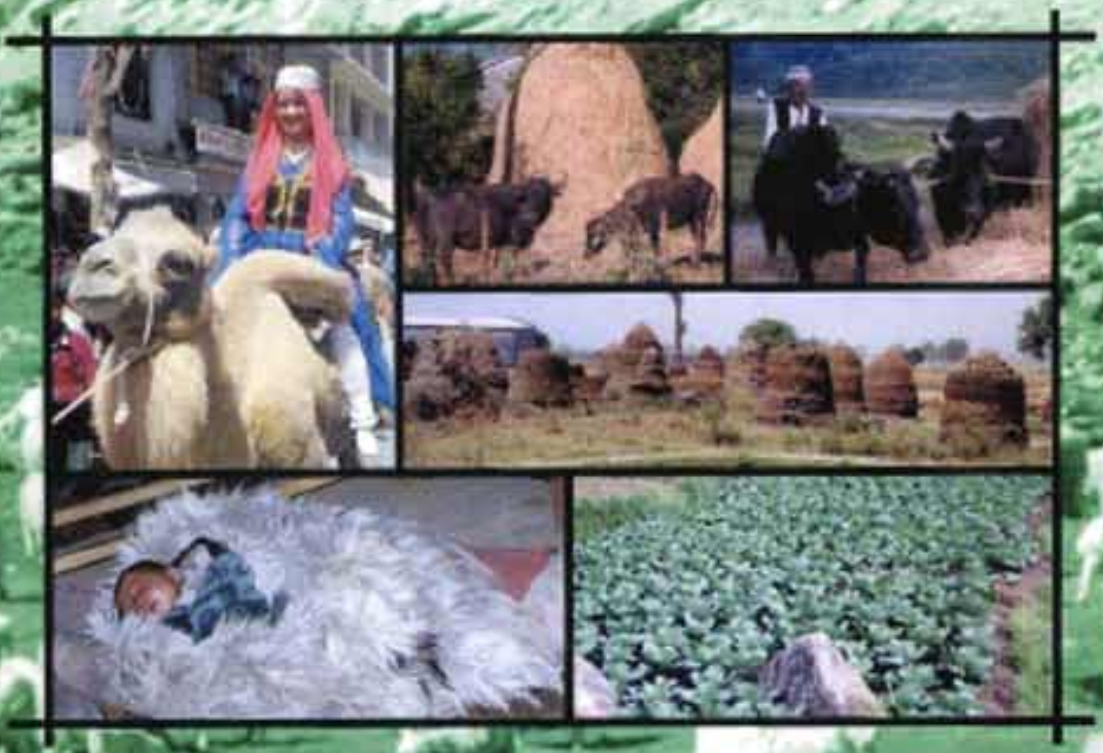
Livestock in Mixed Farming Systems of the Hindu Kush-Himalayas

Trends and Sustainability



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Preface

This January, ICIMOD embarked on the Second Regional Collaborative Programme for the Sustainable Development of the Hindu Kush-Himalayas (RCP II) that covers the period from 1999 to 2002. During this period, ICIMOD will focus on three programme areas. First, poverty reduction and sustainable livelihoods; second, gender-balanced mountain development; third, sustainable management of the mountain commons.

Within RCP-II, emphasis will be on the overall improvement of the economic situation of marginal farms, which we define as farms that are either too small in size or too low in productivity to produce sufficient food and income for the farmers household. We will address the livestock sector in this context in two ways. First, generating knowledge on the present situation of the livestock sector in the HKH; and second, through developing a better understanding of how livestock can fit into a mountain-specific niche as an income generating option for improving livelihoods.

Perhaps the role of livestock is understood best by those who farm the mixed crop-livestock systems in the Himalayas where the land is often steep and fragile. Land-use planners and policy-makers have tended to neglect this important component of the farming system, despite the fact that livestock contributes in many ways to the sustainable livelihood of mountain households.

For the last 10 to 20 years, considerable changes have been taking place in the livestock population structure and management systems in the mid-mountain areas of the Himalayas where mixed crop-livestock farming is the dominant agricultural system. Many studies have been carried out by different institutions and agencies;

however, these were in different geographical locations and with different objectives related to livestock sector development in the HKH region. Knowledge about how these changes and transformations are affecting the sustainability of livestock production systems has not been brought together to help our understanding of the transitions that are taking place. Furthermore, the constraints and opportunities of sustainable livestock management have not been well documented. It is in this context that ICIMOD and FAO have jointly carried out a state-of-the-art review to fill the gaps in our understanding and to identify further priority areas for research.

I thank all of the participants who attended the one-day workshop on '*Mixed Crop-Livestock Farming Systems in High Pressure Areas of the Himalayan Region*', held jointly by ICIMOD and FAO in February 1999, to draw on their knowledge and experience and thereby sharpen the focus and fill in the gaps in an earlier draft of this study. This activity is another example of the excellent institutional relationship between FAO and ICIMOD. This is a natural alliance, given our common mandate of poverty reduction and environmental conservation, particularly in rural areas. By linking FAO's global mandate, perspective, and specialised expertise; and ICIMOD's mountain focus, regional perspective, and multidisciplinary approach; we have already conducted many successful collaborative activities with different divisions of FAO. I am glad that the present study has now allowed us to establish excellent contacts with FAO's Animal Production and Health Division.

I am grateful to Mr. Juhani Maki Hokkonen, FAO-Rome, for sponsoring this study. I would like to thank my colleagues, Dr. Pradeep M. Tulachan and Arun Neupane, for undertaking this job and Dr. Mahesh Baskota and Dr. Tej Partap for providing support and advice. I hope that this state-of-the-art review will lead to better understanding of the critical issues affecting the livestock sector in the mixed crop-livestock farming areas and contribute to policies and programmes that will improve the livelihoods of farming households in the Hindu Kush-Himalayas.

Egbert Pelinck
Director General

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The authors wish to thank Dr. Mahesh Baskota, Deputy Director General, ICIMOD, for his support and advice. The authors would also like to thank all the participants who contributed to the joint ICIMOD-FAO workshop on 'Sustainable Management of Livestock in Mixed Crop-Livestock Farming Systems of High Pressure Areas in the Himalayan Region' held at ICIMOD on 4 February, 1999, for their valuable inputs.

We would like to thank both Mr. Juhani Maki-Hokkenon and Dr. Hiroshi Kudo from FAO, Rome, for funding the study and for their valuable comments

We are also grateful to the International Livestock Research Institute (ILRI) for funding the Livestock Database Project from which some data have been taken for the present study.

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Arun Neupane

Abstract

This is a state of the art review paper which analyses the changes taking place in livestock production management in mixed crop-livestock farming systems. It focus on the area of the Hindu-Kush Himalayas that are under pressure. The paper describes the changes taking place in livestock population and composition in the hills and mountains of Nepal and in the Central and Western Indian Himalayas. It examines the increasing trend of smallholder dairy farming in mountain areas and discusses up various issues related to it. In light of the transition taking place in livestock production management, implications on soil fertility, demand for fodder, and changing linkages to the environment are assessed. Gender aspects in livestock management are also explored. Livestock development policies of the past are reviewed and the necessity for renewed focus emphasised. In concluding, based on the changing patterns of livestock production systems and the lack of success of past development experiences, strategies for sustainable management of livestock production in mixed crop-livestock farming systems of the Hindu-Kush Himalayas are outlined.

Acronyms

ADB	Asian Development Bank
APROSC	Agricultural Projects' Services' Centre
CPR	Common Property Resources
DDC	National Dairy Development Corporation
FAO	Food and Agriculture Organization
FYM	Farmyard Manure
HH	Household
HKH	Hindu Kush-Himalayas
HP	Himachal Pradesh
HYV	High-yielding Variety
ICIMOD	International Centre for Integrated Mountain Development
INGO	International Non-government Association
LRMP	Land Resources' Mapping Project
LSU	Livestock Unit
MPA	Milk Producer Association
N	Nitrogen
NDDB	National Dairy Development Board
NGO	Non-government Association
NRB	Natural Resource Base
TDN	Total Digestible Nutrient
TOR	Terms of Reference

UP	Uttar Pradesh
VDC	Village Development Committee

Contents

chapter one

Introduction

The Context

The last few decades have seen considerable changes taking place in livestock population, structure, and management systems in the mid-mountain areas of the Hindu Kush-Himalayas (HKH) where mixed crop-livestock farming systems predominate. These changes have altered the relationship of livestock to overall farming systems and natural resources' management. In addition, changes in the natural resources themselves have also had an impact on how livestock are managed. In general, change is greater in the hill/mid-mountain regions of Nepal and in the Western Himalayas where there has been rapid population growth leading to decreased farm size and increased land fragmentation.

Several studies have been carried out in the past on the livestock sector development in the HKH by different institutions and agencies in particular areas and with different objectives. However, knowledge about how these changes affect sustainable livestock production systems has not yet been systematically integrated. This report seeks to bring together various studies on the linkages that influence the livestock sector of the HKH region and aims to provide better understanding of the changing linkages between livestock production systems and other components of the farming system such as soil fertility, crop productivity, and natural resources. It is based on a comprehensive review of relevant secondary sources and is supplemented by additional field data gathered from sites in three high-pressure hill districts of Nepal. It is acknowledged that prevailing policies and strategies for livestock sector development in the HKH hills need to be re-examined for their appropriateness in the context of a rapidly changing hill farming and livestock production system.

It is in this context that the FAO Animal Production and Health Division commissioned the International Centre for Integrated Mountain Development (ICIMOD) to carry out this study, the main purpose of which is to provide input from the Hindu-Kush Himalayas to a global FAO study on sustainable livestock production presently being undertaken in the East African highland areas and in the Andean countries of South America. The process has led to an international symposium on 'Livestock in Mountain/ Highland Production Systems: Research and Development Challenges into the Next Millennium' which will be held jointly by the International Livestock Research Institute (ILRI), Food and Agriculture Organization of the United Nations (FAO), Global Mountain Programme, International Potato Centre (GMP, CIP) and International Centre for Integrated Mountain Development (ICIMOD) in Pokhara, Nepal, from December 7 to 11, 1999.

Terms of Reference/Areas of Enquiry

A Letter of Agreement between FAO and ICIMOD was signed. ICIMOD undertook the following areas of study according to the terms of reference given in this Letter of Agreement.

- What have been the changes in livestock population and composition in areas in which livestock are an integral part of the overall farming system?
- How has the growing human population affected livestock population, animal productivity, and agricultural productivity?
- How are population pressures contributing to landholding sizes and livestock holding sizes?
- What are the linkages between livestock and crops and with common property resources and private land?
- What are the changes taking place in terms of livestock holding and management practices as a result of the high pressure on land and increasing cropping intensity?
- How are livestock contributing to the sustainable management of agricultural land and how are they contributing in terms of farm power/energy?
- Are livestock contributing to an improvement in natural resources or to their degradation?
- What are the key policy issues for the Himalayas in terms of livestock sector development?

- What is the role and contribution of gender to livestock management at the household level ?
- How are gender issues addressed in livestock policy formulation, e.g., in extension service delivery systems and research?
- What are the new options for improving livestock management and productivity?

Study Areas and Methodology

This study focusses on 'high pressure' areas of the Himalayan region, namely, the middle hills of Nepal and the Western Indian Himalayas. These are places in which livestock densities in terms of cultivated land, grazing land, and forests are high and areas where mixed crop-livestock farming systems predominate. The areas for study were selected on the basis of these criteria. Overall, the pressure of livestock population on land resources is relatively less in the Eastern Himalayas than in the Western Himalayas.

Since this is a state-of-the-art study, it involves a comprehensive critique of relevant secondary sources and a careful review and analysis of the data and information gathered from these sources. Several case studies carried out by other organizations are reviewed and the data/information collated. In addition, a vast set of scattered data and information from government sources and other research reports are reviewed and analysed. Simple analysis in terms of percentage change between two time periods and growth rates is carried out for data from the livestock sector.

The districts for the field study in Nepal were chosen after ranking all the hill districts based on the values of 'Livestock Pressure Indicators'. High pressure areas were determined on the basis of both livestock and human components (Annexes 1 and 2). The following parameters were used to determine the pressure indicators.

- Human population per hectare of cultivated land
- LSU (livestock units) per hectare of cultivated land
- LSU per hectare of forest and cultivated land and specifically in the case of high pressure in terms of small ruminants

- Small ruminants (sheep and goats) per hectare of cultivated land

The districts selected in Nepal were Kaski and Parbat in the western middle hills and Dolakha in the central hills. Parbat and Kaski both demonstrated intense human pressure on cultivated land. Total livestock pressure on resources is also high in both these districts. The average number of buffaloes per hectare of cultivated land is higher in both Kaski and Parbat than in Dolakha. Dolakha is subject to dense pressure in terms of small ruminants such as sheep and goats.

The information gathered was through general reconnaissance, informal survey of households, and through supplemental information from key informants on the issue of changing trends in livestock management practices and farmers' perceptions on the state of livestock feed resources.

Informal interviews and group discussions took place with farmers' groups, buffalo traders, smallholder dairy farmers, women farmers' groups, milk cooperatives, field-based technicians, and officials.

Following the completion of the draft report, a one-day workshop was carried out to discuss the findings with different stakeholders and experts who have had a lot of experience in livestock sector development. Twenty-eight individuals took part and sufficient time for discussion was provided. A checklist questionnaire was also developed to draw upon their expertise. Their suggestions are incorporated in this study.

chapter two

Livestock Composition in the Himalayan Mountain

Introduction

In the Himalayan subtropical mountains, particularly those of Nepal and India, the majority of farmers operate mixed crop-livestock farming systems. There are a great many different types of agro-ecosystems in this region. Geographic and topographic variations (mountain specificities – Jodha *et al*. 1992) have combined to provide a microcosm of the earth's vegetation types and farming systems. Landholdings are small and fragmented, consisting mostly of marginal uplands. The most common livestock species in mixed crop farming are cattle[1], buffaloes, sheep and goats (Annex 3 summarises typical management practices).

The raising of livestock is integrated with food crop production. While crops provide feed and fodder, livestock provide meat, milk and milk products such as cheese and 'ghee' (clarified butter) for subsistence and as a source of cash income. Livestock also supply draught power to till the land and provide power for other agricultural operations such as threshing and transport.

In this farming system there is a dynamic relationship between common property resources, livestock and crops. It is clear that livestock depend to a certain extent on fodder and grass growing on CPRs: the animals then return the fodder, grass, and crop residues to the cropland via manure. Indeed, livestock are integral to the sustainability of hill and mountain farming. However, this relationship is now under increasing pressure from different sources.

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[1] The author has used the term cattle here to mean strictly cows and bulls and not all domesticated quadrupeds, or all species in the *Bos taurus* category.

Livestock also supply draught power to till the land

There are now varying degrees of commercialisation within these mixed crop-livestock farming systems. In fact, livestock production systems are becoming quite dynamic in certain pocket areas of the mountains with accessibility to road networks and a market for milk. Farmers are being provided with a strong incentive to keep livestock; not just to fulfill the traditional role of providing draught power, milk, meat, and manure for households; but also to generate cash income through the sale of milk and meat. In these areas there has been a shift in management practices, with linkages to common property resources (CPRs) beginning to break down.

Two types of specialised livestock production systems may be noted today. The first is in valley areas with good access to markets. Here, a specialist cattle milk production system based on Jersey cross-bred cattle is emerging. Some areas in Himachal Pradesh (HP) practise such specialisation.

