

INTRODUCTION

Among the major resources available to human beings do lands comprise of soil, water and habitat for associated plants and animals. However, disturbance or pressure on natural resources is the largest single cause of biological diversity loss (Hannah et al. 1995). The Himalayan chain is a unique storehouse of precious biotic and abiotic reserves that stretches from Indus to Bhramaputra (Sahu 1986). It is an important determinant in shaping our economy, milieu and climate (Pant 1980). Therefore, the use of biological resources should be sustainable because our existence depends upon their higher productivity and wise use (FAO 1994).

During the last few decades, forest degradation in tropical Asia has been rampant (Brown & Lugo 1982, Brown et al. 1991, Thapa & Weber 1990). Diminishing of the forest resources in the mountains has been aggravating the pressure on livelihood, directly by causing shortage of firewood, fodder and other resources needed for subsistence living (Thapa & Weber 1990, Sundriyal et al. 1994, Sundriyal & Sharma 1996, Chettri et al. 2002). The pressure is acute when there is preference in species (Rai et al. 2002). In the process, over exploitation and unwise use of these resources have resulted in the disappearance of forests, soil erosion and deterioration of fragile mountain ecosystem throughout the world.

Agro-forestry is an important tool to address the present scenario and has recently received considerable attention (Sharma et al. 1992). The interest is largely due to the evidence that trees and shrubs can be managed to enhance on

productivity and to mitigate day-to-day need for livelihood. It also, to some extent, guarantees the sustainability of agriculture systems. Agro-forestry is defined as “a land use system that integrates trees with agricultural crops or animals, simultaneously or sequentially, to get higher productivity, more economic returns and better social and ecological benefits on sustained yield basis, than from monoculture on the same unit of land, especially under conditions of low level of technologies inputs and on marginal sites.” The rural communities have practiced and evolved different arrangements to ensure the availability of plant-based biomass to complement their supplies from annual cropping to meet their production and consumption needs. Agro-forestry, in a way, represents a compromise between the extensive land use (possible with low population) and intensive land use (possible with low population) and intensive land use (necessary under current demographic pressure). Agro-forestry is a land use system in which woody perennials and herbaceous crops are grown together in mixture with or without animals, which provides greater benefits for the land use than agriculture or forestry alone. This is a land use system that integrates trees, cereal crops and animals in such a way that it may be biologically compatible, economically desirable, practically feasible, and socially acceptable to the farmers. In fact, it is not a new phenomenon; it has been practiced under different conditions and in diverse location for more than a couple of centuries. The primary aims of agro-forestry practices are for sustainable use of resources and environmental security such as conservation and rehabilitation of soil, and sustainable use of natural resources for future use. Hence, agro-forestry system in true sense has been realized as a need of the day. It does not confine to the regional, geographical or agro-climatic boundaries; it has a global application.

1.1. Background

Darjeeling district is situated to the east of Nepal and the south of the Sikkim Himalayas. It has an area of 3264 km² and is located at 27° N. and 88.5° E., with an elevation range of 92m to 2659 m. The area supports a wide diversity of flora and fauna due to complex physiography and bio-climatic zonation and its location at convergence of the Palearctic and Oriental Zoogeographic Realms (Inskipp 1989). About 40% geographical area of Darjeeling is covered by forest followed by 20% of tea plantations. Within this, about 11% of the forest has been protected under Protected area (PA) network (Rastogi & person/ sq km) that exerts tremendous challenges for sustainable utilization of existing natural resources of the area. Moreover, the protected area systems are at far flung areas and don't have proper connectivity among themselves. Though there was connectivity within these PAs in the past due to human encroachment and other developmental activities the connectivity has been disrupted. In recent years, some visible depletion has been observed in the landscape as well as in the status of resources in many parts of Darjeeling. In spite of all these, there are places where conservation and sustainable use of resources has been practiced with different land use models such as agro-forestry outside the protected areas. However, the attention for research on efficiency on such practices in natural resource management and conservation has never got much attention. This study attempts to address the agro-forestry practices by community and their contribution for conservation and sustainable use of resources in one of the corridors connecting Senchel Wildlife Sanctuary with Mahananda Wildlife Sanctuary.

1.2. Aims and Objectives

The aims of the study are to document on:-

- The existing agro-forestry practices and patterns.
- The economy and the benefits from existing agro-forestry systems and
- Draw recommendations on potential interventions and improvements to strengthen agro-forestry system in the area.

1.3. Limitations:

Each and every research work has its own limitations. This study is not an exception. Both the time and the resources play a vital role in research. The present study deals with only eight villages from Darjeeling district. It is a micro level study that may not cover the situation of the whole district of Darjeeling. The study concentrates on the management and utilization of the agro-forestry in eight villages only. The unit of sampling adopted is 10 percent of the total household with random sampling. It does not cover the whole population of the study area. Information is obtained from the villagers recall; therefore, the study depends upon the reliability on the information and the response acquired from the households and key respondents.

1.4. Organization of the Study

This thesis emphasizes on three broad aspects of the study area, namely a) the existing agro-forestry practices and patterns, b) the economy and the benefits from existing agro-forestry system and c) draw recommendations on potential interventions and improvements to strengthen agro-forestry system in the area. The thesis starts with introduction as chapter I with an overview of study, rationale with limitations faced therein and the review of literature. Chapter II provides methodology used and description of study area. Results on overall

agro-forestry practices have been elaborately described in chapter III. Finally, the concluding chapter IV adds on conclusions and recommendations drawn and conservation implication for the area.

1.5. Review of Literature

This section presents review of the various studies previously carried out in the field of agro-forestry in general. However, there are no adequate literatures of agro-forestry practices from the study area. Therefore, it compliments with some relevant works from the past on agro-forestry carried out in different parts of Nepal and Sikkim that are appropriate for the study. Among various literatures on agro-forestry few literatures are reviewed which are as follows:

Amatya (1994) in his study revealed agro-forestry as a promising technique to achieve sustainability in land use and provide substantial opportunity for sustainable use of resources as per the needs of local communities living in the rural areas. Empirical evidences suggest that agro-forestry can provide a sound ecological basis to increase crop and animal productivity, more dependable economic returns and maintain greater diversity. Demonstration and functioning system plus the belief in the potential economic gain are key factors in rapid adoption of agro-forestry as a new land use system. Although agro-forestry is an age-old practice, it is a recent development where it is emerging as a new science. Therefore, care must be taken in this exercise not to view agro-forestry as a solution to all problems of land use management. Adequate planning for integrated land use development is therefore a necessity.

In the year 1996, Gurung stated about the uneven distribution of agriculture land in Nepal. He mentioned that in Nepal the terrain area occupies about 17% of the total agriculture land and the mountains and hills cover the rest. Hence, Nepal has limited land for cultivation. However, 18% of the total land area is under cultivation of which most land for agriculture lies in terrain. In the contrary, more than 50% of the total population resides in the mountains and hills. In spite of this limited land area for agriculture, more than 80% of the population depends on agriculture. The population growth in Nepal is very high. The increasing population pressure has given rise to increasing encroachment in the forested areas. This encroachment has aggravated deforestation, soil erosion resulting into environmental degradation. Nepalese economy being agro-based is closely related with the available land resources. Thus, the land degradation has badly affected in the economic development of the country. This burning problem of the country naturally demands some practical remedies for economic up-liftment and better environment in a sustainable manner. Agro-forestry would have been started long before and it is already getting late. Looking at the agro-forestry as it is now, it becomes obvious that forestry, agriculture and livestock are not in a productive balanced harmony rather they are grossly disturbed. Agro-forestry complying agriculture and environment could be sustainable only if agro-forestry is managed in an integrated manner with agriculture, pasture/forestry, livestock, fruit and vegetable/horticulture within a unit of land to fulfill the basic. The trend of out migration seeking employment in foreign countries and those who have collected a good amount of money have the trends of settling in the urban areas. At the same time, even the poor landholders also shows their interest to migrate to the urban areas where more modern facilities such as health, education etc

exist. Hence, there is ignorance on agro-forestry practices for both rich and poor people.

