Improving food security and livelihood of mountain people through development of agriculture

Ram P. Sah

Agriculture Research Station, Lumle, Nepal

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dirlac@mos.com.np

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Abstract

The livelihoods of preponderant majority of the people in the Hindukush Himalayan Region (HKH) countries (Nepal, Bangladesh, Bhutan, Pakistan, India, China, Myanmar, and Afghanistan) revolve around agriculture. In the HKH countries, while a population of 150 million inhabiting in an area of 3.4 million sq. km gives about 35 people per sq. km, the actual pressure on agricultural land is much higher, thereby availability of cropland is too small to support livelihood of rural households in the mountains.

Management of the marginal lands is getting increasing priority with the increasing population pressure, poverty, soil erosion and degradation, and loss of natural resources for food security, improved livelihood and environmental protection. Diversification of farm activities into high value commercial crops, and processing of agricultural and other natural resource based materials, while adequately maintaining soil, forest and other natural resources, are most logical steps to improving livelihood of mountain people. Mountains provide an excellent avenue of diverse agro-environments, there by niches for horticulture, floriculture, spices and medicinal plants. Poverty, small holding size, food security are the critical challenges in the mountain areas of HKH, and call for a holistic approach to address them for improvement and sustainability.

The paper elucidates the major challenges of the mountain people in the HKH region with particular reference to Nepal, and efforts made through agricultural research and development to improve food security and livelihoods through sustainable management of natural resources.

1 Background

Livelihood of majority of the mountain people in the Hindukush Himalayan (HKH) region countries (Nepal, Bangladesh, Bhutan, Pakistan, India, China, Myanmar and Afghanistan) revolve around agriculture. In the HKH countries, while a population of about 150 million inhabitate in an area of 3.4 million sq. km, giving about 35 persons/sq. km., the actual pressure on slopping hills and mountains on the agricultural land is much greater to support food security and livelihood of the mountain people (Pratap 2001).

The problem of shrinking agricultural land is getting compounded in that new human settlements, urbanization, industrialisation and government infrastructure developments. In his global crop land loss, Gardner (1996) warned about these implications of the trends in cropland loss to food security and livelihoods in the mountains in particular.

Management of the marginal lands is getting increasing priority with the increasing population pressure, poverty, soil erosion and degradation, and loss of natural resources in the hills and mountains for economic growth and environmental protection.

Diversification of farm activities into high value commercial crop, and processing of agricultural and other natural resources based materials, is therefore, the most logical steps towards improving the economic levels of the mountains people (Sharma, 1998). Certain agro-forest species are found at high altitude conditions. The diverse agro-ecological conditions prevailing in the mountain form niches for horticulture, floriculture, spices and medicinal plants (Pratap, 1995). Poverty, small holding size and food security are the critical challenging issues in the mountains and call for a holistic approach for economic growth and environmental protection (Koirala and Thapa, 1997). In recent years, the role of horticultural crops including fruits and vegetables has been found significant to affect livelihood in the mountains (Tulachan, 1999). Livestock particularly buffaloes and goats provide greater opportunities to mountain household to generate cash income.

The paper summarises the challenging issues and opportunities to improve food security and livelihood of mountain household through agriculture research and development with special experiences of HKH including Nepal.

2 Food security and livelihood: concept and status

Hunger and poverty are the two daunting development challenges confronting the world to-day. Of the world population of around 6 billion in 1996, about 1.3 billion people in the developing countries live on a meagre income of less than US$ 1/day (WDR 1996). About 800 million people are foods insecure and about 500 million are chronically malnourished. It is not the production, but the

distribution and access to food for healthy and active life is the critical challenge (IFAD 1993). The hunger and poverty situation is more alarming in the developing world including HKH Mountains. Food security is linked to food intake at the individual level, and food availability at a higher level. Food security will be achieved when poor and vulnerable households living in the marginal areas, have physical and economic access to food, and will be achieved when they have sustainable livelihood. The FAO indicator for subsistence level is 2250 calories/day/cap (0.8 gm/kg body wt. protein and other essential fats and vitamins) food requirement.