The second specialised system is emerging in the middle hills of Nepal where smallholdings close to the main roads depend mostly on crop residues and fodder/grasses grown on private land and CPRs to feed livestock. In these areas, commercial smallholder dairy farming is becoming common. These places are on (or close to) roadheads where government organizations and private dairies establish milk collection centres. There is an increase in the trend for feeding animals purchased concentrate feed, an especially common practice with farmers who are raising improved cross-bred cows or improved buffaloes. Thus, dependency of dairy animals on common property resources is minimal in these areas, and stall feeding is the key management practice. Linkages between crops, livestock, and the forests have weakened. Farmers now rely more and more on private land to meet fodder needs, and there is a decline in the relative importance of farmyard manure (FYM)/compost in the nutrient management system. This decline has to some extent been compensated for by the use of chemical fertilizer. Chapter 4 discusses the issue in detail.

Population Growth and Land Fragmentation

As a result of growing human populations in the HKH mountains, land resources per household are decreasing, with sub-division and fragmentation of land over the generations. Sharma (1993) compiled data on trends in population growth and per capita cultivated landholdings in selected areas of the HKH. The magnitude of reduction in per capita cultivated land is as high as 46.7 per cent within a decade in the case of the Central Himalayas (see Table 2.1). Similarly, the reduction in per capita landholdings in the Western Indian Himalayas and Nepal is also significant. In all likelihood, this trend grew throughout the 1990s.

Table 2.1: **Population Growth Trend and Per Capita Cultivated Land (ha) in Selected Areas of the HKH**

Country/region	Year	Population growth trend	Per capita cultivated land (ha)	Percentage decrease in landholding
India	1961	1.66	0.220	
Himachal	1971	2.09	0.190	39.1
Pradesh	1981	2.15	0.134	(as of 1961)
UP (8 districts)	1971	2.40	0.30	46.7
	1981	2.38	0.16	
Nepal	1971	2.07	0.173	
	1981	2.66	0.133	23.1

Source: Sharma 1993

Although the head of livestock per household is decreasing, the number of livestock overall has not decreased enough to match the reduced per capita resource availability. This is because livestock are an integral part of a large majority of subsistence households and must be maintained at a certain minimum threshold.

Trends in Livestock Population and Herd Composition

In the mixed crop farming systems of the middle mountains of Nepal, pressure from livestock is heavy. In relation to the amount of arable land per person, the livestock population is one of the highest in Asia (LRMP 1993). The population of livestock in Nepal in 1996 was estimated to be about 6.5 million head of cattle, 3.4 million buffaloes, 5.9 million goats, and 0.9 million sheep

(Agricultural Statistics of Nepal 1996/97). Livestock contribute 20 per cent of household cash income in the hills and mountains , without taking home consumption of livestock products into account (Nepal Rastra Bank 1988). On average, a mountain/hill household raises six to 10 head of livestock, including large and small ruminants (Shrestha and Sherchan 1998).

On average, a mountain/hill household raises six to 10 head of livestock.

The analysis of livestock data in Nepal reveals that the most noticeable change in the hills is the significant increase in the buffalo and goat population between 1988/89 and 1996/97 (see Table 2.2). Percentage changes in the number of buffaloes and goats are a positive indication of their importance, while the change in cattle and sheep is negative and shows their decreasing importance in the total herd composition and in the economy. The most noticeable change in the mountains is the considerable decline in the sheep population in total herd composition.

Table 2.3 reveals that between 1984/85 and 1989/90 there was significant growth in the pig population in both the mountains and hills of Nepal. Conversely, the population grew at

Table 2.2: **Livestock Population and Composition in the Mountains and Hills of Nepal (%)**

Livestock classes	Mountains		Hills	
	Change in Population (1988/89 - 1996/97)	Change in Share* (1988/89 - 1996/97)	Change in Population (1988/89 - 1996/97)	Change in Share (1988/89 &1996/97)
Cattle	+3.17	+0.89	+5.77	-0.51
Buffaloes	+0.58	0	+8.30	+0.21
Sheep	-9.59	-1.70	-2.53	-9.59
Goats	+2.87	+0.80	+9.37	+2.87

Sources: (1) Agricultural Statistics of Nepal (1990) and Statistical Information on Nepalese Agriculture (1996/97), HMG Ministry of Agriculture, Agricultural Statistics Division, Singha Durbar, Nepal
*[Percentage share of individual species in total livestock population (Cattle+Buffaloes+Sheep+Goats)]

Table 2.3: **Population Growth Rate (%) of Poultry and Pigs in the Hills and Mountains of Nepal**		
	Percentage	
	1984/85 to 1989/90	1991/92 to 1997/98
Poultry		
- Hills	10.4	0.2
- Mtns	7.1	2.5
Pigs		
- Hills	2.1	1.4
- Mtns	3.4	1.1
Source: Statistical Information on Nepalese Agriculture Series (1984/85 to 1997/1998), Ministry of Agriculture, Nepal		

a rate of slightly more than one per cent annually between 1991/92 and 1997/98.

The number of poultry grew significantly between 1984/85 and 1991/92, at a rate of 10.4 per cent and 7.1 per cent in the hills and mountains respectively. This growth stagnated in the hills between 1991/92 and 1997/98, but still grew at an annual rate of 2.5 per cent in the mountains

In Himachal, the poultry population increased very significantly by 145 per cent from 1972 to 1982. The increase continued between 1982 and 1992. On the other hand, although the population of pigs increased by 179 per cent from 1972 to 1982, it decreased by 14 per cent from 1982 to 1992. In the Kumaon areas (Uttar Pradesh hills), the poultry population has increased since 1972 (see Table 2.4).

Table 2.4: **Trends in Population of Poultry and Pigs in Himachal Pradesh and UP Hills, India**							
Himachal Pradesh							
	1972	1982		% Increase from 1972 to 1982	1992		% Increase from 1982 to 1992
Poultry	188,649	461,285		145	664,039		31
Pigs	2,906	8,107		179	7,105		-14
UP Hills (Kumaon)							
	1972	1978	% Change between 1972-1978	1982	% Change between 1978-1982	1986	% Change between 1982-1986
Poultry	178,978	213,864	+19.5	335,596	+56.9	363,416	+8.29
Source: Himachal,'Livestock Census Himachal Pradesh, 1972, 1982, 1992': UP Hills, in R. Swarup (1991) "Agricultural Economy of Himalayan Region."							

Data from the Indian Himalayas have shown that a large proportion of livestock is raised under the mixed cropping system. Cattle are most common (47.5%), followed by goats (15.8%), buffaloes (12.3%), and sheep (10.4%) in mixed crop farming in the central and eastern Himalayas (Rao and Saxena 1994). Under this system, the landholdings are small and livestock provide a critical supplement to farm incomes. According to studies on livestock conditions, livestock pressure is increasing in the Western Himalayas of India.

In Himachal Pradesh, cattle population during the past two decades has remained at the same level, whereas the buffalo population grew more rapidly. Composition of the cattle population in the state showed improvement as a result of an increase in the share of milch cows and a decrease in the share of dry cows and young stock. Population of in-milk bovines increased at a faster rate that that of other categories of bovine animals and livestock. These changes indicate that livestock owners were replacing low productivity cattle and buffaloes with more productive animals (Chand 1997).

Furthermore, in Himachal about 75–80 per cent of rural households keep milch cattle and over 90 per cent keep either milch or draught animals. Buffaloes are kept by about 50 per cent of households in Mandi District. Smallholder farms commonly keep one to two draught cattle and two to four milch and growing cattle or buffaloes; although the number of households owning two or more milch animals has been declining. Overall, about 40–50 per cent of households keep sheep and goats.This proportion increases to 60–70 per cent in highland areas.

An analysis of temporal changes in livestock population and composition from 1978 to 1988 in the UP Hills and in Himachal Pradesh from 1982 to 1992 (Table 2.5) shows that, whereas the cattle population has declined, the buffalo population has greatly increased. Among small ruminants, the sheep population has declined. It is interesting to observe that there has been a significant increase in the goat population. The percentage share of cattle and sheep has gone down in the overall herd composition, while the percentage of buffaloes and goats has increased.

Table 2.5: **Livestock Population and Composition in the Indian Himalayas**

Livestock species	Central Himalayas (Uttarakhand) 1978–1988		Western Himalayas (Himachal Pradesh) 1982–1992	
	% increase in population	% change in composition	% increase in population	% change in composition
Cattle	-5.2	-3.0	-1.06	-0.71
Buffalo	+15.1	+2.5	+13.64	+1.62
Sheep	-9.1	-1.0	-8.15	-1.91
Goats	+7.1	+1.4	+5.25	+1.00

Source: Directorate of Land Records (1992), Livestock Census, Government of Himachal Pradesh, Shimla.
Revenue Department, Livestock Census, Govt. of UP, Lucknow, India

To conclude, trends in the population of various livestock classes in high-pressure areas under study — Himachal Pradesh, Uttarakhand, and Nepal — are summarised in Table 2.6.

Table 2.6: **Trends in Livestock Population and Composition in the Himalayan Region**

Province/ State/Region	Population				Composition				Year
	Cattle	Buffalo	Sheep	Goat	Cattle	Buffalo	Sheep	Goat	
Himachal Pradesh	↓	↑↑	↓	↑	◆	↑	↓	↑	1982–92
Uttarakhand	↓	↑	↓	↑	↓	↑	↓	↑	1978–88
Nepal (Mtns)	◆	◆	↓	↑	◆	◆	↓	↑	1988–96
Nepal (Hills)	↑	↑	↓	↑↑	↓	↑	↓	↑↑	1988–96

↑↑ Significant Increase ↑ Increase ↓ Decrease ◆ No change

Land Fragmentation and Changes in Livestock Composition

The growth in population has led to an increased number of farm households, but with a decreased farm size. The present trend sees more livestock but fewer animals per household. The increased number of livestock overall has put pressure on natural resources and has necessitated that land be cultivated for animal feed. The following section analyses available data related to this issue.

Field investigations were carried out to ascertain the changing trend in livestock management practice and farmers' perceptions on the state of livestock feed resources. Land fragmentation and the corresponding household-level adaptation emerged as the main

issue. There was clear evidence of significant, ongoing changes over the past two decades. This time frame also coincides with the period of active implementation of government policies to control access to common property resources. Table 2.7 shows that, with the shift towards the nuclear family, there has been extensive fragmentation of landholdings. Thus, while holdings increase in number they decrease in size. The person-land ratio has risen significantly over the area as a whole. Arable land has remained much the same, and there is little prospect for increasing it. With more effective community protection of common property resources, it is logical to conclude that land-based feed resources for livestock are becoming more and more difficult to provide under the prevailing system. These factors have led to the present reduction in the number of livestock in individual farm households. Labour shortages and the change to productivity-enhancing management practices have further contributed to the reduction in livestock numbers at the household level.

Table 2.7: **Change in Land and Family Size in Selected Households of Kabhre VDC, Dolakha, Nepal**

Farmer	Land Size (ha)		Family Size		% Decrease in Holding Size
	20 Years Ago	At Present	20 Years Ago	At Present	
Danima Sherpa	5	2	14	6	57
Krishna	1.75	1.5	8	6	25
Ram P. Dahal	2.9	1.3	6	2	122
Nuru Sherpa	2.5	1.25	12	6	50

Source: Field Survey, Dolakha 1998

Farmers in the area have reduced the number of large ruminants while increasing feed resources (privately planted trees, shrubs, and ground grass) to sustain small ruminants (Table 2.8).

Table 2.8: **Change in Composition of Livestock in Selected Households of Kabhre VDC, Dolakha, Nepal**

Farmer	Cattle		Buffaloes		Sheep		Goats	
	20 years ago	Now	20 years ago	Now	20 years ago	Now	20 years ago	Now
H. P Lamichane	30	12	20	5	20	8	12	20
Nuru Sherpa	3	2	-	2	-	-	2	8
B.K. Chaulagai	2	-	5	2	-	-	6	2
R. P Dahal	4	1	-	2	-	-	4	8

Source: Field Survey, Dolakha 1998

Box 2.1
Two Farmers from Dolakha District

Case 1: Damina Sherpa from Thuloban of Dolakha District

Damina Sherpa's family had 90–100 *ropani* (4.5–5 ha) of land 20 years ago and now has approximately 41 ropani (2 ha) left. There were 14 family members in his family 20 years ago, and now there are six members. The total livestock population has increased due to the change from a joint to a nuclear family, which entails individual families possessing their own livestock. A remarkable increase in the total population of goats has occurred for this reason. According to the farmer, the population of sheep has declined due to a lack of pasture land. The price of selected livestock has been increasing. A goat with a live weight of 20–25 kg presently sells for Rs 2,000–3,000 (farmgate price).

Case 2: Krishna from Sisneri Village of Dolakha District

Krishna lives in Sisneri. His family had 35 *ropani* (1.75 ha) of land 20 years ago. Now he has only 20 ropani. Family size has increased from six to twelve. This particular farmer had a total of 26 livestock 20 years ago, consisting of cattle, buffalo, and goats. Goats accounted for most of his livestock. Currently, he has a total of 11 head of livestock. He states that the livestock population has decreased due to lack of feed/fodder and medical facilities. The animals in his household are fed on fodder from his own land or from fodder which he purchases. (A bundle of hay costs Rs 100). One of the two buffaloes is of an improved breed. Cattle are mostly raised for manure and goats for meat. In Krishna's opinion, the forest has decreased because of the increase in population. However, many grass species are now grown in private forests. These include napier, *Settaria*, pine, *Ulnus*, bamboo and broom grass. In times of fodder scarcity, Krishna gets fodder for his livestock from private land..

The practice of planting fodder on private land has increased in recent years because of decreased access to public land. Goats are easily managed because they feed on a wide range of fodder, grass, and shrub species that are planted around the homestead. Because of their size, their feed requirements are also nominal compared to large ruminants such as buffaloes. Goats also have an advantage in that they can be tended by children. The villages are close to the main highway, i.e., the Lamoshangu-Jiri Road, that provides ready access to large markets. As a result, households are keeping more goats and reducing the number of large ruminants (see Table 2.8).

Keeping fewer animals with more output (milk) by replacing local stock with high-yielding animals and through stall feeding has become an established trend in the middle hills. Stall feeding of animals has increased over the last ten years. One of the disadvantages of this system is the big demand for human labour to tend the animals. The human labour available in the middle hills is increasingly allocated to home-based livestock-rearing activities such as stall feeding.

The changes in farming conditions are also affecting the use of draught animal power. For instance, paddy requires more bullock-pair days than other food crops. The shift to plantation crops in Himachal Pradesh has reduced the demand for draught power. Consequently, the numbers of draught animals declined in six districts of the state during 1972–1992. The shrinkage in the average size of holdings from 1.53 hectares in 1971 to 1972 to approximately 1.20 hectares in 1991 to 1992 has also contributed to a reduction in the draught animal population in the state.

There has also been a significant improvement in agricultural mechanisation

There has also been a significant improvement in agricultural mechanisation in the low-lying districts and in the valley areas of Himachal Pradesh during the last two decades. Singh (1996), however, points out that vegetable cultivation, as opposed to

orchards, is labour-intensive, requiring large inputs of both human and animal labour.

"One assumes that fruit farming (apple orchards, for instance) requires no draught animal power (DAP) input. But the fact is that the area under fruit trees is used extensively for vegetable cultivation. As a result, it has been noted that the orchard-vegetable cropping system demands more DAP than a cereal-based system" (Vir Singh [1998]).

The number of draught animals has increased in areas under commercial crops, such as potatoes and off-season vegetables, that require more bullock-pair days for the preparation of the field than traditional crops. However, there has been an overall decline in the draught animal population. This is a positive development towards a reduction in the overall pressure of livestock on land resources in mountain areas.

chapter three

The Increase in Smallholder Dairies in Mountain Areas

Importance of Livestock in the Farm Household Economy

Livestock have been playing an important role in the farm economy of mountain households. Table 3.1 shows that livestock alone contribute 47.3 per cent and 35.7 per cent of the total agricultural income in the mountains and hills respectively.

