Land Use Pattern, Nutritional Status and Food Security of Indigenous People in Hill Areas of Bangladesh

By

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CONVERSION FACTORS

1 ha	=	10,000 sq.m or 247 decimal
1 decimal	=	40.49 sq.m
1 USD	=	Tk.69.40

ABBREVIATIONS AND ACRONYMS

Aman rice	=	Monsoon season rice
Boro rice	=	Spring season rice (January to mid April)
BARI	=	Bangladesh Agricultural Research Institute
Bashcorol	=	Soft portion of bamboo leaf
BRRI	=	Bangladesh rice Research Institute
CHT	=	Chittagong Hill Tracts
DAE	=	Directorate of Agricultural Extension
HRC	=	Horticultural Research Centre
ha	=	Hectare
Guishap	=	Snake (Chameleon)
Jhum	=	Cultivation on mountainous hill (Shifting cultivation)
Katcha	=	House with straw roof and threshed bamboo/stick/ straw or mud wall
Katcha-pacca	=	House with corrugated iron (CI) sheet roof and threshed bamboo/straw wall
Kondal thor	=	Part of banana plant used as vegetable
kg	=	Kilogram
MSFO	=	Multi Strata Fruit Orchard
Tk	=	Taka (Name of Bangladesh currency)
Toddy	=	Alcohol made from fragmented rice
Uchronga	=	Species of insect, the cricket

Executive Summary

Rationale:

Food is a basic necessity for the existence of human being. Food in appropriate quantity and quality is required for a healthy and productive life and for food security. Indigenous hill people are generally very poor, illiterate, and their livelihood depends mostly on wage earnings and *Jhum* cultivation. They receive the highest income from agriculture compared to other sources, but are constrained by cash and modern technology for higher agricultural production, which is threat to the food security. Hill farmers are also in trouble because their traditional *Jhum* agriculture is becoming increasingly unsustainable. They have to farm more intensively and this is causing a host of environmental and social problems. Therefore, the possibility of switching shifting cultivation to alternative farming systems needs to be explored and encouraged. It is also important to understand the consumption behaviour, assess the food security and nutritional status of the indigenous poor households as to inform the government and help formulate and implement appropriate policy measures to improve the livelihood situation of the indigenous community.

Methodology:

Khagrachari *Sadar* and Dighinala *Upazila* under Khagrachari district were purposively selected for the study. Data were collected from a randomly selected 200 rural and peri-urban indigenous households through personal interview during February-March, 2009. A monitoring study was also conducted with 60 households for six months. A Logit model was used to identify the determinants of food security among the members of the indigenous households in the study areas.

Results:

1. The study revealed that indigenous households generally used upland, plain land, and homestead area for crop production. The average sizes of cultivated upland, plain land, and homestead area were 0.188 ha, 0.304 ha, and 0.077 ha respectively. The cultivation practice in upland is locally called *Jhum* cultivation. Upland was mainly used for producing seasonal indigenous crops, vegetables, fruits, and different forest trees. *T. Aman and Boro* rice were grown mainly on plain land or valley land. Homestead areas were also used for producing different types of vegetables, fruits, and timber trees. It was

observed that 19 different types of crops were grown as mixed crops under *Jhum* cultivation. Irrespective of crops a *Jhumia* household harvested a total of 517.72 kg of crops valuing Tk. 8300 from upland cultivation. Besides, they received 1166 kg paddy valuing Tk.16776 from plain or valley land and 59.38 kg of vegetables valuing Tk.1200.77 from homestead area. The share of the crop income was 44 percent of their annual household income. The other sources of household incomes were non-farm activities (47%), livestock rearing (9%), and other sales (15%) like bamboo, wood, timber, sweeping materials, etc. Both income and expenditure were higher for rural households compared to peri-urban areas. Their annual savings was very low.

2. Farm supplied foods were limited for household consumption because they were sold immediately after harvest. The households were largely dependent on purchased food. Rice from their own production could meet their demand for about 5.56 months a year. Rural households were less dependent on purchased food as compared to peri-urban households. Assistance from government or other sources was limited. Households had to depend largely on indigenous vegetables and wild animals which are not generally transacted in the market. The purchasing power of the ethnic households was in general poor. They had limited options and alternatives for income generation. They were compelled to go under imperfect market situation and prices of output were distorted. In many events they had comply with complicated procedure in marketing their timber products. Especially in marketing fruits they had to pay taxes and levies to different authorities and places. They also had to pay bribe in transferring farm products from one place to another. These entire situations led to a lower price in the product market and higher price in the consumer market, further reducing their real income and purchasing power.

3. Indigenous households' consumption behavior showed that household members ate rice, fresh fish, meat, vegetables, potato, fruits, and spices more than the national average. They consumed egg, milk and sugar or molasses were far below the national average. Ninety two percent rural households and 96% peri-urban households ate rice thrice a day. Items like fruits, vegetables, root and tuber crops, snails, frogs and crabs were eaten seasonally. In general, rural households consumed (5%) higher amount of different foods in comparison to peri-urban households. The seasonality in consumption did not vary

much between rural and peri-urban areas. Peri-urban households showed better knowledge in washing rice before cooking, cooking leafy vegetables and using rice starch as compared to rural households. Most of the indigenous households consumed protein, calcium, and iron higher than the recommendation. The per capita per day consumption of calories, protein, fat, calcium, and iron was estimated at 2594 kcal, 72.23g, 21.06g, 851.58mg, and 46.70mg respectively. Rural households had higher intakes of energy (8.77%), protein (3.82%) and iron (7.84) compared to the peri-urban households. Again, per capita per day intake of calcium by peri-urban households was 0.79% higher than that of rural households.

4. Based on calorie intake, 54% of the households were food secure since their per capita per day calorie intake was 2965kcal which was much higher than FAO recommendation of 2400 kcal. The average per capita per day calorie intake for insecure households was 2072 kcal. The annual crop production of food secured household was 3326 kg, whereas it was 1862 kg for food insecure households. However, food insecurity among the sample indigenous households was more due to poverty and not due to low crop production. The reason for this assertion is that the food-insecure households sold more of their crop output to meet urgent household needs.

5. The results also revealed that both food secure and food in-secure households took the lion share of calorie, protein and iron from rice followed by vegetables, fresh fish, and dry fish. Among various food items rice supplied more than 78% of the total daily energy intake followed by vegetables (5.18%), edible oil (3.35%), fish (3.22%), and spices (1.85%).

6. The results of the Logit model revealed that the coefficients of farm size, off-farm income, household crop production, and fertilizer use were positive and significant, implying that these factors had a positive and significant impact in attaining food security of the indigenous households. On the contrary, dependency ratio had negative and significant relationship with households' food security. This implied that small households and the households with more earning member were more food-secure than large ones.

7. The hilly people faced several risk factors and constraints in improving their livelihood. These factors were lack of modern technology, high price of inputs, lack of organized output market, undefined land ownership, crop damage by wild pig and rat, reduction of land productivity, and natural calamities. They identified some other problems related to their livelihood. These problems were low price of output, scarcity of cultivable hillocks, scarcity of inputs, and quarrel among the villagers for hillocks. Both rural and urban households faced common risks, constraints and problems.

8. In the absence of adequate assistance, households in the hilly areas met the stress situation in their own way. They sold labour during various kinds of stressed situation followed by using of previous savings, borrowed money, selling of livestock, poultry and fruits, and bamboo/fuel/wood/ timber. They had little option to face the emergency situation with little savings in their hand.

Policy Recommendations:

The following policy recommendations have been suggested to improve the production system, food consumption level, livelihood pattern and coping strategies of the people in stressed situation.

1. Government should consider seriously taking steps to gradually reduce *Jhum* cultivation through replacing alternative technology suitable for upland cultivation.

2. *Jhum* farming cannot be suddenly discontinued. In this situation, *Jhum* cultivation should be modernized by replacing *Jhum* crops with modern crop varieties suitable for hill farming.

3. Government should come forward with adequate capital aid and monitoring mechanism for successful implementation of Multi Strata Fruit Orchard (MSFO) technology.

4. Appropriate land use policy defining the land right of the households, conflicts and quarrels among the villagers regarding hillocks should be settled through separate and appropriate land use policy and active participation of local public representative.

5. There is huge potential in the hill areas for agricultural development. BARI should work more in hill area with new varieties and management practices to increase the production of crops, vegetables and fruits. Similarly, BRRI should continue to undertake research

programmes for developing new varieties of rice suitable for local soil, climatic and socio-economic conditions.

6. Appropriate crop varieties should be selected for each particular *Jhum* area depending upon the slope and steepness of the soil. Agricultural Extension Department can assist the farmers in selecting right crops in each particular location. Further research should be taken to assess the appropriate seed rate, fertilizer rate, planting depth, water management, weed management, line spacing, crop management, and farming practices of different *Jhum* and plain land cultivation.
7. Government should provide HYV seeds to the hill farmers through its agencies. Suitability of irrigation should be studied by the hydrological department and irrigation facilities should be extended by the concerned authorities to the hill area particularly in the valley.
8. Fertilizer use has significant positive impact on crop production as well as in reducing food insecurity among indigenous households. Therefore, fertilizer use should be encouraged among *Jhum* farmers.
9. The Vertebrate Division of BARI can launch and initiate new research programmes with the collaboration of other concerned authorities to find out the causes and appropriate measures to control the rat flood.
10. Since the indigenous households sold a part of their farm products and depended largely on purchased food, proper attention should be given to eradicate all the marketing bottlenecks. Modern storage facilities should be developed at grass root levels to ensure households to get an appropriate price of their products.
11. The farmer households should relieve from all illegal toll and bribes, and in particular, all the official formalities in selling timber should be simplified. Complexities should be eliminated to reduce marketing cost and thus to ensure growers share at a higher level.
12. The indigenous foods, especially the various plant species should be popularized through a massive education programme to extend other parts of Bangladesh. The households can get an avenue of income generation through commercialization of these plant species. The medicinal value of these species should be studied and research to promote indigenous foods should be encouraged.

13. Dependency ratio has negative impact on food security. Population control program should therefore be strengthened. Besides, the government would need to minimize the dependency ratio through creating new jobs and income generating activities.
14. The government should take necessary steps for the prevention of livestock and poultry diseases and provide better extension services.
15. The government should establish and expand cottage industries and create employment opportunities for the indigenous people. Government may introduce programmes like *Kajer Binimoi Khadda* (KABIKA) and *Kajer Binimoi Taka* (KABITA) in the study areas.
16. Different social safety net programs like VGF, VGD, Old-age Allowances, Widow Allowances, and Disabled Allowances should be provided to the vulnerable ethnic households during stress situations.

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The Authors

Chapter 1

INTRODUCTION

1.1 Background

Bangladesh is not only an alluvial plain land. About 12% of its territory is occupied by hills. These are located in mainly in the south-east and north east. Two main kinds of hilly land characterize the country: (a) high hill ranges: such as Sitakunda range north of Chittagong, whose highest point mainly lies between 300 and 1000 m above mean sea level. The highest point in Bangladesh, 954 m (3141 ft), lies on the border between Bangladesh and Myanmar. (b) Low hills: such as Lalmai Hills near Comilla, whose crest generally lies below 150 m. The original sediments have been uplifted, folded, faulted and dissected to form long hill ranges or areas of complex hill relief. Most slopes are very steep. A survey of Chittagong hill tracts (CHT) showed that more than 70% of the land outside the Forest Reserves has slopes steeper than 40 percent (regarded as the safe limit for cultivation); the proportion in the forest reserves is probably even higher. Only 3% of the unreserved area, mainly in the valleys, has slopes less than 5% (Forestal, 1966).

The hill areas of Bangladesh include districts of Chittagong, CHT, Noakhali, Comilla, Sylhet, Mymensingh and Jamalpur. Tropically, CHT is the only hill intensive area of Bangladesh. The district alone covers 80.24% of the total hill areas of Bangladesh. CHT district occupies a narrow inland strip of parallel ranges along the Indian and Myanmarese frontiers. According to 1991 census the current population of the district was 974,447 of which 501, 114 were tribals and the rest were from different communities. About 50% of the population is indigenous[1] and mainly the followers of Theravada Buddhism, 48% of the inhabitants are Bengali Muslim settlers. The remaining are followers of Hinduism, Christianity and Animism. The indigenous peoples, collectively known as the *Jumma*, include the *Chakma, Marma, Tripura, Tenchungya, Chak, Pankho, Mru, Murung, Bawm, Lushai, Khyang, Gurkha, Assam and Khumi* tribes.

[1] They are tribal people having distinct life style in terms of social, cultural and behavioral characteristics and food habits living mostly in the peripheral specific regions of Bangladesh. They represent a minor proportion, less than 1% of the total population of Bangladesh.

At least 1.21 lakh hectares of hilly land is used for *Jhum* cultivation every year which adds to massive soil erosion, depletion of forests including reserves ones and extinction of wild life in the Chittagong Hill Tracts. According to the Forest Department and Department of Agriculture Extension (DAE, 2009), over 16 thousand hectares of different reserve forests have also been burnt for the same purpose. Most of the *Jhum* farmers have no permanent residence nor do they possess legal documents as they are engaged in *Jhum* cultivation from the past several years. *Jhum* cultivation causes much harm to the natural environment by destroying forests and harming wild lives and birds. Besides, crops do not grow well for next five years if the land is used for *Jhum* cultivation. Usually *Jhum* cultivation washes away the upper part of micronutrients of the soil, which causes massive soil erosion. Compared to the low-lying floodplains that characterize most of Bangladesh, the topography of the Chittagong Hill Tracts is quite different. Typical of the region are hills, ravines and cliffs, originally covered by dense bamboo, trees, and creeper jungles, but presently bare in many places. The parallel hills extend from north to south. The relief varies from approximately 300-600 meters above sea level in the north to between 450 and 900 meters in the south. Kyokra-Dong, the highest peak of Bangladesh (1230 meter) is located in the southern tip of the Rangamati district, near the borders of India and Myanmar.

Land ownership is a complex issue in CHT region, as many villagers have customary rights to land. Originally people settled where ever they found enough land. Initially, the people were allowed to practice *Jhum*ing and to extract any forest produce in the unclassified state forest to meet domestic requirements. Over time, more and more land was occupied by private owners for food production making it their private property (Riessen, 2000).

Tobacco cultivation in CHT is posing a threat to public health and the environment. According to environmentalists at least 60 to 70 thousand metric tones of firewood are being burnt in 2,000 tobacco processing kilns every year, causing depletion of reserves and natural forests, threatening the environment and ecology of the hills. Besides, it spoils the soil fertility almost totally and once tobacco is cultivated it is difficult to grow other crops on the same land. Some 7000 farmers are involved with tobacco farming in the CHT according to the Department of Agriculture Extension (DAE, 2009). Most of the farmers in Rangamati, Bandarban and Khagrachari have been losing their interest in cultivating indigenous crops

like paddy, banana, maize, cotton, etc. as they became defaulters of loans provided by tobacco companies. Farmers and labourers are of the opinion that staff of tobacco companies offer them lucrative amount of money as loans so as to cultivate their involvement in tobacco cultivation. Sometimes the companies even provide them with bank loans to promote tobacco cultivation.

1. 2 Justification of the Study

Indigenous people in Bangladesh are, in general, very poor, illiterate, and their livelihood depends on wage earnings and shifting cultivation (Uddin *et al.,* 2000). They receive the highest income from agriculture compared to other sources, but are constrained by limited cash and modern technology for higher agricultural production, which is a threat to the natural resources in the area (Farid and Mujibullah, 1990; Chowdhury, *et al*. 2004). Livestock and poultry provide additional income. Most households own a single small dwelling with no modern amenities and their main source of drinking water is natural springs (Miah and Islam, 2007). Their food basket contains mainly indigenous vegetables, fruits and the meat of animals. Understanding the consumption pattern, nutritional status, and household level food security of the indigenous households can provide evidence based information that can help the government to enrich formulation and implementation of appropriate policy measures to uplift the livelihoods of indigenous households.

Shifting cultivation causes huge topsoil loss from the hills and reduces productivity of the soil. Soil erosion with nutrient loss and reduced organic matter has been considered responsible for decreasing productivity of food production and other hillside farms. Many research efforts have been undertaken by scientists focusing on the impact of shifting cultivation on land degradation, nutrient depletion, nutrients balance, soil erosion, resilience, and decreased food production (Gafur, 2001; Gafur *et al*. 2003; Al-Kaisi, 2001; Ewel *et al.,* 1981*;* Weil, 1982; Kyuma *et al.,* 1985; Ramakrishnam, 1992; Miah and Islam, 2006). With this unsustainable land use system, the livelihoods of the hill people are decreasing day by day.

Several agroforestry production techniques designed with various locally adapted trees and crops for different slope conditions optimized the production of agroforestry crops and

minimized environmental degradation from hill region (Paul and Hossain, 2001). Many Bengali migrants have set up multi strata fruit orchards (MSFO) on hills to enhance their livelihoods. This MSFO has already been found suitable for preventing soil erosion and in increasing the cropping intensity of the area (Miah and Islam, 2006). But the indigenous people are still reluctant to follow any modern conservation practices. This is largely due to the lack of awareness and knowledge on modern methods which has subsequently led to a situation of inadequate food production that is threatening their food security. Therefore, the possibility of switching shifting cultivation to alternative farming systems should be investigated.

Based on the above situations, the present study has given much emphasis on focusing the issue of individual household food security, especially in the poorer segment of the population like indigenous people who are actually subsistence farmers and forest dwellers, and vulnerable to various natural calamities. This is because under the burden of chronic poverty, this category of the population may use their natural environment in unsustainable ways, leading to further deterioration of their livelihood conditions (FAO, 2005).

CHT is completely different in physical features, agricultural practices and soil conditions from rest of the country. In tribal areas of CHT traditionally there was a system that land was allocated to *Jhum* cultivators by the chiefs against payment of taxes. Historically, the chiefs have been conservative and reluctant to allow innovations which might weaken their authority. There is also increased population pressure on *Jhum* land. In recent years, large areas of hill land have been appropriated by people from the plains some of them urban entrepreneurs who avail of the 'get-rich-quick' form of land use, which can cause serious degradation of vegetation and soils (Brammer, 1997). Food insecurity is a great concern in CHT where it is sometimes becomes very difficult to arrange three meals particularly for medium or big families. They seldom get a chance to eat a delicious full meal or good food. The rat flood in 2007 created havoc on the *Jhum* cultivation, the consequences of which are still being faced.

In the past, indigenous people practiced *Jhum* cultivation in the same area with a fallow period of 15-20 years, which ensured long-term sustainability of soil fertility. But with the rapidly growing population, the fallow period has been greatly reduced to 3-4 years, allowing

very little time for soil regeneration (Riessen, 2000). While the cultivated crops are traditional, the yield is rather. This cultivation system causes land degradation on the one hand and reduces crop productivity on the other (Gafur, et al., 2003; Miah and Islam, 2007). Therefore, food and nutritional security and the coping strategy of the indigenous people are affected. Given the increasingly unsustainable cultivation system and various stress situations that prevail in CHT, the study was undertaken.

1. 3 Objectives of the Study

a) To investigate land use pattern including crop production system, consumption pattern, nutritional status, and food security of the indigenous people in the hill areas;

b) To explore the livelihood risks and coping strategies of indigenous people during stress situations; and

c) To suggest policy guidelines for enhancing indigenous peoples' livelihoods in the CHT region.

Chapter II

DESCRIPTION OF THE STUDY AREA

Khagrachari was previously under Chittagong Hill Tracts and considered to be a single district of Bangladesh till 1984. In the same year it was divided into three separate districts: Khagrachari, Rangamati and Bandarban. Map of Khagrachari district as in Fig 1. A detailed description of Khagrachari district is given in the sections below:

2. 1 Administrative Units

The district HQ is located at Khagrachari town under sadar upazila. The area of the district is 2699.55 sq. km. There are 8 upazilas, 43 unions/wards and 184 mauzas/mahallahs in the district. The names of the upazilas are: Dighinala, Khagrachari, Lakshimichhari, Mahalchhari, Manikchhari, Matiranga, Panchhari, and Ramgarh. Dighinala upazila alone covers 26% of the area of the district while Khagrachari 11% of the area.

2. 2 Location and Area

Khagrachari district lies between 22.38 north latitudes and 91.44 and 92.11 east longitudes. It is bordered on the north by India. On the east of the district is Rangamati district, on the south there is Chittagong and Rangamati districts and in the west there is Chittagong and India. The area of the district is 2699.55 sq. km including forest area of 1492.22 sq. km. The district is about 1.83% of the total area of the country. In respect of size it ranks 6^{th} among 11 districts in Chittagong Division and 21 st in Bangladesh. On the eight upazilas, Dighinal is the largest having an area of 694.12 sq.km (267.93 sq. miles) and Manikchari is the smallest with an area of 168.35 sq.km (64.98 sq.miles)

2. 3 Soil Condition

The physical characteristics of the district are similar to other hilly districts of Chittagong hill tracts. The landscape presents a scenic view of blending of hills and valleys, spring and lakes and patches of green forest. The valley soil is mainly acid and reddish brown loam. The main

limitation for agriculture is the frequent occurrences of steep slope which render the soil unsuitable to convert it into arable. Some of the lands are utilized for hill slope cultivation.

The soils of the CHT are characterized by low fertility. The texture of the non-alluvial soils and some of the alluvial soils are coarse. About 67% soil of the total area is silt-clay-loam. Based upon soil suitability calculations only 3.2% of land in the region is suitable for all-purpose agriculture, about 15% for fruit gardening and forestry, and 77% for forestation because of poor soil condition.

