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Mountain Agricultural Transformation Processes and Sustainability in the Sikkim Himalayas, India

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Mountain Agricultural Transformation Processes and Sustainability in the Sikkim Himalayas, India

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PREFACE

Applied research on sustainability and unsustainability of mountain agriculture has been an important undertaking for the Mountain Farming Systems' Programme of ICIMOD since 1988. It has been made possible, to some extent, through the constant support of Ford Foundation to the MFS Programme for the project on 'Strategies for Sustainable Mountain Agricultural Development', which was implemented in three phases.

The objectives of the last phase of the project (1994-96) focussed on improving the understanding of the transformation processes and sustainability of mountain agriculture in the Hindu Kush-Himalayan (HKH) region, especially in the Indian Himalayas and Nepal. This was accomplished by carrying field studies and collecting empirical evidence on cash- crop dominated farming systems in the Indian Himalayas of Himachal Pradesh and Sikkim, and the mountain district of Ilam, Nepal.

This is second in the series of publications of the findings of case studies conducted by ICIMOD on Agricultural Transformation Processes and Sustainability in the HKH. The first is on Himachal Pradesh (MFS 96/2). This publication presents findings of the case study carried out in the Sikkim Himalayas.

This study has attempted to document the processes of change and sustainability indicators in the farm households under two different farming systems: one, the maize-potato dominated and, two, the large cardamom-dominated. The large cardamom farming system option has contributed to the well-being of local farmers and has harnessed the local niche which is consistent with the mountain specificities in Sikkim.

The study was carried out by a two-member team, a farm economist, Dr H.R. Sharma of Himachal Agricultural University, Palampur, and an ecologist, Dr Eklabya Sharma of the GBP Institute of Himalayan Environment and Development, Sikkim Unit. Both professionals have accomplished excellent results by combining the economic and ecological concerns, in the same way as the mountain farmers would in their livelihood operations. ICIMOD expresses its appreciation for the cooperation extended by the two institutions namely, the Himachal Agricultural University and the GBP Institute of Himalayan Environment and Development, for consenting to undertake this ICIMOD study in Sikkim.

This study is expected to add to the understanding of sustainability processes in mountain agriculture.

ACKNOWLEDGEMENTS

The authors are grateful to the International Centre for Integrated Mountain Development (ICIMOD) for providing them with an opportunity to carry out this study on sustainable mountain agriculture. During the course of this study, discussions with Dr. Mahesh Banskota, Dr. Tej Partap, and Dr. Pradeep Tulachan helped to clarify various issues. While revising the report for publication, the authors benefited from thorough reviews of the manuscript made by Dr. Tej Partap and Dr. Pradeep Tulachan. The authors are grateful to all of them. The authors are also thankful for the comments and suggestions made by the participants at the seminar which was conducted by the authors in November 1996 at ICIMOD.

The authors are thankful to certain institutions for their affiliation, namely, the Himachal Pradesh Agricultural University at Palampur and the G. B. Pant Institute of Himalayan Environment and Development, for various facilities made available in carrying out this work.

Finally, the authors highly appreciate the friendly nature and cooperation extended by farmers at Damthang and Kabi in Sikkim during the field study. Thanks are also due to the officials of various departments and institutions of both the state and central governments, and to those who supported the study team and provided valuable information for the study.

ABSTRACT

The present study was undertaken in the northern and southern districts of Sikkim, India, in order to examine the effects of mountain agricultural development processes on livelihood options and their implications on sustainability. Sikkim presents a good example of harnessing a local mountain niche by adopting cardamom farming, which is compatible with the mountain specificities. The purpose of the study was to document the range and quality of livelihood options of households under maize-potato dominated and large cardamom-dominated farming systems and, more specifically, to assess the sustainability of large cardamom farming options.

The large cardamom was found to be the most important farming option. Both ecological and economic evidence indicate positive sustainability implications of this cash crop with attributes such as low-volume, high-value, non-perishable; and being less infrastructure intensive, less labour intensive, and less dependent on external inputs. Large cardamom cultivation also provides ecological benefits such as soil conservation, soil fertility maintenance, and extension of forest cover with intact tree biodiversity in the existing farming systems. A number of problems, e.g., viral diseases, inadequate post-harvest technology, and marketing facilities beset the crop. For a majority of the Sikkimese farmers, the sustainability of this crop as a livelihood option is extremely important. Apart from economic considerations, the crop also needs to be protected as a valuable genetic resource. If this crop has to be sustained, it should no longer be neglected and marginalised. Therefore, concerted efforts need to be made on this crop with necessary investments to strengthen physical, institutional, and social infrastructures. The study shows that harnessing local niche by growing large cardamom is consistent with the mountain specificities, and it tends to be sustainable by having positive effects on the quality of life, equity, and the natural resource base.

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One

Diversification of Mountain Agriculture

While indicators of unsustainability pervade the Hindu Kush-Himalayan region and characterise the dominant scenario of mountain agriculture (Jodha 1993; Shrestha 1992), some areas, such as the state of Himachal Pradesh in India, Ningnan County in China, and Ilam district in Nepal, have undergone rapid transformation because of the adoption and implementation of environmentally benign and mountain-specific development strategies. Mountain-specific Research and Development (R&D), harnessing the comparative advantages of high-value cash crops, the promotion of agro-based cottage industries, and off-farm employment are the focusses of development strategies being pursued in these areas.

Traditional cultivation of the large cardamom *(Amomum subulatum)* in the eastern Himalayan state of Sikkim in India is one example of harnessing the local mountain niche. Large cardamom, a native plant of the Sikkim Himalayas, is a perennial low-volume, high-value, non-perishable cash crop grown beneath the forest cover on marginal and barren lands. Sikkim's experience is unique, unlike the experiences of Himachal Pradesh, Ningnan County in China, and the Ilam district of Nepal where high-value cash crops were introduced from the outside. It is a unique example of the ecological and economic viability of a traditional farming system based on indigenously-evolved agroforestry practices. In this instance, the cash crop is domesticated and then developed commercially by the local farming community. As an indigenously-evolved niche-based farming practice it makes an interesting comparison with the practices triggered by the introduction of high-value production options in Himachal Pradesh (Sharma 1996).

The adoption of high-value cash-crop based farming systems compatible with local niche has helped mountain regions in two ways. First, by converting abundant marginal and barren lands into more productive lands and harnessing local niches. Second, by maintaining and improving the ecosystem and the environment of the region through promoting soil conservation and soil fertility. Thus, contrary to popular belief, evidence from these areas suggests that the process of development and conservation of the ecosystem can be mutually supportive and reinforcing. These areas have increasingly demonstrated the feasibility of minimising the environment and development trade-off and the possibility of breaking the cumulative causation between poverty and the environmental degradation cycle, leading to an increase in growth and sustainability linkages. The net result has been the availability of a broader range and a higher quality of livelihood options leading to a better quality of life (Partap 1995).

Diversifying the Options

Increasing options is one process that can be used, whether by a household or a firm, to diversify economic activities in order to improve living standards. Theoretically, several factors impact on the process of increasing options, viz., the availability of basic infrastructural facilities, level of skills and knowledge, and market and environmental factors. It is a moot point whether the increase in livelihood options is caused by distress conditions or by affluence and increase in incomes. In mountainous regions, households are involved in diverse livelihood options such as crops, livestock, agro-forestry, and cottage industries. Many of these options are of low quality and yield extremely low returns, obliging mountain people to carry on with a number of activities. The number of activities might also be higher in relatively more developed areas, but the underlying dynamics are totally different. For example, in such areas, additional activities are undertaken with a view to internalising the externalities; i.e., households specialising in horticulture might also keep cattle, adopt beekeeping, and also raise some crops. In contrast, the diverse activities pursued in backward areas are motivated by subsistence considerations; although households in these areas are not able to switch over to more productive livelihood options because of several constraints such as small landholdings, lack of food security, imperfect markets, lack of knowledge, risks associated with high-value cash crops, lack of measures to cover risks, and so on. In the absence of insurance against risk, the primary means of ensuring food security is by diversifying farming systems.

An understanding of the livelihood options and factors and processes contributing to agricultural transformation can provide useful policy insights for devising development interventions for improving the standards of living of mountain people. For example, food security considerations compounded by small landholdings, and production and marketing risks involved in growing high-value cash (HVC)crops may deter farmers from switching over to HVC crops. Adoption of these options may also involve multi-faceted economic and ecological trade-offs in the beginning and may be unsustainable in the long run. There is not much information about these trade-offs, in terms of their impact on natural resources, quality of life, and equity aspects. It is against this background that the present study was undertaken to study the two most prevalent farming systems, namely, the large cardamom-dominated and maize-potato dominated farming systems of the Sikkim Himalayas.

Objectives

The objectives of this study are as follow.

- To examine the economic transformation that took place over the last twenty years in terms of changes in land-use systems, cropping patterns, input use, and crop yields
- To document the household livelihood options in two major farming systems, namely,

the large cardamom-dominated farming system and the maize-potato dominated farming system, and assess their implications on the quality of life and the equity aspect

- To assess the sustainability implications of the two major farming systems in terms of ecology and environment

- To identify the factors and processes underlying the ongoing process of agricultural transformation

Hypotheses

In compliance with the objectives of the study, the following are the hypotheses for empirical testing.

- That households are guided by survival considerations while switching over to high-value cash crops

- That households practising subsistence farming adopt a large number of livelihood options to meet their basic needs and requirements

- That, in the process of transformation, there are improvements in human resources, reductions in family size, changes in the composition and number of animals, increasing substitution of natural resources with synthetic resources, and increased occupational diversification.

The paper begins with a briefing on the pace and pattern of economic transformation experienced in Sikkim over the past two decades. The implications of major livelihood options, such as crop production, cardamom growing and animal husbandary, which impinge directly upon the natural resource base, and their effect on quality of life and equity aspects are also discussed. Further comparisons are made between the large cardamom-dominated farming system and the maize-potato dominated farming system on the natural resource base such as soil, water, forests, and biodiversity. Finally, the main conclusions and the policy implications of the study are presented.

Two

General Economy of Sikkim

Sikkim, which is situated in the eastern Himalayas, from longitude 88°03'40" to 88° 57' 19" East and from latitude 27°03'47" to 28° 07' 34" North, became the twenty-second state of India on April 26, 1975. It has a total area of 7,096 sq. km., 114km from north to south and 64km from east to west. The entire state is mountainous, with altitudes ranging from 300 to 8,586 masl . There are 440 villages, eight towns, and four districts in Sikkim. The state has four major ethnic groups, namely, *Bhutia*(s), *Lepcha*(s), Nepalese, and *Limbu*(s). The climate of the state varies from cold temperate and alpine in the northeast to subtropical in the south. Agroclimatically, the state is divided into four zones, *viz.*, the subtropical zone (below 1,000 metres); the humid zone (1,000-1,600 metres); the mid-hill dry zone (again in altitudes ranging from 1,000-1,600 metres); and the high hill temperate zone (with an altitude of above 1,600 metres). The genetic diversity, of both forest vegetation and agricultural crops, is enormous. The state has about 600 plant species and more than 4,000 species of flowering plants (Sundriyal et al. 1992, pp 11-12). Some salient ecological features of the state are summarised in Table 2.1.

Demographic Features

Temporal changes in the state's population over the previous century have been shown in Table 2.2[1]. There are three aspects to these changes. First, initially, the population of the state registered a continuous increase, except for the decade from 1911 to 1921 when it declined by 7.05 per cent. In recent years, the maximum increase (50.76 per cent) was recorded during the 1970s, and this could be attributed partly to decline in the death rate (as a consequence of better health facilities) and partly to the immigration of people from other states of the country in the post-merger period. Second, the sex ratio has not only always remained unfavourable, the number of females per one thousand males progressively declined from 907 in 1951 to 835 in 1981 (Figure 2.1). Despite marginal improvements in this ratio during the subsequent decade, the sex ratio in the state still remains much lower than the national average of 920 and also much lower than those of other Himalayan states, apart from Arunachal Pradesh. Third, the density of population has increased significantly during the last two decades, from 30 /km^2 in 1971 to 57 /km^2 in 1991. However, taking into account the fact that nearly 25 per cent of the total geographical area of the state is uninhabited, the density of

1. See Tables 2.2 to 2.24 in Annex 1

Table 2.1: Macro-ecological Features

Parameters	Features
Rivers	Two major river systems originating from glaciers; Rangit (West Sikkim), and Tista (North Sikkim).
Ecological zones	Alpine (>4,000 m), sub-alpine (3,000-4,000 m), cool temperate (2,200-3,000 m), warm temperate (1,400-2,200 m), and subtropical (300-1,400m).
Terrain	Mostly sloping land only with scarce flat lands in valleys. These are marginal lands.
Forests	Lush green broad-leaved mixed forests in subtropical and temperate zones. Silver fir and rhododendron forests in the sub-alpine zone.
Plants of special interest	Rhododendrons, orchids, medicinal plants, and a large variety of wild edible plants apart from plants of academic interest.
Issues of concern	Specific habitat degradation and loss have caused a threat to: (1) wildlife such as the Red Panda, *Thar*(s), and Musk Deer, etc (2) plant diversity such as medicinal plants (*Aconitum* sp, *Nardostachys jatamansi*, *Picrorhiza kurrooa*, *Swertia chirata*, *Podophyllum hexandrum*), wild edibles (*Machilus edulis*, *Bassia buteracea*, *Elaeocarpus sikkimensis*, *Elaegnus latifolia*, etc), wild orchids, and some species of rhododendron.
Policy initiatives	Creation of natural conservation areas such as the Kanchanjunga National Park, Singba Rhododendron Sanctuary, Kyongnosla Alpine Sanctuary, Fambonglho Wildlife Sanctuary, and Maenam Wildlife Sanctuary

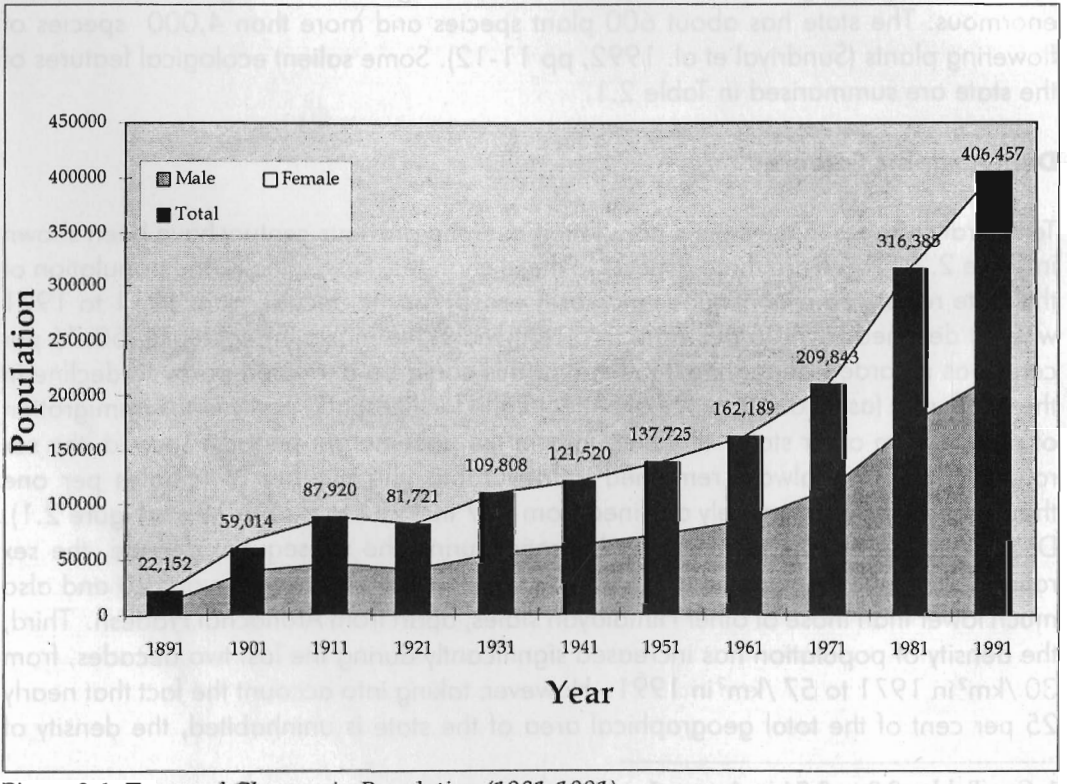

Figure 2.1: Temporal Changes in Population (1981-1991)

population (according to the 1991 Census) comes to around 75/km^2, compared to 57/km^2. Yet another way of gauging the population pressure on land is the density of population per square kilometre of arable land. In the state, only 12 per cent of the total geographical area is available for cultivation, the density of population per square kilometre of arable land comes to as high as 470 persons, indicating a high pressure on arable land.

The state's population, according to the 1991 Census, is around four hundred thousand, 90 per cent of which reside in rural areas (Table 2.3). The tribal population, *Bhutia*(s) and *Lepcha*(s), is 23.36 per cent. Yet another important demographic feature is that a relatively high percentage (18.37%) of the population is found to be below six years of age. These statistics have also improved considerably with the fall in both the death and birth rates. While the former declined from 31 per thousand in 1981 to 23.70 in 1993-94, the latter dropped from 8.90 to 6.40 per thousand in the same duration(Table 2.4).

The state has made substantial progress in improving the quality of its human resources in terms of literacy levels. As depicted in Table 2.5, the literacy level rose from as low as 6.59 per cent in 1951 to as high as 46.48 per cent in 1990-91. The increase has been particularly pronounced since 1971. The most singular feature, however, is an increase in female literacy, which shot up from 1.20 per cent in 1951 to 37.74 per cent in 1991 and is not much lower than the national average of 39.29 per cent. These impressive accomplishments notwithstanding, the literacy levels in the state are much lower than both the national average of 52 per cent and those of other Himalayan states, with the exception of Arunachal Pradesh where it is 41.59 per cent.

The changes in occupational structure in the period from 1971 to 1991 are shown in Table 2.6. Conforming to the prevailing occupational configuration in other states of India, more than two-thirds of the state's working population make a frugal living from agriculture, including livestock-rearing and allied activities. Services, construction, and trade and commerce are other important sources of livelihood. Over time, the 1970s witnessed significant diversification in the occupational structure. For example, the proportion of cultivators declined by as much as 20.88 per cent, while the percentage of those employed in other services increased from 6.23 to 17.93. Construction activities also provided employment to a significant number of workers. In the case of female workers, the increase was particularly high in construction and other services.

The decline in the number of cultivators between the period from 1981 to 1991 was accompanied by a fairly noticeable and proportionate increase in agricultural labourers. Further, while the percentage of workers employed in construction activities and household industries declined marginally, those engaged in other services registered an appreciable decline. The changes during the decade were, however, more conspicuous with regard to female workers. For instance, their dependence on agriculture diminished significantly in comparison to practically no change in the situation of their male counterparts. Again, the percentage of female workers employed in other services rose from 8.42 to

11.19 per cent in contrast to the percentage of male workers which declined from 22.80 to 14.53 per cent. The work participation rate also decreased from 53.18 per cent in 1971 to 40.45 per cent in 1990-91; the decline was equally pronounced for both male and female workers. The work participation rates in the state are not unusually high, keeping in mind the unfavourable physical conditions of the mountain areas coupled with the use of traditional production technology. Over time, female workers have increasingly found employment in those activities which traditionally had been in the male domain.

Land Utilisation, Cropping Patterns, and Crop Yields

The statistics on land utilisation provide insights to understanding the constraints and potentials available for agricultural development in any region. The availability of these statistics thus helps to formulate plans in order to harness natural resources, e.g., forests, to maximise production and at the same time preserve the environment and ecology. Figure 2.2 shows that out of the total geographical area of 710 thousand hectares, only 11 to 12 per cent of the land is available for cultivation, including current and other fallow land. The area under forests accounts for more than one-third of the total, and this has tended to increase over time, mainly in response to the measures taken by the government. Further, large areas of land (almost 25 per cent) are barren and uninhabited and are fit neither for cultivation nor any other use. Nevertheless, the net

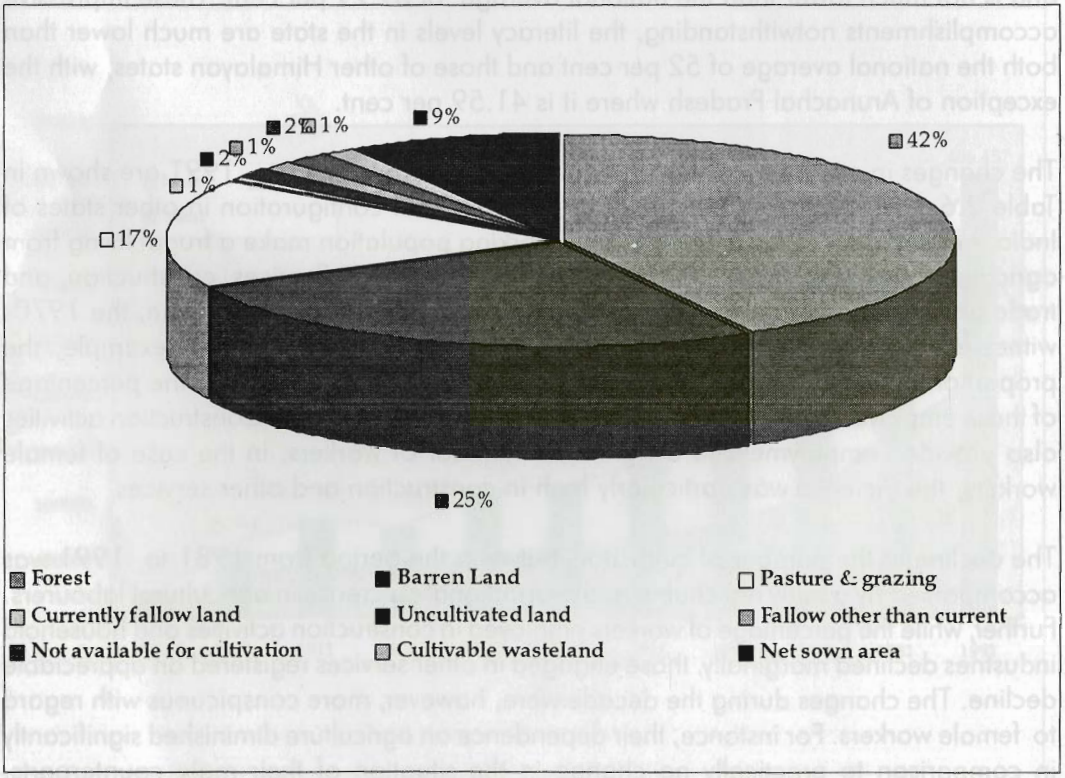

Figure 2.2: Land Utilisation Pattern, 1990-91

sown area is higher than the available land in other northeastern Himalayan states, apart from in Arunachal Pradesh and Meghalaya, where it is 2.7 and 9.1 per cent respectively. The forest cover is, however, comparatively lower in Sikkim than in other states.

The cropping patterns of a region are determined by a variety of factors, most notably, elevation, topography, precipitation, and so on. The climate of Sikkim is conducive for growing a large number of high-value cash crops such as cardamom, potatoes, ginger, and numerous other horticultural crops. In general, while the lower elevations grow paddy and fruits such as oranges (mandarin), the higher areas in the state produce maize and potatoes. Besides, large cardamoms are a traditional cash crop in the state. The cropping patterns of the state have undergone metamorphic changes since the merger with India in 1975. These changes are significant indicators of the ongoing process of agricultural transformation from cereal-dominated subsistence agriculture to high-value, cash-crop dominated commercial agriculture.

The precise changes in cropping patterns in terms of area under different crops between 1975-76 to 1995-96 are shown in Table 2.8 (Figure 2.3). The table highlights the following broad features. First, conforming to the ongoing process of agricultural transformation, the proportion of cultivated area under cereals has declined markedly from 70.16 per cent in 1975-76 to 52.16 per cent in 1995-96.