Food security is greatly influenced by physical, economic, natural resources, socio-cultural, gender and ethnic factors; and could be chromic or transitory. This has direct and indirect effect on health and behaviour of the people. Sustainable livelihood therefore, focus not only on assets but capabilities (including social resources) and activities for a means of living that can cope with and recover from stresses and shocks.

The shrinking cropland in the HKH as a consequence of demographic pressure and sub-division of holdings is endangering food security and livelihood of people (Table 1) per capita agricultural land in most countries is less than 0.2 hectare which is too critical to support livelihood.

In Nepal, the percentage of landless and marginal farms (<0.5 ha) range from 17.6 (Banke) to 84.7 (Achham) including nearly 25 districts (Figure 1) over the critical level (ICIMOD 1997). There has been an increasing trend of food deficit districts in the country in recent years. There were 41 districts food deficit in 1991 compared to 55 in 1995 including 16 in mountains, 33 in hills and 6 terai (Table 2).

Figure 2 illustrates the food self-sufficiency status in the western hills (Vaidya and Floyd, 1997). The problem is much grave in the high hills and mountains where more than 70% of the households have their farm food for less than six months.

3 Mountain farming system: challenges

In the HKH region, the majority of the household operate mix-faming system (Tulachan 1999). Over the years many changes have been taking place in terms of land resource allocation, production, and productivity of cereal food grain crops, horticultural crops, livestock structure and composition all generally influenced by forest and other natural resources, input supplies, marketing and other socio-economic infrastructures (Figure 3).

The important conditions characterising mountain agriculture are inaccessibility, fragility, marginality, diversity and niche (Jodha 1993). The critical challenges in mountain agriculture are crop land security, soil erosion

and declining soil fertility, increasing poverty and farming on marginal farms (Sah 2001). The studies have indicated numerous indicators (Table 3) of unsustainable mountain agriculture in the HKH (Jodha and Shrestha, 1994).

In Nepal, while the contribution of agriculture to GDP has gradually declined to 40% in 2000/01 (MOAC, 2000) hills and mountains contribute nearly 50% to the AGDP where livestock and horticulture still play vital role in the hill farming system (Table 4).

In a study of the western hills, large proportions of households are involved in the agricultural activities (Figure 4).

However, there has been substantial off-farm income source to ensure food security and livelihood in the mountains (Table 5) (Figure 5).

Soil and Nutrient Losses

The direct and primary effect of soil erosion is soil loss and nutrient leaching, resulting in reduction of land productivity. A study in the mid hills of Nepal revealed a soil loss of 20 tons/ha/year from rain-fed marginal land, with a nutrient loss of 300 kg of OM, 15 kg of Nitrogen, 20 kg phosphorus and 40 kg potash (Carson 1992). Similarly, in the western hills (Tripathi et al., 1999), erosion caused a maximum loss of soil 20 t/ha/year including 12 kg of Nitrogen. 66 kg of Phosphorus and 24 kg of Potash. More than 50% of these losses occur during pre-monsoon (May-June) when ground covers are absent, and loss are mostly through leaching than through surface run-off.

Analysis of soil samples from the western hills (Tripathi, 1999) indicated that soils were mostly acidic (3.7 - 7.5 pH) 32.6% samples low in organic carbon (<1.49%), 5.8% low in total N (<0.1%), 8.4% low in available P (<6.4 mg/kg) and 35.35 low in exchangeable K (<0.2 cmols/kg). Nearly 10-20% samples were low in zinc (<0.5 mg/kg), manganese (10 mg/kg) and copper (0.5 mg/kg) while 87% were deficient in Boron (1 mg/kg). These call for an appropriate soil fertility management programme in the mountains.

4 Marginal lands: future hope

Mountain farmers in their desperate bid to maintain their livelihoods under these complex challenges, have adopted multiple strategies to cope with the problems. These include, among others, extending cultivation to steep slopes and increasing male migration to plains and urban areas. The net result has been the accentuation of environmental degradation, marginalization of land, increased drudgery of women, and ultimately, immiserisation, impoverishment and endemic poverty.

The state of affairs of mountains agriculture described above poses difficult questions and paints a grim picture for time to come as:

- Where we go from here?
- How to ensure livelihood and food security?
- What are hopes and options?
- How we preserve environment and rich bio-diversity of mountains?

