to 2002. Such a small decline in area is justifiable considering the environmental constraints and hilly nature of the terrain.

The area under forest increased from 33.31 percent to 57.25 percent for the corresponding period. Such a large increase may be attributable to the efforts of the forest department to plant suitable vegetation species in the barren and uncultivable land and bringing more area under forest land. Also the region has seen major development of horticultural activities over the decades leading to orchard plantations of temperate fruits especially apple, peach, plum and cherry. Thus some increase may be attributed to small

Map No 4.10


MAJOR TREE SPECIES
UPPER BEAS BASIN
N
Legend
Class_Names
agriculture
deodar
kail
pine
fir
other
Kilometers
20 0 20 40
Source: IRS Satellite Image

patches of tree farmlands or orchards which could not be mapped as non-forest. Also the alpine scrub which gets covered by thick annual shrub and herbaceous vegetation could not be categorized under non-forest class. Thus some increase under forest area may be attributed to the inability to map orchards and alpine shrubs using single date image on 1:250,000 scale[27].

Some increase in forest area during 2002 may also be justified by the lack of availability of toposheet covering a small part in the South western Upper Beas basin which could not be mapped because of it. The unmapped area was put under the other category for the ease of analysis. This area is under forest cover, which was known after analyzing IRS satellite image.

Area under the other class includes barren and uncultivable land and glaciers etc. This class has shown a decline in area from 55.87 percent in 1969 to 35.17 percent in 2002. This decline may be attributed to the efforts of the forest department to afforest the barren and uncultivated lands of the region. Another reason for decline in area under other class was that the unmapped area put under this class due to lack of availability of toposheet was found to be under forests. This was known after studying the IRS satellite imagery. So some decline in area under this class may be attributed to this reason.

Thus the analysis of land use of the basin shows a decline in area under agriculture with the possible diversification into horticultural activities. Area under forest has shown an increase but this could be misleading as area under orchard and alpine shrubs are also clubbed within it. This aspect needs proper further investigation. The other class has shown a decline over the period.

Identification of major vegetation species:

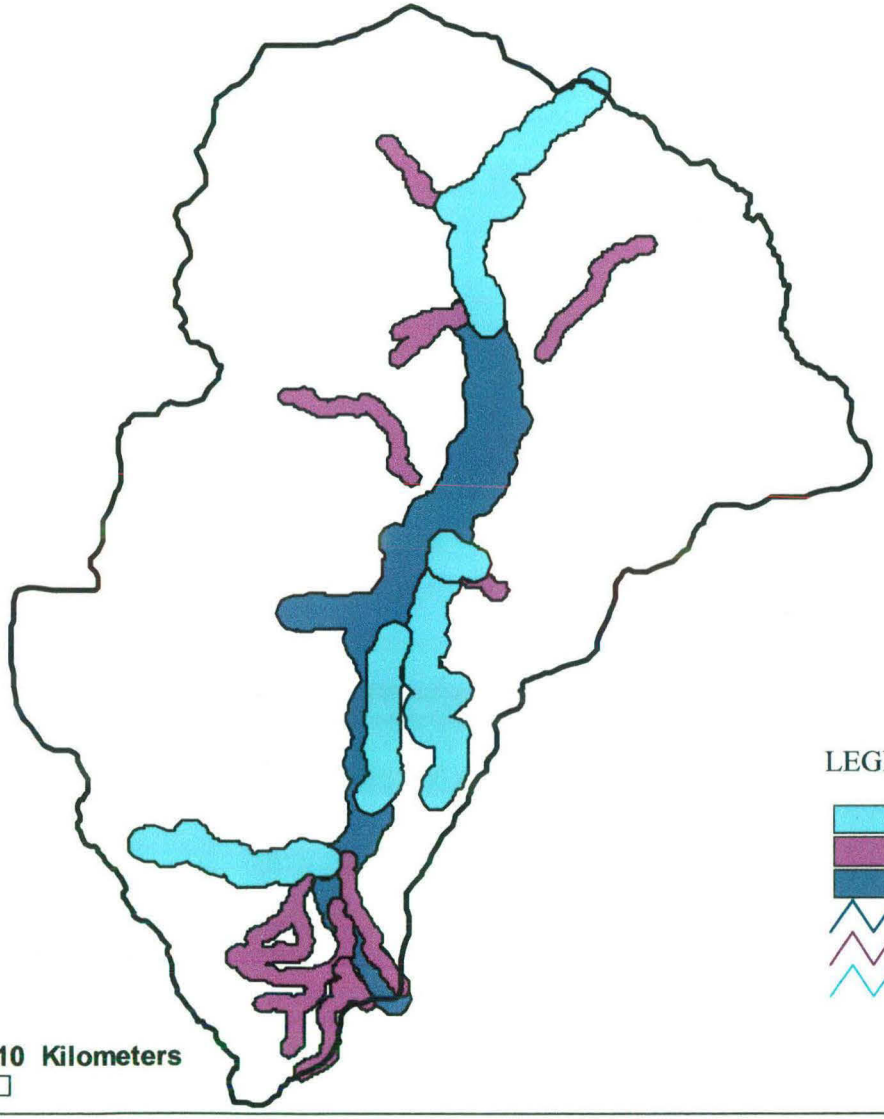
An attempt has been made to broadly identify the major vegetation species found in the forest of the basin. Each vegetation species emits its own spectral signature which is used as a medium to identify these different species. Also the help of toposheet information has been used for identification of various species.