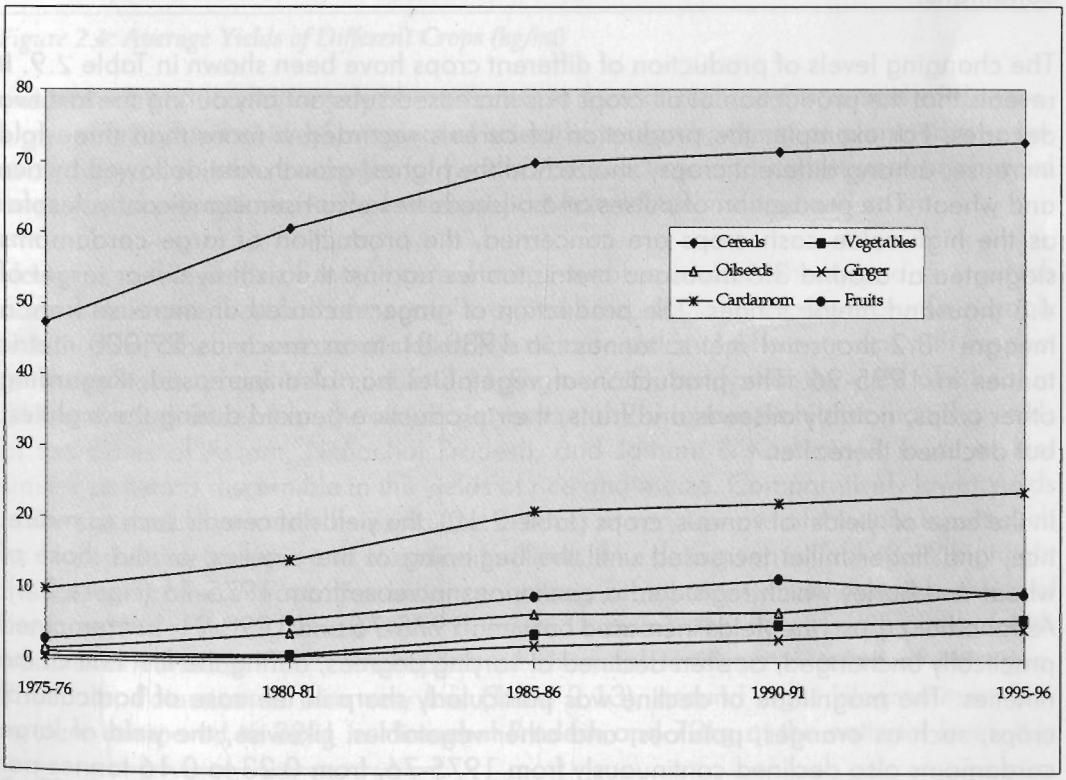

Figure 2.3: Temporal Changes in the Cropping Pattern ('000 ha)

All cereal crops have witnessed a decline, to varying degrees, with maize being recorded at the lowest, followed by rice and finger millet. Wheat, almost non-existent in 1975-76, was introduced in the early eighties and now occupies nearly seven per cent of the total cultivated area. Second, the area under oilseeds increased more than three times, from 2.22 to 7 per cent due to the extension efforts of the Department of Agriculture which promoted quick-growing, high-yielding varieties of rapeseed and mustard. Another interesting feature of the cropping patterns is the unchanged proportion of area under pulses, particularly from 1980-81 onwards. This is in contrast to the trend noted in many other states in India. Third, while the area under fruits has not shown a uniform trend, the area under oranges (mandarin), for which the state has a comparative advantage, particularly at lower elevations, has nearly doubled. The area under vegetables also increased from 0.92 per cent in 1980-81 to 4.17 per cent in 1995-96. Fourth, with regard to spices, the area devoted to large cardamoms remained around 16 per cent over the last few decades. The cultivation of ginger is, however, fast gaining ground, as is evident from the spectacular increase in the proportion of area under this crop. This could mainly be attributed to the launching of a special programme by the state government, for example, the distribution of free seeds to promote cultivation. Fifth, the cropping intensity in the state continues to be low, despite improvements in recent times. In net terms, the cropping patterns in the state are changing in favour of high-value cash crops for which the state is favourably endowed, given its varied agroclimatic conditions.

The changing levels of production of different crops have been shown in Table 2.9. It reveals that the production of all crops has increased substantially during the last two decades. For example, the production of cereals recorded a more than three-fold increase; among different crops, maize had the highest growth rate, followed by rice and wheat. The production of pulses and oilseeds has also risen significantly. Insofar as the high-value cash crops are concerned, the production of large cardamoms stagnated at around 3.6 thousand metric tonnes against the sixth five-year target of 4.5 thousand metric tonnes. The production of ginger recorded an increase from a meagre 3.2 thousand metric tonnes in 1980-81 to as much as 29,000 metric tonnes in 1995-96. The production of vegetables has also increased. Regarding other crops, notably oilseeds and fruits, their production peaked during the eighties, but declined thereafter.

In the case of yields of various crops (Table 2.10), the yields of cereals such as maize, rice, and finger millet increased until the beginning of the nineties, as did those of wheat and barley which registered a continuous increase from 1975-76 (Figure 2.4). As for other crops, the yields increased between 1975-76 and 1990-91, but remained practically unchanged, or even declined at varying degrees, during the first half of the nineties. The magnitude of decline was particularly sharp in the case of horticultural crops, such as oranges, potatoes, and other vegetables. Likewise, the yield of large cardamoms also declined continuously from 1975-76, from 0.23 to 0.16 tonnes per hectare. The dwindling yield of cardamoms, which is one of the leading indicators of

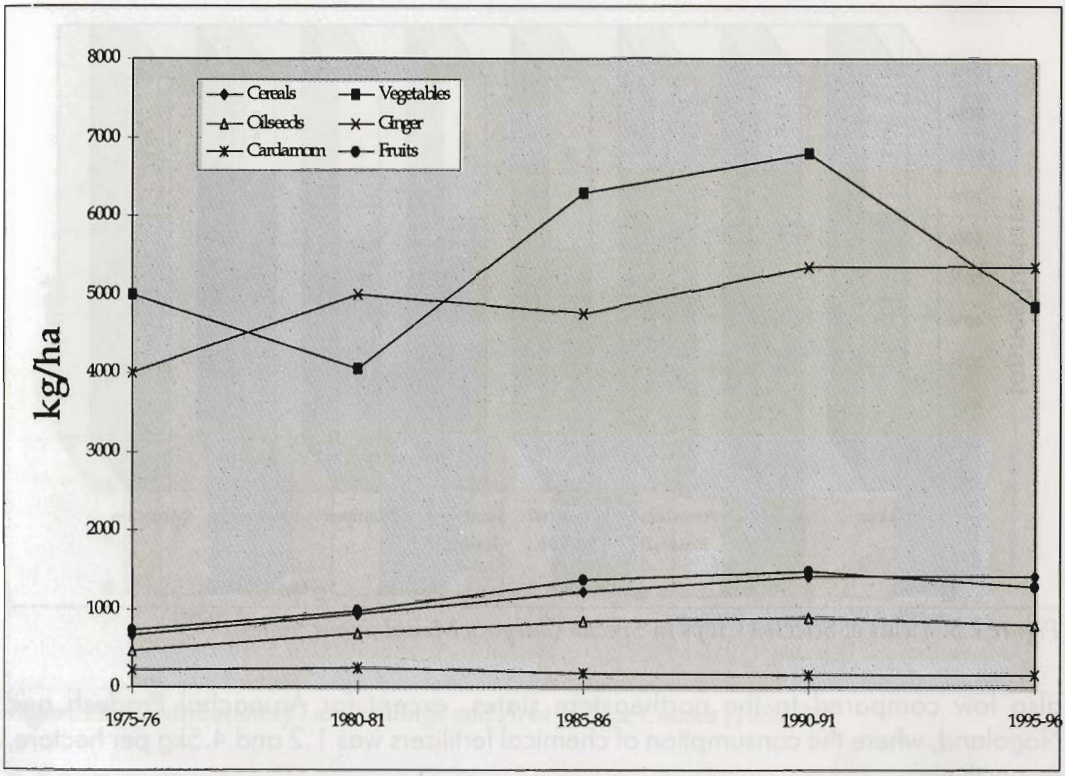

Figure 2.4: Average Yields of Different Crops (kg/ha)

unsustainability, could largely be attributed to factors such as the spread of disease, e.g., *phurkey* and *chirkey*[2]; neglect of scientific research; aging of plantations; non-availability of suitable packages of production practices and consequent haphazard extension of plantations; lack of efficient post-harvest technology, and so on.

However, the yields of major cereal crops such as maize, wheat, and rice, which account for more than half of the total cropped area, do not compare too unfavourably with those of other mountainous states. The data on yields of different crops with respect to these states, presented in Table 2.11 (Figure 2.5), testify that the yield of wheat in Sikkim, though lower than the national average of 2.3 tonnes, is higher than the yields of the states of Assam, Himachal Pradesh, and Jammu & Kashmir. A more or less similar pattern is discernible in the yields of rice and maize. Comparatively lower yields in the state could primarily be explained in terms of very low use of modern inputs such as high-yielding varieties and chemical fertilizers. The data given in Table 2.12 highlight the low use of these inputs. For instance, among cereal crops, more than two-thirds of the area under maize, which is the dominant crop of the state, is still planted with traditional varieties. The consumption of chemical fertilizers in terms of Nitrogen, Phospate, Potassium is also very low (Table 2.13), around eight kilogrammes per hectare compared to 32kg in Himachal Pradesh and 72kg at the national level. It is

2 *Phurkey* and *Chirkey* are local names for a viral disease which slowly kills the whole plant. The symptoms commence with rotting in the root system and spread throughout the plant.

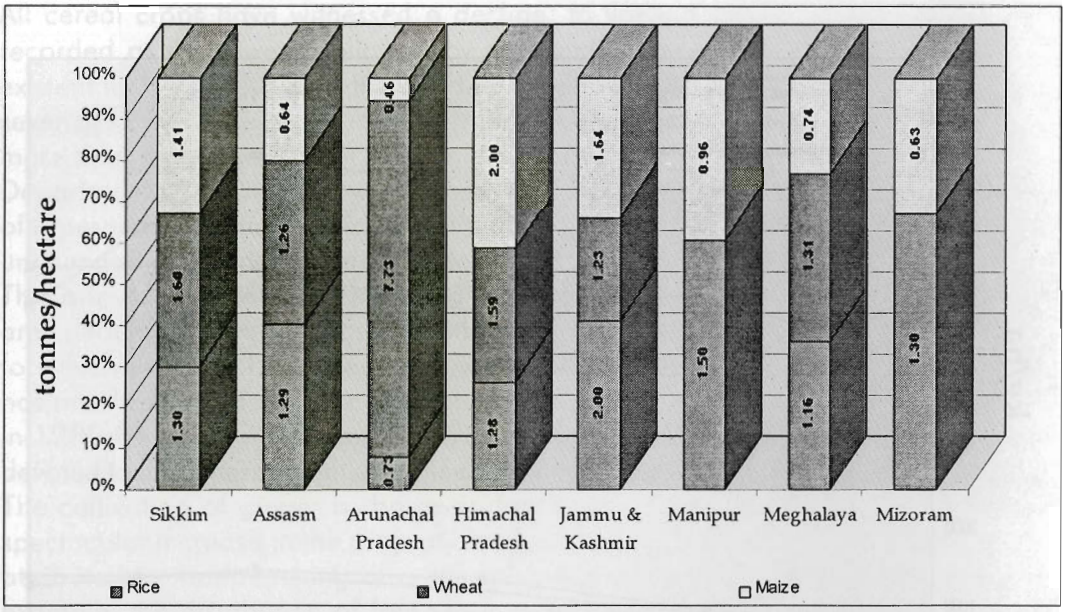

Figure 2.5: Yields of Selected Crops in Special Category Mountainous States

also low compared to the northeastern states, except for Arunachal Pradesh and Nagaland, where the consumption of chemical fertilizers was 1.2 and 4.5kg per hectare, respectively.

In brief, agriculture in Sikkim is a unique example of largely organic-based farming, also called 'low input agriculture'.

Distribution of Landholdings

The changing distribution of landholdings and the significant increase in the proportion of agricultural labour households suggest the ongoing process of marginalisation and rural proletarianisation in the state. As can be seen in Table 2.14 (Figure 2.6), the distribution of landholdings has tended to become more skewed over time; the value of the gini coefficient increased from 0.5169 in 1976-77 to 0.5639 in 1991-92. The worsening distribution of landholdings is also evident from the fact that, in 1991-92, nearly one-half of the total holdings were marginal or below one hectare, whereas their share in the total area was only 10.30 per cent. In comparison, 2.38 per cent of the holdings at the top of the land distribution hierarchy accounted for as much as 20.20 per cent of the total area. The per capita availability of different types of land has also declined rapidly over time as a consequence of the mounting population pressure (Table 2.15).

Livestock Population

The livestock population, excluding poultry, in the state during the last two decades increased from 0.25 to 0.34 million, recording an almost 33 per cent increase (Table

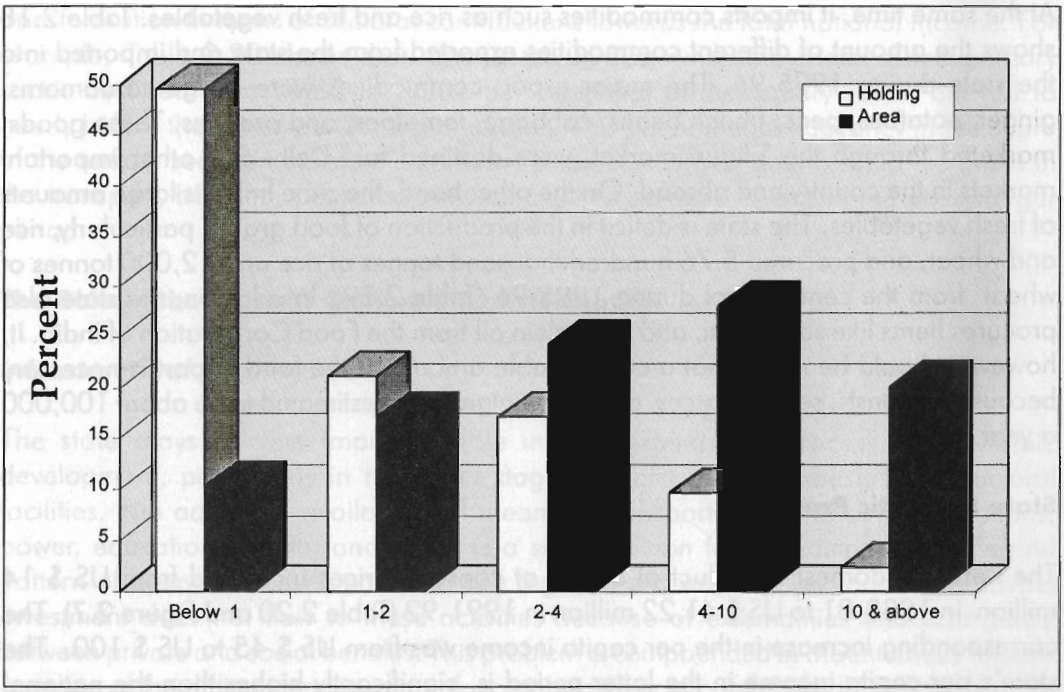

Figure 2.6: Distribution of Landholdings and Area by Size Classes (1990-91)

2.16). Regarding composition, there have been no significant changes in the share of bullocks, yaks, sheep, and equines. The cattle population, however, increased between 1976-77 and 1981-82 but declined thereafter, primarily because of the substitution of local cattle with improved stock. The number of goats has nearly doubled; their proportionate share in the total livestock increased from 23.84 to 33.60 per cent. This suggests the replacement of cattle with goats due to the increasingly dwindling access to forest fodder and also because of the increasing human population pressure on land. The number of domesticated pigs also declined. The poultry population recorded a three-fold increase; practically every household in the state keeps some poultry which, besides enriching the diet, helps to meet emergency cash requirements.

The production of different livestock products has increased over the period. For example, milk production more than trebled from 10.95 thousand tonnes in 1980-81 to 31,000 tonnes in 1994-95 (Table 2.17). Similarly, there has also been a phenomenal increase in the production of eggs. A network of cooperatives has been established under the umbrella of the Sikkim Milk Supply Union to collect surplus milk from the producers and supply to markets in places such as Gangtok. There are around eighty such societies which collect about 5,000 litres of milk per day. More recently, the formation of milk cooperatives has been encouraged by the Indo-Swiss project, and one such co-operative is functioning successfully in western Sikkim.

Trade Flows

The state exports high-value cash crops, such as large cardamoms, ginger, and oranges.

At the same time, it imports commodities such as rice and fresh vegetables. Table 2.18 shows the amount of different commodities exported from the state and imported into the state during 1995-96. The major export commodities were large cardamoms, ginger, potatoes, peas, french beans, cabbage, tomatoes, and oranges. These goods, marketed through the Siliguri market, were destined for Delhi and other important markets in the country and abroad. On the other hand, the state imports large amounts of fresh vegetables. The state is deficit in the production of food grains, particularly, rice and wheat, and procured 5.76 hundred thousand tonnes of rice and 12,000 tonnes of wheat from the central pool during 1995-96 (Table 2.19). In addition, the state also procures items like salt, sugar, and palmolein oil from the Food Corporation of India. It, however, should be noted that a considerable amount of the food import is necessary because of tourists, security forces, and other migrants — estimated to be about 100,000 a year.

State Domestic Product

The net state domestic product of Sikkim at constant prices increased from US $ 14 million in 1980-81 to US $ 41.22 million in 1991-92 (Table 2.20 and Figure 2.7). The corresponding increase in the per capita income was from US $ 45 to US $ 100. The state's per capita income in the latter period is significantly higher than the national average of US $ 63 and those of the other sister states of Assam, Arunachal Pradesh, Himachal Pradesh, and Meghalaya. In terms of per capita income, Sikkim ranks fifth among the states of India. The state's economy is also witnessing rapid structural

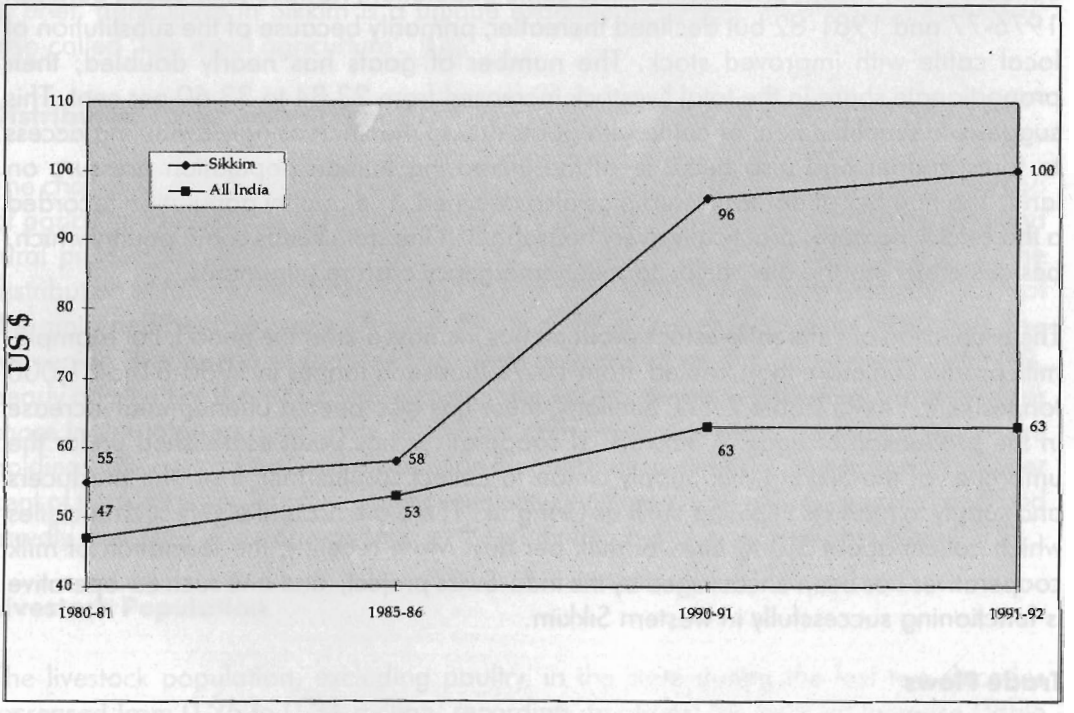

Figure 2.7: Growth of Per Capita Net State Domestic Product

transformation in terms of sectoral contributions towards the total national income. For example, Table 2.20 shows that, during the 1980s, while the share of the primary sector declined from 51.60 to 36.01 per cent, that of the tertiary sector buoyed to nearly half of the total state domestic product. This phenomenal buoyancy in the share of the tertiary sector in the state's domestic product is largely due to rapid increases in the transport, banking, public administration, and services' sector in the post-merger period.

The Role of the State in Economic Transformation

Infrastructural Facilities

The state plays a very important role in accelerating the process of economic development, particularly in the initial stages, by providing the basic infrastructural facilities. The adequate availability of means of transportation and communications, power, education, health, and so on is a *sine qua non* for expediting the pace and pattern of economic development in any region. As is well known, adequate private investment does not flow to these activities because of externalities and divergence between private and social benefits. This problem is compounded in mountainous regions because of the difficult terrain and unfavourable physical conditions. In this context, the state of Sikkim, by all reckonings, has made satisfactory progress in the provision of infrastructural facilities during the last two decades (Table 2.21). The availability of basic facilities, such as education, health, transportation, water supply, electricity, and so on, has improved tremendously. For example, a hundred per cent of the villages have been given electricity connections and more than eighty per cent have access to safe drinking water. The number of educational institutions increased from 264 in 1975-76 to 1,458 in 1994-95. The enrollment, particularly of females, in these institutions has also increased substantially. In fact, every village has a primary school within a radius of two kilometres. The number of banks, post offices, and road lengths has also increased and compares very favourably with the national average and also with those of other mountainous states. While the number of banks per ten thousand is 145.6 in the state, the national average is just half. Again, the per capita deposit in the state in 1993 was US $ 95 compared to the national average of US $ 89.

Plan Outlay

Realising that the lack of adequate infrastructural facilities can pose a formidable constraint to boosting the economic development of the state, its policy-makers accorded a very high priority to transportation and communications. Table 2.22 shows that, in the first four plans implemented before the state's merger with India, the percentage of total plan outlay on this sector varied between 48 per cent in the first plan to 41 per cent in the fourth plan. The sector has continued to remain high on the agenda in terms of sectoral outlays, even in the later plans. Another important aspect which needs to be underscored is that, despite a decline in the proportion of plan outlay allocated to this sector, the absolute amount has increased from US $ 0.45 million in the first plan to US

$ 12.76 million in the seventh plan. Likewise, in order to tap the vast hydro-electricity potential, the power sector has also been given a very high priority, as is evident from the continuous increase in the proportion of plan outlay on this sector. In the eighth plan, nearly one-fourth of the total outlay was earmarked for this sector. Agricultural and rural development are other important sectors. The plan outlay on these sectors was particularly high in the fifth, sixth, and seventh plans. It, however, needs to be mentioned that the provision of adequate infrastructural facilities, such as transportation and communications, for which very high priority was accorded in the first four plans, helps the agricultural sector in more ways than one, e.g., facilitating the marketing of produce, ensuring easy availability of basic inputs, and so on. The proportion of outlay on education also increased, particularly in the seventh and eighth five-year plans. In brief, the development strategy pursued by the state was broadly sensitive to mountain specificities. And, the high priority of the transportation and communication sector eased the inaccessibility and marginality constraints and was instrumental in accelerating the pace of overall economic development in the state.

A break up of the total outlay into plan and non-plan expenditure (Table 2.23 and Figure 2.8) shows that, over the period since 1979-80, nearly half of the total expenditure was non-plan. The burgeoning non-plan expenditure could mainly be explained in terms of ever-expanding service and public administration sectors in the state. Figure 2.9 depicts a very high dependence of the state on central grants to finance its plan and non-plan expenditures. For example, the contribution of tax and non-tax sources of revenue to total state revenue has remained around one-fourth, with the remaining three-fourths coming from central grants.

The very high dependence of the state on central grants to finance its development plans may indicate unsustainability of the whole process of development. However, Sikkim has enjoyed a special category status, the funds from the central government of India are likely to continue for some time into the future. By that time, the state might be able to harness its abundant resources such as hydro-electricity. Large cardamoms, which at present account for around three to four per cent of the total non-tax revenue, and other high-value cash crops also have a potential to contribute to the state exchequer.