The availability of vast amount of marginal land including waste land, grazing land, range land, shrub land and unclassed forest etc in the HKH can provide a ray of hope to mountain farmers to provide support to farming and livelihood in the hills and mountains (Pratap 2001). This requires identification and promotion of suitable technologies with necessary logistic supports to bring about impacts and economic transformation.

Concept and Definition

Usually marginal lands are defined as low potential, resource poor, and fragile, vulnerable or degraded lands. However, in real sense a land could be marginal or highly productive depending upon its use, other biophysical/institutional and socio-economic factors. For example a tract of sloping land is marginal for crop production, but highly potential for grazing, fruit farming or for important herbs. The nature, composition and interaction of the factors, can also differ widely. Also, there are number of factors that may shift such land from one category to another. The shift could be upward through application of appropriate technologies, or downwards as a result of land degradation and/or lack of necessary institutional support to promote a particular enterprise. Hence, marginality is a dynamic process - a land unsuitable for rice due to topography, lack of irrigation, could be highly productive for fruit farming or livestock farming.

The forest and grazing lands are the foundation upon which sustainability of hill farming system is based and there by food security and livelihood of the mountain people. The crop-livestock-forest relationship has begun to weaken in the areas where forest resources are scarce, and where strong influence of market forces on farming exists. In many countries, the marginal land has been over exploited for crop production even on steep slopes and gravel soils that have further aggravated the environment and natural resources in the mountains. The forest does play an important ecological role for maintaining the hydrology and soil movement from the sloping land.

Harmful effect of past neglect

- The global research and development efforts in the past on food grain pushed their technologies to replace local crop varieties - Loss of rich source of genetic material

- Several potential crops of mountain area were left out for research and development
- High value cash crop and herbs were not promoted
- Limited technological options available - remained confined

New mindset

There has been global attention in recent years for research and development to support mountain farmers to improve food security and livelihood (CGIAR, 1999).

- A growing concern for vulnerable and fragile land - because of global diversion of problem of degradation of natural resources, deterioration of mountain environment and destruction of biodiversity (Environmental lobby).
- A concern for poverty - most of the poor line on marginal lands of the developing world concern for marginal lands more productive is considered proxy for removing poverty in these areas (Development lobby)
- A concern for mountain agriculture - where rain-fed sloping farmlands are being marginalized/degraded though their over use or misuse (Agriculture and Environment lobby).

5. The way forward: strategies and programmes

A multi-pronged strategy is the vital option to address the natural, physiographic and socio-economic challenges of mountains to improve people's livelihood and food security. Some of the important ones are described below:

Conservation of Natural Resources

The vast amount of natural resources including forest, soil, water and others available in the mountain will play a key role in the livelihood of people. In the HKH region there has been significant loss of natural resources that have affected people's livelihood. Reckless exploitation of natural resources in the mountain can eliminate future hope (Jodha 1995). Proper attention is needed in introducing new agricultural technologies that do not distort environment and product quality (Tulachan 1999) and to correct the causes of unsustainability (Table 3).

Agriculture on Marginal Land

The vast amount of marginal sloppy land (Table 1) available in the HKH region provides a big hope for future. Marginal lands have been over exploited and misused loading to increased poverty, soil degradation and loss of natural resources. Suitable agriculture/forestry enterprise and their technologies needs

to be developed and implemented for increased income, employment and sustainability. It is equally important that necessary infrastructure, logistics inputs and marketing system are in place to bring about desired impacts.

Management of Soil

The evidence has shown that there is large amount of soil and nutrient losses from the mountain of the HKH region. The problem of drastic decline of native fertility including loss of organic matter, soil pH, major and many micro-nutrients have posed critical threat to profitable farming in many mountain areas (Tripathi et al 1999). Necessary on-farm soil conservation and fertility management approaches are vital to sustainable agriculture and innovative technological break through. It is important to develop crop/technology that do not aggravate the problems. Scattered research in Nepal indicate that sustainable agricultural production can be achieved through adequate use of compost and FYM along rationale use of chemical fertilizers combined with suitable crop and crop varieties (Tripathi 1999).

