

Changing Land-use and Livelihood Patterns in the Eastern Himalayas: A Focus on the Evolving Agroforestry Practices in Sikkim

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Terrace Farming in Sikkim

Preface

The call of the Queen of Hills has compelled me to go to her lap. I have seen the simple people with strong mentality. At all times they are fighting against constraints of nature. In 1975, Sikkim became the 25th State of India. The earlier King's dynasty ruled the state as an independent ruler. What was the Socio-economic condition of the people under the King's rule? Has it changed with the change of ruler? The people of Sikkim were mainly dependent on agriculture and the skewed distribution of land has had to face different hurdles in various times. The main problem in the hilly region is land elevation. The mountainous land being heterogeneous in nature carried heavy pressure due to increased population after the merger with India. The per capita land availability has shrunk drastically. The fragile mountain land has limited productivity due to infertile land and little scope for irrigation. The further increase of agricultural production is quite hard. Rather, the people have to find out supplementary income for betterment of life. The high altitude has a great potential in livestock production. At the same time, Sikkim comprises one of the highest forest areas in India. Surprisingly, the people of Sikkim have indigenous knowledge of farming for commercial crop like large cardamom. Usually, the Government plays a key role in motivating people towards the farming of commercial cash crops shifting from the traditional farming for better livelihood. Here, the indigenous knowledge is applied simultaneously with upgraded technical know-how and research.

Several efforts have been made by the Government as well as by private parties. Keeping in mind the above features, Sikkim could do well with agroforestry. Agroforestry is an integrated land system where agriculture, forestry, livestock production is undertaken on the same piece of land.

I am greatly indebted to my Supervisor Professor Maitreyee Choudhury and Co-supervisor, Dr. Sanchari Roy Mukherjee for guiding me in all aspects in spite of their busy schedules. I would like to thank Professor Jeta Sankrityayana for his valuable suggestions regarding my work. I am grateful to all my teachers at the Centre for Himalayan Studies and the Department of Economics, North Bengal University for their constant encouragement. I am also thankful to all staff and other members of the Centre for Himalayan Studies for extending their cooperation.

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I am grateful to my wife Debasmita Sanyal and my little daughter Pekham for their constant inspiration and mental support to finish my work and for bearing with my frequent absence. I would like to express my sincere

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Signature of the Candidate

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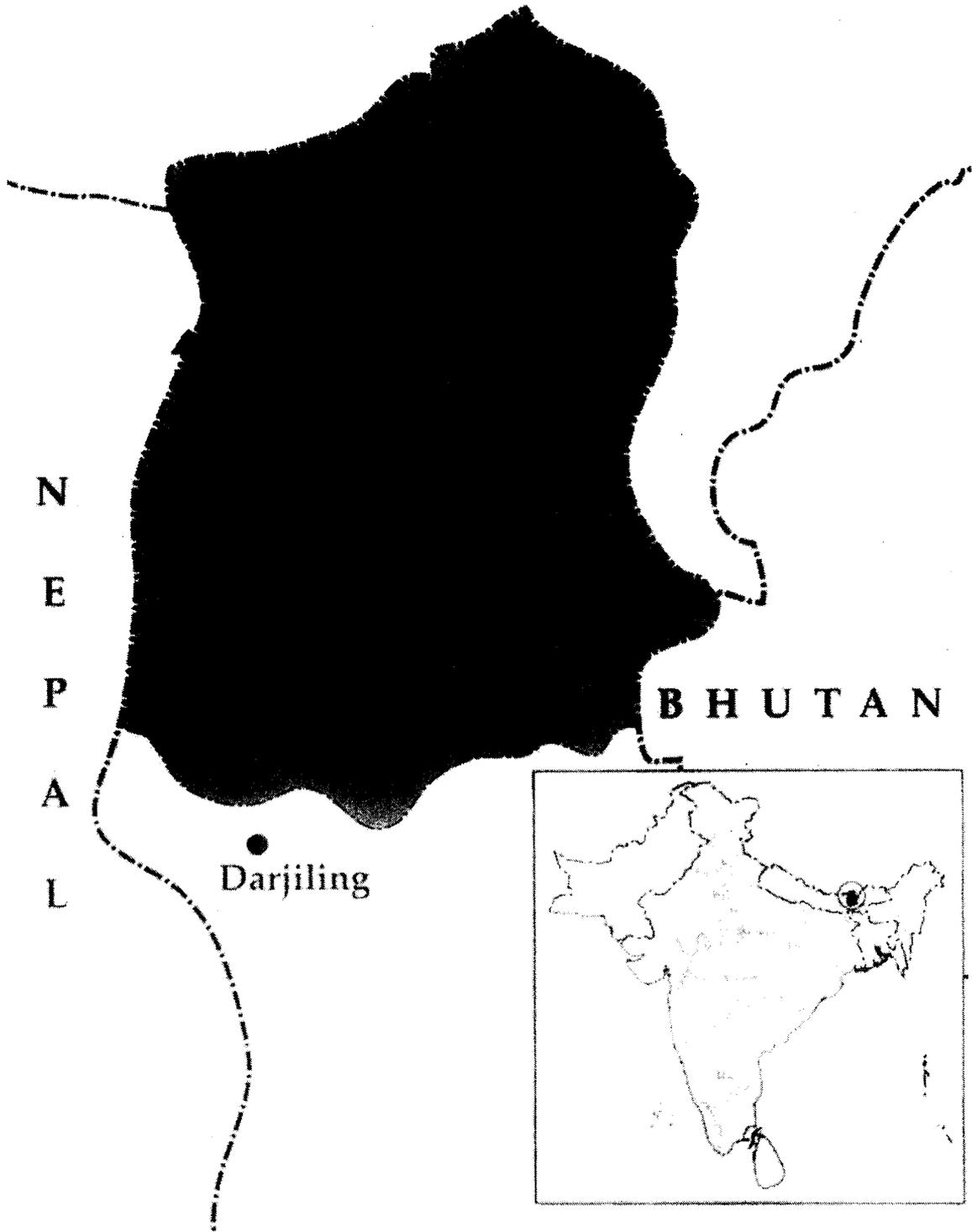
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Map of Sikkim:



Source: Sikkim Human Development Report, 2001

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Chapter - 1

INTRODUCTION

1. Introduction: The Farm Economy

1.1 Importance of Farm Economy

Industrialisation is the process that is technology dependent and assists in furthering economic development of a country. While the transition from less developed state to advanced economy state is determined by the nature of industrial growth, it is primarily because less developed economies are predominantly agrarian by nature. But there is no reason to undermine the farm economy since it is this sector that feeds the industrial economy. Thus, the farm economy is the pillar of a healthy nation, on which the other economy is built. Naturally, the question of healthy and wealthy nation is synonymous to the healthy farm economy. Indian agriculture generates about 27 per cent of gross domestic product (GDP), and agriculture products account for more than 65 per cent of private final consumption expenditure of more than 80 per cent of households. Indian economy employs nearly 60 per cent of its workforce in agriculture. No other country employs such a higher percentage. The aggregate purchasing power of the economy is determined comprehensively by the agricultural income. It explains the geographic dispersion and statistical distribution of household incomes. Therefore, any change in the Indian farm economy is expected to have an impact on the rest of the economy.

The farm economy of the plains and hills are not the same. Agriculture in the plains is in more favourable condition than the hills in the way of further development. While land is inelastic by nature, it is still possible to expand agricultural area in the plains by upgrading fallow land and wastelands. Agricultural productivity can also be increased through irrigation modernized agricultural techniques. All these are undertaken to meet the needs of the people. But, such measures are not sufficient to sustain the flow of agricultural products.

In a study by NSSO, it is found that the farm economy in the hilly area is at a subsistence level because it has to encounter natural bottlenecks towards the way of

development. It could not streamline with the other plain farming economy. So, the economy as a whole could not develop to a great extent in the hill areas.

1.1.1 Environmental Challenges of the Mountain Economy and Mountain Agriculture

Mountains are an important source of water, energy and biological diversity. Moreover, mountains are a source of minerals, forest products and agricultural products and of recreation. Mountain environments, which are most complex and interrelated ecosystem of the planet, are essential to the survival of the global ecosystem. The rapidly changing mountain ecosystems are vulnerable to accelerated soil erosion, landslides and rapid loss of habitat and genetic diversity. On the other hand, there is extensive poverty among mountain inhabitants and loss of indigenous knowledge. So, most of the mountain areas in the world are experiencing environmental degradation and the people residing there are mostly poorer. Therefore, proper management of mountain resources and socio-economic development of the people deserves immediate attention.

The broad definition of mountain agriculture covers all land-based activities such as cropping, animal husbandry, horticulture, and forestry and their inter linkages as well as the support-systems. About 10 per cent of the world's population depends on mountain resources. A much larger percentage draws on other mountain resources, including and principally water. Mountains are a warehouse of biological diversity and scarce species.

Almost fifty percent of world's population is affected in various ways by mountain ecology and the degradation of watershed areas. About 10 percent of the world's population lives in higher slopes of mountain areas, while about 40 per cent occupies the contiguous medium and lower-watershed areas. The serious ecological deterioration prevails in these watershed areas. For example, a large portion of the farming population is now faced with a rapid deterioration of land resources in the hillside areas of the Andean countries of South America. Similarly, the mountain and upland areas of the Himalayas, South-East Asia and East and Central Africa, which make vital contributions to agricultural production, are threatened by cultivation of

marginal lands due to growing population. In many areas this is accompanied by excessive livestock grazing, deforestation and loss of biomass cover.⁽¹⁾

The sustainable mountain development strategies comprise of viable and sound development programme and proper implementation. As poverty increases, less people find fewer accessible resources to meet the needs of food, fodder, fuel and fiber. At micro-level, the hill development characterized by some closely related variables such as: shifting of production from the subsistence level to market oriented production, sale of processed or semi-processed goods, shifting of self-employment to wage-employment, and so on. But, at macro level, the structural changes are associated with shift from agriculture to industry and services, along with migration from rural to urban areas.

Agriculture is the mainstay of the hill economy. Thus any development process in the hills must commence with the development of agriculture. To discuss the developmental aspects, one needs to discuss the role of agriculture in hill development, the relationship of agricultural development with environment, and the opportunities of off-farm development. Till date, the contribution of agriculture is almost 80 percent of NNP in almost all the hill states of India and in Nepal. So, it is evident fairly that higher labour-force is engaged in agriculture both directly and indirectly. The exporting goods of the hill areas obviously are agricultural produce, e.g. Cardamom in Sikkim. Thus, from the point of view of income and employment, agriculture plays the leading role in the hill states.

Environmental changes such as rainfall, mass wasting, land-slides - all these are natural while, deforestation, overgrazing are human induced. The pressure of increasing population in the hills creates pressure on forest and pastures to meet the increasing needs of firewood and household needs for timber and construction. It also exerts pressure on marginal lands to cultivate more and the increased use of water-bodies to meet the resultant increase in the food requirements. All these lead to deterioration in the environment of the hill area. Again, off-farm employment and earning is also closely related with the agricultural income and employment generation.⁽²⁾

1.1.2 Constraints of Mountain Farming in the Himalayas

Himalaya is a vast mountain system covering partly/fully eight developing countries of South Asia, including Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan. Agroforestry land use, covering 20 percent of the total geographical area of the Indian Himalaya, is distributed as patches in the matrix of forests covering 52 percent area.

The constraints of the Himalayas are similar to other mountain areas. The climate of the mountain is most sensitive to the atmosphere. The terrain is the main constraint of the mountain farming system. There, it is very hard to extract any plain land for cultivation. The farmers through their hard labour try to make the terrain suitable for cultivation. Inaccessibility leads to the slow pace of development in the high altitudes. The forests are plagued with overgrazing and over-exploitation. The lack of management of the forest area causes depletion of forests. The grasslands are affected by the overgrazing and results in low quality of fodder. There is rarely any irrigation facility for the betterment of agricultural production. The links to markets are generally very poor, which is the main constraint for the accessibility of agricultural produces. The high rate of male migration causes excess load on the woman. The livestock of the mountain area receives very low volume of fodder. The breeding and extension programme is also not sufficient for the livestock development.

The practice of subsistence farming is the determining factor of land-use in the hill area. The individual farm is the basic unit of this subsistence farming, which consists of the farm household, the land it cultivates, the livestock it holds, and accessible environment that includes non-privately owned forests, pastures and other lands. The extensive environmental damage has made the large portion of the hill economy virtually stagnant. The output produced by the household is not sufficient to support family food needs. [Sedden, 1987]

The constraints in almost all key resources are -

a) Problem of Cultivated Land: The distribution and ownership of land reveal to a large extent the levels of incomes, consumption and employment in an agrarian economy.

i) As reported by M. Banskota (1989), the average size of land-holdings is about half a hectare and almost 10 percent households are landless. The land distribution in the hill area is more uneven than the plains but it is interesting that the number of owners is higher than the plains, which means that the size of land-holding is very small.

ii) As the hill environment is heterogeneous in nature, the productivity varies widely. The declining productivity of cereal grains can be followed as moves from lower to higher altitudes. So, the mountain farmers sometimes change their crop-combinations to offset these locational disadvantages, but to maintain the productivity level is a major problem. [Schroeder, 1985, p. 31-34]

iii) Agricultural density is much higher in hills than in the plains but cultivable land is scarce. So, hill farmers compelled to use marginal and fragile lands more intensively. It causes serious consequences to the environment.

iv) To support agricultural needs, hill farmers of every major agro-eco-zones depended on the use of public land [HMG/SATA, 1980]. But recently, the access to these public lands (pastures or forests) has been restricted strictly, which caused the small farmers to reduce the total production and the income.

v) The problem with the diffusion of improved technology is a big problem in the hill economy. As the hill area is characterized by large-scale variation in climate, soil and other environmental conditions, the land-augmenting technological possibilities are more limited.

b) Problem of Access: Generally, the communication system mainly (roads) in the hill area faces many problems due to topography. The high land-elevation creates problem to construct road for proper and timely access of agricultural produce in the market. It costs much higher than the plains.

c) Fertility Constraints: Chemical fertilizers are not being used intensively in the hill areas. Rather, they depend on the traditional process to maintain the soil fertility. The plant-nutrient recycle system consists of livestock, forests biomass collected by farm labour. Their components are closely related. The decreased volume of forest reduces the supply of leaf litter and fodder, which further lowered the livestock manure. To

make compost and organic manure, farm-labour is very important. At least three hectare of forest lands is required to maintain each unit of adult livestock as opined by some researchers. Similarly, it has been argued by another group that as much as 50 tonnes/ha of leaf-litter is necessary to maintain current fertility levels.

d) Irrigational Problem: The development of irrigation projects is very hard in hill areas. The watershed management system can be developed but it has negligible role of the individuals. The hill-farmers used traditional irrigation systems that are functionally well.

e) Environmental Problem: Deforestation, soil erosion and problem of water-management are the three major areas of environmental concern. Hill agriculture is strongly related with these problems. Deforestation also causes problems to the growing food, fodder and firewood needs of hill households [Bajracharya, 1983; Yadav, 1984]. Soil erosion increased manifold due to cultivation in marginal lands, deforestation, abandonment of old terraces, livestock management system and other cultivation practices. The increased problem of water management caused due to forests and vegetation cover which increased run-off and reduced soil-moisture.⁽³⁾

Despite various constraints, the mountain climate provides opportunities for exploiting niche for vegetables, fruits and medicinal plants for cultivation. As the Himalaya has large forest cover, it provides many opportunities for forest-based enterprises such as medicinal-plants, bee-keeping, JFM etc. As Himalaya is a source of large variety of vegetable and fruit germ-plasms, it has great potential for vegetable cultivation, horticulture, floriculture etc. The fodder and grasslands availability extends the great opportunity for livestock production. Prevalence of steep terrain and denuded lands suggests that development of sound land-use systems should be based on the concept of mixed plants.

1.1.3 Mountain Economies of the Eastern Himalaya

Eastern Himalayas comprises a part of northeastern India, Bhutan and Tibet. Within India the Eastern Himalaya includes Darjeeling hill area of West Bengal, the seven north eastern states, and Sikkim. The North-Eastern states neighbouring Sikkim have similarities in many aspects, especially, the natural resources available at Sikkim and

natural bottlenecks to the development are to some extent similar. So, the comparative study with North-Eastern states and Sikkim is quite necessary.

North-Eastern states comprises of the seven states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura. It is separated from Tibet by Macmahon line. The Northeastern states are connected with the rest of the India through a narrow corridor in Northern part of West Bengal (familiar by the name of 'North Bengal'). This corridor is known as 'Siliguri neck' or the 'Chicken's neck'. This region has international importance on strategic ground, as it comprises 90percent of India's international borders. China is in the north and Bangladesh is in the southwest, while Bhutan is in the northwest part and Myanmar is in the east. This region has distinct climate variations. The climate changes within short distances due to rapid changes in topography. In the western portion of Mizo Hills, in the plains of Brahmaputra and Barak Valley as well as in Tripura the daily temperature in January lies around 15°C. It rises from April and except the southeastern portion of Mizo Hills and Shillong, in July, the mean temperature ranges between 25 °C to 27.5 °C. In the hilly areas, during October, the mean temperature ranges between 20 ° C and 25 ° C, whereas in the western portion of the Mizo Hills, in Tripura and in the Brahmaputra and Barak Valley it is above 25 ° C. In the upper Himalayas in Arunachal Pradesh the lowest temperature is experienced below freezing point.

Among the north eastern states there are many differences with respect to their resource endowments, industrialization and infrastructural development. In Assam, the industry is based on tea and timber, and in other parts of the region it is based on mining, sawmills and plywood. The economy is still based on agriculture and the full potential is yet to be exploited. Employment pressure is on the service sector. Except Meghalaya and Nagaland, the contribution of agriculture to state domestic is much higher. In case of Meghalaya, mining and forestry in case of Arunachal Pradesh are important contributors. The construction sector is also higher contributor in this region.

With interstate variations, about 54percent of the geographical area in the northeast is covered by forest. The highest is in Mizoram (75.59percent), and lowest is in Assam (39.15percent). In Arunachal Pradesh it is 61.55percent just preceded by Manipur (67.87percent). In Tripura it is 60percent just followed by Nagaland (52.02percent)

and Meghalaya (42.34percent). In the interior of Nagaland and Mizoram timber and minor forest produce are the principal livelihood option. In many tribal areas there are immigrants and denudation of shifting or jhum cultivation. The forest ownership pattern also differs in different states. The portion of reserve forest is low in the hill areas due to the fact that the ownership rests on the local communities. The extreme situation of forest timber extraction causes alarming situation of deforestation. Though there is a blanket ban on logging and non-forest activities but the situation is going to be alarming for ecological balance.

The overall land-man ratio is quite favourable because of lower density of population. In view of majority of hilly area the average size of operational holding is quite small. The main obstacles in raising agricultural production are high incidence of shifting cultivation, pre-dominance of small and marginal farmers besides smallholdings. There is also lack in the adoption of improved agricultural technologies such as use of high yielding varieties, chemical fertilizers, modern equipments etc. The total geographical area of northeastern regions is 25.51 lakh hectares of which 22.48 lakh ha. is the reporting area for various types of landuses (CMIE, Agriculture, September, 1999). The forestland is scored highest with 52.38 percent, whereas in all India it is 22.57 percent. The area not available for cultivation is 19.61 percent. The uncultivable land is 7 percent. The fallow land is 3.63 percent. The net sown area is 17.38 percent, whereas the national level is 46.64 percent.

Arunachal Pradesh covers an area of 83,743 sq.km. Its climate varies from alpine in the north to sub-tropical in the south. More than 60 percent evergreen forest covers the state. It has numerous streams, roaring rivers, deep gorges, lofty mountains, snow-clad shining peaks and thousand of species of flora and fauna. It is the largest state in the northeast with a very low land-man ratio. It is known for its forest resources. This hilly state is based on rural economy of which 75 percent of total workforces are engaged in agriculture (mainly shifting cultivation). The forest based industries and handicrafts especially carpet making is considered as secondary sector. The tertiary sector employment is mainly government jobs, which is emerging gradually. The per capita income is highest among the northeastern states and is also higher than the national average.

Sikkim, located in the Eastern Himalayas, is a state where these problems are common. Sikkim covers a small area of the Eastern Himalayas, having hilly terrain spread over 7096 sq km with elevations ranging from 250m to 8595m above mean sea level (amsl). The average annual rainfall ranges from 210 mm to 2500 mm. Temperature in middle altitudes varies from 4.5 degree C to 18.5 degree C. The climate of the state varies from cold temperate and alpine in the north, northwest and northeast to sub-tropical in the south depending on the altitudes. There is a common characteristic of land use in the eastern Himalaya. The lower elevated land is wetland. The high-elevated land is covered by forest and the middle of these two elevations is completely dry land. So, this portion is not suitable for cultivation. The lower elevated wetland is useful for cultivation.

1.2 Statement of the Problem

The evolution of the society is responsible for the evolution of the land-use. In the late-Mesolithic age, human beings learnt to herd and to grow crops. In the subsequent Neolithic society, they domesticated both plants and animals. But in those days, human society was limited in numbers. As days passed, population increased and different societies evolved. All tried to capture land first. In this way, various land-use systems evolved. Among the different land-use systems, mountain land--use is one of the most difficult systems. Mountain area is designed by some specific conditions - inaccessibility, fragility, marginality, diversity, niche and adaptive mechanisms. Despite these constraints, human society settled in the mountain areas and they fought against nature for their survival. They started cultivation for their livelihood by building terraces. In the forest areas of the Eastern Himalayas, *Jhum* cultivation prevailed from the very beginning. Till today, most of the people of the Eastern Himalayas depend on agriculture for their livelihood. It can be found in the forest areas also. In certain places such agricultural practices create environmental problems by deforestation. In recent times, the threats on environment as well as deteriorating conditions of the people compelled academics, researchers, environmentalists and economists to take a serious look. There is a need to develop an understanding pertaining to the linkages between growing population, agricultural sustainability and degradation of natural resources. Systematic study on the inter-relationship between populations, natural resources and land in mountain areas are still hard to come by. It

is obvious that failure to achieve household's basic minimum needs will result in an escalation of degradation in mountain environments.

The steep terrain and denuded lands of Sikkim suggest that the development of sound land-use system should be based on the concept of plant associations of trees with other annual and perennial plants along with livestock to resemble natural ecosystem. Considering this objective, agroforestry can be an ecologically sustainable and economically viable land-use system for Sikkim. The study attempts to identify factors responsible for the changing land-use system in Sikkim where over the years agroforestry has emerged as an alternative livelihood option for the rural population of Sikkim.

Agroforestry is defined as: "... a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels."⁽⁴⁾

As per the report of ICFRE (Indian Council of Forestry Research and Education), the forest ecosystems are facing acute forms of degradation. Most of the ecosystems are threatened by following factors viz.,

- (a) Loss of forest land to agriculture, irrigation, industries, mining and human settlements.
- (b) Loss of forest land due to multipurpose projects, construction of roads, erection of transmission lines, quarrying for minerals, slashing for shifting cultivation and clearing for encroachments etc.
- (c) Degradation due to illicit felling, lopping for fodder and fuel wood, overgrazing, forest litter removal, forest fires, over felling etc.
- (d) Human and cattle population explosion around forest land.⁽⁵⁾

1.2.1 The Study Region

Total geographical area of the state of Sikkim is about 710,000 ha, of which 257,000 ha (36.20 percent) are under forests and 270,000 ha are not available for cultivation.

Permanent pasture and grazing land is 69,000 ha (9.72 percent). The land cover under miscellaneous tree crops and groves is 5,000 ha (0.70 percent). The area under culturable wasteland is 1,000 ha (0.14 percent). The Fallow land other than current fallows is 9,000 ha (1.27percent). The area under current fallows is 4,000 ha (0.56percent). Net sown area is 95,000 ha (13.38 percent). In the year 1990-'91, net area sown in the state was 63,254 ha which increased by a margin of more than 30,000 ha in six years time (1990-91 to 1996-97). The area under fallow other than current fallow was 9,204 ha which reduced by a margin of about 200 ha.

The per capita availability of net cultivable land in Sikkim was 0.31 ha in 1971 that decreased to 0.27 ha in 1981 and in 1991 further decreased to 0.17 ha. The per capita operated area for agricultural use was 0.38 ha in 1971, decreasing to 0.35 ha in 1981 and further reduced to 0.28 ha in 1991. The per capita land under pasture and culturable wasteland was 0.40 ha in 1971, decreasing to 0.24 ha in 1981 and further decreased to 0.18 ha in 1991. Even the per capita forest area declined to 0.65 ha in 1991, which was 1.26 ha in 1971 and 0.83 ha in 1981.⁽⁶⁾

Presently, there are 447 inhabited villages, 8 towns and 4 districts in Sikkim with a population of 5,40,493 in 2001. The population growth was 3.29 percent annually during the period of 1991 and 2001. The agricultural allied sector contributed the maximum share to the net state domestic product. It used to be as high as 80 percent in 1975-76 that came down to 39 percent at present. The evolution of agriculture in Sikkim is worth dwelling upon. The original inhabitants led a very primitive life with limited knowledge of farming. They maintained their livelihoods by gathering wild roots, fruits, hunting and fishing. The Bhutia community first started sedentary farming. They ploughed only the flat segments of land. Later, the Nepali immigrants started terrace cultivation and settled agricultural practices in the gently sloping mountains of Sikkim.

1.3 Literature Review

Mountain Farming Systems vis-à-vis Agroforestry

A regional Asia-Pacific Agroforestry Workshop held in Bangalore on 17-20 December, 2003, organized by the Ministry of Environment and Forests, Government

of India, provides multiple dimensions of agroforestry practices. The important aspects have been discussed below.

In Asia and the Pacific, Agroforestry has been increasingly practiced to promote sustainable land management and to accrue more benefits to the local people. It has also been used to optimize moisture availability, prevent water/wind erosion and protect crops/vegetables from excessive temperature/radiation, and improve soil quality. The agroforestry promotes biological diversity conservation as well as carbon sequestration thus mitigating climate change pressures that are also global environmental benefits.

i) To increase productivity, Agroforestry plays a vital role. The income of rural farmers could be enhanced and diversified with the help of Agroforestry practices by improving supply of food, fodder, fuel-wood, timber and non-timber forest products, thus accruing economic benefits to the rural farmers. This economic benefit attracts other farmers to promote alternative sustainable livelihood. It also helps to improve the soil quality and empowers rural community particularly vulnerable population groups including women and promotes their participation in productive activities.

ii) The medicinal and aromatic plant cultivation and biomass energy source development have been given increasing attention to generate high value of agroforestry produce. The technical and financial resource constraints have to be mitigated to fully materialize the benefit potential.

iii) To support the agroforestry practices it is necessary to change the policy, planning and institutional frameworks. In this process, the multidisciplinary and multi-institutional approaches are essential and thus policy convergence and inter-agency coordination/collaboration are becoming increasingly important.

iv) Agroforestry have been supported by the national and international funding schemes but, there is still a significant gap in the support of such funding schemes among various districts, provinces and countries as many countries haven't yet developed effective funding schemes and partnership.

v) The lack of marketing and communication facility poses constraints towards the growth of agroforestry practices.

vi) To promote agroforestry in the dry and/or degraded lands there is a need to evolve sustainable mechanism and there is a vast scope for private sector participation in the agroforestry as well as farm forestry sector. Due to the lack of effective network mechanism, traditional knowledge, innovative practices and improved technologies for Agroforestry have not yet been sufficiently disseminated.

The workshop also suggests following recommendations for the betterment of agroforestry for the people:

1. To promote agroforestry there is a need to enhance the public and private partnership. For promoting agroforestry, consideration can be given to providing incentives to farmers and stakeholders, adopting economic instruments, increasing fiscal support, reviewing land tenure and benefit sharing schemes.
2. The collaboration among farmers and academician must be further enhanced. The most pro-active support and on-farm research on agroforestry must be enlarged for applying prospective agroforestry practices to farming systems.
3. The partnership and network building of farmers, cooperative, end-users and professional groups on particular ecosystem agroforestry systems should be promoted.
4. To achieve enhanced resource mobilization for agroforestry the scope of public-private-partnership (PPP) should be encouraged and mobilized further.
5. The quality planting and value-added agroforestry produce for commercialization should be enhanced by setting proper priority of research.
6. The use and value addition for Medicinal and aromatic plant, it is necessary scientific examination with a view to sensitizing consumers and stimulating market demand that can be cultivated in agroforestry systems.
7. To make clean development it is necessary to overcome externalities of initiating and promoting biomass energy use. Information exchanges should be promoted particularly on biomass development.
8. To prepare a status regional report on agroforestry an ongoing study on agroforestry practices and techniques in Asia and the Pacific under the

UNCCD/TPN2 (Asia Thematic Programme Network on Agroforestry and Soil Conservation in Arid, Semi Arid and Dry Sub-humid Areas) must be completed through possible on-line consultations as early as possible. It must be launched at an appropriate occasion in the near future and it should be prepared in a way that will be more appropriate for farmers and community based stakeholders.

9. To create awareness among the stakeholders, the extension/publicity activities should be strengthened.

The workshop outcome focused on different forms of agroforestry practiced in the respective countries of the distinguished speakers. While alley cropping, shade-tree combination and home gardens are adopted in Cambodia, hedgerow intercropping, homegarden, silvipasture, and improved fallow are some agroforestry measures practiced in Laos. New dimensions of agroforestry are also being explored in countries, on experimental basis. Agro-tourism in Republic of Lebanon is one of the innovative approaches towards the promotion of agroforestry. Case study for Lebanon where an integrated approach of organic farming and agro-tourism had been undertaken was elicited.

Agroforestry practices is also expected to counter natural hazards which can be found in countries like Jordan, Yemen, Kyrgyzstan, Uzbekistan, Mongolia, Vietnam, etc. Agroforestry practices have been successful in prevention of wind and soil erosion as well as soil conservation in countries of Jordan, Yemen and Mongolia, it has prevented desertification in Kyrgistan, Uzbekistan, Vietnam, etc. Such conservation and preservation of forests is possible only through agroforestry that ensures planting of forest trees and bushes as well as plantations. The latter is evident in Kyrgyzstan where collaborative forest management (CFM) and private plantations plans have been undertaken by which the interests of the local people towards forest conservation options are being developed. The primary target of the plans is the conservation of the walnut-fruit forests which are being grown as the agroforestry species in Kyrgyzstan.

Vietnam presents a notable example of integrated development where agroforestry practices are used to conserve biodiversity. A case in hand is that of Ho Chi Minh city where various initiative have been taken to improve soil quality and the socio-economic situation of the community. Further success stories are also found for

example in Bangladesh which successfully encouraged local initiatives by farmers towards agroforestry through ventures like Homestead and Farmland Agroforestry systems.

Agroforestry practices are getting its due importance around the globe. Many international institutes have been formed to make further study on it. Since it is a dynamic concept, most of the countries (both developed and developing) are adopting this for better land-use system. The first ever world congress on Agroforestry was held in 2004 in the USA. As illustration of the important role of agroforestry, it is found that effective herbicide weeds control increased coffee yields by 50percent in USA. The coffee plants are intercropped with lime-bean (*Phaseolus funatus*), cowpea (*Vigna unguiculata*), soyabean, groundnut and pigeonpea (*Cajanus cajan*). Such examples of success stories of agroforestry practices are found throughout the world. Some of the agroforestry practices in the world are exemplified below to understand the modes and practices adopted in these countries to improve on land-use and enhance the economic condition and well-being of the local populace.

Guan Junwei and Zhang Hongkiang of Beijing Forestry University, in their article named 'Oriental Value and Agroforestry Development in China', has described the role of agroforestry in combating severe problem of food, clothing and environmental degradation in China.⁽⁷⁾

The agroforestry practices of Australia have been documented in a report of Australia in 2000. The potential benefits of agroforestry have been discussed minutely, which include adding to the national supply of timber, essential oils and other tree-based products, diversification and increase of farm incomes, synergistic effects on crop, pasture and animal production, amelioration and containment of land degradation; conservation of biodiversity; and sequestration of greenhouse gases. The extension of agroforestry programme and the obstacles faced are also treated lucidly in the report.⁽⁸⁾

The north-eastern Indian Americans practiced sequential agroforestry practices where alluvial soil is available and they grew annual crops of corn beans and squash and perennial crops of berries. They practiced simultaneous agroforestry system in the uplands. They grew perennial crops of berries and nuts, which were harvested by the

Indians themselves as well as by the animals they hunted; upland soils also produced crops of fuel-wood and other products important to humans and wildlife. Many researches on modern agroforestry have been done and they have adopted various species which are more productive and more insect resistant.⁽⁹⁾ *In case of the developing countries in South Asia, studies are found for agroforestry experiences in Pakistan, Sri Lanka, Nepal, Phillipines, Malaysia, Indonesia, China etc.* The forests of Pakistan (5.4 percent) are under great stress due to heavy demands of timber, fuel-wood and grazing. About, 41.1 percent of timber and 90 percent of fuel-wood demand is annually met from farmlands (Amjad and Khan 1988), which indicates that there is a tremendous scope for raising trees on farmlands through agroforestry practice in Pakistan. Many studies pertaining to shelter-belts and a few on irrigated agricultural land with Polars and Eucalyptus tree species are also found.

The farmers of Sri Lanka practiced number of Agro-forestry systems such as Chena (a form of shifting cultivation), Taungya, i.e., inter-cropping under coconut, Kandy Gardens or Home Gardens, growing tea and coffee under shade of trees, windbreaks and shelter-belts, etc. The most significant agroforestry system is coconut based coffee and tea plantations. A study of Agrarian Research and Training Institute, Colombo (Anonymous, 1976) showed that inter-cropping in coconut increased 300 percent on farm employment in Sri Lanka.

The common agroforestry practices found in Nepal are, shrubs for live fencing around farmland, pasture (grazing) in forest area and use of strips of multipurpose trees and shrubs around the sloping (40 to 70 percent fields), which protect soil from erosion and provides much needed fodder, firewood, fence posts and other type of farm timber.

Homestead gardening is an important agroforestry system in Bangladesh. The trees on homesteads are also an important source of fuel-wood, fodder, building materials and other form of wood. A study by Leuschner and Khaleque (1987) showed that multipurpose trees and women participation in the farm operation enhanced the success of this programme. The common homestead species are mango, jack-fruit, betelnut, coconut (fruit trees), renoli, koroi (timber), etc., Mandar, Shimul (fuel trees), Barak, Muli, (bamboo), etc.

As China is a large country, its climate varies from cold-temperate in North-East to sub-tropical and tropical in the South with annual precipitation ranging from near 2000mm in the South-East to less than 50mm in the North-West, causing a vast area unsuitable for agriculture. The environmental, biological and social characteristics have promoted the development and prospects of agroforestry practices. The existing agroforestry practiced in China are - a) Agro-silviculture system, b) Silvo-fishery system, c) Agro-silvo-fishery system, d) Silvo-medicinal systems, e) Agro-silvo-medicinal system.

Thailand adopted several agroforestry practices of which planting trees in paddy fields, mixed plant system in uplands, *taungya* system, tree intercropping, homestead gardening, etc., are widely prevalent. The most common trees planted in the homestead land are bamboo, *mangifera indica*, etc. Various vegetables and perennials are also planted in the homestead land under the trees.

The primary agroforestry system of Indonesia consists of tree gardens located in the slopes in-between villages and the forest reserve (Michon *et al* 1985). These gardens make up 50-80percent of the agricultural land and are known as parks. Home gardens of villages are also found here. Raisin producing tree *Shorea Juvanica* is also found in some forests of Sumatra.

Wonosobo of Java was the most fuelwood demanding area for tobacco production. Earlier, this area was fully forested. But due to this practice, the forest disappeared gradually. In 1915, the wastelands were given to the villagers on free loan on the condition that they would plant and maintain a wood crop. The villagers adopted various species starting from local ones and introduced the agroforestry practice to improve land efficiency.

In 1950, *taungya* system was introduced in Malaysia, by the forestry department in association with the reforestation programme. Many intercropping systems with cash crops were introduced. Cropping along with livestock keeping was also practiced here since it was found economically feasible.

Agroforestry practices in Philippines took several forms. They are -



- i) Spatially interstitial support trees: In this system fast growing legume trees producing fodder and charcoal and fruit-tree are planted in contours.
- ii) Agroforestry Rotations: Fast growing legume trees and crops are mixed in a common area.
- iii) Field and Grove System: Combinations of wood-trees and fruit trees are planted.
- iv) Agrisilviculture: Fodder and charcoal species and/or fruit trees are planted with food crops.
- v) Silvipasture: Fodder from trees.
- vi) Incipient Aquasilviculture.

In Vietnam, the main agroforestry system reflects an intensive use of land which combines both rice and fuel-wood production.

South American countries of Brazil, Columbia and Mexico also experimented with various agroforestry practices to improve the economic condition of farmers. For example, in the Amazon Estuary (Brazil), people domesticated the *pejibaye* palm as a part of indigenous agroforestry system. The *pejibaye* & coffee mixed-cropping is experimented in Costa Rica with success. It has significant potential for the small farmers. While the *taungya* system was found suitable in Colombia, the homegardens of Mexico was found to have ecological, technological and productive advantage. The home garden animals mainly pigs fed from forage species found in the home gardens.

(10)

Agroforestry in the Himalayas

Over the years, the people of Sikkim have evolved many agroforestry practices that proved to be beneficial to meet the need of food and shelter and also biological needs. As population increases day after day, per capita land availability decreases substantially.

The low land-man ratio, low productivity per unit of land caused the rural people to shift from traditional crops to commercial cash crops. Also, the low cropping intensity

due to mono-cropping has compelled the rural people to change their livelihood patterns. After the merger of Sikkim with India the land-use patterns are changing at a faster pace. The need to expand agricultural production and at the same time retain the existing forests has given rise to agroforestry. Since the agroforestry practices are environment friendly, they may play an important role in developing more intensive, socially responsive, ecologically sustainable and economically efficient patterns of land-use for the people of Sikkim.

The ICAR has identified four types of agroforestry systems in Sikkim up to 1990s. They are agri-silvi system, horti-agri system, mixed homestead gardens and tea and cardamom plantations.