2. 4 Climate

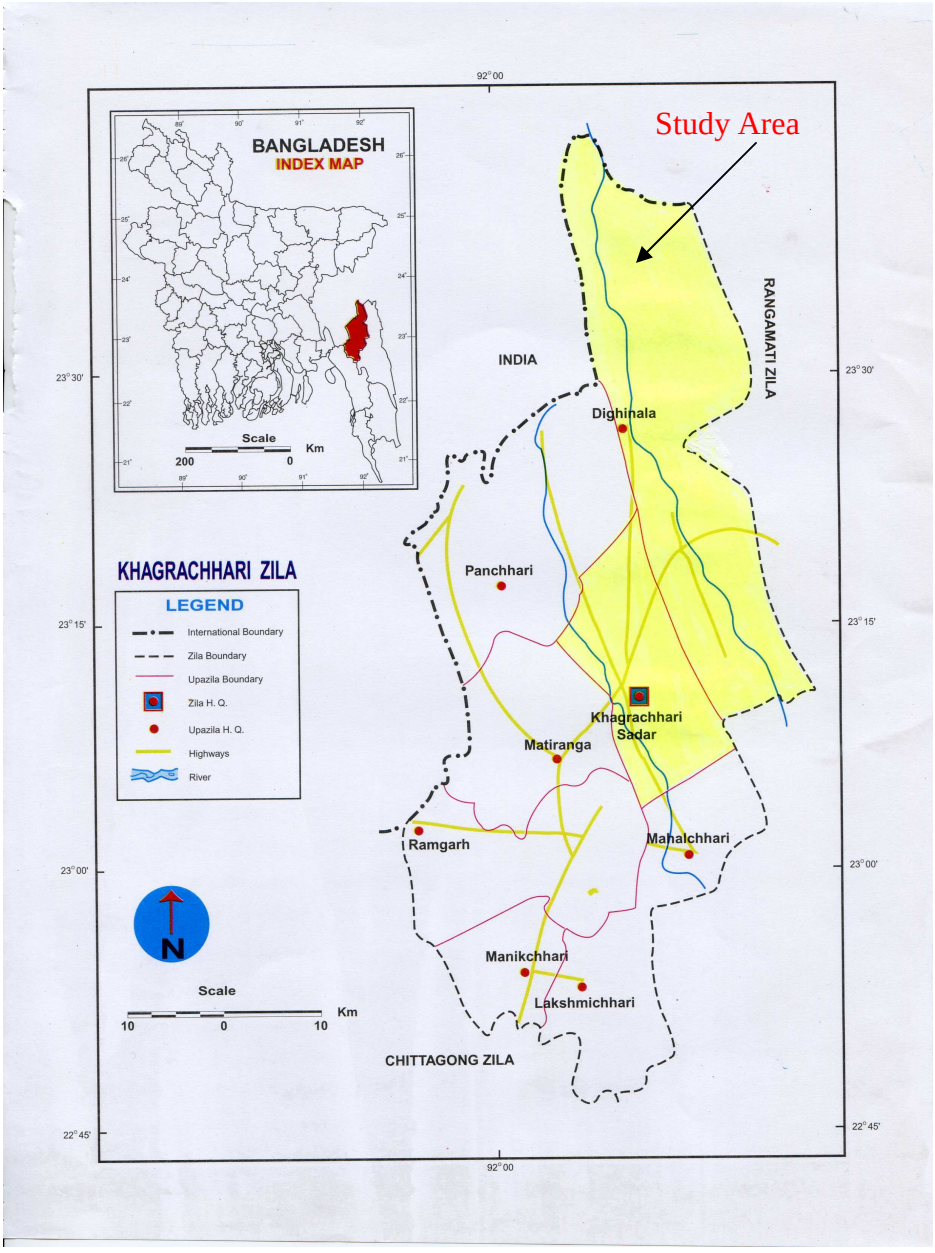
The study area bears a tropical climate. It is remarkable for its uniform temperature, high humidity and heavy rainfall from May to October. The climate is thus moist, warm and equable. Annual temperatures vary from approximately 13° to 35° C. Mean monthly temperature are the lowest during December/January approximately 12°C and 14°C respectively. Monthly maximum temperature rise to 34°C during March-May when minimum temperatures are around 24°C. The higher temperatures are usually accompanied by high humidity during the rainy season. The wind blows from a southwesterly direction during the warmer part of the year but from a northerly direction during the cooler part of the year. The commencement of the wet season in late April is usually accompanied by violent storms, thunder, and lightning. The climate of CHT is characterized as sub-tropical monsoon. The level of humidity is around 85% in July and around 61% in February. Approximately 80% of the mean annual rainfall of 2000-3800 mm takes place in the wet season (May-September), often in the form of torrential downpours. Rainfall during the remaining seven months (drought period), is very low and unpredictable. The southern part of the region receives comparatively more rainfall than the north.

2. 5 River System

The district has a few rivulets, springs and khals[2] flowing through the district. These are the Myanikhal, the Kasalongkhal, the Gangachara, the Mala, the Nava, the Chingri, the Dhurangkhal, the Manikchara, the Feni and the Paklakchara. They have little importance in navigation. They occupy an area of 215 sq. km which is 8.3% of total area of the district.

[2] Small size of ponds which are filled in water during monsoon.

Fig 1: MAP OF THE STUDY AREA



2. 6 Flora and Fauna

The flora of this region shows a considerable admixture of Cachar and Khasia elements. The forests of Khagrachari district may be broadly classified into tropical evergreen, semi ever green and decidous types. The decidous type is always mixed with the evergreen species. Besides, additional undergrowth comprising bamboo brakes and savannh is also included in the forest composition of the district. All these forests generally consist of three stores. Upper storey ranges from 100 to 150 feet in height and is usually composed of trees like *Chapalish, Telsur, Chundul, Narikeli, Civit, Garjan, Koroi, Banderhola, Champa, Chikrashi,* etc. The second storey is formed by trees such as *Pitraj, Nageswar, Toon, Tali, Kamdeb, Raktan, Khoijam, Gutgutia* and others. The third storey consists of different types of grasses like *Honiara, Jamal, Hermosa, Heritage, Gamer, Jarful, Chatom,* etc. Bamboo brakes are not regarded as a separate type of forest. Most commonly, they form the undergrowth under various forest types. They occupy large areas, the common species being *Muli, Mitenga, Dalu, Barua,* etc. Besides, some canebreaks like *Kerak, Gallak, Jaitabeth*, etc. are also found in the more humid localities. There are ferns, moss and orchids. Due to *Jhum* cultivation large areas have been denuded of tree cover. Some exotic plants such as rubber, mahogony, teak, pine, etc. have also been introduced in this district. The major agricultural crops produced in this district are rice, wheat, maize, vegetables, pulses, oilseeds, spices, tobacco, cotton, etc. Most common horticultural crops are banana, pineapple, cashew nut, guava and papaya. The homestead flora includes a wide variety of trees, shrubs and the undergrowth. Roadside trees are mahogony, teak, *Debdaru, Haritaki, Kathbadam, Arjun,* etc. Other mammals that are found in these forests include *Raru Horin* (dear), *Sambar, Pati shial* (Fox), *Bon kutta* (dog), *Buno shukkur* (pig), and *Honey badger*. Besides, different species of squirrels, rats mice and porcupines are also found. A large number of bats including Indian fruit bats are commonly seen.

The forests of Khagrachari are the natural habitat for many different species of birds, beasts, reptiles, amphibians and insects.There are monkeys, gibbon and lemur. The leopard cat and the leopard are also seen. Several species of pigeons and doves including *Harial, Botkol, Dhumkol, Ghugu and Raj ghugu* are found. Different species of parrot, like *Tuta, Lalmatha Tia, Kalomatha Tia* and *Lejkata Tia* are fairly seen. Cuckoo, owls, king fishers of different species are also found in these forests. Among the reptiles and amphibians, *Pahari Kasim,*

Halud Pahari Kasim, different snakes like *Raj Gokrah, Shankhani shap, Ajagar, K, Anjon, Tokkhak* and *Kalo gui*. *Alkeotey, Dhaman. Kuno Bang* (frog), *Kotkoti Bang* (frog) and *Choto Gecho Bang* are found in the forests. Different varieties of fresh water fishes that are commonly found in Khagrachari are *Mrigel, Katal, Ruhu, Boal, Air, Chapila, Tengra, Magur, Singi, Shol, Koi, Phhloi* and some exotic fishes like *Telapia, Nilotica, Silver carp, Mirror carp, Grass carp* have also been found in the district.

2.7 Economic Situation

The economy of Khagrachari is predominantly agricultural. Of the total 1, 30,480 holdings of the *Zila*, 75.63% holdings belong to farmers. Both valley and hilly lands are used for cultivating varieties of crops and fruits. Generally, they produce HYV rice, wheat, vegetables, cash crops, pulses, oilseeds, and others in the valley lands. On the other hand, most tribal farmers cultivate local rice, turmeric, ginger, aroids, marpha, cassava, different vegetables, cotton, etc in the hilly lands under shifting or *Jhum* cultivation. Most common horticultural crops are banana, pineapple, cashew nut, guava, jackfruit, coconut, and papaya. Fish of different types abound in this *Zila* and as in other parts of the country. Besides crops livestock, hunting and fishery are also important sources of household income. The study areas are very rich in forest resources. Of 2699.55 sq. km of the total area of *Zila*, forest occupies about 1492.22 sq. km. Besides farming activities, non-farm economic activities are also source of livelihood to the households.

2.8 Major Problems

Lands and hills of CHT though attractive and resourceful, provide a difficult environment for development. Major problems of the district were identified as physical and agronomic which can be described as steep slopes and poor soils (soil erosion, low moisture holding capacity, low fertility, shallow soils over hard rock, flash flood in valleys, pests etc.), heavy monsoon rainfall, strong winds, weeds etc.; social and institutional (poor transport facilities, backward socio-economic condition, poor agricultural service etc.); nutritional and food security (inadequate food supply, low purchasing power of tribal inhabitants instability in food prices, and production, inadequate cultivable land, low income of the households, difficult and complex socio-political situation, conflict between traditional and constitutional rights, rehabilitation of indigenous and social discrimination

Chapter III

METHODOLOGY OF THE STUDY

3.1 Study Area Selection

It was believed that the level of income, consumption, livelihood pattern, food security status, and finally standard of living of the rural people may be different from that of peri-urban[3] people. Based on this assumption, Dighinala Upazila which represents rural areas and Khagrachari Sadar Upazila which represents peri-urban areas were purposively selected for the present study. The other reasons behind the selection were: (i) the high concentration of households practicing shifting cultivation in Dighinala Upazila; (ii) the lack of prior studies in these areas; and (iii) the existence of a BARI research station which facilitated the logistics of field survey and related arrangements.

3.2 Selection of Sample and Sampling Technique

In selecting samples for the present study, two factors were taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be manageable within the limitation imposed by physical, human and financial resources. A simple random sampling technique was followed for achieving the ultimate objectives of the study. With the help of local Headman and *Karbari* (village leader) a total of 200 indigenous tribal households, including 100 households each from rural and peri-urban areas were randomly selected for the interview.

In the 2nd stage, a total of 60 households, taking 30 each from rural and peri-urban areas were selected from the interviewed sample households for monitoring household level consumption and seasonality of consumption so that the survey results regarding per capita consumption could be verified and compared between the seasons studied.

[3] Peri-urban areas are characterized by strong urban influences, easy access to markets, services and other inputs, ready supplies of labour but relative shortage of land and risks from pollution and urban growth (NRI, 1995).

3.3 Preparation of the Survey Schedule

In conformity with the objectives of the study, a draft survey schedule was prepared in such a way that all issues associated with the land use, nutritional status, and food security of indigenous hill people of Khagrachari district were included. The survey schedule included the detailed information about the sample households on socio-demographic features, land ownership pattern, economics of land use through crop production, sources of income, consumption pattern and quantity, livelihood pattern, and the questions related to livelihood risks and coping strategies during stress situations. The draft survey schedule was pre-tested by interviewing some farmers. In the pretest survey, attention was paid to inclusion of any new information which was not included in the draft schedule. Thus, the draft schedule was improved, rearranged and modified in the light of the actual and practical experience. After making necessary modifications, a final survey schedule was developed in a logical sequence. The comments and suggestions made by the TAT members on the interview schedule were also incorporated in the final interview schedule.

A structured interview schedule was also constructed for collecting household income, expenditure and daily food intake data through regular monitoring of the selected households. Food intake data was gathered using a three day recall method (Reddy, 1997). The monitoring survey schedule contained demographic information, quantity and type of food consumption, household income and expenditure scenario, and problems faced during monitoring period.

3.4 Method and Period of Data Collection

Four trained and experienced enumerators from Agricultural Economics Division, BARI, Gazipur were engaged to collect household data and information through household survey. Another four local level enumerators from tribal community were also employed for assisting them since the Bengali enumerators could not properly understand the language of the tribal people. The researchers themselves also collected data and information along with enumerators from selected households through face to face interview.

Before taking actual interviews, the purpose of the study was clearly explained to the farmers. Initially, the farmers hesitated to answer the question but when they were assured that the study was purely an academic one and would not pose a threat to their livelihood in anyway, they were cooperative with the researchers. At the time of interview, the researcher asked questions systematically and explained the questions whenever it was felt necessary. Farmers were requested to provide correct information as far as possible. After each interview was over, the interview schedule was checked so as to ensure that information to each of the items had properly been recorded. In order to minimize the errors, data were collected in local units, but later those were converted into standard international units.

Two local enumerators were also employed for six months and trained for collecting data and information from selected households on a weekly basis. The researchers visited the sample households once a month and collected data along with enumerators. The main survey work was done between the month of February and March, 2009. On the other hand, the household monitoring study was started in the first week of March, 2009 and continued up to the 31th August, 2009.

3.5 Processing, Tabulation and Analysis of Data

After collecting the first hand information from the study areas, data were edited, summarized and tabulated. After completing the pre-tabulation, actual tabulation work was started. A number of tables were prepared on the basis of the aims and objectives of the study. Finally, tabulated data were analyzed and condensed by using averages, percentages, combination, etc. to depict and interpret the results. The socio-economic problems encountered by sample households during crop cultivation were explained by the percentage of responses made by the sample farmers. Logit model was also employed for identifying the determining factors of household level food security of the indigenous hill people.

3.6 Estimation of Costs and Benefits

The per hectare costs of both on plain land and up-land cultivation were calculated by summing up all the costs incurred for various inputs like human labour, seed, pesticides, and fertilizer. The gross return per hectare was calculated by summing up the value of different

crops grown. In the case of shifting cultivation, the following equation was used to determine the gross margin.

$$GM = \sum_{j=1}^{n} P_j Y_j - \sum_{ij=1}^{n} \left(P_{ij} . X_{ij} \right) \text{ ..... (1)}$$

Where,

GM = Gross margin (Tk/ha)
P_j = Price of the j^{th} crop or product (Tk/kg)
Yj = Quantity of the j^{th} crop or product (kg/ha)
P_{ij} = Price of i^{th} inputs for j^{th} crop (Tk/ha)
X_{ij} = Quantity of the i^{th} inputs for j^{th} crop (kg/ha)
i & j = 1, 2, 3,....., n

3.7 Estimation of Energy and Nutrient Intake

The crops, animal products and other food items consumed from own production and those purchased from market by the sample households were taken into consideration for estimating the per capita daily energy and nutrient intake of the indigenous households of Khagrachari district. For this purpose, household consumption data for the last three days was collected through interviewing female household members. In total, data on eighteen types of food items were collected and considered for analysis. The quantities of crops, animal products and other food items produced and purchased in kilogram were recorded and calculated for the energy and nutrient values (i.e. protein, calcium, iron and fat). This divided by the adjusted household size to obtain the calorie and nutrient intake per capita per day by a household member. Irrespective of male and female, two children under six years of old were considered as one adult member in this study (Omotesho et al., 2006). The tables of nutrient composition of Bangladeshi foods (Darnton-Hill *et al*, 1988) were used to calculate the energy and nutrient values of the foods.

Based on observation, a certain percentage was deducted from each of the produced and purchased food item in calculating the actual edible part. The deducted percentages were 20% for fish and papaya, 25% for orange and bitter plum (jujube), 10% for sweet gourd (yellow pumpkin) and bottle gourd, 5% for potato, brinjal (egg plant), cauliflower, cabbage, leafy vegetables and plantain stem.

3.8 Determination of Household Level Food Security

In order to measure food security, a household food security index was constructed by defining a minimum level of nutrition necessary to maintain a healthy living. It also indicates the 'food security line' for the population under study (Omotesho et al., 2006). Any household above this line was classified as food-secure. The food security line used in this study was measured using average recommended level of calorie intake of 2400 kcal as the desirable and cut off point (FAO, 2002). A similar approach was used by Olayemi (1998) which was 2260 kcal as a daily recommended level of calorie intake.

The calorie content of both the produced and purchased food items were used to estimate the dietary energy availability in the household. The food security index was calculated using the following formula.

$$\text{Food security Index } (K_0) = X/Z$$

Where,

X = Household daily per capita calorie intake

Z = Household daily per capita calorie (Z) required

Thus, for a household to be food-secure K_0 must be greater than or equal to one ($K_0 \geq 1$) otherwise, the household is considered food-insecure.

3.9 Factors Affecting Household Level Food Security

The logit regression model was used to identify the determinants of food security among the indigenous hill people of Khagrachari district. The logit regression model is one of the binary choice regression models in which a dichotomous regression variable is considered as the dependent variable. The logit model was chosen for this study instead of the linear probability and probit models because according to Gujarati (1995), the logit model guarantees that the estimated probabilities lie in the 0-1 range and that they are not linearly related to the explanatory variables. This is an advantage over the linear probability model. In addition, it is easier and more convenient to compute than the probit model. The logit model is based on the cumulative logistic distribution function expressed below.

$$Pi = E(Y = 1/X_i) = \alpha + \beta_i X \quad \text{.....} \quad (2)$$

$$P_i = E\left(Y = \frac{1}{X_i}\right) = \frac{1}{1+e^{-z}} \quad \text{.....} \quad (3)$$

For ease of exposition, $Zi = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots\ldots \beta_n X_n$.

Where Pi = Probability of being food-secured.

The log of odds ratio or the logit (Li)

$$= \text{Ln} \quad \frac{\{\text{The probability of being food-secured}\}}{\{\text{The probability of not being food-secured}\}} = Zi + Ui$$

In order to obtain the value of Zi, the likelihood of observing the sample needs to be formed by introducing a dichotomous response variable Yi (dependent variable). The dependent variable is food security. Households whose per capita per day calorie intake was found to be greater than the food security line were regarded as being food-secure and were assigned a value of 1, while households experiencing a calorie intake less than the food security line were regarded as food insecure and they were assigned a value of 0.

At first nine explanatory variables such as farm land size, adjusted household size, dependency ratio, household crop production, annual household income, off-farm income, input cost, crop diversification index, and education of the household's head were hypothesized to be major determinants of household food security among the indigenous hill people of Khagrachari district. After testing multi-colinearity among variables and the level of significance, six variables were finally included in the model to determine the probability of food security among indigenous households. The independent variables are specified as follows:

X_1 = Farm land size (decimal)

X_2 = Dependency ratio (No. of non-working children and adult/Household size)

X_3 = Annual off-farm and non-farm income of household in taka

X_4 = Household annual crop from own production, in kg grain equivalent

X_5 = Input cost per season in taka

X_6 = Education (Number of years of schooling)

According to Gujarati (1995) the marginal probabilities (equation 4) of factors determining food security among indigenous hill people and the elasticity of the probability (equation 5) of food security were estimated based on expressions derived from the logit model as:

$$dp/dx = \beta i \{P (1- Pi)\} \quad \text{………………………………..………… (4)}$$

$$Ep = \beta i \overline{Xi} (1- Pi) \quad \text{…………………………..…..………………..(5)}$$

Where, βi = Estimated logit regression coefficient with respect to the i^{th} factor

Pi = Estimated probability of an indigenous household food security status

$\overline{Xi}$ = Arithmetic mean of indigenous household i^{th} attribute

Ep = Elasticity of probability of food security

Chapter IV

SOCIO-ECONOMIC PROFILE OF INDIGENOUS HOUSEHOLDS

This section deals with the socioeconomic characteristics of the households. Socioeconomic characteristics of the households are important in influencing production planning. People differ from one another in many respects. There are numerous interrelated and constituent attributes that characterize an individual and profoundly influence development of his/her behavior and personality. It was, therefore, assumed that enterprise combination, consumption pattern and employment pattern of different farm households would be influenced by their various characteristics. Finally, socioeconomic characteristics of the farmers influence their farm decision making. A number of socioeconomic aspects of the sample households were examined. These were family size and composition, age distribution, occupation, level of education, land ownership pattern, household assets, liabilities, and livelihood standard of the indigenous (tribal) households of the study area.

4.1 Ethnic Identity

In the study area basically there are three ethnic groups. These are Chakma, Tripura and Marma.The majority of the sample households belonged to Chakma community (53.5%) followed by Tripura (28.5%) and Marma (18%). Despite differences so many socio-agro-economic commonalities prevails among the ethnic groups.

4. 2 Age of the Households

Age is an important factor that influences farmers' production decision and efficiency and to adopt improved technologies. The percentage distribution of sample respondents according to age group is given in Table 4.1. Most household respondents (31%) belong to 30-39 years age group followed by 40-49 years (25%), 50-59 years (23%), 19-29 years (13%) and 60-80 years (8%) age group. Age distribution was found different in rural and peri-urban areas. Majority of the respondents in rural area belong to 40-49 years age group (32%) followed by 50-59 years (30%) and 30-39 years (26%) age group. In the peri-urban areas majority of the farmers belong to 30-39 years (35%) age group followed by 40-49 years (18%) and 50-59

years (17%) age group. This indicates that household respondents were younger in the rural area in comparison to peri-urban area within the age group of 30-49 years.

Table 4.1. Percentage distribution of sample respondents by age group

Age group (years)	Rural area	Peri-urban area	Both areas
19-29	10	16	26 (13)
30-39	26	35	61 (31)
40-49	32	18	50 (25)
50-59	30	17	47 (23)
60-80	2	14	16 (8)
All groups	100	100	200 (100)

Figures within parentheses indicate percentage
Source: Household survey, 2009

4.3 Education of the Households

The sample farmers are classified into four categories based on their education level. Table 4.2 indicates that 62% of the household heads are educated up to varying levels and the rest 38% had no education. Of the educated respondents, 32% had the education between classes VI-X followed by 54% between class I-V and 5% between classes XI-XII. Though the number of educated farmers was slightly higher in peri-urban area, distinct differences in education level between rural and peri-urban areas were not found.

Table 4.2 Percentage distribution of sample respondents according to education level

Education level	Rural area	Peri-urban area	Both areas
Illiterate	38	39	77 (38.5)
Primary (Class I-V)	29	25	54 (27.0)
Secondary (Class VI-X)	30	34	64 (32.0)
Higher secondary (Class XI-XII)	3	2	5 (2.5)
All	100	100	200 (100)

Figures within parentheses indicate percentage
Source: Household survey, 2009

4.4 Education of the Households Members

Table 4.3 indicates the distribution of family members (aged 6 years and above) by education. It further indicates that 36% of the families members in this group were illiterate and rest

64% were educated; however, percentage of education was higher in the case of male member (72%) than that of female household members (53%). It seems that family members were more educated in the rural area (59%) than this was in the peri-urban area (67%).

Table 4.3 Percentage distribution of education of the household members (six years and above)

Education level	Rural area			Peri-urban area			Both areas		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*	*Male*	*Female*	*Total*
Illiterate	53 (23)	93 (46)	146 (33)	78(34)	96 (49)	174 (41)	131 (28)	189 (47)	320 (37)
Primary	82 (35)	60 (29)	142 (32)	73(32)	60 (30)	133 (31)	155 (33)	120 (30)	275 (32)
Secondary	93 (39)	47 (23)	140 (32)	71(31)	38 (19)	109 (26)	164 (35)	85 (21)	249 (29)
H. Secondary	7 (3)	4 (2)	11 (3)	8 (3)	3 (2)	11 (3)	15 (3)	7 (2)	22 (3)
All	235 (100)	204 (100)	439 (100)	230 (100)	197 (100)	427 (100)	465 (100)	401 (100)	866 (100)

Figures within parentheses indicate percentage
Source: Household survey, 2009

4. 5 Family Size

It was found that family size per household was 4.56 and the household working members and dependent members were 2.18 and 2.69 respectively. In the rural areas, family size, working members and dependent members were 4.85%, 2.58% and 2.45% respectively and in peri-urban area these were 4.27%, 1.79% and 2.91% respectively. This indicates that higher the family size higher were the working members. (Table 4.4)

Table 4.4 Average family size and dependency ratio

Particulars	Rural area	Peri-urban area	Both areas
Family size (No/household)	4.85	4.27	4.56
Working member (No/ household)	2.58	1.79	2.18
Dependent member (No/ household)	2.45	2.91	2.69
Dependency ratio	1.05	1.63	1.23

Source: Household Survey, 2009

4.6 Male-female Ratio of the Household Members

The highest percentage (24%) of tribal household members' belonged to under 10 age group followed 10-18 years age group (21%), 19-29 years age group (18%), 30-39 years age group (13%), 40-49 years age group (10%), 50-59 years age group (7%), 60-80 age group (6%). It was found that age group and the number of family members were inversely related, in that

higher the age group, lower was the number of family members. Regarding sex, number of male members was found to be higher (17%) than the female members. Distribution pattern of the peri-urban area followed a similar pattern of distribution, but there was one exception in the case of rural area where more family members were in the age group of 10-18 years than the age group of less than 10 years. Female members were also found higher in both rural and peri-urban areas (Table 4.5).

