

Role of Forest in Household Food Security: Evidence from Rural Areas in Nepal

Keshav Lall MAHARJAN* and Arun KHATRI-CHHETRI**

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I. Introduction

Forests play a crucial role in the economic life of Nepal, where almost 84 percent of the population live in rural areas and depend heavily on subsistence agriculture. Nepal comprises around 4.27 million hectares (29%) of forest, 1.56 million hectares (10.6%) of shrubland and degraded forests, and 1.75 million hectares (12%) of grassland (MFSC, 2000). Forest plays critical role in the livelihood of the rural people. Majority of the rural households depends on forest resources to meet subsistence needs for staple and supplemental foods, construction materials, fuel, medicines, cash, local ecosystem services and farm inputs, such as, animal feed and nutrients for crops. In rural areas, the contribution of forests to food supply is essential for food security, as they provide a number of important dietary elements that the normal agricultural produce does not provide adequately or help bridge 'hunger periods' when stored food supplies are dwindling and the following harvest is not yet available.

In the rural areas, the problem of food insecurity is not simply one of the

*Graduate School for International Development and Cooperation, Hiroshima University.

**Ph. D. Student at Graduate School for International Development and Cooperation, Hiroshima University.

agricultural outputs, but encompasses all factors affecting a household's access to an adequate year round supply of food. Thus, the problem of household food security also includes seasonal variations in food supply, access and availability of fodder and other forest food, and other non-farm income opportunities (Falconer and Arnold, 1991). In many rural areas, forests and farm trees play an important role in household food security. Many forestry activities have an impact on rural people's food situation, both, directly and indirectly.

In recent years, there has been increasing interest in the contribution that common forest provides to rural employment and income. Large numbers of rural people generate income from forest products, which is often important in filling seasonal or other cash flow gaps, and in helping them to cope with particular expenses or to respond to unusual opportunities (Arnold and Bird, 1999). Forest products collection activities can be very important to the poor people in situations in which they are unable to obtain income, or sufficient income, from agriculture or wage employment, and any other options that exist in village. The poor usually derive a greater share of their overall needs from forestry products and forestry activities (Ogle, 1996). Cavendish's (2000) study from Zimbabwe, for example, shows that environmental resources in some rural areas account for more than 40 percent of average total household income and the poorer the household the greater the share of income from these resources. This is partly due to the fact that they are more likely to be dependent on forest resources for their livelihood as they have no capital and few productive assets (Sterner, 2003). The level of extraction of the forest products depends on socio-economic characteristics of households (Adhikari, 2003). According to Adhikari, households that are rich in private assets, such as, land, livestock, household size [labor], etc. can draw more benefit from the community forests. However, the income from forest products seldom appears to account for a large share of a household's total income, as they are primarily self-consumed and much care is not given to their due evaluation.

Hence, this paper seeks to understand the role of different economic activities, including collection of forest products, on household economy in rural areas of

Nepal. The specific objectives of this paper are: (i) analysis of various income sources according to different economic activities; (ii) find out the contribution of forest products through direct income generation; (iii) find out the supplementary role of forest to supply food as an insurance during the self-food deficit time; and (iv) discuss the indirect role of non-food forest products to enhance the rural livelihood.

Rest of the paper is organized as follows. Second section briefly discusses the hill farming system and food security management. Description of study sites, methods and data collection is in section three. Sections four, five, six and seven include results and discussion of the study. Finally, the paper concludes in section eight with some recommendations.

II. Hill Farming System and Food Security Management

In hills of Nepal, the majority of farmers operate mixed farming system integrating crop and livestock with forest resources. Landholdings are small and fragmented, consisting mostly of marginal uplands. In this farming system there is a dynamic relationship between forest resources, livestock and crops (Maharjan, 2003; Tulachan and Neupane, 1999). The components of hill farming system in Nepal are shown in Figure 1. The forest is the foundation upon which the whole

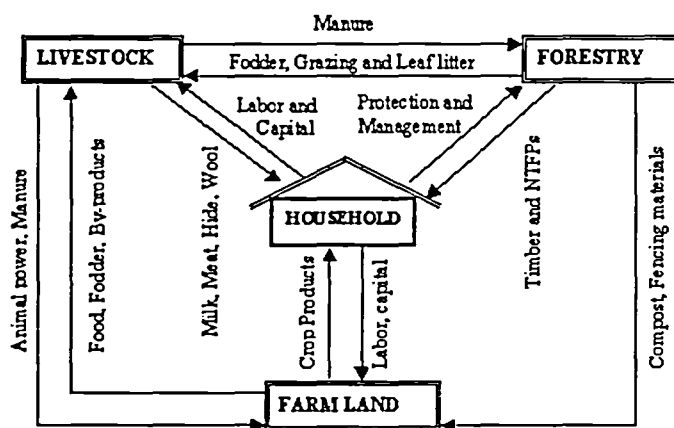


Figure 1 Components of hill farming system in Nepal

Source: Adopted from Rejal and Petheram (2001)

sustainability of hill agriculture is based. It provides raw materials in the form of forage and fodder for animal feed, leaf litter for both animal bedding and composting with dung to provide manure, and fuelwood and timber resources for heating, cooking, and construction. At the National level, forest contributes about 81 percent of the total fuel and about 37 percent of total fodder requirements of Nepal (FAO, 1999). Forest also provides products, such as, food, vegetables, fruits and medicinal products for household consumption and generation of supplementary (cash) income.

Within the overall hill farming system, the role of livestock is not only to provide milk and meat, but a major contributor in the maintenance of soil fertility, through production of organic manure from dung and dung/compost mixtures (Abington, 1992). The whole cropping pattern in the region is dependent upon the application of animal-based manure, and chemical fertilizers are seldom used. Farmers in the mid-hills, under their present circumstances, generally cannot afford chemical fertilizers, both due to the lack of cash needed to purchase them, and the cost of transportation to remote areas. In addition, oxen supply the draught power for land preparation. These animals virtually live on forest products of fodder and grass.