The major vegetation species which could be mapped from satellite image are *Deodar, Pine, Kail* and *Fir*. A large part of forest area of basin is under the *Pine* forest. It is followed by *Deodar* species mainly found on the hill slopes along the Beas valley. The

Map No 4.11

BUFFER ZONES AROUND ROADS

UPPER BEAS BASIN



LEGEND

- Unmetalled road buffer
- Packtrack buffer
- Metalled road buffer
- Metalled road
- Packtrack
- Unmetalled road

10 0 10 Kilometers

Source: S.O.I toposheet

Deodar is found between the elevation ranges of 2000 to 3300 mts. The *Fir* species are found in the higher reaches above an elevation of 3000 meters. *Kail* forest is found only in small area in the Beas basin.

The major vegetation species found in the region are coniferous species of *Pine* and *Deodar*. As *Chir Pine* needles dry out during the summers, it is prone to fires. A proper care and management is urgently required on the part of forest department and villagers.

Buffer zones around roads:

The Upper Beas Basin has seen an increase in infrastructural development in the form of roads over the years. This is due to its strategic significance as an alternative all weather route linking Leh in the state of Jammu and Kashmir and explosion in tourism industry. The national highway 21 traverses along the entire Upper Beas valley. The growing tourism has also necessitated the development and maintenance of roads. This has led to clearing of land on hill slopes for highway construction. These activities have led to a serious damage to forest resources along the valley, and also contributed to slope failures and landslides at many places.

Buffer zones have been demarcated along the metalled, unmetalled roads and packtracks. A buffer of one kilometer is marked along the metalled and unmetalled road and 0.5 kilometer along the packtrack. These buffer zones should be managed properly and care should be taken so that no more felling of tree occurs there. Also within these buffer zones suitable vegetation species should be planted to minimize slope failures. The above analysis shows that the modern tools of Remote Sensing and G.I.S can be of great help to assess and monitor the forests of a mountain region like Himachal Pradesh. The advances in this field of Remote Sensing will help us to study the dynamic temporal changes in case of forest fires, deforestation, density distribution and species composition. With the help of these the forest cover can be reliably and readily mapped and analysed through satellite data. Thus the tools of Remote Sensing and Geographic Information System alone permit complete automation and integrated analysis of forest resources, free from bias and error.