Management of Agro-biodiversity

Through the ages, the mountain farming communities of the HKH region have evolved strategies for harnessing their rich source of local agro-biodiversity for food security and to improve livelihoods. However, in recent decades, population growth has compelled farmers to extend their operations beyond limit - changing the land use systems affecting the local agro-biodiversity. Conservation of the available agro-biodiversity and their careful utilization for economic and environmental benefit to the mountain community provide a strong hope for long term sustainability. They provide an important source of genetic resources for crops, herbs, species and floriculture. Further, the indigenous skill on management and use of these valuable assets is another dimension of science and technology for research and development.

In China success stories for the production of *eucalyptus* oil, anti-caneer drug (taxol), steroid hormones from *dioscorea*, and many other medicinal plants as well as valuable forest products have helped transform the farming system while promoting the agrobiodiversity for economic and ecological benefits (Rongsen 1998).

Fruit Farming on Marginal Farms

Rapid economic transformation has taken place on marginal farms in Himanchal Pradesh, India through apple faming. Majority of the farmers (80%) have small farms 0.5 - 2.0 ha of sloping land, produce a net return of US$ 2700/ha/yr (Sharma 1996). The farming system has changed from subsistence crop-base to fruit farming including livestock component, has increased food security and living standard. The adoption of the niche friendly production system on large

areas of marginal farms in the temperate region made a huge economic and environmental impact. This resulted a net increase of domestic product in Himanchal two hundred times and net per capita income twenty six times between 1971 and 1991. There is hard evidence to show that fruit farming on marginal lands is a superior production option both economically and ecologically (Sharma 1996; Pratap 1995).

- Similarly, fruit farming has brought economic transformation in Pakistan (Gilgit) supported by Aga Khan Rusal Support Project (App 1995).
- In China, west-Sichuwan, the biophysical condition suitable for apple and pear farming, had very limited programme due to lack of transport and R and D programmes. With priority programmes and support from the Government, the state has now commercial production system and has transformed their livelihood.

Examples of such niche success stories for orange, mango, temperate fruits and others do exist in the HKH, and need dissemination.

Cardamom and Ginger Cultivation

Cardamom and ginger farming on the forest floors of Sikkim and Eastern hills of Nepal present an example of technical feasibility of developing economically productive and ecologically sound and stable production system on the marginal and sloping areas (Sharma 1998).

Off-season Vegetable Production

Off-season vegetable production has brought economic transformation in many mountain areas of HKH region. Necessary technological break through, transportation and marketing systems were vital to bring impacts for their commercialisation and impact on economy. In Sichuan Basin of China, off-season vegetables have covered an area of 3933 ha with a production of 94,000 tons valuing 8.48 million US$. Similar examples are available in India and Nepal where utilizing the mountain niches, off-season vegetable production is getting highly remunerative in recent years, to improve livelihood and economy of mountain farmers through direct and indirect effects in income and employment. In certain mountain niches of Nepal (Dhading, Panchkhal, Pakhribas, Lumle RCA-Dhanubase and Yampaphant) off-season vegetable production has gone on commercial scale and transformed their livelihood. A good crop of tomato or cucumber can bring upto US$ 5000/ha net return in 120 days (Sah 2001).

Vegetable Seed Production

Mountain agro-environments provide an excellent avenue for quality vegetable seed production. Several national and international/multi-national companies

and attracted to seed production in the mountains including Nepal. Vegetable seed production has become a very attractive enterprise, but due to lack of suitable varieties, production, processing and marketing system, farmers have faced several constraints. However, the issues are being gradually resolved and DFID funded seed project has helped to improve livelihood of hill farmers. In 1999/2000 the project in the western hills (4 districts) produced 82 mt of vegetable seeds worth Rs. 9.8 million rupees (Chand 1999). This has helped to make a shift from subsistence to semi-commercial farming to improve living and food security.

Other Potential Enterprises

Tea, coffee, citrus, dry-fruits, honey, cikate mushrooms could be other potential enterprises. Also, identification of suitable livestock enterprises for milk, meat, skin and fibre could be potential alternatives that suit well in the system without environment and natural resource degradation.