Table 3.1: **Contribution of Livestock to Total Agricualtural Income of Farm Households (Rs)**

Ecological Region	Crop	Livestock	Agriculture
Mountain	3 549 (52.7)	3 190 (47.3)	6 739 (100)
Hill	4 495 (64.3)	2 495 (35.7)	6 990 (100)
Terai	8 224 (80.0)	2 057 (20.0)	10 281 (100)
Nepal	6 007 (71.7)	2 371 (28.3)	8 378 (100)

Figures within parentheses indicate percentage contribution.
Source: Shrestha and Sherchand (1988)

Similarly, a case study in the Western Himalayas (Himachal Pradesh) shows that livestock contributes 25–26 per cent of the total farm income per household (HH).

Table 3.2: **Contribution of Livestock to Total Farm Income per HH in Himachal Pradesh (IRs per HH)**

	Transformed Area		Non-transformed Area	
	Income per HH	Share in Total (%)	Income per HH	Share in Total (%)
Livestock	12,428	25.64	4,648	26.71
Crop Production	4,148	8.56	5,781	33.22
Fruit Crops	30,962	63.87	6,975	40.08
Vegetable Production	940	1.94	0	0
Total	48,478	100.00	17,404	100

Source: Sharma (1996)

Increasing Trend of Smallholder Dairy Farming

Smallholder dairy farming is becoming increasingly popular in many of the accessible pocket areas of the HKH. It has also been the driving force behind the transformation of the rural economy in many parts of the Nepalese and Indian hills. An established market for fresh milk and the development of milk cooperatives and milk collection centres have made this possible.

While the development of smallholder dairy farming in Nepal's hills was achieved by replacing low-yielding cattle with high-yielding buffaloes (*murras*, or *murrah* cross-breeds); development in the Indian Himalayas, and particularly the Western Indian Himalayas, came about through the replacement of local cattle with improved cattle (Jersey or Jersey cross-breeds). Smallholder dairy farming in both Nepal and the Indian Himalayas is discussed in greater detail below.

SmallHolder Dairy Dynamics in the Middle Hills of Nepal

In Nepal's hills, areas that are accessible via the road network have experienced significant growth in smallholder dairy farming. The marketing of milk has been facilitated by the establishment of milk collection centres that transport milk to the main chilling centres established by parastatal government organizations, as well as by private dairies, in the main towns or cities. The government has established chilling centres that are the ultimate market for the milk sold by the smallholder.

Smallholders manage their herds in order to maintain a steady supply of milk. The number of milch animals that can be reared in a smallholder system has a certain ceiling. The obvious determining factors to this are the size of landholding, the availability of feed, and human labour. There was general consensus among the farmers interviewed that the optimal number of milch buffaloes that can be maintained under the prevailing conditions for smallholders rarely exceeds three animals. Most farmers interviewed owned between one to two milch buffaloes. Given the limitation of the herd size for milch animals, the main problem is ensuring a continuous supply of

Waiting by the road with milk for collection.

milk when one or more of the animals in the herd is not lactating.

Innovative farmers have adapted to the changing circumstances. Box 3.1 illustrates one strategy adopted by a smallholder dairy farmer.

Preference for Buffaloes

Table 3.3 shows that most of the milk production in Nepal is from buffaloes. The share of buffalo milk and cow's milk in the total milk

Box 3.1
Managing a Buffalo Herd in a Smallholder Dairy

A farmer buys a milch buffalo from a lowland buffalo trader at a price of Rs 23,000–28,000. The animal is milked for eight months to a year and the gross income amounts to Rs 25,000–30,000. Some farmers sell expectant '*bakerno*' buffaloes for Rs 18,000–20,000 after one year of milking and buy an in-milk buffalo '*laino*' from the trader at a price of Rs 25,000–30,000. This is to ensure continued milk production. If the farmer waits for the '*bakerno*' buffalo, it takes about eight months before it calves and begins producing milk. The strategy is most suitable for smallholders who manage only one buffalo, but it is also being adopted by those who have more than one buffalo. In circumstances when old buffaloes become '*tharo*' (dry) , they are sold for meat for about Rs 8,000–10,000, depending on body weight. Similarly, in cases in which animals do not conceive for ten years, they are sold for meat, generating a salvation value of Rs 4,000–6,000. The majority of smallholders do not raise buffalo calves to maturity. The calves have a poor survival rate and are deliberately starved. Buffalo calves, if raised, consume three to four litres of milk each day for at least three months, and therefore reduce the amount of milk that can be sold in the market. They are also difficult to maintain after the weaning period because of feed resource constraints. In most cases, the buffalo provides milk from the third day after calving. The process is made easier by an injection that hastens lactation.Farmers prefer lactating buffaloes without calves.

[Based on discussions with farmers from VDCs in Kaski District (exchange rate at the time 1 US$ =68 Rs)]

Table 3.3: **Production and Productivity of Buffaloes and Cows in Nepal, 1996/1997**

	Total Population	Milch Animal Population	Milk Production (in MT)	Share in total milk produced	Milk Yield (kg/year) (average of district values)
Buffaloes	3,362,435	857,420 *(25.4%)*	701,974	69.4 %	807
Cattle	6,931,775	816,270 *(11.8%)*	310,183	30.6 %	371

Source: Statistical Information on Nepalese Agriculture, 1996.1997, HMG, Nepal

produced 1996/1997 was 69.4 per cent and 30.6 per cent respectively, showing that buffaloes are the main milk producers. The high yield of buffalo milk suggests a high proportion of of improved buffaloes, especially in accessible areas.

The preference for buffaloes for milk production has led to a great demand for the high-yielding *murrah* breed. The main reasons for this are identified in Table 3.4.

● Business for buffalo traders: feeding the merchandise

This preference for buffaloes has led to a burgeoning business for buffalo traders. The buffaloes are brought from the Indian border areas in the lowlands and sold for a modest profit through various centres in the country. Box 3.2 describes one case of a buffalo trader in Pokhara. An important factor driving this trade is the fact that farmers in the hills prefer buying buffaloes that are already lactating rather than raising the calves to maturity. Raising calves to the lactating stage is a challenge for the smallholder in the hills for several reasons. First, increasing scarcity of fodder and grass in the high pressure hills means that a farmer cannot afford to maintain and raise the calves through their unproductive phase. Secondly, in the colder climate of the hills the gap between lactations is very long and disrupts the continuous supply of milk. Buffaloes conceive much easier in the warmer climate of the lowlands,

Table 3.4: **Farmers' Reasons for Preferring Buffaloes**

Buffaloes	Cows
Produce more milk than local cows and with a higher fat content (1.4% higher). Fetches a higher price per litre.	Local cows produce less milk with less fat. Milk sells for a lower price per litre.
High salvage value. Tired buffaloes and male buffaloes sell for as much as Rs 8 000 per head at the farm gate.	No salvage value for cows or bulls.
Well-adapted to local feed sources. Performs well on poor quality roughage and agricultural residue (feeds even on millet stover, unlike cows).	Improved cows require quality fodder (legumes) and higher amounts of concentrates for an economically viable performance.
Improved buffaloes, in general, are comparatively more resistant to prevailing diseases than exotic breeds of cattle.	Improved cows are more vulnerable to diseases and cannot be sustained without veterinary support services.
Gives more manure than cows. Two buffaloes give enough manure for 4–5 ropani (0.25 ha) of land.	Less manure output.
Irrigation and cultivation of quality fodder not a prerequisite as it is for improved cattle rearing.	Growing quality fodder for improved cows demands irrigation facilities and diversion of scarce land from food crops to fodder crop production

Source: Gathered through farmer surveys in Kaski and Parbat Districts, Nepal, and through literature reviews

making the present trade in buffaloes from the lowlands to the hills possible.

Trading buffaloes in this manner is a typical case of the upland-lowland interactions prevailing in the HKH. In this particular case, the lowland farmers specialise only in breeding and supplying lactating buffaloes, and the upland farmers do not breed the animals but purchase the buffaloes in order to maintain an uninterrupted supply of milk (Box 3.1).

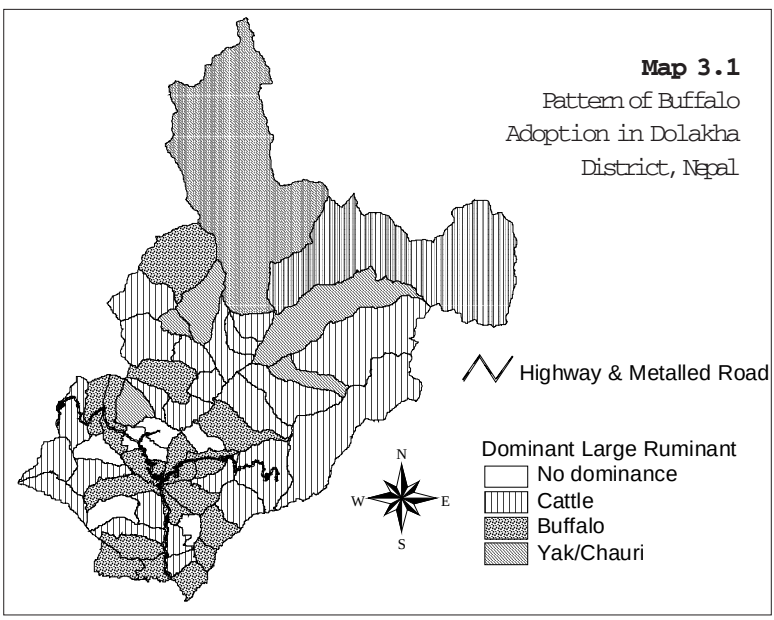
Examples from Dolakha, a high mountain district in Nepal, further illustrate the spatial distribution of livestock. The map shows a spatial distribution pattern of buffaloes and cattle in Dolakha District (Map 3.1). The concentration of buffaloes closely follows the road network, unlike the concentration of cattle (local) which is quite random. In accessible areas, there is an obvious incentive to

Box 7.2
The Case of Buffalo Traders

22 Buffalo dealers have been arriving in Pokhara, for the past 15 years, bringing in cross *murrah*. Each year, 200–300 buffalos are sold in the area. The point of purchase is Sitamadi, a village in Kannadmudia near Raxaul, where farmers rear female calves to maturity and a farmer sells 2–3 buffaloes. Buffaloes are walked up to Raxaul from Sitamudi. From Raxaul, they are transported to the point of sale (Pokhara) in trucks with the capacity to carry seven buffaloes at a time. The transportation cost is Rs 12,000 per trip. Ten years ago, a trader used to make two trips a month, bringing a total of 14 buffaloes. Nowadays, he makes four trips a month bringing a total of 28 buffaloes per month. The trade within the last decade has nearly doubled. The new buffaloes, once they arrive in Pokhara, are hand-fed for two weeks. Such feeding is necessary because the quality of feed available locally in Nepal is poorer (perceived as such by the trader) than that which the buffaloes are fed at their point of origin. They get used to the local feed after two weeks. The price structure of the buffaloes when sold is directly related to the amount of milk they produce: the greater the milk production, the higher the price.

Cost of buffaloes	Total milk production
28,000–30,000	17 litres
16,000–18,000	10 litres

The traders indicated that their monthly profit margin was about Rs 10, 000 per trip. This translates to a margin of Rs 200 per buffalo.



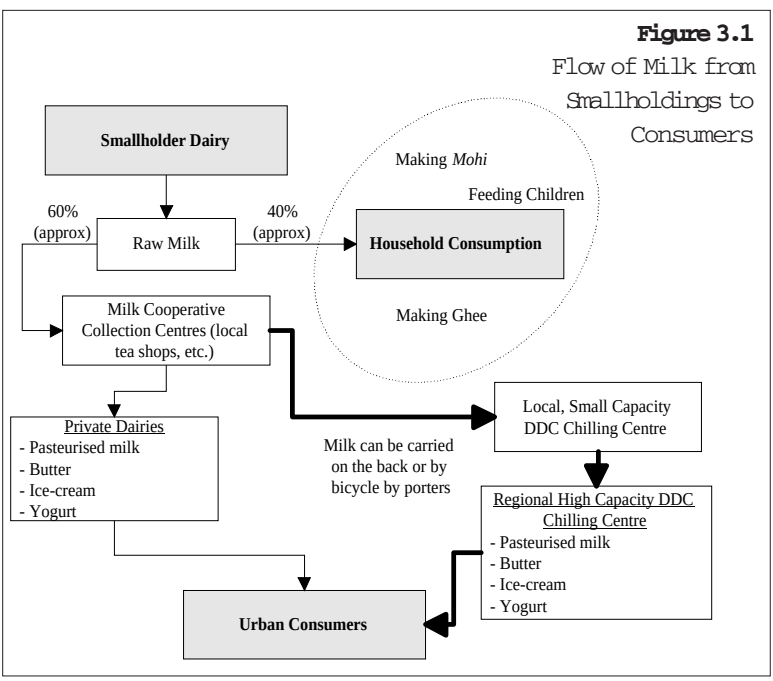
Map 3.1
Pattern of Buffalo Adoption in Dolakha District, Nepal

keep high-yielding buffaloes.

Marketing Channels for the Smallholder Dairy Farmer

Smallholder dairy farm animals produce raw milk, some of which is kept for household consumption and some of which is sold in the market. Usually, the morning milk is sold to the milk collection centres or local teashops and to sweet shops and private dairies (in urban areas). Generally, the evening milk is kept for home consumption. The milk for home consumption goes to make *mohi* (buttermilk), *ghee* (clarified butter), and milk for drinking. Home consumption is important from the perspective of household nutrition. Smallholder dairy households do not necessarily compromise the nutrition of the family and its children by selling all the milk. The milk flow chain for the marketed component of milk is shown in Figure 3.1. Milk is hand-carried to the local collection centre, usually located in a teashop. Generally, these collection centres are cooperative/producer association establishments. From the collection centre, the milk goes to the local chilling centre, usually carried on the back in 20–60 litre milk cans by hired porters, often over long distances (see Annex 4). From the local

Figure 3.1
Flow of Milk from Smallholdings to Consumers



Box 3.3
DDC Chilling Centre in Pokhara

The marketing of milk has been facilitated by the establishment of collection centres that transport milk to the main chilling centre in Pokhara as well to private dairies. The chilling centre of the Dairy Development Cooperation (DDC) in Pokhara collects milk from 5 districts (Gorkha, Syangjha, Kaski, Tanahu and Parbat) involving approximately 7,000 farmers. It supplies pasteurised milk to urban consumers in Pokhara, Syangjha, and Gorkha. The average supply from an individual farm household amounts to 2 litres per day. The average production varies with the peak and lean seasons. During peak season, the total production reaches 15,000–16,000 litres a day, whereas during lean season, it amounts to 5,000 litres a day. Buffalo milk fetches a higher price than cow's milk due to the higher fat content. The average price paid for buffalo milk is Rs 14.32 per litre, compared to Rs.11.72 a litre for cow's milk. The cost per litre takes into account both the fat and the SNF (Solid Not Fat) content which varies between the peak and normal seasons. The price for fat is Rs 1.30 per litre in the peak season, and Rs 1.34 in the dry season. The higher price in the dry season is used as an incentive.

chilling centre, milk is moved to the regional DDC chilling centres via road transport (Box 3.3). The supply to private dairies is from the local collection centres. From these two channels, milk from smallholdings goes to the urban consumers in the form of pasteurised milk and value-added products such as ice cream, yoghurt, and butter. About 100,000 farm families supply milk to urban consumers in this way in Nepal.