Gordon et al. (1990) mentioned that the agro-forestry is the most appropriate technique for promoting peoples participating in resources management. Farmers can easily adopt these systems in their agriculture lands without any risk of investment on crops yield reduction. It is fact that agro-forestry as a permanent income sources, it should be able to generate substantial income while conserving soil and moisture in the field. It is also a major source for fodder for livestock during the dry seasons. Clothing of all barren and wasteland of watersheds can be achieved through modern herald of scientific intervention called agro-forestry system. This system is one of the best for those farmers who depend directly on resource to raise their income standards. This appears to be right way to mitigate poverty at grass root level. Therefore, this system is effective in changing socio-economic conditions of the rural poor. However, a proper management system need to be devised which is capable of producing food from marginal land and also capable of maintaining and improving quality of the productivity and rural farmers weak economic conditions where agro-forestry could be used as a scientific solution for better landuse management.

Sharma et al (1992) studied on the Mamlay watershed management in the state of Sikkim, India. They found that agro-forestry are practiced in a traditional way in Sikkim. Basically, three type of agro-forestry are found in the watershed viz, i) Large cardamom with various trees cover, ii) Mixed agricultural crop with orange orchard and iii) Agricultural crops with various fodder and timber trees. The study revealed that agriculture in the watershed is a composite system

comprising of agriculture, horticulture, animal husbandry and agro-forestry. Agriculture is the main occupation of the people constituting about 62% (1866 ha) area of the watershed. Maize is the main crop grown at all elevations in the watershed. Ginger, cardamom, potato and orange are the main cash crops. Farmers grow at least one of these crops in addition to cultivation of cereals and pulses. The rain fed agriculture is common and just 1% area is under irrigation. Livestock is an integral part of the upland farms of the watershed. The average number of livestock with farm size is significantly related with livestock number. Land capability classification showed that the most of the area of the watershed falls in class III category which is not suitable for cultivation. Such areas should be under permanent vegetation cover, which is partly practiced by the farmers by planting cardamom under permanent tress cover in some of the areas of the watershed.

METHODOLOGY

The present study was designed for both descriptive and exploratory type of research. The study explored the agro-forestry practices practiced by the community in eight villages of Darjeeling and documented their use pattern and existing practices in relation to socio-economic condition of people living therein.

2.1. STUDY AREA- Darjeeling at a Glance

Darjeeling is a hilly district in the West Bengal state of India, Famous as the queen of hills, Darjeeling has an area of 3149 sq km and is a part of the greater Himalayan range. The Singhalila range of eastern Himalayas separates Darjeeling and Sikkim (state of India) in one hand and Nepal in the other. Kanchunjunga range borders Darjeeling with China in its north. The hills of Darjeeling rise from the foothill that has an altitude of 132m The highest attaining ridge has a height of about 3670m. Some major peaks in an around Darjeeling are Phalut (3670m), Senchel (3250m), Meghma (above 3000m), Birch Hill (2150m), Jalpahar (2250m) and Tiger Hill (2650m).

Soil: The soil type of Darjeeling is mainly sandy alluvial. Soil of terai region is black and white whereas it is red in hilly region. The soils in the forested areas are covered with thick mantle of humus soil formed by death and decomposition of plant and animal remains covering the ground surface. The greater portion of the area is lying under Darjeeling gneiss, which commonly decomposes to stiff loam and stiff red clay and pure sand, a condition favorable for tea cultivation.

Climate: The climate of Darjeeling varies from nearly tropical at lower altitude (below 900m) to sub-alpine at higher altitude (above 3600m). It also varies from one part of the district to the other corresponding to variation in altitude and configuration of different areas. Elevation wise, the place is unique in having three distinct climatic zones, viz., tropical, temperate and sub-alpine. The four main seasons of the area are winter, summer, monsoon and autumn.

Temperature: The temperature of Darjeeling hills varies from one place to another with altitude, rainfall, exposure, proximity of snow-covered regions etc. The range of fluctuation of temperature between the day and night is higher in the plains of Siliguri and lesser in the hills at higher altitudes and this condition plays a vital role in determination of the hygienic climate of the hilly regions to the requirements of man and animal.

Relative Humidity: Relative humidity is high in the hills of Darjeeling especially the north facing slopes remain humid throughout the year. It becomes high during morning and afternoon. In the highest hills (around 2000m) the relative humidity ranges between 87 and 99 during rainy season and decreases towards lower hills. Throughout the hills, the drier months are March and April when relative humidity ranges between 45 to 60.

Vegetation: The vegetative cover of Darjeeling hills is varied and diverse due to several factors like favorable climatic set up along with the variation in humidity, temperature, altitude etc. The vegetation is mostly forest covered. There are over three hundred species of dicotyledonous plants growing in this region. There is still a large number of species to be explored and documented. The entry of several species from neighboring countries and their naturalization has

added richness to the flora and vegetation that already displays a district degree of diversity in terms of number of species, altitudinal distribution and ecological relationship.

Senchel Wildlife Sanctuary-Mahananda Wildlife Sanctuary Corridor:

The present study area is located in part of Darjeeling district of India. For the smooth administration, the district has been divided into three sub-divisions namely Darjeeling, Kurseong, and Kalimpong. The eight villages namely Chimney, Majuwa, Chaiteypani, Baggauda, Ghaletar, Selphu, Bada Sittong and Kalijhora or the study area comes under the jurisdiction of Kurseong sub-division. These villages are considered as a corridor connecting the two wild life sanctuaries i.e. Senchel Wildlife Sanctuary and Mahananda wildlife Sanctuary.

2.2. Nature and Sources of Data

This study is mainly based on primary data. The primary data was collected through field survey with the help of a structured questionnaire and informal group discussions. Apart from these, published and unpublished books, journals and reports were also referred in the research. Since the area lacks adequate prior study of this kind, comparison with the historical perspectives was not possible.

2.3. Sampling Design

2.3.1. Household Survey

The total number of households in the study area is 888. However, out of the total about 10% of the households were considered for the sampling in the respective villages. The sample households (10% of total household) of the 8 villages are 9, 12, 16, 8, 8, 9, 11 and 12 respectively (Table 1). The sample household in the villages has been selected randomly for the interview. From the data it revealed that the biggest settlement within the study area is Chaiteypani followed by Majuwa and Galetar is the smallest settlement in the area (Table 1).

Table 1. Table showing the basic information of the study area

Village	Total No. of house holds	No. of sampled house holds (10% of total)
Chimney	96	9
Majuwa	126	12
Chaiteypani	163	16
Baggauda	87	8
Ghaletar	84	8
Selphu	95	9
Bada Sittong	113	11
Kalijhora	124	12
Total	888	88

Source: Field Survey

2.3.2. Focus Group Discussion

Focus group discussion is an important tool for getting information on the history of the management and implications of agro-forestry. During the field activity, informal group discussions were also conducted with the aged and experienced people of the village. Different views were collected from the elderly people of the village, farmers, and teachers.