Forests of Himachal Pradesh are of great utility for the rural society of Himachal Pradesh. The multifarious uses of forest resources have put tremendous pressure on it due to population increase. The requirement of fuel wood, grazing, timber distribution rights,

encroachment in forest areas and forest fires are some of the major problems threatening the forests. The proper management of these resources is thus important considering its great utility and environmental significance. In this respect the involvement of local people i.e. villagers, is a must since these people have traditional rights over these forest. The launching of 'Sanjhi Van Yojna' in 1998 by the Himachal Pradesh government is a right step in this direction. These efforts should also involve the strict adherence to the objectives of the state forest policy 1980. The modern tools of Remote Sensing and G.I.S should also form an inherent aspect of management of forest resources in such areas. With the help of these tools more accurate assessment of forest cover can be made and proper management of degraded forest areas and forest fires can also be done effectively.

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[5] Ibid. pp. 144

[6] Ibid.pp. 143

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CHAPTER V

SUMMARY OF CONCLUSIONS

1.1 Himachal Pradesh is a mountainous state situated in the Western Himalayas. The state possesses unique ecology and flora which comprises both coniferous and non-coniferous species. Being a mountain state, the scope for agricultural and industrial development is limited. Thus the rural population of the state is largely dependent on forest resources for its daily needs. This has put pressure on these precious resources of the state. The management of forest resources thus becomes imperative considering its great utility for the rural society and environment of the state.

2.1. The state of Himachal Pradesh is a unique physiographic unit nestled in the Western Himalaya. It presents a rugged and undulating topography criss-crossed by mountain ranges. The state can broadly be divided into five ecological zones, each supporting a distinct flora and fauna. These are Siwalik hills, Lower Himalaya, Lesser Himalaya, Greater Himalaya and Trans-Himalaya.

2.2. The drainage of Himachal Pradesh holds importance as it provides water to both Indus and Ganges basins. The state is drained by five major rivers with catchment area more than one percent, and four minor rivers with less than one percent catchment area. The major rivers are Satluj, Beas, Ravi, Chenab and Yamuna; and the minor rivers are Markanda and Ghaggar.

2.3. The relative relief of the state shows a general trend of increase from south to north except some areas in the north in the Trans-Himalayan region. It varies from below 600 meters to more than 4100 meters. This shows the rugged and undulating nature of the terrain of the state.

2.4. The soils of Himachal Pradesh vary according to aspect, slope, geology and climatic conditions. Being a mountain state the soils are skeletal in nature with under developed soil profile. However thick fertile soils are found in the broader valleys. The five major types of soil found in the state are Udalfs-Ochrepts, Othents-Ochrepts, Ochrepts-Orthens-Ustalfs and Udolls.

2.5. Due to its unique physiographic location, the state possesses diverse climatic conditions. It varies from hot and sub-humid tropical in the southern part, warm and temperate, cold and temperate in the middle and cold and alpine and glacial in the northern and eastern high mountain ranges. The state experiences pleasant temperature in summer, with rainfall from both the South-West Monsoons and western disturbances.

2.6. The population of the state has steadily increased over the years. It is unevenly distributed with heavy concentration in the districts which are relatively plain, adjoining Punjab. Environment plays a determining role in this regard. It can be seen from the fact that the largest district Lahaul-Spiti has the least density of 2 persons per square kilometer and one of the smallest districts Hamirpur has the highest density of 369 persons per square kilometers. The decadal growth rates of population of most of the districts have shown a decline.

2.7. Only three districts show a favourable sex ratio in the year 2001. These are Kangra, Hamirpur and Mandi. The lowest sex ratio was in the district of Lahaul and Spiti. Una and Bilaspur had a favourable sex ratio in 1991 but showed a decline in 2001.

2.8. Literacy of the state has improved considerably. It was 51.18 percent in 1981 which increased to 77.13 percent in 2001. All the districts have shown an increase in the literacy rate during this period. Hamirpur was the most literate district with literacy rate of 83.16 percent and Chamba was the least literate district with literacy rate of 63.73 percent in 2001.