Table 4.5 Percentage distribution of family members by age and sex

Age group	Rural area			Peri-urban area			Both areas		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*	*Male*	*Female*	*Total*
Under10	56 (21)	43 (19)	99 (20)	55 (24)	68 (35)	123 (29)	111 (24)	111 (35)	222 (24)
10-18	59 (22)	42 (19)	101 (21)	53 (23)	34 (17)	87 (20)	112 (23)	76 (17)	188 (21)
19-29	47 (18)	51 (23)	98 (20)	31 (13)	36 (18)	67 (16)	78 (13)	87 (18)	165 (18)
30-39	32 (12)	31 (14)	63 (13)	35 (15)	24 (12)	59 (14)	67 (15)	55 (12)	122 (13)
40-49	31 (12)	27 (12)	58 (12)	18 (8)	14 (7)	32 (7)	49 (8)	41 (7)	90 (10)
50-59	18 (7)	16 (7)	34 (7)	21 (9)	13 (7)	34 (8)	39 (9)	29 (7)	68 (7)
60-80	20 (8)	12 (6)	32 (7)	17 (7)	8 (4)	25 (6)	37 (7)	20 (4)	57 (6)
All	263 (100)	222 (100)	485 (100)	230 (100)	197 (100)	427 (100)	493 (100)	419 (100)	912 (100)

Figures within parentheses indicate percentage
Source: Household survey, 2009

4.7 Occupational Status

In the study area occupational status of the households were found to be diverse. The main sources of occupation of the respondents ranged from agriculture, service, wage labour, business and driving (Table 4.6).

Table 4.6 Occupational status of the household heads

Occupation type	% engaged
Agriculture	62.0
Wage labour	11.5
Driving	4.0
Service	6.0
Business	16.5

Source: Household Survey, 2009

4.8 Livelihood Standard

Livelihood standards were measured by indicators such as: use of sanitary latrine, drinking of tube well water, use of electricity, buying ability, adoption of contraceptive measures, opportunity for medical facilities, schooling of children, and participation in cooperative society. Higher the users of these facilities higher were their standard of living. Table 4.7 shows that more than half of the households had sanitary latrine facilities (69%), tube well as the source of drinking water (53%), provision of clothes for their family (93%) and relatives during festivals (88%), adopted contraceptive measures (72%), visited the doctor during sickness (98%), sent children to school (74%) and had a kitchen attached to the bedroom (59%). In general, peri-urban households had a higher standard of living as higher percentage of households used sanitary latrine (50% higher), tube well (40% higher), electricity (15% higher), purchased new clothes during religious festivals (13% higher), sent children to school (5% higher) and participated in cooperative society (35%) as compared to rural households. There were not considerable differences in other living standards like offering gifts to relatives during social events, visiting doctors during sickness and having attached kitchen with bedroom. However, rural households showed a better response in adopting contraceptive measures (10% over peri-urban households).

Table 4.7 Livelihood standard of the households

Livelihood standard indicator	% responses		
	Rural area	Peri-urban area	Both areas
Sample size	*100*	*100*	*200*
1. Using sanitary latrine	44	94	69
2. Drinking of tube well water	33	73	53
3. Using electricity	26	31	29
4.Buying new clothes during religious festivals	86	99	93
5. Offering gifts to relatives during various social events	88	87	88
6. Adopting contraceptive measure	76	67	72
7. Visiting doctors during sickness	98	98	98
• Qualified medical practitioners (MBBS)	89	86	88
• Village quack/others	11	14	13
8. Sending children to school	71	76	74
9. Membership in cooperative society	11	46	29
10. Attachment of kitchen with bedroom	59	58	59

4. 9 Farm Size, Tenure Status and Land Use

Table 4.8 indicates farm size, tenure status and land use pattern of the household. Households had both hilly land and plain land under their occupation. Hilly land includes cultivable area, homestead area and garden. Plain land includes cultivable land, homestead area, garden and pond. It also indicates that size of the hilly land and plain land under household occupation was 0.88 ha and 0.28 respectively. Therefore, farm size per household was 1.16 ha. Rural households had higher amount of both hilly and plain land. Rural households had 1.18 ha of hilly land and 0.41 ha of plain land while peri-urban households had 0.58 ha of hilly land and only 0.16 ha of plain land. Thus farm size (1.59 ha/household) in rural areas was more than double than that (0.74 ha/household) in the peri-urban area. The land right of the hilly areas of the households was, however, not well defined. Therefore, they felt unsecured and they could not plan in their own way practicing hill cultivation due to complicated transit rules. However, households reported to have their ownership right on plain land. The land tenure system in the plain land was found similar to the other areas of Bangladesh.

Table 4.8 Farm size of the households in hilly and plain lands

Type of land	Rural	Peri-urban	Both area
Sample size	*100*	*100*	*200*
1. Hilly land (ha)	1.18	0.58	0.88
a. Cultivable land (ha)	188.55	56.79	122.67
b. Homestead (decimal)	51.01	34.75	42.88
c. Garden (decimal)	52.55	52.30	52.43
2. Plain land (ha)	0.41	0.16	0.28
a. Own land (decimal)	87.33	32.95	60.14
b. Rented in (decimal)	9.40	14.33	11.87
c. Rented out (decimal)	11.60	12.30	11.95
d. Mortgaged in (decimal)	5.50	3.60	4.55
e. Mortgaged out (decimal)	2.53	1.90	2.22
f. Homestead (decimal)	5.72	2.40	4.06
g. Garden (decimal)	2.50	0.52	1.51
h. Pond (decimal)	3.92	-	1.96
Farm size (decimal/household)	392.35	183.44	287.90
Farm size (ha/household)(1+2)	1.59	0.74	1.16

Note: Farm size for plain land = (a + b + d + f + g- c - e)

The rural households owned much plain land (63% higher) over peri-urban households. The peri-urban households was found to have more rented in land probably for compensating the shortfall of plain land of their own.

4.10 Housing for Man and Animals

Table 4.9 presents the housing status of the hill people. Their housing condition was found to be very poor. They owned either katcha-pacca or katcha house and katcha kitchen only. Some of them have a common shed to keep cows, pigs and goat, and a separate poultry shed. The value of the katcha-pacca dwelling was Taka 51070 and that of katcha was Tk. 5099. Total value of the housing assets was calculated as Taka 65325 per household. That in the rural and peri-urban area were Taka 62075 and Taka 68574 respectively constituting 10% higher over rural area. The reason was that the houses found in the rural areas were mostly made of low-cost materials such as bamboo, straw, jute stick, etc. As the rural households owned higher number of livestock and poultry resources, they spent more on cow/pig/poultry shed than the peri-urban areas.

Table 4.9 Housing status of indigenous people

House type	Rural		Peri-urban		Both area	
	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)
1.Dwelling house						
• Katcha-pacca	0.70	44860	0.59	57280	0.65	51070
• Katcha	0.36	5458	0.45	4740	0.41	5099
2. Kitchen						
• Katcha-pacca	0.14	5050	0.06	2650	0.10	3850
• Katcha	0.56	4612	0.57	2985	0.57	3799
3. Cow/pig shed	0.35	1290	0.31	608	0.33	949
4. Poultry shed	0.62	805	0.34	311	0.48	558
Total	2.73	62075	2.32	68574	2.54	65325

(a) Katcha-pucca = House wall made of bamboo/straw/mud and tin shaded roof.
(b) Katcha = House wall made of bamboo/straw/mud and roof made of straw.

4.11 Livestock and Poultry Resources

Sample households owned cow, calf, pig, goat and chicken. The value of the livestock and poultry resources was calculated as Tk. 21504. The value of the resources in rural area was

Tk. 24747 and those in the peri-urban area were Tk.18258. This means that value of poultry and livestock resources in rural area is 26% higher than peri-urban area (Table 4.10).

Table 4.10 Ownership of livestock and poultry by study households

Livestock and poultry	Rural		Peri-urban		Both area	
	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)
Sample size	*100*	*100*	*100*	*100*	*200*	*200*
Bull	0.56	9810	0.27	4700	0.42	7255
Cow	0.52	6855	0.48	6352	0.50	6604
Calf	0.41	2820	0.45	3445	0.43	3133
Pig	0.44	1390	0.46	1279	0.45	1335
Goat	1.70	2518	1.53	1860	1.62	2189
Chicken	10.24	1354	5.31	622	7.78	988
All types	13.87	24747	8.50	18258	11.20	21504

Source: Household Survey, 2009

4.12 Agricultural Implements

The households generally used traditional farm implements. The most common implements were wooden plough, wooden ladder, spade, axe, chopper, hand weeder, sickle, and sprayer. The value of the implements per household was Taka 1410.50 The value was higher in the rural area (Tk 1800.90) than that of the peri-urban area (Tk 1020.30). It was nearly double in the rural area indicating higher agricultural activities in this area (Table 4.11).

Table 4.11 Ownership of agricultural implements by study households

Agricultural implements	Rural		Peri-urban		Both area	
	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)
Sample size	*100*	*100*	*100*	*100*	*200*	*200*
Wooden plough	0.92	269.6	0.16	36.2	0.54	152.9
Wooden ladder	0.68	104.0	0.18	26.7	0.43	65.4
Spade	1.57	350.4	1.24	220.5	1.41	285.4
Axe	1.07	245.8	0.81	153.4	0.94	199.6
Chopper	2.88	461.5	2.44	341.7	2.66	401.6
Hand weeder	0.18	10.8	0.19	4.7	0.19	7.7
Sickle	2.93	67.5	1.66	32.9	2.29	50.2
Sprayer	0.06	49.5	0.03	48.0	0.05	48.8
Other	0.72	241.8	0.43	156.2	0.57	198.9
All types	11.01	1800.9	7.14	1020.3	9.08	1410.5

Source: Household Survey, 2009

4. 13 Furniture

Households of the study location generally used bedstead, cot, almirah, dressing table, wooden table, wooden chair, wooden bench, *Ulna* (wooden hanger for cloths), trunk, box and wooden tools. On an average they had 7 pieces of furniture and the average value of the furniture at the present price was calculated as Taka 7895.70. The value of the furniture was 24% higher in the peri-urban area as compared to rural area (Table 4.12).

4 .14 Modern Amenities

Some modern amenities like mobile phone, television, cassette player, bicycle, radio, and sewing machine were used. Other items such as wrist watch, table clock, torch light, and charges light were also used by the respondents. Table 4.13 indicates that the above items were not within the reach of most of the households. The value of the amenities calculated on current price was Tk. 4481.10 and the value of modern amenities in peri-urban area was 13% higher than rural area.

Table 4.12 Household furniture owned by the study households

Type of furniture	Rural		Peri-urban		Both area	
	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)
Sample size	*100*	*100*	*100*	*100*	*200*	*200*
Bedstead *(Khat)*	1.15	3016.0	1.37	4072.0	1.26	3544.0
Cot	0.52	709.0	0.59	624.0	0.56	666.5
Almirah	0.18	511.0	0.29	1198.0	0.23	854.5
Dressing table	0.11	267.0	0.11	274.0	0.11	270.5
Table	0.75	425.0	1.06	631.3	0.90	528.2
Wooden chair	1.93	592.0	2.45	670.8	2.19	631.4
Wooden bench	0.43	174.0	0.17	67.5	0.30	120.8
Ulna	0.36	303.5	0.76	650.0	0.56	476.8
Trunk/Box	0.80	403.5	0.27	103.4	0.53	253.5
Wooden tool	0.44	87.5	0.25	37.4	0.35	62.5
Others	0.20	192.8	0.43	781.2	0.32	487.0
All types	6.87	6681.3	7.75	9109.6	7.31	7895.7

Source: Household Survey, 2009

Table 4.13 Modern amenities owned by the study households

Type of amenities	Rural		Peri-urban		Both area	
	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)
Sample size	*100*	*100*	*100*	*100*	*200*	*200*
Mobile phone	0.14	559.0	0.44	1576.0	0.29	1067.5
Television	0.13	1013.0	0.21	1583.8	0.17	1298.4
Cassette player	0.16	577.0	0.18	337.5	0.17	457.3
Bicycle	0.17	609.0	0.12	395.0	0.14	502.0
Radio	0.14	85.7	0.03	9.5	0.09	47.6
Sewing machine	0.13	737.0	0.11	441.0	0.12	589.0
Wrist watch	0.66	189.8	0.54	137.7	0.60	163.8
T able clock	0.47	120.3	0.43	117.3	0.45	118.8
Torch light	1.28	192.5	0.72	100.2	1.00	146.3
Charge light	0.16	81.3	0.20	99.4	0.18	90.4
All types	3.44	4164.6	2.98	4797.4	3.21	4481.1

Source: Household Survey, 2009

4.15 Utensils and Other Household Goods

Goods mentioned in this section are very essential and necessary items used daily. Items like cooking pot, plate, glass, metallic dish, pitcher, mat, kantha, quilt, woolen blanket, and pillow fall under this category. Table 4.14 shows that almost all the households (with little exception) owned these articles. The value calculated on current price for these items was Tk 6735.85. However, rural households spent much on these articles than peri-urban households.

Table 4.14 Utensils and other necessary goods owned by the households

Utensils	Rural		Peri-urban		Both area	
	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)	Quantity (No)	Price (Tk)
Sample size	*100*	*100*	*100*	*100*	*200*	*200*
Cooking pot	9.32	1703.40	9.85	1586.30	9.59	1644.85
Plate	13.14	920.60	12.36	821.40	12.75	871.00
Glass	8.90	264.19	11.29	398.55	10.10	331.37
Metallic dish	1.77	473.50	1.82	297.45	1.79	385.48
Pitcher	1.99	407.60	1.90	410.20	1.95	408.90
Mat	3.38	629.60	2.60	418.80	2.99	524.20
Kantha	0.05	9.00	0.62	180.20	0.34	94.60
Quilt	3.11	1372.00	2.39	984.00	2.75	1178.00
Woolen blanket	2.19	721.50	1.68	427.50	1.94	574.50
Pillow	6.02	552.30	5.28	468.10	5.65	510.20
Others	1.07	302.50	0.33	123.00	0.70	212.75
All types	50.94	7356.19	50.12	6115.50	50.55	6735.85

Source: Household Survey, 2009

4. 16 Forest Resources

Apart from crops, most indigenous households had forest and fruit trees. The major forest trees were *Segun* (tic), *Koroi, Gamari, Mehogony, Goda,* and *Jata boroi*. Mango, jackfruit, blackberry, litchi, pomelo, jujube, tamarind, banana, and papaya were the fruit trees. The present value of the forest trees was Tk. 52574 and that of the fruit trees was Tk. 9795. The *Segun* tree alone constituted the highest value (77%) of forest tree followed by *Gamari* (15%) and *Koroi* (5%). In the case of fruit tree jackfruit and mango were found to be very common constituting the highest (48%) and second highest value (29%) respectively among fruit trees. The rural households were found richer than the peri-urban households in forest resources. The former had the 65% higher value of forest resources than the later. In contrary, peri-urban households had the higher value of their fruit trees mainly because of the higher concentration of jackfruits in the peri-urban area (Table 4.15).

Table 4.15 Average number of forest and fruit trees per household in the study area

Name of tree	Rural area			Peri-urban area			Both areas		
	No. of adult tree	Present value(Tk)	No. of sapling	No. of adult tree	Present value(Tk)	No. of sapling	No. of adult tree	Present value (Tk)	No. of sapling
A. Forest tree									
1. Sagun	28.74	64540	429.32	20.68	16402	300.26	24.71	40471	364.79
2. Koroi	3.05	4049	2.87	1.37	1536	32.32	2.21	2793	17.60
3. Gamari	14.88	11036	918.51	11.87	5071	14.77	13.38	8054	466.64
4. Mehoguni	0.03	45	0.02	0.68	306	5.23	0.36	176	2.63
5. Goda	0.61	773	0.29	0.77	504	3.22	0.69	638	1.76
6. Jata boroi	0.42	269	1.14	0.73	615	12.46	0.57	442	6.80
All forest	47.73	80712	1352.15	36.1	24434	368.26	41.92	52574	860.22
B. Fruit tree									
1. Mango	3.49	3521	2.67	2.49	2250	171.72	2.99	2886	87.20
2. Jackfruit	3.28	3440	30.78	4.89	5957	17.28	4.08	4699	24.03
3. Blackberry	0.82	898	0.71	0.60	549	1.03	0.71	724	0.87
4. Litchi	0.53	224	0.89	0.84	393	4.09	0.68	308	2.49
5. Pomelo	1.70	485	1.02	0.29	104	5.15	1.00	295	3.09
7. Jujube	1.06	440	0.55	0.60	281	2.51	0.83	360	1.53
6. Tamarind	0.05	95	0.05	0.43	551	15.21	0.24	323	7.63
8. Banana	157.07	-	65.45	49.97	-	4.51	103.52	-	34.98
9. Papaya	1.73	-	0.52	1.52	-	0.74	1.63	-	0.63
10. Other fruits	1.11	223	0.29	.31	177	0.24	0.71	200	0.27
All fruits	170.84	9326	102.93	61.94	10262	222.48	116.39	9795	162.72

Source: Household Survey, 2009

On the whole, the socio-economic profiles reveal that most of the sample respondents and their family members were illiterate. About three members per household were dependent on

others' income. Agriculture and services were the dominant occupation of rural and peri-urban households, respectively. They cultivated 0.88 ha of upland and 0.28 ha of plain land. They used primitive agricultural implements for cultivation. Most households owned a house in which they resided, an average number of 1.39 cows, 2.07 pigs/goats, and 8 chickens. Some households owned modern amenities like mobile phone and TV. They had a good number of timber and fruit trees. All these assets made their overall livelihood standard reasonable to some extent.

Chapter V

ECONOMICS OF *JHUM* AND PLAIN LAND CULTIVATION

Two main types of land that include upland and plain land existed in the study areas. Land use system and its potential use play crucial role in ensuring household level food security. This section deals with the land use pattern, profitability of crop production under shifting (*Jhum*) and plain land cultivation, and problems associated with *Jhum* cultivation.

5.1 Land Use Pattern in the Study Area

The total area of Khagrachari Sadar and Dighinala Upazil are 28,984 ha and 69,413 ha respectively. In Sadar Upazila, forest coverage, cultivated area and other areas occupying 26.2, 44.4 and 29.4%, respectively. On the other hand, the major share of the total area is under forest coverage in Dighinala Upazila. The amount of cultivable area is only 17.8%. The cropping intensity in Sadar Upazila was estimated at 159% in 2008-2009, whereas it was 152% in Dighinala Upazila (Table 5.1).

Table 5.1 Land use pattern in Sadar and Dighinala *Upazila* of Khagrachari district

	Sadar, 2008-09		Dighinala, 2005-06	
	Area (ha)	Percent	Area (ha)	Percent
A. Total area (ha)	28984	100	69413	100
1. Forest area	7582	26.2	56170	80.9
2. Cultivable land	12868	44.4	12359	17.8
a. Single cropped	6205	21.4	6840	9.9
b. Double cropped	5720	19.7	3840	5.5
c. Triple cropped	943	3.3	1679	2.4
3. Fallow land	6665	23.0	300	0.4
4. Homestead, pond and others	1869	6.4	584	0.9
B. Total cropped area (ha)	20474	-	19557	-
C. Horticultural crops (ha)	1950	-	2085	-
D. Cropping intensity (%)	159	-	152	-
Land use (season wise)				
Kharif-1	1891	14.7	3242	26.2
Kharif-2	3750	29.2	4850	39.3
Rabi	3387	26.3	3372	27.3
Year round	3840	29.8	895	7.2

Source: DAE Office, Khagrachari, 2009

Season wise land use pattern implies that the highest amount of land was devoted to year-round crop production followed by *Kharif-2* and *Rabi* crop production in Sadar *Upazila*. On the other hand, the lowest amount of land (7.2% of the total land) was used for year-round crop production in Dighinala *Upazila*. The highest share of the total land was occupied for the cultivation of various crops under *Kharif-2* season (Table 5.1).

5.2 Crop Production Under *Jhum* Cultivation

In the study areas, a type of shifting cultivation locally called *Jhum* has been practised for many hundreds of years. In the past, *Jhum* was practised with a fallow period of 15 to 20 years. This ensured the long-term sustainability of soil fertility. However, due to rapid growth in local populations, this fallow period has been reduced to between three and four years. Under *Jhum* cultivation, vegetation is slashed and burnt between January and May and crops are then planted. These are harvested between June and December. *Jhum* lands were mainly used for the production of forest tree, fruit tree and seasonal crops. The forest trees include *Segun, Koroi, Gamari, Mehogony, Goda, and Jata boroi*. The major fruit trees were mango, jackfruit, blackberry, litchi, pomelo, jujube, tamarind, banana, and papaya. The seasonal crops include rice, maize, sesame, turmeric, ginger, chili, *Sinel* (spice), potato, arum, brinjal, country bean, okra, sweet gourd (yellow pumpkin), white gourd, ridge gourd, yard long bean, *Mia sak* (leafy vegetable), *Marfa* (cucumber) and *Simul alu* (cassava).

Data shown in Table 5.2 reveals that a sample farmer used on an average 0.19 ha of hilly land for cultivating various crops under *Jhum* cultivation. The average cultivated hilly land was higher in rural areas compared to peri-urban areas. The reason behind this higher use is that rural people live in hilly areas and their livelihood mostly depends on the hills. Most important food and cash crops among different crops were local rice and turmeric respectively. Other important and commonly grown crops were *Marfa*, ginger, brinjal and cassava.