Inaccessibility in the mountains is the main constraint to the successful transfer of milk from the smallholdings to the processing centres. Milk, being a perishable commodity, needs to reach the chilling centres in time to maintain quality. Chilling facilities are thinly spread and therefore necessitate long walks for the milk-carriers, putting the quality of the milk at risk.

Apart from outlets to government-owned chilling centres, smallholder dairy farmers also supply milk to private dairies in the area. Small-scale private dairies have also started tapping the

supply of milk from smallholdings by setting up their own collection centres, and by offering slightly higher price incentives to farmers.

Private Sector Involvement in Processing Milk

Private sector involvement in processing milk from smallholdings is increasing. In Nepal, there are more than 20 private milk processors operating. However, private processing enterprises still face several constraints that impede their growth. The difficulties faced are mainly in the area of skill development in dairy processing. Public sector expertise in milk processing has not been transferred adequately to private entrepreneurs, and widespread training is essential. The private sector's efforts are also uncoordinated, and quality enforcement is lacking. The private sector also suffers from unfair competition with the subsidised public sector. These problems are specific to Nepal where there is relatively more involvement of the private sector in the milk

Box 3.4
A Private Dairy in Pokhara, Nepal

An entrepreneur initially invested a total amount of NRs. 2.5–2.6 million to start his dairy business four years ago. Most of the milk is delivered from Syangjha by farmers. Fifty-five per cent of the milk generated comes from buffaloes and 45 per cent from cows. Some of the by-products of milk that he has managed to sell are ice-cream, butter, ghee, and yogurt. He has two showrooms and one factory with a total rental cost of Rs 25,000 per month. His ice-cream sells for Rs 25, which is Rs 10 less than the competing brand. To meet the demand for milk, he imports 20 quintals of milk powder per year, equivalent to 22,000 litres of raw milk from dairy animals. The entrepreneur states that there are fewer farmers who come to sell milk despite the higher price paid per litre –10 per cent higher than regular dairies. He compares the cost of a litre of milk to a bottle of mineral water, both of which cost Rs14–15 per litre. He is concerned about the government's inappropriate pricing policy which benefits urban consumers. He pointed out that incentives have to be provided at all levels to make the dairy business a worthwhile one for private entrepreneurs. The high cost of feed, high interest rates, and difficult labour management are constraints to this entrepreneur's business.

industry than in the Indian Himalayan States. Box 3.4 below describes the case of a private dairy in Pokhara.

Development of Smallholder Dairies in the Indian Himalayas

In the Indian Himalayas, the development of the road network has greatly facilitated the development of the dairy industry. In the hill state of Himachal Pradesh, Himachal Pradesh Milk Producers Federation (HP Milkfed) undertakes marketing of milk in the state. Private milk vendors operate only in areas surrounding towns and cities. HP Milkfed is running nine milk supply schemes in eight districts of the state, and it has three milk plants and 31 chilling centres.

Milk marketing is supported by a state run corporation, the Milk Federation, and a network of milk plants and chilling centres collecting milk from cooperatives and farmers. Box 3.5 provides details of plant operation in Mandi District.

The marketing service has been a major factor in the development of more intensive milk production in the state. There is some demand by farmers for the collection routes to be

Box 3.5
A Successful Milk Plant in Mandi District

In Mandi District, the main milk plant at Chakkar near Mandi town is supported by five 2,000-litre chilling centres with their milk collection routes located in the main milk production areas of Mandi District and also by four other chilling centres in a neighbouring district. The milk plant collects an average of 7,000 litres of fresh milk per day and supplies pasteurised milk in bags to urban markets in Mandi and Kullu, as well as processing milk products such as butter, ghee, *paneer* (curd cake) and ice-cream. Some excess milk (about 10% of the milk collected) is sold to plants in Shimla and in the Punjab during the peak summer collection months. Eleven collection routes are operated in Mandi District, with about 7,000 registered cooperative members. The Milk Federation also supplies some inputs to cooperative members, including fodder mini-kits and subsidised compound concentrate feeds.

extended, although the milk plants currently collect enough milk to satisfy local urban demand for liquid milk and do not have plans to expand. Although the cooperative milk marketing infrastructure is ridden with problems in many areas of the state, there is no alternative other than cooperatives for providing a milk outlet in areas outside towns and cities. Live animals and livestock products are marketed mainly through private trading channels. Live animal markets are held regularly in the main centres and in seasonal markets, moving from the lowlands to the higher valleys in the summer. Milk sales by households located away from the road are nil.

In Kullu District, one 2,000-litre capacity chilling plant exists at Mohol near Kullu town. This plant supports three main collection routes covering 200 km in the Kullu and nearby valleys, collecting up to 900 litres of milk a day in the summer. The plant supplies liquid milk to the hotel and urban markets in the Kullu Valley (there is no packaging facility). Excess milk is sent to the Mandi milk plant.

An interesting difference between the Nepal hills and HP is that, in Nepal, private dairies have their own collection centres and processing units. In HP, it is all handled by the public sector. There is a considerable deficit in milk supply in major towns, e.g., Shimla, where it is believed that 40–50 per cent of the milk supply comes from the lowland states of Punjab and Haryana.

Increase in Improved Animal Breed

In Himachal Pradesh, the number of improved animal breeds has increased with the development of the dairy sector. Proximity to the artificial insemination facility led to an improvement in the stock of animals through the replacement of indigenous cows with cross-bred cows. The provision for the sale of milk and the scope to earn cash income played a strong role in reducing livestock pressure, thereby improving the quality of the herd and reducing the high number of animals that are considered harmful to the ecology (Chand 1997). Figure 3.2 indicates that the share of quality animals such as cross-bred cows and improved buffaloes increased during the period from 1982–1992 in HP. The increase in milch buffaloes and milch cow cross-breds was 6.3 and 13.2 per cent respectively between 1982 and 1992.

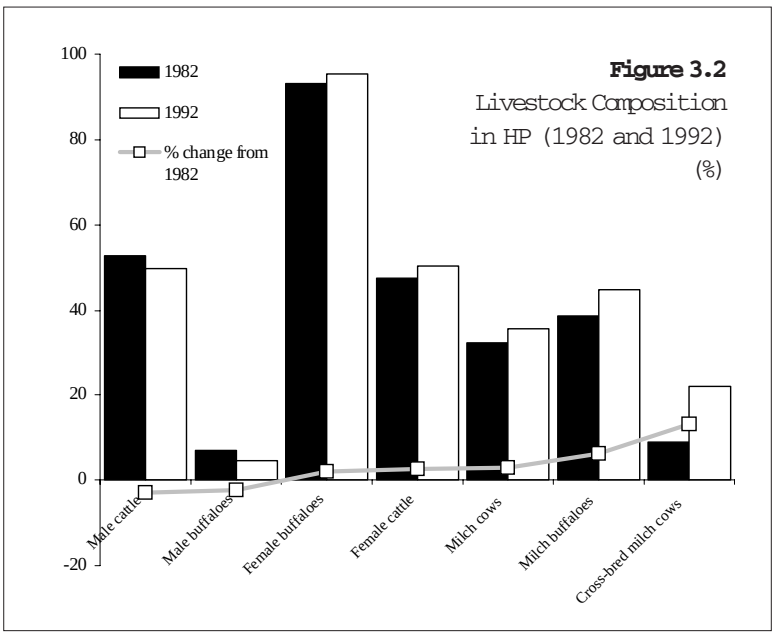


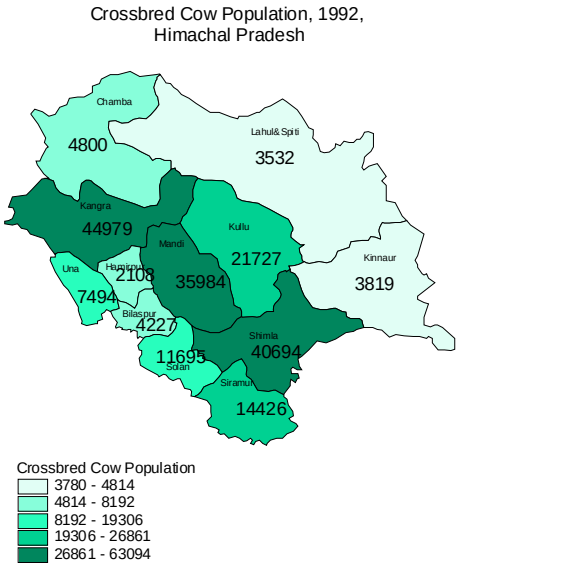
Figure 3.2
Livestock Composition in HP (1982 and 1992) (%)

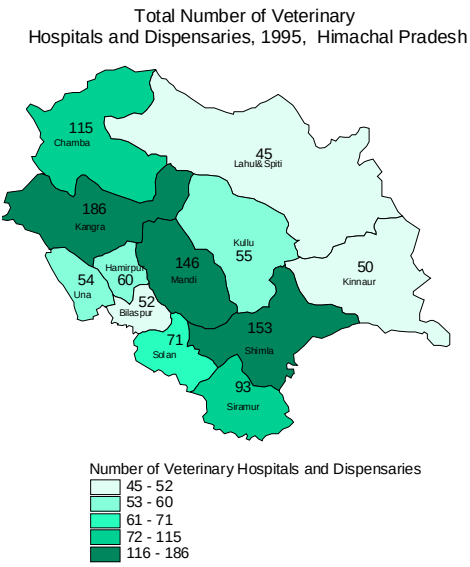
Relationship between the Distribution of Cross-bred Cattle and Veterinary Services in HP

In HP, the cross-bred cattle population is highest in Kangra, followed by Shimla and Mandi. This pattern closely corresponds with the distribution of Veterinary Hospitals and Dispensaries (VHD). Kangra has the highest number of VHDs, followed by Shimla and Mandi. Map 3.2 shows the spatial distribution of the cross-bred cattle population and the distribution of veterinary services in Himachal Pradesh. Availability of veterinary services is an important factor in the adoption of improved breeds. Improved breeds cannot be sustained without adequate livestock support services. Hence, the districts with the highest populations of cross-bred cattle are also the ones that have a higher number of VHDs.

Implications on the Natural Resource Base and the Environment

Recent developments (particularly in transformed areas) include a sharp decline in the number of animals, the replacement


Crossbred Cow Population, 1992,
Himachal Pradesh
Chamba
4800
Lahul& Spiti
3532
Kangra
44979
Mandi
Kullu
21727
Kinnaur
3819
Una
7494
Hamirpur
2108
35984
Bilaspur
4227
Shimla
40694
11695
Solan
Siramur
14426
Crossbred Cow Population
3780 - 4814
4814 - 8192
8192 - 19306
19306 - 26861
26861 - 63094


Total Number of Veterinary
Hospitals and Dispensaries, 1995, Himachal Pradesh
115
Chamba
45
Lahul& Spiti
186
Kangra
Kullu
55
50
Kinnaur
Hamirpur
60
146
Mandi
54
Una
52
Bilaspur
153
71
Solan
Shimla
93
Siramur
Number of Veterinary Hospitals and Dispensaries
45 - 52
53 - 60
61 - 71
72 - 115
116 - 186

Map 3.2

of local animals with improved livestock, stall feeding, and a better market for dairy products. These changes have all contributed to making livestock production economically viable. Rearing livestock in this way is compatible with the natural resource base of the local area, and it makes it a sustainable livelihood option. In comparison, farmers in the non-transformed areas keep a high livestock population of poor quality and graze their animals instead of stall feeding them. This results not only in low production, but also in degradation of pastures and grazing lands (Sharma 1996).

A case of two *Panchayat*(s) (village-level administrative units) in Himachal Pradesh presented in Box 3.6 illustrates differences in livestock management practices and the consequent implications for the natural resource base.

Sharma (1996) goes on to compare micro-level indicators

Box 3.6
Differences in the Linkages to CPRs in Non-transformed *vis-À-vis* Transformed Villages in the Western Indian Himalayas

Dependence on animal husbandry is high in the *panchayat*, where income from crop production is low and scope for the sale of milk does not exist,. However, the resources and incentive to keep better quality animals are lacking. Farmers in this *panchayat* keep animals able to thrive on biomass from common land or on home-produced crop residues. Since such animals are low-yielding, farmers tend to keep more. This makes stall feeding a larger number of animals difficult. Therefore, the owners resort to grazing the animals and increase the grazing duration.

In *panchayat*(s) where dependency on livestock is low due to a higher income from vegetable cultivation or because a sales' outlet for milk is available, farmers maintain fewer but higher quality animals, giving them better nutrition and thereby obtaining a higher milk output than in a *panchayat* with a poorer breed of animals. Good quality animals are taken less for grazing, since grazing results in a reduction in milk yield due to a loss of energy during movement on hill slopes.

related to livestock in the transformed and non-transformed areas in Himachal Pradesh (Annex 7). These show that, with the changed livestock structure and management practices, livestock raising at present has positive effects on the environment and on conservation of the natural resource base.

chapter four

Sustainable Management of Livestock, Feed Resources and Soil Fertility

In the mixed crop-livestock farming systems of the HKH, livestock production and food production systems are closely integrated. Crops provide feed and fodder, while in return livestock supply draught power and manure, as well as milk and meat as a source of cash income. A close link also exists between livestock and common property resources (CPRs). Nutrients from forests, support lands, and crop residues fed to animals are recycled back to the cropland as manure. This complex inter-relationship between forests, grasslands, livestock, and crops in mountain farming systems has contributed to the sustainability of mountain agriculture for generations.

Soil fertility and agricultural productivity are receiving both positive and negative impacts from the declining population of livestock and changing practices of livestock management. A declining availability of fodder resources is a common phenomenon in the mountain areas where a large number of animals must depend on limited supplies of fodder, grass, and leaf litter. Fewer feed resources result in fewer animals, further reducing the amount of farmyard manure. There have been some studies carried out on the relationship between fodder supply and decline in soil fertility. These are summarised in the following sections.

Inter- relationship between Livestock, Soil and Plants

Based on various studies in Nepal, Bajracharya (1999) has identified the following relationship between livestock, soil fertility, and natural resources.

- Livestock convert crop residues and fodder/forage to soil nutrients through manure. Application of manure helps to improve soil texture and decompose litter more easily. It also contributes to increased productivity.
- Using the traditional feeding system and farm yard manure (FYM) preparation method, a large adult ruminant provides approximately 1,140 kg of FYM and potentially approximately 29 kg of nitrogen (N) per year.
- About 50 per cent of leaf litter is removed from the mid-hill forests annually for composting purposes.
- About 30–50 per cent of total animal feed is derived from forests and grasslands.
- Approximately three to seven hectares of forest land (depending upon the type of forest, forest productivity, types of trees available, etc) is needed to maintain one hectare of arable land with livestock without causing deterioration of forest and livestock and in the amount of compost produced.

It is clear that trees, crops, animals, and soil are all interdependent components of mountain farming. None of these should be ignored if the farming system in the hills is to remain sustainable.

Fertility Maintenance Measures

Mountain farmers have developed a number of approaches for managing soil fertility. These approaches are discussed below.

Farmyard Manure (FYM)

Livestock manure is a critical component of hill farming. Farmers indicate that two adult buffaloes give enough manure to fertilize approximately 0.25 hectares of land. According to the farmers, the application of manure is mandatory for the

maintenance of crop productivity. Output of manure varies between cows and buffaloes. Buffaloes give 75 per cent more manure than cows. Farmers, in general, apply more FYM on lowland parcels than on uplands.

In the hills, bedding materials, (crop residues, leaf litter, left over forage, and feed) are spread in the animal shed and are mixed with dung and urine. New bedding materials are added at various intervals, generally once a week, to keep the shed dry. In this system, the whole process of FYM preparation takes place within the animal shed itself. In some areas, it is allowed to remain within the animal shed almost for one year; while in others the compost is carried to the field during winter when it is well decomposed.