2.9. Level of urbanization is still very low in the state of Himachal Pradesh as compared to other states of India. Less than ten percent of the population of state is urban. There was only one class I town and 26 class VI towns in the state in 2001. The largest share of urban population is found in the class III towns which are 25.87 percent and the least share in class VI towns which is 11.66 percent. The decadal growth rate of urban population for the decade 1991-01 is highest in the class III towns which was 76.45 percent and the least in class VI towns which was -20.30 percent.

3.1. Land use in mountains show a marked contrast from the plains in that they have a sequence of zones varying with altitudes. The land use pattern of Himachal Pradesh shows that the maximum area within all the districts was under Forest for the year

1997-98. The only exception was the district of Hamirpur. It was followed Net Area Sown and Pasture and Grazing land. The share of Net Area Sown was highest in the district of Hamirpur which was 32.56 percent and lowest in Lahaul and Spiti which was 0.23 percent in 1997-98. Rest of the land use classes had a minor share.

The correlation between the forest class and other land use classes shows Net Sown Area, Culturable Waste, Fallow Lands and Non-Agricultural uses have a negative correlation with correlation coefficients of -0.927, -0.800, -0.705 and -0.683 respectively. The other two classes were statistically insignificant. The stepwise regression analysis shows that the most important land use class affecting the shifts in forest area was Net Sown Area. This class alone can explain a major part of shifts in forest area with explanatory percentage of nearly 85 percent.

3.2. The forest cover of Himachal Pradesh in 2000 was 38.11 percent of geographical area of the state. The area under dense forest is showing a decreasing trend since the mid nineties while the area under open forests is increasing. The density distribution of forests across various districts show that open forest is the most uniformly distributed whereas forest blank is showing maximum variation.

The share of dense forest is declining in most districts whereas the share of open forest is showing an increase. The largest area of forest of Himachal Pradesh was under the legal class of protected forests. The reserved forest has the healthiest and dense vegetation but has only a small share out of the forest area under various legal classes.

3.3. Himachal Pradesh has a rich and diverse natural vegetation owing to the variation in altitude and climate. The richness and diversity can be gauged from the facts that out of the total 45,000 species found in the country as many as 3295 species are found in the state. More than ninety five percent of the species are endemic to Himachal Pradesh. The vegetation species found in the state range from alpine to temperate to sub-tropical varieties.

3.4. The major forest produce of the state comprises of timber extracted from various species. The growing stocks of some of the commercially important species have increased over the decades except the species of *Sal*. Likewise, the annual yield of these species has also shown an increase. However, the total timber extracted during the decade of nineties has shown a decline due to the government ban on green felling.

Minor forest products taken out from the forests of Himachal Pradesh are resin, medicinal herbs, bamboo and bhabbar grass. The production of resin has shown an increase recently but that of turpentine oil has declined. New varieties of medicinal herbs are also being extracted from forest.

4.1 The earliest systematic attempts for the management of forest of Himachal Pradesh were made by the British. They extracted a large amount of timber from the forests of Chenab but these were suitably afforested. The British also exploited the forest wealth of the region for setting up towns and laying down of railway network. Colonial forest department was established in 1864 and it undertook the process of forest settlement. By the early twentieth century this process was completed.

4.2 After independence several schemes and programmes were started to manage the forests of Himachal Pradesh. Kangra forest co-operative was a novel experiment in this direction. The Joint Forest Management initiative was launched in 1994 on an experimental basis. Success of this initiative encouraged the government to launch 'Sanjhi van yojna' in 1998 which covered the whole of the state. This scheme envisages the full co-operation of rural masses of Himachal Pradesh in the management of forest resources of the state.