Table 5.2 Annual crop production of the households from *Jhum* cultivation

(Figures in kg/farm)

Particulars	Rural area	Peri-urban area	Both areas
Cultivated area (ha)	*0.30*	*0.07*	*0.19*
1. Paddy	229.30	65.10	147.20
2. Maize	10.04	4.75	7.40
3. Sesame	11.64	2.88	7.26
4. Turmeric	329.05	95.70	212.37
5. Ginger	73.90	5.60	39.75
6. Chili	14.44	0.83	7.64
7. Sabarang (spice)	2.37	-	1.18
8. Potato	5.50	-	2.75
9. Arum	12.54	1.15	6.84
10. Brinjal	24.62	1.30	12.96
11. Country bean	7.66	1.77	4.72
12. Okra	4.63	-	2.32
13. Sweet gourd	9.39	0.42	4.903
14. White gourd	7.63	-	3.82
15. Ridge gourd	1.51	0.53	1.02
16. Yard long bean	4.25	1.80	3.02
17. Miasak (leafy veg.)	3.64	-	1.82
17. Marfa (cucumber)	61.75	14.30	38.03
19. Cassava	21.43	4.00	12.72
Total production	835.29	200.13	517.723

Source: Household Survey, 2009

5.3 Crop Production in Plain Land

In plain land *T. Aman* and *Boro rice* were the most commonly grown crops. Other crops of plain land were found to be potato, tomato, brinjal, chili, radish, mustard and cabbage. Table 5.3 shows that a sample household cultivated on an average 0.304 ha of plain land for cultivating rice and other crops. The amount of cultivated plain land for cultivating rice was much higher in rural areas than that of peri-urban areas.

5.4 Crop Production in Homestead Area

Homestead areas were found to be properly utilized by the sample household in the study areas. They were found to grow country bean, bottle gourd, brinjal (egg plant), ginger, potato, maize, snake gourd, ridge gourd, white gourd, bitter gourd, yellow pumpkin, arum, radish, tomato, chili, bean, red amaranth, Indian spinach, okra, cucumber, turmeric and many other crops in their homestead on a small-scale. Banana, papaya and different timber trees were also planted in the homestead areas. A sample household used on an average 0.077 ha of

homestead for cultivating different types of vegetables. The amount of cultivated homestead for cultivating vegetables was higher in rural areas than that of peri-urban areas (Table 5.4).

Table 5.3 Annual household production of rice and other crops in plain land

Cost and returns	Plain land crops			Total
	T. Aman rice	Boro rice	Other crops	
A. Rural area				
Plot size (ha/farm)	0.295	0.105	0.018	0.401
Production (kg/farm)	1077	459	67	1603
B. Peri-urban area				
Plot size (ha/farm)	0.170	0.009	0.013	0.191
Production (kg/farm)	651.6	48	31	731
C. Both areas				
Plot size (ha/farm)	0.232	0.057	0.015	0.304
Production (kg/farm)	864	253	49	1166

Table 5.4 Annual household productions of vegetables in the homestead areas

Vegetable's name	Rural area	Peri-urban area	Both areas
Homestead area (ha)	*0.087*	*0.068*	*0.077*
Vegetable production (kg)			
1. Country bean	11.97	7.22	9.60
2. Bottle gourd (No.)	10.39	5.70	8.05
3. Eggplant	9.90	9.58	9.74
4. Ginger	5.70	12.52	9.11
5. Other crops & vegetables*	28.53	17.23	22.88
All vegetables	66.49	52.25	59.38

*****Other crops and vegetables include potato, maize, snake gourd, ridge gourd, white gourd, bitter gourd, pumpkin, arum, radish, tomato, chili, bean, red amaranth, indian spinach, okra, cucumber, turmeric, etc.

5.5 Profitability of *Jhum* Cultivation

Table 5.5 shows the annual cost incurred, quantity produced, gross return, gross margin and gross margin excluding labour cost per farm of various crops and vegetables in rural and peri-urban areas in the sample hillocks from *Jhum* cultivation. The costs and return on per ha basis were shown in Appendix Table 1. The household size of the farm was 0.19 ha. The size of the farm in rural area was comparatively bigger in rural (0.30 ha) area than in the peri-urban area (0.07 ha).

The cost of cultivation per farm was calculated as Tk 5609. The highest cost of cultivation was incurred for labour (78%) followed by seed (22%) and fertilizer. The average cost of

cultivation in rural areas was Tk. 9034 and in peri-urban areas it was Tk.2184. The reason for higher costs incurred in rural area was higher farm size.

Table 5.5 Annual household incomes from *Jhum* cultivation

(Figures in Tk/farm)

Particulars	Rural area	Peri-urban area	Both areas
Cultivated area (ha)	*0.304*	*0.071*	*0.188*
A. Cost of production			
1. Labour	6965 (77.10)	1760 (80.59)	4363 (77.78)
2. Seed	2040 (22.58)	420 (19.23)	1230 (21.93)
3. Fertilizer	29 (0.32)	4 (0.18)	16 (0.29)
Total cost	**9034 (100)**	**2184 (100)**	**5609 (100)**
B. Gross return			
1. Paddy	3226 (23.5)	905 (31.5)	2065.5 (24.9)
2. Maize	117 (0.9)	55 (1.9)	86 (1.0)
3. Sesame	529 (3.9)	135 (4.7)	332 (4.0)
4. Turmeric	4159 (30.3)	1166 (40.8)	2662.5 (32.1)
5. Ginger	2898 (21.1)	196 (6.9)	1547 (18.6)
6. Chili	429 (3.1)	30 (1.0)	229.5 (2.8)
7. Sabarang (spice)	69 (0.5)	-	34.5 (0.4)
8. Potato	73 (0.5)	-	36.5 (0.4)
9. Arum	160 (1.2)	12 (0.4)	86 (1.0)
10. Brinjal	404 (2.9)	17 (0.6)	210.5 (2.5)
11. Country bean	100 (0.7)	20 (0.7)	60 (0.7)
12. Okra	89 (0.6)	-	44.5 (0.5)
13. Sweet gourd	120 (0.9)	5 (0.2)	62.5 (0.8)
14. White gourd	64 (0.5)	-	32 (0.4)
15. Ridge gourd	19 (0.1)	8 (0.3)	13.5 (0.2)
16. Yard long bean	78 (0.6)	43 (1.5)	60.5 (0.7)
17. Miasak (leafy veg)	45 (0.3)	-	22.5 (0.3)
17. Marfa (cucumber)	926 (6.7)	228 (8.0)	577 (7.0)
19. Cassava	235 (1.7)	40 (1.4)	137.5 (1.7)
Gross return	**13740 (100)**	**2860 (100)**	**8300 (100)**
C. Gross margin(B-A)	4706	676	2691
D. Gross margin excluding labour cost	11671	2436	7053.5

Figure within parentheses are percentage of total

Average sale prices (Tk/kg): Paddy = 5.92; maize = 12.35; Sesame = 45.79; Ginger = 40.33; Turmeric = 12.57; Chili = 30.39; Sabarang = 29.60; Simul alu = 11.40; Marfa = 15.10; Arum = 12.62; Potato = 15.80, Brinjal = 16.31; Country bean = 13.91; Okra = 20.08; Pumpkin = 13.19; White gourd = 10.17; ridge gourd 17.71; Miasak = 12.45; Yardlong bean= 19.33.

The annual gross return per household from *Jhum* cultivation was calculated as Tk.8300. The annual gross returns per household in the rural and peri-urban areas were Tk 13740 and Tk 2860 respectively. The highest income came from turmeric cultivation (32.1%) followed by paddy (24.9%), ginger (18.6%) and *Marfa* (7.0%). The similar trend of incomes received from the aforesaid crops was observed in rural and peri-urban areas. Gross return per household was 71% higher in the rural area than in the peri-urban area. The annual gross margin per household from *Jhum* cultivation was calculated as Tk.2691. The annual gross margin per household in the rural and peri-urban areas was Tk. 4706 and Tk. 676 respectively. Gross margin per household was 76% higher in the rural area than in the peri-urban area.

5.6 Profitability of Plain Land Cultivation

Table 5.6 shows the annual cost incurred, quantity produced, gross return and gross margin per farm of various crops and vegetables in rural and peri-urban areas in the plain land cultivation. The costs and return on per ha basis were shown in Appendix Table 2. The household size of the farm was 0.42 ha. The size of the farm in rural area was comparatively bigger in rural (0.30 ha) area than the peri-urban area (0.11 ha).

It shows that like *Jhum* cultivation their cultivation costs were incurred for labour, seed and fertilizers only. The costs of cultivation per farm were calculated as Tk.4996. The cost of cultivation in rural area was Tk. 6652 and in peri-urban area it was Tk.3338. The reason for higher costs incurred in rural area was higher farm size as was in the case of *Jhum* land cultivation. The annual gross return per household from plain land cultivation was calculated as Tk.16776.

The annual gross return per household in the rural and peri-urban areas were Taka 22632 and Taka 10919 respectively. Gross return per household was 62% higher in the rural area than the peri-urban area. The annual gross margin per household from plain land cultivation was calculated as Tk.11780. The annual gross margin per household in the rural and peri-urban areas was Tk.15980 and Tk.11780 respectively. Gross margin per household was 23% higher in the rural area compared to peri-urban area.

5.7 Profitability of Homestead Vegetable Cultivation

Table 5.7 shows the household costs of and return from homestead vegetable production. The gross margin per household from homestead vegetable production was Tk.1201. In the rural and peri-urban areas the gross margins were Taka 1230 and Tk. 1172 respectively. This indicates that gross margin per household was 6% higher in the rural area than this was in the peri-urban area. Unlike plain land and *Jhum* cultivation, the difference of gross margin per household between rural and urban areas was marginal because farm size per household was only 22% higher in the rural area in comparison to peri-urban areas.

Table 5.6 Annual household incomes from plain land crop cultivation

(Figures in Tk/farm)

Cost and returns	Plain land crops			Total
	T. Aman rice	Boro rice	Other crops	
A. Rural area				
Plot size (ha/farm)	0.295	0.105	0.018	0.401
Labour cost	3074	1180	308	4562
Seed cost	611	149	170	930
Fertilizer cost	790	281	89	1160
Total variable cost	4475	1610	567	6652
Yield (kg/farm)	1077	459	67	1603
Gross return	15245	6500	887	22632
Gross margin	10770	4890	320	15980
B. Peri-urban area				
Plot size (ha/farm)	0.170	0.009	0.013	0.191
Labour cost	1975	90	122	2187
Seed cost	330	17	288	635
Fertilizer cost	477	14	25	516
Total variable cost	2782	121	435	3338
Yield (kg/farm)	651.6	48	31	731
Gross return	9366	720	833	10919
Gross margin	6584	599	398	7581
C. Both areas				
Plot size (ha/farm)	0.232	0.057	0.015	0.304
Labour cost	2525	635	215	3375
Seed cost	471	83	229	783
Fertilizer cost	633	148	57	838
Total variable cost	3629	866	501	4996
Yield (kg/farm)	864	253	49	1166
Gross return	12306	3610	860	16776
Gross margin	8677	2744	359	11780

(i) Average crop prices (Tk/kg): T.Aman rice = 14.20; Boro rice = 14.18, Other crops = 21.11

(ii) Other crops: Potato, tomato, brinjal, chili, radish, mustard, cabbage, etc.

Table 5.7 Annual household income from homestead vegetable cultivation

Vegetable's name	Rural area		Peri-urban area		Both areas	
	Production (kg/farm)	Gross margin (Tk/farm)	Production (kg/farm)	Gross margin (Tk/farm)	Production (kg/farm)	Gross margin (Tk/farm)
Homestead area (ha)	*0.087*		*0.068*		*0.077*	
1. Country bean	11.97	161.54	7.22	87.18	9.60	124.36
2. Bottle gourd	10.39	146.78	5.70	108.35	8.05	127.56
3. Eggplant	9.90	159.10	9.58	151.70	9.74	155.40
4. Ginger	5.70	228.00	12.52	571.70	9.11	399.85
5. Other crops & veg.	28.53	534.46	17.23	252.73	22.88	393.60
All vegetables	66.49	1229.88	52.25	1171.66	59.38	1200.77

Average crop prices (Tk/kg): Country bean = 13.22; Bottle gourd = 16.94; Eggplant = 16.31; Ginger=46.00; Other crops and vegetables = 17.90

5.8 Problems of *Jhum* Cultivation

It is already mentioned that *Jhum* cultivation is the main means of livelihoods of the indigenous people. Therefore, unsustainable use of hilly lands makes hilly people more food insecure in the near future (Miah and Islam, 2007). The sample households encountered several problems relating to *Jhum* cultivation. These problems were loss of bio-diversity (63% of the households responded), low prices of output (47%), scarcity of cultivable hillocks (39%), hardness of soil due to burn (32%), distant location of hillocks (29%), scarcity of inputs (16%), quarrel among villagers for hillocks, distant locations of inputs, and accident due to burn of vegetation (21%). Though all the rural and peri-urban households had common problems, the intensity of their responses varied between them (Table 5.8).

Table 5.8 Problems associated with shifting cultivation in the study areas

Type of food	% responses		
	Rural area	Peri-urban area	Both areas
Sample size	*65*	*25*	*90*
1. Loss of biodiversity	67.7	52	63.3
2. Decreasing productivity of crops	61.5	56	60.0
3. Crop damage by rate/wild animals	46.2	36	43.3
4. Low prices of output	52.3	32	46.7
5. Scarcity of cultivable hillocks	29.2	64	38.9
6. Hardening of soil due to burn	32.3	32	32.2
7. Distant location of hillocks	27.7	32	28.9
8. Scarcity of inputs	16.9	12	15.6
9. Others	18.5	28	21.1

Note: Other problems included quarrel among villagers for hillocks, travelling long distances for inputs and accident due to burns.

Many scientists have also focused on the negative impacts of shifting cultivation such as land degradation, nutrient depletion, nutrients imbalance, soil erosion, deforestation, declining crop productivity in their studies (Ewel *et al.,* 1981*;* Kyuma *et al.*, 1985; Folster, 1986; Andriesse *et al.*, 1987; Ramakrishnam, 1992; Sanchez, 1995; Al-Kaisi, 2001). Hill farmers reportably face a bleak future.

The above discussion reveals that forest coverage and hill areas were much higher in rural areas compared to peri-urban areas. The rural people largely depended on upland cultivation. Rural households cultivated more on plain lands than that of peri-urban households. Therefore, the income of rural households from plain land was much higher (77%) than uplands. However, this may be not be the case in the real situation. The findings also revealed that the hill farmers were facing challenges because their traditional *Jhum* agriculture was becoming increasingly unsustainable. They had to farm more intensively and this was causing a host of environmental and social problems. The *Jhum* crops were also being damaged by wild animals. Therefore, their food security was being threatened by all these factors.

Chapter VI

HOUSEHOLD INCOME, EXPENDITURE AND SAVINGS

The household income, expenditure and savings of the sample households play an important role in attaining household level food security in the study areas. This section discusses the sources of household income, nature of expenditures, savings and liability situation of the sample households.

6.1 Annual Income and Its Sources

The incomes of respondent household come from different sources. These sources were farm income, livestock income, non-farm income and incomes from selling bamboo, fire wood, timber, and sweeping materials (Table 6.1). Farm incomes include incomes from crop, vegetables and fruits produced in households homestead area, plain land area, hilly area under their occupation. Livestock income comprises of income from sale of cow, goat pig, chicken, and milk. The non-farm income comes from labour wage, service and petty business.

The annual income of the households was calculated at Tk. 78590. When an individual income was taken into consideration in ranking, income from plain land cultivation ranked first followed by income from service, wage earninings, hilly land, petty business, fruit sale, cow/goat sale, firewood sale, and timber sale. The annual incomes in rural and peri-urban areas were Tk. 83231 and Tk.73942 respectively. The annual income was 11.2% higher in the rural area compared to peri-urban area. This arose because of much higher income received by the rural household from crop cultivation, livestock rearing, wage labour, and petty business. There was difference in the earning patterns between rural and peri-urban areas. Peri-urban household had 77.7% higher earnings from service sector in comparison to rural households whereas the former earned 37% lower income from wage labour than the latter. Besides, rural households earned much higher income from the sale of cow, goat, pig, and chicken and income from petty business than peri-urban households, while the former earned much lesser income from sale of milk, firewood, and timber (Table 6.1).

Table 6.1 Annual household incomes from different sources

Income source	Annual income (Tk/household)		
	Rural	Peri-urban	Both area
Sample size	*100*	*100*	*200*
1. Farm income	40913 (49)	18987 (26)	29951 (38)
Homestead	1083 (1)	1033 (1)	1058 (1)
Plain land	22631 (27)	10901 (15)	16766 (21)
Hilly land	12812 (16)	2631 (4)	7722 (10)
Fruit sale	4387 (5)	4422 (6)	4405 (6)
2. Livestock income	8003 (9)	4129 (6)	6068 (8)
Cow/goat sale	5315 (6)	2124 (3)	3720 (5)
Pig sale	1342 (2)	763 (1)	1053 (1)
Chicken sale	1049 (1)	486 (1)	768 (1)
Milk sale	297 (0)	756 (1)	527 (1)
3. Non-farm income	26769 (33)	37306 (50)	32037 (41)
Wage labour	13863 (17)	8736 (12)	11299 (14)
Service	5600 (7)	25110 (34)	15355 (20)
Petty business	7306 (9)	3460 (4)	5383 (7)
4. Other income	7546 (9)	13520 (18)	10534 (13)
Bamboo sale	590 (1)	1782 (2)	1186 (1)
Firewood sale	934 (1)	3659 (5)	2297 (3)
Timber sale	1158 (1)	1658 (2)	1408 (2)
Sweep materials (*Jharu*)	297 (0)	581 (1)	439 (0)
Other sources*	4567 (6)	5840 (8)	5204 (7)
Total income	83231 (100)	73942 (100)	78590 (100)

Figures within parentheses are percentages of total.

*Other income sources were govt. relief, land sale/mortgage, house rent, gift, sale of indigenous products, hiring out of power tiller, etc.

Table 6.2 shows the employment patterns of the household members in wage earning activities. The demand for day labourer was found to be fluctuating throughout the year due to variation in cropping pattern. The pattern of labour employment in both types of areas was found almost similar though the rural households could sale their labour more than peri-urban households round the year. On an average, a sample household could sale a total of 106 man-days of human labour per year. The number of annual labour sold by a rural household was much higher than that of peri-urban household. The highest demand for labour prevailed in the study areas from mid April to mid July because of higher labour

demand for shifting cultivation. Within these periods a sample household sold more than 12 man-days of human labour per month (Table 6.2).

Table 6.2 Average number of wage labour sold by a sample household

Month		Wage labour (Person-day/household/year)		
Bengali	English	Rural area	Peri-urban area	Both areas
Baisak	Mid April -Mid May	16.85	10.82	13.83
Jaysta	Mid May - Mid June	15.00	9.94	12.47
Asar	Mid June - Mid July	14.70	9.35	12.02
Srabon	Mid July -Mid August	11.78	8.02	9.90
Vadra	Mid Aug - Mid Sept.	14.96	7.14	11.05
Asshin	Mid Sept - Mid Oct	9.53	3.86	6.69
Kartik	Mid Oct.- Mid Nov	8.07	3.55	5.81
Augrahaon	Mid Nov.- Mid Dec	12.05	3.70	7.88
Poush	Mid Dec- Mid Jan	9.40	4.70	7.05
Magh	Mid Jan -Mid Feb	9.05	4.50	6.78
Falgun	Mid Feb - Mid March	9.07	2.88	5.97
Chaitra	Mid March – Mid April	8.16	4.42	6.29
Total		**138.62**	**72.88**	**105.74**

Source: Household Survey, 2009

6. 2 Household Expenditure

Table 6.3 shows the annual households expenditures for food and non-food items. The expenditures were crop production, food, clothes, medication, housing, children's education, social/religious functions, livestock rearing, chicken rearing, and expenditures from bidi, cigarettes, tobacco, betel leaf, and tea. Total expenditure was calculated as Tk. 70054 which was 14% higher than the total income. The income expenditure ratio was 0.97. The household expenditure of the respondent was higher in rural area (Tk. 75528) compared to peri-urban area (Tk. 64582). The income expenditure ratio in rural and urban area was 1.0 and 0.94 respectively. This means that in rural areas the income exceeded to some extent while in peri-urban area expenditure fell little short of income. It indicates that households of both urban and rural areas had expenditure commensurate with their income.

Table 6.3 Annual household expenditure of the respondent households

Expenditure head	Annual expenditure (Tk/household)		
	Rural	Peri-urban	Both area
Sample size	*100*	*100*	*200*
1. Cultivation cost	8691 (12)	3751 (6)	6221 (9)
Plain land crops	6652 (9)	3331 (5)	4991 (7)
Jhum crops	2039 (3)	420 (1)	1230 (2)
2. Food	40474 (54)	41467 (64)	40971 (58)
3. Cloths	3940 (5)	2999 (5)	3470 (5)
4. Medication	4146 (5)	2997 (5)	3571 (5)
5. Housing	1680 (2)	849 (1)	1265 (2)
6. Children's education	4337 (6)	2861 (4)	3599 (5)
7. Social/religious events	2697 (4)	2436 (4)	2566 (4)
8. Livestock rearing	623 (1)	158 (0)	390 (1)
9. Chicken rearing	201 (0)	41 (0)	121 (0)
10. Bidi/cigarette etc.	2560 (3)	1777 (3)	2168 (3)
11. Tobacco	2362 (3)	1393 (2)	1877 (3)
12. Betel leaf and tea	3817 (5)	3853 (6)	3835 (5)
Total expenditure	75528 (100)	64582 (100)	70054 (100)

Figures within parentheses are percentages of total
Source: Household Survey, 2009

6.3 Household Savings and Loan Position

Table 6.4 shows the savings and loan status of the sample households. Households kept money in cash and deposited in bank. Some households also took money as loan from bank, cooperative society, various NGOs, private money lender and also from relatives and neighbours. The savings of the households calculated was Tk. 10661. The savings of the rural and peri-urban households were Tk. 9930 and Tk. 11393 respectively. The peri-urban household was found to be good saver as their saving exceeded (13%) higher over rural households and most of their savings was deposited in the bank and less were cash in hand. In contrary, the amount of loan they received was Tk. 4761.

The amount of loan taken by the rural households was little over (7%) in peri-urban households. The reason might have been the higher crop expenditure of the rural households as compared to urban households. The saving-loan ratio was greater in rural and peri-urban area was 2.01 and 2.48 respectively.

Table 6.4 Status of yearly savings and loan for respondent households

Source	Amount of savings and loan (Tk/household)		
	Rural	Peri-urban	Both area
1. Amount of savings	9930	11393	10661
Cash in hand	5820	3038	4429
Cash at bank	4110	8355	6232
2. Amount of loan	4937	4584	4761
Bank	2815	1380	2098
Cooperative	120	243	182
NGO	784	1421	1102
Moneylender	55	1330	693
Relatives	1163	210	686
3. Balance (1-2)	+4993	+6809	+5900

Source: Household Survey, 2009

The above discussion revealed that both income and expenditure of rural households were higher compared to peri-urban households. Rural households were mostly dependent on farm income (49%) whereas peri-urban households dependent mostly on non-farm activities especially on services. On the other side, both rural and peri-urban households spent the highest income for collection of food followed by crop cultivation. Their annual savings were very low.