6. Conclusions

The increasing demands of growing population, limited crop land and degradation of natural resources have contributed to poverty and unsustainable mountain agriculture. Marginal lands provide future hope to mountain people - the challenge is to conserve the natural resources, maintain and use the valuable agro-biodiversity, and generate and promote niche specific technologies for greater economic and ecological returns. Comparative advantages of niches potentials should be exploited for high value cash crop and enterprises as seen successful in HKH and other mountain regions around the world. The use of bio-technical tools, organic farming, and nitrogen-fixation activities should be promoted to improve quality of mountain products and protect environment and natural resources.

Development of necessary infrastructures, input supplies, industries and marketing system and other logistic supports are vital to bring sustainable impacts. Strong national, regional and global commitments are vital with priority research and development programmes for improving food security and livelihood of mountain people through a collective participatory approach.

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Table 1 Sloping lands and people in the Hindukush Himalayas reason

Country	Mountain area (sq.km)	Sloping land (8-30%) percent	Sloping land (>30%) percent	Agricultural land (%)	Per capita agricultural land (ha)	Population inhabiting marginal areas (million)	Population density (per sq.km)
Afghanistan	390475	35.1	41.9	10.0	NA	13.8	35
Bangladesh	13189	60.1	12.2	7.8	0.097	1.2	57
Bhutan	46500	12.7	88.4	7.6	0.173	1.2	30
China	1647725	10	50.7	1.2	0.150	19.6	20
India	482920	30.7	21.1	8.3	0.293	35.0	73
Myanmar	280862	37.4	29.1	7.7	NA	5.8	21
Nepal	147181	12.7	66.3	18.0	0.133	18.5	126

Pakistan	404195	29.3	35.6	7.8	0.158	22.7	56

Source: Pratap (2001)

Table 2 Foodgrain Production, Requirement and Balance by Ecological Belt, 1994/95

Particulars	Mountain	Hill	Teria	Nepal
Number of districts Food deficit districts (1991/92) Food deficit districts (1994/95) Mid-year population (million)	16 14 16 1.5	39 27 33 8.9	20 0 6 10.0	75 41 55 20.4
Total cereal prod ('000 mt)a	194	1638	2264	4097
Requirement ('000 mt)a	322	2021	1935	4279
Cereal Balance ('000 mt)a	-127	-383	329	-181

Source: AMDD (1995)
a- SINA/MoAC, 1999/2000

Table 3 Indicators of unsustainable upland farming in HKH (Time Frame 1954 - 1991 = 37 year approx)

Indicators reflecting problems relating to resource base/ production flow and resource management	Range of changes
1. Soil erosion rages on sloping lands	+20 to 30%
2. Abandonment of agricultural land due to decline in soil fertility	+3 to 11%
3. Appearance of stones / rocks on cultivated land	+130 to 100%
4. Size of livestock holding per family (LSU)	-20 to 55%
5. Area of farmland per household	-30 to 10%
6. Forest area	-15 to 85%
7. Pasture / grazing area	-25 to 90%
8. Good vegetative cover on common property land	-25 to 30%

9. Fragmentation of household farmland (in number of parcels)	+20 to 30%
10. Size of land parcels of families	-20 to 30%
11. Distance between farmland parcel and home	+25 to 60%
12. Food grain production and self-sufficiency	-30 to 60%
13. Permanent out migration of families	None to 5%
14. Seasonal migration	High to high
15. Conservation of irrigated land into dry land farming due to water scarcity	+7 to 15%
16. Average crop yield on sloping lands a. Maize and wheat b. Millets	 -9 to 15% -10 to 72%
17. New land under cultivation	+5 to 15%
18. Human population	+60 to 65%
19. Application of compost (organic manure)	-25 to 35%
20. Labour demand for falling productivity	+35 to 40%
21. Forestry farming linkages	Weak to weak
22. Food grain purchases from shops	+30 to 50%
23. External inputs' needs for crop production	High to medium
24. Fuel wood fodder scarcity in terms of time spent in collection	+45 to 200%
25. Fodder supply from a. Common land b. Private land	 -60 to 85% +130 to 150%
26. Emphasis on monocorpping	High to high
27. Steep slope cultivation (about 30%)	+10 to 15%
28. Weed and crop herbaceous products' used as fuel wood	+200 to 230%
29. Conservation of marginal land into cultivation	+15 to 40%
30. Fallow periods	From 6 to 3 months