4.3 Legal provisions and guidelines for control, use and management of forests of Himachal Pradesh have developed over a period of time. These include several acts, rules and settlement reports, notification and government orders some of which have their colonial origin. At different times, legal instruments were introduced to deal with administrative exigencies. The proper implementation of these policy will go a long way in managing and conserving the forests of the state in a scientific manner

4.4 The modern tools of Remote Sensing and G.I.S can be of great help to assess and monitor the forests of difficult terrain. With the help of these techniques forest cover can be reliably mapped and analysed. These tools should form an inherent aspect of management of forest resources of Himachal Pradesh.

The state of Himachal Pradesh has been fortunate to have a diversified and rich flora consisting of both coniferous and non-coniferous varieties. The forest resources are of great importance for its rural society. The growing population has put pressure on these resources

due to which the forests are facing a threat. The role of rural masses in the management of forests can not be neglected. There is a need of 'Forest-people symbiosis' in the management of forests. The Forest department should also strictly implement the various policies and legislations. There is also a need of co-operation between the various departments for this purpose. All these efforts will go a long way in increasing green cover of Himachal Pradesh to the desired level of sixty six percent of the total geographical area of the state as envisioned in the National Forest Policy.

APPENDIX I

Variables Entered/Removed			
Model	Variables Entered	Variables Removed	Method
1	N.S.A	.	Stepwise (Criteria: Probability-of-F-to-enter <= .990, Probability-of-F-to-remove >= 1.000).
2	C_WASTE	.	Stepwise (Criteria: Probability-of-F-to-enter <= .990, Probability-of-F-to-remove >= 1.000).
3	N_A_USES	.	Stepwise (Criteria: Probability-of-F-to-enter <= .990, Probability-of-F-to-remove >= 1.000).
4	FALLOW_L	.	Stepwise (Criteria: Probability-of-F-to-enter <= .990, Probability-of-F-to-remove >= 1.000).
a	Dependent Variable: FOREST		

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.927	0.86	0.846	8.6845
2	0.939	0.881	0.854	8.4462
3	0.943	0.889	0.847	8.6632
4	0.944	0.892	0.83	9.125
a	Predictors: (Constant), N.S.A			
b	Predictors: (Constant), N.S.A, C_WASTE			
c	Predictors: (Constant), N.S.A, C_WASTE, N_A_USES			
d	Predictors: (Constant), N.S.A, C_WASTE, N_A_USES, FALLOW_L			

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta		
1	(Constant)	87.365	4.702		18.581	0
	N.S.A	-1.942	0.248	-0.927	-7.837	0
2	(Constant)	87.821	4.587		19.144	0
	N.S.A	-1.587	0.372	-0.758	-4.271	0.002
	C_WASTE	-1.913	1.525	-0.223	-1.254	0.241
3	(Constant)	88.188	4.731		18.641	0
	N.S.A	-1.477	0.409	-0.705	-3.611	0.007
	C_WASTE	-1.662	1.6	-0.193	-1.039	0.329
	N_A_USES	-0.505	0.678	-0.117	-0.745	0.478
4	(Constant)	87.643	5.122		17.11	0
	N.S.A	-1.42	0.448	-0.678	-3.17	0.016
	C_WASTE	-1.279	1.881	-0.149	-0.68	0.519
	N_A_USES	-0.526	0.715	-0.122	-0.735	0.486
	FALLOW_L	-0.511	1.112	-0.086	-0.459	0.66
a	Dependent Variable: FOREST					

Excluded Variables						
		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
Model						Tolerance
1	N_A_USES	-0.151	-0.981	0.352	-0.311	0.591
	FALLOW_L	-0.148	-0.921	0.381	-0.294	0.548
	C_WASTE	-0.223	-1.254	0.241	-0.386	0.42
2	N_A_USES	-0.117	-0.745	0.478	-0.255	0.565
	FALLOW_L	-0.077	-0.426	0.682	-0.149	0.441
3	FALLOW_L	-0.086	-0.459	0.66	-0.171	0.439
a	Predictors in the Model: (Constant), N.S.A					
b	Predictors in the Model: (Constant), N.S.A, C_WASTE					
c	Predictors in the Model: (Constant), N.S.A, C_WASTE, N_A_USES					
d	Dependent Variable: FOREST					