Chapter VII

FOOD AVAILABILITY, CONSUMPTION AND NUTRITION

Food security encompasses three elements: availability, accessibility and utilization. *Food availability* refers to the physical presence of food at various levels from household to national level, be that from own production or through markets. *Food access* refers to the ability to obtain an appropriate and nutritious diet and is in particular linked to resources at the household level. *Food utilization* refers to the proper use of food, which includes the existence of proper food processing and storage practices, adequate knowledge and application of nutrition and child care, and adequate health and sanitation services (FANTA, 2006). This chapter discusses the food availability at *Upazila* and household level, sources of collecting food, consumption pattern, seasonality of consumption, and per capita intake of nutrition.

7.1 Food Availability in the Study Area

Different types of food crops were grown in three seasons in the study areas. Paddy and maize were the most important and prominent among various crops grown in the study areas. A remarkable amount of area was devoted to cash crop like sugarcane. The other important crops were pulses, oilseeds, potato, vegetables, and spices and condiment. Different types of fruits were also available throughout the year in the study areas. The area and production of the aforesaid crops have been shown in Table 7.1.

Table 7.1 Annual crop production in Khagrachari Sadar and Dighinala upazila

	Sadar, 2008-09		Dighinala, 2005-06	
	Area (ha)	Production (mt)	Area (ha)	Production (mt)
A. Kharif-1 season				
Aus (HYV)	580	1450	625	1842
Aus (*Jhum*)	380	510	1150	1742
Maize (Local)	150	560	270	1285
Sugarcane	150	6900	127	5865
Pulses	31	38.5	35	44.8
Summer vegetables	600	7200	1035	10435
B. Kharif-2 season				
T. Aman (HYV)	3300	10131	4500	14626
T. Aman (local)	450	979	350	802
C. Rabi season				
Boro (HYV)	1250	4375	1802	5586
Maize (local)	250	1075	245	975
Oilseeds	289	292.2	20.0	19.5
Potato& S. potato	350	3720	150	1582
Other spices	198	338	100	175
Winter vegetables	1050	20150	1055	12660
D. Year round				
Ginger (local)	390	4550	170	4335
Turmeric (local)	1500	19880	725	15215
Fruits	1950	33150	NA	NA

Source: DAE Upazila Office, Khagrachari sadar and Dighinala, 2009

7.2 Food Availability at Household Level

Household food supply remained limited and they had to depend largely on other sources of food including those from flora and fauna which have no or little economic value. Table 7.2 shows that their own production of rice could meet their household demand for 5.65 months followed by maize (0.74 months), turmeric (5.20 months), ginger (0.70 months), chilli (1.60 months), vegetables (1.93 months), leafy vegetables (1.82 months) and potato (0.88 months). In general rural households were more dependent on own production for their consumption and the households consumed owned produces longer time a year in comparison to urban households. Households sold part of their products grown for want of cash money as they needed it for non-food consumption expenditures on clothes, medicine, childrens education, festival etc. Otherwise they could have consumed their farm produce for longer time in a year. The households were largely dependent on purchased food.

Table 7.2 Availability of food from own production for household consumption

Type of food	No. of month		
	Rural area	Peri-urban area	Both areas
Rice	7.91	3.39	5.65
Maize	1.07	0.42	0.74
Turmeric	6.30	4.10	5.20
Ginger	0.78	0.61	0.70
Chili	2.63	0.58	1.60
Vegetables	1.85	2.02	1.93
Leafy vegetables	2.33	1.31	1.82
Potato	1.55	0.21	0.88

Source: Household Survey, 2009

Table 7.3 indicates that the highest share of food was purchased from market (62%) followed by own production from field (29%), gift from relatives (5%), homestead production (3%) and government grant (1%). Rural households were less dependent on purchased food (48%) in comparison to peri-urban households (76%) because higher crop production activities in the case of former. It may be mentioned that the collection of food by sample household from government or other sources was very negligible.

Table 7.3 Percent of food collected from different sources for household consumption

Sources of food	% of food collected		
	Rural area	Peri-urban area	Both areas
1. Own production from field	42.06	16.80	29.43
2. Homestead production	2.47	2.57	2.52
3. Bought from market	48.38	76.04	62.21
4. Government grant	1.68	0.56	1.12
5. Gift from relatives	5.41	4.03	4.72
Total	100	100	100

Source: Household Survey, 2009

7.3 Market Access and Purchasing Power of the Household

In general purchasing power of the ethnic households in the study areas was poor. A little less than half (47%) of the *Jhum* cultivators reported that they were shocked by higher prices of inputs and lower prices of farm outputs. The hill people had limited options and alternatives for income generation and heavily depend on *Jhum* cultivation. Due to lack of skill, unfamiliarity with other parts of the country, language gap, and adherence to cultural facilities, their mobility was limited and they could not move to other parts of the country for new jobs and avenue for income generation. The households, due to some reasons, could not go under market forces (both input and product market). ADB (2001) mentioned that the farmers of Chittagong Hill Tracts (CHT) were low paid and worked under imperfect market situations arising from inappropriate policies, and institutional environment such as weak governance, poor infrastructure and support services which distort prices of agricultural products.

Despite high demand and prices of timber in other parts of the country, timber growers of CHT get a small portion of market price for timber because of complicated procedures and bureaucratic meandering. It is almost impossible for the small farmers to get permission to sell timber freely. As a result, they are compelled to sell timber at a lower price in the black market. Trades who have transit permits make a high profit margin by purchasing timber at lower price and selling it at high price in the nearest city of Chittagong. In the same way farmers are getting lower price of fruits and vegetables as they have to pay taxes and levies to different authorities at different places. The farmers have to pay bribe to transfer their agricultural commodities from one place to another. These practices affect not only the prices that farmers receive for their products, but also the market structure and efficiency by limiting the participation and trading particularly by the tribal people, who are less acquainted with the government official and cannot deal with such complications. All these factors coupled with high transportation costs resulting from inadequate transport facilities have led to very low local prices of agro forestry products (Rasul et al., 2002). The situation is further aggravated by high price fluctuation due to lack of storage facilities especially for horticultural crops (ADB, 2001). All these situations in the study area ultimately led to lower price in the product market and higher price in the consumer market which further reduced income and purchasing power of the households.

7.4 Preparation Techniques and Use of Food

Preparation techniques and use of food play an important role in conserving the nutrient value of food. Table 7.4 shows how and at what extent the household members usually followed food preparation techniques. Four indicators on food hygiene and preparation practices such as washing rice before cooking, use of starch of boiled rice, and cutting, washing and cooking procedures of leafy vegetables were taken into consideration. The table 7.4 shows that most of the households (48%) washed rice twice before cooking. Most of the households (59%) kept starch with rice while they cooked rice, but 13% did not and another 27% sometimes kept it. The table further shows that 72% of the households cut leafy vegetables into small pieces before cooking and 28% cut into bigger pieces. A little one half (53%) of the households washed leafy vegetables after cutting followed by 22% and 25% who always washed leafy vegetables before cutting and washed both before and after cutting. It was noted that indigenous households often cut first and then washed, because it has been their customary preference. They were unaware of the fact that there is greater loss of vitamins when the vegetables are cut and then washed. Most of the households (77%) boiled leafy vegetables half, followed by 15% households who boiled leafy vegetables less than half and 9% households who sufficiently boiled leafy vegetables. The peri-urban households showed better knowledge in washing rice, cooking leafy vegetables and using rice starch in comparison to rural households which might have increased the nutritional value of their food.

7.5 Consumption Pattern and Food Preferences

Table 7.5 describes consumption pattern of rural households. Hundred percent of households ate rice and most of them (8% twice and 92 % thrice) ate rice at least once a day. Thirty seven percent households consumed maize daily (29% once, 6% twice and 2% thrice) and 63% on weekly basis (28% once, 28% twice and 7% thrice). None of them ate fresh fish regularly and 86% ate on weekly basis (37% once, 32% twice, 14% thrice and 3 % four times). Dry fish was consumed by 69% households on daily basis and 31% on weekly basis. None ate meat, egg, milk and pulses regularly. Only 36%, 27%, 28%, and 45% households respectively ate meat, egg, milk and pulses weekly. Hundred percent households ate vegetables every day.

Table 7.4 Food preparation techniques habitually followed by ethnic hill people

Items	% responded		
	Rural area	Peri-urban area	Both areas
1. No. of rice wash before cooking			
▪ Once	17	0	8.5
▪ Twice	24	72	48.0
▪ Thrice	59	28	43.5
2. Use of starch of boiled rice			
▪ Through it out	28	0	14.0
▪ Keep it with rice	42	76	59.0
▪ Sometimes through it out	30	24	27.0
3. Cutting procedures of leafy vegetables			
▪ Cut into small pieces	27	30	28.5
▪ Cut into bigger pieces	73	70	71.5
4. Washing techniques of leafy vegetables			
▪ Wash after cutting	49	57	53.0
▪ Wash before cutting	23	21	22.0
▪ Wash before and after cutting	28	22	25.0
5. Cooking techniques of leafy vegetables			
▪ Sufficiently boil	12	5	8.5
▪ Half boil	63	90	76.5
▪ Less than half boil	25	5	15.0

Source: Monitoring Survey, 2009

None ate banana and papaya everyday. Sixty one percent and 25% respectively ate banana and papaya weekly basis. They seldom ate fruits like orange, grapes, apple etc. and only 14% ate monthly. All of them even did not take tea everyday. Only 39% took tea everyday and 61% on weekly basis. However, they were very much fond of tobacco and all of them smoke everyday. They seldom ate wild animals like frog/turtle, crab/snail, uchronga, sazaru/guisap. Five percent and 33% of households ate frog/turtle and crab/snail on monthly basis, and all of them ate uchronga and sazaru/guishap yearly.

Taste and preferences of the women members and children of the households were also investigated to know how this affected the consumption pattern of the entire households. Table 7.5 further shows that rural women moderately or highly preferred rice (100%), fresh fish (6%), dry fish (83%), meat (94%), vegetable (86%), baskorol (67%t), papaya (67%), orange/ grapes/apple (86%), frog/Turtle (69%), crabs/snail (77%), sazaru/guishap (74%).) Besides, children members highly preferred rice (75%), maize (75%), fresh fish (75%), meat (93%), egg (96%), milk (79%), vegetables (74%), mushroom (82%), banana (88%), papaya (82%), orange/ grapes/apple (99%), frog/turtle (68%), crab/snail (89%), sazaru/guisap.

Table 7.5 Consumption pattern of sample household members in rural areas

Food items	% of responses				Preference (%)					
					Female			Children		
	Daily	Weekly	Monthly	Yearly	High	Moderate	Low	High	Moderate	Low
Rice	100	-	-	-	100	-	-	75	25	-
2 times	8	-	-	-	-	-	-	-	-	-
3 times	92	-	-	-	-	-	-	-	-	-
Maize	37	63	-	-	35	37	27	27	70	
1 time	29	28	-	-						-
2 times	6	28	-	-	-	-	-	-	-	-
3 times	2	7	-	-	-	-	-	-	-	-
Fish	-	86	14		64	35	1	75	22	3
1 time	-	37	6	-	-	-	-	-	-	-
2 times	-	32	7	-	-	-	-	-	-	-
3 times	-	14	1	-	-	-	-	-	-	-
4 times	-	3	-	-	-	-	-	-	-	-
Dry fish	69	31	-	-	83	17	-	14	7	5
1 time	2	4	-	-	-	-	-	-	-	-
2 times	4	5	-	-	-	-	-	-	-	-
3 times	63	14	-	-	-	-	-	-	-	-
4 times	-	8	-	-	-	-	-	-	-	-
Meat	-	36	64	-	94	5	1	93	7	-
1 time	-	29	33	-	-	-	-	-	-	-
2 times	-	5	24	-	-	-	-	-	-	-
3 times	-	2	7	-	-	-	-	-	-	-
Egg	-	27	73	-	44	36	20	96	3	1
1 time	-	13	34	-	-	-	-	-	-	-
2 times	-	8	29	-	-	-	-	-	-	-
3 times	-	6	10	-	-	-	-	-	-	-
Milk	-	28	72	-	53	24	23	79	20	1
1 time	-	12	23	-	-	-	-	-	-	-
2 times	-	13	29	-	-	-	-	-	-	-
3 times	-	3	20	-	-	-	-	-	-	-
Pulses	-	45	55	-	27	48	25	25	62	13
1 time	-	19	22	-	-	-	-	-	-	-
2 times	-	22	25	-	-	-	-	-	-	-
3 times	-	4	8	-	-	-	-	-	-	-
Vegetable	100	-	-	-	86	14	-	74	24	2
1 time	3	-	-	-	-	-	-	-	-	-
2 times	10	-	-	-	-	-	-	-	-	-
3 times	87	-	-	-	-	-	-	-	-	-
Arum	-	8	32	60	13	40	47	-	19	81
1 time	-	3	3	2	-	-	-	-	-	-
2 times	-	4	19	22	-	-	-	-	-	-
3 times	-	1	10	36	-	-	-	-	-	-
Tree potato	-	-	36	64	8	50	42	-	43	57
1 time	-	-	14	16	-	-	-	-	-	-
2 times	-	-	13	27	-	-	-	-	-	-
3 times	-	-	9	21	-	-	-	-	-	-
Kondal/thor	-	19	54	27	21	40	39	4	32	64
1 time	-	13	24	8	-	-	-	-	-	-
2 times	-	6	21	5	-	-	-	-	-	-

3 times	-	-	9	14	-	-	-	-	-	-
Baskorol	-	-	-	100	67	31	2	54	36	10
1 time	-	-	-	13	-	-	-	-	-	-
2 times	-	-	-	16	-	-	-	-	-	-
3 times	-	-	-	59	-	-	-	-	-	-
4 times	-	-	-	12	-	-	-	-	-	-
Masrum	-	-	-	100	19	45	36	6	82	12
1 time	-	-	-	28	-	-	-	-	-	-
2 times	-	-	-	33	-	-	-	-	-	-
3 times & above	-	-	-	39	-	-	-	-	-	-
Banana	-	61	39	-	54	34	12	88	12	-
1 time	-	14	9	-	-	-	-	-	-	-
2 times	-	31	18	-	-	-	-	-	-	-
3 times	-	12	12	-	-	-	-	-	-	-
4 times	-	4	-	-	-	-	-	-	-	-
Papaya	-	25	75	-	61	24	15	82	17	1
1 time	-	19	33	-	-	-	-	-	-	-
2 times	-	6	29	-	-	-	-	-	-	-
3 times	-	-	13	-	-	-	-	-	-	-
Orange/grapes/apple			14	86	80	20	-	99	1	-
1 time	-	-	7	23	-	-	-	-	-	-
2 times	-	-	5	41	-	-	-	-	-	-
3 times	-	-	2	22	-	-	-	-	-	-
Tea	39	61	-	-	31	41	28	-	14	43
1 time	13	10	-	-	-	-	-	-	-	-
2 times	8	30	-	-	-	-	-	-	-	-
3 times	18	17	-	-	-	-	-	-	-	-
4 times +	-	4	-	-	-	-	-	-	-	-
Tobacco	100	-	-	-	53	22	25	-	-	-
1 time	15	-	-	-	-	-	-	-	-	-
2 times	15	-	-	-	-	-	-	-	-	-
3 times +	70	-	-	-	-	-	-	-	-	-
Frog/ Turtle	-	-	5	95	69	28	3	32	68	-
1 time	-	-	2	22	-	-	-	-	-	-
2 times	-	-	1	17	-	-	-	-	-	-
3 times	-	-	2	56	-	-	-	-	-	-
Crab/snail	-	-	33	68	77	21	2	89	3	8
1 time	-	-	14	7	-	-	-	-	-	-
2 times	-	-	15	19	-	-	-	-	-	-
3 times	-	-	4	42	-	-	-	-	-	-
Uchronga	-	-	-	100	38	51	11	15	62	23
1 time	-	-	-	31	-	-	-	-	-	-
2 times	-	-	-	36	-	-	-	-	-	-
3 times	-	-	-	33	-	-	-	-	-	-
Sazaru/ Guisap	-	-	-	100	74	21	5	20	80	-
1 time	-	-	-	55	-	-	-	-	-	-
2 times	-	-	-	38	-	-	-	-	-	-
3 times	-	-	-	7	-	-	-	-	-	-

Source: Household Survey, 2009

Table 7.6 describes the consumption pattern of peri-urban households. Like rural household members, hundred percent of the peri-urban members ate rice daily (96% once, 4% twice and none once). Forty three percent households' members consumed maize daily and 57% on weekly basis. None of them ate fresh fish regularly and 91% ate on weekly basis. Dry fish was consumed by 83% household members on daily basis and 17% on weekly basis. Like rural household members none ate meat, egg, milk and pulses regularly. Only 22%, 40%, 24% and 45% household members respectively ate meat, egg, milk and pulses weekly.

Similar to rural household members, hundred percent households ate vegetables everyday. Also like rural household members none ate banana and papaya everyday. Forty nine percent and 21% respectively ate banana and papaya on weekly basis. They seldom ate fruits like orange, grapes, apple etc. and only 9% ate monthly. All of them even did not take tea everyday. Only 71% took tea everyday and 29% on weekly basis. However, they were very much fond of tobacco and all of them smoke everyday. Peri-urban household members also ate wild animal like frog/turtle, crab/snail, uchronga, sazaru/guisap. Eight percent and 24% of households ate frog/turtle and crab/snail respectively on monthly basis, and all of them ate uchronga and sazaru/guishap on yearly basis.

Table 7.6 further shows that peri-urban women moderately or highly preferred rice (100%), fresh fish (68%), dry fish (79%), meat (89%), kondal/thor (82), orange/grapes/apple (76%), tobacco (86%), frog/turtle (73%), crab/snail (74%), ucarongo (71%) sazaru/guisap (77%). Besides, children members highly preferred rice (80%), maize (70%) fresh fish (78%), meat (97%), egg (93%), milk (81%), banana (79%), papaya (79%), orange/ grapes/apple (97%), crab/snail (93%), ucharongo (71%) and sazaru/guishap (85%).

Table 7.6 Consumption pattern of sample households in peri-urban areas

Food items	% of responses				Preference (%)					
					Female			Children		
	Daily	Weekly	Monthly	Yearly	High	Moderate	Low	High	Moderate	Low
Rice	100	-	-	-	100	-	-	80	20	-
1 time	-	-	-	-	-	-	-	-	-	-
2 times	4	-	-	-	-	-	-	-	-	-
3 times	96	-	-	-	-	-	-	-	-	-
Maize	43	57	-	-	25	41	34	30	70	-
1 time	38	28	-	-	-	-	-	-	-	-
2 times	5	24	-	-	-	-	-	-	-	-
3 times	-	5	-	-	-	-	-	-	-	-
Fish	-	91	9	-	68	31	1	78	22	-
1 time	-	34	2	-	-	-	-	-	-	-
2 times	-	32	7	-	-	-	-	-	-	-
3 times	-	16	-	-	-	-	-	-	-	-
4 times	-	9	-	-	-	-	-	-	-	-
Dry fish	83	17	-	-	79	20	1	23	6	4
1 time	10	2	-	-	-	-	-	-	-	-
2 times	6	4	-	-	-	-	-	-	-	-
3 times	67	6	-	-	-	-	-	-	-	-
4 times	-	5	-	-	-	-	-	-	-	-
Meat	-	22	78	-	89	11	-	97	3	-
1 time	-	15	43	-	-	-	-	-	-	-
2 times	-	4	29	-	-	-	-	-	-	-
3 times	-	3	6	-	-	-	-	-	-	-
Egg	-	40	60	-	32	43	25	93	6	1
1 time	-	18	15	-	-	-	-	-	-	-
2 times	-	13	32	-	-	-	-	-	-	-
3 times	-	6	13	-	-	-	-	-	-	-
4 times	-	4	-	-	-	-	-	-	-	-
Milk	-	24	76	-	39	46	14	81	19	-
1 time	-	7	27	-	-	-	-	-	-	-
2 times	-	14	35	-	-	-	-	-	-	-
3 times	-	3	14	-	-	-	-	-	-	-
Pulses	-	45	55	-	19	50	31	19	44	37
1 time	-	25	17	-	-	-	-	-	-	-
2 times	-	15	23	-	-	-	-	-	-	-
3 times	-	5	15	-	-	-	-	-	-	-

Table 7.6 continued ……..

Food items	% of responses				Preference (%)					
					Female			Children		
	Daily	Weekly	Monthly	Yearly	High	Moderate	Low	High	Moderate	Low
Vegetables	100	-	-	-	44	56	-	54	36	10
1 time	13	-	-	-	-	-	-	-	-	-
2 times	20	-	-	-	-	-	-	-	-	-
3 times	67	-	-	-	-	-	-	-	-	-
Arum	-	11	34	55	17	48	35	19	79	-
1 time	-	2	3	10	-	-	-	-	-	-
2 times	-	9	21	21	-	-	-	-	-	-
3 times	-	-	10	24	-	-	-	-	-	-
Tree potato	-	-	23	77	44	56	-	24	76	-
1 time	-	-	15	27	-	-	-	-	-	-
2 times	-	-	7	31	-	-	-	-	-	-
3 times	-	-	1	19	-	-	-	-	-	-
Kondal/thor	-	17	38	45	31	31	38	18	82	-
1 time	-	12	12	13	-	-	-	-	-	-
2 times	-	5	23	6	-	-	-	-	-	-
3 times	-	-	3	26	-	-	-	-	-	-
Baskorol	-	-	-	100	84	15	1	64	35	1
1 time	-	-	-	11	-	-	-	-	-	-
2 times	-	-	-	12	-	-	-	-	-	-
3 times	-	-	-	64	-	-	-	-	-	-
4 times	-	-	-	13	-	-	-	-	-	-
Masrum	-	-	-	100	35	53	12	12	78	10
1 time	-	-	-	34	-	-	-	-	-	-
2 times	-	-	-	35	-	-	-	-	-	-
3 times	-	-	-	31	-	-	-	-	-	-
Banana	-	49	51	-	45	40	15	79	21	-
1 time	-	10	16	-	-	-	-	-	-	-
2 times	-	24	15	-	-	-	-	-	-	-
3 times	-	11	20	-	-	-	-	-	-	-
4 times	-	4	-	-	-	-	-	-	-	-
Papaya	-	21	79	-	43	42	15	79	21	-
1 time	-	14	28	-	-	-	-	-	-	-
2 times	-	6	37	-	-	-	-	-	-	-
3 times	-	1	14	-	-	-	-	-	-	-
Orange/ Grapes/apple	-	-	9	91	76	24	-	97	3	-
1 time	-	-	8	24	-	-	-	-	-	-
2 times	-	-	1	33	-	-	-	-	-	-
3 times	-	-		34	-	-	-	-	-	-
Tea	71	29	-	-	42	47	11	-	19	52
1 time	21	3	-	-	-	-	-	-	-	-
2 times	39	13	-	-	-	-	-	-	-	-
3 times +	11	13	-	-	-	-	-	-	-	-

Table 7.6 continued ……..