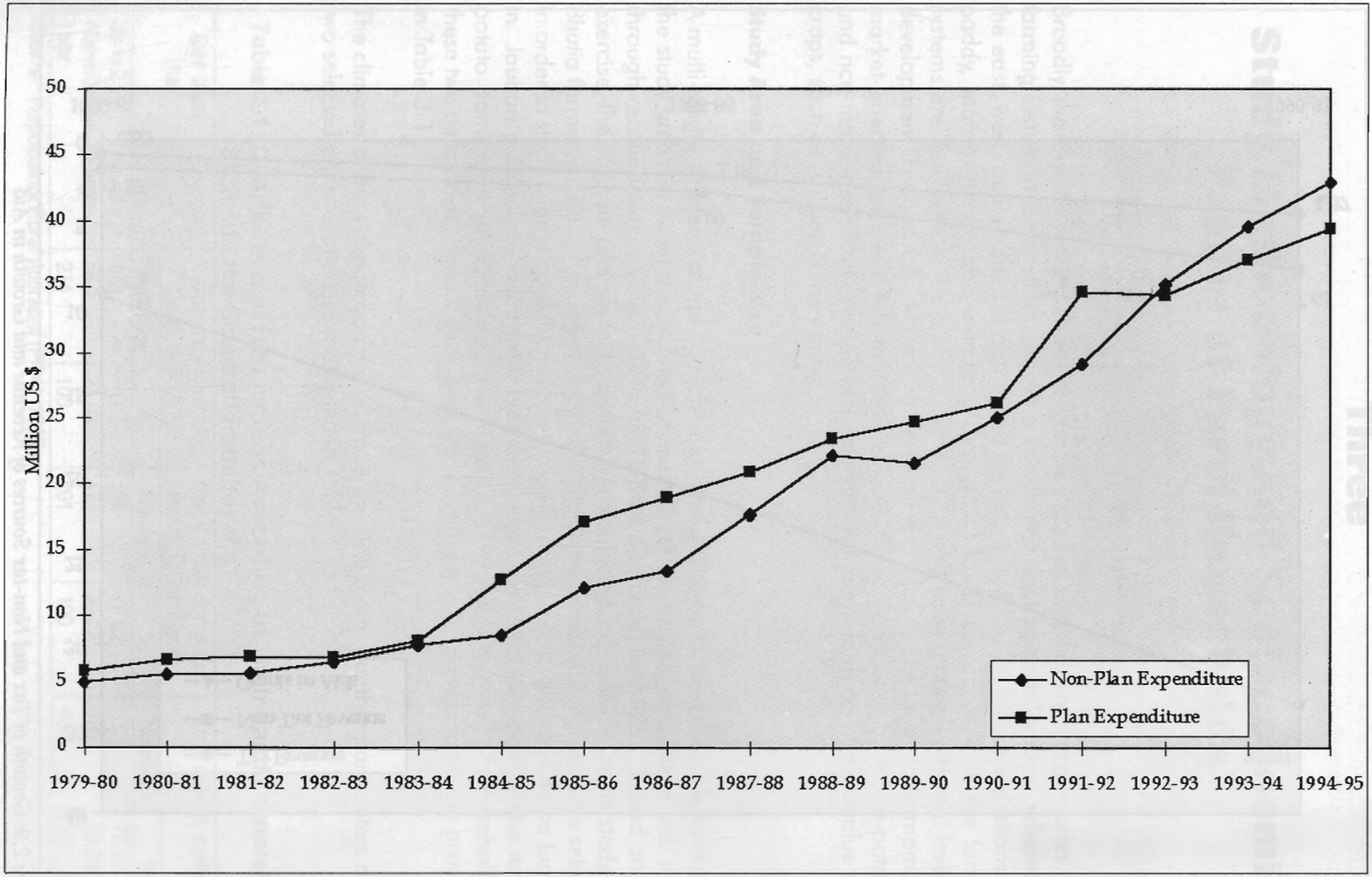

Figure 2.8: Growth of Plan and Non-Plan Expenditure

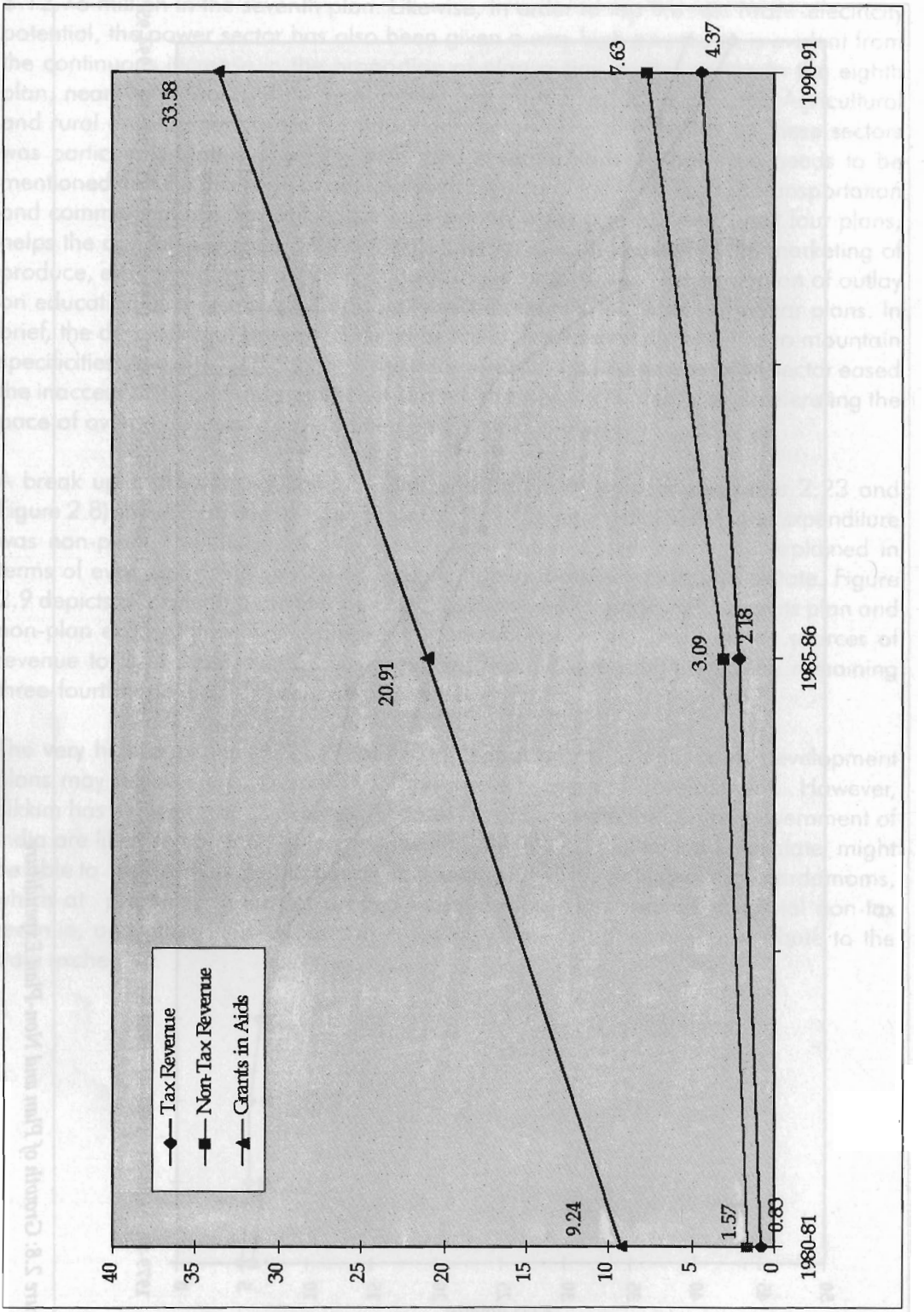

Figure 2.9: Growth of Tax and Non-tax Sources of Revenue and Growth in Aid

Three

Study Methodology and Socioeconomic Profile of Farm Households

Broadly, the farming systems in Sikkim can be classified into three main categories. The farming system in the northern district is dominated by large cardamoms, whereas in the east, west, and south, it is dominated by maize-potatoes at higher elevations and paddy, maize, ginger, and mandarin oranges at lower elevations. All the farming systems are, however, in the process of transition and have attained different levels of development. For example, while farming systems dominated by large cardamoms are market-oriented and relatively more developed, those dominated by maize-potatoes and rice-maize are mainly subsistence-oriented, although farming of high-value cash crops, such as ginger, is increasing.

Study Area and Sample Size

A multi-stage, stratified sampling technique was followed to select sample farmers in the study areas. A direct and indirect assessment of the existing agriculture was made through reconnaissance field visits to all the four districts of the state. Based on this exercise, the northern and southern districts were selected purposively for the study. The *Bhutia* farmers in Kabi *panchayat*, located at 28km away from Gangtok, were selected in order to study a large cardamom-dominated farming system, and the *Sherpa* farmers in Jaubari panchayat, 10km from Namachi, were selected to represent the maize-potato dominated subsistence farming system. The total number of households in these two *panchayat*(s) and their distribution according to land ownership, are provided in Table 3.1.

The climates of both *panchayat*(s) are temperate. The main weather parameters of the two selected *panchayat*(s) are presented in Table 3.2.

Table 3.1: Distribution of Households According to Their Land Ownership Status in the Selected *Panchayat*(s)

Size class (ha)	Category	Cardamom-dominated system (Kabi)		Maize-potato dominated system (Damthang)		Total of both systems	
		Number	%	Number	%	Number	%
Up to 2	Small	178	76.07	154	76.62	332	76.32
Above 2	Large	56	23.93	47	23.38	103	23.68
Total		234	100	201	100	435	100

Source : Participatory Rural Appraisal (PRA), 1996

Table 3.2 Weather Parameters of the Two Farming Systems

Parameters	Cardamom-dominated system	Maize-potato dominated system
Ethnicity	*Bhutia*	*Sherpa*
Altitude (m)	1,200-2,000	1000-2000
Rainfall (mm)	3,000-4,000	1500-2200
Ambient air temperature (°C)		
- Minimum	3-14	1-10
- Maximum	15-30	12-27
Average	10-22	6-19
Soil temperature (°C)	10-24	9-20
Relative humidity (%)	70-98	80-97
Snowfall (frequency)	-	Occasionally

Source: Field observations over the years

A sample of 90 households — 50 from the maize-potato dominated system and 40 from the large cardamom-dominated system — were selected following a proportional allocation method for the study (see Table 3.3). Since a preponderant majority of the households is small, owning less than two hectares of land, the households were classified into two categories: those owning up to two hectares (small farmers) and those owning above two hectares (large farmers).

Table 3.3 Sample Size from the Two Systems Selected

Category	Cardamom- dominated system (Kabi)		Maize-potato dominated system (Damthang)		Total sample size	
	Number	%	Number	%	Number	%
Small	30	75	38	76	68	76
Large	10	25	12	24	22	24
Total	40	100	50	100	90	100

Source: Computed from the above table

Data Collection and Analysis

In order to accomplish the objectives of the study, a combination of Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA), and Formal Survey Methods was employed. This was done by staying with the farmers for about 10 to 15 days in each of the two *panchayat*(s). Data were collected using a well structured, pre-tested questionnaire (see Annex III) on various aspects of the household economy such as the demographic features, literacy, occupational structure, cropping patterns, input use, crop yields, consumption patterns, and so on.

The model presented in Figure 3.1. was used as a basis for determining the scale of empirical work. While analysing the livelihood options, the socioeconomic aspects of the sample households were used as important factors, along with the physical and institutional infrastructures that shape the nature of livelihood options being practised

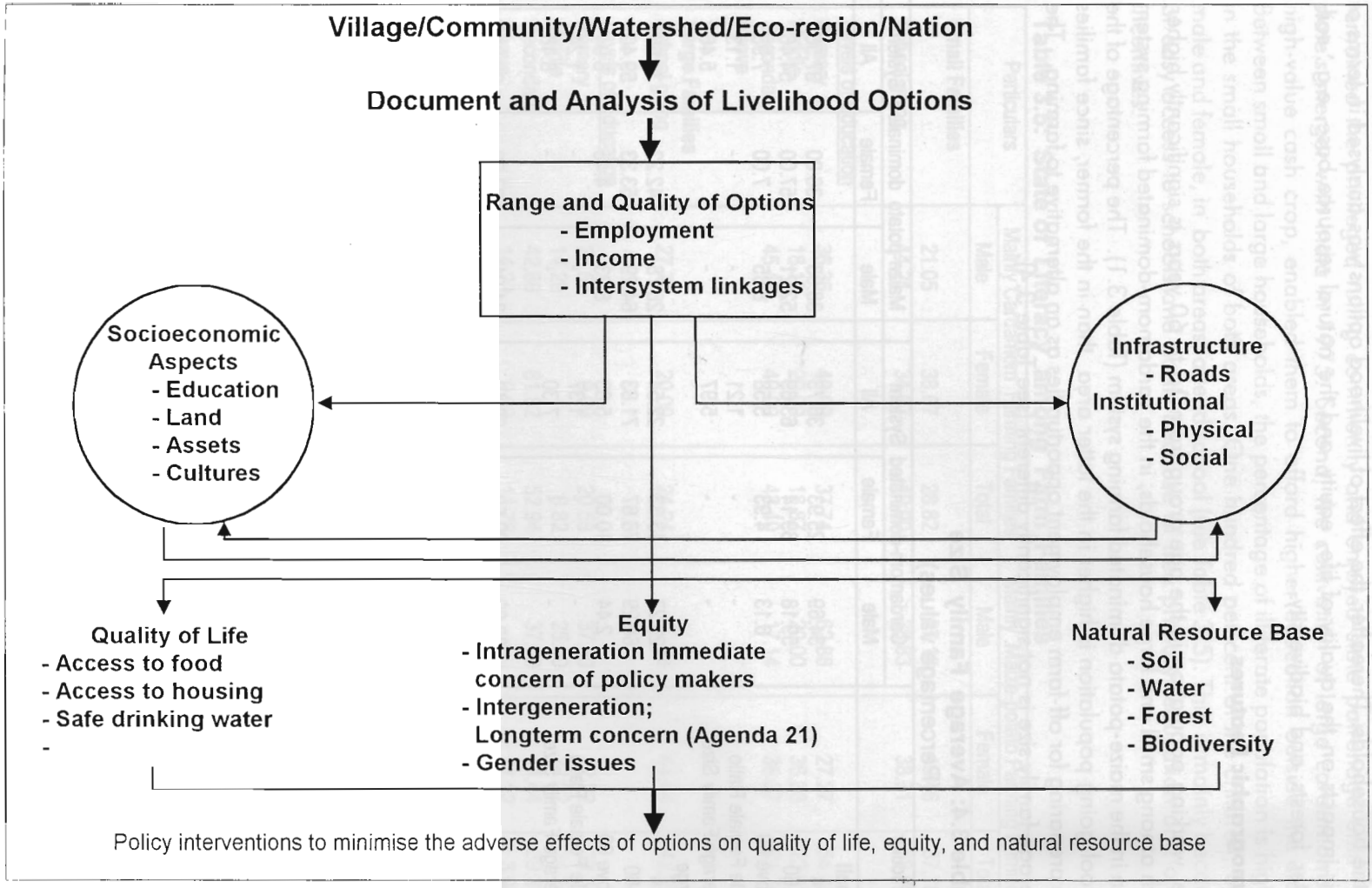

Figure 3.1: Framework for Operationalising the Concept of Sustainability

by the households. Thereafter, the effect of livelihood options was analysed in terms of their impacts on the quality of life, equity, and the natural resource base, e.g., soil, water, forests, and biodiversity.

Demographic Features

The working population in the age group from 15 to 60 years is significantly higher, both among small and large households, in the cardamom-dominated farming system than in the maize-potato dominated farming system (Table 3.1). The percentage of the school-going population is higher in the latter area than in the former, since families are preparing for off-farm employment opportunities as an alternative to farming. The average family size is not significantly different (see Table 3.4).

Table 3.4: Average Family Size
(Percentage values)

Particular	Cardamom-dominated System			Maize-potato dominated System		
	Male	Female	All	Male	Female	All
Small						
0-14	34.69	25.93	30.73	38.93	36.00	37.56
15-60	59.18	69.14	63.69	52.21	57.00	54.46
Above 60	6.13	4.93	5.58	8.85	7.00	7.98
Male Female Ratio	-	-	1.21	-	-	1.13
Average Family Size	-	-	5.97	-		5.46
Large						
0-14	29.27	13.33	22.54	26.78	42.22	33.66
15-60	68.29	76.67	71.83	64.29	53.33	59.40
Above 60	2.44	10.00	5.63	8.93	4.45	6.94
Male Female Ratio	-	-	1.37	-	-	1.24
Average Family Size	-	-	7.30	-	-	8.48
All						
0-14	33.09	22.52	28.40	34.91	37.93	36.31
15-60	61.87	71.17	66.00	56.21	55.86	56.05
Above 60	5.04	5.77	5.60	8.81	6.21	7.64
Male Female Ratio	-	-	1.25	-	-	1.17
Average Family Size	-	-	6.30	-	-	6.15

Source: Field Survey 1996

Education and Gender

The extent of human resource development in terms of literacy is significantly higher in the large cardamom-dominated area than in the maize-potato dominated area. The most glaring contrast is discernible in the female literacy rate which, though lower than the state average of 37.74, is more than double (26.66%) in the former area than in the latter area (11.83%). Also, the percentage of the population attaining education beyond the secondary level is higher in the cardamom-dominated area than in the maize-potato dominated area. These differences could be attributed to two reasons: first, the cardamom-dominated area is inhabited by the *Bhutia*(s) who

remained the privileged ruling community and enjoyed state patronage until the state's merger with India in 1975. Second, the cultivation of large cardamoms, a high-value cash crop, enabled them to afford higher education outside the state. Between small and large households, the percentage of illiterate population is higher in the small households of both areas. One hundred per cent of the children, both male and female, in both areas, attend school (see Table 3.5). This is mainly because of easy access to schools and partly because of free primary education and other incentives.

Table 3.5: State of Literacy among Farm Families

Particulars	Mainly Cardamom Farming Families			Mainly Maize-potato Farming Families		
	Male	Female	Total	Male	Female	Total
Small Families						
	21.05	38.67	28.82	27.18	49.46	37.76
School going	44.21	34.67	40.00	38.83	38.71	38.78
Levels of Education						
Primary	36.36	40.00	37.74	62.86	27.27	54.35
Middle	18.18	20.00	18.87	20.00	36.36	23.91
Secondary	45.46	40.00	43.40	17.14	36.37	21.74
Above	-	-	-	-	-	-
Large Families						
School going	27.78	20.00	24.24	40.38	44.44	42.27
Levels of Education						
Primary	28.57	9.09	20.59	37.50	22.22	33.33
Middle	14.29	-	8.82	25.00	22.22	24.24
Secondary	42.86	81.82	52.94	37.50	44.44	39.39
Above	14.29	9.09	11.76	-	11.12	3.04
All Families						
School going	39.69	30.48	35.59	39.35	40.58	39.93
Levels of Education						
Primary	33.33	29.03	31.76	52.54	25.00	45.56
Middle	16.67	12.90	15.29	22.03	30.00	24.05
Secondary	44.44	54.84	48.24	25.43	40.00	29.11
Above	5.56	3.23	4.71	-	5.00	1.28

Source: Field Survey 1996

The *Bhutia*(s) all over the state are the most progressive community. Their population is concentrated mainly in the northern district which is famous for growing large cardamoms. Owing to the cultivation of cardamoms, they are highly educated and hence occupy the top echelons of the state bureaucracy and other technical posts. There are also some *Bhutia*(s) in the all-India civil service and they occupy high posts in other states and in the central government departments. All this can be attributed mainly to large cardamom farming.

Household Assets

The assets' inventory of sample households in terms of residential buildings, cattle sheds, farm implements, and so on is provided in Table 3.6. The amount of assets per household and per capita was nearly two-and-a-half times more in the cardamom dominated area than in the maize-potato dominated area. In the composition and relative importance of different assets in both areas, residential buildings accounted for more than three-fourths of the total assets. Between the two areas, the share of residential buildings is, however, higher in the cardamom-dominated area than in the maize-potato dominated area. Animals constituted the next important asset in both areas, even though animals are more important in the latter area. The most important difference is, however, in the percentage of non-farm assets such as television, vehicles, and other durable household goods; the share of these assets is around ten per cent in the cardamom-dominated area compared to around five per cent in the maize-potato dominated area.

Livestock Holding Patterns

The livestock holdings of the sample households are shown in Table 3.7. It shows that cattle, goats, pigs, and poultry are important animals. Almost all households keep poultry which, besides enriching their diet, also enable them to meet emergency cash requirements. The cattle reared are local breeds which yield less milk. There is no significant difference in the number of animals owned by the small and large households in the maize-potato dominated farming system. On the other hand, in the cardamom-dominated system, the number of animals owned by large farmers was significantly higher than the number of animals owned by small farmers. This difference in livestock numbers is related to free access to fodder from the forests in the former area. In the latter area, access to fodder from forests was denied in 1980. The community responded to this cessation of access to forest fodder in two ways. First, by adjusting the number of livestock according to the availability of fodder on their farm and on the community support land, and second, by replacing cattle with goats and pigs. The number of animals kept by large farmers who have enough land to ensure year-round fodder supplies was higher than the number kept by small farmers.

Land-Use Patterns

Land-use patterns in the study areas have been shown in Table 3.8. Agricultural land, including the land under large cardamom farming, accounts for more than two-fifths of the farm land in the maize-potato dominated farming system in contrast to nearly four-fifths in the large cardamom-dominated farming system. There are fewer grasslands and pastures in the latter area due to the fact that large areas are under cardamoms. It may be recalled that since cardamoms can be grown on marginal lands, farmers have devoted all their available land to this crop. Land under cardamoms in the maize-potato dominated farming system is much less due to the unsuitability of land for growing this crop because of lack of forest/tree cover and moisture stress. The main

Table 3.6: Inventory of Assets (US$)

Particular	Cardamom Farmers						Maize-potato Farmers					
	Small Farmer		Large Farmer		All Households		Small Farmer		Large farmer		All Households	
	PH	PC	PH	PC	PH	PC	PH	PC	PH	PC	PH	PC
Residential Building	2487 (87.85)	417	4714 (71.94)	664	3044 (80.92)	487	1042 (78.95)	189	2000 (75.98)	238	1268 (77.82)	205
Cattlesheds	28 (0.99)	5	56 (0.86)	8	35 (0.93)	6	25 (1.92)	5	71 (2.71)	8	36 (2.22)	6 -
Traditional Implements	42 (1.47)	7	55 (0.85)	8	45 (1.20)	7	39 (2.97)	7	50 (1.88)	6	42 (2.56)	7
Dairy Animals	101 (3.58)	17	210 (3.20)	29	128 (3.41)	20	101 (7.64)	18	143 (5.43)	17	111 (6.80)	18
Draught Animals	35 (1.23)	6	62 (0.95)	9	42 (1.11)	7	22 (1.69)	4	63 (2.40)	8	32 (1.96)	5
Other Animals	51 (1.80)	8	119 (1.82)	17	68 (1.81)	11	43 (3.25)	8	108 (4.12)	13	58 (3.58)	9
Non-Farm Assets	87 (3.08)	14	1335 (20.38	188	399 (10.62	64	47 (3.58)	9	197 7.48)	23	82 (5.06)	13
Total Assets	2831 (100.00)	474	6552 (100.00)	923	3761 (100.00)	602	1319 (100.00)	240	2632 (100.00)	313	1629	263

Source: Field Survey 1996

Note: PH=Per Household, PC=Per Capita

Table 3.7: Inventory of Livestock Holdings in the Two Farming Systems

Livestock	Cardamom-dominated System			Maize-potato dominated System		
	Small Farmer	Large Farmer	All	Small Farmer	Large Farmer	All
1. Milch Cows						
Local	0.67	1.90	0.98	0.74	0.50	0.68
Improved	0.23	0.60	0.33	0.12	0.25	0.15
2. Non-Milch Cows						
Local	0.20	0.30	0.23	0.56	0.58	0.57
Improved	0.07	0.20	0.10	0.12	0.25	0.16
3. Young stock	0.73	1.5	0.13	0.72	1.33	0.86
4. Bullocks	0.40	1.00	0.55	0.36	0.83	0.47
5. Goats	1.50	3.00	1.88	1.05	1.75	1.22
6. Pigs	0.47	0.70	0.53	0.38	0.92	0.51
7. Poultry	4.23	5.6	4.58	4.76	6.83	5.25
Total Livestock, Including Poultry	8.50	14.8	10.11	8.81	13.24	9.87
Average Milk Yield (per cow lt/per day)						
Local	1.90	1.92	1.91	1.90	2.75	2.04
Improved	4.71	4.00	4.38	3.60	4.17	3.81
No. of Eggs Per annum/HH	124	128	125	88	118	95

Source: Field Survey 1996

Table 3.8 Comparative Land-Use Patterns (per cent)

Paticulars	Cardamom Farmers			Maize-potato Farmers		
	Small*	Large*	All	Small*	Large *	All
Land owned	100.00	100.00	100.00	100.00	100.00	100.00
	(47.70)	(53.20)	(100.90)	(46.64)	(50.20)	(96.84)
Agricultural land	91.48	69.73	80.01	56.90	30.28	43.10
Grassland	7.93	20.86	14.43	32.59	36.45	34.59
Forests	-	-	-	7.16	26.49	17.18
Land not fit for cultivation	0.59	9.41	5.55	3.34	6.77	5.12
Average area of land owned (ha)	1.59	5.32	2.02	1.19	4.18	1.90
Average area of operated land (ha)	1.45	3.71	2.23	0.68	1.27	0.82
Per capita land owned (ha)	0.27	0.75	0.40	0.22	0.49	0.31
Per capita land operated (ha)	0.24	0.52	0.32	0.12	0.15	0.13
Number of fragments	2.33	4.70	2.93	1.10	1.42	1.18

Source: Field Survey 1996
Note: Figures in parentheses indicate the total area of land owned.
** Farmers*

cardamom area is largely inhabited by the *Bhutia*(s), the erstwhile rulers of the state who have larger landholdings than the farmers in the other area who are Nepalese in origin and were not allowed to own land until recently. The *Bhutia* land is also protected by law, because an outsider cannot buy and settle there. Tribally-owned land can only be purchased by tribals; and the land ceiling laws have still not been implemented in the state.

Cropping Patterns

Table 3.9 shows the cropping patterns of the two farming systems. In the maize-potato dominated farming system, maize (*Zea mays*) and potatoes (*Solanum tuberosum*) account for more than 55 per cent followed by large cardamoms (*Amomum subulatum*) which account for about 32 per cent. See Figure 3.2 for the monthly cropping sequence in the two farming systems. *Pahaleo, Seto*, and *Kalo* are the main local maize varieties grown. *Kufri Jyoti, Kufri Sindurey, Kufri Dewa,* and 'Red Imperial' are the important varieties of potato. For the last five years, large cardamom farming has increased rapidly. '*Ramsey*', '*Sawney*', '*Golsey*', ' *Bharlang*', '*Madhusey*', and '*Ramla*' are the main cardamom varieties (Subba 1984, Chapter33). '*Ramsey*' is more popular in the maize-potato farming area, because it requires less water than '*Golsey*'. Peas (*Pisum sativum*), ginger (*Zingiber officinale*), and pulses (*Phaseolus* spp) are the other important cash crops. Among the different categories of farmer, small farmers devote more land to maize and potatoes than large farmers, who devote more land to large cardamoms. The state government's programme of providing free ginger seeds has helped this crop spread rapidly as a year-round crop. Nevertheless, while allocating areas to different crops, farmers take care to grow cereals on relatively flat lands and cardamoms on steeper, marginal, and fragile lands so as to minimise soil erosion and landslides.