The agri-silvi system is largely based on fodder and fuel yielding tree species. Fodder trees become important source of fodder during lean period of October to March. Fuel wood is the main source of domestic fuel in Sikkim. Fodder and fuel trees are found growing on terrace risers of uplands, along farm boundaries. As such it is in the subsistence level.

The horti-agri system is based on inter-cropping of horticultural and agricultural produces. This system is practiced in low to mid hills. Sikkim mandarin orange is inter-cropped with annual food crops like maize. Ginger is also produced commercially. In the high hills of temperate zone, apple is inter-cropped with potato, barley, radish, cabbage and turnip. But the existing poor health of apple trees puts doubt about the substantiality of this system.

The mixed homestead garden type agroforestry system prevails almost everywhere in Sikkim. Around the house, a number of tree species such as tree tomato, guava, banana and some of the fodder trees are grown with crops such as vegetable beans, cucurbits, ginger and turmeric. These are grown for home consumption as well as for commercial purposes.

Tea plantation exists in a small area between 1500 to 1800 m. altitudes. Wild cherry trees are planted as live borders in tea gardens. The quality of Sikkim tea is rated very high.

The indigenous tribes (Lepcha and Limbu) of Sikkim used to collect large cardamom capsules from natural forests. Large cardamom was domesticated in thinned natural forests. The plantations have more than 30 tree species, which provide shade to the crop and fuel for large cardamom drying and domestic use. Among them alder, a nitrogen-fixing tree is most abundant. Local farmers have evolved a classical tree-cutting schedule in plantation area to get continuous supply of fuel wood and fodder without affecting the shade requirements of large cardamom. Some innovative farmers grow fodder trees as a shade to the cardamom plants. The fodder trees are lopped after harvest of cardamom capsule in November. Large cardamom plantations comprising of trees and perennial herbs resembles a natural forest ecosystem. Sikkim grows 90 percent of the total country's cardamom. There is enormous scope to study the role of cardamom, the chief agroforestry produce, in Sikkim's farm economy.

The available land and forest resources have to be used efficiently for equitable development of the region. In resource economics the efficient resource allocation means a situation in which it is not possible to reallocate available resources so as to achieve more or one objective without accepting less of other. In the productivity sense, the yield from all these resources should be optimum so as to achieve equitable development.

Singh and Tewari in their book on Agroforestry and Wastelands provide data on land-use and forest cover of all states and union territories. They provide definitions of agroforestry, both earlier as well as recent. The need and scope of agroforestry have been discussed too. Different types of Agroforestry practices in India have been discussed briefly. They have stated that according to Mr. Ranganathan, agroforestry can increase the GNP of the country by 10,000 crores, provides employments up to 20 million people (1979). Agroforestry systems in various countries include Africa, Asia, Europe, America and Oceania. Later chapters deal with wasteland managements. They have accounted for environmental as well as social aspects of agro-forestry and wastelands.⁽¹¹⁾

Young (1998) in *Land Resources Now and for the Future*, deals with the present problems of land resources and has provided suggestions for future land management. He also mentions agroforestry as effective land management practice. The uses of agroforestry for conservation of soil and water have been discussed. He also suggested agroforestry practices for maintenance of soil fertility.⁽¹²⁾

According to Young (1981), agroforestry has great potential to solve the land-use problem, which can be of two types: problem of farmers and problem of the land. Farmers face several problems such as shortage of subsistence level of foods including seasonal and recurrent, the shortage of feed for livestock which includes seasonal and quality, the shortage of domestic water supply, the shortage of energy from fuel wood and charcoal, the shortage of shelter making materials for housing, compounds and also for fencing the shortage of raw materials for domestic industry or services. The most important is shortage of income and savings sometimes, shortage of power to fulfill social needs. The problems of land are of manifold. The most common problem is soil erosion by water and wind. The other problems are decrease of soil fertility, forest clearance or incursion, forest degradation, pasture degradation, river degradation and weeds, pests or diseases.⁽¹³⁾

Goswami (1982) in his article titled 'Agroforestry – Practices and Prospects as a Combined Land-use System' has stated that Agroforestry is the new name for an old practice. It describes common Agroforestry practices of some countries of humid tropics. He referred to the Taungya system, an age-old Agroforestry practiced by foresters in many countries. But it has been modified for meeting requirements of agricultural lands and preventing forest depletion. In Thailand it has been considered as main instrument for rural development. Many researches have been done so far for the development of trees and crops together. Nowadays it has become a viable alternative for obtaining maximum benefits from scarce resources.⁽¹⁴⁾

Taragi *et al* (1989-90) focus on land-use disparities in the Himalayas based on case study of Kumaon Himalayas. They argued that inter and intra regional differences are caused by physical factors. They have taken three distinctive typical locations viz., valley, slope and upland. It has been found that the valley area is best suitable for agricultural activities especially for cultivation.⁽¹⁵⁾

Singh and Singh (1995) in their article deals with changing land-use pattern of Meghalaya. They have tried to examine the emerging general land-use patterns of Meghalaya plateau in CDBlock level for showing its regional disparities. The upper part of this region (the Khasi and Jaintia Hills), which is dominated by hilly slope, have higher percentage share of land under cultivable waste. The relatively lower part (Garo Hills) is forest dominated. They marked that the land-use types have been

changing on account of changes occurring in the socio-economic factors. In the conclusion they have suggested for watershed management approach.⁽¹⁶⁾

In a regional conference on Sustainable Development of Fragile Mountain Areas of Asia, organized by ICIMOD, in 13-15 Dec 1994, Tony Djogo of Indonesia presented a paper on the role of Agroforestry. He focused on the need of the two sectors namely Agroforestry and watershed. He said that initially the tendency of Agroforestry was to focus on only tree crops or timber crops or food crops but it actually needs integration of all purposes. He has described various aspects of Agroforestry practices to focus more on ecologically sustainable options.⁽¹⁷⁾

Sankrityayana (1997) highlights the evolution of land-use with the change of human society. He has given various data on Eastern Himalayas. The comparative land-use has been studied within Eastern Himalayas. The forest cover in different locations with authentic explanations is given. Though the emphasis is on Darjeeling Himalayas, Sikkim is also referred. The author has studied the paradoxical situations of Darjeeling Himalayas in the context of environment and development. He has suggested for an Integrated System Approach for restructuring the land-uses. According to him, "In the Darjeeling Himalayas the first intervention according to the land management plan has to be made through institutions of ecologically sustainable Agroforestry systems, which protect both local people and trees".⁽¹⁸⁾

Prasad and Negi (1999) discuss the methodology for setting forestry research priorities for India. How the Indian Council of Forestry Research and Education (ICFRE) and Indian Council of Agricultural Research (ICAR) are working to develop forestry research and agro- forestry research are stated. The methodology has been shown by a line-diagram.⁽¹⁹⁾

Mughal *et al* (2000) have jointly studied an area in rural Srinagar of Kashmir Valley where people practice Agroforestry. But due to inadequate technology and research, Agroforestry practices are still very inefficient. People do not meet their requirements of food, fodder and fuel wood for full year from these practices. So they have suggested for better scientific models that should be socially acceptable and economically feasible.⁽²⁰⁾

Minj and Quli (2000) have studied the Palamau district of South-Western part of Bihar. They have taken 100 respondents to fill-up the Questionnaire and collected information on socio-economic parameters like education, type of family, occupation, land-holding etc. Finally t-test was applied with these data to reveal the level of significance of Agroforestry implementation. The study established that Agroforestry is helpful in overall improvement of socio-economic condition of respondents.⁽²¹⁾

Basavaraju and Gururaja Rao (2000) have analyzed very important aspects of Agroforestry practices, viz. tree-crop interaction. They have pointed out that integration of trees in Agroforestry systems results in positive or negative interactions between tree and crops. The balance between these negative and positive interactions determines the overall effect of interactions in a given Agroforestry practices. In this regard they have suggested that selection of suitable tree species for Agroforestry is very important. It also envisaged about the management of Agroforestry systems.⁽²²⁾

Hussain (2000) in his article on land management in the hill ecosystem, studied the area of Yangse valley in the Kameng Himalaya. He said that in recent times the flat lands in the mountain ecosystems have become important from the point of view of development of settled cultivation. The studied area was also reclaimed this purpose but failed due to some socio-economic, technological, environmental reasons. After cultivating for 2-3 years with the help of govt. they could not continue it. Despite these problems there were vast potentials for horticultural and dairy farming excluding agriculture for the due development of the region.⁽²³⁾

In the State of Forests Report of 2001, it has been pointed out that the culturable wasteland and fallow other than current fallow are the potential areas on which forest cover can be extended through afforestation programme. In addition, they suggested innovative Agroforestry practices in those areas.⁽²⁴⁾

Gill and Lal highlight the relation between Agroforestry and environment. They have explained how Agroforestry could be an appropriate measure to curb disaster and to protect the environment. They also highlighted the role of Agroforestry for developmental activities.⁽²⁵⁾

AERC, Assam Agricultural University has studied Terrace Cultivation and its Impacts in North-east India in Nagaland. The land-holding and individual rights to use lands

are determined by customary laws. There are only 13.42 percent area are under-cropped. The trend of Jhum cultivation showed a steady declining during 1990-91 to 1994-05 and increasing since 1995-96. But people are gradually oriented towards settled cultivation. The suggestions include the horticultural and agroforestry schemes should be taken up in the up-hill regions. Now it is the policy of the state govt. to totally stop Jhuming by providing some better alternatives. In conclusion they have written that adequate research knowledge and practical experience are very much needed for efficient allocation of resources and integrated hill area development programmes.⁽²⁶⁾

Mughal and Bhattacharya (2002) have conducted a study to find out the Agroforestry practices in Kashmir Valley of Jammu and Kashmir. They studied the area in 1996 and found the following type of Agroforestry practices: Boundary Plantations, Agri-Silviculture on Sloping Lands, Agri-Silviculture in Plains, Horti-Silviculture, Horti-Silvi-Pasture, Horti-Silvi-Agriculture and Kitchen Garden.⁽²⁷⁾

Avasthe *et al* (2007) have conducted a field survey in Sikkim to study the household income of two most commonly used agroforestry system. The systems are large cardamom and agri-horti (Maize-potato) system. As per their study, the Large Cardamom based agroforestry system generated fifty percent more annual income from one hector production. The agri-horti system generated Rs.48000/-, whereas, the large cardamom based agroforestry generated Rs.92700/-. Similar observations were reported by the Sharma and Sharma (1997).⁽²⁸⁾

Manas Dasgupta (1980) has given a very clear picture of the structure of Sikkim's economy. He has given sufficient data on land-use, population, forest-cover etc. from the Census of 1971 and analyzed the economic situation of Sikkim in pre-merger period.⁽²⁹⁾

Debnath (1980) studied the agricultural situations of Sikkim in pre-merger period (before 1975) when nearly 95percent of the population depended on agriculture. In 1965-66, the proportion of contribution of agriculture including animal husbandry and forestry to the net domestic product was about 80percent. The important cereal crops were maize and paddy and still these are dominating. He briefly described the

production situation of millet, cardamom, mandarin orange and potato etc. The paper gives an overview of agriculture in Sikkim.⁽³⁰⁾

Om Prakash (2007) has studied the west district of Sikkim. He has described the socio-economic and environmental aspects of this district by using questionnaires on socio-economic status and environmental aspects. He has given various data to analyze those aspects minutely. According to him the gigantic problem of this district is soil erosion. He has suggested some important measures to combat soil erosion and restoring ecological balance. He has advocated the introduction of garland rows of trees of fruits, fodder and shrubs after every four or five terraced benches. Also he has given special importance on social forestry.⁽³¹⁾

Subba (1989) has studied the agrarian social structure of Sikkim in different time period. He has analyzed the agrarian society of Sikkim in three phases- pre-British, British and post-British.⁽³²⁾

Ghose (1992), in his article elaborates on off-farm employment generation in Sikkim and the Darjeeling hill areas. He has given a comparative analysis on physical features, climatic conditions and population profiles. Authentically he made his suggestions for increasing off-farm employment to develop the regions. Considering the constraints, he has attempted to show the way of flourishing some sectors that have great future potentials. He briefly highlighted the following sectors: dairy farming, tourism, small-scale industries, poultry farming, horticulture, sericulture, floriculture and finally tea.⁽³³⁾

Research studies conducted by ICIMOD, deal with differential status of mountain agriculture in the Himalayas. Sikkim, one of the study regions in the Eastern Himalaya, for example has adopted the cultivation of high-value crops such as off-season vegetables, orchids, flowers, horticultural crops and medicinal plants as their long-term development strategy. The relation between population and land-use is also outlined while focusing on food-security concepts in mountainous regions. It has also dealt with the role of social science research for sustainable mountain development.⁽³⁴⁾

Sundriyal and Rai (2001) studied the trend and production potential of pulses, its monetary gains and nutritive values. They have given sufficient data to describe the same. For this study, the authors have surveyed the pulse farming areas. They

observed during their survey that mixed cropping is practiced all over the mountain areas and farmers depend on both maize and pulses as basic staples in the Sikkim Himalayas.⁽³⁵⁾

In a discussion paper on Mountain Farming System in 1997 (ICIMOD), emphasis has been laid on the loss of genetic resources in mountain farming systems, - "If the crop fails, not only will valuable genetic resources be lost but the survival of the entire Agroforestry system would be threatened".⁽³⁶⁾

Subba *et al* (2001) have analyzed the situation of food security in Sikkim. It has been stated that the food requirements of the whole population are far below actual production. But Sikkim has a favourable environment and scope for growing a large number of fruits like mandarin orange, guava, litchi, apple etc.⁽³⁷⁾

Sharma *et al* (2002) have opined that large cardamom has great potentiality both economically and environmentally. They also envisaged the population growth and consequent fragmentation of farmland in Sikkim.⁽³⁸⁾

Coelho (1970) in his book *Sikkim and Bhutan* has stated that the main sources of Sikkim's wealth are agriculture and forests. Rice and Maize are the main monsoon crops. The other subsidiary crops include millet, buckwheat, barleys, dhal etc. The cardamom plantations are of importance due to its export potential. The cultivation of potato is also getting importance. Tea plantation is a new venture. Apples and pineapples are also grown and these are supplied to fruit preservation factory at Singtam. The cattle of local breeds, yaks, sheep and goats are found throughout Sikkim. He has highlighted the prospect of paper pulp production.⁽³⁹⁾

Subba (1984) has stated in his book *Agriculture in the Hills of Sikkim* that the agricultural backwardness of Sikkim is caused by several factors. He has pointed out some factors, such as, limited area of cultivable land, low productivity, low irrigation facility, limited agro mechanization, slow adoption of high yielding varieties, cultivation of traditional crops, lack of post-harvest technology etc are the basic hindrances on the way of agricultural progress. For rapid growth of agriculture and rural hill economy he has suggested cultivation of commercial crops in the mixed cropping, relay cropping, multiple cropping, orchard and garden land cropping, mixed

farming and Agroforestry. He has mentioned that no system of land utilization classification is followed in Sikkim.⁽⁴⁰⁾

Dasgupta (1992) in his book *Sikkim: Problems and Prospects of Development* has written on land reforms and development in Sikkim. The land revenue system of Sikkim has undergone various changes. The question of land tenures since 1948-49, changes in land tenure system and the problem of ethnicity have been discussed briefly. The book deals with the problems and prospects of agriculture in Sikkim. The changes of land-use system in Sikkim since 1958-60 to 1980-81 have been given but not analyzed. The district-wise cropped area have been given with necessary description. The then agricultural situation of Sikkim and its limitations has been discussed. The book highlights the mixed farming system of Sikkim. It narrates how the poor people of Sikkim supplement their income through the livestock industry. He has given various aspects of mixed farming system keeping in mind the agro-climatic conditions. The problems of mixed farming system have also been analyzed and the problems and prospects of non-cereals crops (cardamom and oranges) of Sikkim have been discussed. Besides, the author has commented on forest management and economic development and rightly revealed the causes of deforestation and failure of forestry to integrate with development in other sectors. Lastly the problems of resource mobilization have been discussed at length.⁽⁴¹⁾

Rai *et al* (1998) in *Sikkim Perspectives for Planning and Development* deals with various aspects of Sikkim. In the book, Singh described the existing agroforestry practices of Sikkim. He has also suggested the enhancement of productivity and better resource management through agroforestry. The existing agroforestry practices in Sikkim are: large cardamom plantation, agri-silvi system, horti-agri system and mixed homestead garden and tea plantations. Paljor sketched the feed and fodder resources of Sikkim. He has given emphasis on animal husbandry as an integral part of Himalayan farming system. Pradhan highlighted the prospects of tea plantations in Sikkim with the help of tea-production figures and profits reaped by the tea garden at Temi in Sikkim. Balaraman has dealt with the land-use figures of Sikkim and explained its merits as well as limitations. He analyzed land-use pattern incorporating livestock rearing. He has recommended some measures for better livestock rearing in the hills of Sikkim.⁽⁴²⁾

International Centre for Research in Agroforestry (ICRAF), a non-profit making organization with a mission is to improve welfare and enhance environmental resilience through Agroforestry practices have categorized the entire Agroforestry practices into two systems – Simultaneous and Sequential. They are conducting Agroforestry researches in Kenya and also around the world. At present they are pioneer in Agroforestry researches. Their website disseminates valued information on Agroforestry.⁽⁴³⁾

The 1st World Congress of Agroforestry in Florida, USA, recognized agroforestry as a sustainable land management option all over the globe because of its ecological, economic and social attributes. The objective of this Congress is to provide a global forum for Agroforestry professionals to share knowledge, experience and ideas; to plan future strategies in Agroforestry research, education and training and development.⁽⁴⁴⁾

Zhaohua *et al* studied the agroforestry systems in China. In an article the authors have analyzed the urgency of agroforestry. To combat soil erosion, siltation, flooding and desertification and to meet the demands of timber the policy makers suggested combining agriculture and forestry. These included the terms like *stereoscopic agriculture, stereoscopic forestry, multiple ecological systems of agriculture and forestry*. All these terms are synonymous to agroforestry. The aim was to provide the best ecological and economic benefits to the farmer. They have narrated the history of agroforestry practices around the China. China started an Agroforestry system in 1978 that was the biggest programme around the globe. The main forms of Agroforestry were farmland shelter belt and forest networks, intercropping agricultural crops with trees and planting trees around the houses, along the roadside and river banks. A workshop on agroforestry was held in October 1986, and more than 500 papers on Agroforestry were published so far.⁽⁴⁵⁾

Wenshi and Quingrong in their article titled “*Three Norths*” *Forest Protection System and its Benefits* explores the method adopted in China to protect sandstorm damage, minimize soil erosion and improvement of ecological conditions and promote overall development of agriculture, forestry and animal husbandry. They found that the shelter belt system of 1978 was very much effective for the above. The

benefits in ecological, social and economic aspects have also been analyzed in the article.⁽⁴⁶⁾

Zaifu in the article *From Shifting Cultivation to Agroforestry in the Mountain Areas of Yunnan Tropics* has mentioned the common problems of mountain farming systems. It was found in this region that *Taungya* System was an age old system, and Tai people of Yunnan in China called it Tanghai. The people were practicing cash crop plantation, like rubber. It has been developed quickly and became an important pillar of the mountain ethnic economy.⁽⁴⁷⁾

In the executive summary of Indian Council of Forestry Research & Education, the growing pressure on forests has been discussed. They have recognized the alternative and better use of bio-resources to meet the growing demands. The adverse impact of shifting cultivation has compelled the researcher for evolving suitable Agroforestry models. In the objectives and expectations of National Forestry Research Plan, they have recognized that till now no information are available on the land area under different Agroforestry models, nor on its economic performance. International forestry research organizations have prioritized Agroforestry researches under the natural resource strategies and policy, and for domestication of Agroforestry trees.⁽⁴⁸⁾

In this article the authors have shown that the impact of agroforestry is very high and positive in the sense that it generates income for the low income group. The people who practiced subsistence farming also have potential to earn more by adopting some agroforestry practices. The agroforestry practices also combat the land degradation. Several studies showed that the farmland of hill slopes of Nepal loses 8-12 tons/ha/year soils, in addition to this, the inadequate use of fertilizer decreases the fertility of the hill soils. In Thailand, the agroforestry system of eucalyptus (*Eucalyptus camaldulensis*) and leucaena (*Leucaena leucocephala*) intercropped with cassava (*Manihot esculenta*) or mungbean (*Vigna radiata*), was reported to be financially preferable to traditional monocrops (Wannawong, et al., 1991).⁽⁴⁹⁾

In this note, the past and present agroforestry of USA has been discussed briefly. As per the authors, the agroforestry is not a new concept but a new technology. It was practiced in USA since the 1900's. Russell Smith, an economic geographer at Columbia University, advocated the use of permanent tree-protected systems to maximize production on arable lands in 1914 but some political and agricultural groups opposed his ideas of radical

change in methods of food production. The Great Depression of 1930 and “Dust Bowl” spurred political leaders to reconsider current policies and support research in this area.⁽⁵⁰⁾

In this article, the author has described some pre-conditions for adopting spontaneous agroforestry practices in Vietnam. These pre-conditions are really necessary to keep in mind before introducing anything new technology. The pre-conditions for poor households to adopt any spontaneous agroforestry technology are as follows:

- ease of access to markets for the forestry products;
- benefits (economic and other) from agroforestry are higher than from alternatives;
- a viable forestry production technology is available and known to farmers;
- farmer access to sufficient areas of land and security of tenure to that land; and
- farmer confidence in being able to control risk, such as fire, pests, theft.⁽⁵¹⁾

1.4 Research Questions:

Further study will focus on these questions.

Landuse pattern changes over the years everywhere. In case of Sikkim where land is characterized by marginality, fragility and niche, it is important to study the landuse changes. It is the reflection of the entire economy. So the obvious question is - **How the land-use pattern changes over the years?**

Most of the people in Sikkim depend on agriculture for their livelihood. It is the mirror of the economy. The change in economy is reflected through the changes in livelihood patterns. So the important question arises - **How the livelihood patterns have been changed over the years?**

Till date, the study on agroforestry of Sikkim is quite inadequate. The Indian Council of Agricultural Research (ICAR) has identified some agroforestry practices but it has not been ever studied about the area of agroforestry practices in Sikkim as well as the total production. So the question is –

How far the Agroforestry practices are extended in Sikkim?

Sikkim is tiny hill state with very inadequate land for cultivation and surprisingly the economy is based on agriculture. So the study on the socioeconomic aspect is very much needed. It is also needed to study the area where agroforestry practices are present and the area where absent for comparative study. How the agroforestry plays role for economic development and could play role for future development. So the next question is - **What role can Agroforestry play in Sikkim's economy or What is the significance of agroforestry in Sikkim?**

As land is not sufficient, people produce agroforestry products and agricultural products in the same piece of land. The fodder needed for animals are produced in the agroforestry systems they practiced. They have their own system for continuous supply of fodder throughout the year without hampering the production of agroforestry. So the second question is - **What is the interrelationship between Agroforestry, Agriculture and Animal Husbandry?**

It is well known to us that all the agroforestry practices are not sustainable for various reasons. There are so many factors responsible for viable and sustainable agroforestry practices. So the next question is - **Are the existing Agroforestry practices sustainable?**

It has been discussed in many articles that agroforestry practices of Sikkim have great potential. Especially the cardamom cultivation has been given emphasis. But there are another agroforestry practices in Sikkim, which are not discussed as their legitimate importance. So the fourth question is - **What is the future potential of the Agroforestry practices in Sikkim?**

Mountain landuse system is most difficult one for its fragility, marginality and niche. It is important to model suitable landuse system in the hill of Sikkim for the integrated development of agriculture, agroforestry and animal husbandry. Whether the existing system is efficient or not is the matter of study. So the next question is - **How the integrated development programme of Agroforestry, animal husbandry and agriculture can be the more efficient land-use system in Sikkim?**

Every society has its own anthropological aspects. The agricultural as well as agroforestry system of Sikkim is obviously developed throughout the ages. Many communities came into Sikkim for their livelihood and settled there. They adopted and further accumulated the then practices and consequently developed their own practices. So it is interesting to study the following question-**What are the ethnological aspects of agroforestry?**

1.5 Research Methodology

Sikkim is a small hill state with greater land elevation ranging from 270m. to 8580m. The altitudinal differences across the state caused variation in nature in all aspects. Administratively, the state is divided into four districts, namely, North, South, East and West. These four districts belong to different altitudinal locations. It can be called a Stratum. It is assumed that in a stratum, all people are homogenous in nature. So, the sample collected proportionately from each stratum. This type of sampling is literary known as Stratified Sampling. Data is collected from each district and the place is selected on the basis of secondary data. The data on land-use for various years have been collected to analyze the change. Accordingly, the data on livelihood patterns for different years have been collected to analyze the change. The village level data of land-use is not available for all districts except North district. So, the District level data will be analyzed. It is also necessary to correlate the data of land-use and livelihood activity. The secondary data of socio-economic status of a region, demographic data and other agricultural and livestock data are being collected and analysed for such work. Suitable statistical and econometric methods will be applied for analysis.

1.6 Chapterization:

The first chapter sketches the economics of farm economy. The study concentrates on the economy as well as on its resource endowments. Importance is given to landuse and livelihood options of Sikkim, as well as that of Eastern Himalayas. Sikkim is the area of study for its distinct features of landuse, economy, agriculture and different resource endowments. The importance of agroforestry as an alternative option for livelihood is discussed using literature related to agroforestry. Different agroforestry

practices in various countries are discussed briefly to reflect the wide-use and importance of it.

The second chapter deals with the physical geography of Sikkim along with the economy of Sikkim. The climate, the riverine structure, the topography and the watersheds are briefly discussed in this chapter.

The third chapter considers the concept of livelihood in theory as well as in practice. The different aspects of agroforestry are discussed in detail with a focus on Sikkim.

The fourth chapter deals with the theory of resources. The question of efficiency is emphasized in relation to Sikkim's agricultural production. Time series data of different crop production is analysed to obtain a trend in the production of cash crops vis-a-vis traditional crops. The productivity data is also analysed to comprehend agricultural efficiency. Livestock data is also taken into consideration since it forms an integral part of the agroforestry system.

The fifth and sixth chapters are empirical chapters relying on information derived from primary survey conducted in certain villages of Sikkim. Data analysis is undertaken in these chapters to obtain answers to the research questions.

The seventh and the final chapter summarises the findings of the earlier chapters and provides policy measures that may be undertaken to improve on the existing land use system and the livelihood practices of the rural population of Sikkim.

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Chapter 2

Physical Geography, Economy and Land Use Changes in Sikkim

2.1 Physical Geography of Sikkim

The physiographical characteristics, particularly the topography, drainage system and climate shape the livelihood, economy and land use patterns of a region. The topographical features, particularly altitude and aspect in relation to sun and wind decide the habitability of a region. Along with topography, the drainage system too plays an important role in ascertaining the suitability of a place for human habitation. However, climate is the most important and decisive physical element that governs most of human activities. Livelihood and land use patterns of a place bear the distinctive stamp of the climate and the resultant natural setting of the region. The natural environment in the Himalayas still acts as a determinant of livelihood. Moreover, the options of livelihood are limited in land-locked mountain regions. The economy and land use in Sikkim are therefore primarily determined by the physical geographical attributes in the state.

The Physiography of Sikkim

The physiography of Sikkim is characterized by great variation in elevation. The land elevation in Sikkim ranges from 250m to 8500m. The state is separated from Tibetan highland by the convex arc of the Greater Himalaya. In the eastern side the Chola Range separates it from Tibet and in the west the Singalila Range, another offshoot of the Himalayan arc, separates it from Nepal. There are many peaks and passes on the three sides of Sikkim. In the Northern side the important peaks are Lhonak, Sentinel, Khora Khang etc., and important passes are Kongra La, Say Say La etc. In the Eastern sector the high altitude passes are Nathu La and Jelep La. In the Western sector there is the great Kanchenjunga (8595m.). The upper part of Tista basin includes the whole of Sikkim and virtually marks its boundary. All the major rivers of the state flow from north to south following the slope of the land. There are many glacial lakes, which

freeze during winter. The state also has some hot mineral springs, e.g. Ralong in West Sikkim and Phur Cha Chu in the South Sikkim.¹ The topography of the state does not allow human habitation beyond 4000m. The human settlement in Sikkim is generally concentrated below 3000m.

The River System of Sikkim

Tista is the only major river system in Sikkim. The drainage system of the state has a very dense network of streams contributing to the Tista. Its tributaries and sub-tributaries drain the entire state and dissect the land in such a manner that hardly any sizeable piece of level land can be found. So the entire state is divided into various parts. The Tista originates from Chho Lhamo glacial lake. The Rangit is the main tributary of Tista. The important tributaries on the right bank are the Zemu (Lachen) Chhu, Rangyong Chhu, Rangphap Chhu. On the left bank of Tista, the Lachung Chhu is the main tributary. The other tributaries on the left bank are Dik Chhu, Chhombo Chhu, Kalep Chhu, Gey Chhu, Rangpo Chhu, Rongni Chhu etc.²

The Climate of Sikkim

The climate of Sikkim changes within very short distances. As Sikkim is a mountainous state, the climatic contrasts can be felt very frequently. The altitudinal differences play the most important role in determining the weather and climate in Sikkim. The climate prevailing in the state can be classified into six types -

1. *Sub-tropical Humid*: This type of climate prevails in those areas, which are lying below 1500m amsl. In this area, the day temperature is much higher (almost 35 degree C) and the rainfall too is high. The humid period is very long from April to September. In summer months, the nights are cool because of night-shower. The winter season is cold and dry. At Namchi of South Sikkim the summer temperature is as high as 35 degree C but in winter it is as low as 6 degree C.

2. *Semi Temperate*: This type of climate can be found in the range of 1500m to 2000m amsl. The annual mean temperature in summer is 26 degree C and in winter it is 8 degree C. The mean annual rainfall is 2400mm. At Gangtok, the temperature hovers between 2 to 26 degree C and mean annual rainfall is 3500 mm.

3. *Temperate*: This climate is experienced between 2000m to 3000m amsl. Here the temperature ranges between 0 and 15 degree C. Rainfall and snowfall is medium and high. This area is cool in summer but very cold in the winter.

4. *Alpine Snow Forest*: The climate prevails in areas lying between 3000m to 4000m amsl. From November to March, the temperature is extremely low. The harsh climate renders the major part uninhabited. Rainfall occurs between May and September. At Thangu (3812m.) in North Sikkim the average annual the rainfall is only 800mm.

5. *Alpine Meadow or Tundra*: This type of climate prevails in the extreme northern, eastern and western section of Sikkim, where elevation is more than 4000m. amsl. Temperature almost all the time is close to freezing point. Atmospheric pressure is low. The summer is very short. The ground remains snow-covered for several months.

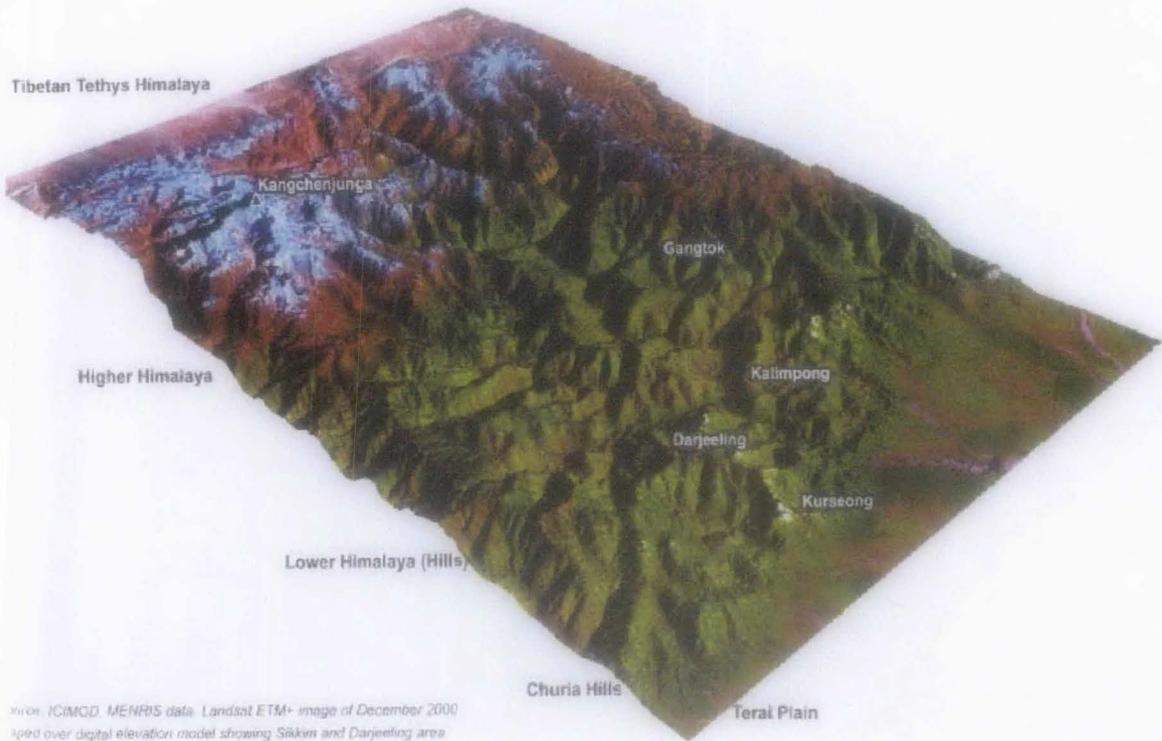
6. *Arctic*: This is experienced in the extreme northwestern part of Sikkim where elevation is more than 6000m amsl. The snow peaks like Kanchenjunga, Kabru, Talung, Pyramid etc. are located within this climatic area. No vegetation and animal life can be seen in this zone.³

The climate of Sikkim in general is cold and humid throughout the year as rainfall occurs almost every month. The state receives an average annual rainfall of 500cm, which is highest in the Eastern Himalayas. This high rainfall causes extensive soil erosion and frequent landslides in some places of Sikkim. Monsoon rain starts normally from June and continues up to early October, with pre-monsoon rains in April-May. The temperature varies with the slopes and altitudes. Maximum temperature is recorded normally in July and August and minimum temperature in December and January. During the monsoon period, the fog is a common feature of the hill weather in Sikkim. In high altitudes, the temperature goes down to freezing point several times in a year. Snowfall is quite common in high altitudes and not a rare phenomenon in the middle altitudes in the Sikkim Himalayas. As per the available data, mean rainfall is lowest in Thangu (820mm) and highest in Gangtok (3494mm). It is revealed from the iso-hyetal analysis of data that there are two maximum rainfall areas in Sikkim: 1) South-East quadrant, including Mangan, Singhik, Dikchu, Gangtok, Rongli etc and 2) South-West quadrant including Hilley. Namchi is located in between these two points, which is

low rainfall area. The North-West snow-covered area receives the least rainfall (4.9mm) but experiences regular snowfall. The rainfall during the monsoon season is heavy and well distributed. The wettest month is July in almost all places in Sikkim. The distribution of post-monsoon rainfall decreases from North to South, and the distribution is just opposite, i.e., from South to North during the Monsoon period. The average number of rainy-days (days with rain of 2.5mm or more) ranges from 100 at Thangu to 184 at Gangtok and the highest annual rainfall for the individual station exceeds 5000mm.

The soil of Sikkim contains medium nutrient and moisture. Soil moisture has an overt impact on forest type and coverage in area. The state primarily consists of gneissose rocks and half-schistose rocks. The first type of rock is brown clay and generally shallow and poor. These groups of rocks are typically crude with high ferric concentration and neutral to acidic and poor organic/mineral nutrients. Most of the evergreen and deciduous forests are carried by this rock.

Figure 2.1: Satellite Image of Sikkim Himalaya



Source: ICIMOD, MENRIS data, Landsat ETM+ image of December 2000
1990 over digital elevation model showing Sikkim and Darjeeling area.

Source: ICIMOD, Digital Elevation Model showing Sikkim and Darjeeling, 2000, www.icimod.org

2.2 Demographic Aspects of Sikkim:

The demographic parameters taken into consideration for the present discussion are the total population, population density, FMR (Female Male Ratio), IMR (Infant Mortality Rate), Birth Rate, Death Rate etc., which reflect the health of the human resources of an area. FMR means number of women per thousand men. IMR means the number of deceased infants per thousand children. Birth rate means the number of people born per thousand people. Death Rate means the number of deceased persons per thousand people.

The state of Sikkim experienced enormous demographic changes in the last hundred years or so. Though the density of population always remained low in the state due to its mountainous territory and poor accessibility, some major changes occurred in the

demographic map of the state after its merger with Indian union in 1975. The following table shows the changes in Sikkim's population, sex ratio and density over time since 1891.

Table 2.1: Temporal Changes in Population, Sikkim, 1891-2001

Year	Total Population	FMR	Population Density/ Sq. km.
1891	22152	912	-
1901	59014	709	8
1911	87920	951	12
1921	81721	970	12
1931	109808	967	15
1941	121520	935	17
1951	137725	907	19
1961	162189	904	23
1971	209843	863	30
1981	316385	835	45
1991	406457	878	57
2001	540493	875	76

Source: Census of India, 1981, 1991, 2001

As seen from the Census records, in the first Census i.e., in 1891, the population of Sikkim was only 22152 and then the FMR was 912. After 10 years, i.e. in the 2nd Census, the number of population increased almost 2.8 times but the FMR decreased to 709. The population density was lowest ever with 8 persons living in a sq. km of area in 1901. In 1921, the population decreased by almost 6000 than in 1911 but with the same population density (12 persons/sq. km.) and highest ever FMR at 970. Since then to 1971, i.e. at the time of the last pre-merger census, the population as well as density increased but there was a fall in FMR. The post merger census of 1981 showed lower

FMR at 835. But during this period, the population increased largely with the addition of more than one lakh people. The population density was 1.5 times more than the previous census. In 1991, the decennial rise in population was slower than the previous increase but the rise in FMR was quite remarkable. The last census in 2001 has shown that the population in the state has increased sharply with the addition of 1.3 lakh more people than the 1991 population total and taking the total population of the state to 540,493. The population density too rose to 76 persons per sq. km. But the increase in population was not reflected in the FMR as it lowered to 875 compared to the 1991 FMR 878.