Food items	% of responses				Preference (%)					
					Female			Children		
	Daily	Weekly	Monthly	Yearly	High	Moderate	Low	High	Moderate	Low
Tobacco	100	-	-	-	86	4	10	-	-	-
1 time	9	-	-	-	-	-	-	-	-	-
2 times	12	-	-	-	-	-	-	-	-	-
3 times +	79	-	-	-	-	-	-	-	-	-
Frog/Turtle	-	-	8	92	73	26	1	42	58	-
1 time	-	-	1	18	-	-	-	-	-	-
2 times	-	-	5	35	-	-	-	-	-	-
3 times	-	-	2	39	-	-	-	-	-	-
Crab/Snail	-	-	24	76	74	24	2	93	4	3
1 time	-	-	12	11	-	-	-	-	-	-
2 times	-	-	12	25	-	-	-	-	-	-
3 times	-	-	-	40	-	-	-	-	-	-
Uchronga	-	-	-	100	27	71	2	13	71	16
1 time	-	-	-	13	-	-	-	-	-	-
2 times	-	-	-	35	-	-	-	-	-	-
3 times	-	-	-	45	-	-	-	-	-	-
4 times	-	-	-	7	-	-	-	-	-	-
Sazaru/ Guisap	-	-	-	100	77	19	4	15	85	-
1 time	-	-	-	53	-	-	-	-	-	-
2 times	-	-	-	40	-	-	-	-	-	-
3 times	-	-	-	7						

Source: Household Survey, 2009

From the above discussion, it is evident that household members were mostly dependent on a rice based consumption pattern. The consumption pattern did not vary considerably between rural and peri-urban households with few exceptions. Household members of both rural and peri-urban areas could not afford to eat important food items like fresh fish, meat, egg, milk and pulses daily. Though somehow some of them managed to eat these foods on weekly basis (except fish), majority of them could experienced these food on monthly basis. Fish was found to have been an important food item and about 90% household members consumed it at least once a week.

Vegetables were common dietary items which were found to be consumed at least once every day by all of them in both rural and peri-urban areas. None could eat fruits like banana and papaya daily, but everyone ate these fruits at least once a month. They seldom consumed orange /grapes/apple. Only few (9-14%) ate these fruits on monthly basis, but all of them had these fruits at least once a year. All the sample households of rural and peri urban areas were

habituated to taking tea and tobacco. Some of the female members were also fond of taking tea and smoking tobacco (no children were reported to smoke). All the household members experienced tea either daily or weekly, but tea was most common in the peri-urban area. All the sample households of peri-urban area smoked everyday while all the sample households in rural area did not smoked everyday. It was observed that households of both the areas had to depend on food items which were considered to be unconventional which had low or no market value (aroids, vegetables like tree potato, kondal thor, baskorol, creature like frog, turtle, crab, snail, uchronga, sazaru, guishap etc.) which were considered to be a important source of nutrient foods of the households.

It was interesting to know whether household consumption decisions or affordability were in line with the taste and preferences of the women and children members of the household. In the rural area households the consumption basket matched the taste and preference of the women members of the households with reference to rice, dry fish and vegetables only and did not match in the case of meat, orange/grapes/apple and marine creatures such as frog, turtle, crab, snail, uchronga, sazaru and guishap. For children, preference of rice, vegetables, and banana were found to match to some extent, while it was not so for maize, fish, meat, egg, milk, pulses, papaya, orange/grapes/apple and creatures like frog, turtle, crab, snail, uchronga, sazaru and guishap. Important food items like maize, egg, milk, pulses, banana, papaya and tea and non food items like tobacco were not in the taste and preference list of women while dry fish, tea and tobacco were not in the list of children.

In peri-urban area households, the consumption basket matched the taste and preference of the women and children members of the househol in the case of rice, dry fish, vegetables and tobacco only and did not match in the case of meat, orange/grapes/apple and creature like frog, turtle, crab, snail, uchronga, sazaru, guishap etc. For children, matching was made in the case of rice, vegetable while matching was not made for maize, fish, meat, egg, milk, banana, papaya, orange/grapes/apple and creature like frog, turtle, crab, snail, uchronga, sazaru, guishap etc. Important food items like maize, egg, milk, pulses, banana, papaya and tea were not in the taste and preference list of women while dry fish, pulses, vegetables, tea and a non food item like tobacco were not contained in the list of children.

7.6 Intake of Food and Other Consumption Items

Both rural and peri-urban households had the same consumption items. Conventional item like rice, pulses, fresh fish, dry fish, meat, milk, egg, leafy vegetables, other vegetables (brinjal, bitter gourd, sweet gourd, white gourd, bottle gourd, country bean, cauliflower, cabbage, yard long bean, okra, plantain stem, radish and arum) potato, tomato, fruits (banana, apple, bitter plum, guava, grapes, orange and papaya), tea, cigarette and tobacco were the intake of the hilly people. Table 7.7 shows that hilly people ate rice of an amount of 562.33 g/capita/day which was 21.83% higher than the national average. Though they ate a good quantity of meat (26.01g/capita/day), fresh fish (35.89 g/capita/day) and dry fish (11.75 g/capita/day), their consumption basket contained very little quantity of maize (2.77 g/capita/day), pulses (6.48 g/capita/day), milk (9.99 ml/capita/day), egg (0.11 no./capita/day), sugar/molasses (2.55 g/capita/day) etc. Especially they consumed pulses, fish, milk, egg, oil, and sugar/molasses far below the national average. However, they consumed different kinds of vegetables and fruits of much higher quantity (337.01 g/capita/day and 52.86 g/capita/day respectively), even much higher than the national average. They consumed edible oil (10.45 ml/capita/day) close to national average (16.5 ml/capita/day) and potato (76.78 gm/capita/day) higher than national average.

A comparative analysis of the rural and urban households reveals that rural households were much (11.3% higher) rice eater than peri-urban households. The reason might be their higher involvement in agricultural activities as well as agricultural production. Other items which rural households consumed more were maize, dry fish, leafy vegetables, potato, tomato, fruits, spices and condiments, and sugar than the peri-urban households. The reason was that rural households cultivated maize, different types of leafy vegetables, papaya, and spices more than that of peri-urban households. It was also observed that average rural households owned more livestock and poultry resources but consumed less meat, milk, and egg because they usually sold most of these products for satisfying immediate cash needs. In contrary, peri-urban households consumed pulses, fresh fish, meat, milk, egg, other vegetables, edible oil, and toddy (tari) more than the rural households due to better purchasing power.

Table 7.7 Per capita per day intake of various foods and other consumption items by ethnic hill people

Food items	Amount intake (g/capita/day)			National average
	Rural area	Peri-urban area	Both areas	
Rice	596.00	528.66	562.33	439.6
Maize	2.98	2.56	2.77	-
Pulses	6.26	6.69	6.48	14.2
Fresh fish	32.68	39.10	35.89	42.1
Dry fish	12.55	10.96	11.75	-
Meat	24.84	27.17	26.01	15.6
Milk	5.84	14.14	9.99	32.4
Egg (No.)	0.10	0.11	0.11	5.2
Leafy vegetables	96.80	91.34	94.07	43.4
Other vegetables[/1]	242.86	243.01	242.94	113.6
Potato	76.84	76.72	76.78	63.3
Tomato	60.41	36.53	48.47	-
Fruits[/2]	62.10	43.63	52.86	32.5
Edible oil (ml)	10.14	10.77	10.45	16.5
Spices and condiments[/3]	31.15	28.30	29.72	53.4
Sugar/molasses	2.94	2.17	2.55	8.1
Tari (Toddy)	8.18	9.22	8.70	-
Total	1273	1171	1222	-

[/1] Brinjal, bitter gourd, sweet gourd, white gourd, bottle gourd, country bean, cauliflower, cabbage, yard-long bean, okra, plantain stem, radish, and arum. [/2] Banana, apple, bitter plum, guava, grapes, orange, and papaya.

[/3] Onion, garlic, turmeric, ginger, and chili.

Source: Household Survey, 2009

7.7 Nutrient intake

It can be seen from Table 7.7 that the hilly people mostly consumed rice (562.33 g/capita/day) followed by other vegetables (242.94 g/capita/day), leafy vegetables (94.07 g/capita/day), potato (76.78 g/capita/day), fruits (52.86 g/capita/day), spices and condiments (29.72 g/capita/day), fresh fish (35.89 g/capita/day). In general, rural households consumed (8.01%) higher amount of different foods in comparison to urban households. The calorie and nutrient content of the food items were calculated using the Bangladesh food composition tables (Table 7.8).

Table 7.8 indicates that both peri-urban and rural households had a nutrient intake higher than the recommended intake per capita per day (FAO, 2002). The per capita per day consumption of nutrients was estimated at 2594 kcal of energy, 72.23 g of protein, 21.06 g of

fat, 851.58 mg of calcium, and 46.70 mg of iron. It was noted that the estimated per capita intake of energy, protein and iron was slightly higher than the recently revised and updated recommended dietary allowances proposed by the ICMR, 2010. The intake of fat was found to be only half of the recommended allowances. Fat in the diet is generally influenced by the purchasing power of a household which was noted to be rather limited in the indigenous population. On the whole, it appears that the diets were adequate in energy and the other nutrients estimated. Table 7.8 further shows the rural households in the study areas had intakes of energy, protein and iron at 8.77, 3.82, and 7.84% respectively which were higher than the peri-urban households. Again, the per capita per day intake of calcium was slightly higher (0.79%) for peri-urban households compared to rural households.

Table 7.8 Average nutrient intake by ethnic hill people

Nutrients	Amount (Capita/day)				Recommended dietary intake*
	Rural area	Peri-urban area	Both areas	National	
Energy (kcal)	2713	2475	2594	2239	2400
Protein (g)	73.64	70.83	72.23	62.52	60
Calcium (mg)	848.70	855.45	851.58	NA	600
Iron (mg)	48.61	44.80	46.70	NA	17
Fat (g)	21.08	21.04	21.06	NA	40

FAO, 2002; ICMR, 2010; Krishi Diary, 2010
Source: Household Survey, 2009
NA= Not Available

7.8 Relative Contribution of Food Items to Nutrient Supply

The relative contribution of different food items consumed by indigenous households in the study areas to dietary energy and selected nutrients per day is shown in Table 7.9. The result reveals that irrespective of study areas the sample households took a lion share of calories from rice, other vegetables, edible oil, and potato. A major proportion of the protein in the diet came from rice, fresh and dry fish, meat, and other vegetables. Major sources of calcium were fresh fish, leafy vegetables and dry fish. Rice, leafy vegetables, dry fish, and other vegetables were the main contributors of iron in the diet. Among various food items consumed by household members, rice supplied more than 77% of the total daily energy intake followed by all vegetables (5.55%), edible oil (3.63%), potato (2.87%), and fish (2.02).

It was noted that the contribution of cereals (mainly rice) to total dietary energy intake was unacceptably high. This is attributed to several factors notably, high availability, cheaper prices, but also old-age dietary habits and cultural practices. The recommended proportion of dietary energy supply (DES) from cereals is 60% for good health and nutrition (FAO, 2007). Higher DES derived from cereals makes a diet undiversified and imbalanced, and people habitually consuming relatively high amounts of cereals are likely to suffer from malnutrition. Indeed, DES from cereals has been found to be strongly positively correlated with percent stunting ($n = 20$, $r^2 = 0.51$, $p = 0.000$) and percent underweight ($n = 21$, $r^2 = 0.37$, $p = 0.003$) in under-5 children (Yusuf et al., 2009).

Table 7.9 Relative energy and nutrient contribution of different food items to the household diet

Food item	Energy		Protein		Calcium		Iron	
	kcal	%	g	%	mg	%	mg	%
Rice	2002	77.17	35.99	49.83	50.61	5.94	25.48	54.55
Maize	10	0.37	0.32	0.44	0.28	0.03	0.06	0.12
Pulses	22	0.86	1.63	2.25	4.47	0.52	0.31	0.67
Fresh fish	52	2.02	8.43	11.67	258.21	30.32	0.99	2.12
Dry fish	33	1.27	6.33	8.76	165.33	19.41	4.36	9.33
Meat	32	1.23	5.83	8.06	5.89	0.69	0.39	0.84
Milk	7	0.26	0.32	0.44	11.99	1.41	0.02	0.04
Egg	0	0.01	0.01	0.02	0.06	0.01	0.00	0.00
Leafy vegetables	46	1.76	3.36	4.65	193.54	22.73	10.42	22.31
Other vegetables	98	3.79	4.41	6.10	72.68	8.53	2.97	6.36
Potato	74	2.87	1.23	1.70	8.45	0.99	0.54	1.15
Tomato	10	0.37	0.44	0.60	23.27	2.73	0.19	0.42
Fruits	48	1.85	0.71	0.98	9.07	1.07	0.34	0.72
Edible oil	94	3.63	0.00	0.00	0.00	0.00	0.00	0.00
Spices	50	1.94	3.24	4.49	32.87	3.86	0.61	1.32
Sugar/molasses	10	0.39	0.00	0.00	0.31	0.04	0.00	0.00
Tari (Toddy)	6	0.22	0.01	0.01	14.55	1.71	0.03	0.06
Total	**2594**	**100**	**72.23**	**100**	**851.58**	**100**	**46.71**	**100**

The major sources of protein and iron of the indigenous households were noted to be rice which supplied 49.83 and 54.55% of the total protein and iron intake, respectively. The second most important sources of protein and iron were fresh fish (11.670%) and leafy vegetables (22.31%) respectively. A good amount of protein was also contributed by dry fish, meat, other vegetables and spices (8.76%, 8.06%, 6.1% and 4.49% respectively). The major

sources of calcium were found to be fish and vegetables which supplied 49.73 and 31.26% of total calcium consumed by an indigenous household member respectively.

Data and information regarding food items and energy intake which were calculated from the past three days intake of sample households revealed that rice, vegetables, edible oil, and fish were the most important food security food items in the study areas. The consumption level and energy intake data were verified through a consumption monitoring survey on selected households in rural and peri-urban areas.

7.9 Seasonality of Consumption

Seasonality of consumption was studied to see whether households maintained their consumption pattern in a uniform way or not. The seasonality of consumption was examined for six month period from March to August, 2009 through monitoring selected households both in rural and peri-urban areas. Table 7.10 shows that households maintained a uniform consumption pattern (1.31%) over time for cereals majority of which were rice. The variation was much higher in the case of pulses (62.57%), fresh fish (28.06%), liquid milk (34.53%), leafy vegetables (22.63%), root and tuber crops (25.94%), other vegetables (19.88%), fruits (74.41%), edible oil (23.03%), sugar (107.99%), tea (107.99), cigarettes (70.10%), toddy (25.36%), snail (62.15%), frogs (66.36%) and crabs (97.64%). Their consumption basket includes both home-produced and purchased foods; therefore, it was needless to relate households' seasonality of consumption pattern with farm production process. The basic food item such as rice did not show much variation in the consumption. Items like fruits, vegetables, root and tuber crops, snails, frogs and crabs showed much variation because of seasonality of market supply and source by nature. Sugar, liquid milk, tea, and non food item like cigarettes were related to festivals and special occasions, thus accounting for variation in consumption.

The seasonality of consumption of the rural and peri-urban households has been shown in Table 7.11 and Table 7.12 respectively. The seasonality in consumption in each area followed the same pattern (with little exception) as it was in the case of average of these two areas. In peri-urban area, the seasonality in consumption of the households varied for some of the consumption items more (10 out of 22) than the rural area. The items were: pulses, eggs,

milk, leafy vegetables, root and tuber crops, other vegetables, spices and condiments, toddy, snails and frogs. But the variation was much higher for other vegetables, toddy, snails and frogs. Besides, in peri-urban area seasonality in consumption of the households varied for some of the consumption items less (12 out of 22) than the rural area. The items were: cereals, fish, dry fish, meat, fruits, edible oil, sugar, tea, cigarettes, tobacco, molasses and crabs. But the variation between rural and peri-urban areas was much different for fish, dry fish, edible oil, sugar, tea, cigarettes and crabs.

Table 7.10 Month-wise average intake of foods by ethnic hill people in the study areas

(Fig in g/capita/day)

Food items	March	April	May	June	July	August	Mean
Cereals	592.76	604.67	614.23	607.22	614.33	604.82	606.34
Pulses	2.68	1.82	1.41	1.13	0.38	0.62	1.34
Fish	23.52	12.61	15.34	17.50	11.83	13.01	15.64
Dry fish	10.87	14.60	13.44	13.71	12.73	14.69	13.34
Meat	12.42	12.49	13.45	12.32	14.28	14.15	13.18
Egg (no.)	0.06	0.05	0.05	0.05	0.05	0.06	0.05
Liquid milk	4.27	5.43	6.71	4.51	3.25	2.41	4.43
Leafy vegetables	53.03	55.49	67.93	75.00	63.55	37.12	58.69
Root and Tuber[1]	74.08	88.62	55.22	44.58	51.33	61.40	62.54
Other vegetables[2]	226.95	168.41	176.38	190.84	259.91	267.24	214.95
Fruits[3]	36.66	51.44	5.99	70.46	115.61	28.09	51.37
Spices and condiments [4]	35.94	41.69	30.21	29.72	30.01	28.19	32.63
Edible oil	9.12	13.66	9.72	8.98	7.00	8.94	9.57
Sugar	2.42	6.89	0.46	0.45	0.23	0.46	1.82
Tea (powder)	0.45	0.20	0.14	0.04	0.03	0.04	0.15
Cigarette (box)	0.21	0.50	0.09	0.06	0.26	0.22	0.22
Toddy (Tari)	5.00	3.71	3.69	3.12	2.70	5.14	3.89
Tobacco	6.10	6.18	6.20	5.67	5.81	5.14	5.85
Molasses	4.91	5.99	5.61	5.33	5.58	5.00	5.40
Oyster	0.90	5.78	2.54	10.09	9.31	9.80	6.40
Frog	0.59	1.63	0.65	3.60	2.99	1.61	1.85
Crab	0.09	-	0.17	5.08	8.35	4.29	3.00
Total	**1103**	**1102**	**1030**	**1109**	**1219**	**1112**	**1113**

[/1] Potato, sweet potato, arum, arum tubers, yam, etc. [/2] Brinjal, Cucumber, banana stem, banana flower, okra, yard-long bean, ridge gourd, radish, cauliflower, cabbage, country bean, tomato, pumpkin, ash gourd, bottle gourd, jackfruit seed, green jackfruit, kakrol, plantain, yam stem, baskoral, and mushroom; [/3] Banana, apple, bitter plum, guava, grapes, orange, mango jackfruit, black berry, pineapple, latkon, watermelon, chalagol, and papaya. [/4] Onion, garlic, turmeric, sabarang, and chili.

Table 7.11 Month-wise average intake of foods by ethnic hill people in rural areas

(Fig in g/capita/day)

Food items	March	April	May	June	July	August	Mean
Cereals	634.72	602.51	614.66	598.62	626.30	625.61	617.07
Pulses	2.53	1.75	1.09	0.91	0.46	0.59	1.22
Fish	20.04	7.84	17.51	17.69	16.22	13.94	15.54
Dry fish	15.29	18.56	19.73	18.54	17.97	21.26	18.56
Meat	16.36	15.38	21.09	15.38	22.67	21.15	18.67
Egg (No.)	0.05	0.02	0.04	0.04	0.05	0.06	0.04
Liquid milk	0.58	0.87	3.93	4.07	6.39	0.08	2.65
Leafy vegetables	58.60	72.13	101.44	116.03	100.40	48.32	82.82
Roots and tubers	70.08	86.18	58.95	50.15	37.32	37.96	56.78
Other vegetables	242.39	134.45	129.91	184.96	269.76	324.87	214.39
Fruits	36.26	40.26	3.21	125.05	34.49	23.85	43.85
Spices & condim.	40.33	37.55	27.33	27.10	29.46	27.45	31.54
Edible oil	9.61	11.22	11.10	9.75	9.30	9.25	10.04
White/red sugar	2.92	3.43	0.66	0.54	0.47	0.56	1.43
Tea (powder)	0.18	0.22	0.12	0.07	0.06	0.08	0.12
Cigarette (box)	0.15	0.80	0.14	0.12	0.52	0.45	0.36
Toddy (Tari)	4.19	4.23	3.79	2.34	2.63	70.38	4.09
Tobacco	8.13	9.09	9.18	8.02	8.67	7.13	8.37
Molasses	7.75	9.10	8.34	7.87	8.57	6.94	8.10
Oyster	-	0.39	0.71	2.89	6.91	12.18	3.85
Frogs	-	1.99	0.69	-	0.11	-	0.46
Crabs	-	-	-	2.31	3.28	2.77	1.39
Total	**1170**	**1058**	**1034**	**1192**	**1202**	**1255**	**1141**

Source: Monitoring Survey, 2009

Table 7.13 shows the seasonal variation of the households in the consumption of energy, protein, fat, iron and calcium. Protein (12.44%) showed highest variation followed by fat (10.25%), calcium (7.38%), iron (5.13%) and energy (1.61%). Rural areas seasonality in consumption pattern showed similar pattern, but in peri-urban area fat exceeded the variation in consuming protein. In the case of peri-urban area the variation of energy, protein, fat, iron and calcium was 4.53, 11.09, 20.12, 6.83 and 11.30% respectively, while in the case of rural area it was 2.10, 14.96, 7.32, 5.91, and 5.10% respectively.

Table 7.12 Month-wise average intake of foods by ethnic hill people in peri-urban areas

(Fig in g/capita/day)

Food items	March	April	May	June	July	August	Mean
Cereals	550.81	606.84	613.80	615.83	602.35	584.04	595.61
Pulses	2.83	1.90	1.72	1.34	0.30	0.65	1.46
Fish	27.00	17.38	13.16	17.31	7.44	12.08	15.73
Dry fish	6.44	10.64	7.15	8.88	7.49	8.11	8.12
Meat	8.47	9.59	5.82	9.26	5.89	7.14	7.70
Egg (No.)	0.07	0.08	0.06	0.07	0.04	0.06	0.06
Liquid milk	7.97	10.00	9.50	4.95	0.11	4.74	6.21
Leafy vegetables	47.46	38.86	34.43	33.98	26.70	25.92	34.56
Roots and tubers	78.08	91.06	51.48	39.02	65.33	84.84	68.30
Other vegetables	211.51	202.37	222.85	196.72	250.05	209.61	215.52
Fruits	37.06	62.61	8.77	15.86	196.72	32.33	58.89
Spices & condi	31.56	45.84	33.09	32.35	30.55	28.94	33.72
Edible oil	8.64	16.09	8.34	8.20	4.70	8.63	9.10
White/red sugar	1.92	10.35	0.27	0.37	0.00	0.36	2.21
Tea	0.73	0.19	0.16	0.00	0.00	0.00	0.18
Cigarette (box)	0.27	0.20	0.03	0.00	0.00	0.00	0.09
Toddy (Tari)	5.81	3.19	3.58	3.91	2.78	2.90	3.69
Tobacco	4.07	3.26	3.22	3.33	2.95	3.16	3.33
Molasses	2.06	2.88	2.89	2.79	2.59	3.06	2.71
Oysters	1.80	11.18	4.38	17.28	11.70	7.41	8.96
Frogs	1.18	1.27	0.61	7.19	5.88	3.23	3.23
Crabs	0.17	0.00	0.35	7.86	13.42	5.81	4.60
Total	**1036**	**1146**	**1026**	**1026**	**1237**	**1033**	**1084**

Source: Monitoring Survey, 2009

The above discussion on six months consumption study reveals that the average per capita per day consumption of rural households was 1141g which was 5% higher than that of the peri-urban households. This finding is highly consistent with the household survey result, since the average food intake of rural household was 1273 g/capita/day which was 8% higher compared to peri-urban households. Furthermore, the average per capita per day energy intake was 2594 Kcal calculated from HH survey, whereas it was 2614 Kcal (0.76% higher) in the monitoring survey. This result is also consistent with consumption monitoring survey results.