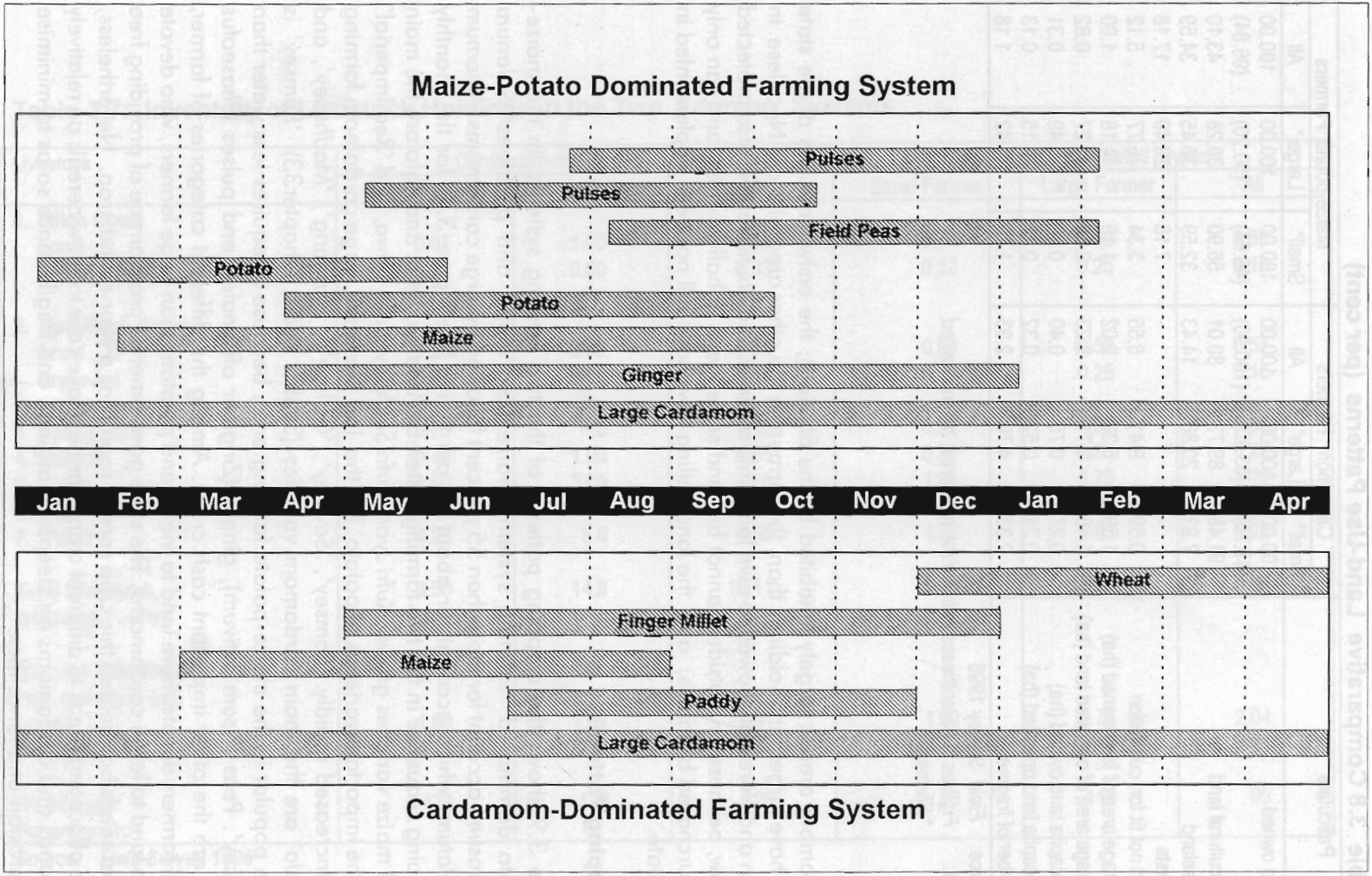

Figure 3.2: Cropping Sequence in Two Farming Systems

Table 3.9: Comparative Cropping Patterns of the Two Farming Systems (per cent)

Crops	Cardamom Farmers			Maize-potato Farmers		
	Small	Large	All	Small	Large	All
Maize	14.43	8.80	11.99	44.19	30.41	39.40
Paddy	15.59	17.10	16.24	-	-	-
Wheat	5.22	2.20	3.92	-	-	-
Finger millet	10.82	11.48	11.12	-	-	-
Potatoes	1.12	-	0.63	17.92	14.58	16.76
Peas	-	-	-	9.70	6.61	8.63
Ginger	0.15	1.03	0.53	2.25	1.77	2.08
Pulses	-	-	-	1.36	2.47	1.75
Large cardamons	52.67	55.39	55.57	24.55	44.15	31.38
Cropping intensity	123	105	101	143.92	134.10	140.30
Cropping intensity excluding Cardamom	163	130	148	155	175	160

Source: Field Survey 1996

In the cardamom farming area, the crop covers over 56 per cent of the farmland. Among the different categories of farmer, while large households devote larger areas to cardamoms, small households use more land for raising crops, not because of survival considerations, as is the common belief, but because they do not have enough land suitable for growing cardamoms at higher elevations. The cropping intensity, largely, is higher in the maize-potato farming area than in the large cardamom farming area. The farmers have tried to cope with the increasing population pressure and the sub-division of landholdings by intensifying cultivation and growing more than one crop. Nonetheless, there is still scope for increasing the area under double cropping.

In the maize-potato dominated farming area, the cultivation of large cardamoms began during the last two decades and became a popular practice more recently. Nearly 30 per cent of the households introduced large cardamom cultivation in the last ten years and about 36 per cent have plantations that are more than 20 years old (Table 3.10). In contrast, in the cardamom-dominated area, farmers have been growing this crop for about a century, and the average age of their plantations exceeds thirty to forty years. It was observed that the farmers in both areas have, more recently, started taking an

Table 3.10: Age of Cardamom Plantations on Sample Farms (per cent)

Age in Years	Cardamom Farmers			Maize-potato Farmers		
	Small*	Large*	All	Small	Large	All
Less than 10 years	-	-	-	41.67	-	30.30
10-15 years	-	-	-	25.00	44.44	24.24
15-20 years	-	-	-	8.33	22.52	15.15
Above 20 years	100.00	100.00	100.00	25.00	33.34	36.31
Per cent of HHs Growing Cardamons	100.00	100.00	100.00	38.46	25.00	23.53

Source: Field Survey 1996

interest in maintaining the productivity of crops, by filling gaps and planting new trees to replace aging ones and so on. The limited farming of cardamoms in the past was because their cultivation was monoplised by a few *Kazis* (big landlords).

Crop Yields

The yields of different crops have been given in Table 3.11. No systematic pattern is evident in the yield levels of small and large households. For instance, contrary to the stylised, inverse farm size-productivity relationship, the yields in the cardamom dominated area are marginally higher in the case of large farmers than in the case of small farmers. However, in the maize-potato dominated farming system, the yields of cash crops, notably, potatoes, ginger, and cardamoms are higher on small farms. It, however, should be kept in mind that the inverse farm size-productivity relationship may not generally hold true in mountain agriculture for two reasons. First, the fertility of land in these areas is a direct function of the elevation of the land, and it depends where the bulk of the land in a particular category is located. Second, in areas where a high-value cash crop is grown, the land under cereals may be of poor quality, resulting in lower yields.

Input Use

The use of chemical fertilizers is negligible. In terms of households, while six per cent of the sample households used chemical fertilizers in the maize-potato dominated area, more than three-fourths did so in the large cardamom-dominated area, and not for cardamoms, but for other crops. Again, in comparison to the reported state average of 52.40 per cent (Table 2.12 in Annex to Chapter Two) of the total cultivated area of maize, wheat, and paddy under high-yielding varieties, not a single hectare of land under these crops on sample farms in both the farming systems had high-yielding varieties. The use of farmyard manure (FYM) was, however, much higher in the former area (6.6 tonnes) than in the latter (3.13 tonnes), which could partly be attributed to the practice of grazing animals. The use of other inputs (e.g., labour) was significantly higher in the

Table 3.11: Comparative Crop Yields of Farmers (tonnes/hectare)

Crops	Cardamom Farmers			Maize-potato Farmers		
	Small*	Large*	All	Small*	Large*	All
Maize	1.19	1.12	1.19	1.10	1.34	1.17
Paddy	1.30	1.59	1.43	-	-	-
Wheat	1.2	1.19	1.20	-	-	-
Finger millet	0.53	0.34	0.46	-	-	-
Potatoes	1.87	-	1.87	3.62	3.16	3.49
Peas	-	-	-	0.74	1.07	0.83
Ginger	3.28	4.5	3.02	5.62	5.11	5.48
Pulses	-	-	-	0.43	0.60	0.45
Large cardamom	0.35	0.39	0.37	0.26	0.25	0.26

Source: Field Survey 1996
** Farmer*

maize-potato dominated area (see Table 3.12). The factor responsible for the low use of modern inputs (cited by farmers) was mainly the lack of timely availability (see Table 3.13).

Table 3.12: Comparative Input Use by Farmers

Particulars	Unit	Cardamom Farmers			Maize-potato Farmers		
		Small*	Large*	All HH	Small*	Large*	All HH
FYM	T/ha	5.16	4.0	4.7	6.2	7.9	6.6
Chemical fertilizers (N)	Kg/ha	4	13	7	1.72	Nil	1.23
Households using chemical fertilizers	%	73.33	90	77.50	7.69	Nil	5.88
High-yielding varieties	% HH	Nil	Nil	Nil	Nil	Nil	Nil
Labour in crop production	Days/ha	75	61	69	85	103	89
Labour in large cardamom production	Days/ha	50	62	56	97	75	86
Seeds							
- Maize	Kg/ha	15.82	19.44	16.96	17	21	18
- Wheat	Kg/ha	21.43	32.22	24.05	-	-	-
- Paddy	Kg/ha	29.01	38.14	33.17	-	-	-
- Finger millet	Kg/ha	8.02	10.42	9.10	-	-	-
- Potatoes	T/ha	-	-	-	1.9	1.6	1.7
- Ginger	T/ha	-	-	-	1.4	1.7	1.5
- Peas	Kg/ha	-	-	-	1.2	1.0	1.1

Source : Field Survey 1996
Note: HH = households; FYM = farm yard manure.
** Farmers*

Table 3.13: Reasons against Using Chemical Fertilizers (% of households)

	Cardamom Farmers						Maize-potato Farmers					
	Small		Large		All		Small		Large		All	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Harmful to soil	3	50.00	1	100	4	57.14	7	58.33	26	70.27	33	67.35
Not available in time	-	-	-	-	-	-	3	25.00	4	10.81	7	14.29
Enough FYM	3	50.00	-	-	3	42.86	1	8.33	5	13.51	6	12.24
Lack of Purchasing power	-	-	-	-	-	-	1	8.34	2	5.11	3	6.12
Total	6	100	1	100	7	100	12	100	37	100	49	100

Source: Field Survey 1996

Four

Comparative View of Range and Quality of Farming Options

Range of Farming Options

The number of livelihood options practised by the sample households from the two farming systems in Sikkim are given in Table 4.1[3] (Figure 4.1). It shows that there is no significant difference in the number of livelihood options adopted by the households between the two farming systems. For example, in the maize-potato dominated system, more than fifty per cent of the households adopted four options, followed by twenty-five per cent adopting three, and around eight per cent adopting five. On the other hand, in the large cardamom-dominated farming system, 47 per cent adopted four options, followed by 27 per cent adopting three, and 13 per cent adopting five options (Figure 4.1). Furthermore, there was a positive relationship between the household and per capita incomes and the number of livelihood options adopted by the households in the maize-potato dominated farming system. The per capita income of those households adopting five options was as high as US $ 235 compared to a low of US $ 57 in the case of households adopting two options. In comparison, no such relationship was seen in the cardamom-dominated farming system; the per capita income of the households adopting one option was as high as US $ 288 compared to a per capita income of US $ 222 for those adopting as many as five livelihood options. A more or less similar pattern was discernible among the small and large households in both areas. It is, however, important to emphasise that the household and per capita incomes from all options in the cardamom dominated farming system were nearly double those in the maize-potato dominated farming system.

The contributions of different options to the total income of the households practising a different number of livelihood options in the maize-potato dominated farming system are shown in Tables 4.2 through 4.4. The contribution of large cardamom farming, as a livelihood option, towards total household income decreases with an increase in the number of options adopted by the households. The pattern is similar in respect of both small and large households. In the case of small and large households which had adopted two livelihood options and did not have large cardamoms, livestock contributed more than 90 per cent of the total income in the case of small households and around 60 per cent in the case of large households. The contribution of the service sector increased with an increase in the number of livelihood options.

3. See Tables 4.1 to 4.4 in Annex 2

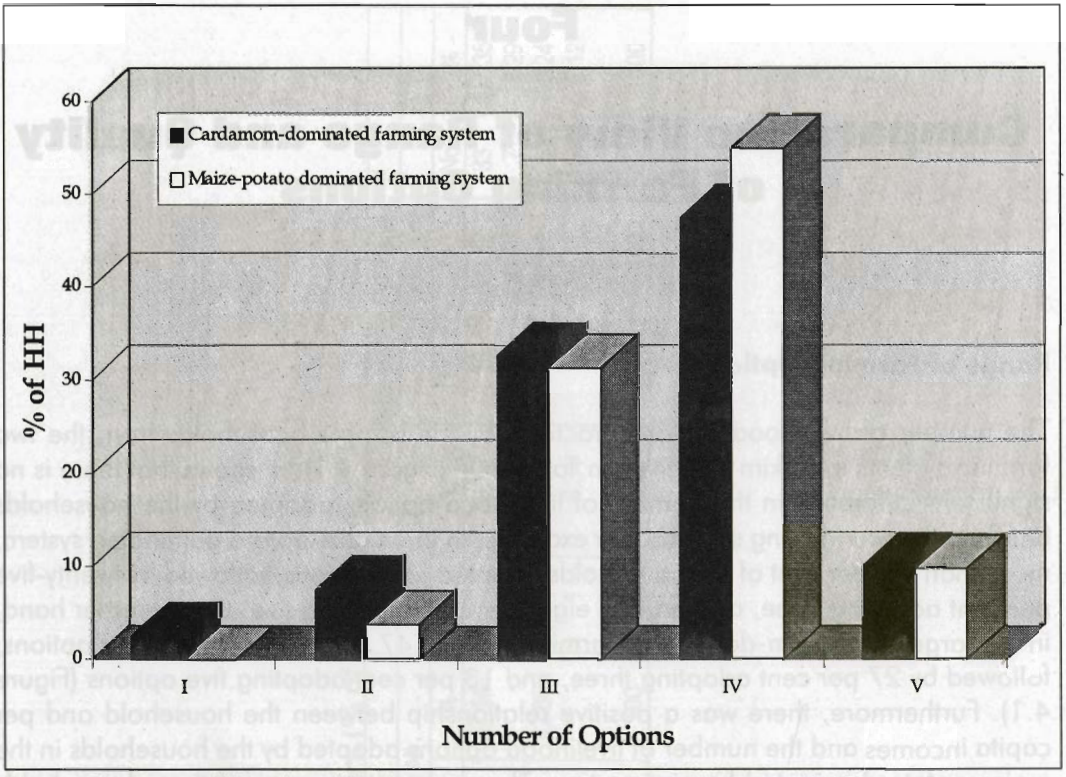

Figure 4.1: Range of Livelihood Options

In the large cardamom-dominated farming system, Tables 4.5 through 4.7 demonstrate the following features. As in the case of the maize-potato dominated farming system, the contribution of large cardamoms to the total household income declines with an increase in the number of options. The notable exception, however, was in the case of households adopting only two or three livelihood options and households adopting large cardamoms as the main livelihood option. In brief, it demonstrates that the households having sufficient land under large cardamoms tend to adopt fewer livelihood options. On the other hand, those who do not have enough land to grow cardamoms tend to diversify their livelihood options in order to meet their basic needs. A variety of factors, at both the household and community levels, determines the number of livelihood options adopted by a household. At the household level, availability of assets (land, labour, assets, skills, and so on) is the important factor affecting the number of options practised by a household.

In sum, the micro-evidence shows clearly that those households in both farming systems which have enough land to grow cardamoms, a high-value cash crop, adopt fewer livelihood options than small holders. In other words, there is some evidence to support the hypothesis that the diversification of livelihood options tends to be distress-driven. However, it should be noted that the number of options practised by a household is, *inter alia*, contingent upon their quality. A household might adopt fewer options which yield a sufficient amount of income, for example, large cardamoms.

Table 4.5: Range-wise Livelihood Options and Their Contribution to Household Income (all households: cardamom-dominated farming system)

Options/Range of Options	Per cent of households					Per cent of income				
	1	2	3	4	5	1	2	3	4	5
Crop production	-	-	100	100	100	-	-	9.15	9.06	4.16
Large cardamoms	100	100	100	100	100	100	65.74	66.84	41.70	28.98
Livestock	-	66.67	100	100	100	-	7.62	18.77	9.43	8.48
Agri-labour	-	-	-	15.79	7.50	-	-	-	2.70	4.99
Non-agri labour	-	-	-	21.05	-	-	-	-	4.05	-
Service sector	-	-	-	63.16	25.00	-	26.64	5.24	33.06	39.92
Business/shop	-	33.00	-	100	100	-	-	-		13.46

Source: Field Survey ,1996

Table 4.6: Range-wise Livelihood Options and Their Contribution to Household Income (small households: cardamom-dominated farming system)

Options/Range of Options	Per cent of households					Per cent of income				
	1	2	3	4	5	1	2	3	4	5
Crop production	-	-	100	100	100	-	-	13.49	7.67	4.16
Large cardamoms	100	100	100	100	100	100	65.74	52.27	42.63	28.98
Livestock	-	66.00	100	100	100	-	7.62	22.35	8.16	8.48
Agri-labour	-	-	-	21.43	75.00	-	-	-	5.08	4.99
Non-agri labour	-	-	-	28.57	-	-	-	-	7.63	-
Service sector	-	33.00	12.50	50.00	25.00	-	26.64	18.89	28.83	39.92
Business/shop	-	-	-	-	100	-	-		-	13.46

Source: Field Survey 1996

Table 4.7: Range-wise Livelihood Options and Their Contribution to Household Income (large households: cardamom-dominated farming system)

Options/Range of Options	Per cent of households					Per cent of income				
	1	2	3	4	5	1	2	3	4	5
Crop production	-	-	100	100	-	-	-	5.71	10.62	-
Large cardamoms	-	-	100	100	-	-	-	78.35	40.65	-
Livestock	-	-	100	100	-	-	-	15.94	10.87	-
Agri-labour	-	-	-	-	-	-	-	-	-	-
Non-agri labour	-	-	-	-	-	-	-	-	-	-
Service sector	-	-	-	100	-	-	-	-	37.86	-
Business/shop	-	-	-	-	-	-	-	-	-	-

Source: Field Survey 1996

Employment

The contribution of different livelihood options towards total employment in person days in both the above-mentioned areas has been shown in Table 4.8 and Figure 4.2. Agriculture which is defined broadly to include crop production, large cardamoms, and livestock-rearing contributes nearly one-half of the total employment days in the maize-potato dominated farming system. Agricultural labour is yet another important source of employment, accounting for as high as one-fourth of the total employment days. Among the non-farm sources of employment, the service sector contributes 15.25 per cent. An almost similar pattern is obtained in the cardamom-dominated farming system with agriculture, defined broadly, accounting for more than 50 per cent of the total employment days, followed by the service sector and agricultural labour. The total number of employment days in the maize-potato dominated farming system is, however, significantly (about 15%) higher than in the large cardamom-dominated area. The situation in the maize-potato dominated farming system typically represents a misguided unemployment scenario, as will become clear in the following paragraphs.

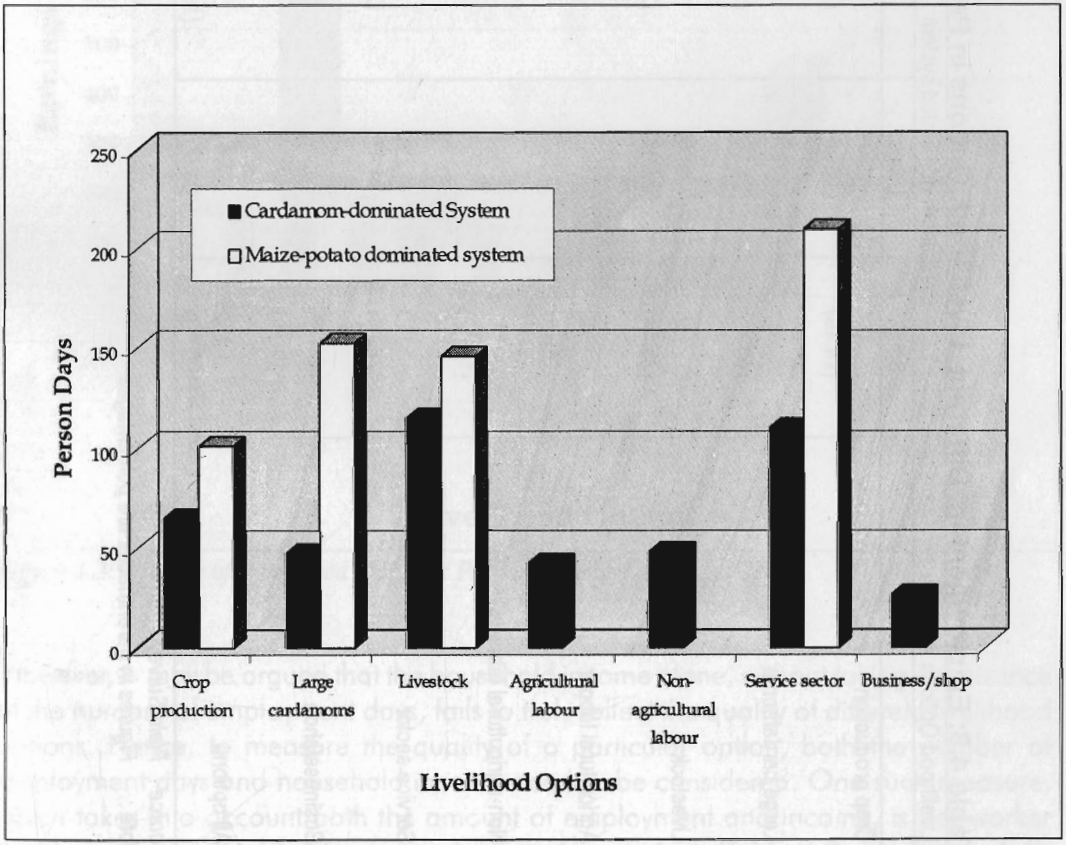

Figure 4.2: Quality of Livelihood Options:: Employment in Person Days

Table 4.8: Employment in Different Livelihood Options in Person Days

Livelihood Options	Cardamom-dominated system			Maize-potato dominated system		
	Small	Large	All	Small	Large	All
Crop production	64	101	73	77	116	87
	(14.15)	(16.58)	(14.84)	(13.97)	(15.57)	(15.13)
Large cardamoms	47	152	73	41	83	50
	(10.40)	(24.96)	(14.84)	(7.44)	(11.14)	(8.70)
Livestock	115	146	122	149	211	144
	(25.44)	(23.98)	(24.80)	(27.84)	(28.32)	(25.04)
Agricultural labour	42	-	32	131	92	124
	(9.29)		(6.50)	(23.77)	(12.35)	(21.57)
Non-agricultural labour	48	-	37	31	30	27
	(10.62)		(7.52)	(5.63)	(4.03)	(4.70)
Service sector	110	210	135	84	183	107
	(24.34)	(34.48)	(27.43)	(15.25)	(24.56)	(18.60)
Business/shop	26	-	20	38	30	36
	(5.76)		(4.07)	(6.90)	(4.03)	(6.26)
All options	452	609	492	551	745	575
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Source : Field Survey 1996
Note : Figures in parentheses are percentages

Earnings

The household earnings yielded through different livelihood options are yet another important indicator of their quality. In this context, Table 4.9 (Figure 4.3) reveals that, in the maize-potato dominated system, the service sector is the most important source of income followed by income from large cardamom and crop production. The pattern is similar for both small and large households. In comparison, in the cardamom- dominated system, almost 50 per cent of the total household income comes from large cardamoms alone. Among the different categories of households, the contribution of large cardamoms is lower in the case of small households (45.45%) than in the case of their larger counterparts (54.43%). Another one-fourth of the household income is contributed by the service sector.