The most important cropping practices are maize-based on the non-irrigated *bari* (upland), and rice-based on irrigated *khet* (low land). Although rice and maize are the two major staple crops of the region, wheat, millet, barley, potato, mustard and some other minor crops also make important contributions to hill agriculture. Farmers have adopted an agroforestry system, planting fodder/fuelwood trees and cereal crops together on the terrace risers of *bari* land and on the bunds of *khet* land. Though the actual loss in crop yield due to competition of crops and trees has yet to be fully quantified in such systems, farmers do report an adverse effect on crop yields. However, the need for trees to supply fodder to the livestock has obliged the retention of trees in and around cultivated land, and the losses in crop yield are accepted as part of the price to be paid to sustain the system (Shrestha, 1992). Commonly, the role of crop residues and agroforestry is also crucial to the

livestock production.

The resource management and food procurement activities in rural household are further elaborated in Figure 2. Households generate cash and kind (food, fuel-wood, medicine, construction materials, etc.) through crop and livestock farming and use of forest resources. However, majority of households in rural Nepal are food self-insufficient and rely on other non-farm sources for food procurement (Maharjan and Khatri-Chhetri 2005). In order to fulfill their livelihood demands the farmers increasingly turn to non-farm activities, both agrobased and non-agrobased in nature, within the rural regions and beyond (Maharjan, 2003).

Main resources necessary for non-farm income generation are labor (skilled and unskilled) and capital. Some of the agrobased non-farm activities are agriculture laboring, such as, land preparation, crop sowing and harvesting, threshing, milling, transportation and marketing of agricultural products, and so on. The non-agrobased non-farm activities are physical construction works, small businesses, professional jobs, skill laboring, such as, making agriculture tools, tailoring, shoe making, house construction, wood work, and so on.

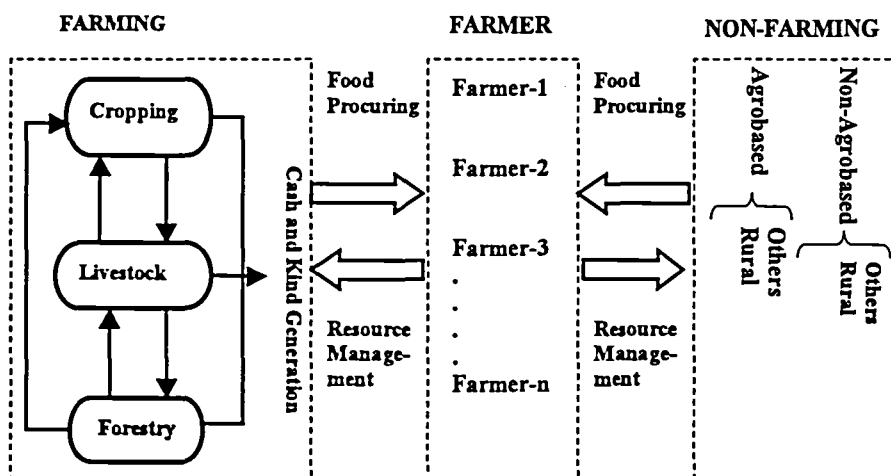


Figure 2 Resource management and food procurement in rural household
Source: Adopted from Maharjan (2003)

III. Study Sites, Methods and Data Collection

The study site for this study is Pyuthan District in Nepal located in a hilly region with a total area of 132,890 hectare, having tropical, sub-tropical and temperate climate (Figure 3). Of the total land area, 34 percent is cultivated land, 59 percent is forestland and 7 percent is other land, including degraded pastureland. The overall composite development indicator is not good for this district but the natural resource endowment is very high, 6th out of 75 districts (DDC, 2001). Agriculture is the main occupation of the people and forest is an indispensable resource for farming system of the district. Forest products found in the district includes a considerable variety of wild food, medicinal plants, such as, *tejpat* (*Cinnamomum tamale*: laurel leaves), *dalchini* (*Cinnamomum zeylanicu*: cinnamomum), *timur* (*Zanthoxylum armatum*: toothache tree), *chiraito* (*Swertia chirayita*: chiretta), fuelwood, fodder, grasses, *khar* (thatch grass), leaf litters, and so on. They are collected from common forests as well as private lands/forests. Domestication of commercially viable forest products species is common in the district. The main income sources of the people are crop cultivation, livestock raising, non-farm income through agriculture and non-agricultural laboring, within the villages and the district, government services, and seasonal out migration for labor work beyond the district, often beyond the country to India and elsewhere.

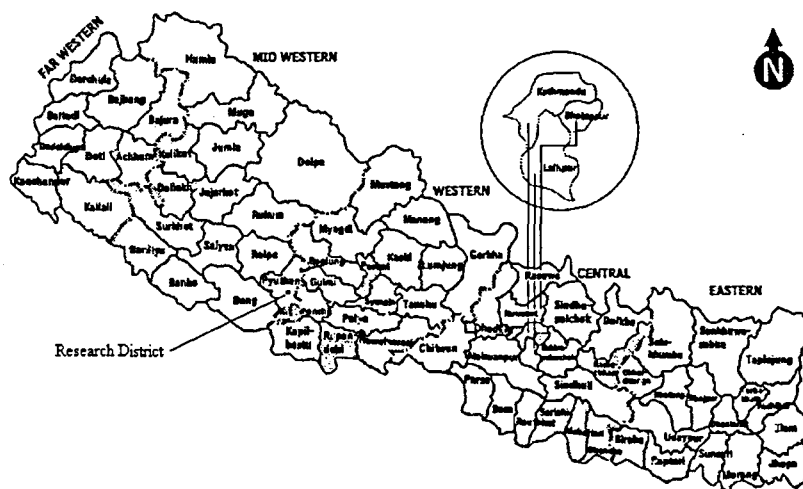


Figure 3 Map of Nepal indicating study site

or common forests. During data collection, questionnaires were designed to separate contribution of different types of forest, private and common, in the household.