Table 2.2: Decennial Population Growth Rate of Sikkim vis a vis India

<i>Census Year</i>	<i>India</i>	<i>Sikkim</i>
1901	NA	NA
1911	5.75	48.98
1921	(-)0.31	(-)7.05
1931	11	34.37
1941	14.22	10.67
1951	13.31	13.34
1961	21.51	17.76
1971	24.8	29.38
1981	24.66	50.77
1991	23.85	28.47
2001	21.51	33.06

Source: Census of India, 1951, 1961, 1971, 1981, 1991, 2001

The decennial growth rates of the population of Sikkim as well as India are given in the above table. In 1921, the decennial growth rate was negative for Sikkim as well as for India. It happened presumably due to the epidemic of influenza that gripped the country in the previous decade. But in 1911, the growth rate was second highest in case of Sikkim. The highest growth rate was in 1981 due to the merger of Sikkim with India in 1975. The highest growth rate in India was in 1971 which happened due to the creation of Bangladesh. In this period, there was a huge influx of refugees to India from Bangladesh. The decennial growth rate became slower after 1981. In 1991, it was 28.47% and in the last census i.e., 2001, it was 33.06%.

Table 2.3: Comparative Table of Birth Rate, Death Rate & IMR

<i>Year</i>	Birth Rate		Death Rate		IMR	
	<i>India</i>	<i>Sikkim</i>	<i>India</i>	<i>Sikkim</i>	<i>India</i>	<i>Sikkim</i>
1997	27.2	19.8	8.9	6.5	71	51
1998	26.5	20.9	9	6.1	72	52
1999	26.1	8.7	8.7	5.8	70	49
2000	25.8	21.8	8.5	5.7	68	49
2001	25.4	21.6	8.9	5.1	66	42
2002	25	21.9	8.1	4.9	64	39
2003	24.8	21.9	8	5	60	33

Source: Sample Registration System, GOI

In the above table, the comparative figure of birth rate shows that the national average is always much higher than the Sikkim average. But it is to be noted that the national average decreased every year, whereas the figure for Sikkim increased and stabled at around 21 since 2000. The death rate is also much lower in case of Sikkim than the national average. In the above table it is found that the national highest was 9 in 1998, whereas in Sikkim, the highest was at 6.5. In case of Infant Mortality Rate (IMR), the figure is much lower than the national average. During the period from 1997 to 2003, the highest IMR in India was 71 in 1997, and in case of Sikkim the highest was 51 in 1997. In 2003, the IMR was 60 in case of India, but in case of Sikkim, it was 33. Thus it can be concluded from the comparative table that the health condition in the state is better than the national standard.

2.3 Economic Aspects of Sikkim

Sikkim is not known to have a robust economy. In the early nineties the per capita gross domestic product in the state was marginally below the all India average. But, since 1999-2000, the state performed better than the all India average. It indicates that

the state economy is growing rapidly since early nineties. It might have happened due to high income from the cash-crops and horticultural crops. The fact is also true for per capita net state domestic product. The following table shows the per capita gross state domestic product in rupees.

Table 2.4: Per Capita Gross State Domestic Product (GSDP) at Constant Prices

(in Rupees)

<u>Year</u>	<u>India</u>	<u>Sikkim</u>
1993-1994	8759	8457
1994-1995	9209	8045
1995-1996	9693	8592
1996-1997	10253	9200
1997-1998	10541	10099
1998-1999	11018	10866
1999-2000	11471	11592
2000-2001	11757	12070
2001-2002	12215	12615

Source: CSO, GOI & ESSME, GOS

Table 2.5: Net State Domestic Product and Per Capita Income at Constant Prices(1980-81) in Sikkim

Year	Domestic product (in thousand Rs.)	Annual Growth Rate	Per capita income (Rs.)	Annual Growth Rate (%)
1980-81	489800		1571.00	
1981-82	521900	6.55	1611.00	2.55
1982-83	588200	12.7	1750.00	8.63
1983-84	614200	4.42	1758.00	0.46
1984-85	694600	13.09	1919.00	9.16
1985-86	755900	8.82	2017.00	5.11
1986-87	891700	17.96	2297.00	13.88
1987-88	1075500	20.61	2678.00	16.59
1988-89	1149000	6.83	2924.00	9.19
1989-90	1228900	5.51	3118.00	6.63
1990-91	1353200	10.11	3369.00	8.05
1991-92	1442900	6.63	3492.00	3.65

Source: Sikkim Human Development Report, 2001

It can be seen from the above table that the annual growth rate of net state domestic product was positive, sometimes with double digits. The highest growth was during 1987-88. The per capita income was also higher since that time and it became highest (Rs.3492/-) in 1991-92. There was a continuous growth from 1986-87 to 1987-88, as a corollary to the growth in per capita income. It appears that there was an increase in

agricultural production including cash crops like large cardamom during that time, which boosted up the hill economy.

To discuss the economic aspects in detail, it is necessary to know the current position of the state in terms of poverty. Generally, the people of mountain area are at comparative disadvantage as far as the sources of income are concerned. There are a variety of reasons that might be responsible for poverty, e.g, limited livelihood opportunity due to marginality, fragility and niche. The low productivity of crops due to absence of irrigation, less fertile soils, less opportunity to use fertilizer etc. make the life of an average farmer in a hilly terrain difficult. Further, the inaccessibility or lack of communication aggravates the problem. So, there is a direct relation between poverty and mountain around the globe. Sikkim is no exception and here too, the common people face a myriad problem due to inhospitable terrain and climate. More than 60% of the total geographical area of the state is not suitable for human habitation. A major part of the state is either inaccessible or has very poor connectivity. Although there is a decline in the percentage of people living below poverty line (BPL), the reality is, the total number of BPL people in the state is alarming. The table below shows the percentage of BPL people in the state in the year 1999-2000 at 36.55, which makes it clear that more than a third of the state's population lives miserably.

Table 2.6: People Below Poverty Line (in %):

<u>Years</u>	<u>All India</u>	<u>Sikkim</u>	<u>Ranking</u>
1973-74	54.88	50.86	16th
1977-78	51.32	55.89	9th
1983	44.48	39.71	15th
1987-88	38.86	36.06	14th
1993-94	35.97	41.43	5th
1999-2000	26.1	36.55	4th

Source: Sample Registration system, GOI

The above table shows the percentage of people living below poverty line. In 1973-74, the position of Sikkim was slightly better than the all India figure. Then Sikkim was an independent state. After the merger of Sikkim with India in 1975, the condition of Sikkim worsened. But, later in 1980s, the number of BPL people decreased in Sikkim. 1990 onwards, the all India figure fell rapidly, but in Sikkim, it increased in 1993-94 and decreased subsequently. But the fall is not satisfactory at all in respect of all India figure.

The economic activities in Sikkim are mainly centered on agriculture and allied activities. Agriculture has the highest contribution to the economic well-being of the state. But, the industry and service sectors also have some contribution. The table below shows the structural change in the Sikkimese economy.

Table 2.7: Structural Shift in the Sikkimese Economy

<u>Sectors</u>	<u>1980-81</u>	<u>1985-86</u>	<u>1990-91</u>	<u>1995-96</u>
Primary	51.59	50.96	46.49	52.03
Secondary	18.10	16.45	12.97	13.65
Tertiary	30.30	32.58	40.53	34.31

Source: Govt. of Sikkim (1998), Sikkim Five Year Plan 1997-2002, Volume-1 and Sikkim in Brief 1998, Bureau of Economics and Statistics, Planning and Development Department, Gangtok

In the above table it is clear that the contribution of primary sector has increased marginally since the merger of Sikkim with India. But, during mid-eighties to early nineties, the contribution decreased marginally. The contribution of secondary sector is decreasing every year. In case of tertiary sector, the contribution increased substantially in 1990-91, and in this period, the role of primary and secondary sector slowed down. Since mid-eighties, the economy of Sikkim followed the same path of dominant primary sector. The service sector is growing every year since the merger of Sikkim with India.

The following table is important to understand the current position of the state in terms of food security.

Table 2.8: Per Capita Availability of Food Grains in Sikkim from 2002-03 to 2003-04

Particulars	Unit	2002-03	2003-2004
Total food production in state	000 Tonnes	97.07	99.34
Food grain for other purpose			
a) Post harvest milling and shortage@15%	000 Tonnes	14.4	14.9
b) Use as beverage@25%	000 Tonnes	24.08	24.84
c) Use as animal feed @23.5%	000 Tonnes	23.64	23.34
d) Use as material for seed, ritual, sale, industries etc@2.5%	000 Tonnes	2.41	2.48
e) Total food grain available for other purpose	000 Tonnes	63.53(66%)	65.56(66%)
Food grain available	000 Tonnes	32.80(34%)	33.78(34%)
State population	Lakhs	5.58	5.77
Floating and migrant population	Lakhs	1.18	1.23
Per capita availability of food grains per day	Grams	153	158
Food grain requirement @ 500gms per day			
a) For state population	000 Tonnes	101.84	105.3
b) For floating and migrant population(92days)	000 Tonnes	5.43	5.66
c) For overall population	000 Tonnes	107.26	110.96
Deficit food grain	000 Tonnes	74.76	77.18

Source: Area and Food Production Statistics of Sikkim 2003-04, GoS, Gangtok

In India, 417gm of food grain per head per day was required during 2001-02 according to the data available in agricultural dept. But, per capita food grain available per day in Sikkim was 153gm in 2002-03 and 158gm in 2003-04. This marginal increase happened due to increase in production from 97.07 thousand tonnes to 99.34 thousand tonnes. As population increases every year and huge number of tourists visit Sikkim, the food requirement for consumption increases every year. The deficit in food grain has increased from 2002-03 to 2003-04. The shortfall in food

grain is substantial and necessitates food grain import from other states to meet up the local demands.

Table 2.9: Comparative Figure of Industries in Sikkim from 2000-2004

Particulars	No. (2000)	No. (2004)
Provisionally Registered	386	320
Small Scale Units	367	367
Permanently Regd. SSU	Na	363
Cottage Industries	36	36
Medium Scale Industries	3	3
PSUs	3	3
Joint Sector Undertaking	Na	Na
Non-functioning Units	87	87

Source: Sikkim: A Statistical Profile 2002, 2004-05, DESME, GoS,

The growth of industrial sector in Sikkim is not good. It is found from the above table that there was a decrease in the provisionally registered industries from 386 to 320. The number of SSU, Cottage Industries, PSUs and Small Scale Units remained unchanged. Thus, it is clear from the above table, that, the industrial growth was stagnant since 2000.

2.4 Land use pattern - Determining livelihood options

Land is the habitat of man and its wide use is crucial for the economic, social, and environmental advancement of mankind. Although it is part of man's natural heritage, access to land is controlled by ownership patterns. Land is partitioned for administrative and economic purposes, and it is used and transformed in a myriad ways. Population growth, technological and social hazards, and environmental degradation are all to be taken into greater account today by policy makers, resource

planners, and administrators who make decisions about the land. They need more detailed land information than has been traditionally available.⁴

Land use of an area is a reflection of the importance of its physiographic conditions, socio-cultural characteristics and politico-historical background because land use characteristics are the results of and land use practices are directly influenced by these attributes of land. The available land resources and their utilisation that show an interactive nature of man with the nature is, therefore, related to the physical and socio-economic conditions of land. [Vink 1972, Singh 1995] Thus, a systematic and regional description of land use patterns has a great significance and the changing nature of land use practices is able to explain the causes of increasing intensity of resource use and changing relationship of man's activities with nature. According to various classical as well as neo-classical theories of land use, the land use practices are influenced by the socio-economic factors like locational factors of land use (economic rent, market access, availability of modern agricultural inputs and transport costs) and social customs and traditions of landholders, tenancy status and the consumption patterns of the farming communities, at micro-aerial scale, but at macro-level the land operations and land use intensifications accelerated by physical factors of land, namely, the relief features, geological structure, soil characteristics and climatic conditions. [McCarty & Lindbarg 1967]

As Sikkim is an agricultural region, the economic wellbeing of its population has a close relation with the current state of agriculture in the state. With considerable variation in physiographic and agro-climatic conditions in the four districts, crop yield and cropping intensity vary considerably from district to district. In Sikkim, the state of regional agriculture depends primarily on the availability of arable lands and the productivity.

Table 2.10: Per Capita Land Availability in Sikkim

Particulars	1971	1981	1991
Net Cultivable Land	0.31	0.31	0.24
Operational Area for Agricultural Use	0.8	0.34	0.27
Land for Non-Agricultural Use	0.33	0.27	0.21
Pastures and Cultural waste	0.4	0.23	0.18
Forest	1.26	0.83	0.65

Source: Bureau of Economics and Statistics, GoS, Sharma and Sharma, 1997

The above table shows the per capita land availability in Sikkim since 1971. It is a matter of great concern that the per capita forest land has decreased substantially from 1.26 ha in 1971 to 0.65 ha in 1991. The operational area for agricultural use too has decreased almost one-fourth from 1971 to 1991. The net cultivable land has decreased marginally compared to others. The same is true for land in non-agricultural use and pastures and cultural waste. It happened because the increase in population necessitated transformation of land from agricultural use to other uses.

Table 2.11: Changes in Land Utilisation Pattern, 1976-77 to 1990-91(Ha)

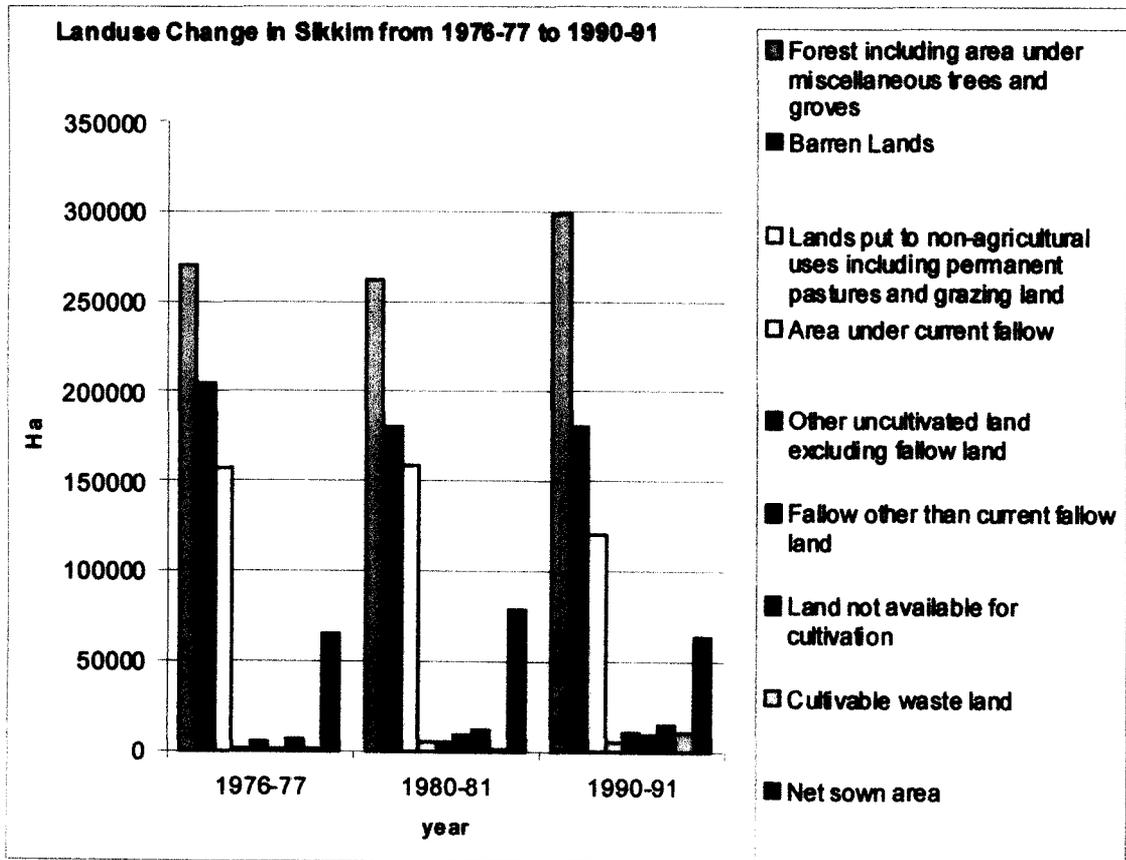
<i>Particular</i>	<i>1976-77</i>	<i>1980-81</i>	<i>1990-91</i>
Total Geographical Area	709600(100.00)	709600(100.00)	709600(100.00)
Forest including area under miscellaneous trees and groves	269380(37.96)	261983(36.92)	298000(42.00)
Barren Lands	204010(28.75)	180250(25.40)	180000(25.37)
Lands put to non-agricultural uses including permanent pastures and grazing land	157148(22.15)	158299(22.31)	120299(16.95)
Area under current fallow	501(0.07)	4428(0.62)	3906(0.55)
Other uncultivated land excluding fallow land	4925(0.69)	4560(0.64)	10830(1.53)
Fallow other than current fallow land	944(0.13)	9474(1.34)	9204(1.30)
Land not available for cultivation	6613(0.93)	11604(1.64)	14300(2.01)
Cultivable waste land	1153(0.16)	681(0.09)	9807(1.38)
Net sown area	64926(9.15)	78321(11.04)	63254(8.91)

Source: Sikkim State Annual Plan, 1996-97, Vol.I, Planning and Development Department, GoS, Gangtok

There are nine different categories of land use in the state of Sikkim, these are – a) Forest, b) Barren Land, c) Pasture and Grazing Land, d) Current Fallow land, e) Uncultivated Land excluding Fallow, f) Fallow other than Current Fallow, g) Land not available for Cultivation, h) Cultivable Waste Land and i) Net Sown Area.⁵ It is found from the above table that the net area sown has increased in 1980-81 by almost 2% but decreased subsequently by almost 2.5%. The cultivable wasteland has decreased greatly in 1980-81 but increased after that. The fallow land other than current fallow has increased enormously from 944 ha to 9204ha and also the area under current fallow has increased enormously. Thus, the total land that could be

brought under use increased during this period but it was not utilized for production. The problem of proper land use management system was persisting in Sikkim during that period. The land under forest cover was almost 38% in 1976-77. It tended to decrease just after merger with India. Subsequently, the area again increased to 42% in 2001 as a consequence of the measures taken by the govt.

Figure 2.2: Landuse Changes in Sikkim from 1976-77 to 1990-91



Source: Sikkim State Annual Plan, 1996-97, Vol.I, Planning and Development Department, GoS, Gangtok

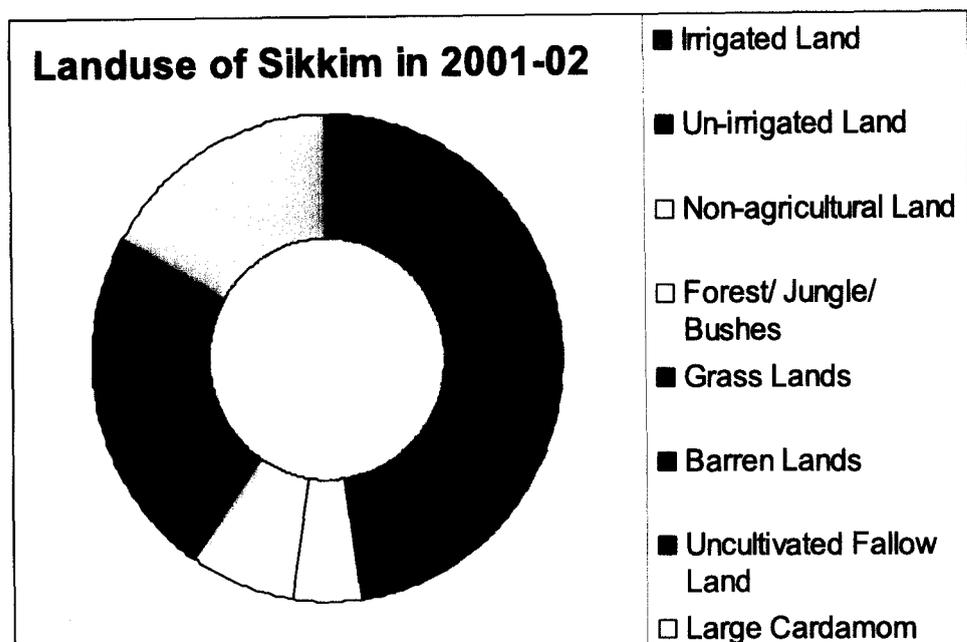
Table 2.12: Land-use Data of Sikkim in 2001-2002

<i>Land-use Types</i>	<i>Lands in 000Ha</i>	<i>Percentile</i>
Irrigated Land	11.31	9
Un-irrigated Land	49.31	38
Non-agricultural Land	6.22	5
Forest/ Jungle/ Bushes	8.98	7
Grass Lands	17.34	14
Barren Lands	4.12	3
Uncultivated Fallow Land	8.54	7
Large Cardamom Plantations	21.22	17
Total	127.04	100.0

Source: Sikkim: A Statistical Profile 2004-05, DESME, Govt. of Sikkim

The land use pattern of Sikkim during 2001-02 shows that more than 1/3rd of the total land (49331.04 ha.) remained un-irrigated. Almost 1/5th of the total land was under large cardamom cultivation, the main agroforestry product, followed by the forest/jungle/bushes (14403.5 ha). The combined figure of Barren Lands and Uncultivated Fallow Land was quite high. The land suitable for irrigation was almost 1/11th (9%) of the total land. So, the pressure on agricultural land was increasing day by day as population increased. The unirrigated land (38%) and forest land (7%) both were under forest cover in previous years' land use category.

Figure 2.3: Landuse of Sikkim 2001-02



Source: Sikkim: A Statistical Profile 2004-05, DESME, Govt. of Sikkim

Table 2.13: District-wise Land-use pattern of Sikkim, 2001-02

Particulars	State Total (ha)	North(%)	South(%)	East(%)	West(%)
Irrigated land	11309.6	12.3	19.2	48.2	20.4
Un-irrigated land	49308.6	7.6	33.2	23.5	35.8
Non-agricultural Use	6224.3	30.5	25.9	30.0	13.6
Forest/Jungle/Bushes	14403.5	6.6	10.1	68.5	14.8
Grass Land	4118.3	1.7	31.2	35.4	31.7
Barren Land	8981.0	11.5	26.6	28.3	33.6
Uncultivated fallow land	8543.2	12.1	7.5	11.7	68.7
Cardamom field	24161.3	37.1	18.2	27.1	17.5

Source: Adapted from Sikkim: A Statistical Profile 2004-05, DESME, GoS, Gangtok

The percentage share of irrigated land (48.2%) is highest in the East district, followed by West district (20.4) but with huge difference. North district has smallest share of cultivable land but with highest share of cardamom field (37.1%). The East district has highest share of forest area with 68.5% followed by the West District. The West district has highest barren and uncultivated fallow land which amounted to 33.6% and 68.7% respectively. This district also has highest percentage of un-irrigated land (35.8%). As the major part of the North district remains under snow cover for months, the land under non-agricultural use is highest in this district (30.5%).

It has been reported in the state of forests in the Survey of Environment 2001, published by The Hindu “It is only the ‘Culturable Wastelands’, covering 13.94 million hectares and part of the ‘Fallow land other than current fallow’, covering 9.89 million hectares, which seem to be potential areas on which forest cover can be expanded through afforestation. In addition, efforts will have to be made to raise trees outside conventional forest areas through innovative Agroforestry programmes.”⁶

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Chapter 3

Changes in Livelihood Patterns

3.1 Different forms of Livelihood:

According to dictionary, Livelihood is “means to living”. According to Chambers and Conway (1992:7) - “Livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required to for a mean of living.” This definition directs the link between assets and options people possess in practice to pursue alternative activities that can generate income level required for survival. The followers of Chambers and Conway have identified five main categories of capital contributing to assets in livelihood, which are as follows: i) Natural Capital, ii) Physical Capital, iii) Human Capital, iv) Financial Capital and v) Social Capital.

- i) *Natural Capital*: It refers to the natural resource base (land, water, trees) that yields products for the use of human survival.
- ii) *Physical Capital*: It refers to assets, which are essential for economic production process, e.g. tools, machines, terraces in mountains for cultivation and irrigation canals etc.
- iii) *Human Capital*: It refers to education level and health status of population.
- iv) *Financial Capital*: It refers to stock of cash to purchase production and consumption of goods.
- v) *Social Capital*: It refers to the social networks and associations in which people participate for deriving support for livelihoods.

The definition of livelihood has been formulated in a most comprehensive way as follows:

“A livelihood comprises the assets (the natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social

relations) that together determine the living gained by the individual or household".
[Frank Ellis]

But the elements cannot assume to be fixed. Rather available activities fluctuate seasonally and across the year. At present, in developing countries, the characteristic of rural livelihood is to adapt in order to survive. The shifting norms and events in the social and institutional context surrounding their livelihoods compel the individual household to change the access to resources and opportunities.

The terms livelihood and income are not synonymous, rather income of an individual, at a given point of time, is the most direct and measurable outcome of the livelihood process. Livelihood is the way to generate income for living. Income consists of both cash and in kind contributions to the material welfare of the household deriving from the set of livelihood activities in which wages, rents and remittances are the components of cash income; and consumption of own-farm produce, payments in kind, and transfers or exchanges of consumption items are the components of in-kind income.

It is also important to know the difference between farm income, off-farm income and non-farm income.

Farm Income: The income generated from own account farming whether on owner occupied land or in tenant land. Broadly, it includes livestock income, crop income, consumption income of own-farm output as well as cash income obtained from output sold.

Off-farm Income: It typically refers to wage or exchange labour on other farm within agriculture. It includes labour payment in kind (either may be as harvest share system or other non-wage labour contracts). It may include the income obtained from local environmental resources such as firewood, charcoal, house-building materials, wild plants etc.)

Non-farm Income: It refers to non-agricultural income sources. It may include the followings - a) Salary income, b) Business income, c) Rental income, d) Urban to rural remittances, e) Pension payment and f) International remittances.

According to Frank Ellis, “Rural livelihood diversification is defined as the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living.”

The evolution of rural livelihoods can be described by three main groups of theories, namely, agricultural development, political economy and population and technology theories.

The evolving role of agricultural sector to the development process has been described by the Agrarian Development Theories. The dual economy approach (Lewis, 1954; Fei and Ranis, 1964) envisaged no prospects for rising productivity in so called traditional agriculture, which could only therefore passively supply resources to the modern sector of the economy until the latter eventually expanded to take its place. Later models retained the core idea that agriculture would decline in its share of GDP as development process, as in the history of the industrialized countries.¹

In 1970, the central focus of agricultural development was the achievement of rising productivity in small-farm agriculture and it remained the orthodoxy well into the 1990.

[Tomich et al., 1995]

The main livelihood activities in mountain areas are terraced agriculture, paddy farming and cash cropping, grazing, fishing, tourism, shifting cultivation, agroforestry etc. Thus the main source of livelihood revolves around agriculture. According to one study, livelihood of majority of the mountain people in the Hindukush Himalayan (HKH) region countries (Nepal, Bangladesh, Bhutan, Pakistan, India, China, Myanmar and Afghanistan) revolves around agriculture. In the HKH countries, a population of about 150 million inhabitants lives in an area of 3.4 million sq. km, with about 35 persons/sq.km. The actual pressure on sloping hills and mountains on the agricultural land is much greater in terms of food security and livelihood of the mountain people (Pratap, 2001).

Mountain area has various constraints in the way of maintaining livelihoods. Almost all the mountain area has limited livelihood options than in the plains. Common

livelihood options prevailing in the mountain area are: terrace cultivation, forestry, service, petty trade, livestock rearing, plantations, cottage industries and tourism etc. In Sikkim, the main livelihood options are – crop cultivation, large cardamom plantation, livestock, agricultural labour, non-agricultural labour, service and business/shop and of late, tourism. Terrace cultivation is practiced in all the four districts. Though crop productivity is not so good in Sikkim Himalaya, most of the people in this state depend on agriculture for their livelihoods. Plantation is another important means of livelihood. In Sikkim, various plantation activities are possible, e.g., of tea cultivation and processing, large cardamom cultivation and processing, mandarin orange, plum, pear and peach growing and packaging, etc. Large cardamom is the most important plantation crop in Sikkim. Livestock rearing is also an important livelihood option in Sikkim. It has both domestic and business aspects. Mainly pig, sheep, buffalo, cow, yak, poultry etc are reared in this area. The service sector has second largest contribution for the livelihoods of the Sikkimese. People working at state or central govt. offices, teachers, doctors etc. fall in this sector. Many people maintain their livelihoods through trading and female participation is quite good in this field.

Agriculture: As can be expected, agriculture is the main livelihood in Sikkim. More than fifty percent people of Sikkim depend primarily on agriculture to earn a living. Though mountain areas have many constraints, the population pressure has compelled the people to plough intensively by way of terrace farming. As flat piece of land is hardly available, people practice terrace farming on mountain slopes having moderate slope. In the pre-merger period, the state was much backward economically and more than 90% people depended on agriculture to maintain their livelihood. But, in post-merger period, the dependency declined to 52%. The people were primarily practicing cereal crop-based farming before 1975. Subsequently they have adapted certain cash crops.

Agricultural Labour: This livelihood option is not as widespread as in the plains, because, there are many constraints of agriculture and labour is a high priced commodity in the mountains. Most of the farm owners work in their own land for to raise crop.

Large Cardamom Plantation: Growing cardamom in small plantations and in forested areas is an age-old livelihood activity of the indigenous tribes of Sikkim. Most of the rural people grow cardamom to supplement their livelihoods. Larger plantations were created much later by wealthy indigenous farmers owing to high profitability and cash rewards brought home by exporting the crop. It is widespread throughout the state, particularly in humid forest areas. Large cardamom is also the main commercial crop in Sikkim. The state is the largest producer of this spice.

Livestock Rearing: The congenial temperate climate and sub-alpine vegetation in the Himalayas are highly favorable for exotic high producing livestock. The highlanders like Lachungpas, Lachenpas, Gurungs and Sherpas of Sikkim have a traditional pastoral economy which has been handed over from generation to generation with their typical kinds of livestock such as Yaks, sheep, mountain goats, pigs and poultry. With the increase in population and the limited availability of land (as 70% of the holding in Sikkim is smaller than 2 hectares) there is already great pressure on the cultivable land and forest and on the environment as well. Many farmers are complaining about the change in environment and decline in soil fertility. Under such situation livestock farming which requires minimal use of land, labour and capital would be ideal sustainable model for development in such difficult mountainous terrain. At present almost 70% of the farmers rear their livestock under stall fed condition and has drastically reduced pressure on land due to overgrazing.

The development of livestock would not only provide supplementary source of income but would provide high protein rich food items such as milk, eggs and meat and organic manure for crop production.²

Forestry

The land cover under forestry was always high in Sikkim. This forest is the hotspot of tremendous biodiversity with 4500 flowering plants, 515 orchids, 36 rhododendrons etc. The latest data of forest land as found from the Forest Survey of India (FSI), State Forestry Report 2003, has shown that the dense forest covered area has declined 29 sq.km., whereas the open forest area has increased 98 sq.km. and scrub area cover has increased also up to 19 sq.km. It can be concluded from the following table that the decrease in non-forest area came under the forest area, which was consequence of the

measures taken to conserve the forest area for environmental aspects. Since most of the forests in Sikkim are protected, people cannot maintain their livelihood depending only on forestry. However they supplement their resources by collecting various forest products, such as, firewood, fruits, roots, resin, etc.

Table 3.1: Sikkim Forest Cover Change from 2001-2003(Sq.Km.)

Category	2001	2003
Dense Forest	2391	2362
Open Forest	802	900
Scrub	341	360
Non-forest	3562	3474
Total	7096	7096

Source: Forestry Survey of India, 2003, Dept. of Forests, Gol

Tourism: The most upcoming economic activity in Sikkim is tourism. Nowadays, it is very important livelihood opportunity open to the people of the mountains like Sikkim Himalaya. The very rich natural and cultural heritage of Sikkim and scenic beauty of the hills make this small Himalayan state in Northeastern India an attractive destination for international and domestic tourists. With over 90,000 domestic and 6,000 international tourists in 1995, tourism is rapidly becoming an important livelihood activity for the Sikkimese people.

3.2 Workers

According to Census of India, “work” is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. It even includes part time help or unpaid work on farm, family enterprise or in any other economic activity. All persons engaged in 'work' as defined above are workers. Persons who are engaged in cultivation or milk production even solely for domestic consumption are also treated as workers. Reference period for determining a person as worker and non-worker is one year preceding the date of enumeration. The workers are further sub-divided into

Main Workers, Marginal Workers, Cultivators, Agricultural Labourers, Household Industry Workers and Other Workers.

Main Workers:

Those workers who had worked for the major part of the reference period (i.e. 6 months or more) are termed as Main Workers.

Marginal Workers:

Those workers who had not worked for the major point of the reference period (i.e. less than 6 months) are termed as Marginal Workers.

Cultivators:

The land owned or held from govt. or from private persons/institutions for payment in money, kind or share and cultivated by a cultivator. The effective supervision or direction in cultivation is included in the cultivation activity.

But, if a piece of land is given out to another person or persons or institution for cultivation in exchange of money, kind or share and not directly supervised by or directed by the owner of the land, then the persons are not treated as cultivators, rather they will be treated as agricultural labourer.

The plantation of tea, coffee, rubber, coconut, betel-nuts etc are not included in cultivation. It involves ploughing, sowing, harvesting and production of cereals, millet crops such as wheat, paddy, jowar, bajra, ragi etc and other crops such as sugarcane, tobacco, ground-nuts, tapioca and pulses, raw jute and kindred fiber-crop, cotton, cinchona and other medicinal plants, fruit growing, vegetables growing or keeping orchards or groves etc.

Agricultural Labourers:

The agricultural labourer has no risk in the cultivation, but simply works on another person's land for wages. They have no right of lease or contract on land on which they work.

Household Industry Workers:

The industry conducted by one or more members of the household at home or within village in rural areas and only within the boundaries of the house where the household lives in urban areas, is called household industry. Most of the workers in this industry consist of members of the household. These are not registered under the Indian Factories Act. The participation of one or more members of a household is the main criterion of a household industry even if the industry is not located in home or in the village. The household industry is not prominent in the area of organized industry in any urban area. The industry should be located within the boundaries of the house in the urban area, otherwise it will not be considered as household industry. It relates to production, processing, servicing, repairing or making and sometimes selling of goods. But, it does not include professions such as a Pleader, Doctor, Musician, Dancer, Waterman, Astrologer, Dhobi, Barber, etc., or merely trade or business, even if such professions, trade or services are run at home by members of the household.

Other Workers:

The workers that are not included in the category of Agricultural Labourer or Household Industry Workers but engaged in the economic activity during last one year are known as Other Workers. It includes all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport, banking, mining, construction, political or social work, priests, entertainment artists, etc.³

Keeping in mind the earlier classification of workforce and the various livelihood opportunities available in Sikkim, the data of various workforce participation since 1971 to 2001 have been shown in the following table to graph the change of the participation.

Table 3.2:**Work Force Participation in Sikkim since 1981 to 2001**

Items	1971	1981	% Change	1981	1991	% Change	1991	2001	% Change
Population	209843	316385	50.8	316385	406457	28.5	406457	540851	33.1
Total Workers	111609	152814	36.9	152814	168721	10.4	168721	263043	55.9
Main Workers	111609	147436	32.1	147436	164392	11.5	164392	212904	29.5
a) Cultivators	NA	88610	NA	88610	97834	10.4	97834	101200	3.4
b) Agricultural Labourers	NA	4887	NA	4887	13793	182.2	13793	9081	-34.2
c) Worker in HHIndustry	NA	1586	NA	1586	1309	-17.5	1309	3168	142
d) Other Workers	NA	52353	NA	52353	55785	6.6	55785	99455	78.3
Marginal Workers	NA	5378	NA	5378	4329	-19.5	4329	50139	1058.2
Non Workers	98236	163571	66.5	163571	237736	45.3	237736	277808	16.9

Source: Adapted from Census of Sikkim and India, 1971, 1981, 1991 and 2001, GoI, New Delhi

The above table shows the broad categories of work-force participation in different censuses of Sikkim. Sikkim became the member of Indian Union in 1975. So, the workforce details were not available in the 1971 census. The detailed data were available in 1981, 1991 and the latest census of 2001. In the decade after the merger of Sikkim with India, the population of Sikkim increased by 50.8 percent. The number of total workers increased by 36.9 percent, but the increase in non-workers was alarming (66.5 percent). The main workers also increased by 32.1 percent. The high growth of population and high growth of non-workers was due to the merger of Sikkim with India. Many people from various parts of the country and even from Nepal came to Sikkim in search of livelihoods.

The second decennial change in population was smaller (28.5 percent) compared to the previous one. The rate of growth of non-workers too slowed down. By that time Sikkim already had substantial increase in total workforce. In that decade, there was 11.5 percent increase in main workers and a very high rate of growth was registered in the category of agricultural labourers, which was 182.2 percent. The most unusual change was seen in case of household industry and marginal farmers. In both the cases, the change was negative. But, during this period the rate of growth of non-workers (45.3 percent) was much higher than the rate of growth of main workers (11.5 percent). This gap proves that the unemployment rate was pretty high during that period.

During the last decade, the rate of growth of population was higher than in the previous decade. But the absorption of the workforce was mainly in 'other workers' category. The rate of growth in cultivators was much lower than the previous decade, which reflects the fact that the agricultural sector was saturated. People supplemented their livelihood by working in marginal work category. The non-agricultural activity e.g., household industrial work too increased substantially.