Table 7.13 Month-wise average intake of nutrients by ethnic hill people

Food nutrients	March	April	May	June	July	August	Mean
A. Rural areas							
Energy (kcal)	2722	2602	2609	2621	2698	2713	2661
Protein (g)	68.91	65.24	73.02	84.15	91.44	93.01	79.30
Fat (g)	19.14	19.44	22.30	19.10	18.24	20.68	19.82
Iron (mg)	45.76	47.14	49.47	52.32	50.62	45.10	48.41
Calcium (g)	992.93	953.21	954.46	998.91	962.37	863.23	954.18
B. Peri-urban areas							
Energy (kcal)	2400	2745	2569	2585	2612	2492	2567
Protein (g)	59.50	66.39	60.74	75.79	77.70	70.69	68.47
Fat (g)	17.34	27.11	17.62	22.13	16.64	18.82	19.94
Iron (mg)	35.52	42.14	37.36	38.18	37.96	34.83	37.66
Calcium (g)	927.60	1008.74	834.98	867.99	826.48	720.93	864.45
C. All areas							
Energy (kcal)	2561	2673	2589	2603	2655	2602	2614
Protein (g)	64.21	65.82	66.88	79.97	84.57	81.85	73.88
Fat (g)	18.24	23.28	19.96	20.61	17.44	19.75	19.88
Iron (mg)	40.64	44.64	43.42	45.25	44.29	39.97	43.04
Calcium (g)	960.26	980.97	894.72	933.45	894.43	792.08	909.32

Source: Monitoring Survey, 2009

Chapter VIII

ASSESSMENT OF FOOD SECURITY AT HOUSEHOLD LEVEL

Food security can be defined as access at all times by all people to sufficient, safe and nutritious food which meet their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). There is, however, no easy way of measuring food security. It is a complex problem determined by the interaction of a broad range of agro-ecological, environmental, socio-economic, political and biological factors. In simple food security can be defined as the combination of three components as (i) availability of food, (ii) access to food, (iii) Utilization of food. Access to food is that people lack sufficient purchasing power to buy food is the main obstacle to achieving food security (Siemon et al., 2002). There is a fourth exogenous dimension that has significant interface with food security, i.e. risk and uncertainty. The above factors and the food security status of households in the study area are discussed in this section based on the relevant facts and figures.

8.1 Availability of Food

Food availability refers to the physical presence of food at various levels from household to national level, be that from own production or through markets (FANTA, 2006). Table 7.2 and 7.3 as described in *Chapter VII* revealed that the household collected only 38% of food from their own production from field, homestead production, government grants and from relatives of their total consumption requirement. The rest of the food they purchased from market. Production of rice which was their staple food and most of them ate thrice a day, could fed them only 5-6 months a year. Production of maize, potato, leafy vegetable and other vegetables could feed them about 1-2 months period of the year. The situation was one step behind in the peri-urban area where households collected only 24% of their consumption requirement of food from their own production from field, homestead production, government grants and from relatives. The rest of the food they purchased from market and food like rice could fulfill their requirement for only 4 months a year. The situation was little improved in the rural area where households collected 63% of food from their own production from field, homestead production, government grants and from relatives of their consumption requirement. The rest of the food they purchased from market. Their own

produced food like rice could fulfill their requirement for only 3 months period of a year. This indicates that food except purchased food irrespective of rural and peri-urban areas largely fell short of their consumption demand. The shortfall of the demand for food was available in the market.

Households produced fruits and vegetables not only for their own consumption but also to sell them in the market. Therefore, a large portion of their production was sold in the market. One study showed that 76% of the local vegetables and fruits produced at Khagrachari were sold in the market (Moniruzzaman et al., 2008). Moreover, indigenous foods of different type of vegetables, fruits and wild animals were available in the study area and most of which had no or less economic value, were important source of their food.

8.2 Access to Food

Food access refers to the ability to obtain an appropriate and nutritious diet and is in particular linked to resources at the household level. Purchasing power depends on income. It is evident from the foregoing discussion in section 7.3 in *Chapter VII* that purchasing power of the hilly people as a whole was not good. Higher input prices, lower product market prices, and higher consumer market prices led them to lower income and low purchasing power of the households. It is observed from Table 6.3 (*Chapter 6*) that each household spent Tk. 40971 (58% of their total expenditures) on food (for 62% of purchased food) of their total expenditure. Opportunity cost of rest 29% of own produced food was calculated as Tk.19164. On that basis the total expenditures/household/day on food alone was arrived at Tk. 167. In the rural area food expenditures was found little higher than this in the peri-urban area. In rural and peri-urban areas expenditures on food were calculated as Tk. 210 and Tk. 140 per household per day respectively. The findings reveal that food may be available, but the households' expenditures on this item may not be sufficient to meet the actual need (nutritional intake) of the family constituting 4.5 members (See Table 4.4 in *Chapter IV).*

The other factors affecting access to food were farm size, household production, off-farm and non-farm income. A detailed analysis and description of these factors is given in section 8.6.

8.3 Utilization of Food

Food utilization refers to the proper use of food, which includes the existence of proper food processing, adequate knowledge and application of nutrition, adequate health and sanitation services. Table 7.6 as discussed in section 7.6 in *Chapter VII* indicates that a good number of households prepared and utilized their food in such a way that nutrient value of the food could be kept to a large extent. Table 7.4 as presented in section 7.5 in *Chapter VII* further showed that the nutritional status of the hilly households was satisfactory though these were not reflected in their expenditures level on food. Also expenditures level is not a good indicator of household's food or nutritional intake. In fact hilly households ate rice, fresh fish, meat, leafy vegetables, others vegetables, potato, fruits, edible oil, spices and condiments more (some far more) than the national level. Moreover, flowers, fruits, buds, stems, shoots, leaves of different known and unknown plant species, popular hilly vegetables and different kinds of wild animals and creatures could have been the important source of their food nutrients though they did not have adequate access to conventional nutrient food like milk, eggs etc. which they consumed far less than that of national average (See Table 7.3 in *Chapter VII*).

8.4 Food Security Status of Indigenous Households

The picture of the extent of household food security in the study area has been presented in Table 8.1. Calorie intake analysis reveals that the majority of the respondent households in rural and peri-urban areas were food-secured. On the other hand, the percent of food-secured households was much higher in rural areas compared to peri-urban areas. However, 35 and 48% of the indigenous households in rural and peri-urban areas were food-insecure. Majority of the food-insecure households, are calorie deficient. The amount of calorie consumed by a food insecure household was much lower (30.12%) than that of food-secured household in the study areas.

Table 8.1 Food security status of indigenous households in Khagrachari hill district

Food security status	% of households			Energy intake (kcl/capita/day)		
	Rural	Peri-urban	Both areas	Rural	Peri-urban	Both areas
Food-secure	65	52	58	3029	2884	2965
Food-insecure*	35	48	42	2126	2032	2072
All households	100	100	100	2713	2475	2594

* Food insecure households are those with a per capita per day energy intake is $\geq$2400 Kcal.

Table 8.2 shows that the food-insecure households consumed less and sold more of the total crop output they produced for meeting household cash needs. The reverse, however, was the case for the food-secured households. The sales of crops by the food-insecure households were essentially for meeting urgent cash needs such as medication for household members, food items such as rice, clothing, and preparation for other social and religious activities. This finding implies that food insecurity among indigenous households in the study area was not as a result of low output level of crops but as a result of the urgency to meet household cash needs from a single economic activity (crop production). This finding agrees with the views of Schuh (2002) who claimed that food security is more of a poverty problem and not as a result of short fall in food production.

Table 8.2 Yearly food production and its disposal pattern by indigenous households

Food security status	No. of house-holds	Food production (kg/household)/[1]			Disposal pattern/[2]		
		Rural	Peri-urban	Both areas	Consumed	Sold	Other uses/[3]
Food-secure	117	3794	2741	3326	59.2	29.5	11.3
Food-insecure	83	1042	2460	1862	35.6	54.0	10.4
All household	200	2831	2606	2719	47.7	41.2	11.1

[1] Total production of crops in kg grain equivalent.
[2] Percentage of total crop production in kg grain equivalent.
[3]Other uses include reserved for seed and given out as gift.

8.5 Relative Contribution of Food Items to Household Food Security

The relative contribution of different food items consumed by indigenous households in the study areas in attaining food security is shown in Table 8.3. The table reveals that the per capita per day intake of all the food items was much higher for food secure household compared to non-secure household. If we look at the per capita per day calorie intake scenario, we can see that more than 78% of the total daily calorie consumed by a food secured indigenous person was supplied from rice followed by vegetables (3.75%) and edible oil (3.35%). The similar results were also observed for food insecure households. This implies that rice, vegetables, and edible oil were the most important food items in the study area since major share of the total calories was derived from these food items.

Table 8.3 Contribution of food items in supply calorie for indigenous households

Food items	Food secured household			Food insecure household		
	Qtty. intake (g/capita/day)	Calorie intake (kcal/capita/day)	% calorie supplied	Qtty. intake (g/capita/day)	Calorie intake (kcal/capita/day)	% calorie supplied
Rice	650.52	2316	78.11	438.01	1559	75.26
Maize	3.76	13	0.43	1.37	5	0.23
Pulses	7.34	25	0.85	5.26	18	0.87
Fresh fish	41.80	60	2.02	27.56	40	1.91
Dry fish	12.70	36	1.20	10.42	29	1.41
Meat	30.53	37	1.26	19.63	24	1.16
Milk	10.76	7	0.24	8.91	6	0.29
Egg (no.)	0.11	0	0.01	0.10	0	0.01
Leafy veg.	95.93	43	1.43	91.45	40	1.96
Other veg.	288.65	111	3.75	246.70	94	4.53
Potato	80.36	78	2.63	71.75	70	3.36
Tomato	55.17	11	0.37	39.04	8	0.38
Fruits	60.82	55	1.87	41.65	37	1.80
Edible oil	11.04	99	3.35	9.62	83	4.03
Spices	32.02	55	1.85	26.49	47	2.27
Sugar/Gur	3.28	13	0.44	1.52	6	0.29
Toddy/Tary	9.49	6	0.19	7.59	6	0.27
Total	**1394**	**2965**	**100**	**1047**	**2072**	**100**

8.6 Determinants of Food Security

Household food security is likely to be determined by different socio-economic factors. The results of the logistic regression model as shown in Table 8.4 and 8.5 have been discussed in the following sections.

8.6.1 Farm land size (X_1)

Farm land size is expected to affect food security status of households positively. According to Najafi (2003), food production can be increased extensively through expansion of areas under cultivation. Therefore, under subsistence agriculture, holding size is expected to play a significant role in influencing farm households' food security.

According to results reported in Tables 8.4 and 8.5, and keeping the other variables in the model constant, farm size is positively and significantly related to the probability of a household being food secure. According to Table 8.5, the marginal effect of a unit change in farm size (decimal), computed at sample mean of holding size, on the probability of food

security is 0.0003345. This means that the probability of food security increases by about 0.0335% for a one hundred decimal increase in farm size.

8.6.2 Dependency ratio (X_2)

Dependency ratio of the indigenous households has a negative relationship with food security. It implies that the households with more earning member are more food-secured than the large households with less earning members. This relationship is not significant in this study.

Table 8.4 Maximum likelihood estimates of variable determining food security among the indigenous hill people of Khagrachari hill district

Explanatory variables	Coefficients	Standard Error	z-statistic	Probability (P>z)
Constant	0.6886929	0.7160041	0.96	0.336
Farm size (X_1)	0.0022734*	0.0012534	1.82	0.070
Dependency ratio (X_2)	-1.0192530	0.9540277	-1.07	0.285
Off-farm income (X_3)	0.0000240***	0.0000078	3.08	0.002
Own production (X_4)	0.0007661***	0.0002444	3.13	0.002
Input cost (X_5)	-0.0005339***	0.0001930	-2.77	0.006
Education (X_6)	-0.1788711***	0.0511104	-3.50	0.000

Note: LR Chi-square = 39.12; No. of observation = 200; Log likelihood = -92.90826
***Co-efficient significant at 1% level; *Co-efficient significant at 10% level;

8.6.3 Off-farm income (X_3)

Off-farm income includes those incomes which come from wage labour, service, petty business, bamboo and firewood sale, timber sale, etc. FAO (1999) reported that employment in off-farm and non-farm activities was essential for diversification of the sources of farm households' livelihoods; it enables households to modernize their production by giving an opportunity to apply the necessary inputs, and reduced the risk of food shortage during periods of unexpected crop failures through food purchases. In this study, sample ethnic households diversified their incomes by selling firewood, timber, many other forest products, and working on farms and non-farms as daily labourers. Diversification of sources of income was a survival strategy of the respondent households to reduce the risk of starvation for themselves and their families during the periods of stress situation and temporary food insecurity.

Table 8.4 shows that yearly off-farm income had a positive and highly significant relationship with the probability of food security. Table 8.5 shows that the probability of being food secured increased with an increase in off-farm income of the sampled households. The probability of food security among sample indigenous households will be increased by 0.35% with the increase in off-farm income of Tk.1,00,000 per year (Table 8.5). It also implies that the households diversifying their income adequately were more food-secured than the households not being unable to diversify their income.

8.6.4 Household crop production (X_4)

Household aggregate crop production had a highly significant and positive influence on food security (Table 8.4). In other words, keeping the other variables in the model constant, household aggregate crop production was positively and significantly related to the probability of a household being food secure. The probability of household food security will be increased by 0.113% if the household aggregate production is increased one ton per year.

Table 8.5 Marginal probability of factors that determine food security among the indigenous hill people of Khagrachari hill district

Variables	dy/dx	Std. Err.	z-statistic	Probability (P>z)	Elasticity
Farm size (X_1)	0.0003345	0.00018	1.84	0.065	0.558
Dependency ratio (X_2)	-0.1499455	0.14076	-1.07	0.287	-0.399
Off-farm income (X_3)	0.0000035	0.00000	3.24	0.001	1.154
Own production (X_4)	0.0001127	0.00003	3.60	0.000	1.331
Input cost (X_5)	-0.0000785	0.00003	-2.93	0.003	-0.935
Education (X_6)	-0.0263143	0.00730	-3.60	0.000	-0.759

8.6.5 Input cost (X_5)

Input cost includes the cost of fertilizers and seed per season. According to the literature, subsistence farming, by its nature, is producing for direct consumption. Any farm input that augments agricultural productivity is expected to boost the overall production. This contributes towards attaining household food security (Brown, 2004). Rutsch (2003) and

Smith and Huang (2000) also found that fertilization of farmland can boost agricultural production and influence the food security status of a household.

A significant negative relationship was found between input cost and the probabilities of a household being food secure (Tables 8.4). This means that the likelihood of food security decreases with the increase in input cost. According to Table 8.5, the probability of food security will be decreased by 0.78% with the increase of input cost of Tk. 10,000 per year.

8.6.6 Education of the household's heads (X_6)

Year of schooling may create some opportunity to increase the household income if there are sufficient job opportunities available for them. In the study area, the literacy rate of the household heads was very poor, which reduce the chance of income increasing. Therefore, this variable had no effect on household income of the sample indigenous households. This finding is consistent with the result found by Miah et al. (2010).

Chapter IX

RISK OF LIVELIHOOD AND COPING STRATEGY

Risk and uncertainty may be of natural and non-natural type which is beyond direct control of the households. In the study area ill defined land right of the hillocks, social conflict among the villagers for hillocks, inadequacy of technology including irrigation technology, unorganized product market are the common constraints in livelihood and in turn food security. The non-natural constraints and particularly the risks and uncertainty including natural disasters affect all other three dimensions of food security. This section describes the risk of livelihood and coping strategies of the ethnic households.

9.1 Risks of Livelihoods in Hill Areas

Risk of livelihood or vulnerability refers to unpredictable events that can undermine livelihoods and cause them to fall into poverty or destitution. Some of these events have a sudden onset (e.g. cyclones) while others develop over a long period (e.g. soil fertility, conflict), but all can have negative effects on livelihoods (FAO and ILO, 2008). Livelihoods are secured when households have secured ownership of, or access to, resources and income earning activities, including reserves and assets, to off-set risks, ease shocks, and meet contingencies (CARE, 2002).

The hilly people identified several risk factors and constraints in improving their livelihood. The highest 54% respondents reported that lack of modern technology was a problem for them followed by high price of inputs (50%), lack of organized output market (46%), undefined land ownership (40%), rat flood (41%), reduction of land productivity (40%), heavy rainfall (31%), drought (24%) and crop damage by wild pig (23%). Table further shows that intensity of these risk factors was not same in rural and peri-urban areas though all these were reported in both the areas (Table 9.1). Detailed description of the livelihood risks factors are given below.

Table 9.1 Responses of sample households on the risks of livelihood in hill areas

Factors of livelihood risk	% of responses		
	Rural area	Peri-urban area	Both areas
No. of respondents	*100*	*100*	*200*
1. Undefined land ownership	55	25	40
2. Reducing land productivity	58	22	40
3. Rat flood	62	20	41
4. Crop damage by wild pig	30	15	23
5. Lack of modern technology	59	48	54
6. Heavy rainfall	38	24	31
7. Drought	28	20	24
8. Higher price of inputs	55	45	50
9. Lack of organized output market	57	35	46

Source: Household Survey, 2009

9.1.1 Undefined land ownership

The land rights in the CHT can be of two types: private right and common right. Private land rights means the right of the individuals, the hill people or the Bengalis, on any particular piece of land with full legal written document and land title. On the other hand, the customary rules practiced in the CHT for many centuries accede to the right of the hill people to common use of available land for *Jhum* cultivation, hunting and collection of forests products (Roy, 1998). It is fact that in tribal areas, *Jhum* land was allocated to cultivators by the chiefs against payment of taxes. Historically, the chiefs have been conservative and reluctant to allow innovations which might weaken their authority.

Since land ownership in CHT is not clearly defined, there is little interest in investing in soil, which has led to the deterioration of faunal and microbial organisms, top soil loss, and land degradation due to slashing and burning during the period of heavy rainfall (Gafur, 2001). Hill farmers, therefore, face a bleak future, with *Jhum* cultivation becoming increasingly unsustainable.

9.1.2 Reducing land productivity

Hill people have been practicing shifting cultivation (*Jhum*) from time immemorial. It is closely related with the socio-cultural settings of some hill communities. In the past, they practiced *Jhum* in the same area with a fallow period of 15-20 years, which ensured the long-term sustainability of soil fertility. But, with the rapid growth in population, the fallow period has been reduced to 3-4 years, allowing very little time for soil regeneration (Riessen, 2000). Therefore, the productivity of hill soil is continuously reducing year after year. The recent study conducted by Miah and Islam (2007) showed that the average revenue received from two principal *Jhum* crops, namely, turmeric, and rice have gradually increased with the increase in the fallow period. A similar trend was also observed for other crops. Nevertheless, per ha gross as well as net return also increased with the lengthening of the fallow period (Table 9.2).

An integrated socioeconomic and erosion study on the sustainability of traditional shifting cultivation (*Jhum*) carried out in 1998 and 1999 in the CHT of Bangladesh expressed the concern that the system non-sustainable under the current conditions with fallow periods of only 3-5 years (Borggaard et al, 2003).

Table 9.2 Profitability of growing *Jhum* crops under different fallow periods

(Tk per ha)

Particulars	Length of fallow period of hill				All years
	Three year	Four year	Five year	Six year	
A. Gross cost					
Total cost	21013	25142	22583	22654	22938
Variable cost	10196	8871	10164	10417	9914
B. Gross benefit	21699	27724	29346	32465	27700
C. Gross margin	11503	18853	19182	22048	17786
D. Rate of return					
Over total cost	1.03	1.10	1.30	1.43	1.21
Over variable cost	2.13	3.13	2.89	3.12	2.79

Source: Adapter from Miah and Islam, 2007

9.1.3 Rat flood

Natural constraints like rat flood have been an unprecedented risk in the recent years. One report says (BSS, 2009) that rodent crisis or extreme prevalence of rat flood has been persisting in the CHT areas since 2007. Some households reported that even they had to

migrate out of the villages for rodent crisis and the households were provided with emergency food support.

Some of the households reported that rat flood was mostly a recurring problem in the study areas. It happens every year with slight exception in the way that when hilly bamboo flowers die naturally after generating highly nutritious bamboo fruits, which rats consume and get extra power to breed up to eight times a year against a normal practice of twice. The rat ate away substantial amount of food in fields and stored food grains at home. Farmers generally do not take any protective measure against these huge numbers of rates.

9.1.4 Crop damage by wild pig

Jhum crops are usually damaged by wild pigs. This is also a recurring problem in the study areas. On the average 23% of the respondents mentioned it as a risk of their livelihood.

9.1.5 Lack of modern technology

It was observed that in hill areas traditional crops were grown mainly for home consumption and households were not very much aware of modern technology. Due to lack of modern crop varieties the hill farmers were receiving low production compared to other farmers in the plain areas. Unavailability of modern irrigation facilities was also a big constraint for higher crop production. In valley land *Chhara Gang* (a narrow flow of water) was the only source of irrigation water. Some farmers opined that modern technology was not environmentally suitable for hilly region.

9.1.6 Variability in weather

The main sources of production risk were variability in weather such as causing drought, hails and storm and flash flood during the crops growing seasons. Bangladesh has three crop seasons: Kharif-I (March to June), Kharif-2 (July to November) and Rabi (December to April). Extreme variability of rainfall is the main source of weather risks that causing variability in yield. The Kharif-2 and Rabi crops are affected by drought in upland, and by flash flood in the lowland. Hails and storm are also found to be problematic in the study areas.

9.1.7 Economic risk

The hill farmers in the study areas face economic risk because of market fluctuations and related economic phenomena occurring over time. One important source of economic risk is lower output price and higher input price. There is uncertainty in output price as it fluctuates over time.

From the above discussion it may be concluded that sustainable food security in the study area may be hindered by all these natural and non-natural constraints from all concerned including the households and as a result they may be deprived of food security as a whole.

9.2 Coping Strategies of the Households in Stress Situation

A coping strategy is a short-term response to threats to livelihoods. Coping strategies can be successful when they are able to preserve vital assets, or negative when they are unable to do so and may lead to downward spirals of impoverishment. (FAO and ILO, 2008). The coping strategies may be two types namely consumption and non-consumption coping strategies. Consumption coping strategies mostly related to food consumption and it can be done quickly (today or tomorrow) as well as reversible, and non-consumption coping strategies is related to asset sale and so on (Maxwell *et al.*, 2003).

This section depicts how the households met their demand for food and other necessities during various stress situations (i.e. crop damage, heavy rain, lack of wage labour, illness, etc) in their own way. Table 9.3 reveals that the highest 51% households sold labour during various kinds of stressed situations followed by use of previous savings (34%), borrowed money (22%), sale of livestock (22%), poultry (28%) and fruit (18%), and bamboo/fuel/ wood/ timber. It showed that they had little option to face the emergency situation while little or no savings were in their hand.