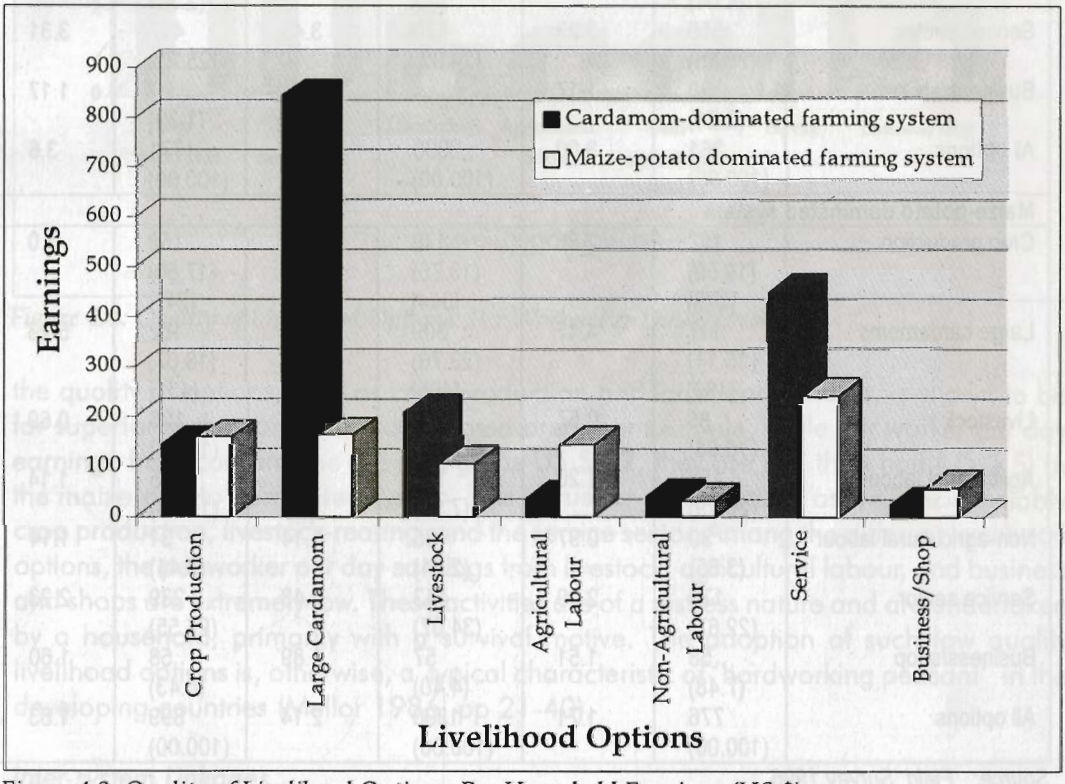

Figure 4.3: Quality of Livelihood Options: Per Household Earnings (US $)

However, it may be argued that the household income alone, without taking cognizance of the number of employment days, fails to truly reflect the quality of different livelihood options. Hence, to measure the quality of a particular option, both the number of employment days and household income need to be considered. One such measure, which takes into account both the amount of employment and income, is per worker per day earnings. Guided by per worker per day earnings (Table 4.9 and Figure 4.4),

Table 4.9: Earnings from Different Livelihood Options (US $)

Livelihood options	Small Farmers		Large Farmers		All Farmers	
	PH	PW/D	PH	PW/D	PH	PW/D
Cardamon-dominated system						
Crop production	104 (7.64) [122]	1.63	265 (8.83) [158]	2.63	144 (8.13) [137]	1.97
Large cardamoms	619 (45.48) [658]	13	1632 (54.43) [763]	10.71	872 (49.25) [666]	11.94
Livestock	149 (10.94)	1.29	381 (12.72)	2.6	207 (11.70)	1.69
Agricultural labour	48 (3.53)	1.14	-	-	36 (2.03)	1.11
Non-agricultural labour	55 (4.04)	1.14	-	-	41 (2.32)	1.11
Service sector	356 (26.16)	3.23	720 (24.02)	3.43	447 (25.25)	3.31
Business/shop	30 (2.21)	1.17	-	-	24 (1.32)	1.17
All options	361 (100.00)	3.00	2998 (100.00)	4.92	1771 (100.00)	3.6
Maize-potato dominated system						
Crop production	152 (19.59) [223]	2.86	178 (13.75) [344]	3.2	158 (17.60) [247]	3.0
Large cardamoms	117 (15.14) [489]	4.17	309 (23.76) [405]	7.71	162 (18.07) [451]	5.23
Livestock	85 (10.98)	0.57	175 (13.46)	0.97	106 (11.83)	0.69
Agricultural labour	158 (20.29)	1.20	103 (7.92)	1.11	145 (16.08)	1.14
Non-agricultural labour	30 (3.85)	0.97	35 (2.64)	1.14	31 (3.44)	1.14
Service sector	176 (22.67)	2.09	443 (34.07)	2.43	239 (26.55)	2.23
Business/shop	58 (7.48)	1.51	57 (4.40)	1.89	58 (6.43)	1.60
All options	776 (100.00)	1.71	1300 (100.00)	2.14	899 (100.00)	1.83

Source: Field Survey 1996

Note: 1. Figures in parentheses are percentages
2. Figures in square brackets are net income per hectare
3. PH = per household; PW/D = per worker per day earnings

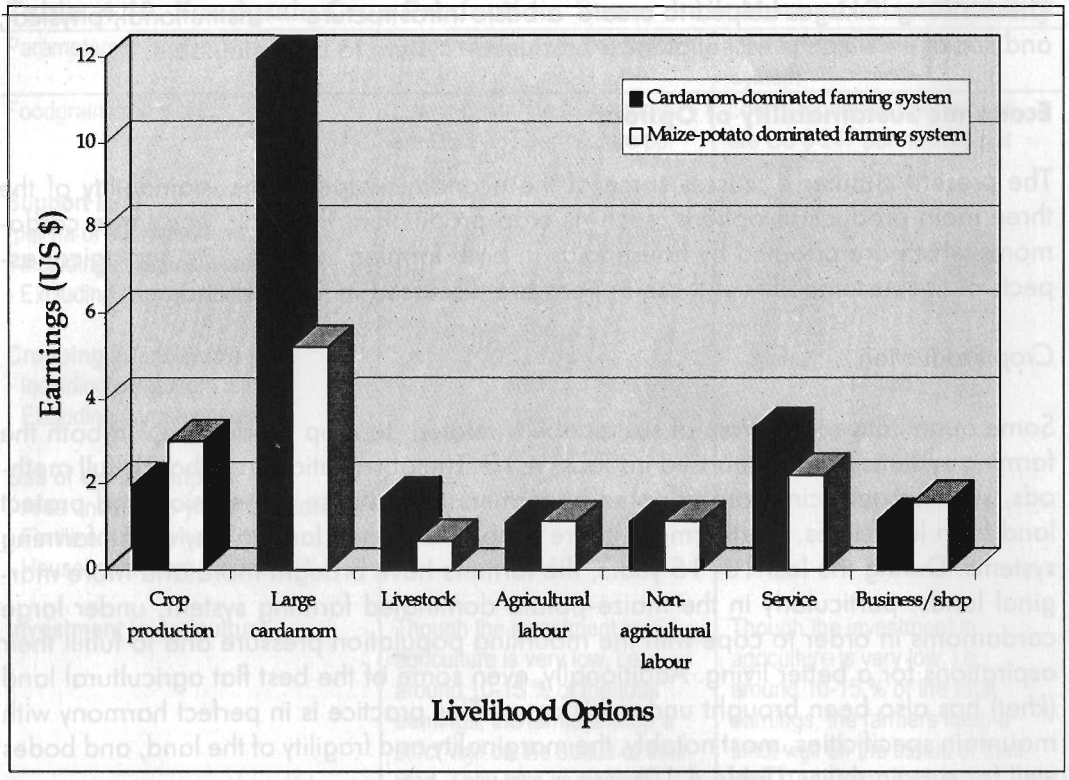

Figure 4.4: Quality of Livelihood Options: Per Worker Per Day Earnings

the quality of options, such as crop production and large cardamoms, is shown to be far superior in the cardamom dominated area. For example, while per worker per day earnings from cardamoms are as high as US $ 12, they are less than half (US $ 5) in the maize-potato dominated system. This is true for other options as well, most notably crop production, livestock-rearing, and the service sector. Among the different livelihood options, the per worker per day earnings from livestock, agricultural labour, and business and shops are extremely low. These activities are of a distress nature and are undertaken by a household, primarily with a survival motive. The adoption of such low quality livelihood options is, otherwise, a typical characteristic of 'hardworking peasant' in the developing countries (Mellor 1986, pp 21-40).

Inter-system Linkages

The study findings suggest that large cardamoms as a production option do not have much of an inter-system linkage due to their special attributes, which are low-volume, high-value, non-perishability; less infrastructure intensive, very good shelf life, negligible use of external inputs, and so on. While these attributes qualify large cardamoms as a livelihood option which is more sustainable, its contribution to the whole production system's diversity and resilience is not so pronounced. This is in contrast to the tremendous amount of inter-systemic and intersectoral linkages, both backwards and forwards, which were generated by the spread of apple cultivation in the state of Himachal Pradesh.

These strong linkages helped to create a basic infrastructure — institutional, physical, and social — which is essential for a production system to be sustainable.

Economic Sustainability of Options

The present chapter discusses some of the economic aspects of sustainability of the three main production options, such as crop production, livestock, and large cardamoms which are adopted by households in both farming systems. The ecological aspects of the sustainability of these options are discussed in the next chapter.

Crop Production

Some quantitative indicators of sustainability related to crop production, in both the farming systems are summarised in Table 4.10 The observations are that skilfull methods, such as terracing, are adopted by farmers to minimise soil erosion and protect land from landslides. Furthermore, there is no abandoned land in any of the farming systems. During the last 10- 15 years, the farmers have brought more and more marginal lands, particularly in the maize-potato dominated farming system, under large cardamoms in order to cope with the mounting population pressure and to fulfill their aspirations for a better living. Additionally, even some of the best flat agricultural land (*khet*) has also been brought under this crop. This practice is in perfect harmony with mountain specificities, most notably, the marginality and fragility of the land, and bodes well for sustainability (Table 4.10).

Livestock

Some aspects of the livestock option which impinge directly on the natural resource base have been given in Table 4.11. A few comments are in order. First, while both grazing and stall feeding are practised in the cardamom-dominated system, in the maize-potato dominated system the animals are completely stall-fed, suggesting positive implications for sustainability. Second, the dependence of households on the forest for fodder and fuel is very high in the latter farming system than compared to the former. In the cardamom-dominated farming system, the households meet their fodder requirements from their own land. In fact, people in the cardamom-dominated areas have adjusted themselves fully to the cessation of access to forest fodder about fifteen years back. They reduced the number of animals and replaced cattle with goats and pigs, which require less grass, in order to overcome the fodder and fuel problem.

Large Cardamom

Table 4.12 presents the sustainability implications of large cardamom as a production option. This production option is perfectly compatible with the mountain specificities of Sikkim and fulfills the necessary and sufficient conditions to be sustainable.

Table 4.10: Foodgrain Crop Production: Some Indicators of Sustainability

Parameters	Cardamom-dominated System	Maize-potato dominated System
Foodgrain crop yields	Low to moderate (net returns are US $ 137 per hectare per annum)	Low to moderate (net returns are US $ 247 per hectare per annum)
Support land (per ha of cultivated land)		
- Including cardamom land	2.57	2.25
- Excluding cardamom land	0.71	1.68
Cropping intensity (%)		
- Including cardamom land	101	140.30
- Excluding cardamom land	140	160
Use of external inputs		
- Area under high-yielding varieties	Nil	Nil
- Fertilizers (N kg/ha)	7	1.23
- Households using fertilizers (%)	77.50	5.88
Investment in agriculture	Though the investment in agriculture is very low, i.e., around 10-15 % of the total earnings, the farmers keep a strict vigil on the status of their land. They take immediate measures if any type of land degradation, e.g., landslides, takes place.	Though the investment in agriculture is very low, i.e., around 10-15 % of the total earnings, the farmers keep a strict vigil on the status of their land. They take immediate measures if any type of land degradation, e.g., landslides, takes place.
Abandoned land	Nil	Nil
Extension of cultivation on to marginal lands during the last 10 – 15 years	Nil	Marginal lands have been cultivated with large cardamoms.

Source: Field Survey 1996

Quality of Life of Farm Families

Other quantitative indicators related to both the crop production and livestock options and which have direct implications on sustainability are described in Table 4.13.

It is clearly shown that the quality of life enjoyed by households in the cardamom-dominated farming system is far superior to that enjoyed by their counterparts in the maize-potato dominated system. For example, both the household and per capita expenditures on superior grains, fruits and vegetables, clothing, and so on are much higher in the cardamom-dominated system (Tables 4.14 and 4.15). The per capita expenditure on education in the cardamom-dominated farming system is nearly five times higher than in the maize-potato dominated farming system (Table 4.14). Most of the families from the cardamom system have sent their children to Gangtok, Darjeeling,

Table: 4.11: Livestock : Some Indicators of Sustainability

Parameters	Cardamom-dominated System	Maize-potato Dominated System
Feeding practices	Grazing-cum Stall Feeding	Stall feeding
Fodder requirements (kg/day)	40	65
Fodder requirements met from the forests (%)	No dependence on forests	50-60
Households depending on forests (%)	No dependence on forests. Deficit households meet fodder needs from within the community, i.e., from fellow villagers	63
Response of community to declining access to forests for fodder	*Gaucharan* forests were taken over by the government in 1981 for replantation. This affected the community's access to fodder. The community responded to this in three ways: (i) reduced the number of animals (ii) some resorted to the practice of transhumance (iii) replaced cattle with goats and pigs, which require less fodder	Free access to forest fodder

Source: Field Survey 1996

The food habits of the people in the maize-dominated farming system have drastically changed in recent years. Though the farming system continues to be dominated by maize and potatoes, maize is no longer the staple diet of the people. Practically all households have switched over to rice, though the rice eaten by them is of poor quality. The people stopped eating maize about ten years ago. The factors which led to this change are: firstly, decline in the productivity of maize and secondly, an increase in both off-farm and on-farm employment opportunities. While more off-farm jobs became available in public works and government-sponsored programmes, the on-farm employment opportunities received a boost with the spread of the cultivation of large cardamoms. Thirdly, in recent years, the price of cardamoms has increased rapidly, and this has led to an increase in the incomes of the people. There is a saying in the area that if one has four kg of cardamoms, one can buy 40 kilogrammes of rice. Fourthly, the availability of rice, both through the public distribution system and in the open market, improved due to better infrastructural facilities such as roads. Fifthly, local people used to take maize in the form of a porridge meal and not as flour. The task of making maize flour is very tough and demanding.

Table 4.12: Large Cardamom: Some Aspects of Sustainability/ Unsustainability

Positive implications for sustainability	Factors threatening sustainability	Needed development interventions
Indigenous plant, therefore perfectly compatible with mountain specificities such as marginality, fragility, diversity, and niche - Promotes natural resource conservation	Rapid spread of viral diseases like *phurkey* and *chirkey*, thus effecting the yield negatively	Need to evolve disease-resistant varieties Develop disease control methods
Low-volume high-value non-perishable cash crop: net return ranges from US $ 714 to US $ 857 per hectare	Over age of the plantations	Require immediate attention to control disease by strengthening the extension network to transfer the available know-how to the farmers
Good shelf life quality and does not require immediate marketing	Lack of appropriate and sound institutional back-up to sustain the system - such as R&D, extension network, and marketing	Scope for investing in the market which is largely controlled by private traders
Negligible dependence on external imputs: only gunny-bags are required		Encourage the farmers to switch over to other high-value cash crops such as floriculture and off-season vegetables
Less infrastructure (like roads) - intensive: compatible with the inaccessibility attribute of the mountains		Promote native handicrafts in order to reduce the excessive dependence of people on large cardamoms
Employment promoting: minimum 80-100 days of employment are generated on one ha of cardamom land		
Fuelwood requirement is 350kg of raw wood to cure 100kg of cardamoms		
The fuelwood requirement is met from the system and a continuous process of thinning of trees goes on.		
Large cardamom enjoys almost an ensured buoyancy of demand and a re-munerative price. This is due to the fact that nearly 80% of the total world production is produced by the state.		
Very easy to propagate and multiply		
Numerous ecological/environmental benefits		

Table 4.13: General Indicators of the Resource Base and Use

Parameters	Cardamom-Dominated System	Maize-potato Dominated System
Time devoted to fetching fuel and fodder	No dependence on forests	Takes 3 to 4 hours compared to 1 to 2 hours ten years ago
Fuelwood consumption	518kg per month; 100% requirements met from farmers own land	527kg per month : 90% of the demand is met from the forests
Water in natural sources	60% of the respondents are of the opinion that the level of water from natural sources has gone down. Households are unanimous in attributing this decline to the commercial deforestation carried out by the government .	63% of the respondents feel that the water level in the natural sources has gone down. According to a few informed persons, the water level has gone down by 30 to 40% compared to 10-15 years ago. This decline is mainly attributed to commercial deforestation carried out by the government.
Frequency and intensity of landslides	There is no perceptible increase in the frequency and the intensity of landslides in the study area.	There is no perceptible increase in the frequency and the intensity of landslides in the study area.
Crop diversity	The decline in crop diversity is not so marked.	The diversity of crops grown has decreased. About 10-12 years ago 10 to 15 crops used to be grown compared to 3 to 4 grown today.
Symptoms/manifestations of global warming	The effect is not felt clearly in the area, perhaps because it has always been a cardamom dominated area.	The local informed people point out the effect of the change in climate. According to them the effect is clearly seen in the case of crops such as ginger, broom grass, soya beans (local variety), and some pulses. These crops were earlier grown only at lower elevations, but now, are also being grown at higher elevations.
Social and cultural values	There has not been any significant change in the cultural and social values of the society. For example, the dress, the institution of marriage, and food habits continue to be, largely, the same as they were 20 to 30 years ago. This could be attributed to the fact that the culture, customs, and traditions of the people evolved along with the large cardamon.	These values have not been affected much. Social and cultural institutions such as *parma* (exchange of labour) are still in vogue. The food habits of the people have, however, changed drastically during the last ten years.

Source: Field Survey 1996

Table 4.14: Indicators of the Quality of Life of the People

Particulars	Unit	Cardamom-Dominated System			Maize-potato Dominated System		
		Small	Large	All HH	Small	Large	All HH
Expenditure on superior grains	US $	241 (40)	334 (47)	264 (38)	113 (20)	204 (24)	135 (22)
Access to food	% of HHs	100	100	100	100	100	100
Expenditure on clothing	Us $	112 (19)	159 (22)	124 (20)	86 (16)	133 (16)	97 (16)
Expenditure on education	US $	84 (14)	169 (24)	105 (59)	44 (8)	171 (20)	74 (12)
Expenditure on milk and milk products	Us $	130 (22)	188 (26)	145 (23)	111 (20)	139 (16)	117 (20)
Expenditure on fruits and vegetables	US $	51 (9)	51 (7)	51 (8)	42 (8)	56 (7)	45 (7)
Expenditure on health	US $	14 (2)	20 (2)	12 (2)	12 (2)	15 (2)	13 (2)
Value of residential housing	US $	2487	4714	3044	1042	2000	1268
Literacy	per cent	26.60	36.67	29.52	23.46	34.02	26.96
Percentage of households in debt	per cent	10.00	-	7.5	20	-	15.68
Access to safe drinking water	per cent	100	100	100	100	100	100
Access to electricity	per cent	100	100	100	100	100	100
Access to clean lavatories	per cent	30	60	37.5	50	70	47.06
Households below poverty line	per cent	-	-	-	15.38	16.67	23.52
Degree of desperation	-	Nil	Nil	Nil	Nil	Nil	Nil
Operation of social sanctions	-	Strong	Strong	Strong	Strong	Strong	Strong

Source : Field Survey 1996

Note : 1. Figures in parentheses denote per capita expenditure
2. HHs = households

Table 4.15: Consumption Pattern of Sample Households (US$/per HH /pa)

Particulars	Large Cardamom-dominated System			Maize-potato Dominated System		
	Small	Large	All	Small	Large	All
A. Food						
Rice	241	334	264	113	204	135
	(24.08)	(21.20)	(23.06)	(16.50)	(18.05)	(17.09)
Maize	-	-	-	27	43	31
				(3.94)	(3.80)	(3.92)
Pulse	33	65	41	13	25	16
	(3.30)	(4.12)	(3.58)	(1.90)	(2.21)	(2.03)
Oil & Ghee	30	68	40	24	41	28
	(2.99)	(4.32)	(3.49)	(3.50)	(3.62)	(3.54)
Milk/milk	130	188	145	111	139	117
Products	(12.99)	(11.94)	(12.66)	(16.20)	(12.30)	(14.81)
Meat & Eggs	69	88	74	50	68	54
	(6.89)	(5.59)	(6.46)	(7.30)	(6.02)	(6.84)
Locally made	72	149	91	27	43	31
Wine	(7.19)	(9.46)	(7.95)	(3.94)	(3.81)	(3.92)
Beverages	18	22	19	19	21	19
	(1.80)	(1.46)	(1.66)	(2.77)	(1.86)	(2.40)
Fruits &	51	51	51	42	56	45
Vegetables	(5.09)	(3.24)	(4.45)	(6.13)	(4.96)	(5.70)
Miscellaneous	31	36	32	31	36	33
	(3.10)	(2.29)	(2.79)	(4.53)	(3.19)	(4.18)
Total food	675	1002	757	457	676	509
expenditure	(67.41)	(63.62)	(66.11)	(66.71)	(59.82)	(64.43)
B. Non-food grain						
Clothing	112	159	124	86	133	97
	(11.19)	(10.09)	(10.83)	(12.55)	(11.77)	(12.28)
Education	84	169	105	44	171	74
	(8.39)	(10.73)	(9.17)	(6.42)	(15.13)	(9.37)
Health	14	20	15	12	15	13
	(1.40)	(1.27)	(1.31)	(1.75)	(1.33)	(1.65)
Transport	35	78	46	22	40	26
	(3.50)	(4.95)	(4.02)	(3.21)	(3.54)	(3.29)
Social	43	98	57	29	55	35
Ceremonies	(4.30)	(6.22)	(4.98)	(4.23)	(4.87)	(4.43)
Miscellaneous	38	49	41	35	40	36
	(3.80)	(3.12)	(3.58)	(5.11)	(3.54)	(4.55)
Total non-food	326	573	388	228	454	281
expenditure	(32.59)	(36.38)	(33.89)	(33.29)	(40.18)	(35.57)
Total food & non-food	1001	1575	1145	685	1130	790
expenditures	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)

Source: Field Survey 1996
Note: Figures in parentheses are percentages

and other cities for education. Furthermore, while around one-fourth of the households are below poverty line in the maize-potato dominated system, there is no incidence of poverty in the other system. The quality of life in both areas is, however, equally high in terms of the very low degree of desperation and operation of social institutions; both areas are very rich in terms of their cultural values. Despite the fact that people in the cardamom dominated areas are economically much better-off, their traditions and cultures, such as dress, marriage, cooperation among the people, food habits, and so on, are still intact. This is in contrast to other transformed areas, e.g., Himachal Pradesh, where economic prosperity has dealt a severe blow to these values (Sharma 1996, pp 54-55). The reason perhaps lies in the fact that the cultural values and ethos of the people evolved concomitantly with the domestication of large cardamom.

Equity Concerns of Existing Farming Systems

The information derived from different indicators of equity for both farming systems, given in Table 4.16, is mixed. For example, the income distribution (measured by the Gini ratio) is more unequally distributed in the cardamom-dominated farming system than in the maize-potato dominated farming system. Nevertheless, the distribution of land, both owned and operated, is more skewed in the maize-potato dominated system. The low incidence of inequality in land distribution in the cardamom-dominated farming system could be attributed to their being a relatively homogeneous community

Table 4.16: Indicators of the State of Equity between the Two Farming Systems

Particulars	Unit	Cardamom-dominated System	Maize-potato Dominated System
Male wages	US $	1.14	1.14
Female wages	US $	1.00	1.14
Income distribution	Gini ratio	0.4617	0.3280
Distribution of owned land	Gini ratio	0.3673	0.4105
Distribution of operated land	Gini ratio	0.3000	0.3583
Female participation in household decisions	per cent	80	95
Sexual division of labour	-	Flexible: All activities, except ploughing and roofing of the house, are performed by both sexes	Flexible: All activities, except ploughing, wood cutting, and roofing of the house, are performed by both sexes
Females having secondary education	per cent	54.84	40
School-going children		100	100
Male	per cent	100	100
Female	per cent	100	100
Female illiteracy	per cent	40	44.93

Source: Field Survey 1996

insofar as land ownership is concerned. To recall, the *Bhutia*(s) belong to the erstwhile ruling class of the state and owned larger areas of land than the *Sherpa*(s). Similarly, while some indicators of gender equity, such as female literacy and percentage of females having higher education, are higher in the cardamom-dominated area, female wage rates are still lower than those of their male counterparts.

In sum, the micro-evidence indicates that the major livelihood options being practised by households in the two farming systems, such as crop production, livestock, and large cardamoms, have positive implications for sustainability. There is, however, no evidence to support the hypothesis that, in the process of transformation, some endogenous factors and processes, expressly operating on the demand side, are generated in the system which tend to ease the pressure on natural resources. Despite fairly high levels of earnings and the quality of life achieved in the cardamom-dominated farming system, the dependence on natural resources has not decreased much. For example, there has not been a decrease in the fuelwood required to cure cardamoms, no reduction in family sizes, no reduction in the number of livestock, nor any improvement, and so on. This is in variance with the experience of other transformed areas, e.g., Himachal Pradesh, where over time the dependence on natural resources has tended to decline.

Five

Large Cardamom Farming : An Indigenous Sustainable Production Option in the Sikkim Himalayas

History of Farming

The large cardamom is a native plant of Sikkim. While *Amomum subulatum* is the cultivated species, wild relatives such as *A. linguiforme, A. kingii, A. aromaticum, A. corynostachyum,* and *A. dealbatum* are still found in the state. Collecting large cardamom capsules from natural forests has been a traditional activity of one of the aboriginal ethnic groups in the state, the *Lepcha*(s). And, when the ownership of these forests passed into the hands of the village community, the crop was domesticated. Later, the cultivation of the crop spread among the *Bhutia*(s). For quite some time before 1950, the cultivation of the crop was monopolised by big *Bhutia* landlords, called *Kazi*(s). Since the state lies on the traditional trade route to Tibet, the use of cardamoms expanded to cities in the plains, and also to other countries. Likewise, because of the special attributes of the crop, namely, those of a high-value, low-volume, non-perishable cash crop; less dependent on external inputs; less infrastructure-intensive (roads); an assured market; and so on, the cultivation of cardamoms spread without much institutional and infrastructural support from the government. Its capsule is used as a spice/condiment and contains about three per cent essential oil — rich in *cineole*. The state accounts for around 80 per cent of the total world produce. The other producers of large cardamoms are Nepal, Bhutan, and the northern parts of West Bengal.

The crop is cultivated on marginal lands and can be grown between 600-2,000masl. It is a shade-loving tree and requires a lot of moisture with a perennial source of water around. It is propagated by raising seedlings from seeds in nurseries and also through separating the rhizomes from the plants. Traditionally, the farmers have been following the second method as it is relatively easy, less time-consuming, and cheaper. This method is, however, also responsible for the spread of diseases as the planting material is likely to carry disease, thereby reducing the productivity and also the lifespan (Subba 1984, Chapter 33). Harvesting of the crop commences from August and lasts until November, depending upon the elevations and variety.