Before the household survey, a checklist of all potential forest products that user households extract from the different types of forests was prepared to avoid underestimation of harvested products (Table 1). Standardization of local units (e.g., *doko*, *muri*, *pathi*, *mana*, *dharni*) into metric system units was also done during the household survey. The forest products include tree, grass, fodder, leaf litter, roots,

Table 1 Foods, fruits, vegetables, spices and medicinal plants collected from the forest

Local name	Scientific name	English name	Part use
Foods			
1. Giththa (Bantarul)	<i>Dioscorea bulbifera</i>	Air potato, Yam	- Air tuber and corm
2. Vyakur (Kukurtarul)	<i>Dioscorea deltoidea</i>	Deltoid yam	- Corm
3. Honey			- Honey of wild bee
Vegetables			
1. Kurilo	<i>Asparagus racemosus</i>	Asparagus	-Spear
2. Jaluka		Wild colocasia	-Leaf and stem
3. Sisnu	<i>Urtica dioica</i>	Stinging nettle	-Leaf
4. Nyuro		Fern	-Leaf
5. Chyau	<i>Morchella spp.</i>	Mushroom	-Shoots
6. Lude sag	<i>Amaranthus spp.</i>	Amaranth	-Leaf and stem
7. Tama		Bamboo shoot	-Young plant
Fruits			
1. Chutro	<i>Berberis aristata</i>	Indian barberry	
2. Bimiro	<i>Citrus medica</i>	Citron	
3. Amala	<i>Phyllanthus emblica</i>	Indian gooseberry	
4. Okhar	<i>Juglans regia</i>	Common walnut	
5. Kamala	<i>Mallotus philippensis</i>	Wild citrus	
6. Kafal	<i>Myrica esculenta</i>	Box myrtle	
7. Bhalayo	<i>Semecarpus anacardium</i>	Marking nut	
8. Chyuri	<i>Aesandra butyracea</i>	Indian butter tree	
9. Teju			
Medicinal plans			
1. Bojho	<i>Acorus calamus</i>	Calamus	-Root
2. Ban lashun	<i>Allium wallichii</i>	Forest garlic	-Leaf and tuber
3. Pakhanbed	<i>Bergenia ciliata</i>	Rockfoil	-Root
4. Sugandha kokila	<i>Cinnamomum glaucescens</i>		-Flower
5. Jhyau	<i>Parmelia species</i>	Lichen	-Whole plant
6. Jatamasi	<i>Nardostachys grandiflora</i>	Indian nard	-Whole plant
7. Nundhiki	<i>Osyris wightiana</i>		-Fruit
8. Majito	<i>Rubia cordifolia</i>	Indian madder	-Root
9. Chiraito	<i>Swertia chirayita</i>	Chiretta	-Whole plant
10. Pudina	<i>Mentha arvensis</i>	Filed mint	-Leaf

stems, barks and leaves of medicinal plants, wild food, fruits, etc. This study tried to calculate the forest products values on the basis of their use by the people. Local price data were collected to calculate the resource values and allowed calibration of environmental resource use value against a full accounting of the household's other economic activities.

To find out the contribution of different income sources in total income, households' incomes were calculated according to economic activities. Household income sources were grouped into five major sources, namely, (i) income from agriculture, (ii) income from livestock, (iii) income from private forest, (iv) non-farm income, and (v) income from forest resource collection from common forest.

Income from agriculture: To calculate agriculture income data, different crops cultivated by each household in a year, area and out put of these crops were collected. A checklist of per unit crop output according to land type was prepared based on district agriculture statistics to find out the more accurate estimation of household income from agriculture. To verify the accuracy of district agriculture statistics data with the study area, some key informants were interviewed and crosschecked. Key informants indicated that average yield of most of crops in the district level was slightly lower than the district level agriculture statistics. In both study sites, agriculture was mostly rain-fed and availability of irrigation was very much limited. The households for this study were mostly small-scale agriculturalists producing primarily for self-consumption. Most of the inputs are self-supplied and households rarely hired labor force or purchased other inputs like seeds, fertilizers, manure and pesticides for agricultural production. However, labor exchange practices (*parma*²⁾) were prevalent. The total gross income from the agriculture was calculated based on the crop output.

Income from livestock: The major livestock in the study area were cattle, buffalo, goat, sheep and poultry. The total income from livestock includes the value of milk, eggs, as well as animals sold and consumed by family. Dung was excluded to avoid double counting because all households used dung in agriculture production.

Labor hiring for livestock rearing was not found in this area. Inputs for the livestock were self-supplied and collected from the common property resources.

Non-farm income: Income from wage laboring, business, professional work (teaching, government and non-government employment) within the district, remittance and pensions are included as non-farm income. The temporary migrants working in the cities and foreign countries and remitting money are also regarded as household members in this study, since they are important members in the household not only remitting much needed cash but also consuming it upon their return to the village.

Income from private forest: Households used most of the outputs derived from the private forest in livestock and agricultural production. Income from the private forest included selling of highly valuable commercial forest products, timber and value of subsistence use for livestock and agriculture production. Commercially valuable forest products like *timur*, *dalchini*, *rittha* (*Sapindus mukorossi*: soap nut) and *chyuri* (*Bassia butyracea*: Indian butter tree) are collected from private lands.

Income from forest resource collection: Income from non-food forest products extracted from the forests is also computed. Households in the study areas collected (i) dry wood for fuel (ii) grass and leaf fodder and leaf litter for livestock (iii) *khar* grass for roof construction, and (iv) medicinal herbs and plants. For the majority of households, the income from forest products collection was the sum of the revenue obtained from these products and contributes significantly to the enhancement of their livelihood.