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4632.571	1	4632.571	61.423	0
	Residual	754.206	10	75.421		
	Total	5386.777	11			
2	Regression	4744.73	2	2372.365	33.255	0
	Residual	642.047	9	71.339		
	Total	5386.777	11			
3	Regression	4786.369	3	1595.456	21.258	0
	Residual	600.408	8	75.051		
	Total	5386.777	11			
4	Regression	4803.915	4	1200.979	14.423	0.002
	Residual	582.862	7	83.266		
	Total	5386.777	11			
a	Predictors: (Constant), N.S.A					
b	Predictors: (Constant), N.S.A, C_WASTE					
c	Predictors: (Constant), N.S.A, C_WASTE, N_A_USES					
d	Predictors: (Constant), N.S.A, C_WASTE, N_A_USES, FALLOW_L					
e	Dependent Variable: FOREST					

APPENDIX II

Forest Area 1999			
District	Dense	Open	Frst_blank
Bilaspur	65	170	193
Chamba	1585	716	2616
Hamirpur	93	95	31
Kangra	1338	301	1203
Kinnaur	436	213	4444
Kullu	1631	343	2982
Lahaul & Spiti	34	116	9982
Mandi	982	557	321
Shimla	1808	582	1121
Sirmaur	742	366	735
Solan	274	218	236
Una	132	285	70

Forest area 1991			
District	dense	open	Frst_blank
Bilaspur	101	65	261
Chamba	1625	392	2874
Hamirpur	156	60	33
Kangra	808	625	1361
Kinnaur	565	68	5775
Kullu	1817	131	2966
Lahaul &Spiti	0	17	9354
Mandi	839	462	777
Shimla	1921	299	1227
Sirmaur	740	279	704
Solan	164	251	317
Una	175	220	162

APPENDIX III

RESULTANT CHANGES IN VARIOUS CLASSES OF FOREST 1985-86 TO 1997-97

Years	Reserved	Protected	Unclassed	Others	Total_frst
1985-86	1896	33454	1402	947	37699
1986-87	1896	33471	1426	908	37701
1987-88	1896	33448	1405	908	37657
1988-89	1896	33349	1437	908	37590
1990-91	1896	33349	1397	947	37589
1991-92	1896	33349	1397	947	37589
1992-93	1896	33165	1084	915	37060
1994-95	1896	31472	1084	953	35405
1995-96	1896	31453	1084	993	35426
1996-97	1896	33005	930	1155	36986
1997-98	1896	33011	991	1118	37016

APPENDIX IV

Himachal pradesh forest department based Land use classification 1984-85

	Geo_Area			1984-85				
District	(Proff_Survey)	Forests	N.A_uses	N.S.A	Fallow_land	C_waste	M_T_groves	P_G_land
Bilaspur	1167	424	152	319	27	45	1	199
Chamba	6528	3927	144	427	39	53	6	1932
Hamirpur	1118	249	123	385	85	128	1	147
Kangra	5739	2860	853	1225	128	477	1	195
Kinnaur	6401	430	100	73	21	35	1	5741
Kullu	5503	3227	39	351	27	28	3	1828
Lahaul & spiti	13835	2228	16	31	39	2	1	11518
Mandi	3950	2190	119	945	26	40	2	628
Shimla	5131	2829	91	443	39	136	350	1243
Sirmour	2825	1723	127	744	68	111	30	22
Solan	1936	718	112	429	43	128	7	499
Una	1540	520	199	426	134	115	1	145
Total H.P	55673	21325	2062	5800	676	1300	402	24108