Table 3.3: District-wise Comparative Workforce Participation (1991-2001)

District	Area (km ²)	Main Workers		Marginal workers		Non-workers		Cultivators		Agricultural Labourers	
		1991	2001	1991	2001	1991	2001	1991	2001	1991	2001
North	4226	42.9	42.83	1.23	14.78	55.87	42.39	46.25	38.82	14.95	8.87
South	750	41.8	43.55	0.98	9.49	57.22	46.96	70.79	69.57	5.12	3.83
East	954	37.14	37.77	1.37	9.94	61.49	52.29	39.27	32.5	8.4	6.92
West	1116	44.32	36.67	0.54	6.46	55.14	56.87	77.41	67.3	7.29	7.69

Source: Sikkim: A Statistical Profile 2002, DESME, Govt. of Sikkim, Gangtok

The North district of Sikkim, with an area of 4226 sq. km, covers more than fifty percent area of the state. But, most of the area is uninhabited because of high altitude and very low temperature. In 1991, more than half (55.8 percent) of the population was non-workers and 42.9 percent was main workers. Very few (1.23 percent) were marginal workers. In 2001, the number of marginal workers has increased substantially, accounting for 14.7 percent while the number of non-workers decreased to 42.3 percent. It might happen that many people have got the opportunity to work for less than 180 days in a year during the decade.

It is also to be noted that the number of agricultural labourers and cultivators have reduced remarkably, which indicates that, peoples were absorbed marginally in other works.

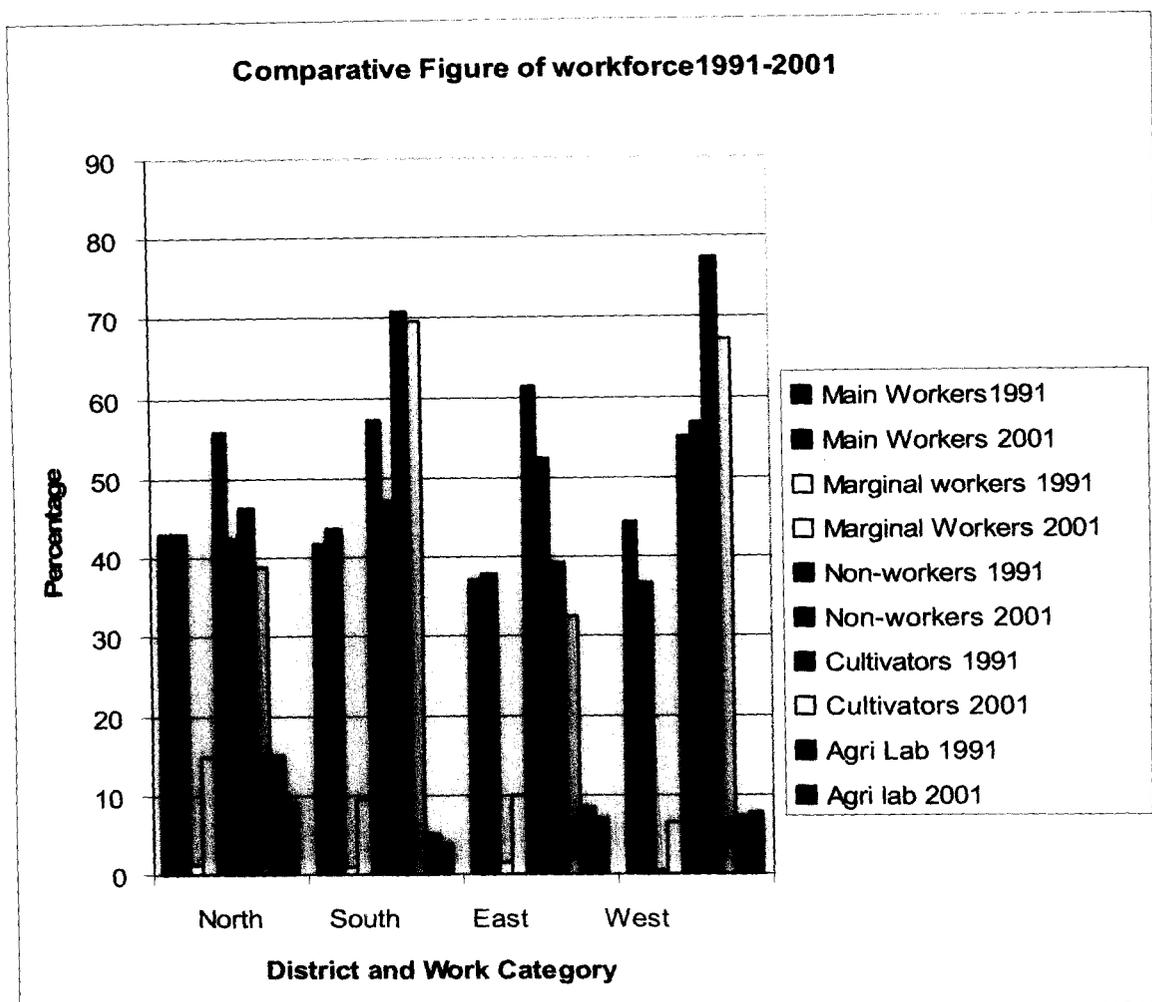
The South district, with an area of 750 sq. km is smallest district in Sikkim. The number of main workers in the district has increased marginally from 41.8 percent to 43.55 percent during this decade. The number of agricultural workers and cultivators has decreased marginally. There is a substantial fall in non-workers and substantial rise in marginal workers, which is same as in North district.

The East district is the most populous district though in terms of area (954 sq. km) it ranks third among the four districts of Sikkim. The percentages of main workers in the district have changed marginally during the last decade. The percentage decrease in cultivators is almost same to percentage increase in marginal workers. There is also decrease in agricultural labourers during 1991-2001. The percentage of non-worker has been reduced substantially, which might be due to increase in opportunity of non-farm activities.

There is a substantial fall in main worker in West district, which is 2nd largest in area (1116 sq. km). The fall in main worker is almost 8% and the increase in marginal worker is almost 6%. The fall in cultivator is almost 10%, which might have been absorbed by non-farm activities. Thus, it can be concluded from the workforce participation figure that the livelihood activity was shifting from farm to non-farm.

In the North, South and East districts the percentages of non-working population have decreased substantially during the last decade (1999-2001). The East district, which had 61.49% non-working population in 1991 has reduced the same to 52.29%. The North district has cut down its non-working population by a margin of 13.48%. The South district too has reduced the non-working population by nearly 10%. The only exception is the West district, where the percentage of non-workers has showed marginal increase. Overall, the state shows a positive shift from high non-working to moderate work-force participation.

Figure 3.1: Comparative Workforce Participation from 1991-2001



Source: Sikkim: A Statistical Profile 2002, DESME, Govt. of Sikkim, Gangtok

3.3 Why Agroforestry?

According to K.F. Wiersum, agroforestry was developed in 1970s and it included two developmental pathways – one was, incorporation of trees in agricultural cropping systems and the other was, incorporation of crops in forest systems. The first one was most focused and lot of research work has been done. But, the forest vision got little attention in practice and in research works. Of late, people are getting more aware to save the natural forests and practices analogous to major agro forestry systems - Home Gardens and Forest Gardens are getting importance.

Home Gardens: It is predominantly found in fencing of gardens or surrounding of houses planted with trees or fruits, vegetable herbs and annual crops [Kumar and Nair 2004].

Forest Gardens: It is a mixed tree plantation surrounding or at some distant places from villages. It includes a higher percentage of native trees but less intensively tended than the home gardens (Wiersum 1982).⁴

The Agroforestry practices are the call of time and it does not confine to any particular region or area. It has a universal acceptance for its wide scope. The scope and need of Agroforestry is discussed in the following paragraphs:

A) *Agroforestry for Food, Fuel and Fodder*

As population increases, the demand for food and fuel increases proportionately, particularly in developing countries like India. But the production of food and fuel is not enough to feed all. It is also true for livestock, which demands fodder. So there is acute shortage of food, fodder and fuel especially in Asian countries. There is little scope to increase the arable land. So, it is important to develop new land management system so that it could be possible to meet the demand for food, fodder and fuel from the existing land. The agroforestry system could be a possible solution in enhancing the supply of food, fodder and fuel.

B) *Agroforestry for Soil and Water Conservation and Conservation of Production Base*

The surface run-off washes away soil and the land is degraded due to water erosion. This problem is very much acute in our country, particularly in the mountain areas. Agroforestry has the provision to reduce it and save land from erosion and degradation.

Table 3.4: Natural Risk Factors & Environmental Degradation in India

Principal Cause of Land Degradation	Land Area Affected [MHa]	% to Total
Water Erosion	111.0	64.09
Wind Erosion	39.0	22.52
Water logging	8.5	4.91
Soil Salinity and Coastal Dunes	5.5	3.18
Soil Alkalinity	2.5	1.44
Ravines and Gullies	4.0	2.31
Riverine and Torrents Area	2.7	1.56
Total Land Area Affected	173.2	100

Source: adapted from M Velaynthum [1992]

It is found from the above table that the water erosion is the dominant cause for environmental degradation in India. More than 64% percent of the total area in the country is affected by water erosion. Agroforestry can cloth the barren and wastelands of watersheds. Agroforestry plantation on pastures or on agricultural lands will induce more interception of rainfall, more infiltration and lower the intensity of rainfall to reduce the soil and water loss.

C) *Agroforestry and Improvement of Soil:*

The production base of soil can be increased by Agroforestry practices and it also helps to improve the quality of the soil by leguminous tree plantations. The leguminous trees enrich soil by biological nitrogen fixation, composing organic matter and recycling of nutrients. The shade tree *Alnus Nepalensis* (Utis) planted as shade tree for the large cardamom in Sikkim has the highest nitrogen fixing capacity (444 x 1000000 KJ/per hectare/per year).

D) *Agroforestry and Agro-based Cottage Industries:*

Almost 70 percent of the Indian farmers are marginal and many of them live below poverty line. The Agroforestry programme will help to uplift the socio-economic condition of the poor by the agro-based cottage industries, such as, dairying, fruit and fibre industries, piggery, poultry, gum, lac, paper pulp, herbal drugs, cut flowers, bee-keeping, sericulture, production of raw silk, dyes and mushroom industries, etc. These cottage industries will provide gainful employment to farmers, and strengthen the economic conditions.

E) *Agroforestry and Micro-climatic Moderation:*

In semi-arid or arid regions of India (e.g. Rajasthan), the agricultural production is not stable due to poor yields and frequent crop failure by low and absentee rainfall. The system can be stabilized by the help of Agroforestry, as it compensates the failures by giving income from products other than the crops. To moderate the micro-climatic condition in the locale of trees, agroforestry will benefit field crops growing in association with trees. Plantation of tree rows on field borders has valuable influence of wind-breaks in protecting crops. Agroforestry programme provides the farmers with timber and fire-wood for domestic use, fodder for cattle,

agricultural implements and fertilizer for their fields. Thus agroforestry not only makes the farmers self-sufficient, it also supplements income without affecting agriculture.

F) *Agroforestry and Ecological Balance:*

The high population growth and pressure on forests may imbalance ecology. Nowadays, the forests are confined within hilly tracts. As the soils of hills are either rocky or less fertile, when brought under plough, it further aggravates the ecological imbalances.

The agroforestry systems have considerable scope of harnessing advantages of forest by planting trees on marginal lands and terrace boundaries. It can restore the ecological balance without reducing the area under agriculture. The vast non-arable marginal and degraded lands can be brought under agroforestry. The system is very much site and climate specific.⁵

3.4 Types of Agroforestry

There are two basic categories of agroforestry systems found around the globe:

i. *Simultaneous Agroforestry System :*

In this system, crops, animals or trees grow together at the same piece of land at the same time. In this system, trees and crops compete for light, water and nutrients. Spacing and other means are used to minimize the competition. The crop roots should be less deep than the tree roots. The tree should have a small canopy, so they do not shade out too much light from the crops. In this system, the trees appear in a linear arrangement like a row, or in strip for more than one row. Many categories of plantings can be found, in simultaneous agroforestry system, viz.,

- a) Boundary Plantings: Trees are used to delineate plots or farms. These trees can provide wood, fodder or other products.
- b) Contour Hedges: Trees are planted to prevent erosion and form biological terraces.
- c) Living Hedges: Living hedges, live fences and woody strips are all variations on the technique of using shrubs or bushes to form a continuous barrier. These are used

to form animal paddocks but they can provide food and various other products as well.

- d) **Windbreaks:** To protect crops or animals windbreaks or shelterbelts are used. It is also useful for conserving soil moisture, give shelter to the farm home and beautify the site.
- e) **Hedgerow Intercropping (Alley Cropping):** In this system, trees are planted on land along with crops; the crops are grown in alleys between the rows of trees. This system has a specific object to maintain soil fertility by planting nitrogen-fixing leguminous trees or shrubs in areas where shortage of land makes a long fallow period difficult or impossible. But, it is practical only in limited circumstances as there is competition between hedge and crop for moisture and nutrients.
- f) **Parkland System:** It includes combination of trees and crops in which the woody component is a permanent upper storey. Multipurpose trees like fruit trees may be planted in a scattered manner on the crop land.
- g) **Silvopastoral System:** It incorporates a discontinuous trees storey, over a continuous grass cover. The animals can graze in pastureland under trees or they can feed off tree fodder or browse. The fodder from the trees can also be cut and carried to livestock penned elsewhere.
- h) **Agroforests:** It is a special category of agroforestry. It is a plant community that resembles a natural forest in that it is generally multi-strata and contains large, mature trees and shade-tolerant under storey plants. It is a managed system, e.g., home garden, familiar in humid tropics. It contains different plant species of various sizes, types and growth cycles and planted near a homestead. It is useful for providing a wide variety of foods and other domestic needs as well as commercial products.

ii. *Sequential Agroforestry Systems:*

In this system, crops and trees take turns in occupying most of the same space. The system starts with crops and end with trees. The competition is lower in this regard because of time sequence. Crops in this system grow less rapidly and the trees grow

rapidly, reprocess nutrients from bottomless layers, fix nitrogen and have a large shade to help suppress weeds.

This system consists of different agroforestry practices such as:

a) Shifting Cultivation:

This is the most extensive farming system of humid tropics and one of the old and traditional systems, which is also familiar known as slash-and-burn agriculture. In this system, farmers cut, let dry and burn the forest vegetation, then plant crops or pastures, using the ash as fertilizer to enrich temporarily the poor soil. They stay for as long as the soil can support their crops, usually two or three cycles and then let a forest fallow grow for 15-30 years until sufficient nutrient accumulates in the biomass. After 15-30 years, the farmers return in the slash-and-burn site, and the cycle continues.

This traditional system is sustained for long period, because, it is useful for low population pressure with vast range of forest. As the population increased rapidly with shrinking forest, the cycles become shorter and shorter until they are no longer sustainable. The shrinking forests have no time to accumulate nutrients for biomass, thus the fallow periods become shorter and shorter.

b) Relay Cropping:

This system is very promising for single rainy season area. The crops and trees are planted in the same piece of land at the beginning of the rainy season. The crops grow rapidly, and the trees grow slowly, thus minimizing the competitions. The trees grow rapidly after the crops are harvested. During this time, a short time fallow can be seen. The trees drop their leaflets, providing mulch; then the trees are cut and harvested for poles or firewood. To get the benefit from nutrients and improved soil fertility the crops are planted again, while the trees begin to grove and re-sprout from seeds.

c) Multi-Strata System:

It also involves planting annual crops with several species of trees at definite spacing. Trees get established and grow while crops get dominance. The planted

trees are of different eventual size, shape and use from various strata or canopies, with or without simultaneous cropping. To control weeds and for the use of grazing, leguminous type of ground cover is used.

d) Improved Fallows:

To shorten the fallow period and increasing its biomass and nutrient accumulation, these are used in the humid tropics as an improvement of shifting cultivation. These are also used in the sub-humid tropics to occupy land for accumulation of biomass and nutrients in the soil and to smooth the weeds. Normally, improved fallows are planted shortly before or after the harvesting periods. Generally, fast growing nitrogen fixing trees are used as they do not compete with crops.

e) Taungya System:

This is one of the oldest agroforestry systems in the world. In this system, the forest authority allows the farmers to use the forest land planted to young trees. The farmers grow crops for several seasons and also take care of young trees, until the trees grow enough to cover the entire crop area and then the forest authority takes over the plots again.⁶

3.5 Agroforestry Evidences in Sikkim

Over the years, the people of Sikkim have evolved many agroforestry practices that proved to be beneficial to meet their need of food and shelter and also biological needs. As the population increased, per capita land availability decreased substantially. The low land-man ratio, low productivity per unit of land caused the rural people to shift from traditional crops to commercial cash crops. Also, the low cropping intensity due to mono cropping compelled the rural people to change their livelihood patterns. After the merger of Sikkim with India the land-use patterns changed at a faster pace. The imminent need to expand agricultural production while retaining the existing forests has given rise to agroforestry. Since the agroforestry practices are environment friendly, they may thus play an important role in developing more intensive, socially responsive, ecologically sustainable and highly efficient patterns of land-use for the people of Sikkim. Up to 1987, the ICAR identified three distinct agroforestry systems in Sikkim, which were as follows: I) Large

Cardamom + Utis, Chillowani etc., II) Fodder trees with upland crops and III) Citrus + Maize (Ragi); Buck Wheat/ Soya bean/ Beans/ Ginger.

Later, the Indian Council of Agricultural Research (ICAR) identified four types of agroforestry systems in Sikkim. They are sylvi-horti systems, horti-agri systems, and miscellaneous fruit trees in homestead and agri-silvy systems. The main commercial and native spice of crop is large cardamom. In Sikkim, the Lepchas, the first inhabitants of Sikkim, used to collect the capsules from the natural forests. Eventually when the forests passed into village ownership the crop was domesticated. Now, Sikkim contributes about 53% of the world's production of large cardamom. A map of major large cardamom growing areas in Sikkim prepared by Sharma shows that the southern half of Sikkim produced the most of cardamom, i.e. within 600m to 200m or Sub-tropical to Temperate zone (Sharma, et al 2000). The Large Cardamom (*Amomum Subulatum*) is grown under the shade of thinned forest or man-made forest under moist soil with high organic matter content, in the sylvi-horti systems. Up to 1993, 29 shade tree species have been identified which also serve as the main source of fuel, fodder and timber. The predominant shade tree is Utis (*Alnus Nepalensis*), which is a fast growing nitrogen-fixing non-legume. In the horti-agri systems Sikkim mandarins are intensively intercropped with various cereals, pulses and vegetable species. Ginger requires high dose of farmyard, which is also helpful for mandarins, and is the most remunerative cash crop. Guava, banana, drum sticks and few vegetable species like tomato and chili are found scattered over the lands around farmhouses. The agri-silvy system is largely based on fodder and fuel yielding tree species. Fodder trees become important source of fodder during lean period of October to March. Fuel wood is the main source of domestic fuel in Sikkim. Fodder and fuel trees are found growing on terrace risers of uplands and along farm boundaries. 24 fodder trees have been identified of which *Ficus Spp.*, *Artocarpus Lokoocha* and *Litsea Polyantha* are found to be most popular among the farmers. *Guercu Lamellosa* was ranked at number one, followed by *Castonopsis Tribuloides*, *Eurya Japonica*, *Schima Wallichii* and *Alnus Nepalensis*. As such it is in the subsistence level.⁷

Large cardamom (*Amomum subulatum* Roxb.) is a native plant of Sikkim Himalaya and is probably one of the oldest spices known to the mankind. As mentioned by Susruta, it was used in Ayurvedic preparation as early as in the 6th century BC. It was

known to the Greeks and Romans as Amomum. The spice was recorded by the Greek philosopher Theophrastus in the 4th Century BC. The cardamom capsule contains about 3% of essential oil rich in cineole. The indigenous tribe, Lepchas, used to collect the capsules from the natural forests. But later these forests passed into the ownership of villages and the plants have been domesticated eventually. Subsequently, Bhutia landlords, named Kazis, monopolized the cardamom plantations and started to cultivate in their large size land-holdings. Subsequently, the Nepalese community knew about this and they too started to harvest *Amomum subulatum* Roxb. as a cultivated species, but there are five more wild species planted in Sikkim, these are: *Amomum Linguiforme*, *Amomum Kingii*, *Amomum Aromaticum*, *Amomum Corynostachyum* and *Amomum Dealbatum*.

Cardamom is a perennial, low-volume crop, less dependent on external inputs, less infrastructure intensive, high value and non-perishable cash crop planted in marginal lands under tree cover. Normally, it grows in the altitudes of 600-2000m amsl. Humid sub-tropical semi-evergreen forests of mountainous sub-Himalayan regions are its natural habitats. But it is also cultivated in Nepal, Bhutan and Darjeeling hills. The areas receive 2000-3500mm annual rainfall apportioned over 200 days. The higher reaches of the warmer zones and lower altitudes of cooler zones, which have proximity to snow-line, are best for the fast growth of large cardamom. The constant high relative humidity with temperature ranges between 6 to 30 degree C, are experienced in Sikkim. During the time of flowering, both heavy rainfall and frost or hailstorms may damage the growth of the plants and production. It is a shrub by habit and has several tillers consisting of pseudo stems with leaves on the upper part. The spikes appear on the rhizome from the point where the pseudo stems shoots up. It is propagated by raising seedlings from seeds in nurseries and also through separating the rhizomes from the plants. Harvesting of the crops start from August and lasts till November depending on elevations. It is cultivated under various shade trees. But the most familiar shade-tree Himalayan alder, *Alnus nepalensis* D.Don, locally named Utis, is planted in large area, which has both the ecological and economic importance. Intensive studies have been carried out to evaluate the ecological and economic aspects of Himalayan alder.

The post harvesting technology of cardamom is still traditional. The cardamom is processed by using traditional device and indigenous knowledge. The collected capsules are dried in smoke of local Bhatti or kilns. It is a made of smoke-proof stones and mud-walls on all four sides with a small opening in front-side to put fire-wood. The top side is made of bamboo-mats. The capsules are spread on this mat for drying. These are kept for two to three days in continuous smoke for complete dryness. The colour becomes dark brown. Around 300-400kg woods are required to dry 100kg of cardamom capsules. The Spices' Board of India, which was established in 1979 under the Cardamom Act of India, devised a modern fuel-efficient Bhatti for drying of cardamom capsules by passing hot air through. The cardamoms processed in this Bhatti retain their original pink colour and require less fuelwood. But the cultivators have not welcomed it heartily. They have pointed out several reasons behind this. The quantity of cardamom dried in this Bhatti is not so bulky that can affect the market. The original coloured cardamom, i.e., pink, is not accepted with higher price by the traders. This modern Bhatti is established in cardamom producing places, where the cultivators have to bring their products for processing and to wait until their turns. Ultimately, it takes more time and becomes costlier than the traditional Bhatti.

The nitrogen and phosphorus concentration of *Utis* is very high than other mixed trees. As per data available, 65.34 KgN/Ha/Year is fixed in the *Uti* cardamom agroforestry system. The concentration of phosphorus is also much higher than other tree *Utis*, besides its ecological aspects, has economic aspects also. The woods required for the processing of cardamom capsules come from the *Uti* trees. The excess fuel-woods are used for domestic purposes. Experiments show that *Uti* *Nepalensis* has woody biomass accumulation from juvenile stage and continues to increase subsequently. The woods amount to 99t/ha in seven year stand and 597t/ha in 56 year stand (Sharma and Ambasht, 1991).

The sustenance of cardamom is sometimes threatened by viral diseases like Phurkey and Chirkey. These diseases spread because of the practice of cutting through rhizomes. These diseases cause tremendous loss to the harvesters.

The recent study of ICAR, Tadong Centre, Sikkim, which has been published in the Indian Forester (July, 2007), sketched the various agroforestry systems in different

altitudes in a comprehensive manner. According to the study, there are nine major agroforestry systems in the sub-tropical (300 -900m amsl) and mid-hill temperate zones (900-1800m amsl). The systems are – agri-horticultural, agri-horti-pastoral, agri-silvi-pastoral, horti-silviculture, agri-horti-silvi-pastoral, livestock-based mixed farming, sericulture-based mixed farming, sericulture-based farming, bamboo-based farming, homesteads and tea plantation.

Agri-horticultural system: The cultivation of maize and intercropping with ginger, turmeric, buckwheat, beans, pulse-type beans, tapioca and Sikkim mandarin (*Citrus reticulata Blanco*)-ginger/turmeric comprise the system. Recently the practice of mushroom, gladiolus and different type of orchids are getting momentum.

Agri-horti-pastoral: In this system, the Sikkim mandarin, guava, banana, avocado, lemon, gooseberry, ficus sp., broom grass (*Thysolaena agrostis*), *Dolpizium* sp. and other ferns are intercropped with maize, ginger, turmeric, tapioca, buckwheat, wheat, pulses, oilseeds, beans, oat, millets, rice and vegetables. The broom grass is now very popular as it fulfills the fodder requirements as well as fuel-woods.

Agri-silvi-pastoral: This system comprises the crops like maize, wheat, pulses, buckwheat, oilseeds, beans, finger millet and intercropped with *Alnus nepalensis*, *Schima wallichii*, *Prunus cerasoides*, *Terminalia myriocarpa*, *Castanopsis tribuloides*, *Litsea polyantha*, *Macranga denticulata*, *Ficus* sp., broom grass, ferns.

Horti-silviculture: In this system, the large cardamom is intercropped with *Alnus nepalensis*, *Schima wallichii*, *Macranga pustulata* etc. The combination of first one as shade tree with cardamom is most sustainable system in Sikkim.

Agri-horti-silvipastoral: The Sikkim mandarin, avocado, pears, amla, guava, broom grass are intercropped with maize, tapioca, ginger, vegetables, beans, pulses, oilseeds. This system fulfills the requirements of fruits, fuel woods and fodder.

Livestock-based mixed farming: In this system, the common livestock (goats, cattle, pig, poultry etc) are reared with various species of fodder trees like *Cyperus* sp., *Ficus* sp., *Agave* sp. etc.

Sericulture based farming: The Mulberry (*Morus laevigata*) cultivation for silkworm and the interspaces are used for the cultivation pulses, oilseeds, millets, broom grass etc.

Bamboo-based farming: In this system, the various species of bamboo are intercropped with ginger, turmeric etc. The main species of bamboos are *Chimonobambusa sp.*, *Dendrocalamus sp.*, *Bambusa sp.*, *Himalayacalamus falconeri* etc.

Homesteads: The farmers of Sikkim are observed to cultivate various vegetables in the surroundings of their dwellings. Usually, they use the small piece of land for homestead gardens. In this system, the Sikkim mandarin, lime, tomato, guava, papaya, avocado etc are intercropped with vegetables, medicinal plants, orchids, marigold, gladiolus, tuberose and even stall-fed animals like cattle, goats, ducks, pigs etc.

Tea-plantation: Tea is planted in one area of Sikkim (Temi, almost 500ha) by the state government. The wild-cherry (*Prunus cerasoides*) is planted in the boundary area and also used as shade tree.

In the Temperate zone (1800m to 2700m amsl), three type of agroforestry systems are found. These are as follows: Agri-horticultural, Horti-silvi-pastoral and livestock based farming.

Agri-horticultural: In this system, the Sikkim mandarin and apple are intercropped with potato, maize, barley, rice, buckwheat, radish, cabbage, cauliflower etc.

Horti-silvi-pastoral: In this system Sikkim mandarin, apple are intercropped with maize, millets, potato, sometimes large cardamom with some fodder trees like *Alnus nepalensis*, *Quercus sp.*, *Betula alnoides*, *Acer sp.* etc.

Livestock-based mixed farming: The various species of fodder trees are planted with livestock, like goats, pig, sheep, poultry, yak etc. The important fodder species are *Betula uitlis*, *Acer sp.*, *Setaria sp.*, *Rubus sp.*, *Avena sp.*

In the sub-apline zone (2700-4000m amsl), only one type of agroforestry system is observed. As this zone is in high altitudes, the horti-pastoral-transhumance is

practiced here. During November to April in each year the local bhutia community migrates here for such practice. The *Quercus sp.*, *Acer sp.*, *Betula utilis*, *Sorbus sp.*, *Carex sp.*, *Trisetum sp.*, *Allium sp.*, etc are produced with various horticultural crops like radish, peas, potato, beans, maize, cabbage, cauliflower etc

The most high altitude area is alpine zone (more than 4000m amsl). In this high altitude area, transhumance is practiced during certain time of each year. The local Bhutia community usually migrates there and practices the livestock-based mixed farming. In this system, the livestock like yak, sheep, and mules are reared with potato, cabbage, peas and *Poa sp.*, *Agrostis sp.*, *Carex sp.*, *Rumex sp.* Etc. In this area, yak is reared as a main source of livelihood and also used as mode of transport.⁹

The horti-agri system is based on inter-cropping of horticultural and agricultural produces. This system is practiced in low to mid hills. Sikkim mandarin orange is inter-cropped with annual food crops like maize. Ginger is also produced commercially. In the high hills of temperate zone, apple is inter-cropped with potato, barley, radish, cabbage and turnip. But the existing poor health of apple-trees puts doubt about the substantiality of this system.¹⁰

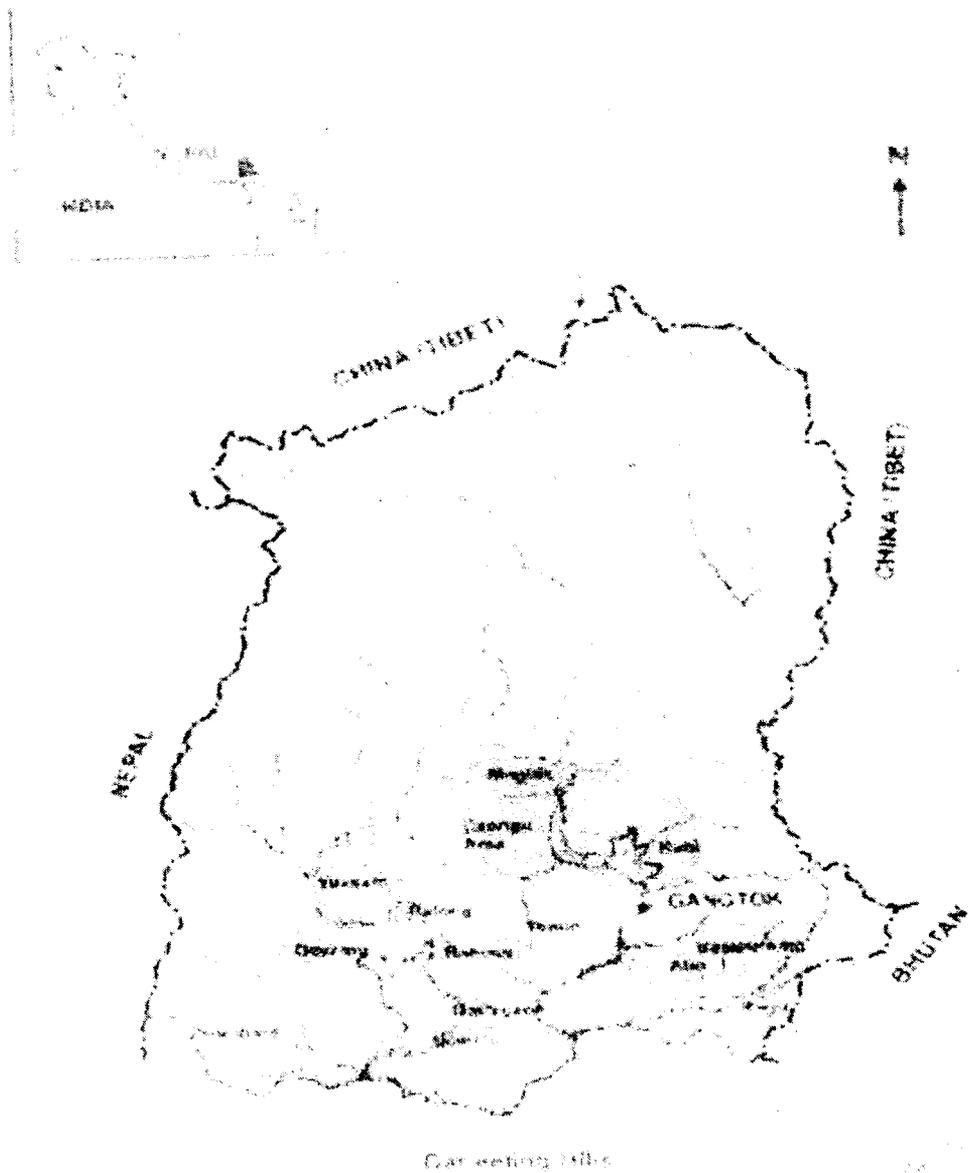
The mixed homestead garden type agroforestry system prevails almost everywhere in Sikkim. Around the homestead, a number of tree species such as tree tomato, guava, banana and some of the fodder trees are grown with crops such as vegetable beans, cucurbits, ginger and turmeric. These are grown for home consumption as well as for commercial purposes.¹¹

Tea plantation exists in a small area between 1500m to 1800 m. altitudes. Wild cherry trees are planted as live borders in tea gardens. The quality of Sikkim tea is rated very high. However, of all agroforestry systems practiced in Sikkim, cardamom plantation has been found to be the most successful and widespread. The indigenous tribes (Lepcha and Limbu) of Sikkim used to collect large cardamom capsules from natural forests. Large cardamom was domesticated in thinned natural forests. The plantations have more than 30 tree species, which provide shade to the crop and fuel for large cardamom drying and domestic use. Among them alder, a nitrogen-fixing tree is most abundant. Local farmers have evolved a classical tree-cutting schedule in plantation area to get continuous supply of fuel wood and fodder without affecting the shade

requirements of large cardamom. Some innovative farmers grow fodder trees as a shade to the cardamom plants. The fodder trees are lopped after harvest of cardamom capsule in November. Large cardamom plantations comprising of trees and perennial herbs resemble a natural forest ecosystem. Sikkim grows 90 percent of the total country's cardamom. There is enormous scope to study the role of cardamom, the chief agroforestry produce, in Sikkim's farm economy.¹²

The large cardamom farming is the main traditional farming system in the Sikkim Himalaya. This system prevails in the marginal lands of forests also. It is very much suited to the environment of Sikkim, because, cardamom cultivation is not only economically valuable but ecologically sustainable. It is not only labour-intensive, but it is a low-volume, non-perishable crop.

Figure 3.2: Map of Large Cardamom Growing Area in Sikkim:



Source: Sharma & Sharma, Mountain Research and Development

Though, cardamom is cultivated in Darjeeling, Nepal and Bhutan Hills, Sikkim contributes 53% of the world's production. It is predominantly farmed in the southern half of Sikkim between 600m to 2000m. i.e., from the sub-tropical to the temperate zone. It is found from the location map of large cardamom production area (which is given above) in Sikkim that the farmed area is continuous from Singhik to Kabi in the North district. In South districts, the production area is scattered in Ralong, Rabong and Namchi area. In the East district, the plantations are situated in Aho and Tumen.

In the West district, the production area is found around Yuksum. There are some other cardamom areas scattered throughout Sikkim. A study was conducted by Sharma et al in 2000 to examine the impact of agroforestry. According to them, a total of 16,949 cardamom holdings have been recorded in Sikkim, of which 70% are smaller than 1ha; 30% holdings are 1-3 ha in size. The most used shade tree in new plantations is the nitrogen fixing alder (*Alnus Nepalensis*) locally known as Utis. But there are several other shade trees, e.g., *Schima Wallichii*, *Engelhardtia Acerifolia*, *Eurya Acuminata*, *Leucosceptrum Canum*, *Maesa Chisia*, *Symplocos Theifolia*, *Ficus Nemoralis*, *Ficus Hookeri*, *Nyssa Bessiliflora*, *Osbeckia Paniculata*, *Viburnum Cordifolium*, *Litsaea Polyantha*, *Macaranga Pustulata* etc.

The total cropped area in the state increased by 106%, while the land under large cardamom increased by 135% in 20 years. Many new large cardamom plantations are on terrace fields that were previously used for cultivation of paddy and other crops. As found from the study, the gross income from large cardamom cultivation in Sikkim has increased from US \$1.9 million in 1975-76 to 5.7 million in 1985-86 and 6.4 million in 1995-96. [Conversion at the current rate of US\$1=Rs.50]

A study that compared two systems – one dominated by large cardamom and the other by maize and potatoes, showed that the household income and per person per day income were almost doubled in the large cardamom system.

Cardamom is almost a closed system in the sense that it does not need any external inputs. To cure the cardamoms capsules 800-1000kg/ha of fuelwood is required; and the shade tree produces 4500 – 5500kg/ha, thus offering a huge surplus for other purposes.¹³

3.6 Livestock – As an Integral Part of Agroforestry:

The cooler hills of the Himalayas have tremendous prospect of livestock rearing, particularly in the high altitude grasslands and meadows. The present rural livelihood system in Sikkim is well balanced from ecological point of view. However, with the increase in population and the limited availability of land, there is already great pressure on the cultivable land and forest and on the environment as well. Many farmers are complaining about the change in environment and decline in soil fertility. Under such situation livestock farming which requires minimal use of land, labour

and capital would be ideal sustainable model for development in such difficult mountainous terrain. The terrace boundary may be used for planting fodder trees, which will be further used as feeds to the stall-fed livestock. The people of Sikkim are already practicing such agroforestry, where the land is used as an integral part of agriculture, forestry and livestock. The grass and legumes planted on steep soil not only provide nutrition but protect the land from erosion and add nitrogen to the soil, which increases fertility of the soil.¹⁴ The potential of livestock rearing as a part of agroforestry is tremendous, which is evident from the secondary data. The following table shows the growth of livestock production in different livestock census.

Table 3.5: Growth of Live-stocks Production:

<u>Name of the Live-stocks</u>	<u>1977</u>	<u>1997</u>	<u>2003</u>	<u>Change(1977-2003)</u>	<u>%Change</u>
Cattle	157546	143024	160932	3386	2.1
Buffaloes	5438	1970	2118	-3320	-61.1
Sheep	16104	5023	5746	-10352	-64.3
Goat	88986	82980	123841	34855	39.2
Yak	3995	4731	5719	1724	43.2
Poultry	220927	219552	321919	100992	45.7
Pig	18596	26975	40938	22342	120.1

Source: Adapted from Sikkim: A Statistical Profile 2003-04, DESME,

Govt. of Sikkim, Gangtok.