Calculation of gross and net value of forest products from the forests: Gross income from the forest products is calculated by multiplying the total quantity collected for 12 months by their respective prices. Valuation of fuelwood and *khar* grass was done based on market prices. Leaf litter, fodder and grass were non-marketed forest products but it was found that some households were bartering

them with grains in the dry season. Hence, the willingness to pay method was used to value them. Net income was calculated by deducting all cash cost, including cost of tools and equipments used during their collection and labor costs of time directly associated to reach forest, and collection and transportation of forest products from the forest to house.

IV. Socio-economic Characteristics of Households

In the study villages, 59 percent of the households are headed by males and 41 percent by females (Table 2). The difference between male-headed and female-headed households is important in rural Nepal, where male household members often enjoy greater freedom, greater income earning opportunities and greater control of resources. It is, therefore, hypothesized that male-headed households derive more income from the use of natural resources (agriculture, livestock and forest resource collection) than female-headed households. In the study villages, out migration of male members is prominent. In majority of the households, some of the male household members are working outside village or outside the country to generate income to support the household expenses. The caste/ethnic³⁾ composition under this study village is categorized into four main

Table 2 Socio-economic characteristics of households

Variables	Percent	Variables	Percent
Household head		Household size	
Male	59	Small (1-5 members)	38
Female	41	Medium (>5-10 members)	53
Caste/ethnicity		Large (>10 members)	9
Bahun	9	Landholding	
Chhetri	41	Small (up to 5 <i>ropani</i>)	40
Magar	22	Medium (>5-10 <i>ropani</i>)	29
Occupational caste	28	Large (>10 <i>ropani</i>)	31
Household head education		Livestock holding	
Illiterate	58	Small (up to 5 LSU)	61
Literate	42	Medium (>5-10 LSU)	28
		Large (>10 LSU)	11

groups. They are *bahun*, *chhetri*, *magar* and occupational caste. The dominant group among the total households in the village is *chhetri* (41%), followed by occupational caste (28)%, *magar* (22%) and *bahun* (9%). Majority of the household heads in the study villages are illiterate (58%). The mean education level of family members is primary level (4 years of schooling).

The average household size is 7 (Table 3) and 53 percent of households are medium in size (>5-10 members), followed by small (1-5 members), 38 percent and large (>10 members), 9 percent. The household size is an important variable that determines the supply of labor to the farm operations as well as the supply of labor force to non-farm economic activities. At the same time large household also means an increase in the number of consumption units in the household. Thus, the household size may have direct influence on the capacity of a household to collect forest products where there is no restriction in such collection. Therefore, large households have more labor to spread across various collecting and gathering activities and may be able to derive more food and non-food items from the forest.

Table 3 Statistical features of some important socio-economic variables

Variables	Minimum	Maximum	Mean	Standard Deviation
Education	0.00	13.00	3.65	5.11
Household size	3.00	19.00	6.86	2.78
Total land holding (<i>ropani</i>)	1.00	104.00	12.84	17.19
Irrigated land holding (<i>ropani</i>)	0.00	25.00	1.65	3.83
Non-irrigated land holding (<i>ropani</i>)	1.00	40.00	5.51	6.77
Private forest (<i>ropani</i>)	0.00	44.00	5.72	8.45
Livestock unit owned	0.00	21.00	5.61	4.32

Note =1 hectare = 19.79 *ropani*, n= 100.

The land is categorized in to three main types in the study villages, i.e., irrigated land, non-irrigated land and private forest. The average land holding size is about 13 *ropani* and irrigated land size is very low as compared to non-irrigated land and private forest. Among the households, 40 percent are small (up to 5 *ropani*), 29 percent, medium (>5-10 *ropani*) and 31 percent, large (>10 *ropani*) landholders. Generally, household members with larger land ownership and livestock holding

are expected to collect proportionally more forest products, due to both, their larger production and larger needs. The extent of the forest use by the particular household is associated with the number of livestock units (LSU) raised by the households. In this sample, 61 percent of the households are small (up to 5 LSU), 28 percent, medium (>5-10 LSU) and 11 percent, large (>10 LSU) livestock holders. The agriculture and livestock productions in the study villages are very low and majority (84%) of the households are food self-insufficient. Among them nearly half (45%) are food self-sufficient for less than six months a year. Therefore, these households are more dependent on non-farm income sources and forest resource collection to sustain their livelihood.

V. Economic Activities and Household Income

The study villages are located in the remote areas of the district and Table 4 shows the income from different sources according to household's socio-economic activities. Majority of villagers are small land and livestock holders and farming alone couldn't fulfill their food and non-food demand. Non-farm activity is a major source of income in the study villages.

Income from agriculture and livestock are second and third important sources of household's income. Maize is the primary crop followed by millet, barley, buckwheat, mustard, and legumes in non-irrigated lands. Rice and wheat are main crops in irrigated land. Income from commercially valuable forest products from private land, such as, *timur*, *dalchini*, *rittha* and *chyuri* supplements the household economy and aids in accessing the market food. People grow them by transplanting naturally regenerated seedlings/seeds, especially on terrace risers and are actively maintained by effectively planning the use of their family labor in management and collection of these products.

In the study villages, income level and contribution of different economic activities to total household income differs according to socio-economic characteristics of the households. The contribution of agriculture, livestock and private forest

income are higher in male-headed households than female-headed households where as the non-farm income is higher in female-headed households (Table 4). This indicates that male-headed households are managing available resources more effectively than female-headed households. In female-headed household, non-farm income is higher due to the remittances from their husbands and or other family members working out side the district or in other countries, particularly India.