2.4. Data Analysis

After the completion of the field survey, the collected data of the villages were categorized and classified in a tabular form. For the presentation of the report, simple parameter like mean, percentage, average are used to simplify and summarize the tables.

SOCIO-ECONOMIC CHARACTERISTICS OF SENCHEL-MAHANANDA CORRIDOR

3.1. Demographic Structure

The villages covered were Chimney, Majuwa, Chaitepani, Baggauda, Ghaletar, Selphu, Bada Sittong and Kalijhora. At least 10% of the total households from each of the eight villages were covered during the sampling. House of house interviews were made with the head of the family or the key informants. The selection of the households were made in a random manner. The demographic structure of the sample households is discussed under the following headings.

3.1.1. Average Family Size

The average family size, demographically, is not very high in the area. Since the literacy rate is quite good, people seem to be conscious of the family planning. The Indian government through different programmes has also helped the villagers to control population growth. The average family size of the area is 5. The village wise distribution shows similar type of family size in all the studied villages. However in some of the villages, the number of family size is 4 (Table No 2)

Table 2. Table showing the information average family size of the study area.

Village	Total number of people in the sampled household	Family size
Chimney	47	5.2
Majuwa	64	5.3
Chaiteypani	79	4.9
Baggauda	32	4
Ghaletar	45	5.6
Selphu	43	4.7
Bada sittong	56	5.0
Kaljijhora	71	5.9

Source: Field Survey

3.1.2 Age and Sex distribution

The total number of interviewed households from eight villages was eighty-five. The total population recorded within these 85 households was 440. The analysis shows the ratio between the male and female is almost equal (Table 2). Although, the males are relatively higher in number than the females, i.e. males 52% and females 48%, the age wise distribution verifies that greater percentage of population is dominated by the youngsters which is 36.8%, ranging from 21 to 40 years of age (Table 2). The teenagers ranging from 11 to 20 years of age constitute the second largest group with 23.1%. Similarly, the middle age group of 41 to 60 years of age has the percentage of 33.5%. The aged people, above 60 years, people between 6 to 10 years and up to 5 years of age group share the percentage of 7.7%, 6.3%, and 3.4% respectively (Table 3).

Table 3. Table showing information on age and sex distribution of the sampled villages.

Age	Male	Female	Ratio	Total No.	%
0-5	4	11		15	3.4
6-10	20	8		28	6.3
11-20	54	48		102	23.1
21-40	78	84		162	36.8
41-60	54	45		99	22.5
60+	18	16		34	7.7
Total	228(52%)	212(48%)		440	100%

Source: Field Survey

3.1.3. Major Ethnic Groups

The human settlement is determined by various factors that are suitable for the substantial development of an area. The study area has combination of different ethnic groups. Altogether sixteen different castes namely Tamang, Chettri, Rai, Thapa, Khawas, Sherpa, Gurung, Gazmer, Lohar and Newar comprising upper caste and lower caste were found in the sample households, which have been grouped as Buddhists and Hindus. Racially, all these castes belong to Aryans or Mongolians. Despite of diverse caste groups and religion, there is no communal disharmony in the area.

The population figure shows that the Hindu community is dominant in the area. Out of the total, 71% are Hindus and Buddhists comprise 28%. Of the total eighty-five interviewed households, sixty-one households belong to Hindus and 24 households belong to Buddhists. The ratio of male and female both between the Hindus and Buddhists are almost similar. However, the male population is slightly higher in both the races. Race wise, people of the study area follow two major religions, Hinduism and Buddhism.

3.2. Education

Education plays a vital role in nations building and for the development and diffusion of modern ideas and technology. The education table below (Table

3) indicates that education is not poor in the area. Majority of the people are literate. There is no serious unbalance between the male and female education. Education status shows that greater number of people is literate up to secondary level (45.2%). The primary standard i.e. up to class 5, occupy the second place with 28.6%. However, in higher education that is above higher secondary level the number of male is higher than the number of female (Table 3). Among the 6.1% graduates altogether, 88% is male and only 11% is female. The number of illiterate people is 11.3%, out of which 76% is female and 24% is male. The number of people qualified up to post-graduate level is 4. Apparently, no females have attended to that level (Table No 4)

Table 4. Table showing the basic information on education pattern of the study area.

Education	Total number	%	Male	%	Female	%
Below school age	4	0.9	2	0.8	2	0.9
Illiterate	50	11.3	12	24	38	76
Primary	126	28.6	63	50	63	50
Secondary	199	45.2	104	52	95	47
Higher Secondary	30	6.8	19	63	11	36
Graduate	27	6.1	24	88	3	11
Post graduate	4	0.9	4	100	-	-

Source: Field Survey

3.2 Occupational Status

The study area is comprised of eight villages and the prime occupation of the people is agriculture and cattle rearing. The occupational structure reveals that greater numbers of people are farmers (31.1%) practicing agriculture with more emphasis to vegetable production, cash crops and dairy products (Table 4). The cultivation of rice, wheat and other cereal crops are not quite feasible because of steep terrain, scarcity of water and cold climatic condition. About 15% of the total sampled population is engaged in jobs, which include both the

private and the government job. The second highest group belongs to students with 28%, who are following their academic career. About 14.5% are engaged in housework mainly as house wives. The number of business people is very low in the area. They comprise only 1.5% of the total. Likewise, the retired, labor and unemployed make their group with 3.1% and 5.2% respectively (Table 5).

Table 5. Table showing the information on occupational structure the study area.

Occupation	Number	Percentage%
Farming	138	31.3
Govt. or private job	66	15
Housework	64	14.5
Student	124	28.1
Business	7	1.5
Retired	14	3.1
Labour+unemployed	23	5.2

Source: Field Survey

3.3 Land Holdings

Land holding is one of the most important factors especially for the people engaged in agriculture occupation. On the basis of land holding, farmers of the study area have been classified into four groups as shown in the Table 5. The study site is located in the fringe area of the restricted zone or the forest area. Out of eight surveyed villages, people residing in six villages have private or registered land, which accounts 76.4% of the total. The rest of the villages viz Bagguda and Kalijhora have encroached the government land couple of decade ago and not yet registered. The other categories were not found in the area except 1% on lease (Table 6).

Table 6. Table showing the information on land holdings from sampled households of the study area.

Land holding	Number of households	Percentage%
Personal	65	76.4
Government land	19	22.3
Lease	1	1.1
Shared	-	-
Any other	-	-

Source: Field Survey

3.4 Land Holding Size of Sample Household

Basically the land holding size is different from one village to another as shown in table 6. By land holdings categorization, three of the villages namely Chimney, Majuwa and Chaiteypani have similar type in their pattern. The size they possess is in between 1 acre to 1.5 acre. However, the farmers of Ghalter are ranked first among the villages with the average land size of 4 acre per household. Baggauda and Kalijhora villages have encroached the government land especially the forest area. However in Baggauda, the government has provided around 1 acre of land to individual households, living for ages in the forest area, which is now a permanent village. Kalijhora is situated on the National Highway sides of Sikkim and have encroached the reserve forest land. In Kalijhora the people are basically labors not depending on the agriculture. (Table No 7)

Table 7. Table showing the information on size of land holding in the study area.