The use of raw materials for bedding varies from place to place depending on forest species, forest condition, and socioeconomic circumstances. Compost used in crop production is at the moderate- to well-decomposed stage, with the majority of it being applied from December to February on maize crops.

However, decrease in supplies of bedding materials due to degradation of forest resources and the decreasing number of livestock affects sufficient production of FYM.

- One adult cow or buffalo excretes about 29 kg of nitrogen (N) per annum. Up to 90 per cent of this may be lost in the stall if too little bedding material is used. If urine is not collected in closed pits, rain and sun cause leaching and volatilisation of N from the urine, which contains 65 per cent of the nitrogen excreted. Dung contains 35 per cent N, so loss of nitrogen through uncollected urine is greater.
- If bedding material is not sufficient or is of low quality, it will not absorb moisture from dung and urine efficiently and will not prevent nitrogen loss.
- N volatilisation, denitrification, and leaching occur in open manure pits that render FYM exposed to sun and rain.

FYM is often only partially decomposed. This reduces the amount of humified organic matter and can lead to the immobilisation of FYM when it is applied to the soil.

Green Manure

Applying green manure is one of the traditional methods of maintaining soil fertility employed by hill farmers. Leaves and twigs of various trees and shrubs are collected and incorporated into the soil. The other uses of these green manure species are as live fences, hedge plants, insect repellents, and for better use of marginal land. Maintaining such plants as fences and planting them on marginal land and on river banks improve the landscape and control soil erosion. Conservation, evaluation, and utilisation of green manure species available locally should be encouraged to provide a sustainable supply of nutrients to the soil. However, such species are restricted to specific altitudes and some are threatened by over-exploitation.

Mulching

Mulching is a common method adopted by farmers for moisture conservation, weed control, and for maintaining soil fertility after decomposition. Mulching materials, such as weeds, fallen leaves, crop residues, fodder leftovers, and decomposed twigs, supply the soil with plant nutrients. The moisture conserved in the soil as a result helps to decompose the mulch.

In Situ Manuring

In situ manuring is an important form of soil fertility management, particularly in the high mountains where cultivation of forage and application of manure are difficult. In this practice, during winter animals are kept on fallow land and dung and urine are used directly on the field. Farmers believe this system makes the best use of urine. The animals are also moved from one terrace to another, particularly in the uplands, and migratory sheep and goats graze on stubble on arable land. This practice has been declining in recent years due to the fall in livestock population and the intensification of crops.

Soil Fertility Decline and Livestock Management Practices

There has been a general decline of livestock numbers, particularly in areas of the middle hills that are under intense pressure and where the decline per household is most prominent

(Sharma 1996). A decline in the number of draught animals is also well documented (Singh 1997). This is due to the decreased size of holdings, reduced livestock feed resources, increasing population pressure, and a deepening shortage of human labour. Reduced livestock numbers result in reduced FYM. It is clear that the increasing inability of smallholders to keep a large number of animals because of feed constraints has had an indirect impact on soil fertility. During field investigations in Nepal, farmers stated that their rationale for keeping at least one or two head of local cattle (otherwise unproductive) was mainly to provide manure.

Along with a trend of declining numbers of livestock, there have also been changes in livestock management practices. The most important change is the increase in stall feeding. This has been brought about by both the shrinkage in grazing resources and incentives to rear high-yielding animals such as improved buffaloes and cattle. These improved and cross-bred animals require better management and nutrition as well as stall feeding. Control by the Village Forest Development Committee on grazing and cutting forage has contributed to reducing animal numbers since reduced feed forces farmers to remove unproductive animals.

These factors have encouraged fodder planting on private land, better regeneration of existing forests, and more efficient collection of urine and dung for composting. There is a theory that livestock numbers do not determine soil fertility, but rather the way in which manure is managed does. Since stall feeding, as opposed to grazing, has a greater manure retrieval rate, stall-fed systems can produce more FYM per animal than more extensive systems (Vaidya *et al.* 1995).

The use of chemical fertilizer is increasing in some areas of the middle hills, especially the lower altitude areas with better access[2]. Crop intensification, the decrease in livestock population, and consequent reduction in the output of dung, labour shortages, and a depleting natural resource base have all prompted farmers to use fertilizers to maintain soil fertility. All this is occuring despite the apparent greater efficiency of the stall-fed system over the open

[2] Accessibility and market availability are closely linked to altitude since much of the recent infrastructural development has taken place in the low middle hills.

grazing system. A suitable market and accessibility to infrastructure both have a significant effect on soil fertility trends. Chemical fertilizer has become a major source of plant nutrition in accessible areas. Its use is particularly prevalent in the production of commercial vegetables and other high-value crops.

In Himachal Pradesh, the average rate of inorganic fertilizer used increased ten-fold from 1.7 to 18.6 kg N/ha from 1966/67 to 1985/86, with similar increases in other nutrients. Inorganic fertilizer supplies and transport are subsidised by between 30 and 40 per cent to the farm gate and are supplied widely throughout the state. Some supplies even reach accessible, high altitude locations, although in general these still rely heavily on manure. These areas are likely to be most vulnerable to a reduction in livestock populations.

In their study, Vaidya *et al.* (1995) mention that a large proportion of farmers reports an increase in soil fertility on both *khet* (irrigated lowland) and *bari* (dry upland) in the roadside villages. This could be related to the intensive use of chemical fertilizers here. In these villages, over 80 per cent of farmers use chemical fertilizer, and there has been a commensurate rise in FYM/compost applications.

The key issue is farmers' ability to use FYM/compost application and chemical fertilizers in order to adjust their fertility management strategies to cope with the increased demand on the soils' nutrient reserve.

Biogas Generation and Livestock-Environment Relationships

Biogas generation is emerging as a promising role for livestock to alleviate the burden on resources in the high pressure areas of the low hills of Nepal. Biogas, as a supplement to fuelwood for household energy needs, has great potential in the low hills.

At a site in Kaski District, information was gathered regarding the level of biogas use and the favourable impact on the local natural resource base. In one of the accessible villages in Kaski District, approximately 30 per cent of the households were reported to have biogas plants. The general opinion was that biogas had

increased the importance of livestock at the farm level, but it had not replaced firewood altogether as a source of fuel. The use of biogas is mainly limited to cooking food for the family, and fuelwood is still used for cooking animal feed as well as for heating milk to make ghee.

Nevertheless, farmers indicated that biogas had reduced the total use of fuelwood by 20–25 per cent, and labour and time have been saved from collecting firewood in the forest, thus contributing to conservation of forest and support lands. Households keeping biogas plants were generally more inclined towards smallholder dairy farming and kept at least two buffaloes in the herd. Buffaloes have greater manure output than local cattle. It was reported that two buffaloes give enough manure to generate cooking gas for a family of four to six.

Declining Sources of Fodder and Farmers' Responses

There are various sources of fodder — public forest, agricultural residue, shrubland, pasture and grazing land, terrace risers, and private fodder trees. The most significant source of fodder and leaf litter (leaf litter is used as bedding material for livestock and forms the bulk of FYM) is the public forests for the large majority of households. Fodder from the forests of Nepal contribute about 50 per cent of the Total Digestible Nutrients (TDN). A study in western Nepal indicated that, according to present agricultural and forestry management practices, 3.5 ha of forest land (for fodder) was needed to sustain the productivity of one ha of agricultural land (Wyatt-Smith 1982). However, the gross per capita availability of forest land is only 0.14 ha (FAO 1979). General degradation of forests in the high-pressure mid-hills has reduced the amount of fodder and leaf litter, with implications both for livestock productivity and productivity of agricultural lands.

In the middle hills of Nepal, only about 64 per cent of the livestock's total feed requirements are met (APROSC 1986). Good quality green fodder in adequate quantities is generally available only from June to November (the wet season). Thus the major problem is the lack of green fodder during the long dry season from December to May. The past norms were for farmers to overcome this problem by growing fodder trees on their farms and extracting

tree fodder from the forests. However, due to increasing population pressure, this source is shrinking.

Stall feeding of livestock is recommended as a solution, as is the production of more fodder on individual farm holdings and the creation of more community forests composed of multipurpose tree species. Since there are biological and physical limitations to planting significant numbers of additional trees (particularly on private farms), a more viable alternative is to improve the management of existing as well as future tree resources and to increase their productivity (Rusten and Gold 1991).

Feed Resources from Private Land and Implications for CPRs

Many areas in the hills have already started to respond to the challenges of managing livestock feed in the face of dwindling fodder and leaf litter. Changed livestock management systems, e.g., stall feeding and planting of fodder trees close to the homestead, are especially visible in areas with increased market integration. Interlinkages with the environment are also changing in these areas.

According to farmers, straw makes the largest contribution towards livestock feed and comes largely from rice, finger millet, and maize. In Nepal as a whole, agricultural residue makes up 36 per cent of the total fodder supply (Giri 1990). Ground grass makes an additional contribution to livestock feed and is mostly available during the rainy season. This can usually be collected from waste land, private land, and other public land. Farmers have been managing the scarcity of fodder from public forests by planting fodder trees (Table 4.1) and cultivating grass on private land that is otherwise unsuitable for growing food crops or vegetables.

During the winter months, corn stalks and '*badhar*' (*Artocarpus lakoocha*) are fed to livestock. Farmers also save dry fodder (paddy and wheat straw, maize, stover, etc) during this period to feed large ruminants. Dry fodder production is minimal and would last only a few months if fed to the animals on a regular basis.

In some villages, farmers have adapted to winter fodder shortages by cultivating exotic oats, cultivated after the rice harvest

Table 4.1: **Commonly Cultivated Fodder Trees in the Middle Hills of Nepal**

Local name	Scientific Name
Tote	*Ficus hispida L.*
Gidagi	*Ginderi premna*
Berula	*Ficus clavata*
Kutmiro	*Litsea polyantha*
Badahar	*Artocarpus lakoocha*
Dabdabe (ramsing)	*Garuga pinnata Roxb.*
Khanayo	*Ficus cunia*
Pakhuri	*Ficus glaberrima Bl.*
Kabro	*Ficus lacor*
Koiralo	*Bahunia variegata L.*
Aankhapakuwa	*Ficus clavata Wall. ex. Miq.*
Dhungre	*Ficus sp.*
Barro	*Terminalia belerica C.B. Clarke*

Source: Adapted from Tulachan (1985)

sometimes, replacing wheat. One of the villages even exported about 1.5 tonnes of oat grass to other districts. This conscious effort to tackle the shortage has paid off in abundant milk supplies in this village.

Some resource poor farmers have responded to the lack of fodder from private land by making arrangements to harness fodder from the private land of resource-rich farmers. Box 4.1 below illustrates such a case.

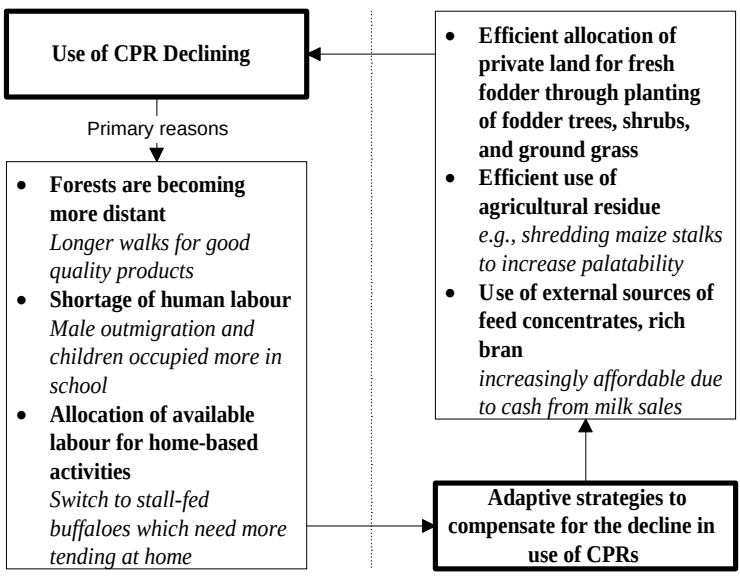
The following figure (Figure 4.1) adapted from a village case study (Neupane 1994) summarises the shifting scenario of livestock-CPR interaction in an accessible village where smallholder dairy farming has advanced well. According to the study, stall-feeding of buffaloes has become the norm in the village, meaning less grazing.

Another aspect of change in this village is the constant reduction in human labour. This shortage has reduced activities that take labour and time, e.g., taking animals out for grazing and grass and fodder collection from distant public forests. Planting fodder trees is also very common. Fodder planting is not only limited to trees but also to shrub species on terrace risers. When fodder from land-based resources is in short supply, substitution is

Box 4.1
Labour for Fodder: A Case of resource poor Farmers of marginal – lands Adaptation to Fodder Needs

Farmers with marginal farm land are generally thought to be more dependent on CPRs (public forests) because they do not own enough land to grow fodder. However, there was an interesting case in one village in Parbat. A poor farmer was found to be working on a large farm in a 'labour for fodder' arrangement, whereby the fodder produced on private land was exchanged for labour. There were also cases where fodder (in this case, particular fodder trees) were paid for in a 'lease' arrangement, in which the purchaser could harvest the tree for the season for a certain sum of money. Even farmers with just 2 to 3 *ropani* (0.1–0.15 ha) of homestead – hardly any extra land apart from the house and animal shed – were found to be keeping at least one milch buffalo, maintaining the animals through buying grasses/ fodder from others sufficient to last for a single season.

Figure 4.1
Changing Pattern of CPR Use and Livestock Management in a Transforming Village



made by buying feed and concentrates, and agricultural residues (shredding of maize stalks for example) are used more efficiently. Farmers' increased income from milk sales has increased the affordability of external inputs. All of these changes related to livestock management imply a decreasing dependence on CPRs (Annex 6) .

Perceptions of the Role of Community Forestry

Mixed reactions were heard from farmers regarding the impact of community forestry. Some felt that community forestry had a positive impact on the fodder and leaf litter supply from marginal lands because of natural growth as a result of protection from harvesting.

Meanwhile, others felt that community forest management decreased the availability of fodder and litter resources as the forest is closed to free grazing and there is control on collection of fodder/ litter. Although minimum fees on a monthly basis can be paid to acquire fodder grass from community owned lands, poor farmers do not find this acceptable.

With the growing scarcity of fodder and leaf litter, farmers are searching for alternatives. A greater number of farmers is addressing the fodder scarcity through use of their own lands. In some villages, about 30–40 per cent of the land-rich farmers have private support land. *Kharbari*(s) (marginal sloping land) on which normally grass and fodder trees are grown are now being used more intensively. Increased fodder shortages and the high cost of feed provide incentives for the increased cultivation of trees on farms. There has also been an increase in the trend of growing leguminous fodder trees on the field bunds of cultivated terraces.

In recognition of the degraded state of the forests, communities and policy-makers are turning to community forestry as a potential solution. Over the past decade, communities have formed groups with the help of district forestry officers to manage their forests according to their needs. The impact of community forestry is being seen in fodder, leaf litter, and timber supplies.

chapter five

Gender and Livestock

In view of women's significant role in livestock production, it is vital to address gender concerns in the sustainable management of livestock in mixed crop-livestock farming systems and in marketing. It is believed that, without the involvement of women farmers from the very beginning, no livestock development programme can be expected to succeed. Unfortunately, there have been only a few studies carried out on gender issues in relation to livestock systems in the Himalayan areas. Based on these limited studies, this chapter discusses the major gender-related issues.