Ecological Sustenance

The previous chapters amply demonstrate that the large cardamom agroforestry system has positive sustainability implications in terms of the quality of life and equity, for both intra- and inter-generations. Nonetheless, another important requisite for understanding

the sustainability of a particular system is to assess its impact on different components of the natural resource base such as soil, water, forests, and biodiversity. Therefore, in this chapter, comparisons of ecological indicators pertaining to the natural resource base of the two dominant farming systems' areas are made.

The sustainability implications of large cardamoms as a production option are explained in Table 4.12. As shown and discussed, large cardamoms as a production option are perfectly compatible with mountain specificities and fulfill both the necessary and sufficient conditions to be sustainable.

Biomass and rates of production of different components of cardamom and maize-potato dominated production systems are given in Table 5.1. The standing biomass in the cardamom system is about 2.5 times higher than in the maize-potato system, thereby

Table 5.1: Comparison of Biomass and Productivity of Cardamom and Maize-potato Dominated Farming Systems

Parameters	Cardamom-dominated System	Maize-potato dominated System
Biomass (kg/ha)		
- Tree		
Bole	10094	4391
Branch	2871	1093
Leaf and twig	1443	337
Root	4144	1507
Total	18552	7328
- Crop/cardamon		
Above ground	4910	2205
Below ground	1868	701
Total	6778	2906
Stand total	25330	10234
Net productivity (kg/ha/year)		
- Tree		
Bole	1546	627
Branch	364	154
Leaf and twig	1440	1584
Root	541	193
Total	3891	2558
- Crop/cardamom		
Above ground	3044	2205
Below ground	367	701
Agronomic yield	330	7147
Total	3741	10053
Stand total	7632	12611

Source: Sharma et al. 1994 and 1995

Note: The tree density was 684 per hectare in cardamom agroforestry and 191 per hectare in the maize-potato dominated farming system. The age of the cardamom bushes was eight years at the time of estimation.

providing more biomass resources for farm family utilisation. The rate of production of the tree component is also higher in the cardamom system. The agronomic yield is very low in the cardamom system, as much as 21 times less than in the maize-potato system, indicating that cardamoms are a low-volume, high-value cash crop. The cardamom is a negligible input crop grown on marginal lands. Farming it is an excellent example of harnessing the local mountain niche.

Soil fertility levels influence plant productivity considerably. Therefore, soil health is critical, especially in the mountains where erosion problems are quite conspicuous. The soil nutrient levels, especially organic carbon and total nitrogen, in the cardamom agroforestry system are comparatively higher than in the maize-potato dominated system (Table 5.2). Soil erosion rates measured in the rainy season reveal about 16 times lower values in the cardamom system. The nutrient losses through soil erosion and overland flow suggest that the cardamom agroforestry system provides a much better protective cover. The low volume of soil erosion and subsequently low soil nutrient loss from cardamom agroforestry in comparison to the maize-potato system indicate that the former is an ecologically viable system.

Table 5.2: Soil Nutrient Concentration, Soil Erosion and Nutrient Loss through Eroded Soils in Both Systems

Parameters	Cardamom-dominated System	Maize-potato Dominated System
Nutrient concentration (mg/g soil)		
Organic carbon	23.87	19.54
Total nitrogen	3.30	2.28
Total phosphorus	0.75	0.73
Soil erosion (kg/ha)	30	477
Nutrient loss through eroded soil and overland-flow (kg/ha)		
Organic carbon	1.87	11.86
Total nitrogen	0.42	2.35
Total phosphorus	0.02	0.68

Source: Rai and Sharma 1995
Note: Values are the means of six samplings spread over the rainy season

The large cardamom is cultivated usually on steep hill slopes under tree cover, either in natural forests or in plantations. It is a shade-loving plant and requires a lot of moisture with a perennial source of water around, and it is usually cultivated in areas where the mean annual rainfall varies between 1,500-3,500mm. The high moisture regime and relative humidity in the micro-climate of a large cardamom plantation have to be maintained. The percentage partitioning of incident precipitation into various pathways of the cardamom and maize-potato dominated systems is given in Table 5.3. The canopy interception of precipitation is much higher in the cardamom system. The overland flow is only 2.17 per cent of precipitation in the cardamom system and 9.2 per cent in the maize-potato system. These values suggest that the cardamom system retains more water from precipitation in the various sub-components than does the maize-potato

Table 5.3: Percentage Partitioning of Incident Precipitation (100%) into Various Pathways in Both Systems

Parameters	Cardamom-dominated System	Maize-potato Dominated System
Tree partitioning		
Throughfall	55.06	61.54
Stemflow	3.85	5.07
Canopy interception	38.92	23.83
Overland-flow	2.17	9.55
Floor partitioning		
Leachate	41.03	48.69
Interception	17.88	17.92

Source: Second Author
Note : Values are means of six samplings spread over the rainy season

system. The large cardamom system regulates the precipitation partitioning to adjust high moisture maintenance in the micro-climate, indicating its potential for moisture balance. This suggests an ecological sustenance of the cardamom system, in spite of its high moisture requirements.

Nitrogen and phosphorus are the two most important nutrients required by plants for their growth. Bio-geochemical cycling of these nutrients in various components of cardamom and maize-potato dominated agroforestry systems are provided in Table 5.4. The nitrogen level in the soil and the standing biomass of the cardamom system are much higher than those in the maize-potato system. The return of nitrogen to the soil through decomposition is also much faster in the cardamom system than in the maize-potato system.

Table 5.4: Nutrient Dynamics of Both Systems

Nutrient	Cardamom-dominated System	Maize-potato Dominated System
Nitrogen		
Soil (kg/ha up to 30cm soil depth)	8164.00	3850.00
Standing state in biomass (kg/ha)	300.24	181.71
Uptake (kg/ha/year)	112.20	125.69
Retention (kg/ha/year)	52.84	44.34
Return to soil (kg/ha/year)	56.45	37.99
Exit through agronomic yield (kg/ha/year)	2.91	43.36
Phosphorus		
Soil (kg/ha up to 30cm soil depth)	360.50	996.50
Standing state in biomass (kg/ha)	25.13	24.30
Uptake (kg/ha/year)	9.85	15.86
Retention (kg/ha/year)	5.08	5.05
Return to soil (kg/ha/year)	4.25	5.11
Exit through agronomic yield (kg/ha/year)	0.52	5.70

Source: Sharma et al. 1994 and 1995

The nitrogen exit from the maize-potato system via agronomic yield is very high, as much as about 15 times that of the cardamom system. However, phosphorus levels in the soil were higher in the maize-potato dominated system, presumably as a result of pH regulation (Sharma 1995). The standing state, retention, and return of phosphorus to the soil are similar in both systems. The uptake and phosphorus exit through agronomic yield are high in the maize-potato dominated system; the uptake being 1.6 times higher, whereas the exit is as high as 11 times from the maize potato system than from the cardamom system. The nutrient dynamics suggest that the cardamom agroforestry system is much less nutrient-exhaustive. This crop does not require any external nutrient inputs. It being a low-volume and less nutrient-exhaustive crop, it has a high degree of sustenance in terms of nutrient cycling.

Influence of *Alnus* as a Shade Tree

The large cardamom is cultivated either under mixed tree species or under *Alnus nepalensis* cover. New plantations and large patches of cardamom agroforestry systems have been recently converted into monocultures of *Alnus nepalensis* to be used as shade trees. Biomass, net primary productivity, and agronomic yield in the cardamom agroforestry system increased while under the shade of *Alnus* (Table 5.5). The agronomic yield of the large cardamom is about 2.2 times higher beneath the *Alnus* tree than

Table 5.5: Productivity, Yield and Nutrient Dynamics of Large Cardamom Agroforestry under *Alnus* and Mixed Tree Species as Shade Trees

Parameters	*Alnus*-Cardamom	Forest-Cardamom
Biomass (kg/ha)	28422	22237
Net primary production kg/ha/year)	10843	7501
Agronomic yield (kg/ha/year)	454	205
Nitrogen		
Standing state in biomass (kg/ha)	395.15	205.26
N_2-fixation (kg/ha/year)	65.34	-
Uptake from soil (kg/ha/year)	78.49	80.56
Retention (kg/ha/year)	56.12	27.45
Return to soil (kg/ha/year)	83.67	29.23
Exit through agronomic yield (kg/ha/year)	4.04	1.78
Use efficiency	73	93
Back-translocation from senescent tree leaf (%)	3.85	17.49
Phosphorus		
Standing state in biomass (kg/ha)	32.357	17.900
Uptake from soil (kg/ha/year)	13.178	6.517
Retention (kg/ha/year)	6.328	3.840
Return to soil (kg/ha/year)	6.146	2.347
Exit through agronomic yield (kg/ha/year)	0.704	0.330
Use efficiency*	823	1151
Back-translocation from senescent tree Leaf (%)	22.62	31.37

Source: Sharma et al. 1994

** Nutrient use efficiency is the ratio between annual net primary productivity and nutrient uptake.*

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** Nutrient use efficiency is the ratio between annual net primary productivity and nutrient uptake.*

beneath mixed tree species. *Alnus nepalensis* is an actinorhizal tree capable of fixing atmospheric nitrogen (Sharma and Ambasht 1984, 1988; Sharma 1988). According to the data, 65.34 kg/N/ha/year were fixed in the cardamom agroforestry system. This has accelerated nitrogen cycling. Phosphorus cycling in *Alnus*-cardamom also accelerates.

Nitrogen and phosphorus concentrations of different tissues of N_2-fixing *Alnus* are higher than those of mixed tree species (Sharma et al. 1994). The nitrogen and phosphorus back translocation before leaf abscission is lower in *Alnus* than in mixed tree species because of higher availability and uptake of these elements in the *Alnus*-cardamom stand (Table 5.5). The general concept of inverse relationship between availability and conservation stands authenticated by this study. *Alnus* has more availability of these elements than mixed tree species and hence records a lower back translocation, indicating its poor strategy. This has caused retention of a higher concentration of these nutrients in litter, which on decomposition are available in greater volume to the large cardamom for uptake. Nutrient-use efficiency may be expected to drop as the use of that nutrient increases because the availability of some other resource (such as water, energy, or light) limits production. Nutrient-use efficiencies in cardamom-based agroforestry systems decreased as an influence of N_2-fixing *Alnus*, a pattern consistent with the expectation that efficiency should decrease with increasing rates of uptake (Table 5.5). Production in *Alnus*-cardamom could be further improved if other limiting factors were to be removed as nutrient availability is not a constraint. The large cardamom agroforestry system under the umbra of *Alnus* is more productive since it has faster rates of nutrient cycling. The poor nutrient conservation and low nutrient availability are not constraints.

Moreover, the low nutrient use efficiency of *Alnus* and malleability of nutrient cycling under its influence make it an excellent associate, promoting higher availability and faster cycling of nutrients. Therefore, use of N_2-fixing *Alnus* as a shade tree for large cardamom agroforestry provides multi-facet beneficial attributes which are not available to that extent from other mixed species of shade trees.

Performance of *Alnus* and Cardamom on Aging

Plant performance is a function of age. Aging causes loss in productive potential, vigour, and amplitude of resilience, especially in perennial plants. With this in mind, the effects of the age of *Alnus nepalensis* on its functions and large cardamom on its agronomic yield have been assessed. Experiments show that woody biomass accumulation of *Alnus nepalensis* continued with aging, having just 99t/ha in a seven-year stand to as much as 597t/ha in a 56-year stand (Sharma and Ambasht 1991). This species has the potential for producing large quantities of wood suitable for both fuel and timber purposes. The net primary productivity of *Alnus* increased sharply in the juvenile stage to an optimum value of 25t/ha/year in a seven-year stand. The productivity remained fairly high for up to 30 years in *Alnus*, and it has the potential of fixing atmospheric nitrogen which shows a function of stand age. Nitrogen accretion

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through fixation achieved the highest value in a seven-year stand and showed a fairly good value up to 30 years. These age-regulated functional parameters suggest that *Alnus* trees should be retained in large cardamom plantations only until they are 30 years of age. Beyond this, the *Alnus* becomes expensive and can sustain itself only without providing much benefit to its associate large cardamom. The agronomic yield of the large cardamom is achievable within from three to four years of its planting and peaks below 10 years of age. The yield continues to be fairly good until 20 years, beyond which it decreases sharply. Therefore, the age of the cardamom should be limited to around 20 years. The gaps created by the withering of cardamom bushes are filled and also selective felling of old trees is carried out by farmers. However, more emphasis should be given on the age issues pertaining to both *Alnus* and cardamom for long-term sustenance of the system.

Biodiversity for Sustenance

Biodiversity is yet another indicator for sustainability. Biologically, diversified systems have a greater capacity for resilience and hence show more sustenance. The large cardamom is a native of the Himalayas of Sikkim and occurrences of five species of wild cardamom (*Amomum linguiforme, A. kingii, A. aromaticum, A. carynostachyum, and A. dealbatum*) are recorded in the region. *Amomum subulatum* is a cultivated species of large cardamom. Large cardamom is cultivated as a monocrop and the agri-biodiversity issue does not arise in this system. However, this practice has supported highly diverse tree components as shade trees (Table 5.6). The system supports as many as 23 tree species. The diversity index is high. These trees have multiple uses for

Table 5.6: Species' Diversity of Trees in Cardamom and Maize-potato Dominated Systems

System	Tree species' number	Tree diversity index*	Prominent trees of occurrence
Cardamom-dominated	23	4.10	*Acer oblongum, Actinodaphne* sp., *Alnus nepalensis, Casearia glomerata, Castanopsis tribuloides, Engelhardtia acerifolia, Eurya accuminata, Ficus hookerii, Juglans regia, Leucosceptrum canum, Litsaea polyantha, Lyonia ovalifolia, Maesa chisia, Nyssa sessiliflora, Osbeckia paniculata, Ostodes peniculatus, Prunus nepalensis, Saurauia nepaulensis, Schima wallichii, Symplocos theifolia, Toona ciliata, Viburnum cordifolium*
Maize-potato Dominated	15	2.81	*Acer pectinata, Alnus nepalensis, Antidesma diandrum, Bassia butyracea, Bauhinia purpurea, Celtis tetrandra, Engelhardtia spicata, Ficus clavata, Ficus hookerii, Ficus nemoralis, Litsaea polyantha, Ostodes peniculatus, Saurauia nepaulensis, Schima wallichii, Vitex* sp

Source: E. Sharma

** Shannon and Weaver diversity index*

farmers, e.g., fodder, fuel, timber, materials for field implements, and residues for animal bedding. These trees also support birds and other wildlife, and this has direct bearings on the ecosystemic structure and its functioning. Maize-potato dominated agroforestry also supports about 15 tree species with various uses, especially fodder and fuelwood values (Table 5.6). The diversity index of the tree component is lower in the maize-potato system than in the cardamom system. Agri-biodiversity is high in the maize-potato dominated system. Table 5.7 shows the local germ plasm varieties of agricultural crops available in Sikkim and also the hybrids that have been tested. The varieties of local germ plasms for many of the crops are noteworthy.

Table 5.7: Local Germ Plasm Varieties and Hybrids of Crops Tested in Sikkim

Crop	Growing elevation (m)	Number of local germ plasms	Number of hybrids tested
Large cardamom	600-2000	5(1)	-
Ginger	up to 1500	4+	2
Turmeric	up to 1500	5	4
Finger millet	500-1600	4	5(1)
Buckwheat	300-2500	1	-
Pulses	up to 2200	18	402(5)
Paddy	up to 1800	19	60(6)
Maize	up to 2400	4	43
Wheat	up to 2200	-	34(1)
Barley	800-2800	-	5
Potatoes	up to 2800	-	13(5)

Source: E. Sharma

Note : Values in parentheses are the number of hybrids/germ plasms performing well.

Cardamom Processing and Constraints

The post-harvest technology continues to be traditional. The farmers have devised indigenous ways of processing cardamoms. The capsules are dried in locally-made *bhatti*(s) (curing houses or kilns). These are made of smoke-proof stones and mud walls on all four sides with a small opening in front to put the firewood. These kilns are installed in the cardamom fields. A bamboo mat is spread on the top of the *bhatti* and fresh capsules are spread on it. These are smoked continuously for three to four days until the capsules are completely dry. Raw wood is used for curing cardamoms, as they have to be dried gradually by smoke. Around 300- 400kg of raw wood are required to cure 100kg of cardamoms. The wood is culled from the plantation field and a continuous process of thinning the old trees goes on. The capsules, when completely dry, turn dark brown. The dried capsules are stored in gunny bags, each containing about sixty kilogrammes.

The office of the Spices' Board of India, established under the 'Cardamom Act of India', was opened in Gangtok in 1979 to encourage the cultivation of the large cardamom by providing suitable technologies both for propagating the crop and for processing the produce. Ever since, the Board has taken measures to provide improved

know-how to farmers. The Board devised a fuel-efficient *bhatti* in which cardamoms can be dried by passing hot air through. In contrast to the traditional *bhatti*, the capsules dried in the *bhatti* devised by the Board retain their original colour (pink) and require less firewood. To begin with, these *bhatti*(s) were installed in major cardamom-producing areas; there were two such kilns at the cardamom-dominated study site.

The *bhatti*, however, did not find favour with the farmers because of three reasons. First, the amount of the capsules dried in the modern *bhatti* was too small to make any impact on the market. Consequently, the produce with the original colour was not accepted by the traders, and they paid a lower price. Second, the amount of cardamoms dried in the modern *bhatti* remained small as the process was time-consuming and costly for the farmers, as they had to bring their produce to a central place, where the *bhatti* was installed, and queue up for their turn. It was also costly to install the modern *bhatti* in the cardamom field. Third, the producers who dried their produce in the modern *bhatti* were of the opinion that, instead of being fuel efficient, it consumed more fuel and time and was, therefore, more costly. Produce dried in the modern *bhatti* had a poor shelf life or keeping quality. These factors, *inter alia*, led to the non-adoption of the improved *bhatti* designed by the Spices' Board of India.

Further, the activities of the Spices' Board are restricted to the major cardamom-growing areas like the northern district. For example, it has not made its presence felt in the maize-potato dominated area where the cultivation of cardamoms has spread rapidly in the last ten years or so. This is evident from the fact that only 20 per cent of the sample households knew of its existence.

Since the modern kilns for curing the capsules have been more or less rejected, the Board is now concentrating on providing nursery plants and subsidies to encourage people to replace disease-affected plantations. Subsidies are provided at a rate of around rupees* four thousand to five thousand per acre. Most of the households in the cardamom-dominated area have made use of this facility. Some farmers, particularly the marginal ones complain, however, that most of the subsidies are pocketed by a few influential farmers.

The market for cardamoms is controlled by private traders. The margin between the producers' price and the market price is around Rs 10 to Rs 15 per kilogramme. Many producers, particularly the small-scale ones, take an advance from private traders and sell their crops before hand at a much lower price. The government did intervene some time ago in order to regulate the market, but without success. The Spices' Board is also concentrating on educating the farmers about the prices prevailing in the national and international markets and the different marketing avenues available to them.

The major problem endangering the sustainability of the crop is the rapid spread of diseases. *Phurkey* and *chirkey* are the two viral diseases which have brought about a

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There are 35.50 Indian rupees to the US dollar

great deal of damage to the crops. However, there is no strong institutional back-up to deal with this problem. In spite of the fact that a regional research station of the Indian Council for Agricultural Research (ICAR) is located in the state, not much attention has been given to evolving disease-resistant varieties and to a suitable package of production practices for the crop. The farmers themselves have taken some measures to combat the disease. The Spices' Board and Department of Agriculture advise the farmers to uproot and burn disease-affected plants, and sometimes whole stands which are infected. This advice is not acceptable to farmers. As one farmer puts it:

> *"if we follow their advice what shall we eat, as we largely depend on cardamoms for our livelihood? Despite the plantations being affected by the disease, we still reap something".*

The gestation period of four to five years is, perhaps, too long for the farmers to wait and follow scientists' advice to use new planting materials from seeds. Another problem is that, over the generations, farmers have been harvesting this crop with virtually no labour expended and only by visiting the plantation a couple of times in a year, mostly at harvest time.

In spite of the important role of the large cardamom in the state economy in terms of accounting for around 17 per cent of the total cropped area, providing a source of income for a significant proportion of the population, contributing around four to five per cent of the total non-tax revenue to the state exchequer, and also earning foreign exchange for the nation, the crop suffers from the problem of marginalisation. As seen above, it has not received adequate attention neither from scientists, nor from policy-makers. The state unit of the Indian Council for Agricultural Research Station, which is mandated to look after the crop, is concentrating on crops such as wheat, rice, ginger, etc, that are not only less suitable to the mountain ecology, but are also much more nutrient-exhaustive than large cardamoms. Not only that, the research station itself suffers from the problem of marginalisation. It has always remained understaffed; the scientists posted from other states try to get transferred as soon as possible. In sum, in spite of the state having overcome the problem of political marginalisation, it has itself marginalised, to varying degrees, the crops and sectors that are more compatible with the mountain ecosystem and which bode well for sustainable mountain agricultural development. This is in contrast to the experiences of the spread of horticultural crops, mainly apples, in the state of Himachal Pradesh. Apples, like cardamoms, are a high-value cash crop and a source of livelihood to a significant proportion of the population. To cater to the needs of the farmers for technical know-how about horticultural crops, the state government has set up a fully-fledged University of Horticulture and Forestry, which is one of its kind in Asia.

An old farmer succinctly sums up the state of affairs:

> *"Now when the crop demands more care and attention, they are simply not prepared for it. Cardamoms have spoiled our work ethic and have made us lethargic.*

Nevertheless, farmers are struggling hard to overcome this bad practice and have begun devoting more attention to the crop as per the need of the hour. Further, while large farmers have begun to rotate the crop on different plots, as recommended by scientists, the marginal and small farmers, who cannot afford to rotate the crop, have resorted increasingly to the practice of uprooting disease-affected plants quickly and planting new saplings to control disease.

To conclude, the large cardamom is an excellent crop, eminently suited to the mountain environment and ecology. To repeat, cardamoms are grown on marginal and barren lands; they are a low-volume, high-value, non-perishable cash crop; have an assured market; and are not infrastructure intensive. Efforts should, therefore, be directed towards mitigating diseases and saving crops from further damage. Other high-value cash crops which have a local niche need to be identified and brought into the mainstream to improve the sustainability of mountain agriculture.

Six

Summary and Conclusions

Farmers from the state of Sikkim, located in the eastern Himalayas, are a good example of harnessing a local mountain niche through adoption of cardamom farming, a practice compatible with mountain specificities. The per capita income, again at constant prices, is around one hundred US dollars, compared to the national average of US $ 63. Among the different states, Sikkim ranks fifth in terms of per capita income. Nearly half of its population is now literate, compared to nearly one-fifth about two decades ago; the female literacy rate has undergone tremendous progress, from less than one-tenth to around two-fifths.

Farming in Sikkim is fast changing towards high-value cash crops, such as vegetables, ginger, fruits, oilseeds, and pulses, for which the state possesses a comparative advantage. This is evident from a significant decline in the percentage of area under cereals, from nearly three-fourths to one-half. The yields of various crops have increased by varying degrees and compare somewhat favourably with other mountainous states and also with national averages. The yield of large cardamoms has, however, declined continuously. The most striking feature of state agriculture is very low use of external inputs, e.g., chemical fertilizers. The consumption of fertilizers is as low as eight kilogrammes per hectare, compared to the national average of 72kg and 32kg in Himachal Pradesh.

Broadly, agriculture in Sikkim is dominated by three major farming systems. While in the north it is dominated by large cardamoms, in the east, west, and south maize and potatoes dominate the farming system at higher elevations and paddy, ginger, mandarin oranges, and wheat at lower elevations. The two farming systems, namely, the large cardamom-dominated and the maize-potato dominated, account for nearly sixty per cent of the total cultivated land in the state. The present study was undertaken to analyse the diverse economic and ecological features of these two farming systems and, more importantly, to examine how these features impinge upon the sustainability of mountain agriculture. More precisely, the study aimed to document the range and quality of livelihood options of households under the two farming systems and to assess the sustainability of the cardamom farming option.

A multi-stage, stratified sampling technique was followed to select the sample households in the study sites. To begin with, two *panchayat*(s) — one representing the cardamom-dominated farming system (Kabi, in northern Sikkim) and the other the maize-potato dominated farming system (Damthang, in southern Sikkim) — were selected purposively.

The selection of the two *panchayat(s)* was proceeded by reconnaissance field visits to all four districts of the state, and detailed discussions and dialogues with concerned state government officials, scientists, and other informed people were carried out. Households were classified into two categories: those who owned up to two hectares were listed as small farmers and the others were designated as large farmers. Finally, a sample of 90 households was selected for detailed study to be conducted on the basis of the proportional allocation method; there were 40 from the cardamom-dominated area and 50 from the maize-potato dominated area. A conceptual framework was developed to operationalise the concept of sustainability. For example, the different livelihood options adopted by households were studied in relation to socioeconomic features and basic infrastructural facilities in the two farming systems selected. Thereafter, implications of different options for sustainability were analysed in terms of their impact on quality of life, equity, and the natural resource base. Some ecological and economic indicators were constructed to quantify different dimensions of sustainability .

The micro-evidence shows that the yields of cereal crops were low except for those of paddy. The low yields of cereal crops are attributed to negligible use of external inputs. Crops in both farming systems are largely market-oriented. For example, despite the fact that the maize-potato farming system operates at a near subsistence level, maize is no longer the staple diet of the people, although it is an important crop. Because of the traditional market institution, called *haat* in local parlance, the Sikkimese farmer is very well acquainted with market behaviour. The important constraints that hinder farmers from switching over to high-value cash crops include the lack of institutional backup and other basic inputs.