The different physical constraints of Sikkim towards the livelihood options compelled the people to think for better alternative which will be sustainable to the hilly environment as well as for the material well-being of the poor people. As an integrated part of the agroforestry system the livestock production in Sikkim grows day by day. The main livestock of Sikkim are Cattle, Buffaloes, Sheep, Goat, Yak, Poultry and Pig etc. It is clear

from the picture that the production of all the live-stocks except Buffaloes and Sheep has increased enormously. This statement can be seen from the below table. Just after the merger of Sikkim with the Indian Territory, the number of all the live stocks was low, but it has been decreased largely in 1997 except Yak and Pig. But in 2003, again all type of live-stocks has increased largely. Especially the production of Cattle, Goat, Yak, Poultry and Pig has increased manifolds. This rise in production might be due to shifting of people from cultivation to this sector and also the increased demand for meats in this area due to large number of visitors from outside as well as for domestic consumption. It is urgent need to think about the production of Sheep to produce wool. Yak is very useful here, especially for temperate zone of North Sikkim. The milk of Yak is concentrated, which is locally called Chhurpi and used as durable food. Many crafts are being produced from Yak. Cattle are used for cultivation as well as for dairy.

Table 3.6: Production of Live-Stock Produce in Sikkim:

<u>Particulars</u>	<u>2000-01</u>	<u>2001-02</u>	<u>2002-03</u>	<u>%Change</u>
Milk(ltrs.)	2682923	3183808	3237778	20.7
Butter(kg.)	10570	10320	8070	-23.7
Chhurpi(kg.)	2071	5166	3563	72
Cream(kg.)	206	922	923	348.1
Paneer(kg.)	2895	5104	5314	83.6
Curd(kg.)	412	458	477	15.8

Source: Sikkim: A Statistical Profile 2003-04, DESME, Govt. of Sikkim,

The milk production as well as other milk produces except butter has increased manifolds in 2002-03. The volume of milk production has increased substantially, which proves that people are engaging more to the livestock production as an alternative livelihood in the hill area. But, the production of butter has decreased gradually. The chhurpi production has

increased seventy-two percent. The volume of cream production is highest in the sense of percentage; it is more than four times. The paneer production also increased highly, it is almost double. The curd production also increased but marginally. Thus, it is clear from the above table that the people switch off their livelihood from traditional system to live-stock.

The above table shows the production of live-stock produce in Sikkim. The milk production has increased 20.7%, but the production from milk, like cream and paneer has increased substantially. But, surprisingly, the production of butter has decreased during the period. The production of Curd has increased marginally. All these products have great potential. If the local needs meted up, it can be exported to Siliguri town, which is just around 70KM from the capital of Sikkim, i.e., Gangtok.

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Chapter 4

Landuse Efficiency, Cropping Pattern & Agricultural Productivity in Sikkim

4.1 Land use efficiency – Productivity Measures (Agricultural):

Efficient Resource Allocation is a situation in which it is not possible to reallocate available resources so as to achieve more of one objective without accepting less of another. This applies whether the resources are those available to an individual, a firm, or a govt. If an individual could gain by shifting expenditure from one good or service to another, the existing allocation is not efficient. If a firm could shift resources so as to achieve more of one objective, profit for example, without accepting less of another, say growth, the existing allocation is inefficient.¹

The main resource in the earth is land. The land is degraded for many reasons. Sometimes it is caused by the interference of human beings. There may be technical problems but the main reason of land degradation is economic as opined by Edward. According to him, the marginal agricultural lands in the developing countries are less productive and thus generate low income to the poor. The poorer people try to increase their agricultural lands by converting the forests in to cropping lands. As a matter of fact, the use of such land is easier and cheaper. As a consequence, the land degradation further expands for such use of frontier and marginal lands

A study in 1990 shows that the annual deforestation rate in tropical countries was 0.8% (5.4 million ha per annum) during 1981-90, among them the highest rate of deforestation occurs in Asia (1.2%). Another interesting survey was conducted in 1997 [Barbier & Burgess, 1997] in 53 tropical countries to explain the determinants of deforestation. The results showed that the increase in population density increases forest clearance; rising per capita income and agricultural yields reduced the demand for forest conversion. So, it was concluded that as countries develop economically and as the productivity improves, deforestation should be low.

The poorest 20% of the rural population in developing countries was mainly concentrated in low potential lands as opined by Leonard et al. (1989). Low potential is defined as resource poor or marginal agricultural lands, where inadequate rainfall, adverse soil conditions, fertility and topography limits agricultural productivity and increased the risk of soil degradation. Out of 75% of the poorest 57% in Asia, 20% in Latin America and 51% in Africa can be found in low potential lands.²

Generally, the mountain area has many constraints for cultivation. The mountain soil is not very fertile because of limited soil components and chances of further deterioration by landslides or other natural calamities. The high altitude area naturally has low temperature and cold weather throughout the year that renders diversification of agriculture difficult. The low irrigational facility has compelled the people for low yield from agriculture. Normally, the high altitude area has very few flat pieces of lands. They practiced terrace cultivation, but it is very costly and labour intensive. The poor communication leads to less usability of fertilizer for the enhancement of production as well as productivity.

Sikkim is a tiny hill state with common mountain features. The people of Sikkim are practicing terrace cultivation and struggling for more agricultural production. But, due to geographical constraints, production and productivity are not enough to feed the increased population. If we see the production figure of agricultural crops in different time periods at equal intervals, the tendency can be traced automatically. The data of agricultural production from 1975-76, 1985-86, 1995-96 and 2000-01 have been given to show the changes.

The agricultural income has been divided into two broad aspects: a) Income from non-commercial crops and b) Income from commercial crops. So, the discussion will be made keeping in mind the above aspects.

The traditional or non-commercial crops of Sikkim are Rice, Maize, Millet and Buckwheat. These crops are grown traditionally for domestic consumption. Since late 1970s to early 1980s, the wheat cultivation got popularity and its production increased manifold. The commercial crops are Ginger, Potato, Mandarin, off-season vegetables and the indigenous large Cardamom etc.

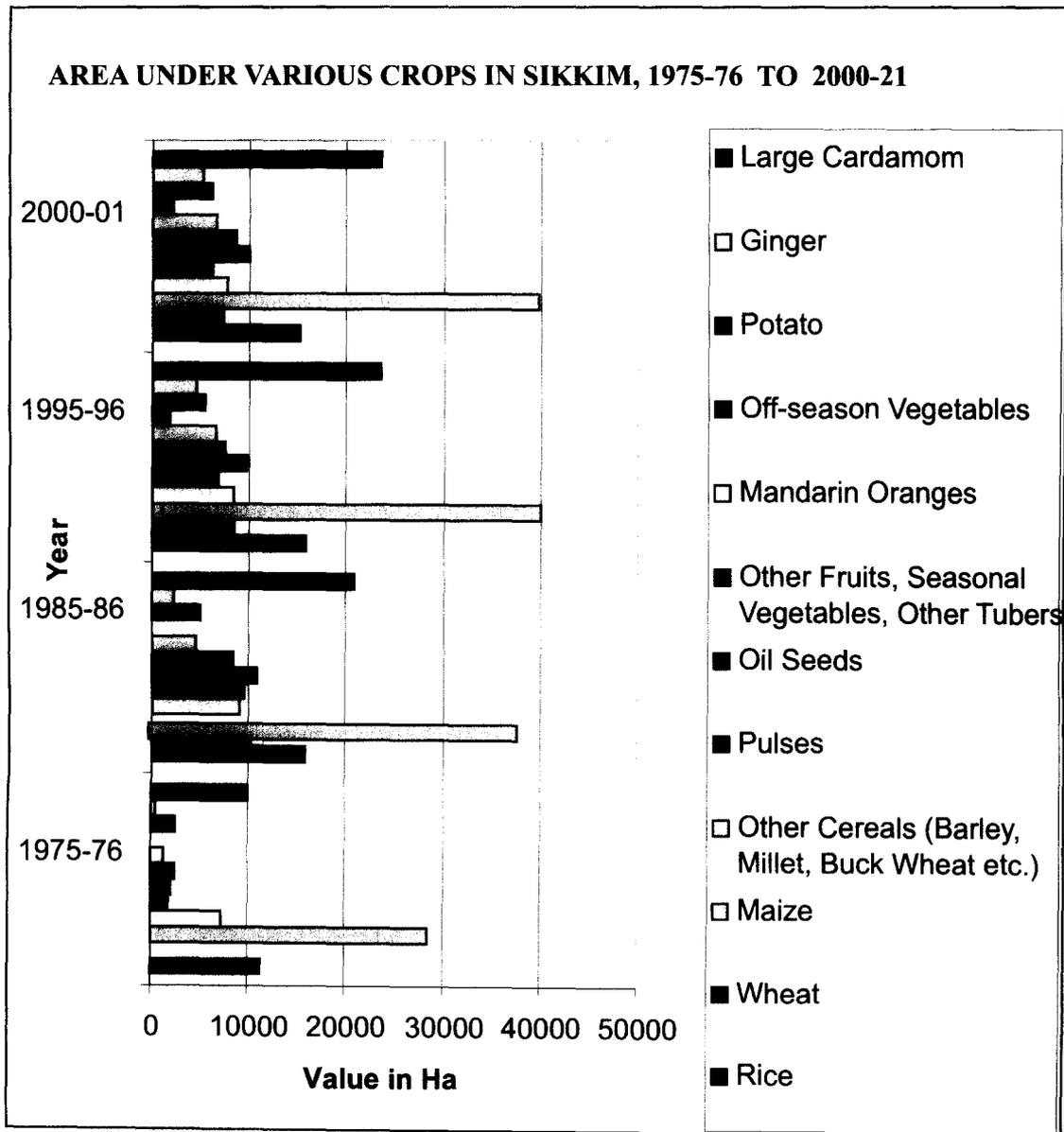
Table 4.1: Area (Ha) under various Crops in Sikkim from 1975-76 to 2000-01

CROP NAME	1975-76	1985-86	1995-96	2000-01	Gain/loss in 25 years(%)
Rice	11400	15900	15940	15210	33.4
Wheat	150	10100	8420	7210	4706.7
Maize	28500	38100	39940	39900	40.0
Other Cereals (Barley, Millet, Buck Wheat etc.)	7200	9000	8270	7690	6.8
<i>Total Cereals</i>	<i>47250</i>	<i>73100</i>	<i>72570</i>	<i>70010</i>	<i>48.2</i>
Pulses	1700	9500	6730	6030	254.7
Oil Seeds	2000	10750	9730	9990	399.5
Other Fruits, seasonal vegetables, other tubers	2600	8450	7400	8650	232.7
Total Common Crops	53550	101760	96430	94680	76.8
Mandarin Oranges	1400	4600	6600	6650	375.0
Off-season vegetables	0	20	1700	2020	0
Potato	2400	5000	5500	6200	158.3
Ginger	500	2300	4500	5100	920.0
Large Cardamom	10000	20900	23550	23480	134.8
Total Cash Crops	14300	32820	41850	43450	203.8
Total Cropped Area	67850	134580	138280	138130	103.6

Source: Sikkim: A Statistical Profile 2002, DESME, Government of Sikkim

The above table shows the area under different crops. The total cropped area has increased more than 100% (103.6%). This increase in area made it possible to cultivate by converting land from other cultivable wasteland or land converted from forest. It can be followed from the table that the traditional crop (rice and cereals) area increased till mid-eighties, but after that the area decreased gradually. The area under wheat production increased remarkably (4706.7%). Wheat was introduced in Sikkim in the late '70s. So, in early eighties and early nineties the area under wheat production increased substantially. People also started growing cash-crops like mandarin oranges, potato, ginger etc, and the area under horticultural crops increased remarkably. The production of off-season vegetables was not a common practice earlier. The farmers started to cultivate these after the merger of the state with India and subsequently the area under such crops increased substantially. The area under pulses, oil-seeds, potato, mandarin oranges etc too increased during this period. The area under cereal crops increased by 48.2%, whereas, the total area under common crops reached 76.8%. This difference is caused by an increase in area for production of pulses, oil-seeds and horticultural crops. All the cash/commercial crop areas increased significantly. Actually, Sikkim started to switch from traditional crop to commercial/cash crop since its merger with India. It is evident from the figure (203.8%) of area under total cash crops. The area under traditional crops declined during late eighties to mid-nineties. But during this period the area under cash crops or horticultural crops increased. Thus, it can be concluded on the basis of the secondary data that the land use practice of the people of Sikkim was changing from traditional practices. More and more people were shifting from their age-old traditional cereal based agriculture to cash-crop based agriculture to maintain their livelihood with limited resources and increasing population pressure.

Figure 4.1: AREA UNDER VARIOUS CROPS IN SIKKIM, 1975-76 TO 2000-21



Source: Sikkim: A Statistical Profile 2002, DESME, Government of Sikkim

Table 4.2: Change in Crop Production (in Tonnes) in Sikkim:

CROP NAME	1975-76	1985-86	1995-96	2000-01	Gain/loss in 25 years(%)
Rice	10000	16500	21870	21350	113.5
Wheat	150	16200	15300	10100	6633.3
Maize	16500	47600	56560	59610	261.3
Other Cereals (Barley, Millet, Buck Wheat etc.)	4500	7700	8060	6970	54.9
Total Cereals	31150	88000	101790	98030	214.7
Pulses	700	8450	5910	5160	637.1
Oil Seeds	700	10250	7640	7380	954.3
Other Fruits, seasonal vegetables, other tubers	3200	17800	23300	27750	767.2
Total Common Crops	35750	124500	138640	138320	286.9
Mandarin Oranges	3600	5000	7000	7500	108.3
Off-season vegetables	0	40	7600	9550	0.0
Potato	5000	16400	24000	25500	410.0
Ginger	2000	10900	2400	2400	20.0
Large Cardamom	2300	3900	3600	4670	103.0
Total Cash Crops	12900	36240	66200	71220	452.1
Total Crop Production	48650	160740	204840	209540	330.7

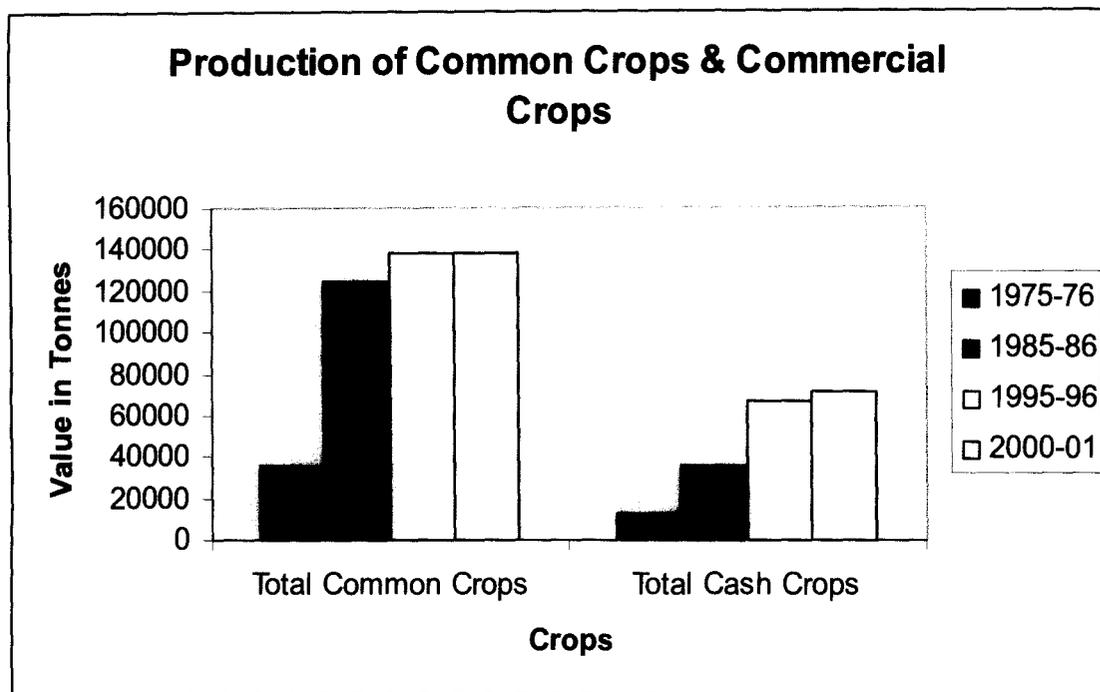
Source: Sikkim: A Statistical Profile 2002, DESME, Government of Sikkim

It has already been stated that the area under production has increased in case of cash-crops from the time of Sikkim's merger with India, and the traditional cash crops' production area decreased since late-eighties. The production of all the crops has increased manifold from 1975 to 2001. But it is interesting to see that during late eighties to mid-nineties the production of cereals have started to decline except for maize and fruits or seasonal vegetables. The production of total cereals has increased by 214.7%. But the production of the total common crops has increased by 286.9%. The difference is caused by production of pulses, oil seeds and various fruits or tubers. The production of all the cash crops like mandarin oranges, potato, ginger etc have increased substantially with uniformity. The production of ginger has decreased remarkably. The production of off-season vegetable has been introduced since mid-eighties and increased thereafter to a large extent. The production areas of commercial crops have been increased manifold but the production did not. It happened due to fall in productivity. The production of total cash-crops has increased substantially to 452.1%. This increase is contributed by potato and off-season vegetables which helped the farmers to get more profits.

Sikkim produces many crops and maize is the most important one. The production of maize has decreased from 1997-98 to 1999-2000. The rice production was in second position, followed by wheat. The production of almost all crops has decreased in 1999-2000. In 1998-99, there was a very long spell of dryness in Sikkim. According to the Agricultural department of Sikkim, the total rainfall was 93.34mm, which was lowest over last 25 years. It had visible adverse affect on the economy, especially, on rabi and cash crops and obviously on drinking water in mountains. It also had adverse impact on the main cash crop, cardamom. It is estimated that sixty percent of the state's large cardamom was lost during that spell.

The South district ranked first in horticultural production except potato and fruits. The North district was first in the production of cardamom, while the West district was first in the production for potato. East district was first amongst the four for the production of fruits.

Figure 4.2: Production of Common and Commercial Crops from 1975-76 to 2000-01



Source: Sikkim: A Statistical Profile 2002, DESME, Government of Sikkim

The productivity is defined as production of per unit land. Generally, in India, agricultural productivity is measured in kg. per Hectare. The productivity of land depends on various factors. The character of soil, weather of the particular area, precipitation, availability of water, topography, irrigational facility, fertilizer availability etc. are important factors that can change the productivity of a particular produce.

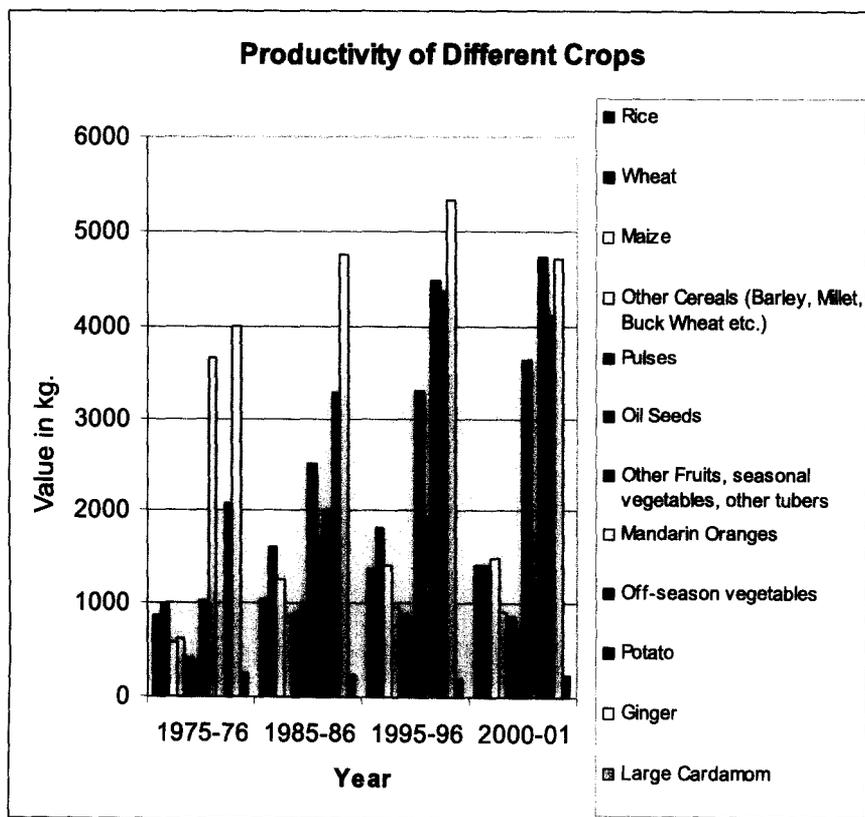
Table 4.3: Change in Productivity (in Kg) of Various Crops:

CROP NAME	1975-76	1985-86	1995-96	2000-01	Gain/loss in 25years
Rice	877	1038	1372	1403	59.97
Wheat	1000	1604	1817	1400	40
Maize	579	1249	1416	1494	158.03
Other Cereals (Barley, Millet, Buck Wheat etc.)	625	855	974	906	44.96
Total Cereals	659	1203	1402	1400	112.44
Pulses	412	889	878	857	108
Oil Seeds	350	953	785	739	111.14
Other Fruits, seasonal vegetables, other tubers	1015	2514	3290	3651	259.7
Total Common Crops	667	1223	2067	1460	118.89
Mandarin Oranges	3675	1672	1928	1764	-52
Off-season vegetables	0	2000	4470	4728	
Potato	2083	3280	4363	4112	97.4
Ginger	4000	4739	5333	4705	1762
Large Cardamom	255	233	191	233	-8.62
Total Cash Crops	1001	1340	1937	1894	89.21
Total Crop Productivity	732	1248	1568	1584	116.39

Source: Sikkim: A Statistical Profile 2002, Government of Sikkim

It is found from the table as well as from the diagram below that the productivity of rice has increased (59.97% in 25 years) day by day since Sikkim's merger with India. In case of wheat the productivity increased up to 1995-96 but decreased again since 2000-01. The productivity of maize has increased consistently since 1975-76. In case of other cereals and total cereals, the productivity has increased up to 1995-96 and again decreased since 2000-01. In case of pulses and oil seeds, the productivity increased sharply in 1985-86 but again decreased slowly since then. The productivity of other fruits, seasonal vegetables, and other tubers has increased sharply since 1975-76 and it is as high as 259.7%. In case of total common crops, the productivity has increased since 1975-76 to 1995-96 and again decreased in 2000-01. As productivity is concerned with the soil quality, irrigational facility etc, the productivity could increase only up to certain limit. The scope for further increase is very limited.

Figure 4.3: **Productivity of Various Crops from 1975-76 to 2000-01**



Source: *Sikkim: A Statistical Profile 2002, DESME, Government of Sikkim*

Table 4.4: **Area , Production and Productivity of Horticultural Crops:**

Year	Crops	Area('000ha)	Production('000ton)	Productivity(kg/hact)
1998-99	Fruits	5.83	8.337	1453
	Vegetables	5.22	24.17	4704
	Spices	7.11	33.04	4725
	Roots & Tuber Crops	15.53	1.28	81
2002-03	Fruits	7.13	11.2	1570
	Vegetables	7.78	37.18	4781
	Spices	26.97	35.41	1313
	Roots & Tuber Crops	7.26	30.83	4246
2003-04	Fruits	7.65	11.52	1510
	Vegetables	8.52	41.89	4919
	Spices	31.7	38.71	1222
	Roots & Tuber Crops	7.91	35.19	4449

Source: Adapted from Sikkim: A Statistical Profile 2004-05, DESME, Govt. of Sikkim, Gangtok

The horticultural department has laid emphasis on horticultural crops like Mandarin, Large Cardamom, Ginger, Turmeric, Potato and other fruits. The quantity of Ginger production was highest in 1998-99. But the most important commercial crop is Large Cardamom. Sikkim is the chief producer of Large Cardamom in the country. It is very surprising that the productivity of spices has decreased suddenly in 2002-03 and deteriorated further in 2003-04 though the area of cultivation has increased sharply by more than four times from 1998-99 to 2003-04. The production of Roots & Tuber

Crops has increased substantially high but the area under production became almost half than 1998-99. The production, productivity as well as area under production for vegetables have tended to increase every year.

4.2 Cropping Patterns:

The Cropping systems of a region are decided by a number of soil and climatic parameters which determine overall agro-ecological setting for nourishment and appropriateness of a crop or set of crops for cultivation. But at farmers' level, potential productivity and monetary benefits act as guiding principles while opting for a particular crop/cropping system. These micro level decisions with respect to choice of crops and cropping systems are further narrowed down under influence of several other factors related to infrastructure facilities, socio-economic factors and technological developments, which are operating interactively at micro-level. These are: a) *Infrastructure facilities*: Irrigation, transport, storage, trade and marketing, post-harvest handling and processing etc. b) *Socio-economic factors*: Financial resource base, land ownership, size and type of land holding, household needs of food, fodder, fuel, fibre and finance, labour availability etc. and c) *Technological factors*: Improved varieties, cultural requirements, mechanization, plant protection, access to information, etc.³

In Sikkim, there is a visible lack in the development of infrastructure. The irrigation facility is very much limited. The transportation is also very inadequate due to steep terrain. The storage facility is limited. The lack of communication also leads to lack of marketing, because, the produce can not be transported from the remote villages to market places. The provision of post harvest handling and processing of agricultural produces are also very much lacking.

The socioeconomic factors have direct impacts on the cultivators to make a decision for changing cropping patterns. The financial resource bases of the cultivators have increased after the merger of Sikkim with India. The financial institutions (banks, co-operatives etc) made various options for the financial assistance to the farmers.

The average size of operational land-holdings by all social groups has been shown in the following table since the merger of Sikkim with Indian Union. The average size for marginal holding decreased from 0.50ha to 0.40 ha since 1976-77 to 1991-92. The same picture can be seen in large landholdings. Interestingly, the small, semi-medium and medium holdings have increased marginally. This might have happen due to further marginalization of land-holdings due to population pressure and increasing proletarianisation in the state.

Table 4.5 : Average Size of Operational Land-holdings in Sikkim

Category	1976-77	1980-81	1985-86	1991-92
Marginal(below 1ha)	0.50	0.47	0.50	0.40
Small(1-2 ha)	1.45	1.44	1.40	1.70
Semi-medium(2-4 ha)	2.84	2.80	2.80	3.00
Medium(4-10ha)	5.86	5.78	6.00	6.10
Large(10 and above	18.44	15.89	2.20	18.00

Source: Compiled from the data of Agricultural Situation in India, Vol.40 & 50, No.2 & 4, GoI.

The technological development for getting high production is lacking. The use of HYV seeds, fertilizer, technical know-how for the betterment of the agricultural process - all these factors have very limited usability.

Like other mountain states, in Sikkim, the areas with low elevation grow paddy and fruits like mandarin. The high altitude areas grow maize and potato, besides large cardamom. So, the farming system in Sikkim is mainly divided into two broad categories: Maize-Potato dominated system and Cardamom dominated system. The cropping sequence varies in different farming systems. In Maize-potato farming system, potato is harvested in January and Maize in the middle of February. Ginger is harvested in middle of April and pulses in middle of July followed by Peas. The

cropping intensity is comparatively higher in this system. Cardamom plantation is practiced throughout the year.

In the cardamom dominated farming system, maize is harvested in March, finger millet in April and paddy in July. Wheat is produced during the month of December. Cardamom plantation is practiced throughout the year.

The cropping pattern in Sikkim has changed over the years. The cropping pattern of a region is determined by a variety of factors, most notably, elevation, topography, precipitation and so on. The cropping patterns of the state have undergone metamorphic changes since the merger with India in 1975. In the pre-merger period, the agricultural dependency of the people was much higher. Later, this livelihood activity changed but with slower pace. Earlier, there were traditional crops like maize, paddy, millet, pulse etc, but as time passed the farmers tried orange, apple, tea etc. Wheat was introduced in late seventies in Sikkim. The shift of farmers from traditional cereal based low-income crops to high-income cash-crops can be seen clearly in the figures given in the tables. As land is not adequate in the hill area, cultivators have to cultivate many crops throughout the year. So, the cropping intensity is comparatively higher in the hills.⁴

In the pre-merger period, Sikkim's agriculture was very much backwards because of skewed distribution of land-holding, practice of mono-cropping, non-existence of agricultural technology, lower investment, lack of marketing etc. But, the post-merger agricultural policy was oriented towards peasant economy, which covers land reforms, agricultural credit and marketing, provision of inputs like HYV seeds, fertilizers, minor irrigation and encouragement to cash-crops and horticultural products. Some new crops like wheat, rajmah, rape and mustard oil-seeds were introduced after the merger of Sikkim.⁵

The maize cultivation belt is located in the humid tropical zone foothills of Southern Sikkim. As it requires high temperatures and good amount of rainfall, maize is sown in early summer and harvested in September-October. Cultivation of maize requires a good amount of human labour for thinning and weeding process. Longitudinal ditches are prepared in maize fields to save land from erosion. It is a staple food of this belt and is also used for preparation of poultry feed and beer.

Paddy is another important crop of Sikkim. Paddy is a crop mainly of river valleys. Along river beds the crop is raised with the help of irrigation. Small channels taken out of the rivers irrigate the surrounding land. On higher areas where temperature and rainfall conditions permit the cultivation of paddy, the crop is grown on terraced fields. In the river bottoms usually transplantation method is followed but on the higher terraced fields broadcasting method is followed. Now with the assistance of Agriculture Department new high yielding varieties of paddy are grown on the terraced farms with Japanese method. Paddy is a summer crop and it is grown everywhere in the state except very higher areas and most of the paddy is raised on unirrigated fields. Because of copious rainfall during its growth period it is possible to raise paddy on unirrigated fields.

Wheat and barley are winter crops. Wheat is raised in Southern and Central Sikkim where temperature and growing period during winter permit the cultivation of this crop. In areas with short growing period and insufficient moisture during winter barley and buck wheat are raised. On the soils which are not fit for paddy or wheat cultivation or where short growing period does not permit the cultivation of superior cereals, millets are raised.

Cardamom, oranges and apples constitute an important part of Sikkim's trade with other parts of the country. Luscious oranges are grown in the southern warmer area of the state whereas apples are grown in elevated areas of Central and Northern Sikkim. Cardamom is a foreign exchange earner crop also. Therefore special steps are being taken to augment the production of cardamom.⁶

The caste-wise average size of land-holdings in Sikkim have been shown in the following table. Though, the data used in this table are of 1985-86 and 1991-92, the trend of holdings can be seen as a consequence of the measures taken by the govt. several times regarding the land transfer. Govt. took measures to protect the ST people, who were the indigenous tribes of the state. So, the size of average holdings not declined even marginally, rather, increased in all categories except marginal holdings. Though, the percentage of SC population is very small in Sikkim, the average land-holdings declined in all categories, except, the large holding. Therefore,

it can be concluded that the landholdings of SC people have marginalized since the merger of Sikkim with India more drastically than among any other castes.

Table 4.6 : Average size of operational Land-holdings of SC & ST in Sikkim

Category	SC		ST	
	1985-86	1991-92	1985-86	1991-92
Marginal(below 1ha)	0.5	0.4	0.5	0.5
Small(1-2 ha)	1.1	1.5	1.3	1.5
Semi-medium(2-4 ha)	2.7	2.9	2.9	3.1
Medium(4-10ha)	5.8	5.7	6.1	6.4
Large(10 and above	11.7	27.3	16.5	16.2

Source: Compiled from the data of Agricultural Situation in India, Vol. 50, No.4, GoI.

The following table shows the ethnic community-wise land-holdings since the merger of Sikkim with India. The highest percentage of paddy-field holding was with Nepali community, followed by Bhutias. Nepali community holds highest percentage of dry-lands and wastelands. But, Lepchas, hold maximum cardamom fields. The Bhutia community had 2nd highest cardamom fields, paddy-fields and wastelands.

Table 4.7: Ethnic Community-wise Distribution of Land-holdings in Sikkim (1976-83)(Area in ha)

Caste	Total Paddy Fields(%)	Total Dry Lands(%)	Wastelands(%)	Cardamom(%)	Total Cultivated land(%)
Bhutia	27.12	16.13	24.18	27.05	20.32
Lepcha	14.97		17.53	32.72	20.38
Nepali	57.19	64.95	62.00	22.37	58.66
Total Public	99.28	99.56	99.60	82.15	99.36

Source: Human Development Report of Sikkim, 2001, GoS, Gangtok

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Chapter 5

Socio-Economic Impact of Agroforestry: Case Study-I

5.0 Introduction

The present chapter deals with the socioeconomic impact of agroforestry on the survey respondents, the information collected on the basis of a predesigned questionnaire. The sampling procedure as explained in the first chapter relates to stratified sampling process pertaining to the study area. The area was selected on the basis of a priori information from secondary data sources. Altogether 160 respondents have been chosen for sample survey, covering the four districts of the state - 25 each from North and West districts, 80 from East district and 30 from South district. However, 3 households were subsequently dropped from tabulation owing to errors in response. Thus the total number of respondents for the present study totaled 157. Taking the household size of the respondents one finds that in the North District, the 25 households represent 145 number of population and in the South district 30 households cover 166 persons. The East district comprises 445 persons, which covers nearly 50 percent of the total sample population of 893. The West district covers 137 persons from 25 households. The sample is collected by following the principle of purposive stratified sampling. In North District, the village called Phensong Phaney of Mangan sub-division is selected, which is mainly Lepcha dominated village. In South district, Jaubari, Assangthang, Kopchey, Mikkhola villages from Namchi Sub-division are selected, all of which are dominated by Nepali people. In East district, Sicheygaon, Assam Lingzay, Central Pendam, Sherwany villages are selected from Gangtok sub-division and Dikling from Pakyong sub-division. These villages are mainly settled by Nepali community. Begha and Lingchom villages are selected from Gyalshing sub-division of West district. These villages are inhabited by Sherpa and Gurung community people. The area profile of the surveyed villages as evident from secondary data sources can now be attempted to get a picture of the area under study.

Work participation rates [WPRs], defined as the proportion of women or men who are economically active, compared to their total number within the population - are nevertheless commonly used as a measure of the economic roles of the population. In

Sikkim, the participation of women in economic activity is quite favourable than plains due to its social compositions, ethnicity and customs. So, the general WPR is quite high in the Sikkim mountain area.

5.1 Description of Villages

The North district is almost uninhabited by common people. Most of the area is captured by the Indian Army for its political importance. Large area of the district is covered by snow throughout the year. The selected village Phaney Phensong of Mangan sub-division is mainly lepcha dominated village. According to 2001 census, nearly 88 percent of the population belong to Scheduled Tribe. The total population in the village is 767, of which, 393 are males and 374 are females. The female-male ratio (FMR) is favourable at 952. The economic status of the population as is reflected by the work participation rate (WPR) is 54.4 percent and literacy rate is 56.4 percent. The primary activity for livelihood is agriculture.

The village called Assangthang of Namchi Sub-division in South district is comparatively prosperous with high literacy rate (82.2 percent) and high WPR (71.3 percent). Most of the people (77.6 percent) are engaged in cultivation. The number of SC and ST people is not as high as the North district. The FMR is lower than the North district at 887.

Jaubari of Namchi sub-division is a *Sherpa* dominated (78.2 percent) village with a total of 522 inhabitants. The *panchayat* is 10 km away from Namchi town. The FMR is favourable at 933, but, the literacy rate is comparatively lower at 62.4 percent. Cultivation is the main activity (94 percent) among the inhabitants. The WPR is high at 85.6 percent. High WPR also indicates high participation of both men and women in livelihood activities.

Kopchey is a comparatively larger village in the Namchi sub-division of South district with 1240 inhabitants. The activity is diversified in this village. The number of STs in the village is small with only 12.5 percent, and the rest of the population belongs to other castes. The literacy rate is high at 73.4 percent and the FMR is highly favourable at 1016. However, the WPR is low compared to other villages in the district, figuring close to 42 percent.

Mikkhola is another comparatively less inhabited village with 620 people in Namchi sub-division in the South district. This village has a mixed composition of people. Here SC, ST and other castes people are living together. Most of the people are engaged in cultivation (83 percent). The village has 78 percent literacy rate along with reasonably high WPR at 68 percent.

Dikling in East District also has a mixed composition of people with FMR (898) lower than the state average and the literacy rate is almost the same as the state average (67 percent). Less than 50 percent of the populations are engaged in agriculture. The WPR is quite favourable at approximately 61 percent.

The village called Lingzey (Assam) is located in the East district of Gangtok subdivision. The literacy rate is high at 75 percent. More than fifty percent of the populations are cultivators. The WPR is comparatively low (47 percent). Both SC, ST people live there, with Nepalis dominating the population residing here.

Sichegaon under Gangtok subdivision is the largest village among the selected villages. It is also dominated by the Nepali people, but cultivation is not the main activity. Only 15.7 percent people are engaged in cultivation. The FMR is 891. The literacy rate is high at 72.5 percent. The WPR is low at 42.7 percent only, which means, there is not many livelihood opportunities.

Begha is a village in the West district in Gyalshing sub-division. The percentage of ST people is 35.5. The FMR is high at 1005 but the literacy rate (53.4) is much lower than the state average. The low WPR (40 percent approximately) might be due to low participation of women and less work opportunities. Cultivation is the primary activity as 70 percent of the population are engaged in cultivation. Lingchom is another village in this sub-division. In this village, the percentage of SC and ST is very small. The FMR is 956. The literacy rate is also lower in this village. Almost fifty percent of the people are engaged in cultivation. Here also the WPR is lower with 50.8 percent. Central Pendam of Gangtok sub-division in East District is the largest village amongst the surveyed area.

The survey questionnaire designed to elicit information about the socioeconomic milieu of people represented, consisted of several demographic and economic aspects, expected to draw a sufficiently clear picture of their background.