Village	Total land in acre	Average land in acre
Chimney	13.59	1.51
Majuwa	16.29	1.35
Chaiteypani	20.13	1.25
Baggauda	6.85	0.85
Glaletar	45.13	4
Selphu	25	2.77
Bada sittong	22.01	2.0
Kalijhora	6.43	0.53

Source: Field Survey

AGRICULTURE AND LIVESTOCK SITUATION**4.1. Land Use**

The information from the field revealed that the land availability is an important component in development of agricultural sector. The farmers of the are have divided their existing land especially for cash crops, vegetables and fodder for animals. The data revealed that the highest number of households (58)% are engaged in potato cultivation followed by radish (49%), rayo sag (48%) (see table 9). The use of land for vegetables is both for consumption and selling. Out of the 49 households who are producing potato, about 4% are using more than an acre of land and about 6% use 50 decimals to 1 acre of land (Table 9). The highest percentage (35%) of land is used for potatoes ranging from 1 to 10 decimals. About 49% of total households are using lands for radish out of which, 5% of the households uses more than an acre of land. Similarly, 17% households use between 50 decimals to 1 acre of land and the greater percentage 28% use 10 decimal to 25 decimal to cultivate radish. Rayo sag is cultivated for consumption rather than selling. About 95% of the total cultivate rayo sag using 10 decimals of land (Table 9).

However, if the total landuse pattern is to be considered then about 24% of land is used for maize cultivation followed by raddish (22%) and the least is recorded for cucumber cultivation (Table 10). It is noted from the data that Chimney village uses the largest area for potato as well as raddish cultivation (Table 10) followed by Chaiteypani. However, being in the lower altitude Ghaletar, Shelpu and Bada Sittong uses more lands for zinger and maize.

Table 9. Table showing the information on land use (in acre) in range for agriculture in the stud area.

Item	0-0.01	0.01-0.25	0.25-0.50	0.50-1 acre	>1 acre	Total	%
Potato	17	16	11	3	2	49	58
Raddish	10	12	11	7	2	42	49
Rayo Sag	38	2				40	47
Peas	28	2				30	35
Ginger	5	11	6	8	2	32	38
Beans	37	2	1			40	47
Maize	20	7	9	8	2	46	54
Carrot	4	1				5	6
Cabbage	9					9	10
Millet	3	3	2	1		9	10
Cucumber	2					2	2
Brinjal	5					5	6

Source: Field Survey

Table 10. Table showing the information on land use for agriculture in the study area in acre.

Agriculture produce	Villages								Total	%
	Chimney	Majuwa	Chaiteypani	Baggauda	Ghaletar	Selphu	Bada Sittong	Kalijhora		
Potato	6.61	1.90	4.56	0.90	1.15	0.84	0.43		16.39	20.9
Raddish	7.01	1.47	4.56	3.90		0.20			17.14	21.9
Peas	0.40	0.24	0.53	0.10	0.20	0.15	0.35	0.02	1.99	2.5
Beans		0.46	0.57	0.14	0.42	0.56	0.35	0.17	2.67	3.4
Rayo Sag	0.61	0.30	0.41	0.14	0.15	0.25	0.22	0.09	2.17	2.8
Zinger		0.30			6.60	3.43	4.16	1.04	15.53	19.8
Maize		0.41	0.30	0.15	6.85	3.55	6.70	1.16	19.12	24.4
Millet					0.30	1.10	0.60	0.02	2.02	2.6
Carrot		0.05		0.04	0.25	0.10			0.44	0.6
Cucumber						0.05	0.02		0.07	0.1
Cabbage			0.05	0.14	0.10		0.15		0.44	0.6
Brinjal		0.22						0.09	0.31	0.4
Total	14.63	5.35	10.98	5.51	16.02	9.13	12.98	2.59	78.29	100

Source: Field Survey

4.1.2. Agriculture Situation

As mentioned earlier, the area is highly engaged in agricultural activities. The study indicates that ten major items, especially vegetables production have been emphasized. Due to difference in altitude and temperature, there is village wise variation in the cultivation of agricultural items. The range wise distribution of production has been shown in (Table 11). Potato is cultivated almost in all the villages and has occupied the highest number of households (60%). Within these households about 17% produces more than five quintals and 50% produces one to five quintals per season (Table 11). The productions are used both for the consumption and for sale as well. Beans have the second place with 56% of the total households, but the quantity of its production is quite low. About 64% of the total sampled households produce only up to 20 kg, which mostly used for domestic consumption. There is no one producing more than a quintal. It was noted that about 55% of the total household cultivates maize. The greater percentage among the maize cultivators produces between 50 to 100 kg that is 40%, 27% produces 1 quintal to 5 quintals and only 6% produces more than 5 quintals. Next to maize is raddish. This item is produced in a commercial manner but the percentage of household is low because its practice is confined to some of the villages with high altitudes. 49% of the total households produce raddish in which 43% produces more than 5 quintals and 43% produces 1 to 5 quintals per season. Like beans, peas are also produced in the small quantities. Only 3% produces 1 quintal to 5 quintals and 46% of the total produces 20 kg to 50 kg. The climatic condition for zinger is not suitable in the high altitudes. Zinger cultivation is favorable in moderate temperature; therefore, is confined to certain villages. Out of the total, 37% cultivates zinger. Among the zinger cultivators, 28% produces more than 5 quintals and 62% produces 1 quintal to 5 quintals of

ginger per person. The cabbage, millet and carrot are also cultivated. Perhaps, the production is low compared to other items.

Table 11. Table showing the information on range of agriculture production in kilogram in households in the study area.

Item	0-20	20-50	50-100	100-500	500>	Total	%
Potato	1	3	8	30	9	51	60
Raddish		3	3	18	18	42	49
Peas	14	16	4	1		35	41
Ginger	2	1		20	9	32	37
Beans	31	16	1			48	56
Maize	2	10	19	13	3	47	55
Carrot	2		2		1	5	6
Cabbage	1	3	5			9	10
Millet	2	2	1	4		9	10
Cucumber		2				2	2
Brinjal	4					4	4

Source: Field Survey

However, if the total production pattern among the villages is to be considered then about 41% of production share is from raddish followed by ginger (24%), potato (20%) and the least is recorded for cucumber cultivation (Table 12). It is noted from the data that Baggauda village produces the highest amount of raddish (15.1 ton / annum) followed by Chimney (11.3 ton / annum) (Table 12) followed by Chaiteypani. However, being in the lower altitude Ghaletar, Shelpu and Bada Sittong produces more ginger and maize compared to other villages (Table 12).

Table 12. Table showing the information on agriculture production (ton per annum).

Agriculture produce	Villages								Total	%
	Chimney	Majuwa	Chaiteypani	Baggauda	Ghaletar	Selphu	Bada Sittong	Kalijhora		
Potato	7.47	2.8	3.61	0.75	1.97	0.71	0.19		17.5	20.4
Raddish	11.3	2.85	5.19	15.12		0.40			34.86	40.5
Peas	0.14	0.13	0.32	0.14	0.05	0.13	0.18	0.03	1.12	1.3
Beans		0.16	0.25	0.08	0.11	0.24	0.17	0.07	1.08	1.3
Ginger		0.16			10.9	3.70	4.45	1.22	20.43	23.8
Maize		0.49	0.19	0.10	2.99	1.10	1.94	1.16	7.97	9.3
Millet					0.09	0.42	0.35	0.02	0.88	1.0
Carrot		0.06		0.02	1.00	0.40			1.48	1.7
Cabbage		0.13	0.03	0.18	0.10		0.1		0.54	0.6
Cucumber						0.05	0.03			
									0.08	0.1
Brinjal								0.03	0.03	0.0
Total	18.91	6.78	9.59	16.39	17.21	7.15	7.41	2.53	85.97	100

Source: Field Survey

4.1.3. Consumption

All the agriculture products produced in the area are used both for the consumption and selling. The major items that are cultivated only for consumption are maize, rayosag, cucumber, millet and brinjal. However, the other agriculture items are produced for commercial purpose as well as consumption. The people producing in higher quantities consume almost 40 percent of their total.