Gender Division of Work

In the mountain areas, contribution of labour is the most important factor in livestock management and production. Sex and age both play a critical role in determining labour allocation. Generally, women perform activities such as collecting green grasses/weeds (including fodder tree forage), feeding animals, grazing animals, cleaning animal sheds, and composting animal waste. Elderly women milk the animals and prepare butter and ghee. Children of both sexes (although mostly female) graze the animals. Elderly males make decisions regarding the breeding of animals and marketing of animal products.

In the mid-mountain areas, where paddy is the dominant summer crop, the daily labour for collecting fodder grasses decreases sharply from June to September. Two factors contribute to this decrease. First, paddy planting requires the most work, so labour is diverted from livestock production to planting out rice. Secondly, green grasses and field weeds are found in abundance, and hence a reduction in the time required to collect them. The

decrease in labour allocated to green fodder collection from October to December is also attributable to the paddy harvest time when land must be prepared and planted with winter crops such as wheat and mustard. In contrast, the sharp increase in labour allocated to grazing from February to June is due to the fact that farmers are relatively free from cropping activities. Moreover, green grasses/weeds are not available to be cut and carried.

Collection of Green Grasses/Weeds and Tree Fodder

With the first rainfall in May, native grasses and weeds begin to emerge. Green grasses/weeds are plentiful along the village roadside, field bunds, water canals, and in communal grazing areas during the summer. They continue to be available for six to seven months per year, although the quantity available declines sharply in the latter months. Forage from fodder trees is available during the dry period of the year when there are no green grasses or weeds. Fodder trees are grown around homesteads, on field bunds, and at roadsides. The number of hours spent by women farmers every day in this activity is significantly higher than the number of hours spent by men. The labour hours fluctuate from season to season, depending on the peak and lean period of crop production activities. Women usually feed the livestock. In some months, mainly during the peak period for crop production, men also allocate time for feeding animals.

Grazing

The maximum hours spent per day on grazing animals takes place during the first two months of the year, Baisakh–Jestha (mid-April to mid-June), the dry period of the year and during the last three months of the year, from Magh–Chaitra (mid-January to mid-April). Green grasses become scarce in these months and animals must graze on the crop stubble in fallow fields, on public grazing lands, along field bunds, and at the village roadside. Women spend much more time grazing animals than do men.

Cleaning the Animal Shed

During the lean period — Chait, Baisakh, and Jestha (mid-March to mid-June), animal sheds are cleaned exclusively by women, although in some households they may be assisted by a

permanently employed *hali* (ploughman). However, during the peak season, such as during paddy transplanting, weeding, and harvesting, male members of the household contribute more than 50 per cent of the total time spent on cleaning animal sheds.

Preparation of Cooked Feed

During periods of feed scarcity, farmers feed livestock on home-made concentrate called *kudo* (a mixture of rice bran, maize flour, and mustard cake boiled in water). Only women prepare this and feed it mostly to lactating animals in the morning and evening. The time spent on its preparation is highest during the dry period, and less during the monsoon season when plenty of native green grasses and field weeds are available.

Pandey (1997) provides gender disaggregated data regarding women's involvement in rearing livestock and growing crops, as follow.

- Women play a greater role in feeding animal, making compost/FYM, and crop production activities and in collecting and carrying fodder and litter to the house (Tables 5.1, 5.2, and 5.3).
- Women spend three to six hours a day on livestock and FYM activities, two to eight hours/day on crop-related farm

Table 5.1 **Involvement in Feed and FYM Management (Data for the Hills)**

Activities	% of Labour from Women
Feeding fodder	34
Feeding concentrate	66
Cleaning sheds and making compost	52
Applying manure	68
Source: Pandey (1997)	

Table 5.2: **Involvement in Crop Production (Data for the Hills)**

Crops	% of Labour from Women
Maize	65
Millet	74.5
Pulses, legumes, oilseeds	61
Source: Pandey (1997)	

Table 5.3: **Percentage-wise Labour Input in Goat Production System (Tanahu District)**

Labour Input	Adult Females	Girls	Total Females	Adult Males	Boys	Total Males
Barn sanitation	82.0	8.6	90.6	6.0	3.4	9.4
Watering	80.5	10.6	91.1	4.4	4.7	9.1
Grazing	42.0	25.0	67.0	20.0	13.0	33.0
Forage collection	78.2	9.5	87.7	8.1	4.2	12.3

Source: Pandey (1997)

activities, and about three hours a day on fodder, bedding material, and fuel collection.

- They expend 62 per cent of their total labour on fodder, bedding material, and fuel collection, 52 per cent on cleaning sheds and compost making, 68 per cent on FYM application, and 61 to 75 per cent on crop production as a whole.

Women put in more than 80 per cent of the work required for the management of small ruminants such as goats. For example, a field study in the mid-hills of Tanahu District (Pandey 1997) shows that the labour contribution by women farmers was 90.6 per cent for barn sanitation, 91.1 per cent for watering, 87.7 per cent for forage collection, and 67 per cent for grazing; giving a total labour contribution of 84.1 per cent. In contrast, the contribution of male farmers was only 15.9 per cent. A study in a hill village (Bhatt *et al*. 1994) reveals that in, on a typical day, a young Tamang girl's chores include a considerable amount of time spent on livestock management-related activities (see Annex 7)

Data from Himachal Pradesh show that labour spent by women on livestock management is close to three times higher than that spent by men. On the other hand, labour spent on cereal crops, vegetables, and fruit does not show significant difference (see Table 5.4).

Gender Equity and Decision-making

Most of the women interviewed expressed a growing trend of equity between themselves and their husbands in labour expended. Although men have added social obligations to meet the needs of

Table 5.4: **Hours Spent by Men and Women in Production of Cereal Crops, Vegetables, Fruit and Animal Husbandry in the Low Hills, Mid-hills and High Hills (hrs per worker per day)**

Activities	Low Hills		Mid-hills		High Hills	
	Male	Female	Male	Female	Male	Femal
Cereal Crops	1. 28	1.04	0.82	0.70	0.54	0.5
Vegetables	--	--	2.11	1.74	0.10	0.1
Fruit	--	--	--	--	1.75	0.8
Animal Husbandry	1.95	4.74	5.01	4.05	0.40	2.4

Source: Adapted from Singh 1995.

the family, women have facilitated these obligations by carrying out as much as 60 to 70 per cent of the household work.

An interesting example of gender equity is seen in the innovative ideas of some farmers. One such case concerns a farmer in Batule Chaur (Ram Bahadur Biswakarma) regarding the duties related to the management of livestock carried out by himself and his wife (Box 5.1).

A case study in the hills of Tanahu District of Nepal suggests that most of the decisions regarding livestock systems are taken jointly by husbands and wives. Nevertheless, except for breed selection, decisions regarding marketing, household management, the spending of income, and issues related to goat raising are mostly made by women (Table 5.5).

Box 5.1 A Case of Gender Equity in Livestock Production Management

When Ram Bahadur bought a milch buffalo, he discussed division of labour with his wife. Instead of assigning the duties for his wife and for himself, he preferred to play an approximate version of heads and tails: He asked his wife what she would like to choose, heads or tails? If the head part was chosen, the duties assigned would be collecting and cutting grass along with duties related to feeding. If she chose the tail part, the duties would be related to milking the buffalo, cleaning the shed, selling the milk, etc. The wife chose heads and Ram Bahadur was unfortunately left with most of the labour.

Table 5.5: **Decision-making Process in Tanahu District (%)**			
Items	Male	Female	Both
Breed selection	28.0	15.8	56.2
Marketing	21.9	22.1	56.0
Household management	15.5	47.9	36.6
Spending of income	26.6	32.6	40.8
Goat raising	20.2	39.0	40.8
Source: Pandey (1997)			

Among the routine jobs is feeding the animals in the early morning before the animals are sent out to graze; cleaning the animal/cowshed; putting the dung in a proper place (generally in a heap away from the house); and milking cows (and/or cleaning them). Stall-fed cows are also fed with bran and oil cakes or specially prepared animal feed two to three times a day during the lactation period.

The situation is more or less the same in other parts of the mountains. For example, in HP, rearing domestic animals, particularly caring for milch animals, is the primary responsibility of the women of the household (see Table 5.6). Women have to fetch the green fodder from the field bunds on their own fields in the rainy season and from CPRs in other seasons. Daily care of cows/

Table 5.6: **Daily Time Allocation for Maintaining Improved Cross-bred Cows in Himachal Pradesh**		
Activity	Time (minutes)	
	Male	Female
Taking the animals out of the shed in the morning	20%	*80% 15 minutes
Cleaning sheds	10%	(90%) 30 min
Feeding (grass)		*10 minutes
Cleaning/washing		*10 minutes
Milking		*15 minutes
Feeding (feed) and giving concentrates		*5 minutes
Watering the animals		*5 minutes
Feeding grass (2–3 times a day)		*7 minutes
Milking in the evening and feeding bran/concentrate after taking the animals to the shed		15 minutes
* means mostly women are involved. Source: Negi (1998)		

buffaloes is their responsibility in about 95 per cent of cases. However, this is a little different in the case of the lower hills where more buffaloes are kept. In this case, men also share in animal care, but the main responsibility is that of the women, who stay at home.

- During the day, women water the stall-fed/young stock animals.
- In the high hills and mid-hills women also collect tree fodder for the animals.
- Average estimates of time required for these activities are given below (male and female, as per the general practice).

Men, for the most part, take the livestock to the veterinary hospital for health care and for artificial insemination. Bullocks and local cows are mainly open-grazed. During the ploughing season, bullocks are usually given a special diet. This includes animal feed, wheat/barley bran, barley grain, and so on.

Changing Gender Roles

Because of the heavy investment and rising cash income opportunities from improved dairy animals, male members of the family are taking on more of the workload for livestock management. In many areas, men are becoming more involved in the purchase of manufactured livestock feed and milking and even in fodder collection and feeding of animals. In addition, decisions about investing in improved animal breeds are made jointly, involving women in the decision-making process.

Although there have been some concerns regarding who gets to keep the cash from these activities, women do take care of marketing of milk to an increasing extent. The study group visited milk collection centres where women were found carrying milk from three to five hours' walking distance away and earning the money. This is an area in which further studies can be done.

During the rapid surveys in the mid-hills of Nepal, women were found to be more knowledgeable about indigenous fodder grass species and fodder trees than men. They are also more knowledgeable about local treatment methods than men. On the

other hand, men know more about introduced grass species and fodder trees as well as about modern veterinary treatment. This is mainly because institutional programmes are geared towards providing training and exposure opportunities for men rather than women.

Gender Roles in Soil Management

Sustainable soil management is a critical issue in the high pressure hill/mountain areas because of deteriorating soil fertility and the consequent decline in crop productivity. Women can play a crucial role in managing and improving soil fertility, if they are involved in an appropriate manner as suggested below (Bajracharya 1999). Some of the measures identified are as follow.

- Involve women farmers in all activities for feed and FYM management
- Give them information on nutrient loss in the stall-fed system and ways to prevent loss
- Discuss the importance of N-rich legume feed for increasing milk production
- Consider their knowledge and ideas (they do have knowledge worth exploring)
- Support them in getting the inputs and services required (training and extension)

chapter six

Livestock Sector Development Experiences

Over the past three decades, considerable efforts have gone into livestock research and development in the Himalayan regions of India and Nepal. Policy approaches have centred on the problems of animal breeds, animal feed, and animal health. Innovations, until now, have been designed to address technical/scientific problems and have neglected many interrelated socioeconomic and bio-physical characteristics: more specifically, they have failed to address the very particular characteristics of the mountains. Development efforts have been geared towards improving animal breeds to increase incomes and improve the living standards of mountain farmers. Ample experience has been gained in this respect. This chapter will review the development experiences of past and present institutional programmes.

Animal Breed Improvement

Institutional programmes in livestock sector development have so far focussed on improving animal breeds. The main purpose of improving animal breeds was to bring about the 'white revolution' through livestock sector development for increased family incomes and employment for mountain farmers. Technical innovations were geared to meeting this objective and did succeed in some pockets of the foothills and in the mid-hill regions that were well connected with market towns through roads. In fact, the white revolution programmes mostly benefitted comparatively well-to-do livestock farmers who happened to be located in dairy areas in the plains and had access to modern technology (SHERPA 1991). The majority of mountain households — rural and inaccessible with a marginal and fragile resource base — remained unaffected.

Experiences in the Indian Himalayas

In the UP hills, where the white revolution programme has been going on for about three decades, the number of cross-bred cattle as per the 1982 livestock census was only 28,026 out of a total breeding stock of 6 32,533: only 4.4 per cent of the total stock. Similarly, the number of bullocks in the region was 12,77,396, of which only 66,214 were cross-bred (a little over 5%). Furthermore, the number of cross-bred cows and bullocks was not evenly distributed. Out of 28, 026 breeding cross-breds (cows), 11,737 (42%) were in Nainital District alone – which has a large milk market and access to the road network (SHERPA 1991).

The reason for such poor performance was because improved breeds of cows were supplied to the weaker sections without providing poor farmers with the means of maintaining them. A large number of artificial insemination centres was opened, but these centres hardly touched the rural areas. According to recent estimates, cross-bred cattle make up less than two per cent of the total cattle population in Uttarakhand in the Central Indian Himalayas (SHERPA 1997).

The Indian State of Himachal Pradesh (HP) introduced programmes for upgrading cattle in the 1950s and again in the early 1970s. The focus was on producing Jersey cross-breeds. This succeeded to some extent in areas with access to milk markets through a well-developed road network. However, according to rough estimates, cross-bred animals constitute only six per cent of the total cattle population in Himachal Pradesh, despite three decades of planned development in improving cattle breeds (Negi 1990).

On the other hand, the buffalo improvement programmes in Himachal Pradesh were a considerable success. Buffalo breeding, until the 1980s, was introduced in only a few areas. Now, artificial insemination facilities for buffaloes are provided in 190 extension stations in the State. The technique has become so popular that demand for *murrah* semen strains far exceeds the production (Singh and Sharma 1990). A study has revealed that, in the total milk pool of the mountain villages, contribution of buffalo milk was as large as 98 per cent. The number of buffaloes in the herds of HP

increased significantly, while the number of cattle decreased or remained stagnant.

Nevertheless, the bulk of livestock population in the Indian Himalayan region still consists of local species – 95 per cent of the cattle, over 70 per cent of the sheep, and most of the goats. This evidently reveals the limited success of institutional policies geared towards promoting cross-breeding programmes.

Experiences in the Nepalese Mountains

In Nepal, the improved cattle programme was introduced three decades ago. While this approach had some visible impact in the vicinity of urban areas, almost 90 per cent of the countryside remained largely untouched by three decades of institutional programmes for upgrading local animals by crossing them with exotic stock (Joshi 1996). Private dairies started with improved cows failed in the mid-hills due to lack of quality feed and proper health services.

Today, most of the milk supplied from the mid-hills is from the buffaloes on smallholdings which raise one or two milch buffaloes to supplement their incomes (Miller 1993; Tulachan 1997). Although the milk yield of cross-bred cattle and buffaloes was marginally better than that of local livestock, farmers complained that it was only at the cost of higher feed intake and increased health care management (Joshi 1997). Similarly, the performance of exotic or cross-bred goats is also not much better than that of the indigenous goat population (Oli 1987).

Despite a 150 per cent increment in wool produced from the exotic Polwarth x native Baruwal cross-bred sheep, the animals were not adopted into the prevailing management regime and were eventually rejected by farmers (Joshi 1997). This implies that the introduction of exotic stock has not benefitted the majority of mountain households. In other words, the programme of introduction has been less than successful in meeting its targets.