1997-98

	Geo_Area							
District	(Proff_Survey)	Forests	N.A_uses	N.S.A	Fallow_land	C_waste	M_T_groves	P_G_land
Bilaspur	1167	428	121	308	28	58	1	223
Chamba	6528	4917	120	424	22	61	1	983
Hamirpur	1118	219	175	364	86	57	1	216
Kangra	5739	2842	753	1191	90	251	543	69
Kinnaur	6401	5093	512	76	17	62	9	632
Kullu	5503	4956	56	366	28	32	6	59
Lahaul & spiti	13835	10132	48	32	2	6	4	3611
Mandi	3950	1860	69	911	61	42	2	1005
Shimla	5131	3528	78	711	139	96	17	562
Sirmour	2825	1843	97	422	54	131	181	97
Solan	1936	728	99	394	57	130	8	520
Una	1540	487	120	403	197	113	14	206
Total H.P	55673	37033	2248	5602	781	1039	786	8184

LAND USE DATA OF HIMACHAL PRADESH

1984-85

District	(Proff_Survey)	%forest	%N.A_uses	%N.S.A	%Fallow_land	%C_waste	%M_T_groves	%P_G_land
Chamba	6528	60.16	2.21	6.54	0.60	0.81	0.09	29.60
Kangra	5739	49.83	14.86	21.35	2.23	8.31	0.02	3.40
Hamirpur	1118	22.27	11.00	34.44	7.60	11.45	0.09	13.15
Una	1540	33.77	12.92	27.66	8.70	7.47	0.06	9.42
Bilaspur	1167	36.33	13.02	27.34	2.31	3.86	0.09	17.05
Mandi	3950	55.44	3.01	23.92	0.66	1.01	0.05	15.90
Kullu	5503	58.64	0.71	6.38	0.49	0.51	0.05	33.22
Lahaul & spiti	13835	16.10	0.12	0.22	0.28	0.01	0.01	83.25
Shimla	5131	55.14	1.77	8.63	0.76	2.65	6.82	24.23
Solan	1936	37.09	5.79	22.16	2.22	6.61	0.36	25.77
Sirmour	2825	60.99	4.50	26.34	2.41	3.93	1.06	0.78
Kinnaur	6401	6.72	1.56	1.14	0.33	0.55	0.02	89.69

1997-98

District	(Proff_Survey)	%forest	%N.A_uses	%N.S.A	%Fallow_land	%C_waste	%M_T_groves	%P_G_land
Chamba	6528	75.32	1.84	6.50	0.34	0.93	0.02	15.06
Kangra	5739	49.52	13.12	20.75	1.57	4.37	9.46	1.20
Hamirpur	1118	19.59	15.65	32.56	7.69	5.10	0.09	19.32
Una	1540	31.62	7.79	26.17	12.79	7.34	0.91	13.38
Bilaspur	1167	36.68	10.37	26.39	2.40	4.97	0.09	19.11
Mandi	3950	47.09	1.75	23.06	1.54	1.06	0.05	25.44
Kullu	5503	90.06	1.02	6.65	0.51	0.58	0.11	1.07
Lahaul & spiti	13835	73.23	0.35	0.23	0.01	0.04	0.03	26.10
Shimla	5131	68.76	1.52	13.86	2.71	1.87	0.33	10.95
Solan	1936	37.60	5.11	20.35	2.94	6.71	0.41	26.86
Sirmour	2825	65.24	3.43	14.94	1.91	4.64	6.41	3.43
Kinnaur	6401	79.57	8.00	1.19	0.27	0.97	0.14	9.87