Potatoes: Out of the 51 households producing potatoes, 37% consume more than a quintal of their production. 43% consume up to 1 quintal and 17% consume up to 50kg of their total production.

Raddish: Though the production of raddish is very high in some of the villages, the rate of consumption is very low. Among the 42 households producing raddish, 64% consume up to 50kg and just 12% use more than a quintal for their domestic purpose of their total production.

The peas and beans are mostly produced for domestic consumption in the form of vegetables. Among the peas producing group 35% of the total households 57% consume up to 20kg and 37% consume up to 5kg. Similarly, beans is cultivated by 48% of the total in which 66% consume up to 20kg and 27% consume up to 5kg. Likewise, the consumption of other items is shown in the table below (Table 13).

Table 13. Table showing the information on agriculture products consumption in kilogram in the study area.

Item	0-5	5-20	20-50	50-100	100>	Total	%
Potato		1	9	22	19	37	51
Raddish		3	27	7	5	12	42
Peas	13	20	2				35
Ginger	22	10					32
Beans	13	32	3				48
Maize		2	11	17	17	36	47
Carrot	1	4					5
Cabbage	1	7	1				9
Millet		2	2	1	4	44	9
Cucumber			2				2
Brinjal	2	2					4

Source: Field Survey

Again, if the total consumption pattern among the villages are to be considered then about 34.4% of production share is from potato followed by maize (34%), and raddish (17%) and the least is recorded for cucumber

cultivation (Table 14). It is noted from the data that chimney village uses the highest amount of potato (2.37 ton / annum) followed by Majuwa (1.95 ton / annum). Similarly, raddish is also highly consumed locally in Majuwa and Chaiteypani (Table 14). In case of Ghaletar, Shelphu, Bada Sittong and Kalijhora maize is used in higher quantity among the production items they harvest (Table 14).

Table 14. Table showing the information of range of agricultural products consumption in the study area (ton / annum).

Agriculture products	Villages								Total	%
	Chimney	Majuwa	Chaiteypani	Baggauda	Ghaletar	Selphu	Bada Sittong	Kalijhora		
Potato	2.37	1.95	1.87	0.10	1.07	0.51	0.19		8.06	34.4
Raddish	0.49	1.20	1.90	0.30		0.10			3.99	17.0
Peas	0.02	0.09	0.1	0.05	0.007	0.02	0.06	0.10	0.45	1.9
Beans		0.17	0.14	0.03	0.06	0.07	0.07	0.35	0.89	3.8
Ginger		0.01			0.06	0.05	0.06	0.30	0.48	2.1
Maize		0.49	0.19	0.10	2.99	1.10	1.94	1.16	7.97	34.0
Millet					0.09	0.37	0.35	0.15	0.96	4.1
Carrot		0.01		0.02	0.01	0.01			0.05	0.2
Cabbage		0.03	0.01	0.08	0.02		0.02		0.16	0.7
Cucumber						0.05	0.03		0.08	0.3
Brinjal								0.32	0.32	1.4
Total	2.88	3.95	4.21	0.68	4.31	2.28	2.72	2.38	23.41	100.0

Source: Field Survey

4.1.4. Crop Loss

The study area lies in the periphery of the fringe area. The farmers have complained that the wild animals damage their cultivation. Wild animals especially in villages of Chimney, Majuwa, Chaiteypani and Baggauda always damage 40 to 50 percent of their production. Particularly, the wild bore from the forest enter the villages. Some of the farmers were found in a state of frustration

as their crops are damaged before harvesting because of wild animals. The government of India has strictly prohibited the killing or trapping of the animals. No necessary action has yet been taken either from the government side or by any social organization to protect the agricultural field from wild animals.

4.1.5. Quantity Sold

The farmers of the study area cultivate the agricultural products commercially to generate income. Some of the major items, which are produced in higher quantities, are ginger, raddish, carrot, and potatoes. Beside these peas, beans and cabbage are also produced in commercial manner. In some of the villages, raddish has got greater importance commercially. Out of the total, 40% is engaged in the raddish cultivation. In this category 53% sell more than 5 quintals and 35% sell up to 5 quintals per season by individual household. Commercially engaged potato producing group account for 30% of the total. Out of which 19% sell more 5 quintals and 50% sell up to 5 quintals per household. Similarly, 30% of the total households produce ginger on commercial manner. In this category, 26% sell above 5 quintals and 67% sell up to 5 quintals of their production. Peas and beans are produced relatively lesser in quantities. 23% of the total households produce peas for selling. But only 4% sell more than a quintal where as 43% sell just up to 20kg and 34% sell up to 50kg per season. 50% sell up to 1 quintal and 44% sell just up to 20kg. Carrot is sold by very less number of farmers. The percentage is 3 in the total but their distribution is equal. 33% sell more than 5 quintal, 33% sell up to 5 quintal and 33% sell up to 50kg. the farmers producing cabbage on commercial scale has also small group. Only 7% of the total farmers cultivate cabbage. In this group, 28% sell up to 1 quintal, 42% sell up 50kg and 28% sell up to 20kg per household.

Table 15. Table showing the information on range for sale of agricultural products in kilogram in the study area.

Item	0-20	20-50	50-100	100-500	500>	Total	%
Potato		3	5	13	5	26	30
Raddish			4	12	18	34	40
Peas	10	8	4	1		23	27
Ginger		1	1	20	8	30	35
Beans	8	9	1			18	21
Maize							
Carrot		1		1	1	3	3
Cabbage	2	3	2			7	8

Source: Field Survey

The figure of the commercial oriented item shows that raddish cover almost 51% followed by the ginger 29% and potato 13.8%. Particularly, among the commercially grown items, raddish is sold in greater quantities by Baggauda (14.8 ton / annum) and Chimeny (12.22 ton / annum). But the cases are different in Ghaletar and Bada Sittong. Their major item for selling is ginger in which Ghaletar produces (10.82 ton / annum) and Bada Sittong (4.29 ton / annum). Likewise, the other items like peas, beans, cabbage ets also help to generate income to the farmers but the quantity is relatively very low (Table16).

Table 16. Table showing the information on sale of agriculture products in the study area.

Village	Chimney	Majuwa	Chaiteypani	Baggauda	Ghaletar	Selphu	Bada	Kalijhora	Total	%
Potato	4.5	1.18	1.65	0.65	0.90	0.20			9.08	13.8
Raddish	12.22	1.93	4.15	14.80		0.30			33.40	50.8
Peas	0.47	0.07	0.22	0.09	0.72	0.11	0.12	0.02	1.82	2.8
Beans		0.02	0.11	0.05	0.05	0.15	0.10	0.03	0.51	0.8
Zinger		0.15			10.82	2.66	4.29	1.20	19.12	29.1
Maize					0.05				0.05	0.1
Millet									0.00	0
Carrot		0.05			0.90	0.39			1.34	2.00
Cabbage		0.10	0.02	0.10	0.08		0.08		0.38	0.6
Cucumber									0.00	0
Brinjal									0.00	0
Total	17.19	3.50	6.15	15.69	13.52	3.81	4.59	1.25	65.7	100

Source: Field Survey

The study site is a rural area without any industries or factories. As a result most of the population is agriculture oriented. Agriculture is practiced in traditional method and subsistence type of farming was noted. The use of local seeds and organic manure (cow dung) was evident in the area. Altogether, eight villages were taken into consideration for the study in which bit variation in cropping was recorded.