In the context of Nepal, most of the development programmes have been supply driven. A good example is the introduction of improved cross-bred cows for dairy use through subsidised Asian

Development Bank (ADB) loans for farmers through heavy subsidies. After ten years or so, many farmers, especially those in the mountains who obtained these animals, complained of very little economic return from them, and many of them had even replaced the cross-bred cows with improved buffaloes. On the other hand, despite the lack of government emphasis, the raising of improved buffaloes has become popular. Private traders have done well because of the great demand from local farmers. There is no involvement of private traders in supplying improved cows. The reason for this is simple: the institutional policy to promote smallholder dairies was simply supply-driven, and not demand-driven. Private traders started introducing improved buffaloes when they saw a good potential demand for improved buffaloes in accessible areas.

As a result, the number of buffaloes increased rapidly at the household level, as more and more farmers switched from cows to buffaloes for milk production in accessible areas. Most of the small-scale commercial farmers failed to raise improved cows as a result of low milk prices, lack of salvage value, and the need for extra care and quality feed. In contrast, farmers saw that improved buffaloes had numerous advantages related to high salvage value, ability to survive on farm waste and residues, higher fat content in the milk, and lower cost of management and day-to-day care. Despite the fact that improved cows supplied milk for almost 12 months on a regular basis in each lactating period, the need for quality feed made it difficult for farmers to raise them.

Animal Feed Improvement

Feed shortage has been a serious problem for livestock farmers throughout the HKH. In Uttarakhand, the Central Indian Himalayas, the current shortage of feed and fodder is estimated to be 65 per cent (Dhar 1997). The magnitude of the problem varies from zone to zone. Similarly, in Nepal, the shortage of animal feed is acute during the dry period and winter when livestock is generally under fed by one-third of the required amount. The country as a whole has a feed shortage of 20–36 per cent; the problem being more acute in the hills and mountains (Sherchan and Pradhan 1997).

Improved forage was introduced successfully in lowland valleys or relatively better-off areas where input and irrigation were

available. Improved forage was not successful in marginal and fragile mountain areas, because of high input-dependency and excessive demand on scarce land and irrigation resources. In the mountains, usually, only a small per centage (if any) of arable land is irrigated. Moreover, it is difficult for farmers to set aside already scarce land for fodder production, since it would take away the fertile land allocated to cereal crop production and affect the food supplies of farm families.Nevertheless, now attempts are being made to introduce different forage/fodder crop species on degraded lands in the hills of Nepal. Successes have already been experienced.

High-yielding exotic varieties of fodder were introduced in several areas. However, institutional programmes for high-yielding varieties (HYVs) were delivered with subsidies, without which they could not be sustained. This indicates that HYV forage crops are not economically viable. Past initiatives in fodder development programmes in Nepal have had some success in areas with access to a market for milk. In most areas, with no access to a milk market, such as the inaccessible mountains, fodder programmes have been unsuccessful. In such areas, a few farmers adopted the improved forage technology initially, but they gave it up after subsidies were withdrawn. Indigenous and local forage species did not receive much attention, despite their great potential.

The HP Animal Husbandry Department has recently started a scheme to supply fodder crops and grasses to interested farmers in 'Fodder Mini-kits' of two to five kilogrammes of seed. The seed is multiplied and distributed through district Veterinary Hospitals and Veterinary Dispensaries.

The fodder species multiplied include forage maize and cow pea, forage oats, forage sorghums and millets, berseem, lucerne, and clovers; vetch and pea; and grasses – including perennial and Italian rye grass, broom, red fescue, Guinea grass *(Panicum maximum),* and orchard grass. These are mainly suitable for the lowlands and irrigated areas. About 200–300 mini-kits are distributed annually in Mandi District, and just less than 100 in Kullu, mainly to specialist milk producers. At present there is no demonstration or extension support programme.

Animal Health

Experience has shown that animal health problems are closely linked to animal nutrition and animal breed. The shortage of quality feed plays an important role in animal health, since nutritional stress contributes significantly to the susceptibility of animals to disease. Improved breeds are more susceptible to these diseases: cross-bred cattle are thought to be more susceptible to internal parasites, probably due to nutritional stress. Any increase in the number of cross-breeds demands the parallel development of an effective health service.

In general, the major infectious diseases are under control in Himachal Pradesh. The main endemic infectious diseases include rinderpest, foot-and-mouth disease (FMD), haemorrhagic septicaemia and blackquarter. These diseases are mostly controlled by annual vaccination campaigns throughout the state. Isolated outbreaks still occur; rinderpest was last reported in the state in 1987. FMD occurs quite widely with limited impact amongst indigenous cattle compared to the *Bos taurus,* cross-bred cattle. Contagious caprine pleuropneumonia (CCPP) occurs sporadically in goats and small ruminants and can have a significant effect on the local economy. Vaccinations are given occasionally on migration routes when vaccines are available.

Minor infectious diseases remain widespread and can harm the economy. Probably the most prevalent infections for all classes of livestock in both lowland and highland areas are internal parasites, particularly liver fluke (both *Hepatica fasciola* and *H. gigantica*) in irrigated and wet areas and lung and intestinal worms. Tick-borne disease is a potential problem in both low and highland areas. Jersey crosses are more susceptible than indigenous cattle.

Development of Veterinary Services: Case of HP

In HP, each district operates one mobile veterinary dispensary with a four-wheel drive vehicle which is used for vaccine and drug supplies, vaccination campaigns, and mobile services.

The number of veterinary hospitals and dispensaries in the state increased from 350 in 1972 to 847 in 1992. Some of the veterinary dispensaries are allied with an artificial insemination facility for breeding cattle.

Given the low density of veterinary institutions and the rugged topography, veterinary and breeding facilities are not available in most areas. Veterinary services are administered by the state and district animal husbandry departments and provided through veterinary hospitals and veterinary dispensaries. Veterinary hospitals are staffed by one graduate veterinary officer and two pharmacists (veterinary assistants with one year's training), while veterinary dispensaries are staffed by one pharmacist. The number of veterinary hospitals and dispensaries is 12 and 29 respectively in Kullu District and 25 and 97 in Mandi District. Dispensaries are distributed widely throughout the district, but practical field coverage is limited by the complete lack of transport.

Lessons from Livestock Sector Development and Past Policies

Past policies have mainly been top-down. What was 'perceived' as beneficial, for example improved breeds, was given priority and resources allocated. However, mountain farmers have, at the same time, been exercising their options themselves without much influence from ongoing institutional interventions. The choices they have made are compatible with the prevailing economic and ecological environment in the mountains and are in accord with the imperatives of mountain characteristics. Some of these choices have proved successful, if not all. Official interventions have so far failed to build on and facilitate further consolidation of farmers' own successes. The case of the official supply-driven push for improved cattle in contrast to the demand-driven experience with improved buffaloes is a pertinent example. Policy measures in the past have largely failed to recognise the prevailing ground realities/processes in community areas targetted for development interventions.

Another weakness in the livestock sector development effort was the narrow sectoral approach. For example, the problems of animal breeds, animal feed, and animal health cannot be solved through isolated interventions because they are obviously interrelated and interdependent. Moreover, intervention efforts did not take into account fully the socioeconomic dynamics prevailing in the mountain communities targetted for intervention.

Programmes for livestock sector development mainly benefitted already resource-rich farmers and were not targetted at disadvantaged groups — women and marginal farmers. Women play an especially significant role in raising and caring for livestock and have first-hand knowledge, more than men in some cases, about the problems of raising livestock. However, it is mostly men's accounts and knowledge of problems that enter mainstream perceptions.

Livestock research and development have also focussed, perhaps too much, on large ruminants. Continued focus on large ruminants (particularly milch animals) is justified to a point though, since income from milk plays a key role in bringing cash to rural households. However, there needs to be more diversification. Micro-livestock (small ruminants and poultry) should also be given due importance. Small ruminants require less investment, are less risky, and are easily marketed. They are especially important for women and poor farmers. In the case of women, the option of raising small ruminants also offers more autonomy in decision-making, and thus empowerment, as opposed to the option of large ruminants, the economic undertakings of which are mainly a male domain.

Nevertheless, the mixed crop-livestock farming system areas with accessibility and proximity to the roadhead have had success with improved breeds of cows. For example, in Himachal Pradesh, as discussed elsewhere, improved Jersey cows have contributed to mountain farm households in terms of improving the farm economy and local environment. Similarly, in those hills of Nepal that are accessible and close to the roadhead, improved buffaloes have contributed positively to the household economy. As discussed in the preceding chapters, there are many positive lessons to be learned from the transformation processes taking place in many areas of the HKH. The smallholder dairy system in mixed crop-livestock farming — the main thrust of this study — contains lessons for development of realistic strategies for sustainable management of livestock. These strategies will be described in the next chapter.

Framework for Livestock Sector Development in the Himalayas

As discussed earlier, the past high input-output, technological innovation model copied from productive areas of the world cannot be easily transferred to the Himalayan region with its diverse socioeconomic circumstances and specific mountain characteristics: inaccessibility, fragility, marginality, niches, and diversity. Therefore, a framework has been developed to address the mountain-specific characterisitics in relation to livestock sector development (Figure 6.1). This framework shows the interlinkages of research and development with three key components: conservation, bio-physical considerations, and socioeconomics. These components, need to be considered while developing new technological innovations for animal feed, health, and breeds. The various issues shown in Figure 6.1 have direct implications for

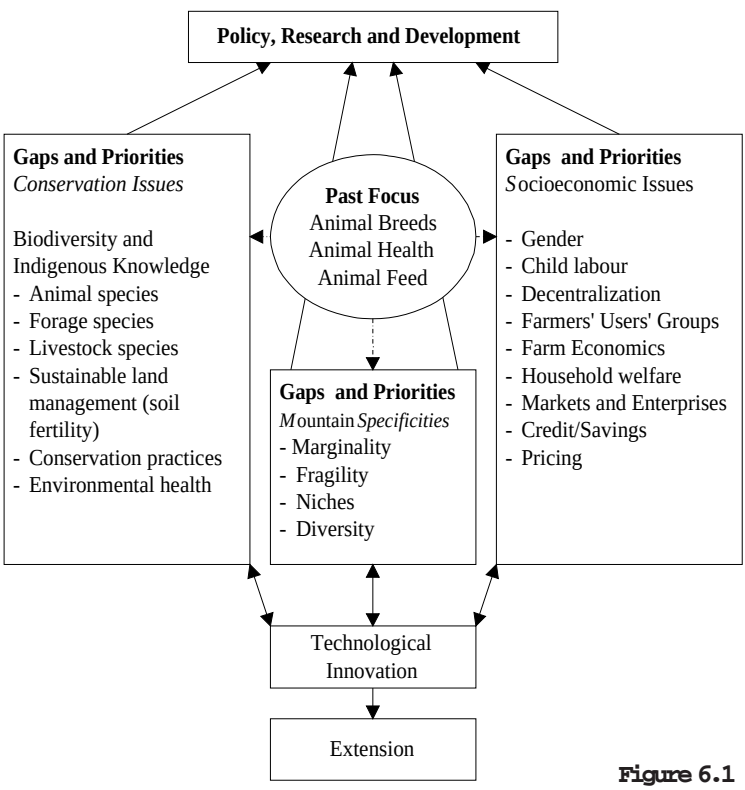


Figure 6.1
Framework for Livestock Development in the Himalayas

human welfare and environmental health vis-à-vis livestock sector development.

Conservation issues are at the fore, having direct implications on the conservation of diversity in local animal, forage, and grass species. Conservation is also vital for maintaining sustainable land-use systems and soil fertility levels and minimising soil erosion and run-off , all of which are positively related to environmental health. On the socioeconomic front, gender, child labour, indigenous knowledge, markets, farmers' groups, and community mobilisation, as well as farm economics and household welfare, are emerging as strong issues directly related to livestock sector development in the Himalayas. Above all, mountain specificities, such as marginality and fragility, diversity and niches, have a crucial role in determining livestock species and breeds.

Although most mountain areas are marginal, there are some areas that are not necessarily so. The mountain areas are rich in diversity and niches, and livestock development policies should take into account the comparative advantages of certain areas of the mountains. A 'pocket-area' approach should be adopted for improving the livestock sector in the context of local socioeconomic conditions. As discussed elsewhere, while the government policy of introducing improved cows failed in many areas of the UP hills, it succeeded in a number of pocket areas of Himachal Pradesh. Because of ecological diversity, the pocket-area approach suits mountain areas far more than a blanket approach for the entire mountains. While developing such an approach, the framework presented in Figure 6.1 should be useful for addressing interrelated issues and linkages in the mountain environment.

chapter seven

Strategies for Sustainable Management of Livestock in Mixed-Crop Livestock Farming Systems

In this chapter, strategies are set out that have been formulated on the discussions so far (see Annex 8 for a summary of trends and implications). Research has shown that problems prevail on several levels, hindering the smooth progress of sustainable and remunerative livestock systems in mountain areas. At the production level, the smallholder faces problems of acute fodder shortage and is still largely isolated from appropriate and beneficial technological options. At the market level, pricing policies and market institutions need to be improved. Policies have so far been somewhat removed from reality as faced by mountain farmers whose needs, capabilities, and achievements must be recognised and strengthened.

Key thrust areas, strategies, and potential options/approaches for sustainable livestock management are discussed below, along with current constraints and strategies for overcoming them.

Improvement in the Feed Resource Base

Reiteration of the Problem

Feed shortage is a major problem for livestock farmers throughout the HKH. In Uttarakhand in the Central Indian Himalayas, the present shortage of feed and fodder is estimated to be 65 per cent (Dhar 1997). The magnitude of the problem varies from zone to zone. Similarly, in Nepal, scarcity of fodder (especially during winter) is a crucial problem in raising livestock. The shortage of animal feed is acute during the dry period and winter and livestock are generally underfed by one-third of the amount required. Nepal faces a 20–36 per cent feed shortage. The situation

is much worse in the mountains because of small landholdings and the limited support land for grazing. The fact that ruminants are underfed has resulted in late maturity, high calf and adult mortality, poor lifetime performance, and infertility in cattle and buffaloes (Sherchand and Pradhan 1997).

The primary reasons for the shortage of fodder are the shrinking per capita landholdings and loss of forest land which have reduced the resource base per head of livestock. Animal numbers per household have decreased while the total livestock units have gradually increased. Many CPRs, where farmers used to graze their livestock unimpeded, are also becoming protected areas.

Community sanctions are in place in intense pressure areas, with penalties for those who encroach on community forest areas to graze livestock. Such restrictions contributed to the farmers' problem with fodder collection, at least during the early phase of community forestry. Even in well-managed community forests, fodder species and grasses are still scarce. Attempts were made to introduce exotic fodder species in community forests, but these species did not perform as hoped. Attention should be directed to local species that adapt well.

Strategies

- Increase production of fodder trees and fodder grasses in community controlled areas
- Enhance the productivity of fodder grasses and fodder trees from private farms
- Improve access to quality feed (feed concentrates)

Potential Options/Approaches for Land-Based Feed Resources

- Increase planting of fodder species (trees, grasses and shrubs) on uncultivated community and private land (marginal land, terrace risers)

Significant research has been carried out in agroforestry and related technologies that can help to generate fodder all year round to cope with the winter shortage. These need to be promoted through better extension services. The government could support

research to identify fast-growing fodder trees and improved grasses for specific agro-climatic zones and arrange for multiplying and distributing seeds and seedlings. Incentives such as short training courses, in-country tours, and prizes for taking care of planted trees would be useful. Trees and grasses would not only supply livestock fodder but would also supply much-needed fuelwood, as well as conserving soil and preventing erosion. Potential areas where these could be grown are community land that is not fully utilised and private land.