The evidence also indicates that mainly three to four livelihood options are common. While there is a positive relationship between the number of options adopted and the household and per capita incomes in the maize-potato farming system, no such relationship can be established in the large cardamom farming system. The per capita and household income in the cardamom farming system were nearly double those of the maize-potato farming system. The micro-evidence, therefore, lends credence to the hypothesis that the adoption of a higher number of livelihood options is motivated by survival considerations and tends to be distress-driven.

Among the various indicators measuring the quality of a livelihood option, per worker per day earnings were used as the best gauge; in that, such a gauge takes cognizance of both income and employment. Going by this yardstick, the qualities of different livelihood options, particularly of cardamoms, livestock, and the service sector, were far superior in the cardamom-dominated system than in the maize-potato dominated farming system. Crop production as an option yielded higher per worker per day earnings in the maize-potato dominated system. As regards the contribution of different options towards total household income, large cardamoms accounted for nearly half of the income in the cardamom-dominated farming system. In comparison, more than 50 per cent of the household income was contributed by off-farm livelihood options, such as agricultural labour and service, in the maize-potato dominated farming system.

Livelihood options were screened for their implications on sustainability. Some quantitative indicators, both economic and ecological, were constructed for three major production options, namely, crop production, livestock, and large cardamom farming, in order to assess their sustainability. In this respect, the evidence at our disposal suggests that crop production as an option has some positive features such as sufficient area of support land and low cropping intensity. However, very low productivity (net returns per hectare vary from US $ 137 to US $ 247) makes this option unsustainable. Similarly, the livestock option is sustainable but at low rates of productivity, particularly in the cardamom-dominated area.

The large cardamom, being a high-value cash crop perfectly compatible with mountain specificities is, however, the most important farming option. The evidence, both ecological and economic, - indicates positive sustainability implications due to its special characteristics such as low-volume, high-value, non-perishable cash crop (net returns per hectare vary from US $ 741 to US $ 857), less infrastructure-intensive (e.g., roads) and, thereby, it is compatible with the inaccessibility attribute of the mountains, with no dependence on external inputs. On ecological accounts, the large cardamom fairs extremely well; it helps to conserve soil and maintain soil fertility, forests, and biodiversity. For example, the nitrogen exit from the production system through agronomic yield is as low as 2.91 kilogrammes per hectare per year in comparison to as high as 43.36 kilogrammes from the maize-potato dominated farming system. The phosphorus exit is also much lower, 0.52 kilogramme per hectare compared to 5.70 kilogrammes in the maize-potato dominated system. The tree diversity index is 4.10 in the cardamom-dominated farming system compared to 2.81 in the maize-potato farming system.

In the ultimate analysis, different livelihood options impact on the quality of life of the people. In this context, various indicators, such as expenditure on superior grains, education, clothing, health, and incidence of poverty, suggest a high quality of life for large cardamom farmers compared to that of the maize-potato farming families. The low quality of life in the latter case is the direct manifestation of low crop yields; crops being the dominant livelihood option. Insofar as equity aspects are concerned, the evidence is not so conclusive. Nevertheless, some aspects of equity do suggest sustainability of the large cardamom farming system.

Farming Prospects for Cardamoms

The large cardamom, from all angles, is an excellent crop suitable to the mountain ecology and environment. For a majority of farmers in Sikkim, the sustainability of this crop as a livelihood option is extremely important. Apart from economic considerations, the crop also needs to be protected as a valuable genetic resource. If the crop fails, not only will a valuable genetic resource be lost but the survival of the entire agroforestry system would be threatened. The crop is a native plant of the state and possesses some special attributes, and it did not require much institutional support from the government in the past. This is in variance with the spread of high-value cash crops, such as apples in Himachal Pradesh and sericulture in Ningnan County, China, where

ample state support in the form of subsidies and infrastructure had to be provided. But this crop, if it is to be sustained, can no longer be marginalised and neglected.

A number of problems, such as diseases, traditional technology, and marketing, besets the crop. Its sustainability is being increasingly endangered by the spread of viral diseases. The two diseases, *phurkey* and *chirkey*, have already inflicted substantial damage. The plantations are highly susceptible to these diseases, being overage, and due to the practice of propagation through rhizomes. To recall, many of the plantations, particularly in the cardamom-dominated area, are more than 50 years of age. Despite being the most important environmentally friendly crop, the crop has been neglected and not much attention has been given to evolving disease-resistant varieties in the existing R & D set-up. In fact, the crop until recently, has been the victim of interdepartmental rivalries. While both the agriculture and forest departments claim ownership of the crop, neither of them have taken measures to protect it from diseases and provide other supporting facilities. The only institution which is rendering some service to check diseases and educate farmers about the market is the Spices' Board of India. The Board is providing nursery plants and subsidies to replace the aged and disease-affected plantations. Therefore, measures are needed, first to evolve disease-resistant varieties and second to educate farmers about the available technical know-how to combat the diseases, this can be achieved by strengthening the extension facilities.

As seen earlier, the yield levels of crops in both areas are very low. The low yields are primarily due to the fact that practically no modern inputs, such as high-yielding varieties and chemical fertilizers, are used. However, while not advocating indiscriminate use of chemical fertilizers, farmers need to be educated about balanced use of chemical fertilizers and bio-composts. Farmers complained about inputs, particularly seeds, not being made available in time and in adequate quantities. They also complained about lack of packing materials.

The whole issue of subsidies needs a fresh look. Some subsidies may be essential for a mountainous state like Sikkim. Resources should be invested to create basic infrastructural facilities —physical, institutional, and social. Since sustainable development is a dynamic process, the availability of these facilities will make the system more resilient to unforeseen shocks and stresses.

REFERENCES

Jodha, N. S., 1993. *Indicators of Unsustainability: Approaching Sustainability through Unsustainability*. MFS Discussion Paper 35. Kathmandu:ICIMOD.

Mellor, John, 1986. 'Determinants of Rural Poverty: The Dimensions of Production, Technology and Prices'. In Narain, D., Mellor, J. and Desai, G. (eds) *Agricultural Change and Rural Poverty: Variations in Themes*. New Delhi: Oxford University Press.

Partap, T., 1995. *High Value Cash Crops in Mountain Farming - Mountain Development Processes and Opportunities*. Discussion Paper Series No. MFS 95/1. Kathmandu: International Centre for Integrated Mountain Development.

Sharma, E., 1988. 'Altitudinal Variation in Nitrogenase Activity of the Himalayan Alder Naturally Regenerating on Landslide-Affected Sites'. In *New Phytologist*, Vol. 108, 411-416.

Sharma, E. and Ambasht, R. S., 1984. 'Seasonal Variation in Nitrogen Fixation by Different Ages of Root Nodules of *Alnus nepalensis* Plantations in the Eastern Himalayas'. In *Journal of Applied Ecology*, Vol. 21, 265-270.

Sharma, E. and Ambasht, R. S., 1988. 'Nitrogen Accretion and Its Energetics in the Himalayan Alder'. In *Functional Ecology, Vol* 2, 229-235.

Sharma, E. and Ambasht, R. S., 1991. 'Biomass, Productivity and Energetics in Himalayan Alder Plantations'. In *Annals of Botany*, Vol. 67, 285-293.

Sharma, H. R., 1996. *Mountain Agricultural Development Process: Micro-level Evidence from Himachal Pradesh, Indian Himalayas*. Kathmandu: International Centre for Integrated Mountain Development.

Sharma, R., 1995. *Symbiotic Nitrogen Fixation and Biological Maintenance of Soil Fertility in the Sikkim Himalayas*. Ph.D. Thesis, H.N.B. Garhwal University, U.P., India.

Shrestha, S, 1992. *Mountain Agriculture: Indicators of Unsustainability and Options for Reversal*. MFS Discussion Paper, No. 32. Kathmandu: ICIMOD.

Subba, J. R., 1984. 'Agriculture in Hills of Sikkim'. In *Sikkim Science Society*. Gangtok: Sikkim Science Society.

Sundriyal, R. C., Rai, L. K. and Sharma, R., 1992. 'Potential Useful Plants of Sikkim'. In *Hima-Paryavaran*, Vol. 4 , No. 1.

Annex I

The General Economy of Sikkim in Tables

Table 2.2: Temporal Changes in Population: 1891 - 1991

Year	Male	Female	Total	Sex ratio (females per '000 males)	Decadal % age variations	Density of population
1891	11589	10563	22152	912		
	(52.32)	(47.68)	(100.00)			
1901	39795	28219	59014	709	166.40	8
	(67.43)	(32.57)	(100.00)			
1911	45059	42861	87920	951	48.98	12
	(51.25)	(48.75)	(100.00)			
1921	41492	40229	81721	970	-7.05	12
	(50.77)	(49.23)	(100.00)			
1931	55825	53983	109808	967	34.37	15
	(50.84)	(49.16)	(100.00)			
1941	63289	58231	121520	935	25.42	17
	(52.08)	(47. 92)	(100.00)			
1951	72210	65515	137725	907	13.34	19
	(52.43)	(47.57)	(100.00)			
1961	85193	76996	162189	904	17.76	23
	(52.53)	(47.47)	(100.00)			
1971	112662	97181	209843	863	29.38	30
	(53.69)	(46.31)	(100.00)			
1981	172440	143945	316385	835	50.76	45
	(54.50)	(45.50)	(100.00)			
1991	216427	190030	406457	878	28.48	57
	(53.25)	(46.75)	(100.00)			

Source: (i) Census of India, 1981 Series, Sikkim: General Population Tables and Primary Census Abstracts, Part II A and Part II B.

(iii) Census of India, 1991 Series, Sikkim: General Population Tables and Primary Census Abstracts, Part II A and Part II B.

Note: Figures in Parentheses are percentages

Table 2.3: Demographic Features: 1991

Particulars	Male	Female	Total
1. Population	216427	190030	406457
Per cent of total population	53.25	46.75	100.00
Rural	195277	174174	369451
Per cent of total population	90.23	91.66	90.90
Urban	21150	15856	37006
Per cent of total population	9.87	8.34	9.10
2. Population above 6 years	178433	163377	331810
Per cent of total population	81.63	82.44	85.97
3. Population below 6 years	37984	26653	74647
Per cent of total population	18.37	17.56	14.03
4. SC populations	5.74	6.14	5.93
5. ST populations	21.95	22.84	23.36

Source: Sikkim: A Statistical Profile, 1979 - 80 to 1991 - 92, Bureau of Economics and Statistics, Department of Planning, Govt. of Sikkim, Gangtok

Table 2.4 Changes in Vital Statistics: 1980 - 81 to 1993 - 94

Year	Birth rate	Death rate	Infant mortality
1980 – 1981	31.00	8.90	-
1990 – 1991	24.40	7.40	45
1993 – 1994	23.70	6.40	45

Source: Same as Table 2.2

Table 2.5: Changes in Literacy Rates: 1951 to 1991 (per cent)

Year	Male	Female	Total
1951	11.19	1.20	6.59
1961	19.50	4.20	12.30
1971	25.37	8.90	17.74
1981	43.95	22.20	34.05
1991	54.16	37.74	46.48

Source: Same as Table 2.2

Table 2.6: Temporal Changes in the Occupational Structure by Sex: 1971 to 1991

No.	Sectors	1971			1981			1991		
		M	F	Total	M	F	Total	M	F	Total
1.	Cultivators	74.53	92.28	81.00	50.16	79.52	60.10	50.96	71.74	57.84
2.	Agricultural labourers	4.12	3.16	3.77	3.45	3.06	3.31	8.04	7.37	7.81
3.	Livestock, forestry, hunting, Fishing and plantation orchards and allied	0.60	0.48	0.55	1.93	0.92	1.59	2.99	1.58	2.53
4.	Mining and quarrying	0.09	0.00	0.05	0.17	-	0.11	0.30	0.05	0.22
5.	Manufacturing, processing, Servicing and repairing									
	(a) Household industries	0.50	0.04	0.34	1.25	0.74	1.08	0.99	0.33	0.77
	(b) Other than household Industries	1.31	0.26	0.93	3.14	1.29	2.51	3.94	1.88	3.26
6.	Construction	4.85	0.87	3.40	10.47	4.98	8.62	8.84	3.54	7.09
7.	Trade and commerce	3.09	0.48	2.14	5.08	1.00	3.70	6.79	2.08	5.23
8.	Transport, storage and communication	2.27	0.42	1.59	1.55	0.07	1.05	2.62	0.24	1.82
9.	Other services	8.64	2.01	6.23	22.80	8.42	17.93	14.53	11.19	13.43
	Total workers	100.00 (70933)	100.00 (40644)	100.00 (111577)	100.00 (97508)	100.00 (49928)	100.00 (147436)	100.00 (109994)	100.00 (54398)	100.00 (164392)
	Per cent of main workers to total Population	62.97	41.82	53.17	56.55	34.69	46.60	50.82	28.63	40.45

Source: *(i) Census of India, 1971 Series, Sikkim: General Population Tables and Primary Census Abstracts, Part II A and Part II B*
(ii) Census of India, 1981 Series, Sikkim: General Population Tables and Primary Census Abstracts, Part II A and Part II B
(iii) Census of India, 1991 Series, Sikkim: General Population Tables and Primary Census Abstracts, Part II A and Part II B

Note: *Figures in Parentheses are the total number of workers*

Table 2.7: Changes in the Land Utilisation Pattern, 1976 - 77 - 1990 - 91 (hectares)

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

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

Note: Figures in parentheses are percentages

Table 2.8: Temporal Changes in the Cropping Pattern: 1975 - 76 to 1995 - 96 ('000 hectares)

Sr. No.	Crops	1975 – 76	1980 – 81	1985 – 86	1990 – 91	1995 - 96
1.	Rice	11.40	14.80	15.50	16.05	15.94
		(16.92)	(16.15)	(12.56)	(12.13)	(11.46)
2.	Wheat	0.15	7.00	7.40	7.82	8.42
		(0.22)	(7.64)	(5.99)	(5.91)	(6.05)
3.	Maize	28.50	30.20	39.00	39.90	39.94
		(42.32)	(32.95)	(31.62)	(30.14)	(28.71)
4.	Finger millet	4.80	5.00	4.80	4.90	5.00
		(7.13)	(5.46)	(3.89)	(3.70)	(3.59)
5.	Barley	0.90	0.58	1.00	0.90	1.08
		(1.34)	().63)	(0.81)	(0.68)	(0.78)

Table 2.8: Temporal Changes in the Cropping Pattern: 1975 - 76 to 1995 - 96 ('000 hectares)

Sr. No.	Crops	1975 – 76	1980 – 81	1985 – 86	1990 – 91	1995 - 96
6.	Buckwheat	1.50	2.76	2.00	1.72	2.19
		(2.23)	(3.01)	(1.62)	(1.30)	(1.57)
	Total Cereals	47.25	60.34	69.70	71.29	72.57
		(70.16)	(65.84)	(56.49)	(53.86)	(52.16)
7.	Urd	1.55	4.00	3.90	4.01	4.44
		(2.30)	(4.36)	(3.16)	(3.03)	(3.19)
8.	Other Pulses	0.15	0.12	1.60	2.12	2.29
		(0.22)	(0.13)	(1.30)	(1.60)	(1.65)
	Total Pulses	1.70	4.12	5.50	6.13	6.73
		(2.52)	(4.49)	(4.46)	(4.64)	(4.84)
9.	Rape seed and Mustard	0.50	1.70	2.70	3.10	5.84
		(0.74)	(1.85)	(2.19)	(2.34)	(4.20)
10.	Soyabean	1.00	2.30	3.70	3.62	3.81
		(1.48)	(2.51)	(3.00)	(2.73)	(2.74)
11.	Other Oil Seeds	-	-	0.30	0.07	0.08
				(0.24)	(0.05)	(0.06)
	Total Oilseeds	1.50	4.00	6.70	6.79	9.73
		(2.22)	(4.36)	(5.43)	(5.13)	(7.00)
12.	Orange/Citrus	1.40	2.62	4.60	6.00	6.60
		(2.08)	(2.86)	(3.73)	(4.53)	(4.74)
13.	Other Fruits	1.50	3.08	4.45	5.50	2.60
		(2.23)	(3.36)	(3.62)	(4.15)	(1.87)
	Total Fruits	2.90	5.70	9.05	11.50	9.20
		(4.31)	(6.22)	(7.34)	(8.68)	(6.61)
14.	Vegetables	1.00	0.84	3.80	5.15	5.80
		(1.48)	(0.92)	(3.08)	(3.89)	(4.17)
15.	Potatoes	2.40	1.90	5.00	5.36	5.50
		(3.56)	(2.08)	(4.05)	(4.05)	(3.95)
16.	Large Cardamoms	10.00	14.00	20.90	22.00	23.50
		(14.86)	(15.28)	(16.94)	(16.62)	(16.89)
17.	Ginger	0.50	0.64	2.30	3.00	4.50
		(0.74)	(0.70)	(1.86)	(2.27)	(3.23)
18.	Other Tuber and Rhizomatic crops	0.10	0.10	0.42	1.15	1.60
		(0.15)	(0.11)	(0.34)	(0.87)	(1.15)
	Total Miscellaneous	13.00	16.64	28.62	31.51	35.10
		(19.31)	(18.17)	(23.20)	(23.80)	(25.22)
	Total Cropped Area	67.35	91.64	123.37	132.37	139.13
		(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
	Cropping Intensity	103.73	117.01	-	134.57	141.44

Source: Department of Agriculture, Government of Sikkim, Gangtok

Note: The figures in parentheses are percentages

Table 2.9: Temporal Changes in the Production of Major Crops: 1975 - 76 to 1995 - 96 ('000 tonnes)

Sr. No.	Crops	Years				
		1975-76	1980-81	1985-86	1990-91	1995-96
1.	Rice	10.00	10.63	17.05	22.04	21.88
2.	Wheat	0.15	10.30	11.22	13.08	15.30
3.	Maize	16.50	28.93	49.25	57.60	56.56
4	Finger Millet	3.20	3.84	4.30	4.62	4.75
5.	Barley	0.50	0.46	1.30	1.18	1.57
6.	Buckwheat	0.80	1.38	1.38	1.42	1.74
	Total Cereals	31.15	55.54	84.50	99.94	101.80
7.	Urd	0.60	2.92	2.90	3.05	3.23
8.	Other Pulses	0.10	0.10	1.70	2.38	2.70
	Total Pulses	0.70	3.02	4.60	5.43	5.92
9.	Rape Seed and Mustard	0.20	0.90	2.30	2.65	4.39
10.	Soyabean	0.50	1.81	3.10	3.02	3.21
11.	Other Oil Seeds	-	-	0.15	0.04	0.04
	Total Oilseeds	0.70	2.71	5.55	5.71	7.63
12.	Orange/Citrus Fruits	3.60	7.35	12.10	15.45	8.70
13.	Other Fruits	1.10	3.00	6.10	8.05	3.30
	Total Fruits	4.70	10.35	18.20	23.50	12.00
14.	Vegetables	5.00	3.40	23.90	35.00	28.00
15.	Potatoes	8.00	6.64	26.40	34.97	24.00
16.	Large Cardamons	2.30	3.50	3.90	3.60	3.60
17.	Ginger	2.00	3.20	10.90	16.00	29.00
18.	Rhizomatic Crops	0.10	0.20	1.10	3.00	1.60
	Total Miscellaneous	12.40	13.54	42.30	57.57	58.20

Source: Department of Agriculture, Government of Sikkim, Gangtok

Table 2.10: Average Yields of Different Crops: 1975 - 76 to 1995 -96 (kg/hectare)

Sr. No.	Crops	Years				
		1975-76	1980-81	1985-86	1990-91	1995-96
1.	Rice	877.19	718.24	1100.00	1373.21	1372.61
2.	Wheat	1000.00	1471.43	1516.22	1672.63	1817.60
3.	Maize	578.95	957.95	1262.82	1443.61	1416.01
4	Finger Millet	666.67	768.00	895.83	942.86	950.00
5.	Barley	555.56	793.10	1300.00	1311.11	1451.48
6.	Buckwheat	533.33	500.00	690.00	825	790.97
	Total Cereals	659.26	920.45	1212.34	1401.88	1402.75
7.	Urd	387.10	730.00	743.59	760.60	724.10
8.	Other Pulses	666.67	833.33	1062.50	1122.64	1179.04
	Total Pulses	411.76	733.01	836.36	885.81	878.90
9.	Rape Seed and Mustard	400.00	529.41	851.85	854.84	750.00
10.	Soyabean	500.00	786.96	837.84	834.25	841.10
11.	Other Oil Seeds	-	-	500.00	571.43	500.00
	Total Oilseeds	466.67	677.50	828.36	890.94	784.58
12.	Orange/Citrus Fruits	2571.43	2805.34	2630.43	2575.00	1318.18
13.	Other Fruits	733.33	974.03	1370.79	1463.64	1269.23
	Total Fruits	1620.69	1815.79	2011.05	2043.48	1304.35
14.	Vegetables	5000.00	4047.62	6289.47	6796.12	4827.59
15.	Potatoes	3333.33	3494.74	528.00	6524.25	4363.64
16.	Large Cardamons	230.00	250.00	186.60	163.64	153.19
17.	Ginger	4000.0	5000.00	4739.13	5333.33	5333.33
18.	Rhizomatic Crop	1000.00	2000.00	2619.05	2608.70	1000.00
	Total Miscellaneous	953.85	813.70	1477.99	1827.04	1658.12

Source: Department of Agriculture, Government of Sikkim, Gangtok

Table 2.11: Yields of Selected Crops in Special Category Mountainous States: A Comparative View (average of 1990 - 91 to 1992 - 93) tonnes/hectares

States	Rice	Wheat	Maize
Sikkim	1.30	1.60	1.41
Assam	1.29	1.26	0.64
Arunachal Pradesh	0.73	1.73	0.46
Himachal Pradesh	1.28	1.59	2.00
Jammu & Kashmir	2.00	1.23	1.64
Manipur	1.50	-	0.96
Meghalaya	1.16	1.31	0.74
Mizoram	1.30	-	0.63
Nagaland	1.26	3.23	0.37
Tripura	1.83	1.89	0.41
All India	1.74	2.33	1.53

Source: Interstate Economic Indicators, 1994, Plan Finance and Resource Division, Planning Department, Government of Karnataka

Table 2.12: Temporal Changes in the Area under High-yielding Varieties: 1975 - 76 to 1995 - 96 (ha)

Crops	1975 – 76	1980 - 81	1985 - 86	1990 - 91	1995 – 96
Rice	100	4000	4970	7050	8775
	(0.88)	(27.03)	(32.06)	(43.93)	(55.05)
Wheat	100	6940	7360	7670	8200
	(66.67)	(99.14)	(99.46)	(98.08)	(97.39)
Maize	1510	8740	12090	16980	16720
	(5.30)	(28.94)	(31.00)	(42.55)	(41.86)
Total	1710	19680	24420	31700	33695
	(6.18)	(39.47)	(31.50)	(49.71)	(52.40)

Source: Department of Agriculture, Government of Sikkim, Gangtok

Note: Figures in parentheses are percentages to the total area of respective crops under high yielding varieties

Table 2.13: Consumption of Chemical Fertilizer in Nutrient Terms: 1990-91 to 1995-96

	Fertilizers (tonnes)		Per hectare (kg)	
	1990 – 91	1995 - 96	1990 – 91	1995 – 96
N	246	640	4.87	5.76
P	191	391	2.28	2.0
K	61	50	0.72	0.40
Total	398	1081	7.87	8.24

Source: Same as for 2.12

Table 2.14 Changing Distribution of Land Holdings and Area by Size Classes: 1976 - 77 to 1990 – 91

Size Class (Ha)	1976 – 77					1980 - 81					1990 - 91				
	Holdings		Area			Holdings		Area			Holdings		Area		
	No	%	Area (Ha)	%	Av. Size	No	%	Area	%	Av. Size	No	%	Area	%	Av. Size
Below 1	10660	34.32	5439	6.88	0.51	25535	45.44	11960	10.97	0.47	26119	49.56	11461	10.30	0.44
1 – 2	7843	25.25	11267	14.25	1.44	13076	23.27	18797	17.23	1.44	11162	21.18	19019	17.09	1.70
2 – 4	7438	23.95	21028	26.60	2.83	10926	19.44	30502	27.97	2.79	9065	17.20	27049	24.30	2.98
4 – 10	4285	13.80	25142	31.80	5.87	5788	10.30	33562	30.77	5.79	5102	9.68	31286	28.11	6.13
10 & Above	835	2.68	16186	20.47	19.38	873	1.55	14247	13.06	16.32	1249	2.38	22487	20.20	18.00
Total	31061	100.0	79062	100.0	2.55	56198	100.0	109068	100.00	1.94	52697	100.0	111302	100.0	2.11
Gini Ratio	0.5169					0.5273					0.5630				

Source: Agricultural Census Reports for 1976 - 77, 1980 - 81 and 1990 - 91, Bureau of Economics and Statistics, Government of Sikkim, Gangtok

Table 2.15: Per Capita Land Availability, 1971 to 1991 (hectare)

Particulars	1971	1981	1991
1. Net Cultivated Land	0.31	0.31	0.24
2. Operated Area for Agricultural Use	0.38	0.34	0.27
3. Land for Non-Agricultural Use	0.33	0.27	0.21
4. Pastures and Cultural Waste	0.40	0.23	0.18
5. Forest	1.26	0.83	0.65

Source: *Sikkim: A Statistical Profile, 1979-80 to 1991-92, Bureau of Economics and Statistics, Department of Planning, Government of Sikkim, Gangtok*