Table 4 Annual average income according to economic activity and socio-economic characteristics

Attributes	Agriculture	Livestock	Non-farm	Forest products*	Total
Household head					
Male	13,695	8,185	28,485	3,099	53,464
Female	7,177	6,387	32,054	1,574	47,192
Caste					
Bahun	20,878	10,859	33,178	4,434	69,349
Chhetri	15,875	9,935	42,913	2,669	71,392
Magar	7,930	7,927	15,683	2,874	34,414
Occupational caste	3,179	2,332	21,136	1,243	27,889
Household head education					
Illiterate	6,059	5,469	21,597	1,739	34,864
Literate	17,876	10,180	41,482	3,488	73,025
Household size					
Small	7,815	4,726	23,544	2,249	38,334
Medium	10,381	8,454	26,350	2,331	47,516
Large	28,342	13,011	78,180	4,259	123,792
Landholding					
Small	3,951	3,104	21,524	1,105	29,683
Medium	8,652	7,663	28,555	2,497	47,367
Large	22,365	12,851	42,122	4,218	81,556
Livestock					
Small	7,169	3,750	25,243	1,750	37,912
Medium	12,639	10,289	29,244	3,388	55,560
Large	28,272	20,715	57,836	4,160	110,984
Consumption expenses					
First quintile (Poorest)	4,642	3,115	17,341	1,818	26,916
Second quintile	9,662	7,230	18,705	2,348	37,945
Third quintile	9,977	9,489	33,315	2,254	55,035
Fourth quintile (Richest)	19,626	10,099	49,829	3,599	83,153

Unit = Nepalese rupee (NRs), 1 \$ = 75 NRs. *Cash income derived from selling forest products from private land excluding subsistence use.

The disparity in income distribution is also found according to caste/ethnicity. The agriculture and livestock incomes are higher in *bahun* and *chhetri* groups as compared to *magar* and occupational castes. The total average income for *magar* and occupational caste groups is less than that for *bahun* and *chhetri*. Occupational castes are more dependent in non-farm income sources because they do occupational work⁴⁾ more than agriculture and livestock farming. In terms of contribution of forest products in total income, *bahun* and *magar* are more benefited from the private forest. Although the income from commercial forest products in *magar* group is not as high as in *bahun*s it is relatively more important to them as they are earning less from other income activities.

The educational status of household head and total income are directly related in the study villages. Income level is higher in all economic activities in households headed by literate persons. In terms of contribution, non-farm income sources are important for households with illiterate household heads, although the amount is relatively smaller. In case of household size and landholding size, large households with more landholding have more income from all the economic activities than small landholding size and the small household size. These household's labor resources helped them to generate more income through appropriate allocation into different economic activities. Similarly, large livestock holding size have more income from all the economic activities than small livestock size. Households with large landholding size have more livestock and bigger household size and *vice-versa*. These three variables (household size, landholding, and livestock holding) are closely inter-related in the household level resource endowment. They have combined impact in output as well as consumption expenses.

The total household consumption expenses indicated the level of well being for particular household. Based on the consumption expenses, households are categorized into four quintile groups to compare their income level generated from various economic activities. Richest households have higher income from all the sources but contribution of each source is different according to the quintiles. The contribution of agriculture is higher in second quintiles where as contribution of

livestock is higher in second and third quintiles. Non-farm income is more important for poorer households even though the amount is much smaller as compared to richer ones.

Table 5 shows the cross linkage of landholding and income sources according to different socio-economic variables. In the study area, land holding is important variable and has positive relationship with caste, education level and household size. Households from higher castes and with higher educational level also have more incomes from agriculture, livestock, non-farm and private forest. It is also found that landholding size and household size are positively related and have higher income level from all the income sources.

Similarly, the relationship between household consumption expenses and income sources according to these socio-economic variables are shown in Table 6. Unlike landholding, consumption expenses are not always related positively with

Table 5 Relationship between landholding size and other socio-economic variables

Land category / Income sources	Caste/ethnicity				Education		Household size		
	Bahun	Chhetri	Magar	Dalit	Illiterate	Literate	Small	Medium	Large
Agriculture									
Small	13,517	6,009	3,375	2,594	3,173	6,281	3,766	4,373	2,293
Medium	12,348	10,820	5,344	6,688	7,546	10,750	6,770	9,245	10,540
Large	24,947	25,769	13,196	-	12,537	26,386	18,190	17,659	45,882
Livestock									
Small	5,750	5,095	3,710	1,921	2,283	5,565	1,596	5,245	7,250
Medium	12,520	8,801	5,781	4,792	7,208	8,526	6,230	7,470	15,225
Large	11,156	13,633	12,458	-	12,415	13,029	10,692	12,761	17,040
Non-farm									
Small	28,800	26,455	19,000	19,070	17,771	32,782	16,012	28,952	16,250
Medium	28,700	37,615	13,418	33,525	23,447	38,260	19,725	23,468	112,200
Large	35,400	56,056	17,552	-	30,440	46,900	44,511	26,968	89,344
Private forest									
Small	1,728	1,177	1,475	996	925	1,644	1,082	1,094	1,425
Medium	4,043	2,343	2,086	2,723	2,354	2,766	3,611	2,178	1,059
Large	5,015	3,812	4,480	-	3,153	4,653	3,760	3,738	6,673

Note: - indicates no sample in that group.

these variables. The first quintile of the consumption expenses has the lowest income from all economic activities and in all castes, educational levels and household sizes. Large households have higher consumption expenses because of more consumption units within the household. Often the income level in 2nd and 3rd quintiles is higher than 4th quintile in case of incomes from agriculture and livestock, and private forest income in some group of caste and household size. Non-farm income is positively related with the consumption expenses in all castes, educational levels and household sizes and compensates the lesser amount of income from other sources, consequently enhancing their abilities to secure household food demands. This indicates that total consumption expense is not necessarily positively related to all income sources and household can compensate their consumption expenses through diversified economic activities.