APPENDIX V

Attributes of Upper Beas basin (Satellite image)		
ID	landuse	Areainsq.km
1	agriculture	0.003
1	agriculture	0.004
1	agriculture	0.004
1	agriculture	1.421
1	agriculture	0.03
1	agriculture	0.032
1	agriculture	0.559
1	agriculture	12.388
1	agriculture	21.209
1	agriculture	3.838
1	agriculture	2.075
1	agriculture	2.919
1	agriculture	3.82
1	agriculture	4.046
1	agriculture	51.833
1	agriculture	2.828
total	**agriculture**	**107.009**
2	dense forest	0.707
2	dense forest	6.887
2	dense forest	26.267
2	dense forest	2.291
2	dense forest	7.073
2	dense forest	13.149
2	dense forest	15.821
2	dense forest	5.457
2	dense forest	3.229
2	dense forest	2.28
2	dense forest	20.82
2	dense forest	1.215
2	dense forest	25.386
2	dense forest	0.8
2	dense forest	21.664
2	dense forest	7.55
2	dense forest	9.072
2	dense forest	5.01
2	dense forest	2.055
2	dense forest	0.391
2	dense forest	1.524
2	dense forest	2.122
2	dense forest	8.211
2	dense forest	5.277
2	dense forest	7.082
2	dense forest	4.067
2	dense forest	21.434
2	dense forest	9.232
2	dense forest	37.82
2	dense forest	11.592
2	dense forest	2.101
2	dense forest	0.335
2	dense forest	0.41
2	dense forest	0.332
2	dense forest	0.068

Attributes of Upper beas basin (Toposheet)		
ID	landuse	Area
1	agriculture	21.558
1	agriculture	1.077
1	agriculture	12.242
1	agriculture	1.115
1	agriculture	0.083
1	agriculture	7.736
1	agriculture	6.933
1	agriculture	1
1	agriculture	0.084
1	agriculture	14.442
1	agriculture	0.402
1	agriculture	0.451
1	agriculture	8.554
1	agriculture	0.569
1	agriculture	0.417
1	agriculture	21.672
1	agriculture	0.508
1	agriculture	0.057
1	agriculture	0.127
1	agriculture	0.063
1	agriculture	0.021
1	agriculture	0.046
1	agriculture	1.761
1	agriculture	1.111
1	agriculture	0.337
1	agriculture	0.112
1	agriculture	0.053
1	agriculture	0.03
1	agriculture	1.49
1	agriculture	1.637
1	agriculture	0.391
1	agriculture	3.289
1	agriculture	0.14
1	agriculture	0.083
1	agriculture	0.076
1	agriculture	0.83
1	agriculture	3.448
1	agriculture	4.55
1	agriculture	2.222
1	agriculture	1.372
1	agriculture	0.129
1	agriculture	0.225
1	agriculture	0.063
1	agriculture	0.526
1	agriculture	18.521
1	agriculture	1.182
1	agriculture	6.092
1	agriculture	0.108
1	agriculture	3.164
1	agriculture	0.22
1	agriculture	0.326
Total	agriculture	152.645

2	dense forest	0.057		2	forest	42.897
2	dense forest	0.094		2	forest	19.205
2	dense forest	0.099		2	forest	2.016
2	dense forest	1.09		2	forest	42.246
2	dense forest	0.726		2	forest	96.303
2	dense forest	0.046		2	forest	0.667
2	dense forest	0.025		2	forest	91.992
2	dense forest	0.06		2	forest	164.816
2	dense forest	0.141		2	forest	8.64
2	dense forest	0.043		2	forest	1.211
2	dense forest	0.189				
				Total	forest	469.993
total	dense forest	291.301		3	other	17.848
3	open forest	2.584		3	other	0.378
3	open forest	5.067		3	other	0.078
3	open forest	2.124		3	other	0.249
3	open forest	6.194		3	other	9.26
3	open forest	14.127		3	other	4.511
3	open forest	3.454		3	other	4.59
3	open forest	6.977		3	other	6.715
3	open forest	13.271		3	other	8.295
3	open forest	11.582		3	other	9.86
3	open forest	1.469		3	other	21.34
3	open forest	0.722		3	other	15.232
3	open forest	448.9		3	other	0.568
				3	other	689.343
total	open forest	516.449				
4	other	0.265		Total	other	788.267
4	other	3.369				
4	other	1.867				
4	other	15.341				
4	other	1.047				
4	other	2.269				
4	other	471.988				
total	others	496.146				

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