5.2 Socio-demographic Characteristics of the Survey Respondents

Table 5.1: Age Group of Sample Respondents

<u>Age-group</u>	<u>Respondents</u>	<u>Percentage</u>
20-29	10	6.4
30-39	19	12.1
40-49	45	28.7
50-59	50	31.8
60-69	22	14.0
70+	11	7.0
Total	157	100

Source: Primary Survey, 2007

The age of the sample respondents ranged from 20 to 89. It is found from the above table that the respondents in the age-group above 50 are more in number than those below 50. The age distribution of respondents is uni-modal with single modal cluster in the age-group 50-59. The average age of the sample respondents is 48.6 years. The people aged above 50 have the experience of both pre-merger and post-merger conditions of Sikkim. It is also important to select respondents above 60 as well as 70, because they became adults much earlier than Sikkim's merger with India in 1975.

Table 5.2: Family Type & Average Age of Sample Respondents

<u>Family Type</u>	<u>No.</u>	<u>Percentage</u>	<u>Average Age</u>
Extended	12	7.6	48.1
Unitary	93	59.2	47.8
Joint	52	33.1	51.3

Source: Primary Survey, 2007

As is well-known, the breakdown of joint and extended rural families is accelerated by landlessness and assetlessness. One of the principal reasons for this is that the landless households are not tied either to extended families or property. Nuclearisation of the sample respondent-families is thus also reflected in their propensity to seek distant livelihood opportunities and move. The unitary family is dominant type in the area under study. The figure is as high as 59 percent, followed by the joint family, which is around 33 percent. The extended family is still prevailing in this hill state, although in small numbers, with only 7.6 percent of the 157 respondents.

Table 5.3: Earning Status of Sample Respondents

<u>Earning Status</u>	<u>No. of Respondents</u>	<u>Percentage</u>
Joint	119	75.8
Sole	38	24.2

Source: Primary Survey, 2007

More than 75 percent of the respondents are joint earners. Only a quarter percentage of the respondents are sole earners. Economic pressure within households is thus apparent with single earners being unable to sustain household expenditure under increasing market economy. Alternative livelihoods to supplement household income thus become important in the case of agricultural households with limited earnings. Joint earning also often is an indicator of an important aspect of household work participation where the participation of men as well as women is quite high in the surveyed area.

Table 5.4: Educational Status of Sample Respondents

<u>Education</u>	<u>Number</u>	<u>Percentage</u>
Illiterate	74	16.3
Functionally Literate	72	15.8
Up to Class IV	70	15.4
Class IV to VIII	97	21.3
Above Class VIII	139	30.5
Secondary-Graduate	3	0.7

Source: Primary Survey, 2007

The above table shows that the literacy rate is more than 80 percent among the sample population. It is also evident from the secondary data that the national average literacy rate is 65.38 percent, whereas it is 68.8 percent for Sikkim. Thus, the literacy rate is higher in Sikkim than the national average. It is also evident that a high percentage of respondents (30.5 percent) has studied till the secondary level (above VIII).

A study of the places of schooling reported by literate respondents indicated a considerable degree of educational mobility as a possible result of family migration. The mobility is higher in the East district than other districts because this district is comparatively well connected by road and other infrastructural conditions are better. Some of the respondents were from Nepal after their schooling in Nepal.

Table 5.5: Caste-wise Distribution of Sample Respondents

CASTE	NO OF RESPONDENTS	Sample Population(%)	Male	Female
GEN	41	224(25.08)	114	110
OBC	64	361(40.43)	174	187
SC	7	40(4.48)	17	23
ST	45	268(30.01)	130	138
TOTAL	157	893(100)	435	458

Source: Primary Survey, 2007 (Percentage in parenthesis)

Almost one-fourth of the total respondents are from general category. Rest three-fourth is from backward community as found during the survey. The percentage of respondents of various castes has been found to be similar to the representation in the overall secondary data of the state. The number of females in general caste is lower than the number of males, but the number of females is higher than the male in the SC, ST and OBC communities.

Table 5.6: Gender Composition & Dependency among Sample Respondent Families

<u>Family Composition</u>	<u>Number</u>	<u>Percentage</u>	<u>FMR</u>
Total Males	435	48.7	
Total Females	458	51.3	1053
Male Minors	160	51.3	
Female Minors	152	48.7	950
Earning Males	176	57.7	
Earning Females	129	42.3	733

Source: Primary Survey, 2007

The FMR is 1053 among the total population of the surveyed respondents. But, the low FMR in the minor group shows that the birth of male child is higher. In the earners group, the FMR is very low at 733. Although, WPR in Sikkim is high, low participation of women in the workforce and owing to low educational status is seen among the respondent population. Lack of education is a constraint for women restricting them from participating in the service sector.

Table 5.7: Family Size Distribution of Sample Respondents

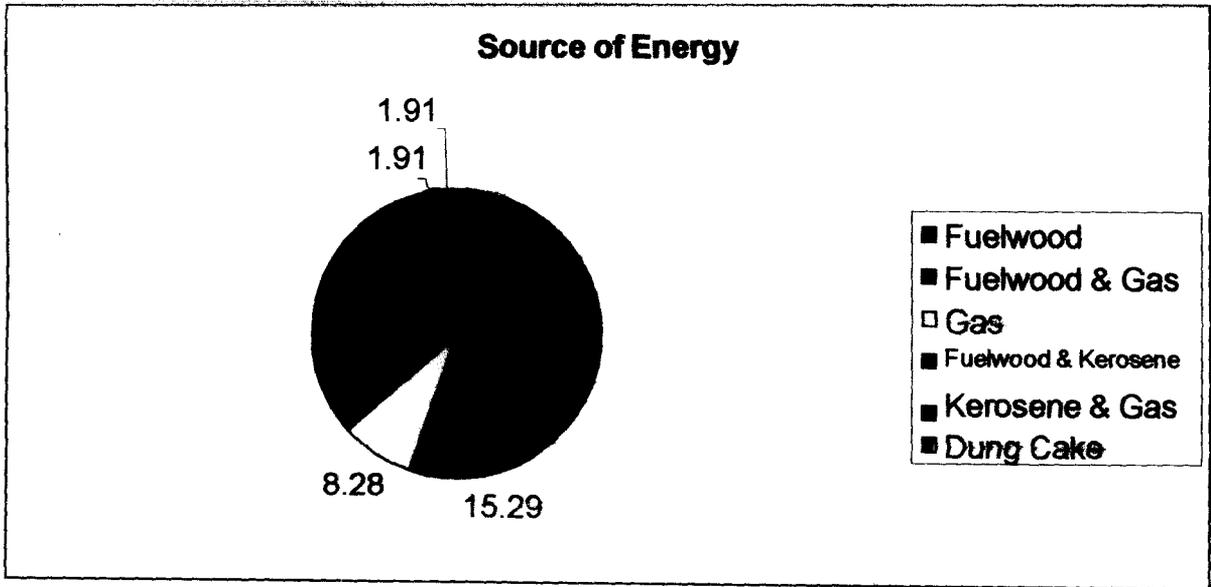
<u>Family Size</u>	<u>No. of Families</u>	<u>Percentage</u>
2	2	1.3
3-4	52	33.1
5-6	58	36.9
7-8	28	17.8
9-10	13	8.3
11-12	3	1.9
13+	1	0.6

Source: Primary Survey, 2007

In the above table, the modal class for family size of respondents is 5-6, which is quite high. The percentage of family member ranging between 3-6 is 70 percent and in Table-5.2 we have seen that the percentage of unitary family is almost 60 percent, which means that the nuclear families of Sikkim have family members ranging from 3-6.

General living conditions of the respondents are portrayed in the following tables. Living conditions is the mirror of general economic status of the respondents. Certain features were found to be universal among the respondents like fuelwood being the most common form of energy used because it could be collected and came without a price. Commercial energy on the other hand is hardly used, the sole exception being kerosene which is widely used in the non-electrified households for lighting purposes.

Figure 5.1: Energy Source of Sample Respondents



Source: Primary Survey 2007

It is clear from the above that most of the respondents are getting their energy from fuelwood. Sometimes, they take support of LPG and Kerosene in addition to fuelwood. A negligible percentage of respondents use dung cake as energy source. Comparatively, wealthier respondents get their energy source from Kerosene & LPG or sometimes only from LPG.

5.3 Economic Status of the Survey Respondents

Living conditions is also typically reflected by the type of houses where the respondents live. Going by the broad housing structures commonly found in India, houses have been classified as *kuchha*, *Semi-pucca* and *pucca*. But, in the hills *Kuchha* house built of clay is virtually absent among respondents possibly due to limited availability of clay soil in hilly regions. The house-types selected in this region are built with bamboo, cement, wood and wattle & daub. The cemented or *pucca* houses are built by comparatively wealthier households. Wattle & Daub house is made by economically backward households.

The economic status of a population can be identified through various indicators ranging from their holding of assets, type of assets, and of course, from their major sources of income. Within the asset holding housing status and/or land-holding occupy prime positions as economic indicators. The following analysis of house-type of respondents has thus been attempted to assess the economic status of the survey respondents under study. No distinction in terms of geographical location or demographic characteristics has been resorted to during the analysis, with the sole objective of differentiating the survey respondents in terms of their economic status.

Table 5.8: House-type of Respondents

<u>House Type</u>	<u>No. of Households</u>	<u>Percentage</u>
Bamboo	1	0.7
Cement	21	13.8
Wooden	126	82.9
Wattle & Daub	4	2.6

Source: Primary Survey, 2007

It is found from the table that more than 80 percent people live in wooden houses. It could have been due to the easy availability of wood from forests and other environmental reasons. The wealthier households have brick and cemented house, which

is around 14 percent. Very few (2.6 percent) households have wattle & daub house. Only one respondent had bamboo-made house. People living in the wattle & daub houses live in acute economic deprivation.

Table 5.9: House Status of Respondents

<u>House Status</u>	<u>No. of Households</u>	<u>Percentage</u>
Rented	6	3.8
Self-owned	150	96.2

Source: Primary Survey, 2007

Around 96 percent of the households have their own house with the remaining living in rented houses. The urban pull seems to be not so strong since migration is not a common feature in these hills.

Table 5.10: House-size of Respondents

<u>House Size</u>	<u>No. of Households</u>	<u>Percentage</u>
Single-storied	85	55.2
Double-storied	69	44.8

Source: Primary Survey, 2007

From the above table, it is seen that the percentage of single storied houses is more than fifty-five percent and the percentage of double-storied house is almost 45 percent, showing very little difference in house-size between different economic classes of the population.

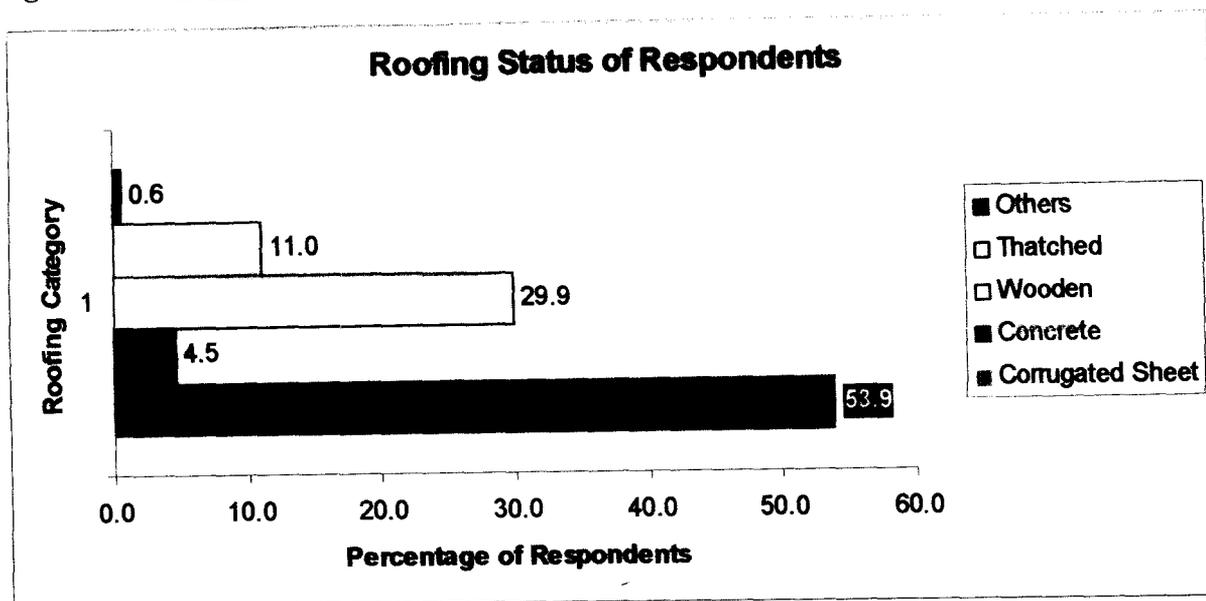
Table 5.11: Roofing Status of Respondents

<u>Roofing Status</u>	<u>No of Households</u>	<u>Percentage</u>
Corrugated Sheet	83	53.9
Concrete	7	4.5
Wooden	46	29.9
Thatched	17	11.0
Others	1	0.6

Source: Primary Survey, 2007

Roofing of houses on one hand reflect the economic status of the respondent sample, while on the other the choice is also governed by the climatic conditions that prevail in the region. It is clear from the above table that more than fifty percent people have used corrugated sheets for roofing of their houses. Only, 4.5 percent people have used concrete roofing. Almost 30 percent respondents are using wooden roof and 11 percent have thatched roof. Thus, it may be concluded from the above that most of the people are not affluent enough to have concrete roof. Corrugated sheet is comparatively cheaper and is widely used.

Figure 5.2: Roofing Status of Sample Respondents



Source: Primary Survey 2007

Table 5.12: Family Earner Distribution

<u>Earners</u>	<u>Families</u>	<u>Percentage</u>
1	31	21.2
2	79	54.1
3	18	12.3
4	12	8.2
5	4	2.7
6	1	0.7
7	1	0.7

Source: Primary Survey, 2007

It is an important feature of Sikkims' economy that more than 54 percent of the households among the respondent families are joint earners. The work participation rate among women is much higher in this state. It has been seen during the survey that large number of women are mainly engaged in petty trade in their own households. Up to seven earning members in a family has been found during the survey.

Table 5.13: Primary Occupation of Sample Respondents

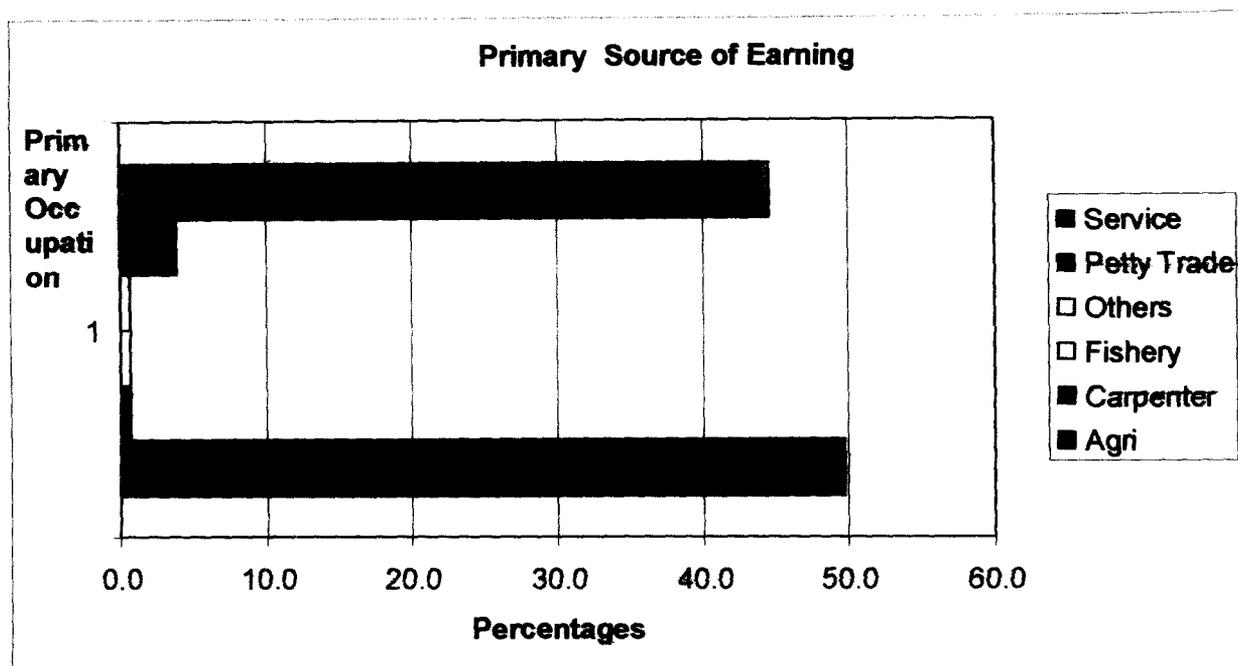
<u>Primary Occupation</u>	<u>No.of Respondents</u>	<u>Percentage</u>
Agriculture	78	49.7
Carpentry	1	0.6
Fishery	1	0.6
Others	1	0.6
Petty Trade	6	3.8
Service	70	44.6

Source: Primary Survey, 2007

Almost 50 percent of the respondents are engaged in agriculture, as is evident from the above table. Participation in the service sector is also high at almost 45 percent, followed by petty trade. With increasing focus on tourism, the potential of petty-trade is also increasing. The picture is almost the same as the data found from the secondary source. The engagement of the respondents in the activity of carpentry, fishery and others is negligible, pointing to the fact that the economy of Sikkim is still agriculture dominated.

The main livelihood activities are shown in the following chart. It is evident from the following chart that the service sector is growing very fast and there is a shift in livelihood activity among the respondents.

Figure 5.3: Primary Source of Earning of the Sample Respondents



Source: Primary Survey, 2007

Table 5.14: Secondary Source of Income of Sample Respondents

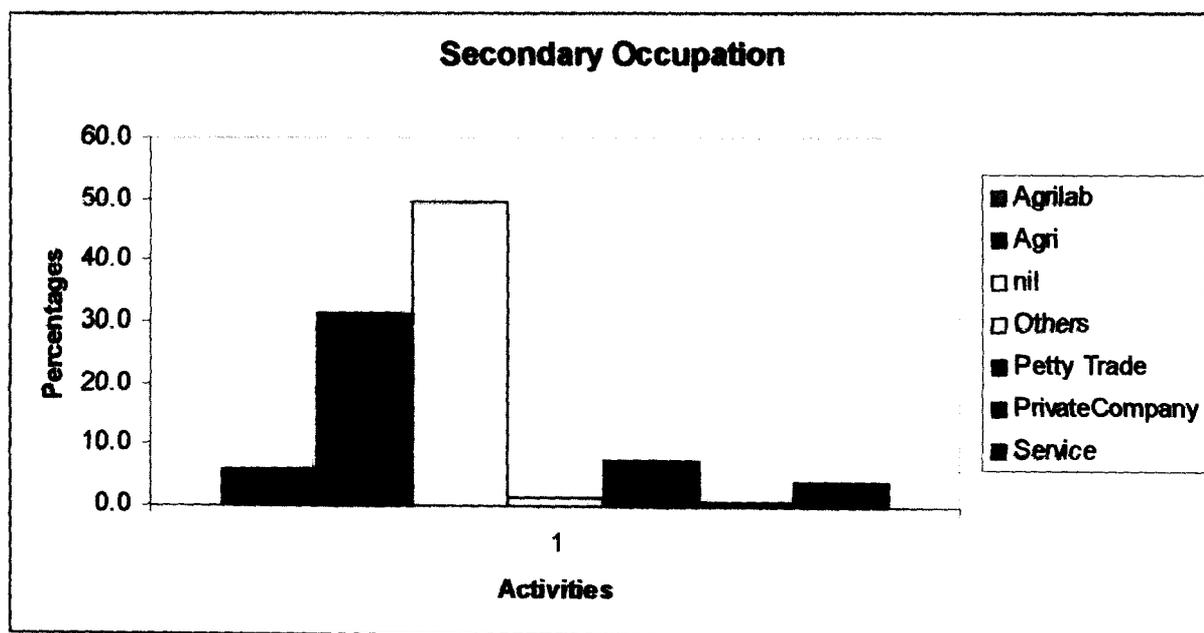
<u>Secondary Income</u>	<u>No.of Respondents</u>	<u>Percentage</u>
Agricultural Labourer	9	5.7
Agriculture	49	31.2
Nothing	78	49.7
Others	2	1.3
Petty Trade	12	7.6
Private Company	1	0.6
Service	6	3.8

Source: Primary Survey, 2007

Almost 50 percent of the respondents have no secondary sources of income. But the engagement in agriculture is the highest, followed by petty trade. Women, as were found during the visit in Sikkim dominate the activity of petty-trade. The service sector as a

secondary income source has very negligible contribution. The following chart shows the secondary source of earning of the sample respondents. It is clear from the picture that some of the respondents are engaged as wage labour in agriculture although it was found during the survey that very few marginal farmers are compelled to work as agricultural labourers. The earnings from agriculture is not adequate enough to maintain their livelihoods with family, which forced people to look for alternative livelihoods.

Figure 5.4: Secondary Source of Income of the Sample Respondents



Source: Primary Survey, 2007

As tourism is emerging as a lucrative livelihood option to the mountain people, transportation in small four-wheelers are getting popularity for easy accessibility of mountain roads. So, many young men are engaged in driving taxis. Even it is found that college-going students are finding this as an important earning source by accepting this part-time activity. This type of activity is included in the other category.

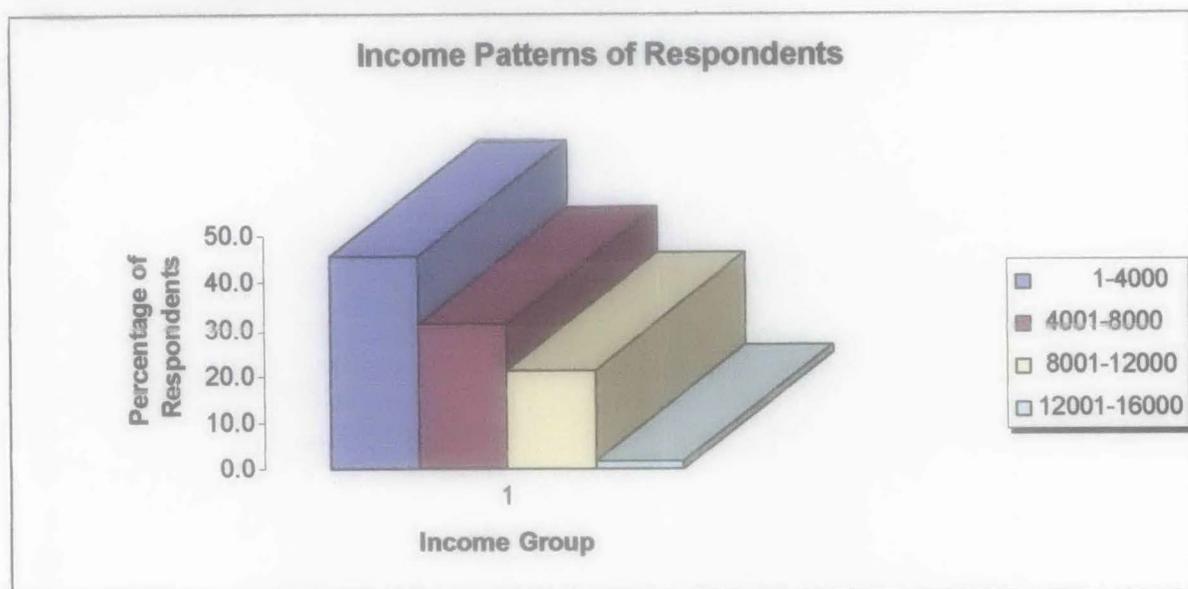
Table 5.15: Income Patterns of Households

<u>HH Income in Rs.(monthly)</u>	<u>No.of Respondents</u>	<u>Percentage</u>
1-4000	70	45.5
4001-8000	48	31.2
8001-12000	33	21.4
12000+	3	1.9

Source: Primary Survey, 2007

Almost half of the total respondents belong to the lower income group. This is primarily because that a significant number of the respondents practiced subsistence farming that accrues low production and low income. But, as participation in the service sector is also high among the respondents, the percentage of respondents in the Rs.8000/- - Rs.12000/- group is a little more than 20 percent. High income group is negligible at only 2 percent, where the respondents are found to have both sources of earnings. The per capita income of the respondents is approximately Rs.1200/- per month, although it does not reflect the poor economic status of the very low income groups primarily among agriculturists and wage labourers. The largest proportion of the respondent population belong to the least income bracket while only a negligible proportion belong to the highest income bracket.

Figure 5.5: Income Patterns of the Sample Respondents



Source: Primary Survey, 2007

In order to assess the impact of agroforestry practices on changing livelihood patterns, it is important to group the respondents into agroforestry and non-agroforestry practicing categories. The following table shows that among the total respondents more than fifty percent practiced agroforestry and around 43 percent did not practice agroforestry. Nearly 2/3rd of the respondents practicing agroforestry resort to the practice of homestead gardening which in itself is the second largest category (36.3 percent) among the total respondents.

5.4 Socioeconomic status of Survey Respondents in terms of engagement in Agroforestry

Table 5.16: Sample Respondents Engaged in Agroforestry & Non-agroforestry

	Type of Agroforestry	No. of Respondents	Percentage
Agroforestry	Cardamom	32	20.4
	Homestead	57	36.3
Non-Agroforestry	None	68	43.3

Source: Primary Survey, 2007

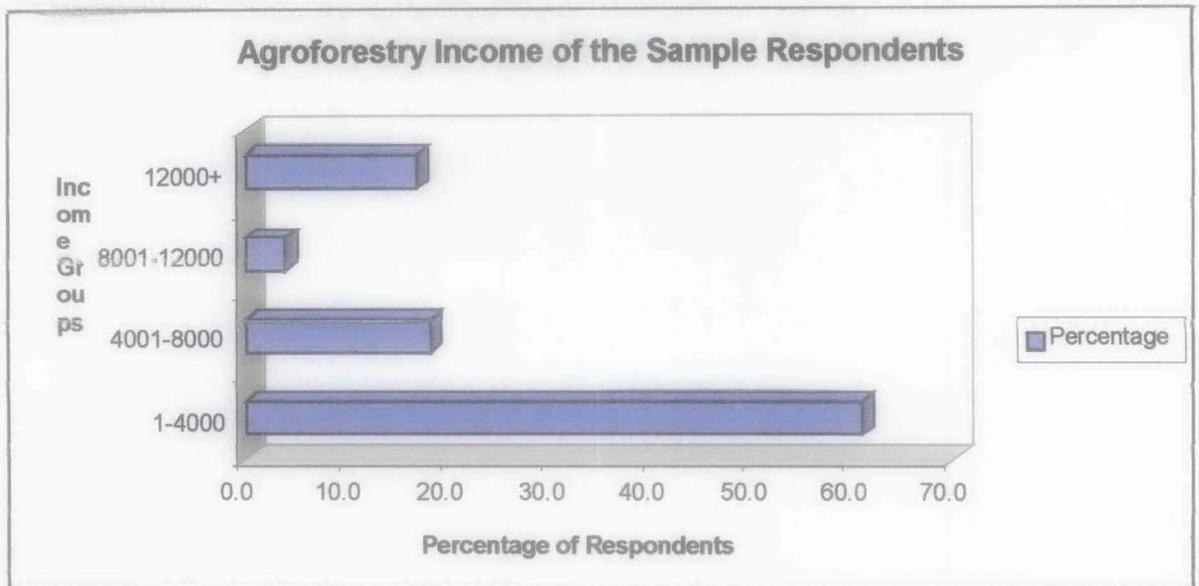
It has been seen during the survey that the primary agroforestry system practiced among the respondents is large cardamom plantation. It is known that the large cardamom needs humid condition within a temperature range of 10-33 degree C having uniform rainfall of 2000-3500mm and the environmental condition prevailing under the shade of forest trees. In Sikkim, Utis is most commonly used as shade tree, which is also useful as fuelwood and timber.

Table 5.17: Agroforestry Income of Sample Respondents

Agroforestry Income(Annual)	No. of Respondents	Percentage
1-4000	47	61.0
4001-8000	14	18.2
8001-12000	3	3.9
12000+	13	16.9

Source: Primary Survey 2007

Figure 5.6: Agroforestry Income of the Sample Respondents



Source: Primary Survey, 2007

As reflected in the table and as well as in the chart, income from agroforestry of the sample respondents is at subsistence level inadequate to sustain present livelihood patterns. Most of the respondents (around 60 percent) fall in the lower income category. Only 17 percent of the respondents earned more than Rs.12000/-, i.e., Rs.1000/- per month, which is lower than the per capita income of Rs.1200/- among the respondent sample. Cardamom commands a high price in the market but as we shall see later that the production is not adequate for individual families to earn a very high income. This is primarily because most of the farmers are in the marginal category with low production potential, as seen below.

Table 5.18: Average Size of Land Holding

Agroforestry Type	Total Holdings(Acre)	Average Holding(Acre)	Land
Cardamom	36.01	1.13	
Homestead	93.71	1.64	

Source: Primary Survey, 2007

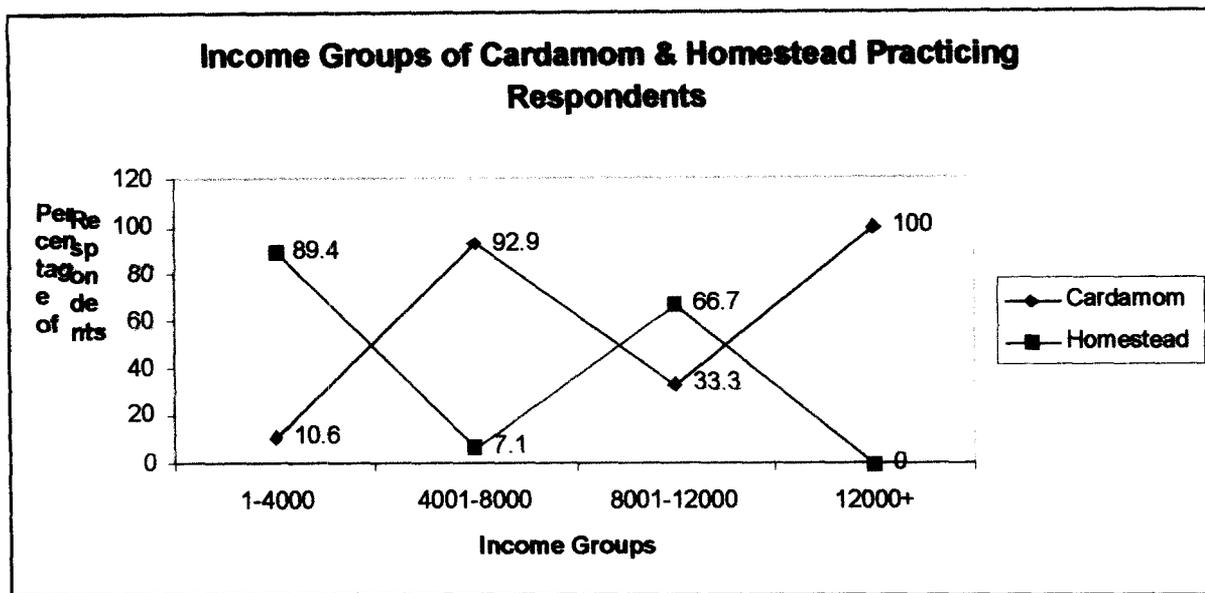
As per classification of the government, the land holding of the agroforestry practicing farmers of sample respondents fall under marginal group (below 1 ha). Thus, it is clear from the above table that the respondents belong to marginal category with small land holding size. The average land holding of the cardamom plantations of the respondents is 1.13 acre per household, which is even lower than the commonly practiced homestead agroforestry (1.64acre).

Table 5.19: Income from Agroforestry

<u>Agroforestry Income</u> <u>(Rs.in Yearly)</u>	<u>No. of Respondents</u>	
	<u>Cardamom</u>	<u>Homestead</u>
1-4000	5 (10.6%)	42 (89.4%)
4001-8000	13 (92.9%)	1 (7.1%)
8001-12000	1 (33.3%)	2 (66.7%)
12000+	13 (100%)	0 (00.0%)
Total	32	45

Source: Primary Survey, 2007

Figure 5.7: Income Groups of Cardamom & Homestead Practicing Respondents



Source: Primary Survey, 2007

The above table and chart show the annual income from cardamom plantations and homestead gardening among the common agroforestry practices. The first income group falling within Rs.4000/- consists of almost 90 percent of respondents practicing homestead agroforestry. The practice is also high among the Rs.8001-12000/- income group. The highest income group is entirely dominated by the cardamom practices. Thus, it is clear from the above table that cardamom practicing agroforesters have more income than the homestead gardening practices. The small and marginal land-holders who are practicing cardamom plantations, belong primarily to the second income group of Rs.4001-8000/-. However, those who have comparatively large land-holdings, belong to the highest income group of Rs.12000/- and above. Most of the homestead gardening practicing people belong to low income groups and very few of them are in higher income groups. Thus, while a significant proportion of the number of respondents practice homestead gardening, they fall in the lower income category rather than the high income category, when compared to those who practiced cardamom plantation agroforestry. Data on livelihood practices of the respondents also show that the number of agroforestry practicing respondents is greater than the non-agroforestry practicing

respondents, but the former belong to lower income categories than the latter. However, there is still much scope for betterment of the homestead and cardamom agroforestry practices.

Conclusion

The above is the description of the socio-economic characteristics of the sample respondents in aggregate, with only distinction being made between agroforestry practicing and non-practicing respondents. The following chapter is a continuation of the present analysis in a disaggregate form. District-wise analysis while grouping the respondents in terms of caste and community are undertaken to obtain a comparative picture of the impact of agroforestry on the sample respondents in each district.

Chapter 6

Socio-Economic Impact of Agroforestry: Case Study - II

6.0 Socio Economic Impact of Agroforestry

The previous chapter outlines the various socioeconomic aspects of the respondents surveyed in the villages of Sikkim to assess the impact of agroforestry on livelihood choices of the respondents. The analysis had proceeded on the basis of the villages and the total sample surveyed. Although the inferences drawn from the analysis informs us about the respondents demographic and socioeconomic background, the analysis lacks in providing an overview in terms of the districts of the state and in terms of community and ethnolinguistic character of the respondents. The present thus attempts to carry the analysis forward in order to get a disaggregated impact of agroforestry on livelihood changes in terms of the four districts – north, south, east and west, and in terms of communities – SC, ST, OBC, General caste, within which the various ethnoreligious groups prevail.

6.1 District-wise Socioeconomic status of the Survey Respondents

6.1.1 Religion and Caste Compositions of Respondents

Table 6.1: Religion and Caste Compositions of Respondents

District	Caste/Tribe					Religion		
	Respondents	GENERAL	OBC	SC	ST	Buddhist	Christian	Hindu
North	25	0	0	0	25	25	0	0
South	30	10	17	0	3	2	0	28
East	77	34	31	7	5	6	6	65
West	25	3	10	0	12	22	0	3
Total	157	47	58	7	45	55	6	96

Source: Primary Survey, 2007

It can be seen from the above table that all the respondents of North district belong to ST community and all are Buddhists. In South, most of the respondents (28) are Hindu, rest are Buddhist. More than fifty percent respondents are from other backward communities with 10 respondents being from general castes. One-tenth of the respondents belong to ST community. The most populated East district has

representation of all communities and religions. Though, most of the respondents are Hindus, but they have come from all the castes. Both Buddhists and Christians have equal representation (6 each). In West district, almost fifty percent of the respondents are from ST community followed by OBC. Most of the respondents are from Buddhist community.

6.1.2 Education Status of the Sample Population

Table 6.2: Education of the Sample Population

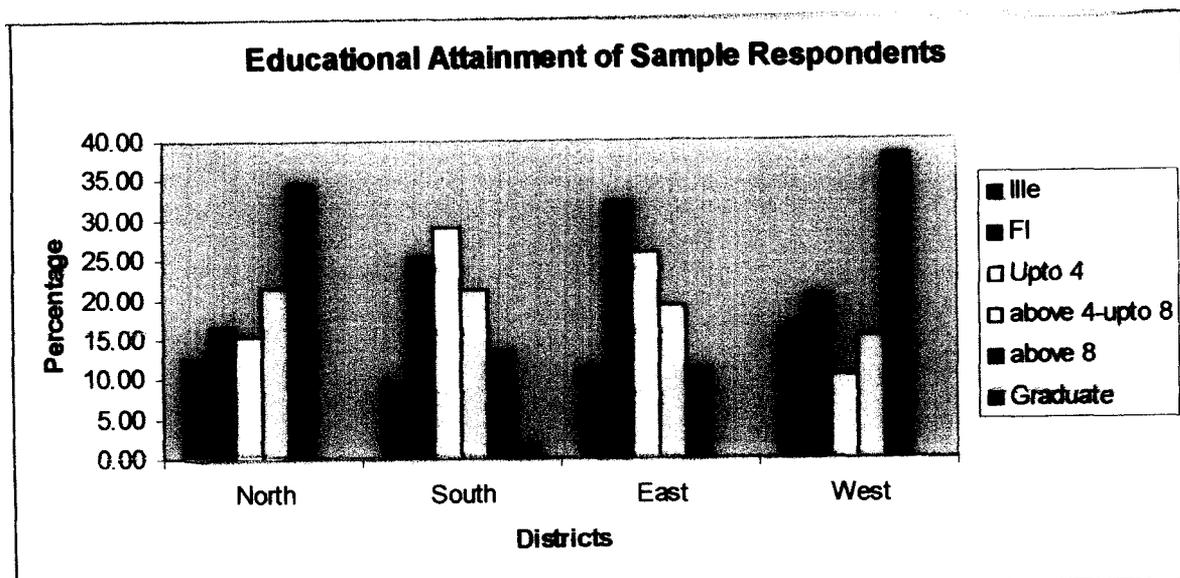
Districts	Sample Population	Male	Female	Illiterate	Functionally literate	Up to IV	V to VIII	VIII and above (XII)	Graduate
North	145	70	75	18(12.41)	24(16.55)	22(15.17)	31(21.38)	50(34.48)	0(0.00)
South	166	80	86	16(9.64)	42(25.30)	48(28.92)	35(21.08)	22(13.25)	3(1.81)
East	445	214	231	50(11.24)	143(32.13)	115(25.84)	85(19.10)	50(11.24)	0(0.00)
West	137	71	66	22(16.06)	28(20.44)	14(10.22)	21(15.33)	52(37.96)	0(0.00)
Total	893	435	458	106(11.87)	237(26.54)	199(22.28)	172(19.26)	174(19.48)	3(0.34)

Source: Primary Survey, 2007

(Percentages in parenthesis)

Though the inhabitants of the North district by and large belong to the backward ST community, the literacy rate among the respondents is high at 88 percent. For the study region in the West district, the lowest literacy rate is in this district at 84 percent, among the respondents. It is also established from secondary information that the Buddhist community in Sikkim is the frontrunner in the way of progress. It has been found from secondary data that the high level official posts in Sikkim, as well as in other states are from Buddhist community who are also economically progressive than the other communities and religious groups. The respondents in the South and East districts are comparatively more literate and are predominantly Hindus. Only three respondents of the South district are found to have completed graduation. There is little variation in educational attainment upto class VIII between the districts. However, beyond class VIII, the difference among the respondents in each district is quite stark with North and West district having around 35 percent of the respondents who have studies beyond class VIII. It may be recalled that the North district is dominated by the Buddhists as far as the survey villages are concerned. But, college level education and graduates were found only in the South district.