Table 6 Relationship between household expenses and other socio-economic variables

Consumption expenses quintiles/ Income sources	Caste/ethnicity				Education		Household size		
	Bahun	Chhetri	Magar	Dalit	Illiterate	Literate	Small	Medium	Large
Agriculture									
1st quintile	14, 543	3, 616	3, 518	1, 896	2, 774	7, 486	4, 349	2, 592	-
2nd quintile	24, 462	11, 272	9, 604	3, 648	7, 807	10, 293	5, 389	12, 071	-
3rd quintile	15, 345	13, 591	5, 056	7, 502	7, 968	15, 378	14, 299	7, 263	10, 541
4th quintile	30, 048	26, 182	13, 592	2, 353	8, 252	26, 572	16, 171	15, 713	33, 429
Livestock									
1st quintile	7, 890	-	4, 600	1, 538	1, 703	4, 638	2, 971	1, 080	-
2nd quintile	3, 000	8, 482	10, 463	3, 163	9, 928	5, 325	1, 896	10, 373	-
3rd quintile	11, 217	14, 845	6, 456	4, 883	8, 344	15, 175	10, 350	9, 946	15, 225
4th quintile	16, 000	10, 291	10, 417	1, 808	5, 443	12, 127	4, 805	9, 590	12, 379
Non-farm									
1st quintile	12, 600	18, 285	13, 800	11, 910	13, 972	10, 640	10, 909	17, 567	-
2nd quintile	10, 800	21, 178	11, 725	18, 000	21, 667	21, 895	19, 452	23, 387	-
3rd quintile	32, 000	30, 600	16, 750	30, 329	32, 588	19, 875	22, 560	20, 231	112, 200
4th quintile	55, 533	82, 643	18, 153	48, 800	22, 545	71, 972	150, 000	39, 041	68, 460
Private forest									
1st quintile	2, 551	1, 035	1, 925	1, 080	1, 289	1, 481	1, 589	862	-
2nd quintile	12, 350	2, 542	2, 625	1, 580	1, 734	3, 209	2, 176	3, 014	-
3rd quintile	2, 568	2, 415	2, 831	1, 146	2, 256	2, 745	2, 674	2, 419	1, 059
4th quintile	4, 923	3, 513	3, 728	1, 367	1, 565	4, 376	5, 775	2, 446	5, 174

Note: - indicates no sample in that group.

VI. Supplementary Role of Forest in Household Food Security

In the study areas, people visit forests extensively to meet dietary shortfalls and to supplement household income during particular seasons in the year. During the self-food deficit periods, they suffer from seasonal food shortages when stored food supplies have dwindled and new crops are still in the field. For most of the households, June to August (rainy season) and February to April (spring season) are food deficit months. During this period the consumption of forest food increases. These two periods are off-seasons for agriculture work and household members allocate more of their time to collect forest products during these periods. On the other hand, some favored forest food, such as, mushrooms and honey, have particular harvest seasons that do not necessarily correspond to food shortage periods. In these cases, food is gathered for as long as it is available in the forest.

Forest contributes variety of supplementary food sources, such as, food, fruits, vegetables, nuts, gums, saps, medicine and so on. For the majority of rural people, forest food adds variety to diets and provides essential vitamins, minerals, protein and calories. Some species are noteworthy as particularly rich sources of vitamins, minerals, proteins and fats (Table 7).

Different kinds of food gathered from the forests, range from *giththa* (*Dioscorea bulbifera*: air potato/wild yam) and *vyakur* (*Dioscorea deltoidea*: deltoid yam) to leaves and edible mushrooms, fruits and medicinal plants (Table 1). Wild *giththa*

Table 7 General contributions of forest foods to human nutrition

Type of forest food	Nutrient
Fruits, tubers and berries	Carbohydrates (fructose and soluble sugars), vitamins (especially C), minerals (calcium, magnesium, potassium), protein, fat or starch
Nuts	Oils and carbohydrates
Young leaves, herbaceous plants	Vitamins (beta-carotene, C), calcium, iron
Gums and saps	Proteins and minerals
Invertebrates (insects, snails)	Protein, fat, vitamins
Vertebrates (fish, birds, mammals)	Protein

Source: FAO (1994)

and *vyakur* still exist only in wild forms in Nepal. These forest products have contribution both as a staple food as well as vegetables in the diet of local people in study area. The protein contains in *giththa* and *vyakur* is found comparatively higher than reported value for potato and sweet potato, and is said to be good in amino acid composition (Bhandari, 1995).

Thus collected forest products are sold and/bartered in the village and nearby markets to earn cash and food grains. Some of the forest products, such as, *tama*, *kurilo* (*Asparagus racemosus*: Asparagus), *nyuro*, *chyau* (*Morchella spp.*: Mushroom), *amala* (*Phyllanthus emblica*: Indian gooseberry), *okhar* (*Juglans regia*: Common walnut), *kafal* (*Myrica esculenta*: Box myrtle), honey, *timur*, *chiraito* (*Swertia chirayita*: Chiretta), *majito* (*Rubia cordifolia*: Indian madder), etc. have high demand in the market. Cash and kind generation from the selling of these products is relatively low but for some of the poorer households these products provide some relief in the time of hardship. However, not only poor but also the richer households consume these forest products through purchasing and/bartering with food grains with the collectors.

VII. Indirect Role of Forest to Enhance Rural Livelihood

Another contribution of forest in livelihood of rural people is through the supply of inputs necessary for crop and livestock production and cash generation by selling these non-food forest products in local markets. Table 8 presents the distribution of value of these non-food forest products collected from the common and private forests, separately. Among all the products, extraction of fodder, grass, leaf litter and fuelwood from common forest are significant. Fodder, grass and leaf litter do not provide direct cash income but have crucial role in farming system to increase the total crops and livestock production. Fuelwood is mostly used for cooking and heating purposes and some households earn cash by selling it to the nearby markets.

Distributions of value of different non-food forest products derived from the

Table 8 Value of non-food forest products collected according to household characteristics (in NRs.)