Regarding the production, consumption and selling of the crops, it is evident that individual farmers cultivate some of the crops for domestic consumption and some for selling purpose. Since, the land holding size of the individual farmers does not suit the farming on a commercial scale, high value crops has been given greater importance in the area. For instance, Raddish (34.86

ton/annum), zinger(20.4 ton/annum) and potato (17.5 ton/annum) are produced on large scales. However, the rate of consumption for raddish (3.99 ton/annum) and zinger (0.48/annum) is low and potato (8.06 ton/annum) is high. Almost half of the production of potato is consumed by the households but in case of raddish and zinger not even $\frac{1}{4}$ of the total production is used for the domestic purpose and primarily goes for selling. The highest consumption of the products is noticed on maize (7.97 ton/annum). Similarly, the other crop like peas, beans, carrot and cabbage are grown both for consumption and selling. And almost half of the production is consumed by the farmers themselves. About these, some of the crops like maize, millet, rayo sag, brinjal are produced just to supplement the need of the farmers and they do not reach markets.

4.2. Livestock

Cattle rearing are found as one of the important occupations in the study area. The number and types of livestock in a region are determined by the altitude, climate and vegetation of the region. In the study area, livestock farming has been given equal importance as to crop farming. Almost all the families have kept some combination of different types of livestock.

The main varieties of livestock are cow, goat, pig and poultry. No buffalos are found in the area. The study reflects that cow has dominated the cattle population representing 77% of the total (Table 8). The poultry farming is also an important aspect in the area and is second highest with 76% in the total. The pig and the goat represent 24% and 22% respectively. The oxen and the sheep are very rare in the area.

Cow is raised for production of milk and its by-products. Beside this, cow is the major source of manure for agriculture. Since agriculture is practiced in a traditional method, farmers totally depend on cow dung as manures for their farmland. There is no record on use of chemical fertilizers in the area. The goat, pig and poultry are raised for meat. Goat also produces manure. The study area is a hilly terrain with steep topography; therefore, the use of animals to plough agriculture land is not feasible. Hence, people do not raise oxen except for breeding. From the survey it was noted that all the cattle are stall feeded. Though there are green forests surrounds the areas, the government has strictly prohibited the grazing of animals in the forest. However, the farmers have access to get the grass and the shrubs from the forest.

The livestock products in the form of milk and its by-products are sold in the local markets. There is one dairy farm in the area, which acts as a milk collection center. The major market for milk and its by-products like cheese, paneer, butter, churpi etc is Kurseong. Some of the farmers also sell their products in Siliguri, a market that lies in terai.

Table 8. Table showing the information on livestock distribution range among the household in the study area (0-2, 2-5, 5-10, 10> are the range of number of cattle and other numerical below them are the total number of household).

Cattle	Range of livestock				Total cattle	% of households
	0-2	2-5	5-10	10>		
Cow	45	17	4		166	77
Goat	4	12	2	1	90	22
Pig	19	2			29	24
Poultry	7	25	23	10	486	76
Bull	2				2	2
Sheep		1			4	1

Source: Field Survey

4.3. Market

All the agricultural and livestock products are either for consumption or selling. The farmers of the study area have got two major markets for selling their products. The area is linked with Kurseong and Siliguri by roadways. Though Kurseong is in proximity to some of the villages but the market is small. Kurseong is a small hilly town whereas Siliguri is a comparatively bigger market situated in the plains area. Therefore, usually the agricultural items in bulk are taken to siliguri. Some of the villages like Chimney, Baggauda, Chaiteypani and Kalijhora are connected with metalled road but Ghaletar, Selphu and Bada Sittong have steep and unmetalled road, whereas Majuwa is off the road.

Farmers get reasonable price of their products. The average selling rate of potato is Rs 5 per kg and farmers sell it on their own. The rate of raddish market keeps on fluctuating; though the dealers collect it from the field itself, the average price ranges between Rs 4 to Rs 6 per kg. The zinger farmers sell their

product at the rate of Rs 8 per kg. Peas and beans get almost equal selling price, their rate ranges from Rs 8 to Rs 10 per kg. Similarly, the selling market rate of cabbage is Rs 10 per kg which the farmers sell without the help of any dealers.

AGROFORESTRY IN SENCHEL-MAHANANDA CORRIDOR

5.1. Agro-forestry products

Along with the production of crops, the farmers of the study area are engaged in production of agro-forestry produce too. The major agro-forestry products of the area are broom, cardamom and medicinal plants. Out of 85 total surveyed households, about 48% are engaged in plantation of broom grass in their agro-forestry system. Temperature plays a vital role in the cultivation of broom. The entire area does not have the similar type of temperature, so the broom plantations have flourished where the temperature is moderate. The second agro-forestry product is large cardamom. This is mainly used as a spice. The number of cardamom cultivators compared to broom is low. Out of total sample households, 22% cultivate cardamom. Steep and wet landscape is favorable for the production of cardamom. Apart from these, plants having medicinal values are also planted in the area such as pakhanbet (*Bergenia ciliata*), chiraito (*Swertia chirata*), budo okhati (*Astible rivularis*), ghew kumari (*Aloe vera*), bhonjo (*Acorus calamus*), betlauri (*costus sp.*) etc.

5.2. Agro-forestry Production

The study reveals that in the selected site, people involved in the production of agro-forestry products are relatively few compared to agricultural products. This is because the requirement of agro-forestry products is not possible to maintain everywhere. For example, cultivation of broom is much more suitable neither in the high altitudes nor in the hot climate but somewhere between these two. Likewise, cardamom is cultivated in the higher altitudes and

wet environment. The agro-forestry products are planted mainly for commercial purpose rather than domestic consumption. These are good income generating products and have got a good market price. The domestic consumption of broom is very little. It is used for sweeping and cardamom as a spice to add taste.

Among the villages, Bada Sittong produces the highest quantity of broom 3.45 ton per year and Baggauda does not have any production because of climatic factor. Similarly, Majuwa produces highest amount of cardamom whereas Baggauda is nil. Moreover, all the villages produce broom and cardamom but with difference in quantity. About 48% of the sample households produce broom (Table 17). Among the broom cultivators, 10% produce more than 5 quintals a year. 7% produce 3 quintals to 5 quintals per year. 17% produce 50 to 100 kg and 31% produce less than 50 kg per year. The quantity of cardamom production is less compared to broom. 89% of the total cardamom cultivators produce less than 50 kg annually and only 10% produces 50 to 100 kg per year.

Table 17. Table showing the information on production of agro-forestry products in the study area.