Table 2.16: Trends in the Livestock Population, 1976-77 to 1991-92

Sr.No.	Particulars	1976-77	1981-82	1986-87	1991-1992
1.	Cattles	75180	95392	98586	110727
		(29.38)	(35.55)	(34.16)	(32.44)
2.	Bullocks	28282	27134	39806	44708
		(11.05)	(10.11)	(13.79)	(13.10)
3.	Buffaloes	4050	4045	3088	2932
		(1.58)	(1.51)	(1.07)	(0.86)
4.	Yaks	-	3470	5354	5439
			(1.29)	(1.86)	(1.59)
5.	Sheep	13025	10817	10933	16268
		(5.09)	(4.03)	(3.79)	(4.77)
6.	Goat	60998	96285	98210	114707
		(23.84)	(35.89)	(34.03)	(33.60)
7.	Equines (Horses, Ponies,	2257	1093	1409	2082
	Mules & Donkeys)	(0.88)	(0.41)	(0.49)	(0.61)
8.	Pigs	72077	30093	31207	44477
		(28.18)	(11.21)	(10.81)	(13.03)
	Total	255869	268329	288593	341340
		(100.00)	(100.00)	(100.00)	(100.00)
	Poultry	135967	251859	277158	465751
	Total including Poultary	391836	520188	545751	807091

Source: *Agricultural Census Reports for 1976-77, 1981-82 and 1986-1987 and 1991-92, Bureau of Economics and Statistics, Department of Planning, Government of Sikkim, Gangtok*

Note: *(i)* *Figures for 1991-92 are provisional and are, therefore, indicative only*
(ii) *Figures in parentheses are percentages*

Table 2.17: Changes in Livestock Production: 1980-81 to 1994-95

Sr. No.	Particulars	Unit	1980-81	1985-86	1990-91	1994-95
1.	Milk	'000 tonnes	10.95	19.00	27.00	31.00
2.	Eggs	million	1.25	3.50	12.00	15.00
3.	Wool	million kg.	0.02	002	0.03	0.03

Source: Draft Eighth Five Year Plan, Government of Sikkim, 1992, p 103

Table 2.18: Trade Flows from and into Sikkim, 1995-96 (meteric tonnes)

Sr. No.	Commodities	Export	Import
1.	**Spices**		
(i)	Large Cardamom	2873.76	-
(ii)	Ginger	12784.30	-
	Total Spices	15658.06	-
2.	**Vegetables**		
(I)	Potatoes	431.11	-
(ii)	Peas	159.90	-
(iii)	French Beans	96..97	-
(iv)	Cabbage	93.81	-
(v)	Tomatoes	73.30	1101.98
(vi)	Chayote	62.62	
(vii)	Bean Butter	4.36	
(viii)	Radish	1.69	
(ix)	Onion	-	1753.27
(x)	Cabbage	-	624.19
(xi)	Cauliflower	-	613.34
(xii)	Chillies (long)	-	300.35
(xiii)	*Brinjal* (Aubergine)	-	299.01
	Total Vegetables	955.40	8501.24
3.	**Fruits**		
(I)	Orange	1137.58	-
(ii)	Pears	86.28	-
(iii)	Guava	8.68	-
(iv)	Banana	-	292.73
(v)	Mangoes	-	214.12
(vi)	Apples	-	169.19
(vii)	Pineapple	-	
	Total Fruits	1250.15	872.56
4.	**Flowers**		
	Cut Flowers	886.70	-
	Flower Bulbs	1569.60	-
	Total	2456.30	-

Source: Department of Horticulture, Government of Sikkim, Gangtok

Table 2.19: Procurement of Food Grains and Other Essential Items from the Central Pool: 1991-1995

Items	Unit	1991	1992	1993	1994	1995
Rice	Tonnes	5,40,00	5,40,00	5,40,00	5,40,00	5,76,00
Wheat	Tonnes	720	720	720	120	120
Sugar	Tonnes	1980	2156	2136	2056	2048
Palmolein Oils	Mts	100	100	100	100	110
Salt	Mts	5130	5130	5130	5130	5130

Source: Food and Civil Supplies' Department, Government of Sikkim, Gangtok

Table 2.20: Growth in the Net State Domestic Product: 1965-66 to 1991-92 (at 1980-81 prices)

Year	Net State Domestic Product			Percentage Share of Different Sectors		
	Total (US $ Million)	Per Capita Sikkim	Per Capita All India	Primary	Secondary	Tertiary
1965-66	-	-	-	80.61	7.3	12.10
1980-81	14	55	47	51.60	18.10	30.30
1985-86	22	58	53	50..96	16.45	32.54
1990-91	38.9	96	63	46.49	12..97	40.54
1991-92	41.22	100	63	36.01	13.14	50.85

Source: 1. *Economic Survey of Sikkim, Bureau of Economics and Statistics, Dept. of Planning, Govt. of Sikkim, Gangtok, Sikkim*
2. *For 1965-66: Pradyumna P. Karan (1984), Sikkim Himalaya: Development in Mountain Environment, Institute for the Study of Languages and Cultures of Asia and Africa, p 23*

Note: 1. *Primary Sector includes agriculture and allied and mining*
2. *Secondary sector includes manufacturing, construction, electricity, water supply, etc*
3. *Tertiary sector includes transport, communications, trade, hotels and restaurants, banking, insurance, public administration, etc*

Table 2.21: Infrastructural Facilities: 1975-76 to 1994- 95

Particulars	Unit	1975-76	1979-80	1984-85	1990-91	1994-95
Power Generated	MkWh	2.25	23.11	29.34	38.89	58.54
Villagers Electrified	Per cent	-	11.11	27.45	100.00	100.00
Educational Institutions	Number	264	470	666	1235	1458
Enrollment in School	Number					
Boys	Number	13764	30852	50103	59971	-
Girls	Number	7195	19580	32528	50846	-
Total	Number	20959	50432	82631	1,10,813	1,28,253
Health Beds	Number	357	628	705	795	875
Hospital Dispensary	Number	31	52	105	163	173
Beds per 1,000 Pop.	Number	1.19	1.98	2.01	1.96	2.15
Water Supply	% of Village	24.04	-	-	-	81.30
Road length surfaced	km	-	1292	-	621	776
Unsurfaced		-	-	-	894	911
Total		-	1292	1391	1515	1727
Road length per 1,000 km	km	-	221.30	238.20	259.50	295.80
Post office including telegraph offices	Number	-	125	125	125	190
Banks	Number	-	10	-	55	66
Banks per ten thousand of population	Number	-	32.2	-	132.2	145.6

Source: Compiled from :

1) *Sikkim: A statistical profile, 1979-1980 to 1991-1992, Bureau of Economics and Statistics, Dept. of Planning, Government of Sikkim, Gangtok*

2) *Sikkim at a Glance, 1995, Bureau of Economics and Statistics, Dept. of Planning, Government of Sikkim, Gangtok*

3) *An Economic Survey of Sikkim, 1991-1992, Bureau of Economics and Statistics, Dept. of Planning, Government of Sikkim, Gangtok*

Table 2.22: Changes in Sectoral Outlays in Different Plans: First Plan to Eighth Plan (per cent)

Sectors	First plan	Second plan	Third plan	Fourth plan	Fifth plan	Sixth plan	Seventh plan	Eighth plan
Agriculture and allied	16.40	16.00	14.09	16.90	27.72	28.37	23.17	13.61
Rural Development	-	-	-	-	-	-	1.71	2.37
Irrigation and Flood Control	-	-	-	-	0.94	0.38	4.77	2.41
Power	9.20	8.40	7.30	5.80	9.69	8.43	17.24	24..91
Industries and Mines	5.60	1.90	8.10	9.76	6.52	4.69	3.67	3.85
Transport & Communications	48.20	48.00	47.60	41.30	27.40	24.38	19.28	16.67
Education	7.10	12.40	7.90	8.70	7.31	7.00	12.08	11.83
Health	7.10	7.20	9.40	3.90	3.70	3.13	2.51	9.67
Other Sectors	6.40	6.10	5.61	13.60	16.71	23.62	15.57	14.68
Total (Million US $)	100.00 (0.93)	100.00 (1.83)	100.00 (2.78)	100.00 (5.36)	100.00 (16.57)	100.00 (45.71)	100.00 (66.20)	100.00 (154.29)

Source: (1) The expenditures for the sixth, seventh, and eight five-year plans have been compiled from respective plan documents , Department of Planning, Government of Sikkim, Gangtok

(2) The sectoral outlays for the first five year plan have been taken from the sixth five year plan, 1980-85, Department of Planning, Government of Sikkim, Gangtok, p11

Note: Figures in parentheses are total plan outlays in million US $

Table 2.23 : Growth in Plan and Non-plan Expenditure (million US $)

Year	Non-plan expenditure	Plan expenditure	Total
1979-80	4.95	5.81	10.76
	(46.02)	(53.98)	(100.00)
1980-81	5.47	6.67	12.14
	(45.08)	(54.92)	(100.00)
1981-82	5.59	6.93	12.52
	(44.68)	(55.32)	(100.00)
1982-83	6.45	6.77	13.22
	(48.83)	(51.17)	(100.00)
1983-84	7.80	8.11	15..91
	(55.04)	(44.96)	(100.00)
1984-85	8.44	12.73	21.17
	(39.88)	(60.12)	(100.00)
1985-86	12.21	17.09	29.30
	(41.68)	(58.32)	(100.00)
1986-87	13.45	18.86	32.31
	(41.63)	(58.37)	(100.00)
1987-88	17.71	20..95	38.66
	(45.82)	(54.18)	(100.00)
1988-89	22.14	23.41	45.55
	(48.60)	(51.40)	(100.00)
1989-90	21.55	24.70	45.62
	(46.59)	(53.41)	(100.00)
1990-91	24.96	26.07	51.03
	(48.91)	(51.09)	(100.00)
1991-92	29.16	34.61	63.77
	(45.77)	(54.23)	(100.00)
1992-93	35.16	34.38	70.04
	(50.56)	(49.44)	(100.00)
1993-94	39.51	37.04	76.55
	(51.61)	(48.39)	(100.00)
1994-95	42.87	39.43	82.30
	(52.08)	(47.92)	(100.00)

Source: *Report on study of the financial position of the government of Sikkim on the 31st March, 1994, Government of Sikkim, Gangtok*

Note: *Figures in parentheses are percentages*

Table 2.24: Growth in the Tax and Non-tax Sources of State Revenues: 1979-80 to 1994-95 (million US $)

Year	Tax revenue	Non tax revenue	Grants in aid	Total
1979-80	0.81	1.07	7.50	9.38
	(8.65)	(11.36)	(79.99)	(100.00)
1980-81	0.83	1.57	9.24	11.64
	(7.13)	(13.51)	(79.36)	(100.00)
1981-82	1.01	1.37	8.79	11.17
	(9.03)	(12.27)	(78.70)	(100.00)
1982-83	1.10	2.18	9.63	12.91
	(8.52)	(16.90)	(74.58)	(100.00)
1983-84	1.36	2.25	12.41	16.02
	(8.51)	(14.02)	(77.47)	(100.00)
1984-85	1.73	3.05	17.29	22.07
	(7.82)	(13.82)	(78.36)	(100.00)
1985-86	2.18	3.05	20..91	26.18
	(8.32)	(11.81)	(79.87)	(100.00)
1986-87	2.78	4.17	25.47	32.42
	(8.59)	(12.87)	(78.54)	(100.00)
1987-88	3.32	5.14	27.77	33.23
	(8.86)	(14.25)	(76.89)	(100.00)
1988-89	4.32	6.54	31.84	42.70
	(10.12)	(15.31)	(74.57)	(100.00)
1989-90	4.54	5.87	27.95	38.36
	(11.84)	(15.30)	(72.86)	(100.00)
1990-91	4.37	7.63	33.58	45.58
	(9.59)	(16.73)	(73.68)	(100.00)
1991-92	4.41	8.18	39.53	52.12
	(8.46)	(15.70)	(75.84)	(100.00)
1992-93	4.65	8.83	46.32	59.80
	(7.77)	(14.77)	(77.46)	(100.00)
1993-94	5.97	7.87	50.43	64.27
	(9.31)	(12.25)	(78.44)	(100.00)
1994-95	5.43	8.42	61.50	75.35
	(7.21)	(11.18)	(81.61)	(100.00)

Source: *Report on study of financial position of the Government of Sikkim as of the 31st March, 1994, Government of Sikkim, Gangtok*

Note: *Figures in parentheses are percentages*

Annex II

Tables Depicting Livelihood Options in Sikkim

Table 4.1: A Comparative View of Range of Livelihood Options Adopted by Farm Families

Number of options	Small Farmers			Large Farmers			All Farmers		
	% of HH	HH income (US$	Per capita income (US$)	% of HH	HH income (US$)	Per capita income (US $)	% of HH	HH income (US$)	Per capita income (US $)
Cardamom-dominated system									
I	3.33	1150	288	-	-	-	2.50	1150	288
II	10.00	858	172	-	-	-	7.50	858	172
III	26.67	1083	201	50.00	2192	304	32.50	1509	248
IV	46.67	1542	251	50.00	3805	514	47.50	2137	330
V	13.33	1718	222	-	-	-	10.00	1718	222
All options	100.00	1361	233	100.00	2998	411	100.00	1771	281
Maize-potato dominated system									
I	-	-	-	-	-	-	-	-	-
II	2.56	198	99	8.33	315	45	3.92	256	57
III	33.33	556	113	25.00	1057	144	31.37	650	121
IV	53.85	704	131	58.30	1473	156	54.90	896	140
V	10.26	2012	224	8.37	1801	300	9.81	1970	235
All options	100.00	776	141	100.00	1300	154	100.00	899	145

Source: Field Survey, 1996

Note : 1. Livelihood options adopted by the households are (1) crop production; (2) large cardamons; (3) livestock; (4) agricultural labour; (5) non-agricultural labour: (6) service; and (7) business/shop

2. Household and per capita income are net incomes over cash variable expenses

3. HH = household

4. The exchange rate is one US $ to Rs. 35

Table 4.2: Range-wise Livelihood Options and Their Contribution to Household Income, All Households: Maize-Potato Dominated Farming System

Options/Range of Options	Per cent of households					Per cent of income				
	1	2	3	4	5	1	2	3	4	5
Crop production	-	100.0	100	100	100	-	27.06	21.69	12.91	24.75
Large cardamoms	-	-	37.50	92.86	100	-	-	19.23	15.84	4.97
Livestock	-	100.0	100	100	100	-	72.94	11.76	18.09	11.28
Agri-labour	-	-	43.75	57.14	80.00	-	-	23.58	16.81	7.14
Non-agri labour	-	-	6.25	7.14	20.00	-	-	3.96	3.01	4.18
Service	-	-	12.50	25.0	60.00	-	-	19.78	27.05	33.76
Business/shop	-	-	-	17.86	40.00	-	-	-	6.29	13.92

Source: Field Survey 1996

Table 4.3: Range-wise Livelihood Options and Their Contribution to Household Income, Small Households: Maize-Potato Dominated Farming System

Options/Range of Options	Per cent of households					Per cent of income				
	1	2	3	4	5	1	2	3	4	5
Crop production	-	100	100	100	100	-	8.99	28.19	14.44	21.59
Large cardamoms	-	-	30.76	90.48	100	-	-	17.60	11.60	11.40
Livestock	-	100	100	100	100	-	91.01	8.89	19.22	4.18
Agri-labour	-	-	53.85	66.67	75.00	-	-	33.92	22.96	3.62
Non-agri labour	-	-	7.69	4.76	25.00	-	-	5.70	2.32	5.11
Service	-	-	7.69	19.05	75.00	-	-	5.70	21.11	41.32
Business/shop	-	-	-	19.05	25.00	-	-	-	8.35	12.78

Source: Field Survey 1996

Table 4.4: Range-wise Livelihood Options and Their Contribution to Household Income, Large Households: Maize-Potato Dominated Farming System

Options/Range of Options	Per cent of households					Per cent of income				
	1	2	3	4	5	1	2	3	4	5
Crop production	-	100	100	100	100	-	38.42	4.71	10.72	38.90
Large cardamoms	-	-	66.66	100	100	-	-	47.17	27.40	8.51
Livestock	-	100	100	100	100	-	61.58	12.54	11.01	10.71
Agri-labour	-	-	-	28.57	100	-	-	-	7.98	22.84
Non-agri labour	-	-	-	14.28	-	-	-	-	3.99	-
Service	-	-	-	14.28	100	-	-	-	3.32	19.04
Business/shop	-	-	33.33	42.86	-	-	-	35.58	35.58	-

Source: Field Survey 1996

Annex III

Survey Questionnaire

HOUSEHOLD QUESTIONNAIRE

Name of household _____ Village _____

District _____ Ethnicity _____

Date of Interview _____

1. Demographic Features

No	Name of Head of the Family	Age	Sex	Education	Occupation				
					Main	Subsidiary Day/Month	Monthly Income	Place of Work	Remarks
1.									
2.									
3.									
4.									
5.									
6.									

Code:

Education: O Illiterate, 1. Primary, 2. Middle, 3. Matric, 4. Graduate, 5. Above, 6. School Going

Occupation: 1. Agriculture, 2. Service, 3. Shop/Business/Trade, 4. Agricultural Labour, 5. Non agricultural Labour, 6. Carpenter/Mason, 7. Other

2. Land Utilisation Pattern

1.	**Total Land Owned**	**Acres**	
2.	Land Leased Out		
3.	Land Leased In		
4.	**Operated Land**		
	*Khet**		
	Pakho (Bari)		
5.	Grassland/Pasture		
6.	Fallow Land		
7.	Forests/Trees		
8.	Land Not Fit for Cultivation		
9.	No. of Fragments		

* *Khet* irrigated farmland
Pakho (Bari) unirrigated farmland

3. Livestock Inventory

	Livestock	No.	Present Value	Production	Fodder Month/Day	Concentrates Kg/days	Labour Hours/Day	Other
1.	Cows Local							
	Improved							
2.	Young Stock							
3.	Bullocks							
4.	Pigs							
5.	Goat							
6.	Sheep							
7.	Poultry							
8.	Other							

4. Asset Inventory

	Particular	Present Value	
1.	Residential Houses		
2.	Cattle Sheds		
3.	Agricultural Assets		
	- Traditional		
	- Modern		
4.	Furniture		
5.	Television		
6.			

5. Consumption Pattern

Items	Quantity Per Month	Value (Rs)
A. Food Grains		
1. Maize		
2. Rice		
3. Wheat		
4. Finger Millet		
5. Potatoes		
6. Pulses		
7. Oil/Ghee		
8. Milk		
9. Sugar		
10. Meat/Eggs		
11. Beverages		
12. Fruits/Vegetables		
13. Other (wine/cigarettes)		
B. Non-food	Total Yearly Value (Rs)	
1. Clothing		
2. Education		
3. Health		
4. Transport		
5. Social Ceremonies		
6. Fuelwood		
7. Electricity/Kerosene Oil		
8. Other		

6. Some General Questions Relating to Livestock

6.1 Do you have grazing animals Yes/No

If yes where (I) Forests
(ii) Wasteland
(iii) Pastures

6.2 Fodder requirements met from own land? Yes/No
If no, to what extent are they met from the forests?

6.3 Milk sold per day (kg)? _____

Price _____

6.4 Other Livestock products sold?

Quantity_____

Price _____

6.5. No. of animals sold during last year? _____

Price _____

7. Gender Issues

Who makes the household decisions?

Male _____

Female _____

Both _____

7.1 Wage Rates? Male _____

Female _____

7.2 Who owns the land? Male _____

Female _____

7.3 Sexual division of labour

Activities	Male	Female

8. Some General Questions

8.1 For how many months is your home production sufficient? _____

8.2 From where do you buy food for the remaining months?

(1) Fair Price Shop _____

(2) Shop _____

(3) Landlords _____

8.3 Do you use moden inputs? Yes/No

If no, why?

(I) Not available in time _____

(ii) Do not have money _____

(iii) Harmful to soil _____

(iv) Other reasons _____

8.4 How do you cure cardomoms?

(I) Traditional *bhatti*

(ii) Modern

Why don't you use a modern *bhatti*?

(i) Not convenient

(ii) Requires more fuel

(iii)

(iv)

8.5 To whom do you sell cardomoms

(I) Village Traders _____

(ii) Merchants from _____

(iii) Directly to the market _____

8.6 Has there been any change in the varietes of large cardamoms for the last 10-15 years Yes/No

8.7 What facilities have been provided by the government to increase its production?

(a)
(b)
(c)

8.8 Has the Spices' Board of India helped to increase its production? Yes/No

If yes, how?

(a)
(b)
(c)

8.9 Hold old is your plantation? _____

8.10 How much wood is required to cure one maund* of cardamoms

_____

8.11 Why don't you switch over to other cash crops?

(1) Not enough land
(2) Production is risky
(3) Good soil is not available
(4) Marketing problems
(5)

8.12 Is there any change in the water level in natural resources?

_____

8.13 Have there been any increases in the intensity and frequency of landslides over the last two decades?

_____

8.14 Is there any change in the rainfall patterns? _____

8.15 Are there any changes in the climate and crops grown in a particular place?

_____

8.16. Time devoted to fetch field fodder twenty years ago? _____

now? _____

8.17. Are there any increases in land and water related disputes? _____

8.18. Are there any changes in the availability of common land? _____

8.19. Are there any changes in the sustainability of common land? _____

8.20. Is there any abandoned land? _____

8.21. Has the diversity of crops grown increased or decreased?

_____

* A maund is a measurement of weight varying locally - normally equivalent to a 37.32 kilogrammes.

9. Cropping Pattern/Labour Use

No	Crops	Area (Acres)	Production (Maunds)			Labour use (days)			Bullock (Labour Days)	FYM/ Compost (Kilta)	Chemical Fertilizers (Bags)	Seed (kg)	Others
			Total	Self Con	Sold (price)	Preparation of Land	Wee-ding	Harves-ting					
1.	**Maize-Potato** Local Improved												
2.	**Maize-Pulse** Local Improved												
3.	**Maize-Ginger** Local Improved												
4.	**Paddy-Fallow** Local Improved												
5.	Large Carda-mon-Agro-For												
6.	Ginger												
7.	Wheat												
8.	Barley												
9.	Millet												
10.	Potatoes												
11.	Oil Seeds												
12.	Pulses												
13.	Vegetables												

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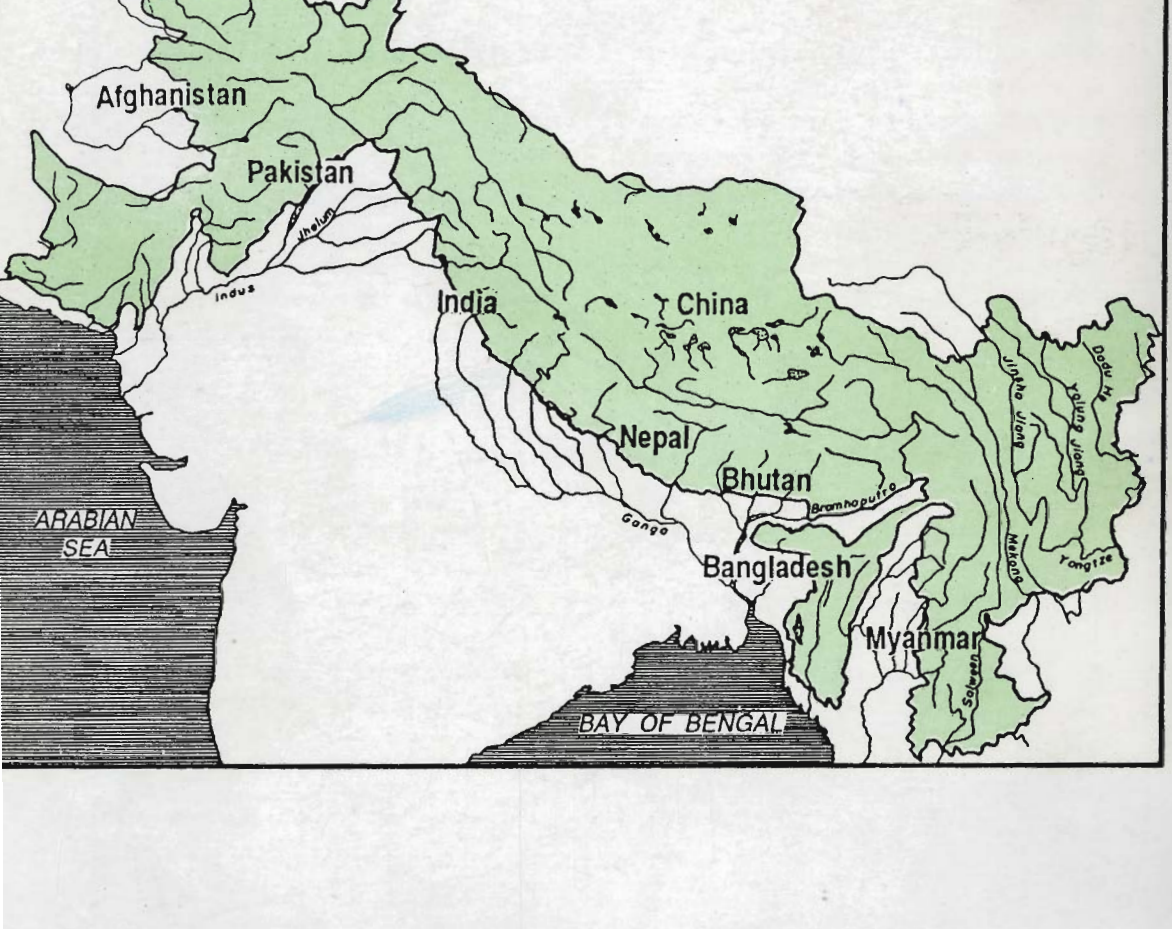
- Afghanistan
- Bhutan
- India
- Nepal
- Bangladesh
- China
- Myanmar
- Pakistan



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