HHhead	Collection from common forest					Collection from private forest				
	Grass	Fodder	Leaf Litter	Fuel wood	Total	Grass	Fodder	Leaf Litter	Fuel wood	Total
Male	529	1,948	1,008	4,943	8,710	1,696	2,990	645	1,448	6,795
Female	369	1,377	560	3,955	6,281	1,092	2,101	454	1,063	4,721
Caste										
Bahun	256	1,749	398	5,083	7,513	2,310	3,556	986	1,904	8,755
Chhetri	895	2,422	1,625	8,258	13,242	1,640	3,179	669	1,576	7,077
Magar	379	1,615	821	2,943	6,142	1,338	2,280	424	1,108	5,177
Dalit	440	324	205	1,013	1,983	979	1,788	394	817	3,985
Education										
Illiterate	453	1,888	789	5,157	8,569	1,159	2,099	441	1,042	4,757
Literate	479	1,474	873	3,683	6,533	1,849	3,353	739	1,633	7,585
HHsize										
Small	356	1,024	327	2,780	4,504	1,184	2,118	417	1,037	4,760
Medium	528	2,059	1,068	5,153	9,113	1,488	2,835	620	1,330	6,290
Large	542	2,597	1,488	8,339	13,026	2,333	3,539	887	2,122	8,911
Landholding										
Small	251	1,366	281	3,881	5,801	963	1,649	372	802	3,788
Medium	608	1,660	378	4,081	6,743	1,476	2,895	613	1,242	6,242
Large	605	2,213	1,942	5,813	11,090	2,049	3,634	775	1,965	8,448
Livestock										
Small	333	1,232	300	3,417	5,304	1,075	2,054	460	973	4,569
Medium	627	1,795	1,267	4,560	8,802	1,892	3,292	733	1,591	7,524
Large	773	4,178	2,606	10,699	18,309	2,393	4,101	735	2,283	9,552
Con.exp.										
1 st quintile	359	1,517	504	4,101	6,506	940	1,668	280	856	3,750
2 nd quintile	492	1,757	770	3,651	7,293	1,244	2,455	551	1,123	5,389
3 rd quintile	514	1,477	938	4,751	7,705	1,483	2,871	544	1,309	6,227
4 th quintile	491	2,104	1,085	5,649	9,352	2,128	3,510	891	1,872	8,412

Note: All the amounts are evaluated according to local (quasi) market prices. Cash income from commercial forest products in private forest was excluded and in common forest, was negligible.

common and private forests differ according to socio-economic characteristics of the households. In most of the cases, the value of non-food forest products derived from common forests is higher than those from private forest. Regarding the gender, households headed by male members are collecting more non-food forest products than those with female heads. Women may not travel as far as men to extract these products due to the additional travel time involved, and other household

responsibilities. It appears that *bahun* and *chhetri* collects more of such forest products than *magar* and *dalits*/occupational castes.

However, education is negatively related to value of these forest products collections from common forest but positively related for private forest. This indicates that better educated household head may have better earning opportunities outside the village and such laborious forest extraction activities beyond the private forest may be less attractive to them. This is supported by the findings in the earlier section that the total non-farm income is higher in the households headed by educated member. This finding is similar to that of Gunatilake (1998) and Adhikari (2003) who observe that education is negatively related to forest income. But their findings not necessarily hold true in case of private forest whose use depends completely on own decision only and needs lesser traveling time to collect the forest products, unlike the most cases of common forest.

The value of forest products collected from the common and private forests is also positively related to household, land and livestock holding sizes. Households demand more forest products when they possess more land and livestock. On the other hand, large households are able to extract more non-food forest products due to abundance of labor in the household. Therefore, households with bigger household size, large land and livestock holdings extract more of these forest products. Similarly, richer households extract more of these forest products because they possess more land and more number of LSU.

Table 9 presents the relationship among landholding, socio-economic characteristics and evaluation of extractions from common and private forests. The landholding size has direct impact on the collection of forest products both in common and private forests. Higher caste households (*bahun* and *chhetri*) with large landholding size collect more forest products. Similarly, large landholders with low educational level and large household size collect more forest products than small and medium size landholders.

Table 9 Relationship of landholding and forest extraction according to socio-economic characteristics

Land category/ Income sources	Caste/ethnicity				Education		Household size		
	Bahun	Chhetri	Magar	Dalit	Illiterate	Literate	Small	Medium	Large
Common forest									
Small	5,549	7,768	2,094	1,794	6,780	2,862	4,362	7,321	7,956
Medium	6,298	9,619	4,380	1,974	7,881	3,792	7,204	6,513	7,034
Large	10,692	20,276	9,985	-	15,105	9,448	2,434	13,812	17,419
Private forest									
Small	3,368	4,073	3,180	3,736	3,424	4,872	3,255	4,337	4,680
Medium	9,820	7,736	4,211	5,438	4,777	8,500	6,308	5,978	8,245
Large	9,298	8,698	7,179	-	8,524	8,381	6,876	8,537	10,816

Similarly, Table 10 presents the relationship among the consumption expenses, socio-economic variables and value of forest products collected from common and private forests. Unlike the figures in Table 9, consumption expenses are not positively related to all the socio-economic variables and collection of non-food forest products from common and private forests. This analysis shows that in many cases, collections of these forest products from common and private forests are lower in the 1st and 2nd quintiles than the 3rd and 4th quintiles. In all castes these collections increase with the increase in consumption expenses except the *magars*. The collection from the common forest is highest in 4th quintile for *dalit*/occupational caste but this value is highest in 3rd quintile in case of private forest. In the same

Table 10 Relationship of Expenses and forest extraction according to socio-economic characteristics

Expenses quintiles/ Income sources	Caste/ethnicity				Education		Household size		
	Bahun	Chhetri	Magar	Dalit	Illiterate	Literate	Small	Medium	Large
Common forest									
1st quintile	3,723	9,169	1,244	1,377	7,287	3,382	5,158	8,903	-
2nd quintile	7,883	13,777	9,385	1,224	11,871	6,113	6,017	8,638	8,126
3rd quintile	7,921	9,764	7,262	1,964	8,547	4,627	2,498	11,013	7,084
4th quintile	8,503	20,239	2,900	2,658	6,452	8,294	1,736	5,380	14,724
Private forest									
1st quintile	8,040	3,119	3,691	3,352	3,401	5,114	3,858	3,541	-
2nd quintile	8,610	5,522	5,919	4,322	4,912	5,420	3,958	8,317	11,330
3rd quintile	8,406	6,408	4,363	6,050	5,973	6,704	6,202	5,897	8,245
4th quintile	9,630	9,879	6,658	4,245	5,195	9,908	8,688	8,074	9,063

consumption quintiles the value is higher from common forest when household heads are illiterate but this value is higher for private forest when household heads are literate. Within small household size, households with less consumption expenses (1st and 2nd quintiles) are collecting more of these products from the common forest. Hence, the impact on collection of non-food forest products according to level of consumption expense is different from those according to landholding size.