Fig 6.1: Education of the Sample Respondents



Source: Primary Survey, 2007

6.1.3 Asset Holdings of Respondent Families

Table 6.3: Housing Assets of Respondent Families

Districts	House Type			No. of Rooms(Avg)	Construction Cost in Rs. (Avg)	Maintenance Cost in Rs. (Avg)
	Wooden	Pucca	Wattle & Daub			
North	25	0	0	6.7	139600	4080
South	16	13	1	6.8	55367	1580
East	65	8	4	5.9	23247	1139
West	25	0	0	6.9	137400	4920
Total	131	21	5	6.3	66089	2294

Source: Primary Survey, 2007

The North district as mentioned earlier is characterized by high altitude and very low population density. Difficult terrain, problems in accessibility and extreme climate are common features of this district, causing all the respondents to build wooden houses, entailing very high construction cost. This is due to heavy transportation cost and the ensuing high cost of materials. Maintenance cost is thus also high. The west district is similar in physical aspects and is faced with similar problems of transportation difficulties, etc. The west district also has higher construction cost, and maintenance

cost is higher than the north, as per the survey results deliver. All this cause economic hardship to the people concerned. The construction cost as well as maintenance cost is the lowest in the east district, possibly due to the comparatively low transportation cost as the proximity of state capital, which also has comparative advantage due to proximity with Siliguri, the corridor of North-East. Another reason might be the average number of rooms in east district is lower than the other districts causing the construction and maintenance cost to be low. The *pucca* houses are found largely in the south and east district, more because of land stability and relatively flat land being available in these two districts.

Table 6.4: Self-owned Land holding (in acre per capita) by the Sample Population

Districts	Sample Population	Irrigated	Unirrigated	Leased in tenant	Leased in share crop	Leased Out
North	145	0.60	0.00	0.02	0.00	0.10
South	166	0.27	0.18	0.00	0.00	0.00
East	445	0.17	0.01	0.05	0.14	0.00
West	137	0.36	0.00	0.01	0.00	0.04
Total	893	0.29	0.04	0.03	0.07	0.02

Source: Primary Survey, 2007

The per capita irrigated land in the North district is the highest at 0.60 acre per capita. The region experiences very harsh climate with severe winters. High gradient of land, relatively low precipitation and cold is not conducive to agriculture. Hence, irrigation is imperative for production of crops and vegetables. The North district also occupies 50 percent area of the state and thus cultivated land also has a wider coverage. The West district has the second highest per capita irrigated land (0.36 acre). Though the South district has comparatively leveled land, the per capita unirrigated land is the highest (0.18 acre) among the districts. The East district with highest population density and highest number of population caused lowest per capita irrigated land.

6.1.4 Changing Landuse and Livelihood Patterns

Table 6.5: Ratios of Land-related Indicators

Dists	Total Land(Acre)	Total Cultivated Land(Acre)	%Share Cropped_to_TotLand	%Irrigated Land	Unirrigated/Irrigated	Land/Man
North	153.50	42.5	0.00	57.00	0.00	1.06
South	88.44	24.8	0.00	59.60	67.58	0.53
East	252.56	22.1	24.53	30.21	2.10	0.58
West	86.50	30.2	0.00	56.65	1.02	0.63

Source: Primary Survey, 2007

The total land is highest in East district with 252.56 acre. But, the total cultivated land is highest in North district with 42.5 acre. The North district is 2nd highest in total land. The West district is 2nd highest in cultivated land with 30.2 acre. Surprisingly, the East district has lowest cultivated land and the West district has lowest total land. The percentage of share-cropped to total land is high at 24.53 percent, in the East district. This is a pointer to the fact that many respondents were landless and assetless, both being indicators of economic deprivation, in the East district. The percentage of irrigated land is also the lowest (30.21 percent) in East district when compared to the other districts, as per the survey information. The highest irrigated land is available in the South district. The percentage of unirrigated to irrigated land is also the highest in South district at 67.58. This is particularly because total available land for cultivation high in this district. The land man ratio is highest in North district (1.06 acre).

Table 6.6: Land Utilization – Present and Past – by the Sample Population

Districts	Sample Population	Present Land Utilizations (Acre Per Head)				Past Land Utilizations (Acre Per Head)			
		Culti-Vated	Home-Steeds	Planta-tions	Fallow	Culti-vated	Home-steeds	Planta-tions	Fallow
North	145	0.29	0.03	0.21	0.00	0.40	0.03	0.13	0.00
South	166	0.15	0.03	0.05	0.09	0.13	0.03	0.06	0.09
East	445	0.05	0.01	0.00	0.01	0.04	0.01	0.00	0.01
West	137	0.22	0.03	0.12	0.00	0.27	0.03	0.08	0.00
Total	893	0.71	0.10	0.39	0.09	0.85	0.10	0.28	0.09

Source: Primary Survey, 2007

The above table presents changes in land use over 5 to 10 years in the sample villages which have been grouped under North, South, East and West districts. Information on per capita land availability for cultivation, homestead, plantations and fallow, is provided for the study villages of the 4 districts. The North district, characterized by difficult terrain, is dominated by agroforestry farming system with almost 71 percent of land under cultivation and almost 24 percent under plantations in the surveyed villages. While per capita cultivable land has decreased over the years, it has been partially compensated by increase in plantations. Similar picture is evident in West district, although percentage decline in per capita land under cultivation in the district is lower than the North. Per capita land available for cultivation increased over the period in the sample villages in the South district, with also a marginal decline in per capita land under plantations. The South district is involved predominantly in wheat-potato based farming system. In contrast to the three districts, the East district, characterized by urbanized centres, per capita land available for cultivation is minimal with negligible plantation area. Thus, in the East district, dependence on agroforestry is minimal.

Table 6.7: Crop Information – Present and Past – of the Sample Population

Districts	Present Crop Information			Past Crop Information		
	Spring	Summer	Winter	Spring	Summer	Winter
North	Wheat	Maize	Paddy	Wheat	Maize	Paddy, Wheat
South	Cereals, Potato, Soybean	Maize	Cereals, Ginger, Pulses, Pea	Cereals, Potato	Maize	Cereals, Pulses,
East	Maize, Millet	Maize, Paddy, Potato	Millet, Potato, Mustard, Paddy	Maize, Millet	Paddy, Maize	Millet, Potato, Wheat
West	na	Pea, Potato, Maize	Maize, Paddy, Ginger	na	Potato, Maize	Maize, Paddy

Source: Primary Survey, 2007

Generally, North district is high altitude area and mostly uncultivated area. But, the surveyed area is among the cultivated one. The traditional cropping system is still

prevailing with minor change in cropping pattern. Previously, the wheat production was familiar, but due to declining profitability, the cultivators started to switch over to plantations. South district has started soybean production in spring and ginger and pulses in winter, in addition to other traditional crops. In East district, the potato and mustard production have been started with other traditional crops. The West district, which is the important cultivated district of Sikkim, also has minor change in the cropping pattern. The cultivators started to produce pea and ginger in summer and winter respectively. Thus it can be concluded that the change of cropping pattern can be followed in almost all the four districts and the shift is towards cash crops or plantations from traditional crops.

Table 6.8: Sources of Income(in Rs.) of the Sample Population

Districts	Sample Pop.	Monthly Income (Avg)	Income from Agro forestry	Agri. prod. (cereals)	Milk	Fruits	Eggs & Poultry	Family remit.	Artisan earning	Trade Earning	Salary	Wages
North	145	1516.7	133.3	233.8	93.8	0.0	45.5	6.9	0.0	84.1	923.4	2.8
South	166	1288.5	30.7	63.3	7.8	0.0	4.1	0.0	0.0	200.7	953.1	0.7
East	445	558.7	47.4	28.1	31.0	5.5	7.0	0.0	0.0	0.0	83.6	16.0
West	137	1567.2	18.6	28.1	31.0	5.5	7.0	0.0	0.0	0.0	83.6	16.0
Total	893	968.9	9.4	104.7	87.7	2.7	24.0	1.1	1.1	65.3	451.1	17.0

Source: Primary Survey, 2007

Table 6.9: Primary and Secondary Occupation of the Respondents

Districts	No of Respondents	Primary Occupation (no. of respondents)				Secondary Occupation (no. of respondents)					
		Agri-Culture	Service	Petty Trade	Others	Agri-Culture	Service	Petty Trade	Others	Ag Lab	NIL
North	25	8	15	2	0	9	0	1	0	0	5
South	30	9	19	2	0	4	0	8	1	0	6
East	77	44	25	0	8	22	1	2	3	0	49
West	25	12	11	2	0	12	0	1	0	7	5
Total	157	73	70	6	8	47	1	12	4	7	65

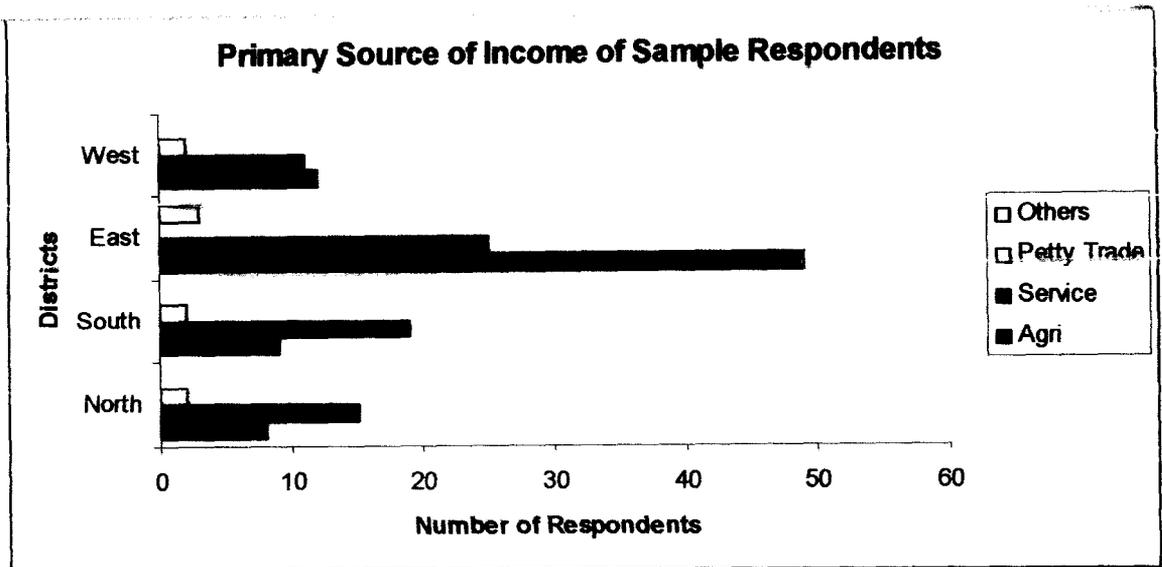
Source: Primary Survey, 2007

Although around 60 percent of the respondents in the North district are primarily engaged in the service sector, nearly 80 percent of the respondents are engaged in agriculture, both as primary or secondary occupation. This explains very high per capita income among the respondents in this district since both primary and supplementary earnings are drawn from two dominant sources of earning, i.e., the service sector and agriculture. The average income from agriculture is the highest in North district. If the income from agroforestry is added to this income, the resulting income is thus higher than the other districts. However, it is evident that contribution of agroforestry to the monthly per capita income of the respondent group is largely responsible for the high per capita income in this district, when compared to the other three districts of the state. Similar picture can be drawn for the South district where engagement in the service sector is predominant among the respondent group, closely followed by involvement in agricultural activities. However, in this district, contribution from agroforestry does not constitute a major earning source since earnings from trading activities are significant among the respondent group in the South district.

It is important to note that, in the East district, around 90 percent of the respondents (for both primary and secondary occupation) were found to be engaged in agriculture and allied activities. The average monthly income is the lowest in this district when compared to other districts of Sikkim, although the infrastructural facility is more adequate in this district, as noted earlier. The important aspect of East district is that most of the respondents did not have any secondary source of income as reported in the survey. The activity of petty-trade in some cases is chosen as secondary source of income rather than primary. The East district has lowest per capita income,

In case of West district, the contribution of agriculture and service is almost equal. The highest monthly per capita income is evident in the West district, of which, income from the service sector is the highest. The income earned from livestock produce (milk) also has a substantial contribution in the total earnings of the households in this district signifying the strong impact of livestock rearing on the economy of the West district.

Fig 6.2: Primary Source of Income of Sample Respondents



Source: Primary Survey, 2007

Table 6.10: Livestock Holding by Sample Population

Districts	Cattle	Mules	Goats	Ducks	Chicken	Others
North	83	0	50	0	145	0
South	11	0	89	3	133	0
East	131	30	53	2	104	10
West	152	0	112	0	338	0
Total	377	30	304	5	720	10

Source: Primary Survey, 2007

The North district, dominated by agroforestry, the livestock holding is 2nd lowest preceded by South district. In the North district, people mainly practiced cardamom plantations, they hold comparatively less number of cattle, goats, and chicken. However, the holding of sheep and yak were reared by the respondent households, although they were widely found in the North district. The South district has fewer livestock holding as the respondents earn highest from agriculture in this district. The West district has highest number of livestock holding. The comparatively lower income from agriculture and agroforestry, compelled the population to depend on livestock rearing to maintain their livelihoods.

6.2 Community-wise Socioeconomic status of the Survey Respondents

6.2.1 Educational Status of Survey Respondents

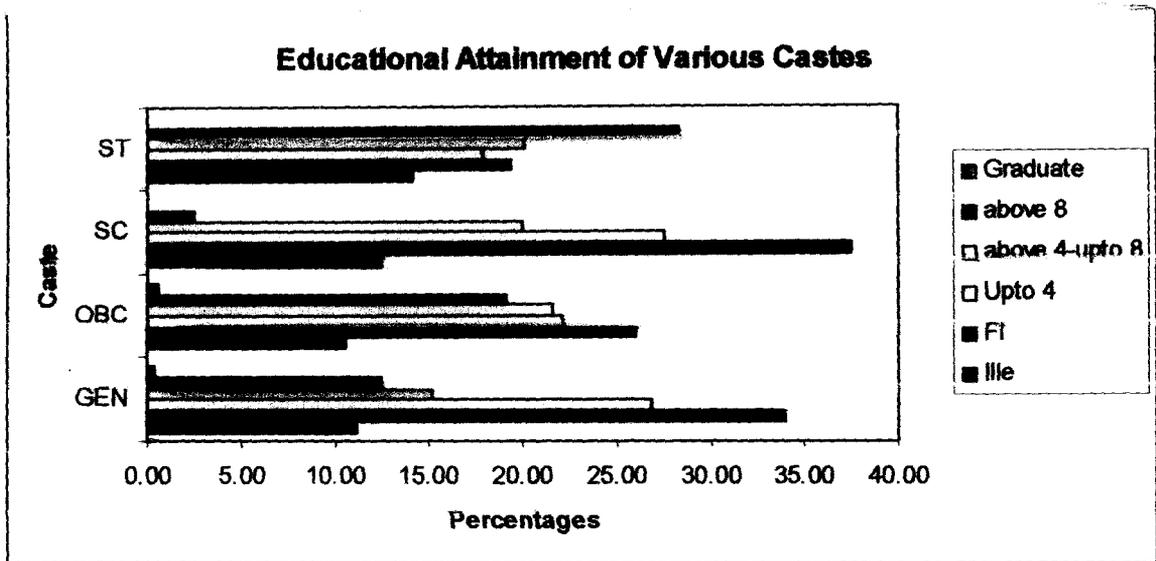
Table 6.11: Education of the Respondents by Community

Comm unity	No of respon dents	Samp le Popul ation	Male	Fe mal e	Education					
					Illiterate	Func. Lit.	Upto IV	V to VIII	above VIII – XII	Grad uate
GEN	41	224	114	110	25(11.16)	76(33.93)	60(26.79)	34(15.18)	28(12.50)	1(0.45)
OBC	64	361	174	187	38(10.53)	94(26.04)	80(22.16)	78(21.61)	69(19.11)	2(0.55)
SC	7	40	17	23	5(12.50)	15(37.50)	11(27.50)	8(20.00)	1(2.50)	0(0.00)
ST	45	268	130	138	38(14.18)	52(19.40)	48(17.91)	54(20.15)	76(28.36)	0(0.00)
TOTAL	157	893	435	458	106(11.87)	237(26.54)	199(22.28)	174(19.48)	174(19.48)	3(0.34)

Source: Primary Survey, 2007(Percentage in parenthesis)

The literacy rate is comparatively low among the respondent STs, in conformity with the generally higher illiteracy within the ST community. Literacy rate is high among the OBCs, with two out of three respondent-graduates belonging to OBC community. The general trend in this state is that enrolment in higher studies is the lowest than other stages, although overall literacy for the state is high.. Thus, the percentage of functionally literate respondents is higher in all communities. But, the percentage of sample population who have studied upto class eight and above is much higher among the STs. If income can be taken as a criterion that enables education, then it justifies the higher level of education attained by the STs who in the sample belong to higher income groups in the state.

Fig 6.3: Educational Attainment of various Castes



Source: Primary Survey, 2007

6.2.2 Occupational Status of the Survey Respondents

Table 6.12: Primary and Secondary Occupation of the Respondents by Caste, Tribe, etc.

Comm unity	No. of respon dents	Primary Occupation (no. of respondents)				Secondary Occupation (no. of respondents)					
		Agric ulture	Servi ce	Petty Trade	Oth ers	Agric ulture	Servi ce	Petty Trade	Oth ers	Agricult ural Labour	None
GEN	41	23	17	0	1	10	2	2	1	2	24
OBC	64	31	30	2	1	20	4	6	2	6	26
SC	7	2	0	0	5	0	0	0	0	0	7
ST	45	17	23	4	1	19	0	4	0	1	21
TOTAL	157	73	70	6	8	49	6	12	3	9	78

Source: Primary Survey, 2007

The above table shows that the respondents belonging to the ST community have higher income due to the engagement of more than fifty percent of the respondents in the service sector. This is a distinct change from the past since it is evident that more STs are opting for the service sector implying that opportunities are being created. The salaried income is higher compared to other sources of income. Agriculture

assumes the first place in terms of income generation where the STs once again have fared better for reasons explained later in the chapter. Petty trade is another important livelihood activity among the ST people. All the SC respondents depend on agriculture as agricultural labourer and they do not have any secondary source of income at all making them relatively poorer. Thus, the SC respondents are in the marginal category of income. Almost 50 percent of the OBC respondents have service as primary income source. Agriculture also dominates as a secondary source of income, irrespective of the primary income source. Agricultural labourer or wage labourers are found as a secondary livelihood activity but in low numbers.

6.2.3 Living Conditions and Asset Holding by Community

Table 6.13: House Types of Respondents by Community

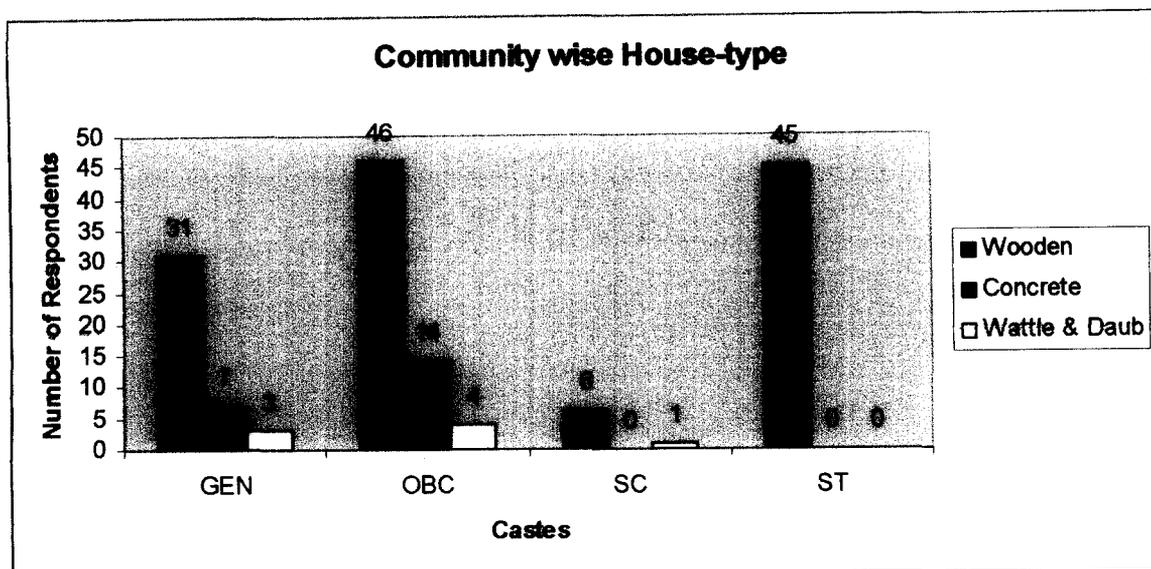
Caste, Tribe, etc	No. of respondents	House Type			No. of Rooms(Avg)	Construction Cost (Avg) in Rs.	Maintenance Cost (Avg) in Rs.
		Wooden	Pucca	Wattle & Daub			
GEN	41	31	7	3	6	49243.9	1782.9
OBC	64	46	14	4	6.7	45789.1	1862.5
SC	7	6	0	1	3.4	8428.6	1471.2
ST	45	45	0	0	6.5	11927.8	350.0
TOTAL	157	128	21	8	5.1	57672	2147.1

Source: Primary Survey, 2007

House type of a people is an indicator of the socio-economic status. The affluence of people can be derived from the type of houses they live in. Wealthy people are expected to build *pucca* houses with several rooms. As the house is made of costly materials, the construction cost and maintenance cost is also higher. The medium income group builds wooden houses and poor people build wattle & daub. As per the survey, the highest percentage of concrete houses belongs to OBC community, followed by the general community. All the ST respondents build wooden house, which implies that they belong to medium income groups. But, the SC respondents have almost 25 percent of wattle & daub houses. Within the respondent sample, it is noticed that the OBCs are in higher income brackets evident from the previous chapter. The average number of rooms in these households is around 7 (seven). The

construction cost and maintenance cost is dependent on various factors like proximity to market place, smooth supply of raw materials, adequate communication facility for transportation, and availability of skilled personnel, etc. Very high construction cost is seen to have been incurred by the general category people, though the number of *pucca* houses belonging to them is less than the OBC category. One of the reasons may be they were at a distance from the market place and the communication network was not adequate. The maintenance cost of STs houses was the least since they were made of wood.

Fig 6.4: Community-wise Housing Type



Source: Primary Survey, 2007

Table 6.14: Distribution of Land-holding of Sample Population by Community

Community	Sample Population	%irrigated	%scrop/totalland	Unirri/irrigated	%land/man
GEN	224	24.91	24.22	69.01	0.57
OBC	361	48.69	10.85	5.62	0.59
SC	40	36.41	45.80	0.00	0.43
ST	268	56.34	0.00	6.26	0.79
TOTAL	893	45.82	10.86	13.55	0.64

Source: Primary Survey, 2007

(Scrop: Sharecropped)

Taking Tables 14 and 15, one can assess the economic status of the sample population according to their caste and community. The respondents of the ST community have highest percentage of irrigated land (56.34 percent) with highest land-man ratio (0.79 acre/person). This is also reflected in a high land utilization for the purpose of cultivation and plantations. While per capita cultivated land among the ST community declined over the period concerned, the decline is compensated by a substantial increase in plantation crops. This holds true for the OBC respondents too. That the ST community is in a relatively better economic position is also evident from the absence of any sharecroppers among the STs. It is evident from earlier information that the OBC and ST community people belong to high or medium income groups.

The General caste respondents have very low percentage of irrigated land with low land-man ratio. However, the SC community is relatively worse off economically since they do possess marginal land and whatever cultivation they do is as sharecroppers or agricultural labourer on other people's land. The lowest land-man ratio (0.43 acre) is of SC community. The highest percentage of share crop to total land is hold by the SC at highest rate of 45.80 percent.

Table 6.15: Livestock Holding of Sample Population by Caste, Tribe, etc.

Community	Cattle	Mules	Goats	Ducks	Poultry	Others
GEN	43	8	103	0	98	1
OBC	129	14	80	2	239	3
SC	6	7	3	0	15	0
ST	170	1	112	0	343	0
TOTAL	348	30	298	2	695	4

Source: Primary Survey, 2007

Livestock rearing is an important source of mountain livelihood. As agriculture is at subsistence level, mountain people hold livestock for supplementary income. Poultry farming is most familiar among mountain people. Rearing cattle is also popular but dependence on forests for fodder often acts as a limiting factor. Thus, planting of fodder trees as a part of the agroforestry practice is important in case of the segment of population who practice animal husbandry. Other important livestock reared in mountain area are goats, mules, ducks etc. Though, yak and sheep are very important

livestock in mountain, but none were found during the survey. ST community holds highest no of livestock as a whole, which also accounts for their high income generation. They are closely followed by the OBCs.

6.2.4 Changing Landuse and Livelihood Patterns by Community

Table 6.16: Land Utilization – Past and Present - of Sample Population by Community

Com munit y	Sample Population	Present Land Utilizations (Acre Per Head)				Past Land Utilizations (Acre Per Head)			
		Culti- vated	Home- Steads	Planta- Tion	Fallow	Culti- vated	Home- Steads	Planta- Tions	Fallow
GEN	224	0.09	0.01	0.03	0.05	0.09	0.01	0.04	0.05
OBC	361	0.06	0.01	0.02	0.01	0.06	0.01	0.01	0.01
SC	40	0	0	0	0.01	0	0	0	0
ST	268	0.24	0.03	0.15	0.01	0.31	0.03	0.09	0.01
TOTA L	893	0.12	0.01	0.06	0.02	0.14	0.01	0.04	0.02

Source: Primary Survey, 2007

The landuse of Sikkim has thus changed over the years. The per capita cultivated land of ST and OBC community respondents have declined with a corresponding increase in plantations. Although livelihood change is not evident since most of the respondents are involved in agriculture and agroforestry, but the focus is changing with plantation based farming or agroforestry gaining priority over traditional crop based farming. The plantations and various fruit orchards, fodder trees, timber trees etc. are planted to meet the domestic needs while enhancing the economic wellbeing of the respondents. However, the landuse change is marginal in case of general community.

Table 6.17: Crop Information of Sample Population by Community

Community	Present Crops Information			Past Crop Information		
	Spring	Summer	Winter	Spring	Summer	Winter
GEN	Cereals, Maize, Potato	Maize, Paddy	Cereals, Ginger, Pulses, Millet, Paddy, Mustard, Potato	Cereals, Maize, Millet, Potato	Maize, Paddy	Cereals, Pulses, Paddy, Millet, Potato
OBC	Cereals, Maize	Maize, Paddy, Pea, Potato	Ginger, Maize, Millet, Mustard, Potato, Paddy	Cereals, Maize	Maize, Paddy, Ginger, pea, Potato	Maize, Mustard, potato
SC		Maize		Maize	Paddy	Wheat
ST	Maize, Millet, potato, Wheat	Maize, Paddy, Pea, Potato	Maize, Paddy, Pea, Potato, Mustard	Maize, Potato, Wheat	Maize, Paddy, Ginger, Pea, Potato	Maize, Paddy, Wheat, Potato,

Source: Primary Survey, 2007

The cropping pattern as a whole has not changed significantly over the years. The spring, summer and winter crops of traditional farming is still practiced with some new introduction like horticultural and cash crops, e.g., mustard, pea, soybean, beans, etc. As seen in the table of different districts' cropping pattern, the same trend can be followed. In addition to traditional crops the cultivators practicing new cash crops or sometime plantations in the marginal lands.

6.2.5 Agroforestry and its impact on Socioeconomic Status of the Communities

Table 6.18: Sources of Income of the Sample Population by Caste, Tribe, etc.

Caste, Tribe, etc.	Sample Population	Sources of Income (avg)										
		Monthly Income (Avg)	Agri. Prod.	Milk	Fruits	Eggs & Poultry	Family Remittance	Artisan Earning	Trade Earning	Salary	Wages	
GEN	224	462.5	67.86	29.24	6.92	4.46	0.00	0.00	0.89	275.00	33.71	
OBC	361	605.82	37.95	66.45	2.49	19.94	0.00	0.00	27.70	241.83	11.15	
SC	40	120.00	50.00	0	0	0	0	0	0	0	70.00	
ST	268	1202.61	213.43	148.58	0.00	49.39	3.73	3.73	108.96	657.09	13.43	
TOTAL	893	723.85	98.43	78.79	2.74	24.00	1.12	1.12	44.12	363.94	20.13	

Source: Primary Survey, 2007

It is found from the survey data that the per capita monthly income of ST respondents is the highest at Rs.1233.94, followed by the OBC category. The SC respondents have lowest per capita monthly income. This is corroborated with the information regarding their livelihood choices. Most of them practice agriculture but with little or no land of their own. Sharecroppers are predominant among the SCs and as has been noticed earlier, minimal irrigation is accessed by the SCs. There is thus sufficient reason to infer that agricultural productivity will be low and consequently earnings from agriculture will be lower. It is also evident from earlier discussions that subsistence farming is the mainstay among the survey respondents, especially among the SCs. Livestock holding is also minimum for the SCs.

However, it is also important to note that the service sector contributes the highest to total income among the surveyed respondents irrespective of communities, castes, etc. Milk as livestock produce and egg or poultry also jointly contributes a substantive amount to total income just after agriculture, in fact, often more than agriculture. Agricultural produce is an important source of income for the ST community. With a high percentage of irrigated land in the mountains amongst this community, it is

expected to reap the benefit from agriculture. Very few artisanal activities were found among the ST community. It has marginal contribution to the livelihood of the mountain people.

Table 6.19: Agroforestry and Non-agroforestry Practices

Practice	No of Respondents	Caste, Tribe, etc.	Community	Religion	Sample Population	Male	Female	District
Agroforestry	88	G - 26 OBC - 32 ST - 23 SC - 7	B - 4, L - 16, N - 62, S - 2, LI - 4	B - 24 C - 3 H - 61	533	256	277	N - 19 S - 6 E - 60 W - 3
Non-agroforestry	69	G - 5 OBC - 32 ST - 22	N - 37, R - 1, B - 1, G - 10, L - 8, S - 12	B - 32 C - 3 H - 34	360	179	181	N - 6 S - 24 E - 17 W - 22
Total	157				893	435	458	

Source: Primary Survey, 2007

(Community: B=Bhutia, L=Lepcha, N=Nepali, S=Sherpa, Li=Limbu) (Religion: B=Buddhist, C=Christian, H=Hindu) (Caste: G=General, OBC=Other Backward Caste, ST=Scheduled Tribe, SC=Scheduled Caste) (District: N=North, S=South, E=East, W=West)

The table above portrays a composite picture of the survey respondents in terms of their adoption of agroforestry and non-agroforestry practices for their livelihood. Among 88 respondents who have adopted agroforestry practices for their livelihood, 23 are from ST community of which 16 are from the Lepcha community. The highest numbers of respondents who practice agroforestry are from OBC community, followed by the General Caste. Most of the general caste people residing in east district practice agroforestry. All the respondents of north district are ST, but 19 of them practice agroforestry. In South and West district, small number of respondents practice agroforestry, most of them are engaged in non-agroforestry practices. In these two districts the higher numbers of respondents are from OBC community.

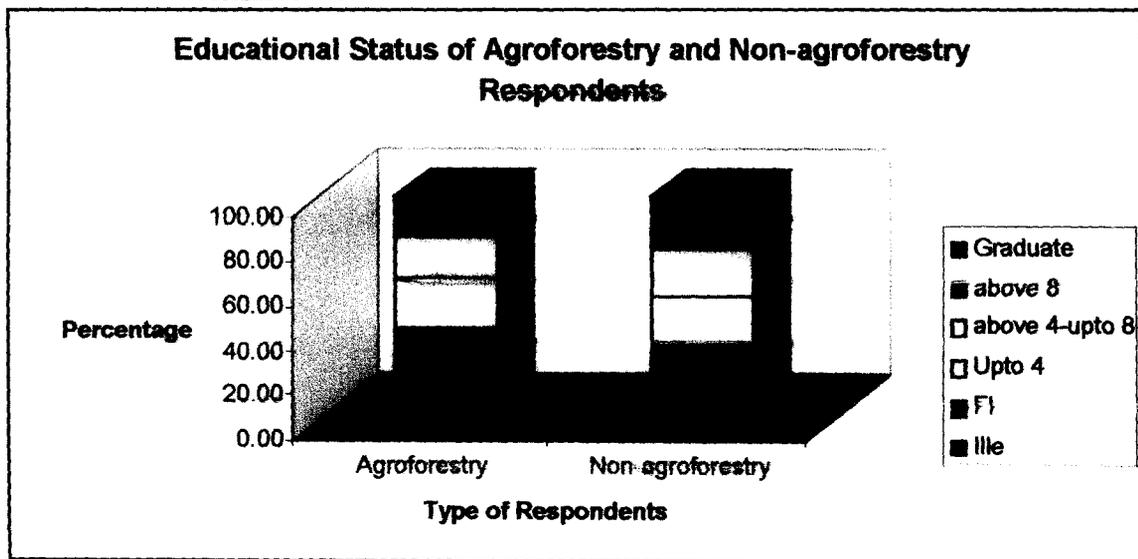
Table 6.20: Education Status of the Sample Population

Practice	Sample Population	Education					
		Illiterate	Functionally Literate	Up to 4	5 to 8	above 8	Graduate
Agroforestry	533	63(11.82)	157(29.46)	120(22.51)	99(18.57)	94(17.64)	0(0.00)
Non-agroforestry	360	43(11.94)	80(22.22)	79(21.94)	75(20.83)	80(22.22)	3(0.84)
Total	893	106(11.87)	237(26.54)	199(22.28)	174(19.48)	174(19.48)	3(0.34)

Source: Primary Survey, 2007 (Percentage in parenthesis)

The above table is useful to compare the educational status of agroforestry and non-agroforestry practicing respondents. The percentage of illiterates is almost the same among the respondents practicing agroforestry and non-agroforestry. But, the percentage of educational attainment at class V and above is higher. The three graduates are from non-agroforestry practicing respondents.

Fig 6.5: Educational Status of Agroforestry and Non-agroforestry Respondents



Source: Primary Survey, 2007

Table 6.21: Housing Asset of Respondent Families

Practice	House Type						
	No of Respondents	Wooden	Concrete	Wattle & Daub	No. of Rooms (Avg)	Construction Cost in Rs. (Avg)	Maintenance Cost in Rs. (Avg)
Agroforestry	88	79	5	4	6.0	50170.5	1997.7
Non-agroforestry	69	53	16	0	6.8	86391.3	2671.0
Total	157	132	21	4	6.3	66089.0	2294.0

Source: Primary Survey, 2007

The socio-economic statuses of the agroforestry and non-agroforestry respondents are reflected by the housing asset holding by them. The average numbers of rooms hold by the non-agroforestry practicing respondents are 6.8, which are much higher than the agroforestry practicing respondents. The average construction cost and average maintenance cost is higher for non-agroforestry practicing respondents. Because, most of the concrete house is made by non-agroforestry respondents. The cost of concrete house is manifold than the wooden or wattle & daub. The carrying cost of raw materials for concrete house is higher in remote areas.