Item	Total No of HH	%
Broom	41	48
Cardamom	19	22

Source: Field Survey

Broom cultivation has been given greater importance by most of the villages as it possesses multiple use. The study reveals that broom is cultivated in higher extent by Bada Sittong (3.45 ton/annum) and Ghaletar (2.69 ton/annum)

and is nil in Baggauda because of climatic unsuitability (Table 18).The comparative study of broom and cardamom reflects that the selling price of cardamom is ten times higher than that of broom. But the production of cardamom is very low.Majuwa is the only village producing cardamom more than a quintal(0.34 kg/year)and is followed by Ghaletar (0.04 ton/annum).Again the Baggauda and Kalijhora lack the production of cardamom as they are situated beyond the optimum feasibility of cardamom cultivation.

Table 18. Table showing the information on total production of agro-forestry products in the study area (ton / annum)

Village	Chimney	Majuwa	Chaiteypan i	Baggauda	Ghaletar	Selphu	Bada Sittong	kalijhor a
Broom	1.0	0.39	0.17		2.67	1.51	3.45	0.30
Cardamom	0.03	0.34	0.03		0.04	0.01	0.02	

Source: Field Survey

5.3. Seasonality

The area favors the production of vegetables and cash crops. Plowing, sowing and harvesting of the major crops practiced in the area were recorded. The study indicates the village wise distribution of crops due to difference in temperature and altitudes. Raddish is generally cultivated with greater extent in three villages- Chimney, Majuwa and chaiteypani which is situated in higher altitudes. However, the cultivation of raddish was found in other villages also. Generally, plowing and sowing of raddish is done in the month of May and is harvested in between July and August. Zinger is cultivated in villages with low altitude and moderate temperature. Usually, plowing season is February to March and sowing is done in March and April. The zinger gets ready to be harvested in month of September and October. Potatoes, maize, beans, peas and other vegetables are grown in almost all the villages. The month of plowing for

potatoes is November to December and sowing is December to January. Potatoes are harvested in the month of May. Plowing for maize is done in the month of January and February and usually sowing is done in February. The harvesting time for maize is June-July. For peas, the field is prepared in September-October followed by sowing in the same month and is finally harvested from December up to January. For cultivation of beans, generally, the plowing of field is done in the month of March followed by sowing in the same time and is harvested in the June-July. Similarly, the other crops are cultivated but with different months (Table No. 19).

Table 19. Table showing the information n farming seasonality in the study area.

Items	Plowing	Sowing	Harvesting
Raddish	May	May	July-August
Potato	Nov-Dec	Dec-Jan	May
Maize	Jan-Feb	Feb	June-July
Ginger	Feb-March	March-April	Sept-Oct
Peas	Sept-Oct	Sept-Oct	Dec-Jan
Beans	March	March	June-July
Rayo-sag	Oct	Oct	December
Cabbage	Dec-Jan	Dec-Jan	April-May
Millet	July-Aug	Aug	Oct-Nov

Source: Field Survey

5.4. Firewood Consumption

People of the study area collect firewood from their farmland or private land. The government has strictly prohibited the collection of firewood from the forest. The need of firewood as fuel for various purposes is not fulfilled from the farmland or private land itself because the average land holding size is generally small. Further, the land has been divided into agricultural land, fodder and firewood. Whatever species they have in their farmland or private land is used both as fodder and firewood. Therefore, to fulfill the need of the fuel, people have adopted the modern way to supplement the fuel need in the form of petroleum gas, kerosene and coal.

The higher percentage of firewood is consumed in the preparation of animal feed that is 2509.8 ton per year. In this category, the highest consumption is in Ghaletar with 536.5 to per year and the lowest in Chimney 42.8 ton per year. The other villages consume around 3 to 4 tons in average per annum. This is followed by cooking with 2509.8 ton per year. For cooking, firewood is consumed in heavy amount in Chimney 525.6 tons per year and lowest in Baggauda 99.2 ton per year. Cardamom is not produced in all the villages. Among the cardamom producing villages, greater quantity of firewood is consumed in Majuwa 614.2 per year and the lowest in Bada Sittong 40.0 ton per year. In firewood consumption, winter warming occupies the third place with the total consumption of 888.6 ton per year. The village wise use of firewood for winter warming shows that the Chimney consume greater quantity 330.9 ton per year whereas Kalijhora uses just 18.8 ton per year. This is because Kalijhora is situated at the base of the hills and is relatively warmer. The record shows that alcohol is not prepared in all the villages. Out of the surveyed eight villages, alcohol preparation was recorded in three villages. In this category, greater quantity of firewood is consumed in Bada Sittong 74.9 ton per year and Ghaletar with 57.4 ton per year. Similarly, the total consumption of firewood varies from one village to another. The greater quantity of per capita consumption was recorded in Ghaletar 2.34 ton per year and the lowest in Kalijhora 0.63 ton per year (Table 20)

Table 20. Table showing the information on firewood consumption in the study area.

Village	Cardamom Curing (ton/yr)	Water Heating (ton/yr)	Animal Feeding (ton/yr)	Cooking (ton/yr)	Alcohol Prep. (ton/yr)	Winter Warming (ton/yr)	Total (ton/yr)	Per capita (kg/day)
Chimney	63.9	109.0	42.8	525.6		330.9	1072.2	2.14
Majuwa	614.2	19.1	383.2	379.4		191.6	1587.5	2.37
Chaiteypani	157.3	18.5	319.7	185.9		111.5	792.9	0.99
Baggauda			317.5	99.2		198.4	615.1	1.76
Ghaletar	204.7	19.1	536.5	287.4	57.4		1105.1	2.34
Selphu			346.7	385.2	19.2		751.1	1.68
Bada sittong	40.0		393.7	273.7	74.9	37.4	819.7	1.45
Kalijhora			169.7	275.3		18.8	463.8	0.63
Total	1080.1	165.7	2509.8	2411.7	151.5	888.6	7207.4	

Source: Field Survey

5.5. Source of fodder

Related with livestock farming, animal nutrition is one of the most important aspects to be considered. As most of the experts involved in livestock tend to concentrate on animal health and as improved breed but they often neglect the problems of animal nutrition (Hopkins, 1983). Animal requires adequate nutrition for maintaining their health as well as for production purpose. Production may be of milk or meat. Thus, sufficient nutrition is required to increase the productivity of livestock whether it is improved or local breed animal.

One of the most serious problems of livestock keeping in the hills of Darjeeling is the shortage of livestock feed. The scarcity of feed is felt more acute during the winter or dry seasons. Green grass and fodder leaves are easily available during the monsoon months.

The people in the study area, engaged in livestock farming, collect the fodder for animals either from the forest or private farmland. Farmers use to plant fodder or green grasses around their homestead and the bunds of their terraces. Wise (1984) estimated that terrace walls contribute up to one quarter of

flat land area. From the forest, the government has strictly restricted the cutting of the fodder trees but the people are suppose to collect grass, dried things and fallen leaves. Some of the name of the species, in the form of grass, collected from the forest is listed below. It is reported that farmers, on average, spend one and half hours or two hours daily to collect one bhari of grass, weighing around 60 kg, from the forest. The farmers in the study area have planted fodder trees in their private land or farmland to supplement the fodder need. The fodder trees in the farmland supply good quality fodder during the winter months. These trees are mainly of fodder and fruit and they also fulfill the demand of fuel. Some of the major fodder trees planted in the area are listed below (Table 21). Broom plant has got greater importance in the farmland because after the plucking of brooms, the leaves are used as fodder and the stems as fuel. At the top of that the crop residues are also used to feed the animals.

Table 21. List of fodder plants used from forests and farmlands in the study area.