VIII. Summary and Conclusions

The analysis of household level data indicates the following observations:

- a. Analysis of household level economic activities indicates that these two study areas are forest dependent communities. On an average 25 percent of households' total gross income is derived from the use and sale of forest products. The agriculture and livestock farming activities, which contribute 28 percent of the household total gross income, is dependent on the use of forest resources. On the other hand, rural people collect many wild food, fruits, vegetables, medicinal plants, and so on for home consumption and some households sell these forest products to gain cash and kinds in the local markets. The actual share of forest products to household total income is higher when such collections are evaluated at market prices.
- b. Similarly, non-farm income contributes 47 percent of the household's total gross income. Income from out migrated people for skilled and unskilled laboring has largest share in non-farm income. In these communities many of the productive human resources are out migrated and the remaining is engaged in collecting forest products to enhance their livelihood.
- c. The out migration of male members has direct impact in agriculture and livestock production and collection of forest products. Although non-farm income is higher in female-headed households, total income is rather lower than the male-headed households. Thus, the effective use of local resources in the village to some extent is affected by out migration.
- d. Higher caste households have more private resources than lower castes.

Therefore, their incomes from all economic activities are higher as compared to lower caste. But the contribution of non-farm income source in the total income is higher for lower caste and resource poor households.

- e. The variables of landholding, livestock holding and household size are important determinants of forest use. Bigger land and livestock holdings demand more forest products and large households supply more labor to collect the forest products.
- f. Use of common forest is important both for large and small land and livestock holders. Private forest alone cannot supply total demand of forest products for large land and livestock holders. For small landholders common forest is main source to get agriculture and livestock inputs.
- g. Education of household head has positive impact on household income level. Incomes are higher from all economic activities in households with literate heads. But households with illiterate heads are more dependent on common forest than private forest to meet their household needs.
- h. Consumption expenses and income level from all economic activities are not positively related. The middle and poorer households (based on total expenses) can generate more income than richer ones from the particular economic activity according to labor use of the household members. Thus, household decision to allocate available labor in different economic activities ensures their level of income from each economic activity.

From the above observations this paper concludes that in the mid western hills of Nepal, diversification of economic activities is important to the management of household economy. Farming is the main stay of life for many but non-farm engagements and forest play crucial roles in sustaining their livelihood. The whole farming system of crop and livestock production is dependent on the use of forest resources. Forest also generates cash income through commercial forest products and provides direct food items, as well. Consumption of forest food increases during the food deficit months of rainy and winter seasons when the usual food stock dries up. These two periods are off-season for agriculture work and household members usually divert their time to collect forest products. The collection and consumption

of wild food is more common in poorer households. Thus, these products play a crucial role in bridging the gap of food deficit in these households and stop them from going hunger.

The prominent out migration of male household members has negative impact on agriculture and livestock production as well as collection of forest products. This leads to poor management of locally available natural resources and lessens the benefits derived from them. The out migration is relatively more in resource poor households, which also happen to be *dalits*, the lower stratum of the society.

This analysis shows that land and livestock holdings are positively related to collection of forest products from common and private forests. Households belonging to higher caste have more land and livestock holdings. The educational level, household size, total household expenses are also more among large land and livestock holdings. Therefore, landholding size is an important determinant of income and consumption levels in the rural areas. But, the contribution of common forest is higher in poor households with small land and livestock holdings. This nature of forest dependency indicates that common forest is crucial for the livelihood of those households who have less private resource endowment.

Hence, policy intervention seeking to enhance food security and improve the living standard of the people in remote rural areas should consider the nature of household's dependency on different types of income activities. This study indicates that forest products play a crucial role in enhancing food security in the areas where agriculture and livestock productions are low and non-farm income opportunities are less. Further, poor people, due to their less land and livestock holdings do not get substantial benefits from just conventional use of forests, i.e., collection of non-food forest products related to crop and livestock production. Thus, common forest management policy needs to be directed at increasing cash income through increasing alternative forest products, mainly commercial forest products that can also equally benefit the poor households. Income generation through the collection and selling of such commercial forest products can help to

improve their food security status by enhancing their capacities to access the market food, rationally.

Note

- 1) One hectare = 19.79 *ropani*.
- 2) This is local term used to indicate the labor exchange practices in the study site mostly during the time of planting and harvesting of crops.
- 3) One integral aspect of Nepalese society is the existence of the Hindu caste system, modeled after the ancient orthodox Brahmanic system of the Indian plains. Broadly, there are four main castes, i.e., *bahun*, *chhetri*, *vaishya*, *shudra* and in that hierarchy. However, in Nepal hills the latter two castes are often missing. Occupational caste, also known as Dalit, is a group of people outside of the four castes, considered as polluters below them. Ethnic group, such as, *magar*, although doesn't come under the caste hierarchy, is allotted status lower to the higher Hindu caste people by the authority. However, any discrimination according to caste/ethnicity is illegal according to current law.
- 4) Occupational work includes tailoring (*damaĩ*), shoe making (*sarki*), making agriculture tools (*kami*), and jewelry making (*sunar*). Occupational caste group people supply their services to the villager and collect seasonal agricultural products and money according to the nature of their works.

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