Note: A positive sing (+) means increase and negative sign (-) means decline/decrease
Source: Pratap, 2001

Table 4 AGDP Shares by Region, population growth and poverty status, 1991/92

Particulars	Mountains	Hills	Terai	Nepal
AGDP Shares (%)				
Field crop	3.4	18.8	23.6	45.8
Horticulture crop	1.1	5.3	6.5	12.9
Livestock	2.8	16.7	12.0	31.5
Forestry	0.7	4.1	4.0	8.8
Fisheries	0.0	0.0	1.0	1.0
Total	**8.0**	**44.9**	**47.1**	**100.0**
Population growth % (1981 - 91) *	0.7	1.6	3.0	2.18
Poverty **				
Incidence %	64	64	34	49
Number of poor (million)	1.0	5.1	2.8	8.9

Sources: Based on NPC revised GDP series and regional estimates of AGDP.
*** CBS (1991)**
****APP calculations 1991/92**

Table 5 Percentage contribution of income sources to total household income by domains

Domain	N	Cash crop	Cereal crop	Livestock	Off-farm
River basin	71	10.25	7.39	16.45	65.90
Low hill	279	11.77	8.23	20.08	50.92
Middle hill	278	5.98	5.97	16.41	71.64
High hill	72	2.98	12.15	17.31	67.56
Mountain	1	-	50.00	40.00	10.00
Overall	701	8.40	7.71	18.00	65.89

Source: Vaidya and Floyd, 1997

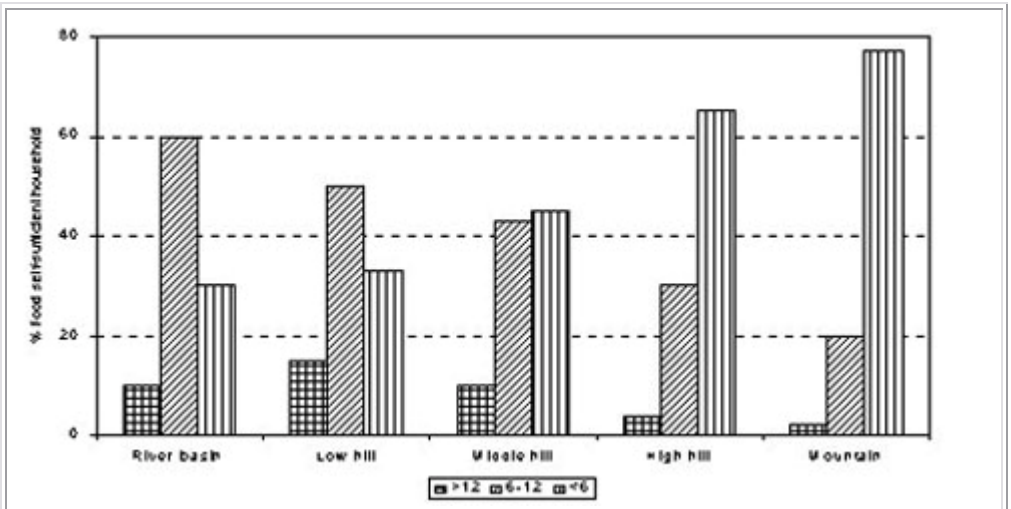


Figure 2 Food self-sufficiency levels by domains in the RCA (months)