From forest		From farmland	
Local Name	Scientific Name	Local Name	Scientific Name
Kane	<i>Rhaphidophora sp.</i>	Kaulo	<i>Machilus edulis</i>
Banso	<i>Eragrostis tenella</i>	Dudhilo	<i>Ficus nemoralis</i>
Chariamilo	<i>Tryfolium repens</i>	Gagoon	<i>Saurauia napaulensis</i>
Amliso	<i>Thysanolaena maxima</i>	Malata	<i>Macaranga pastulata</i>
Gagleto	<i>Elastostemma sessile</i>	Chap	<i>Michelia sp.</i>
Arupate	<i>Prunus Nepaulensis</i>	Pipli	<i>Symintonia populnea</i>
Jhinguni	<i>Eurya acuminata</i>	Timbur	<i>Litsae citrate</i>
Kurkurae jhar	<i>Equisetum sp.</i>	Bamboo	<i>Bambusa nutans</i>
Dothi sara		Nevara	<i>Ficus roxburghii</i>
Chipley	<i>Gonostegia hirta</i>	Dhoday	<i>Napier</i>
Bilaunae	<i>Maesia chisia</i>	Ghurpis	<i>Leucosceptrum canum</i>
Duboo		Kimboo	
		Uttis	<i>Alnus Nepalensis</i>
		Camuna	
		Amliso	<i>Thysanolaena sp.</i>

Source: Field Survey

In the study area, there is no particular place for grazing. Government of India has strictly restricted the grazing of animals in the forest area. Therefore, stall-feeding is widely carried out in the area.

5.6. Conservation Initiatives

The people in the study area are primarily farmers and are involved in cattle rearing and other agricultural activities. In the conservation process, people of the study area seem to be active in a forestation in order to keep the greenery and supply of fodder, fuel wood and timber in their homestead or private land. Since there is no formal village level organization such as village development committee (VDC), people take initiatives of planting trees especially during rainy seasons in their surroundings on their own. The department of forest has also helped the farmers through different schemes by supplying variety of seedlings of trees suited in the area. Since the villages are situated in the fringe area of the forest and between the two wildlife sanctuaries, the people help the security personnel in policing the poaching and hunting of the wild animals and endangered species. However, there are no involvements of any NGOs or other external conservation organizations in the area. The area is a hilly region with steep hills and is prone to landslides. Farmers in the study area, in order to prevent the landslide on minor scale, construct, walls of stone on their own. For the proper drainage of the rainwater during the rainy seasons in the cultivable field, farmers channel the flooded water into jhoras. To control the erosion of topsoil in the steep landscape region, the farmers create terraces. For the conservation of the drinking water catchments, villagers have planted banana trees and have created temples with the mythological belief that god shelter in the water catchments area.

In the rural areas, to deal with the development and conservation process the government implements its schemes through panchayet. A panchayet member is elected from each of the villages for the term of five years. With the help of the panchayet member and through the funds of the government, villagers construct and maintain the trails and roads in the villages.

CONCLUSION AND RECOMMENDATION

Conclusion

Darjeeling is one of the districts in West Bengal State of India. About 40% of the area, in Darjeeling, is covered by forest and 20% by tea gardens. Therefore, individual farmers find it difficult for agro-forestry. Rapid population growth and family fragmentation are dividing the existing land that are practiced for agro-forestry resulting in small land holding which can be difficult for practice of agro-forestry on commercial manner. Due to deforestation and over growth of population, dependency in protected areas for resources such as fuel, fodder and timber are increasing. Protected areas have a previous history of forest working and have accordingly been home to resident communities in the form of forest villages. Existing protected areas such as Sanchel Wildlife Sanctuary and Mahananda Wildlife Sanctuary are facing immense pressure on their resources from the people living in its fringe areas.

The present investigation was carried out in eight villages namely Chimney, Majuwa, Chaitey pani, Baggauda, Ghaletar, Selphu, Bada Sittong and Kalijhora which comes under the supervision of Kurseong sub-division in Darjeeling district. The total number of households was 888 in which 85 households were interviewed taking around 10% of the total households from each village randomly. These villages are considered to be the connecting corridors between the Sanchel Wildlife Sanctuary and Mahananda Wildlife Sanctuary. Basically, all the villages are situated in hilly region but with difference in altitude. The study was carried out to learn the existing agro-forestry practices and patterns, the economy and the benefits from existing agro-

forestry systems and to draw recommendations on potential interventions and improvements to strengthen agro-forestry system in the area.

The results of the study shows that primarily the people of the study area are farmers, especially, engaged in vegetable and livestock farming. However, other categories of occupations were also recorded like government job, private job, teacher, army personnel, and businessman etc. demographically, people ranging the age between 20 to 40 years are dominant in the area and the average family size is five persons per household. The educational status of the area is not so poor. Greater percentage of population has attended the schools up to secondary level. There is no serious unbalance between the male and female education. Although, in higher education, females are slightly behind compared to males. Mainly two categories of land holding were found one is personal land and the other who have encroached the government land.

Livestock rearing is one of the important occupations in the area. Farmers sell livestock products in the form milk and meat to generate income. The fodder for the livestock is collected both from the farmland and the forest. In agricultural practice, the farmers have mainly emphasized the vegetable production. Crops like raddish, potatoes, zinger, and carrots are produced in commercial manner. Moreover, the other crops are produced for domestic consumption as well as selling. Farming is practiced in traditional method with human labour input and without use of any chemical fertilizers. The agro-forestry products mainly the cardamom and broom give a good income to the farmers. The medicinal plants are also produced in small quantities for domestic purpose and do not have any market. But the cultivation of agro-forestry products is not feasible in the all villages due to variance in temperature and

altitude. Farmers supply their agricultural as well as the agro-forestry products to two major markets in the area, which is connected by roadways. The need of firewood and fodder is basically supplemented from farmland as the collection from the forest is prohibited. However, farmers can collect the grass from the forest to feed their cattle. Farmers take their own initiatives in maintaining the greenery of the area. No active involvement of any NGOs or other social organizations were recorded in the area.

Since all the villages are situated in the fringe area of the forest, farmers have complained that the wild animals damage their crops. No precautions have been taken to control the wild animals from entering the crop fields. Secondly, the farmers are facing the problem of scarcity of water to irrigate their cultivable land. Villages like Ghaletar, Selphu and Bada Sittong are deprived of electrification. Apart from these, farmers in the area lack the scientific knowledge of farming.

Recommendations

From the present study, the following recommendations can be drawn so as to encourage the agro-forestry system for sustainable development of the area.

- Immediate measures should be taken to control the wild animals making the villagers' crop fields as their playground.
- Some of the villages lack the facility of electrification and transportation. Though the region has unmetalled road, the road should be well maintained for the smooth transportation. The government should come forward to fulfill the need of the power.
- Fuel wood is the major source of energy in the region. In order to reduce the dependency of firewood from forest, an alternative energy source such as micro hydropower, biogas plants, harvesting of solar energy or wind energy should be introduced by the concerned agencies.
- Most of the villagers are poor. One way to boost their income is by encouraging them to take cultivation of medicinal plants. As a number of medicinal plants exist in the area, it may not be a difficult proposition.
- People should be educated to maintain the importance of biodiversity and to make the environment eco-friendly. NGOs may come forward to help in the venture.
- In order to raise the income through agricultural production, the use of improved seeds and scientific method of farming should be encouraged to the farmers by the concerned authorities.

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