Fig 6.6: House-type of Agroforestry and Non-agroforestry Respondents

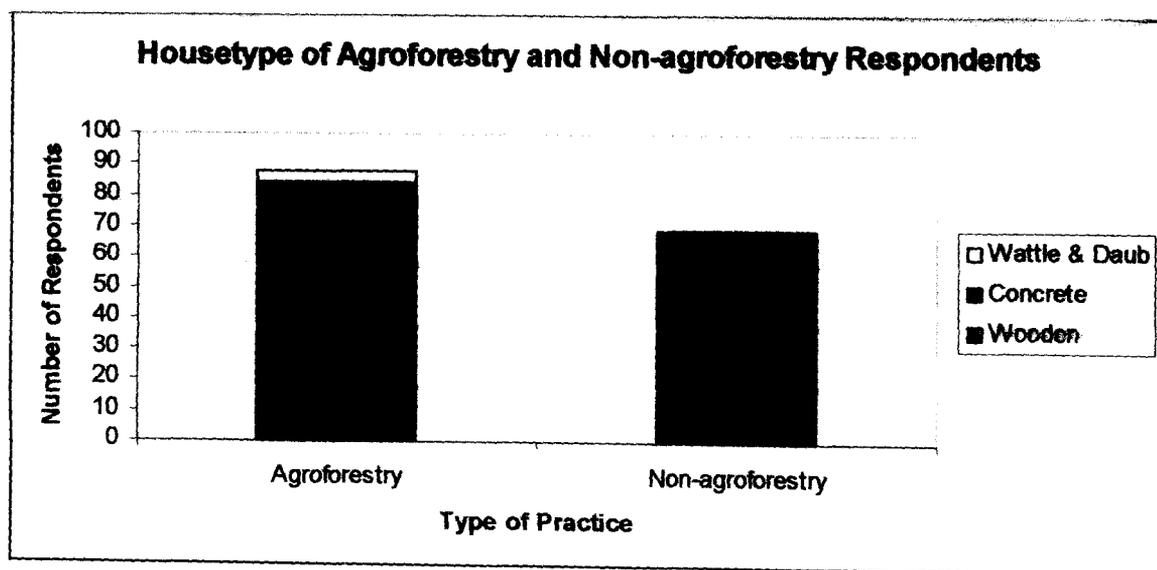


Table 6.22: Self-owned Land-holdings of Sample Population

Practice	Sample Population	Self – owned Land-holding(per capita)				
		Irrigated (Acre)	Unirrigated (Acre)	Leased in tenant(Acre)	Leased in Share Crop(Acre)	Leased out(Acre)
Agroforestry	533	0.30	0.05	0.05	0.12	0.02
Non-agroforestry	360	0.27	0.02	0.01	0.00	0.03
Total	893	0.29	0.04	0.03	0.07	0.02

Source: Primary Survey, 2007

The per capita irrigated land holding of agroforestry practicing respondents is 0.30 acre, which is higher than the non-agroforestry practicing respondents. Per capita land holding is higher for agroforestry practicing respondents for all categories, except for those who have leased out land. As non-agroforestry practicing respondents earned more from service sector, they often lease out land against monetary rent. The leased in share crop is zero among the non-agroforestry respondents, because almost 60% respondents are dependent on service followed by agriculture. The dependency on land of the non-agroforesters is comparatively lower than the agroforestry practicing respondents.

Table 6.23: Present and Past Land Utilizations by Sample Population

Practice	Sample Population	Present Land Utilizations (Acre Per Head)				Past Land Utilizations (Acre Per Head)			
		Cultivated	Home-Steeds	Plantations	Fallows	Cultivated	Home-Steeds	Plantations	Fallows
Agroforestry	533	0.141	0.018	0.065	0.029	0.154	0.018	0.052	0.029
Non-agroforestry	360	0.124	0.020	0.064	0.005	0.148	0.020	0.043	0.004
Total	893	0.713	0.096	0.386	0.094	0.847	0.096	0.282	0.094

Source: Primary Survey, 2007

Homesteads are used intensively by the people of mountains; especially those are dependent on agriculture. Generally, various vegetable or fruit trees are planted for domestic use. The agroforestry practicing respondents planted orange and guava in

addition to various vegetables in the homesteads. Various types of bamboos (Mali, Kathha, Bhaloo etc) are also planted along the edges of homesteads. The fodder trees like fig, nipear, chilwane etc are being planted in the homestead area by the agroforestry practicing respondents. Even the large cardamom plantation is also practiced in homesteads.

The landuse patterns have changed in the same direction among the respondents of agroforestry and non-agroforestry. The per capita cultivated land has declined with corresponding increase in plantations. The per capita fallow land has increased marginally in case of non-agroforestry. It might be that the respondents' not practicing agroforestry have main activity of service. They don't bother to cultivate their lands so intensively for livelihoods.

Table 6.24: Present and Past Crop Information of the Sample Population

Practice	Present Crops Information			Past Crop Information		
	Spring	Summer	Winter	Spring	Summer	Winter
Agroforestry	Maize, Millet, Potato, Wheat	Maize, Paddy, Ginger	Cereals, Potato, Millet, Mustards, Pea	Maize, Potato, Wheat	Maize, Paddy,	Cereals, Mustards, Paddy, Wheat, Potato
Non-agroforestry	Cereal, Beans, Soybean, Maize	Maize, Paddy, Pea, Potato	Ginger, Paddy, Millet, Potato, Mustard, Pea, Orange, Plum	Cereals, Maize, Millet, Wheat	Maize, Paddy, Potato,	, Maize, Millet, Pulses, Potato,

Source: Primary Survey, 2007

The cropping pattern has changed over the years among the agroforestry practicing respondents. They have transitioned from producing traditional cereal based crops of all seasons to horticultural cash crops like mustards, ginger, pea and other off-season vegetables like cucumber, gourd, pumpkin, squash etc. The same is true for non-agroforestry practice. They have started growing beans, soybeans and horticultural crops like mandarin oranges, plum etc.

Table 6.25: Livestock Holding by Sample Population

Practices	Cattle	Mules	Goats	Ducks	Chicken	Others
Agroforestry	195	25	158	2	256	5
Non-agroforestry	182	5	146	3	464	5
Total	377	30	304	5	720	10

Source: Primary Survey, 2007

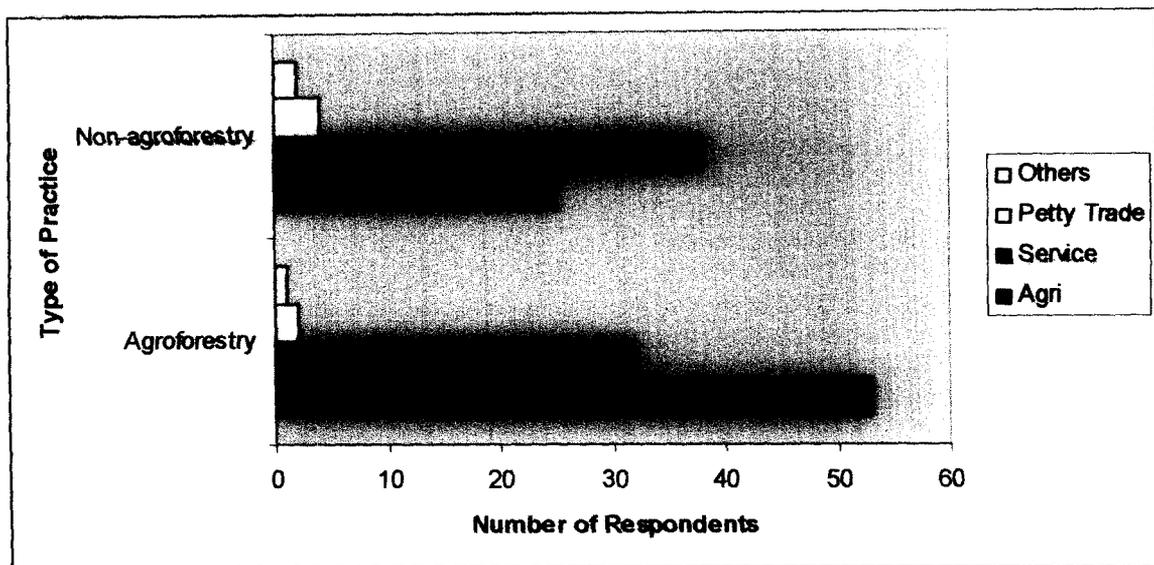
Livestock rearing is an important livelihood activity in the mountains but not yet up to the mark. Though, the number of agroforestry respondent is much higher than the non-agroforestry, the holding of livestock is not high proportionately. Even the holding of chicken by non-agroforesters is almost double than the agroforesters. It might be the reason that the complementary income from livestock among the non-agroforestry respondents is comparatively higher, which pushed the non-agroforestry respondents in higher income groups. It will be clear in the following table.

Table 6.26: Sources of Income of the Sample Population

Practice	Sample Population	Sources of Income(average in Rs.)										
		Monthly Income (Avg)	Agri. Prod. (Cereals)	Milk	Fruits	Eggs & Poultry	Family Remit.	Artisan Income	Trade Earning	Salary	Agro-forestry	Wages
Agro forestry	533	646.34	87.9	56.0	4.6	20.8	1.8	0.0	27.7	299.6	166.2	9.29
Non-agro forestry	360	956.94	130.3	82.9	6.8	30.8	2.7	0.0	41.1	443.6	0.00	13.75
Total	893	723.85	98.43	78.79	2.74	24.00	1.12	1.12	44.12	363.94		16.99

Source: Primary Survey, 2007

Fig 6.7: Primary Source of Income of Agroforestry and Non-agroforestry Respondents



Source: Primary Survey, 2007

The per capita monthly income of non-agroforestry practicing respondents are almost double than the agroforestry practicing respondents. A lion's share of the total income comes from salary, i.e., services. The livestock based income is also substantial proving that animal husbandry is also the mainstay for the respondents in mountainous regions. Income derived from agriculture is not equivalent to income from agroforestry practices, as is evident from the above table. However, lower income from agriculture is adequately compensated by high salary levels from services causing respondents who are in service moving to a higher income brackets. Earnings from trading activities also contribute a large portion to the total income for the non-agroforestry practicing respondents. The income earned by agroforestry practicing respondents is almost 40 percent less than the non-agroforestry because the income exclusively coming from agroforestry is not as substantially high as to offset the income from service and trade, so that the total income can reach higher level. As the number of salaried respondents are much higher, the average incomes of non-agroforestry practicing respondents are higher than the agroforestry practicing respondents.

Table 6.27: Primary and Secondary Occupation of the Respondents

Practice	Number of Respondents	Primary Occupation (no. of respondents)				Secondary Occupation (no. of respondents)					
		Agri-culture	Service	Petty Trade	Others	Agri-culture	Service	Petty Trade	Others	Ag Lab	None
Agroforestry	88	48	32	2	6	28	1	4	2	1	52
Non-agroforestry	69	25	38	4	2	21	5	8	1	8	26
Total	157	73	70	6	8	49	6	12	3	9	78

Source: Primary Survey, 2007

In the present study, one finds that the proportion of service holders among the non-agroforestry practicing respondents is much higher than the agroforestry practicing respondents. Even among the agroforestry practicing respondents, agriculture is the primary livelihood activity and a greater number among them have no secondary source of income at all. But, in case of non-agroforestry practicing respondents, service is the primary activity rather than agriculture. In such cases, a large proportion of the respondents are dependent on service as primary source of income. Since it has already been established that salaried respondents earn a higher income, it is thus implied that the non-agroforestry practicing people have better earnings than those practicing agroforestry. As against this, one finds that in the past very few among the agroforestry and non-agroforestry practicing respondents were engaged in service. Over the years more numbers have joined services with opening of opportunities. In case of agroforestry practicing respondents, there has been an increase in participation in agriculture by 50 percent whereas in case of non-agroforestry practicing respondents, increase has been negligible. As land-holding is not so large, the livelihood option for agricultural labourer is low. Very few people with service as primary income hire labourers for cultivation of their land. It is also evident from the secondary source.

Chapter 7

Summary, Policy Suggestions & Conclusions

7.1 Summary and Conclusions

The economic wellbeing of the population of Sikkim is closely related with the current state of agriculture in the state. In spite of rapid urbanization in the state, agriculture is still the mainstay of Sikkim's economy. However, physical constraints have limited agricultural growth within the state and thus its contribution to the State Domestic Product has not increased like other agricultural states in India. The contribution of agriculture to the Sikkim's economy was 51.59% in 1980-81, and in 1995-96, it became 52.03%. In India, 417gm of food grain per head per day was required during 2001-02 according to the data available from the agricultural department. But, per capita food grain available per day in Sikkim was 153gm in 2002-03 and 158gm in 2003-04. This excess food requirement is imported from other parts of the country. Since 1999-2000, the Gross State Domestic Product figure (Rs.11592/-) became higher than the all India average (Rs.12615/-). It indicates that the state economy is growing rapidly since the early 1990s. The per capita income (Rs.3492/-) was the highest during 1991-92. It is evident from secondary information source that annual growth rate of net state domestic product of Sikkim was positive, sometimes in double digits. The highest growth was during 1987-88. The growth of per capita income was also high during that time. There was a continuous growth from 1986-87 to 1987-88, as a corollary to the growth in per capita income. There might be huge agricultural production (160740 tonnes) including large cardamom (3900 tonnes) during 1985-86, which boosted the hill economy.

The distribution of landholding in Sikkim is very much skewed. As the Government took measures to protect the ST people, who were the indigenous tribes of the state, the size of average holdings of STs did not decline, rather, it increased in all categories except marginal holdings. Though, the percentage of SC population is very low in Sikkim, the average land-holdings declined for all categories, except, the large holdings. Therefore, it can be concluded that the landholdings of SC people have been marginalized more sharply than any other castes, since the merging of Sikkim with

India. The ethnicity-wise land-holdings since the merger of Sikkim with India show that the highest paddy-field holding was with Nepali community, closely followed by Bhutias. Nepali community holds highest dry-lands and wastelands. But, the Lepchas, the oldest tribe, hold the highest cardamom fields. The Bhutia community had 2nd highest cardamom fields, paddy-fields and wastelands.

The earlier chapters have been discussed in view of the research questions in the first chapter. Attempt to answer the question of changing landuse pattern of Sikkim has been tried with the help of secondary data in 2nd chapter and subsequently in the analytical chapters, e.g., chapter 5 & 6. It is found from the data that the land used for cultivation is declining over the years and land under plantations has been increasing, giving way to increasing agroforestry practices, especially in the North and West districts. The declining per capita land due to population pressure is spectacularly high. The percentage of people below poverty-line in Sikkim in 2001 was 36.55, which was much higher than the all-India average, 26.1 percent, and the state was ranked 4th in all-India ranking. The problems of rural poverty and natural resource degradation have close linkages and linkages are not simple in any causal sense. The spatial concentrations of rural poverty are major contributors which are the ecological and geographic constraints of location. Most of the rural poor worldwide are found in these least favoured areas where natural and human factors combine to constrain agricultural production and market access [**Pender, Hazell and Garrett, 2001**]. The ecological conditions are heterogenous in less favoured areas around the world. The nature of soils, slopes, altitude and other microclimatic factors such as water availability, quality and accessibility varies widely over small areas. In such areas, farmers' practices are diverse and spread risk across a wide variety of livelihood strategies that are dependent on multiple resources. Sikkim is a small hill state which has a lot of constraints for agricultural development. The scope for industrial development is also restricted due to its geographic features. People are thus compelled to look for diversified activities. The dependency on cultivation is shrinking over the years. The Millennium Development Goals of UNDP has targeted an eradication of extreme poverty and hunger. The first goal calls for halving the proportion of people who suffer from hunger, between 1990 and 2015. Other goals endorse the need to promote gender equality and to empower women, and to integrate the principles of sustainable development into policies and programmes to reverse the

loss of environmental resources [World Bank, 2001: 5]. So, Sikkim has protected forests by enacting various laws, which helped the people to think of alternative landuse system which will be ecologically and economically sustainable. The rural people of Sikkim need to adopt such a landuse system which will be used for multi purposes simultaneously. Agroforestry is such a landuse system where land is used simultaneously for agriculture and forestry. Sikkim has its own indigenous agroforestry system – large cardamom plantation in marginal forests.

The definition of livelihood has been formulated in a most comprehensive way by Ellis: “A livelihood comprises the assets (the natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determines the living gained by the individual or household”. [Frank Ellis] The mountain area is characterized by fragility, marginality and niche. So, the livelihood options are comparatively lower and different than the plains. In Sikkim, the main livelihood options are – terrace cultivation, plantation, service, livestock rearing, petty trade or business and tourism. The question of livelihood change in Sikkim has been discussed in the third chapter. Previously, most of the people were dependent on forestry. The indigenous tribe, Lepcha, was totally dependent on forestry, and sometimes fishing and hunting. Initially, the Nepali people of Sikkim built terrace and started cultivation. Primarily, cereal based crop farming was practiced. Maize, wheat, rice, buck wheat, millet, etc., were cultivated dominantly. The cropping pattern has changed through the years. The population started to shift from traditional farming to cash-crop based farming. They started to produce mustard, potato, ginger and other horticultural crops. In the pre-merger period, more than 70 percent people were dependent on agriculture but in the 1990s it fell below 50 percent. The activity of plantation has increased enormously. In Sikkim, cardamom is the main plantation activity and it is the oldest cash-crop which was introduced by the natives. The plantation of some fruit trees, fodder trees and timber trees can be seen in the homesteads. Tea plantation is also introduced in Temi by the Government. Since agriculture is still at a subsistence level and it is too hard to maintain livelihood by the sole earning from agriculture, people are compelled to think for alternative livelihoods, like rearing livestock. Mainly, goats, pigs, mules, cattle, poultry, yaks, sheep are reared in Sikkim. Almost all households reared one or the other livestock for supplementary source of income. Poultry farming is the most

common form of livestock here. Main livestock produces are milk, cottage cheese, curd, *chhurpi*, butter, eggs, and meat etc., which are consumed domestically and the surplus used for business purposes.

As the population increased in the Sikkim hills and per-capita land diminished, people have tried for new landuse system which could be sustainable in both ecological and economic aspects. Agroforestry practice was found to be the required answer to increasing economic pressure. Agroforestry is defined as: “... a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels.” (ICRAF, Nairobi)

The recent study of ICAR, Tadong Centre, Sikkim, which has been published in the Indian Forester (July, 2007), sketched the various agroforestry systems in different altitudes in a comprehensive manner. According to the study, there are nine major agroforestry systems in the sub-tropical (300-900m amsl) and mid-hill temperate zones (900-1800m amsl). The systems are – agri-horticultural, agri-horti-pastoral, agri-silvi-pastoral, horti-silviculture, agri-horti-silvi-pastoral, livestock-based mixed farming, sericulture-based mixed farming, sericulture-based farming, bamboo-based farming, homesteads and tea plantation.

Among the above mentioned systems, the most popular and indigenous practice is Horti-silviculture and other popular systems are livestock-based mixed farming and homestead gardening. In the horti-silviculture system, large cardamom is cultivated with *Utis (Alnus Nepalensis)*. Studies of different organizations show that horti-silviculture is a sustainable practice.

In Sikkim, the Lepchas, the first inhabitants of Sikkim, had collected the cardamom capsules from the natural forests. Eventually when the forests passed into village-ownership, the crop was domesticated. Sikkim is the largest producer of this spice. It has highest production in the world. The shade tree *Utis* is very popular and suitable to the environment of Sikkim. It is popular for its utility as fuel-wood and light timber. This fuel-wood is used during the processing of the cardamom.

Livestock-based mixed farming system is also very common in the Sikkim Himalaya. In this system, the common livestock (goats, cattle, pig, poultry, etc.) are reared with various species of fodder trees like *Cyperus sp.*, *Ficus sp.*, *Agave sp.*, etc.

Another common agroforestry system is homestead gardening. The farmers of Sikkim are observed to cultivate various vegetables in the surroundings of their dwellings. Usually, they use the small piece of land for homestead gardens. In this system, the Sikkim mandarin, lime, tomato, guava, papaya, avocado, etc. are intercropped with vegetables, medicinal plants, orchids, marigold, gladiolus, tuberose, etc. Even stall-fed animals like cattle, goats, ducks, pigs, etc., are reared within the homestead premise.

The socio-economic aspects of agroforestry in Sikkim have been drawn from the primary data collected through sample survey. It is evident from the secondary data as well as from primary data that the national average literacy rate is 65.38 percent, as against 68.8 percent for Sikkim. Thus, the literacy rate is higher in Sikkim than the national average. But, the enrolment rate in higher education level is substantially low. It is also evident from the secondary as well as primary data that the main livelihood option is agriculture, followed by service.

The main agroforestry practices found during the survey are Cardamom Plantations and Homestead Gardening. It is found that homestead gardening is commonly practiced by the lower income group and cardamom plantations are managed by the higher income groups. Cardamom is a relatively more profitable cash crop than the other cash crops or horticultural crops cultivated in homesteads. However, survey findings provide a contradictory picture where the socio economic conditions of the non-agroforestry practicing respondents are comparatively better than the agroforestry practicing respondents. The primary reason behind this as is evident from the survey information is that, most of the non-agroforestry respondents are service holders. The salary earning from the service sector is much higher than the earnings from agriculture. It is therefore evident that the agriculture sector is still at subsistence level though the cropping pattern has been changing from traditional cereal based crops to cash crops. The earning from cash crops or plantations is yet to surpass the earnings from non-farm activities like service in the tertiary sector.

Another important aspect visible from survey data is that the people of ST community are in the most favourable socio-economic conditions, with land-holdings greater than any other community. The percentage of cultivated land holding and also number of service holders are much higher in case of the ST community. The OBC community occupies the second position in terms of economic status, again primarily because of possessing large land holdings supplemented by salary earnings from service. The SC community among the respondents in Sikkim is the worst off due to low percentage of land-holding and no supplementary income sources other than livestock rearing. Thus the ST community is the most privileged community in the Sikkim districts. The enactment of various land protection rules has also been supportive to the ST community lending them a comparative economic advantage over the rest of the population. After the merger of Sikkim with India, the land transfer from the indigenous tribes of the state had been banned.

7.2 Policy Suggestions and Conclusion

The World Bank [2001:6-7] has suggested a comprehensive strategy to attack the multidimensional problem of poverty in developing nations. They suggested three ways by which poverty alleviation could be achieved – by promoting opportunity, facilitating empowerment and enhancing security. All three measures are complementary to each other causing pro-poor research to be streamlined towards the focus on assets, rights and institutions, as these provide a structure for opportunities for the poor and reduce their vulnerability, rather than ways to enhance income or expenditure.

On the basis of discussion made above the following policies are suggested for reducing poverty, reducing pressure on fragile resources and natural habitats and proper landuse management:

- 1) As the expansion of cultivated area on the Sikkim Mountain is constrained by difficult terrain and ecologically fragile bio-hotspots, alternative measures need to be undertaken to feed the growing population. To increase agricultural yields through diversification in agriculture will reduce the need for expansion of cultivated area. There is also a need for research to generate appropriate technologies in every agricultural process.

- II) To improve land use planning, a land use map needs to be prepared up to village level and to promote intensification and protect vulnerable natural ecosystem.
- III) To make provisions for technical education and agricultural extension to encourage more trained personnel into agriculture and agroforestry.
- IV) To simultaneously generate employment opportunities in non-farm sector to reduce the pressure on land. In Sikkim, non-farm employment includes government service, petty trade, cottage industry, small scale industry, etc.
- V) Where non-farm employment is limited especially in the North and West, agricultural progress is essential. This may be achieved by encouraging the use of manure, bio-fertilisers, integrated pest management, and good soil management practices for sustainable landuse system. Generally, the use of fertilizer is very limited in Sikkim; sometimes it is lowest in India. But, the scope of manure, bio-fertilisers are wide, which will accelerate the fertility of the soil.
- VI) There is a need to promote agroforestry programmes to reduce farmers' dependence on common property resources like the forests, and encourage multiple-use sustainable forestry practices and afforestation programmes.
- VII) To provide incentives for agroforestry programmes in low output degraded pastures that may be regenerated through reseedling and fertilisation. Several combinations and rotations of selected grasses and legumes can be made by planting their pasture species.
- VIII) To accustom with global biodiversity strategy, the landuse system should be managed in such a way that conserve the biodiversity at present as well as in future.
- IX) To protect the forest land, the user rights of local communities and groups should be secured that they can manage and use forest resources. Their security would ensure their cooperation with the government. In Sikkim, the enactment of law for forest conservation has restricted and sometimes

banned grazing. Even the collection of fuelwood was also restricted, which actually restricted the attachment of the local communities with forests.

- X) To introduce easy access to credit from financial institutions as an incentive to encourage the local unemployed people to engage in small business ventures as diversion to non-farm employment. Agricultural credit may also be provided to increase investment in agriculture and consequently enhance agricultural production making the venture profitable to the cultivators.
- XI) To provide responsive extension services to the local communities to develop improved farming and marketing skills. The improved farming will increase productivity, hence, total production and the improved marketing skill will help the farmer to sell the produce with higher profit margin.
- XII) The widely accepted and traditional agroforestry practice is homestead gardening. But, there is also scope for forest garden simultaneously with the homesteads. Forest garden is a promising agroforestry practice and is proving to be a suitable practice to protect the forest and at the same time opening new livelihood options.
- XIII) Sikkim is a rich state for its forest, water, flora-fauna, rare species of plants, etc., and therefore the policy should be made in such a way that will help to protect the natural resources while ensuring optimum utilization of the resources for the development of the state. For this an appropriate strategy for natural resource management (NRM) is of utmost necessity while protecting the forest cover of Sikkim. The water resources in Sikkim have high potential for hydro-electric power generation.
- XIV) The state and local policies should be made on the basis of comparative advantage of the region. The topographic variation within the state has divided the entire state into various agro-climatic zones. Each agro-climatic zone has unique environmental conditions for farming with ensuing environmental comparative advantages for different products.

- XV) The geographical constraints of the state create obstacles for development. There is thus a need to increase the investment in physical infrastructure and social infrastructure using environment friendly technologies. The state should enact and implement a suitable legal framework so that the mountain population can access natural resources for their livelihoods.
- XVI) To provide scope for greater participation of women in workforce, who are the major stakeholders and backbone of the mountain economy. Though, Sikkim is a state with low FMR, low literacy rate, but there is no social restriction of women for participation in workforce like many communities in the plains. However, the WPR is lower among women than men and thus measures need to be taken to encourage their participation.
- XVII) To adopt an effective approach, it should be decentralized and participatory in nature, for development and conservation of mountain areas.
- XVIII) The Research & Development efforts should be made to develop technologies and products with unique or comparative advantages in mountain areas.
- XIX) Creation of provision for technology transfer among the mountain regions around the world. Generally, mountain areas are backward in comparison to plains throughout the world for their physical constraints. The mountain people are thus mostly the poorer section of the population of the country. But, such features are no longer universally true for all mountain areas, e.g., the mountain area of China and other advanced countries are comparatively advanced and developed. So, it is necessary to import the suitable technology which might be helpful towards the way of mountain development.
- XX) To get the positive impact of globalization the human resource should be developed. The skilled human resource only can use the benefit of the globalization. So, it is necessary to provide general as well as technical education to the people of Sikkim.

- XXI) Since there is a clear demarcation in the adoption of livelihood strategies between the districts of Sikkim, it is necessary to improve upon the strategies and enhance the living standards of the population. Primary survey has revealed that the segment of population practicing agroforestry is worse off in economic terms than the non-agroforestry practicing population. Thus, maintenance of traditional agroforestry systems and introduction of new strategic agroforestry practices are imperative to initiate the process of development. In Sikkim, Cardamom growing is the age-old agroforestry practice, but the development of this plantation is not upto the mark for various reasons. There is a lack of proper awareness among the farmers. The processing of cardamom capsule is time consuming. There is a lack of proper marketing, which deprive the farmers from reaping high profit, though the product commands a high price in the world market. All the potential agroforestry practices are to be maintained so that the people can accrue increased benefits from it.
- XXII) There is a tremendous scope of tourism in Sikkim. The traditional tourism has to be molded into eco-tourism, which has great potential in this state. The scenic beauty, the forest resources, the greater elevation and multi-vegetation are the important features for the development of Sikkim's tourism. What it requires is attractive wrapping for marketing. The major livelihood of the poor people will depend on this sector in the near future.
- XXIII) To enhance the size and diversity of agroforestry practices, selective growing of trees need to be undertaken to bring about improvement of livelihood.
- XXIV) Designing proper silviculture and farming practices to optimize food production, carbon sequestration and biodiversity conservation, has become a necessity at present. In Sikkim, the most popular and widely used shade tree in the plantation area of cardamom is Utis. It is a leguminous nitrogen fixing shade tree with carbon sequestration feature. There are several shade trees available, but there is a need to test their environment viability.

XXV) Non Timber Forest Products (NTFPs) market should be strengthened for the forest-dependent community. Forests provide various products like wild fruits, honey, fodder, fuel-wood etc, which help the poor people in their livelihood choice. To reap the benefit, it is necessary to strengthen the market for such products.

XXVI) Domestication of wilder fruit trees for the improvement of mountain livelihood can be an option to widen the livelihood choice.

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Appendix-I

List of Notified ST in Sikkim:

1. Bhutia (including Chumbipa, Dophapa, Dukpa, Kagatey, Sherpa, Tibetan, *luchungpa, lachungpa*, Tromopa, Yolmo)
2. Lepcha

List of Notified SC in Sikkim:

1. Kami
2. Damai
3. Sarki
4. Maji

List of Notified OBC in Sikkim:

1. Bhujal
2. Gurung
3. Limboo
4. Mangar
5. Rai
6. Sunuwar
7. Tamang
8. Thami
9. Jogi
10. Dewan

Appendix-II

Unit Conversion

1 Hac. = 2.47acre

1Sq. Ft. = 0.000023 acre

11 (74)

UNIVERSITY OF NORTH BENGAL

SOCIO-ECONOMIC SURVEY IN SIKKIM FOR RESEARCH II

Date: _____
Subdivision: _____

Study Area: District: _____

Name of the Revenue Block/ Village: _____

GP: _____ Name of the Hamlet: _____

No. of Households in the Hamlet: _____

Date of Habitation (approx. year): _____

Location Description: Upland/ Midland/ **Lowland**/ Riverine/ Steep Slope/ Mild or Moderate slopes/ extreme rocks/ Others (specify) _____

1. Name of head of the family: Mr./Ms. _____

2. a) Age: _____ b) **Gender**: M/ F _____

3. a) Religion: Buddhist/ Hindu/ Christian/ Others (specify) _____

b) Caste: (specify) _____

c) Community: Lepcha/ Limbu/ Nepali/ Bhutia/ Tibetan/ Others (specify) _____

d) Language: Nepali/ Bhutia/ Lepcha/ Hindi/ Nepal Dialect- _____

Principal- _____

Second- _____

Third- _____

4. Literacy: Illiterate- _____ Functionally Literate- _____

Upto IV- _____ Upto VIII- _____

Above VIII (Specify) _____

5. Place of Education: _____

6. Household size: Male: 2 Female: _____ Total: _____

7. Household: New/ Old

If New, Whether due to Migration/ Neucleisation/ Others (specify) _____

7. Family Status: Unitary/ Joint/ Extended _____

8. Earning Status: Sole/ Joint _____

9. Primary Source of Income: Agriculture/ Service/ **Petty** Trade/ Others (specify) _____

10. Secondary Source of Income: Agriculture/ Service/ Petty Trade/ Others (specify) _____

11 a) Dependent Minors: Male- _____ Female- _____

b) Dependent Elders: Male- _____ Female- _____

c) Earning Minors: Male- _____ Female- _____

d) Earning Elders: Male- _____ Female- _____

12. Total Household Income: Monthly _____ Annually _____

13. Sources of Income: Monthly Annually

a) Sales of Agricultural Produce: _____

b) Sales of Milk: _____

c) Sales of Fruit: _____

d) Sales of Eggs and Poultry: _____

e) Remittances from relatives: _____

f) Profits Earned (for Artisans): _____

g) Profits Earned (for Traders): _____

h) Salaries Drawn: _____

i) Daily Wages Drawn: _____

TOTAL: _____

14. Daily Wage Rate: Male: _____ Female: _____

15. Self Consumption (monthly): **Quantity** Units Value

a) Agricultural Produce (Cereals): _____

- b) Agricultural Produce (Vegetables):.....
- c) Craft Items. etc.
- d) Fruits
e) Fish:
f) Milk:
g) Eggs & Poultry:
h) Pig & Cow:
- Total:
16. Household Fuel Sources: Firewood Dungcake Agro-wastes Coal Kerosene Gas
Weekly: Quantity
- 17a) Potable Water Sources: River Jhora/Khola/PHE/ Others specify.....
b) Distance from House: Km.
18. Livestock Holding: (Number)
- | | | | | |
|-------------|------------|-------------|----------------|----------------|
| a) Cattle | Total..... | Draft..... | Milch..... | Yearlings..... |
| b) Mules: | Total..... | Draft..... | Milch..... | Yearlings..... |
| c) Goats: | Total..... | Draft..... | Milch..... | Yearlings..... |
| d) Sheep: | Total..... | Draft..... | Milch..... | Yearlings..... |
| e) Duck: | Total..... | Layers..... | Yearlings..... | |
| f) Chicken: | Total..... | Layers..... | Yearlings..... | |
| g) Yak: | Total..... | Draft..... | Milch..... | Yearlings..... |
| h) Others: | Total..... | Draft..... | Milch..... | Yearlings..... |
- (specify)
19. House Type: Concrete Wooder/Wattle & Daub/ Others(specify
20. House Status: Self-owned/Rented/Quarter
21. Size of House: Double/ Single Storeyed
22. Roofing Materials: Thatched/ Corrugated Sheet/ Concrete/ Wooden/ others
(specify).....
- 23a) Plinth Area:.....
b) Construction Cost:.....
24. Room Details:
- Sleeping Room.....No
Living Room.....No
Kitchen.....
Storeroom.....No
Courtyard.....
Bathrooms.....No
For Livestock.....No
25. Annual Maintenance Cost:..... **Rupees**
26. Status: Cultivator/ Agricultural Labour/ Others (specify).....
- 27a) Land-holding (cottah):
- | | Total | Irrigated | Non-irrigated |
|---------------------------|-------|-----------|---------------|
| Self-owned: | | | |
| Leased-in (tenanted): | | | |
| Leased-in (sharecropper): | | | |
| Leased-out: | | | |
| Pari Khet: | | | |
| Sukha Khet: | | | |
- b) Whether reclaimed? NY(when.....)
- c) Land Quality (farmer's perception): very fertile/ moderate fertile/ unproductive
28. Size of: Ownership-holding.....Cottahs
Operational-holding.....Cottahs

29. Present Land Utilisation (cottahs) Cultivated.....
 Homestead.....
 Plantations.....
 Fallows.....
30. Past Land Utilisation (cottahs) Cultivated.....
 Homestead.....
 Plantations.....
 Fallows.....
31. Reason for Fallows:.....

32. Pani Khet Land (Terraces):
 Year of Terracing:.....
 How much area under terracing over 10 years?.....

33. Have any new roads/ trails constructed? **N/Y**(when.....)

- 34a) Orchard Groves Area (Present):
- | b) | Name | Season | Average Yield/tree |
|----|------|--------|--------------------|
| 1. | | | |
| 2. | | | |
| 3. | | | |

- 35a) Orchard Groves Area (Past):..... years
- | b) | Name | Season | Average Yield/tree |
|----|------|--------|--------------------|
| 1. | | | |
| 2. | | | |
| 3. | | | |

36. Water Resource Informations:
 Principal Source of Water: Jhora/ Khola/ Stream/ others(specify).....
 Status of Water-source: Perennial / Seasonal
 Alternative source during scarcity of water:.....
 Distance of water source:..... Km.

- 37a) Wild-fruit Collections:
- | Name | Place | Quantity | Season |
|------|-------|----------|--------|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
- b) Collector (Relation with the Household)

38. Crop Information (Present):
- Spring Crops:.....
 - Summer Crops:.....
 - Winter Crops:.....

39. Production Information (Present):
- | Crop | Area | Month | Production |
|-------|------|-------|------------|
| Crop1 | | | |
| Crop2 | | | |
| Crop3 | | | |
| Crop4 | | | |

40. Crop Information (Past.....):
- Spring Crops:.....
 - Summer Crops:.....
 - Winter Crops:.....

41. Production Information (Past.....):

Crop1.....Area.....Month.....Production.....
 Crop2.....Area.....Month.....Production.....
 Crop3.....Area.....Month.....Production.....
 Crop4.....Area.....Month.....Production.....

Agroforestry Informations:

42. a. Type of Agroforestry: Cardamom/~~Homestead~~/MortiAgri/Orchards/

Others(specify).....

b. Total Area for Production:.....

c. Total Production.....kg.

d)Market-value:.....Rs

43. Soil Conservation Measures: Natural/ Physical

44a) Soil Conservation Plants:

List of Plants- Trees/ Shrubs/ Grasses/ Others(specify).....

Locations- Terrace Edges/ Sloped land/ Along Water Sources/ Up slopes/ Down slopes/ Others (specify).....

b) Is it for personal use? Yes/ No

c) Labour-hours needed:.....days/ hours

d)Cost:.....Rs.

45a) Other Physical Measures for Soil Conservations

Boulder Walls/ Jhora framing/ Others(specify).....

b) Classify Benefits: Personal/ Community

c) Construction Expenditure:

d) Labour-hour needed:day/ hours

e) Is it Seasonal? Y/N List

46. Perennial Plants on Homestead: of Plants

(Tree Category) (Local Name)

1.

2.

3.

4.

Use
Personal Selling No

47. Medicinal Plants and Herbs on Homestead

(Shrubs Category) (Local Name) List of Plants

1.

2.

3.

4.

Use
Personal Selling No.

48. Principal Fodder Plants:

Name of Plants

Name of Animals

Season

Quantity

1.

2.

3.

4.

49. Fodder for

a) Stall-fee: Animals: Quantity Collection Source Persons Engaged (relation)

b) Pasturing Animals: Quantity Collection Source Persons Engaged (relation)

c) Weekly hours spent on collection: hrs.

50a) Pasture Area: Govt./ Private

b) Any land reverted to Pasture: N/Y (when)
Area:

51. Bamboo Plants:

Type: Location Quantity (Annual) Use

- 1.
- 2.

52. Root Plants: Name Quantity Collection Source Season

(Tapioca, Parrot etc.)

- 1.
- 2.
- 3.
- 4.

53a) Principal Fuel Plants: Name Location Season Quantity

- 1.
- 2.
- 3.
- 4.

b) Collection Time (weekly): Rs.

c) Collector (-relation with the household)

54. Principal Problems Identified by the Household

In-sufficient water source/ Rocky Land/ Gritty / Pest infestation/ Slope

55. Most Devastating Natural Problems: Land slides / Erosion others (specify)

56. Have you ever faced this problem: N/Y (when)

Where?

57. Loans Outstanding

Loans Repaid

Loans Amt. Period Interest Rate Loans Amt. Period Interest Rate

a) Cash Loans

b) Loans in Kind

58. Loan Sources:

Amount (Rs.)

Interest Rate (Annual)

Relatives/ Friends:

Shopkeepers/ Moneylenders:

Banks/ Cooperatives:

59. Migration Information:

Personal

Spouse

a) Migrant Generation

b) Migration from: Within Sikkim/ Darjeeling/ Nepal/ Others (specify)

c) Migration Place

d) Migration Reason

60. a) Out Migration Members

b) Out Migration Place

c) Out Migration Reason

d) Urban Migration