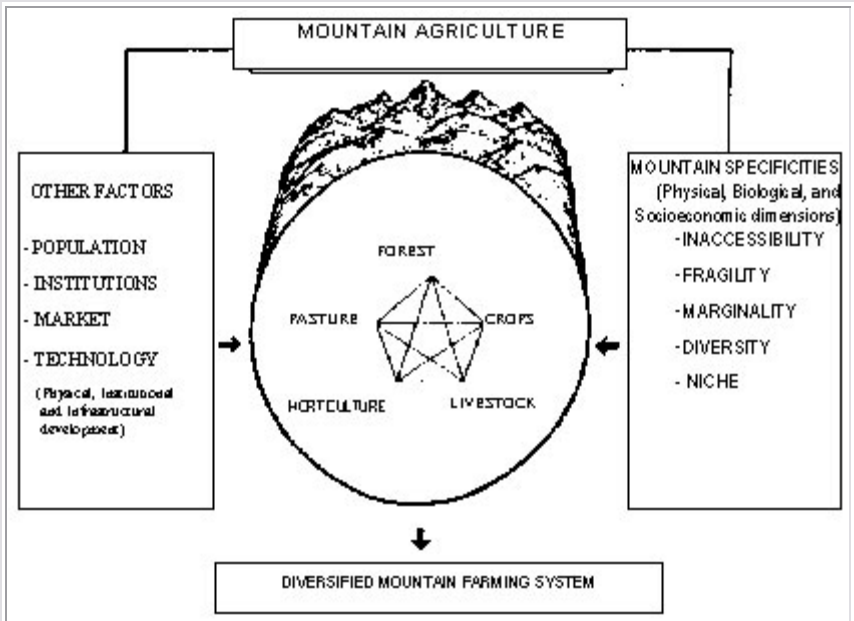
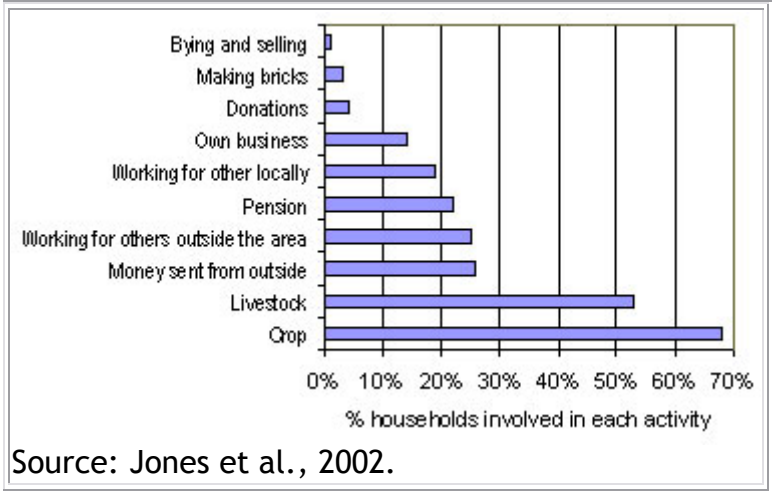
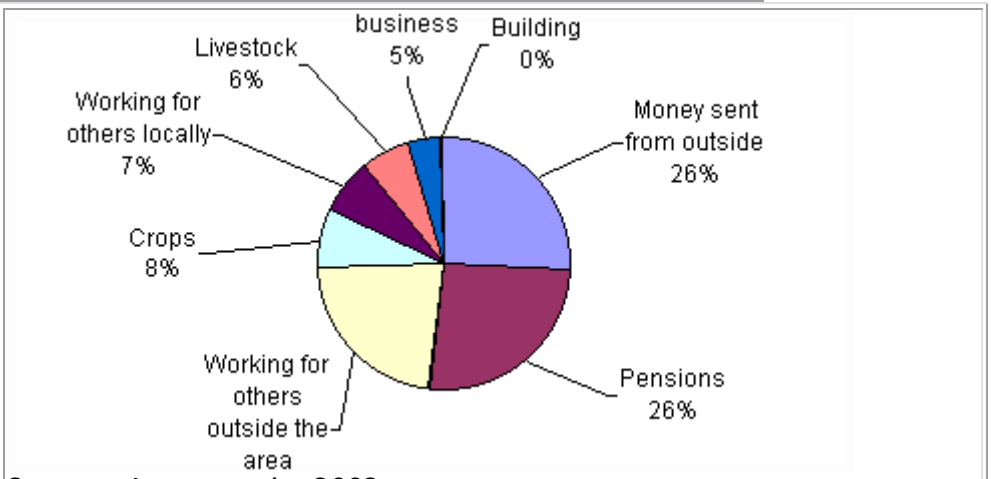


Figure 3 Mountain Agricultural System



Source: Jones et al., 2002.

Figure 4 Main livelihood activities



Source: Jones et al., 2002

Figure 5 % of total income from the main income sources (all FSGs)

Figure 6 Agricultural Frame-work for Mountain Livelihood

Notes to readers

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The author may be reached at:

Ram P. Sah
Agriculture Research Station
Lumle
P.O. Box 1,
Pokhara
Nepal

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