Table 9.3 Responses of sample households on coping strategies during stress situation

Coping strategy	% of responses		
	Rural area	Peri-urban area	Both areas
1. Labour sale	57	45	51
2. Use previous savings	26	42	34
3. Borrow money from others	15	29	22
4. Livestock sale	33	15	24
5. Poultry sale	35	21	28
6. Fruit sale	21	15	18
7. Bamboo/fuel wood/timber sale	45	11	28

Source: Household Survey, 2009

Chapter X

CONCLUSION AND POLICY RECOMMENDATIONS

10.1 Conclusions

Most of the sample respondents and their family members were illiterate. About three members per household were dependent on others income. Agriculture and service were the dominant occupation of rural and peri-urban households respectively. Most households owned a living house an average number of 1.39 cows, 2.07 pigs/goats, and 8 chickens. Some households owned modern amenities like mobile phone and TV. They had a good number of timber and fruit trees. All these assets made their overall livelihood standard higher to some extent.

Indigenous households used upland, plain land, and homestead area for crop production using primitive agricultural implements. The average sizes of cultivated upland, plain land, and homestead were 0.188 ha, 0.304 ha, and 0.077 ha respectively. Upland was mainly used for producing seasonal indigenous crops, vegetables, fruits, and different forest trees. *T. Aman and Boro rice* were grown mainly on plain land or valley land. Homesteads were also used for producing different types of vegetables, fruits, and timber trees. It was observed that 19 different types of crops were grown as mixed crops under *Jhum* cultivation. Irrespective of crops a *Jhum*ia household harvested a total of 517.72 kg of crops valuing Tk. 8300 from upland cultivation. Besides, they received 1166 kg paddy valuing Tk.16776 from plain or valley land and 59.38 kg of vegetables valuing Tk.1200.77 from homestead area.

Forest and hill areas were much higher in rural areas compared to peri-urban areas. Rural households were largely dependent on upland cultivation, but sample rural households cultivated more on plain lands than the peri-urban households. Therefore, the income of rural households from plain land was much higher (77%) than uplands. This result might be opposite in the real situation. The hill farmers faced difficulties because their traditional *Jhum* agriculture was noted to be become increasingly unsustainable. They had to farm more intensively and this was causing a whole host of environmental and social problems.

Nevertheless, the *Jhum* crops were damaged by wild animals. Their food security was threatened by all these factors.

Both income and expenditure of rural households were higher than those of the peri-urban households. Rural households were mostly dependent on farm income (49%) whereas peri-urban households depended mostly on non-farm activities especially on services. The other sources of household incomes were non-farm activities (47%), livestock rearing (9%), and other sales (15%) like bamboo, wood, timber, sweeping materials, etc. Both rural and peri-urban households spent the highest income for collection of food followed by crop cultivation. Their annual savings were very low.

Limited farm supplied foods were left for household consumption due to sale at and immediately after harvest. The households were largely dependent on purchased food. Own production of the staple food rice could meet demand for about 5.56 months a year. Rural households were less dependent on purchased food compared to peri-urban households. Assistance from government or other sources was considered to be limited. Households had to depend largely on various indigenous foods like vegetables and wild animals of low or no market value. The purchasing power of the ethnic households was in general poor. They had limited options and alternatives for income generation. They were compelled to go under imperfect market situation and prices of output were distorted. In many events they had to go under complicated procedure in marketing their timber products. Especially in marketing fruits they had to pay taxes to different authorities at different places. They had to also pay bribe for transferring farm products from one place to another. These situations led to a lower price in the product market and higher price in the consumer market further reducing their real income and purchasing power.

Indigenous households' consumption behaviour revealed that indigenous household members ate rice, fresh fish, meat, vegetables, potato, fruits, and spices more than the national average. They consumed egg, milk and sugar or molasses far below the national average. Ninety two percent rural households and 96% peri-urban households ate rice thrice a day. Items like fruits, vegetables, root and tuber crops, snails, frogs and crabs were eaten seasonally. In general, rural households consumed higher amount (5%) of different foods in comparison to peri-urban households. The seasonality in consumption did not vary much between rural and

peri-urban areas except little exception. Peri-urban households showed better knowledge in washing rice before cooking, in cooking leafy vegetables and using rice starch compared to rural households.

The food consumption of the indigenous households revealed that the energy and nutrient intake (e.g. energy, protein, calcium, and iron) was more than the recommended allowances stipulated in some of the countries in the region. The per capita consumption per day of calories, protein, fat, calcium, and iron were estimated at 2594 kcal, 72.23g, 21.06g, 851.58mg, and 46.70mg respectively. Rural households consumed energy, protein, and iron 8.77, 3.82, and 7.84% higher respectively than the peri-urban households. Again, the per capita per day intake of calcium by peri-urban households was 0.79% higher than that of rural households. Fat consumption was mostly same for both types' households.

Based on calorie intake, most of the sample households (58%) were food secure since their per capita per day calorie intake was 2965 kcal which was much higher than the minimum per capita requirement of 2400 kcal. The average per capita per day calorie intake for insecure households was 2072 kcal. The annual crop production of food secured household was 3326 kg, whereas it was 1862 kg for non-secure households. However, food insecurity among the sampled indigenous households was more of poverty issue and not due to low crop production. The reason for this assertion is that the food-insecure households sell more of their crop output to meet urgent household needs.

Both food secure and insecure households took a lion share of the energy, protein and iron from rice followed by vegetables, fresh fish, and dry fish respectively. Among various food items, rice supplied 78.11% of the total daily calorie intake followed by vegetables (5.18%), edible oil (3.35%), fish (3.22%), and spices (1.85%). This implies that rice, vegetables, edible oil, fish, and spices were the most important food security items in the study areas. Similar observations have also been found in the study conducted by Mazed (2003).

Logit model revealed that the coefficients of farm size, off-farm income, and household crop production were positive and significant which implies that these factors had a positive and significant impact in attaining food security of the indigenous households. On the contrary, dependency ratio, input cost and education had negative and significant relationship with

households' food security. Negative dependency ratio implies that small households and the households with more earning member were more food-secured than large ones.

The hilly people faced several risk factors and constraints in improving their livelihood. These factors were lack of modern technology, high price of inputs, lack of organized output market, undefined land ownership, crop damage by wild pig and rat, reduction of land productivity, and natural calamities. They identified some other problems in their livelihood. These were: loss of bio diversity, low price of output, scarcity of cultivable hillocks, hardness of soil due to burn, distance of hillock from homestead, scarcity of inputs, quarrel among the villagers for hillocks, accident due to burn. The rural and urban households had the common risks, constraints and problems.

In the absence of adequate assistance, households in the hilly area met the stress situation in their own way. Sample households sold labour during various kinds of stressed situation followed by use of previous savings, borrowed money, selling of livestock, poultry and fruits, and bamboo/fuel/wood/ timber. They had little option to face the emergency situation with little savings in their hand.

10.2 Policy Recommendations

Based on the findings of the study, the following policy recommendations have been suggested to improve crop production system, food consumption level, livelihood pattern, and coping strategies of indigenous households in various stress situations.

A. Jhum farming

17. *Jhum* farming causes soil loss from hill, degrades soil quality, decrease crop yield, loss of bio-diversity, and causes various environmental degradations. Therefore, government should consider taking immediate steps to gradually deduce *Jhum* cultivation through replacing alternative technology suitable for upland cultivation.
18. Hill farmers have been practicing *Jhum* farming since time immemorial in a situation where there is scarcity of plain land. They are not acquainted with modern cultivation practices. Therefore, *Jhum* farming cannot be suddenly discontinued. In this situation,

Jhum cultivation should be modernized through replacing *Jhum* crops with modern crop varieties suitable for hill farming.

19. The soil conservation technology named Multi Strata Fruit Orchard (MSFO) was found profitable and could have the potential to improve hill people's livelihood. The adoption of this technology is capital intensive. The government would need to make provisions for adequate capital aid and monitoring mechanisms for successful implementation of this technology.

20. Indigenous people need to be motivated towards improvement of hill soil since the land ownership is not well defined. On the other hand, limited land per household is one of the important bottlenecks for food shortage. Therefore, serious thought should be given to appropriate land use policy defining the land right of the households, conflicts and quarrels among the villagers regarding hillocks, through separate and appropriate land use policy and active participation of local public representative.

B. Crop management practices

21. There is huge potential in the hill areas for agricultural development. Bangladesh Agricultural Research Institute (BARI) should work more in these areas evolving new varieties and management practices to increase the production of crops, vegetables, and fruits. Similarly, Bangladesh Rice Research Institute (BRRI) should undertake further research programme to bring out new varieties of rice adaptable to local soil, climatic and socio-economic condition.

22. Drought and heavy rainfall are common characteristics of hilly areas. All crops and varieties might not perform well in the hilly areas. Appropriate crops and varieties should be selected for each particular *Jhum* area depending upon its slopes and steepness. Agricultural Extension Department can assist the farmers in selecting right crops in each particular *Jhum* areas. Further research should also be done to assess the appropriate seed rate, fertilizers rate, planting depth, water management, weed management, line spacing, crop management, and farming practices of different *Jhum* and plain land cultivation. Hill Research Station, BARI located at Khagrachari that was established for improving the socio-agro-economic condition of hill areas should exploit its full potential and mandate related to this.

C. Inputs supply

23. The availability of production inputs like seed, fertilizers, irrigation, and insecticides are important for higher production. Therefore, the government should provide HYV seed to the hill farmers through its agencies. Irrigation is complementary to HYV and improved variety. Therefore, suitability of irrigation should be studied by the hydrological department and irrigation facilities to be facilitated immediately by the concerned authority to the hill area particularly in the valley areas.

24. Farmer in the hilly areas have been suffering from rat flood since 2007 causing serious crop loss in the field and at home. Though at present, prevalence of this was less than before, farmers are scared of the rat and many of them reported it to be a serious problem for loss of their crops. The Vertebrate Division of BARI can launch and initiate a new research programme with the collaboration of other concerned authorities to find out the causes and appropriate measures to control the rat.

25. Since the indigenous households sell part of their farm products and depend largely on purchased food, proper attention should be given to eradicate the marketing bottlenecks. Modern storage facilities should be developed at grass root levels to ensure their product prices and food security. Adequate price and marketing information disseminated through internet and other media can help to ensure fair price of their product. Adequate transport facilities should be developed to market their agricultural products in distant markets up to Chittagong city. The farmer households should be relieved from all the illegal tolls and bribes and, particularly all the official complications in selling timber should be removed to ensure marketing cost at lower level and growers share at higher level.

D. Food consumption and nutrient intake

26. It is understood that the indigenous households collect and gather food (e.g. vegetables and wild animals) from the hilly areas which are an integral and important source of their dietary nutrient intake. These indigenous foods especially the various plant species should be popularized through a massive awareness programme to the other parts of Bangladesh. The households can get an avenue for income generation through commercialization of these plant species. The medicinal value of these species should be scientifically documented and serious consideration should be given to research on the

food composition and nutritional contribution of indigenous foods. Logit function revealed that dependency ratio had negative impact on food security. Besides, government can minimize dependency ratio through creating new jobs and income generating activities in the study areas.

27. The role of livestock and poultry is important in attaining food security since it can generate off-farm income and supply nutrition for the farmers. Therefore, the government should take necessary steps to reduce livestock and poultry diseases and provide better extension services.

28. In different stress situations indigenous hill people remained helpless and survive on their small savings, livestock, and other irregular non-farm and off-farm activities. Therefore, the government should establish cottage industries for the indigenous people. Government may also introduce programmes like *Kajer Binimoi Khadda* (KABIKA) and *Kajer Binimoi Taka* (KABITA) in the study areas.

29. Different social safety net programs like VGF, VGD, Aged Old Allowances, Widow Allowances, and Disabled Allowances, etc. may also provide more effective support to the vulnerable ethnic households during stress situations.

10.3 Areas for further research

The major areas for further research were identified as under:

- Study of the impact of alternative cropping patterns to discourage shifting cultivation for enhancing food security in CHT.
- Assessment of changing climate impact on crop production in CHT.
- Assessment of impact of the intensive crop production in valleys and foot slopes for uplifting food security in CHT.
- Assessment of food aid program and role of NGO's activities on attaining food security in the CHT.
- Feasibility study on livestock and fishery based agro-forestry programs for sustainable food security.

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Appendix Tables

Table 1. Annual household income of the sample farmers from *Jhum* cultivation

(Figures in Tk/farm)

Particulars	Rural area	Peri-urban area	Both areas
A. Cost of production			
1. Labour	22914.85	26188.8	23208.5
2. Seed	6711.6	6249.6	6543.6
3. Fertilizer	95.41	44.64	85.12
Total cost	29721.86	32497.92	29837.22
B. Gross return	0	0	0
1. Paddy	10613.54	13466.4	10988.46
2. Maize	384.93	818.4	457.52
3. Sesame	1740.41	2008.8	1766.24
4. Turmeric	13683.11	17350.08	14164.5
5. Ginger	9534.42	2916.48	8230.04
6. Chili	1411.41	446.4	1220.94
7. Sabarang	227.01	0	183.54
8. Potato	240.17	0	194.18
9. Arum	526.4	178.56	457.52
10. Brinjal	1329.16	252.96	1119.86
11. Country bean	329	297.6	319.2
12. Okra	292.81	0	236.74
13. Sweet gourd	394.8	74.4	332.5
14. White gourd	210.56	0	170.24
15. Ridge gourd	62.51	119.04	71.82
16. Yard long bean	256.62	639.84	321.86
17. Miasak	148.05	0	119.7
17. Marfa	3046.54	3392.64	3069.64
19. Simul Alu	773.15	595.2	731.5
Gross return	45204.6	42556.8	44156
C. Gross margin(B-A)	15482.74	10058.88	14316.12
D. Gross margin excluding labour cost	38397.59	36247.68	37524.62

Average sale prices (Tk/kg): Paddy = 5.92; maize = 12.35; Sesame = 45.79; Ginger = 40.33; Turmeric = 12.57; Chili = 30.39; Sabarang = 29.60; Simul alu = 11.40; Marfa = 15.10; Arum = 12.62; Potato = 15.80, Brinjal = 16.31; Country bean = 13.91; Okra = 20.08; Pumpkin = 13.19; White gourd = 10.17; ridge gourd 17.71; Miasak = 12.45; Yardlong bean= 19.33.

Source: Household Survey, 2009

Table 2. Annual household income sample households from plain land crop cultivation

(Figures in Tk/ha)

Cost and returns	Plain land crops			Total
	T. Aman rice	Boro rice	Other crops	
A. Rural area				
Labour cost	10420.86	11233.6	17112.48	38766.94
Seed cost	2071.29	1418.48	9445.2	12934.97
Fertilizer cost	2678.1	2675.12	4944.84	10298.06
Total variable cost	15170.25	15327.2	31502.52	61999.97
Yield (kg/farm)	3651.03	4369.68	3722.52	11743.23
Gross return	51680.55	61880	49281.72	162842.3
Gross margin	36510.3	46552.8	17779.2	100842.3
B. Peri-urban area	0.170	0.009	0.013	0.191
Plot size (ha/farm)	0.9996	0.999	0.99996	2.99856
Labour cost	11613	9990	9384.24	30987.24
Seed cost	1940.4	1887	22152.96	25980.36
Fertilizer cost	2804.76	1554	1923	6281.76
Total variable cost	16358.16	13431	33460.2	63249.36
Yield (kg/farm)	3831.408	5328	2384.52	11543.93
Gross return	55072.08	79920	64074.36	199066.4
Gross margin	38713.92	66489	30614.16	135817.1
C. Both areas	0.232	0.057	0.015	0.304
Plot size (ha/farm)	0.99992	0.99978	1.00005	2.99975
Labour cost	10882.75	11137.9	14334.05	36354.7
Seed cost	2030.01	1455.82	15267.43	18753.26
Fertilizer cost	2728.23	2595.92	3800.19	9124.34
Total variable cost	15640.99	15189.64	33401.67	64232.3
Yield (kg/farm)	3723.84	4437.62	3266.83	11428.29
Gross return	53038.86	63319.4	57336.2	173694.5
Gross margin	37397.87	48129.76	23934.53	109462.2

(i) Average crop prices (Tk/kg): T.Aman rice = 14.20; Boro rice = 14.18, Other crops = 21.11

(ii) Other crops: Potato, tomato, brinjal, chili, radish, mustard, cabbage, etc.

Source: Household Survey, 2009

Table 3. Recommended Intakes of Nutrients

Age	Body weight (kg)	Energy		Protein (g)	Vitamin A (mgm*)	Vitamin D (mgm)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Folic acid (mgm)	Vitamin B12 (mgm)	Ascorbic acid (mg)	Calcium (g)	Iron (mg)
		Kcal	mega-joules											
Children														
< 1	7.3	820	3.4	14	300	10.0	0.3	0.5	5.4	60	0.3	20	0.5-0.6	5-10
1-3	13.4	1360	5.7	16	250	10.0	0.5	0.8	9.0	100	0.9	20	0.4-0.5	5-10
4-6	20.2	1830	7.6	20	300	10.0	0.7	1.1	12.1	100	1.5	20	0.4-0.5	5-10
7-9	28.1	2190	9.2	25	400	2.5	0.9	1.3	14.5	100	1.5	20	0.4-0.5	5-10
Male adolescents														
10-12	36.9	2600	10.9	30	575	2.5	1.0	1.6	17.2	100	2.0	20	0.6-0.7	5-10
13-15	51.3	2900	12.1	37	725	2.5	1.2	1.7	19.1	200	2.0	30	0.6-0.7	9-18
16-19	62.9	3070	12.8	38	750	2.5	1.2	1.8	20.3	200	2.0	30	0.5-0.6	5-9
Female adolescents														
10-12	38.0	2350	9.8	29	575	2.5	0.9	1.4	15.5	100	2.0	20	0.6-0.7	5-10
13-15	49.9	2490	10.4	31	725	2.5	1.0	1.5	16.4	200	2.0	30	0.6-0.7	12-24
16-19	54.4	2310	9.7	30	750	2.5	0.9	1.4	15.2	200	2.0	30	0.5-0.6	14-28
Adult man														
Moderately active)	65.0	3000	12.6	37	750	2.5	1.2	1.8	19.8	200	2.0	30	0.4-0.5	5-9
Adult women														
(Moderately active)	55.0	2200	5.2	29	750	2.5	0.9	1.3	14.5	200	2.0	30	0.4-0.5	14-28
Pregnancy														
(later half)		+350	+1.5	38	750	10.0	+0.1	+0.2	+2.3	400	3.0	50	1.0-1.2	-
Lactation														
Ffirst 6 months)		+550	+2.3	45	1200	10.0	+0.2	+0.4	+3.7	300	2.5	50	1.0-1.2	-

***** mgm = Micro gram

Source: Handbook on Human Nutritional Requirements FAO Nutritional Studies No. 28/WHO Monograph Series No. 61, FAO, Rome 1974.

Table 4. Summary statistics of the variables used in logit model

Descriptive Statistics	Calorie intake (Kcal)	Dependency ratio	Farm size (dec)	Input cost (Tk/year)	Of-farm income (Tk/year)	Own prod^{n} grain_equv. (kg)	Education (No. of schooling)
Mean	2594	0.548	263.92	1762.15	48198	1741.50	4.245
St. Error	40	0.014	16.34	124.14	2412	151.16	0.2841
Median	2563	0.600	220.00	1348	42100	1247.00	5
Mode	2302	0.500	200.00	0	26000	0	0
St. Devi	566	0.202	231.10	1755.61	34113	2137.67	4.0181
S. Variance	320213	0.041	53408	3082161	1163716366	4569647	16.146
Kurtosis	0	1.321	1.88	0.8097	8	21.14	-1.4409
Skewness	0	-0.489	1.36	1.1525	2	3.62	0.2718
Range	3231	1.250	1180.00	8001	252000	18359.00	12
Minimum	1272	0	0	0	0	0	0
Maximum	4503	1.250	1180	8001	252000	18359	12
Count	200	200	200	200	200	200	200

Table 5. Maximum likelihood estimates of variables determining food security

Logit Estimates (Software: STATA)

Iteration 0: log likelihood	=	-112.46703
Iteration 1: log likelihood	=	-96.536929
Iteration 2: log likelihood	=	-93.297666
Iteration 3: log likelihood	=	-92.91596
Iteration 4: log likelihood	=	-92.908264
Iteration 5: log likelihood	=	-92.90826

Number of observation	=	200
LR chi2 (9)	=	39.12
Prob > chi2	=	0.0000
Pseudo R2	=	0.1739
Log likelihood	=	-92.90826

Variables	Coefficients	Standard Error	z-statistic	Probability (P>z)	[95% Conf. Interval]	
Farm size	0.0022734	0.0012534	1.81	0.070	-.0001831	0.00473
Dependency ratio	-1.0192530	0.9540277	-1.07	0.285	-2.889113	0.8506065
Of-farm income	0.0000240	7.79e-06	3.08	0.002	8.74e-06	0.0000393
Own production	0 .0007661	0.0002444	3.13	0.002	0.0002871	0.0012451
Input cost	-0.0005339	0.000193	-2.77	0.006	-0.000912	-0.000155
Education	-0.1788711	0.0511104	-3.50	0.000	-0.279045	-0.078696
Constant	0.6886929	0.7160041	0.96	0.336	-0.714649	2.092035

Note: 0 failures and 1 success completely determined.

Table 6. Marginal effects after logit

Y = Pr (food security) (predict) = 0.8207599

Variables	Coefficients	Standard Error	z-statistic	Probability (P>z)	[95% Conf. Interval]	
Farm size	0.0003345	0.00018	1.84	0.065	-0.000021	0.00473
Dependency ratio	-0.1499455	0.14076	-1.07	0.287	-0.425823	0.125932
Of-farm income	0.00000353	0.00000	3.24	0.001	1.4e-06	5.7e-06
Own production	0 .0001127	0.00003	3.60	0.000	0.000051	0.000174
Input cost	-0.0000785	0.00003	-2.93	0.003	-0.000131	-0.000026
Education	-0.0263143	0.0073	-3.60	0.000	-0.040625	-0.012003

Table 7. Correlation among independent variables

	farmsize	d_ratio	farmin~e	offfin~m	cdiownpro	inputcos	educat	ah_size
Farm size	1.0000							
Dependency ratio	-0.0722	1.0000						
Farm income	0.5689	-0.1048	1.0000					
Off farm income	-0.1133	0.1169	-0.1592	1.0000				
Crop diversification index	-0.1516	0.0605	0.0072	-0.0569	1.0000			
Own production	0.4082	-0.2191	**0.8085**	-0.2080	0.0246	1.0000		
Total input cost	0.5629	-0.1289	0.5901	-0.1717	0.0004	0.6284	1.0000	
Education	-0.0463	0.2239	0.0776	0.2780	0.1255	0.0408	-0.0236	1.000
Adjusted household size	0.2777	0.0648	0.3704	0.173	-0.0046	0.223	0.358	0.011	1.00