- Assist private farmers in multiplying, distributing/selling fodder trees and forage grass seeds

Given the opportunity, local farmers can take the lead in raising nurseries of fodder trees and growing seeds of forage grasses for their own use as well as for profit.

- Promotion of efficient use of agricultural residues

Given the limitation of small landholdings, technologies that enable maximum fodder/feed output with minimum land resources should be promoted.

Many farmers in the high pressure areas of the HKH have partially adopted these solutions: their experiences need to be built upon and replicated.

- Encourage better management of common resources for fodder supply

Community planting and sharing of fodder can be encouraged. Communities can be organized in groups to grow fodder grasses on CPRs and in forests. On-farm adaptive research has proven that fodder grasses can be grown on very marginal lands in pine forests.

- Promote entrepreneurship in supply of quality concentrate feeds

For a smallholder dairy, a timely supply of quality concentrate feed is critical, especially in periods of fodder scarcity. Private, local suppliers should be encouraged.

Improvement in Animal Productivity

Reiteration of the Problem

Low productivity in terms of milk is a major constraint. Poor feeding practices, local breeds and their sub-optimal nutrition, and low milk prices (resulting in less incentive to keep productive animals) are the primary reasons behind poor milk production. High-yielding animals are expensive. Quality animals have been promoted in the past, but the improved cattle were an inappropriate choice , especially in the Nepalese hills and mountains (see Box 7.1). Affordable and adaptable options for quality animals, such as improved buffaloes, have not been given priority by the government sector, so that, even when mountain

Box 7.1
Inappropriate Choice of Quality Animals

In recognition that the productivity of livestock presently owned by the large majority of smallholders in high pressure areas is very low, government institutions have in the past promoted the adoption of high-yielding animals (mainly cattle) through distribution and credit arrangements. Improved cattle were vigorously promoted in some parts of Nepal, including the hills of Kaski and Parbat (the sites for the present study). Similarly, in the Indian hills too, exotic and/or exotic cross-breeds were introduced many years ago. However, there were several problems that hindered the optimal performance of such animals in mountain farming systems. These included sub-optional nutrition and management, greater susceptibility to prevailing diseases and pests, and thinly spread veterinary services. High-yielding breeds (especially cattle) require quality fodder. There are two constraints involved in growing improved forage for improved cattle. Firstly, farm sizes are small and fragmented and farmers need to keep most of the available land for food crops. Secondly, cultivation of improved fodder grasses requires irrigation, which is not available to most farmers. Mountain conditions of inaccessibility and the resulting lack of access to inputs and services, even if affordable, also presents a challenge to rearing such improved cattle breeds, because they are dependent on both quality feed (concentrates and quality fodder) and on a good veterinary network.

farmers desire to replace their local buffaloes, they cannot overcome the inaccessibility and isolation of their mountain farms to aquire and raise the improved breed. Inadequate extension and promotion/demonstration are also constraints. Farmers from remote villages indicated that they were not well informed about opportunities for raising improved buffaloes. At present, improved buffaloes are sold mainly by private traders from the lowlands and have not reached the smaller market towns of the hills. The relevant government institutions should play a part in helping to ensure that improved buffaloes reach these small market towns.

On the other hand, to curb the increasing livestock pressure in HP, Ranveer (1995) suggests that the livestock population in HP should be reduced by 34.4 per cent. To some extent, this has occurred through the introduction of quality dairy animals such as Jersey crosses. Cross-bred cows only account for 14 per cent of the total cow population in HP, and there is plenty of scope for increasing their proportion while decreaseing the number of unproductive cows of local breed.

Strategies

- Promote appropriate,manageable productive animals
- Improve the productivity of the animals that are adopted
- Promote the trade in improved buffaloes

Potential Options/Approaches

- Reassess policy regarding cross-bred cattle promotion; focus on appropriate, manageable productive animals

Box 7.1 describes the case of an inappropriate choice for productive animals; a lesson that is important. Research and development should focus on building on the successes of people's choices. Development policy should be more participatory in order to reflect the ground realities. Wherever feasible, encouragement for adoption of cross-bred cattle is needed. Nevertheless, its introduction as a blanket solution should be avoided.

- Encourage local people in improved buffalo trading

Make farmers aware of the areas in which they are sold. Facilitate

market arrangements whereby buffalo traders and the farmer willing to buy them can come together. This might include organizing 'market days' in villages for the sale of improved buffaloes.

- Increase price incentives

If the commodity derived from livestock, e.g., milk, fetches a price that covers the cost of production and leaves a profit, there is an increased incentive to feed the animal well and increase the productivity of otherwise unproductive animals. The price of milk set by parastatal government organizations is low and is not set according to the cost of production. Price policies should be reassessed and a market for value-added products, such as *khuwa* (milk concentrate) , ghee, and, in urban areas, ice cream, should be increased. Price incentives through diversification of milk products will encourage households to improve the productivity of animals

- Improve market infrastructure and market scope

The possiblity of selling milk encourages farmers to keep productive animals. Examples from Dolakha demonstrate that animals kept within the vicinity of road networks were productive animals (in this case buffaloes as opposed to local cattle). With this increase in access the quality of animals kept and, therefore, the total milk collected also increase. In most of the chilling centres visited, it was found that milk arriving from villages more than two hours' walk away were from local buffaloes. A greater proportion of the milk was arriving from villages closer by and was from both improved buffaloes and cows. There is considerable scope for increasing the demand for pasteurised milk. The majority of school-going children do not have access to milk. A milk-feeding programme for all school going children during their 'tiffin' hours at school can increase milk consumption significantly.

- Encourage farmers' groups

Several factors make membership of producer associations, such as farmers' cooperatives, conducive to keeping productive animals. In certain cooperatives, compulsory quotas for milk supply must be adhered to, and this means that farmers will have

to keep/buy productive animals. Risk factors, such as disease and unavailability of credit, are lessened in a group situation compared to individual ventures. Farmers' groups are often linked with credit schemes and are capable of organizing animal health services.

Improvement in Livestock Support Services

Reiteration of the Problem

There is a significant shortage of livestock support services. One of the reasons for farmers' reluctance to adopt improved animals is the insecurity of their investment. Animals, particularly improved breeds, are prone to diseases and cannot be sustained without readily available drugs and vaccines and regular monitoring of their health. Veterinary services in Nepal are largely confined to the government sector.

The number of skilled livestock technicians is also very small and extension and line agencies are understaffed. Shrestha and Sherchan (1988) calculate that the ratio of veterinarians to livestock in Nepal is such that each veterinary doctor has to provide services for 42,000 livestock units in the hill region. Lack of trained human resources in livestock health services is of great concern. Private sector involvement in livestock support services (dispensaries for drugs and vaccines) is limited and needs to be encouraged.

Strategies

- Improve human resource base in livestock support services sector
- Promote private sector participation in livestock health serveices

Potential Options/Approaches

- Training and building local people's capacity

Experiences from the Indian Himalayas (HP) should be extended to the hills of Nepal. Training of 'paravets' able to provide privately-owned mobile services could work well.

- Involve the private sector

Private enterprises should be more actively encouraged to establish veterinary dispensaries.

- NGOs should be encouraged

NGOs can be involved in the provision of veterinary services and in carrying out training for local human resources capable of providing such services.

Reassess the Price Policy for Milk

Reiteration of the Problem

The present price policy for fresh milk favours urban consumers. Farmers often state that the cost of production would exceed the price they get for their milk if they were to only feed their livestock on purchased feed. Lower milk prices and increasing feed costs could jeopardise the economic viability of raising livestock. Presently, the National Dairy Development Corporation (DDC) sets the milk price. It has the largest processing facilities with milk collection and chilling centres and is the farmers' major customer.

Farmers complain that the DDC fixes the price that provides just enough margin to cover their production costs. Although private dairies pay an approximately ten per cent higher price per litre of milk than DDC, because of their limited collections centres, the majority of farmers cannot sell milk to the private dairies.

The other reason cited by farmers for the stagnant price of milk has been the excess use of imported powdered milk by the DDC (Dairy Development Corporation), as well as by private dairies.

Strategies

- Set prices realistically to reflect the cost of production
- Lift subsidies to enable fair competition

Potential Options/Approaches

- Implement fair price policies

Analysis of the cost of production must be taken into account before the price of milk is determined. When such prices are determined there should be an adequate margin of benefit for milk producers.

- Facilitate fair competition so that private dairies can play a greater role in the market

The government should facilitate these changes, monitor quality, enforce standards, and enact suitable policies from time to time.

- Discourage excessive use of powdered milk for processing

Excess use of imported powdered milk should be discouraged, especially if it is subsidised.

- Enforce quality control

There is a need to control the quality of the pasteurised milk sold. It has been reported that there is a common practice of using low quality powdered milk and buttermilk for sale in the market.

Promotion of Manufactured Livestock Feed

Reiteration of the Problem

Reliance on non-land based, external sources of feed is bound to increase in future, as the villages transform from subsistence to semi-commercial economies. Maintaining a productive herd of livestock will require more and more inputs of livestock feed from outside.

However, one of the biggest problems faced by a smallholder dairy household is the increasing price of manufactured feed in the face of stagnating milk prices. Interviews with farmers indicated that, if they were to depend entirely on purchased feed, the cost of feed would exceed the benefits derived from the sale of milk. The

small farmers, without enough land of their own to supply land-based feed, bear the full brunt of the high cost of feed. Dependence on land-based fodder resources is becoming increasingly difficult for smallholder dairy farmers.

Strategies

- Monitor prices and quality of livestock feed in the market
- Set milk prices realistically (as discussed above)

Potential Option/Approaches

- Promote competition and monitor quality

There is involvement of the private sector in production of livestock feed in Nepal, but there is very little competition. Prices and quality are not monitored. Farmers at the field study sites expressed dissatisfaction over the quality of feed. Relevant bodies to monitor the quality and price of livestock feed should be instituted.

- Increase availability of feed concentrates

Encourage more private sector involvement and competition.

- Train local entrepreneurs

Enforce production of quality feed and provide support/ training for development of micro-enterprises for feed production in rural areas.

Fostering Credit and Savings' Institutions / Minimisation of the Risk in Livestock Raising

Reiteration of the Problem

Credit facilities are essential for encouraging the adoption of productive animals, since it is an expensive investment for the smallholder. Despite continuing efforts, official credit for smallholders is not easily available through government institutions. A large number of farmers willing to invest in livestock still have to resort to unofficial credit at high interest rates. Unavailability of

credit is therefore another constraint to livestock sector development for small-holders.

Delivery of government credit services mainly occurs in the cities and administrative centres, away from the villages. There is a paucity of field-based government credit institutions in remote areas. Community credit and savings' organizations have been relatively successful and need to be replicated in different areas. Concessional loans should be provided to local credit/savings' organizations.

Investment in productive livestock has a lot of risk and uncertainty. As mentioned previously, availability of risk neutralising factors, such as veterinary services, encourages farmers to adopt improved breeds. Insurance of livestock against death and natural hazards is lacking. Farmers also face uncertainties at the market level. Lack of guaranteed marketing prospects for livestock products and unfair prices add to the uncertainty.

Strategies

- Improve credit access, especially for disadvantaged groups, women and marginal farmers
- Promote insurance policies for livestock and foster local institutions
- Enhance local savings' and credit organizations

Potential Options/ Approaches

- Improve linkages between farmers and bank/financing agencies for credit

Promote field-based government credit institutions. Encourage and mobilise community organizations for savings and credit. Provide concessional loans to community credit and savings' organizations.

- Encourage and foster farmers' organizations

Experience from successful transformed areas has proven that the formation of farmers'groups greatly helps cushion the individual farmer from the risks associated with livestock raising.

Community-level institutions, such as milk producer associations (MPAs), community credit and savings' organizations, and cooperatives, need to be promoted more, and successful experiences should be replicated.

- Promote insurance policies for animal against death and disease

The private sector should be encouraged to enter the business of insuring livestock, although initially some assistance should be given by the government.

- Widen markets

Increase market network linkages, including domestic and regional markets.

Promotion of Appropriate Technologies for Inaccessible Areas

Reiteration of the Problem

Lack of accessibility has greatly hindered prospects for improving the livelihood of smallholders through a remunerative, cash-oriented livestock sector. Access in terms of proximity to the roadhead and milk collection centres usually correlates to increased incentives for the small-holder to commercialise. However, small-scale chilling centres (usually at the roadheads) are still few and far between and are largely inaccessible to remote farmers. There are numerous households practising mixed crop-livestock farming systems in the inaccessible areas where raising of cattle and buffaloes is common.

Presently, farmers are carrying their milk a distance of five to six hours'to milk collection centres (Annex 4). In most inaccessible areas, local buffaloes are the prime milk producers. There are hinterlands further afield that require eight to 12 hours of walking to get to milk collection centres at the roadheads.

Appropriate milk processing technologies for such inaccessible areas has not so far received any attention. In order to promote milk collection and benefit poor farmers, appropriate technologies and facilities need to be developed for these remote

areas. The quality of milk and milk products has suffered because of the long distances that have to be covered to reach the chilling centres.

Strategies

- Institute policies for appropriate technologies for remote areas
- Build capacity of private small-scale (cottage) industries

Potential Options/Approaches

- Direct efforts towards developing /designing small-scale, intermediate raw milk chilling/processing facilities appropriate to inaccessible areas

Chilling facilities with a capacity of 100 to 600 litres have already proved successful in some areas, e.g., Ilam in Nepal. They need to be promoted and further developed. Existing technologies must be upgraded. Means of increasing the shelf life of milk is an important issue for farmers in remote areas. Appropriate technologies are necessary for this purpose.

- Promote cottage and micro-enterprises for high-value products (*khuwa*, ghee etc)

Private entrepreneurship in milk processing and milk product diversification has not been encouraged so far. Policies and the operating environment should be made more conducive for small dairies. Efforts should be made to:

- institute specific financing schemes;
- enable fairer price policy/ fairer competition; and
- make inputs like starter culture and rennet easily available.

- Promote environmentally-friendly processing technologies

Processing plants of any scale require a lot of fuel. So far, fuelwood has been meeting the energy demands of these plants.

Factories that run on diesel fuel have already proven successful (e.g., in Ilam, Nepal). Such technologies should be encouraged and subsidised like the biogas plants. Subsidies are well justified in

cases like this, since they contribute to alleviating the pressure on the environment.

Promotion of Diversification through Value-adding to Increase Returns

Reiteration of the Problem

Diversification of milk products has not been fully undertaken to maximise returns from the sale of different value-added milk products. Presently, milk sold by the smallholder is usually raw, unprocessed milk. There is plenty of scope for diversifying milk into different products, both traditional and modern. The traditional products include the butter, *ghee* (clarified butter), *khuwa* (condensed milk), and *chuurpi* (hardened cheese) that have always been marketed by smallholders. Modern products include ice cream and flavoured milk. Disadvantages resulting from 'milk holidays' for fresh milk could be compensated for by profitably channelling milk into new products.

Strategies

- Promote milk product diversification
- Increase the market share of traditional and modern value-added milk products

Potential Options/Approaches

- Facilitate marketing for traditional products like *khuwa*

Khuwa is an essential ingredient in local sweets. It has a large market and is widely consumed in urban areas. The producer-client link for traditional milk products such as these is very weak and is not as well established as that of raw milk. Experiences from Baroda in India have shown that *khuwa* production and distribution on a large scale can be operated quite successfully. An outlet for value-added products is especially important since it maintains a cash-flow for rural households in glut periods. This would be most desirable in accessible areas.

- Improve technologies for existing traditional products

Khuwa and unique products such as yak cheese require improved production technology. For urban-based dairies, skill

development programmes for products such as ice cream need to be extended to private sector enterprises. Nepal's dairy skills are still limited to public sector technicians.

- Promote programmes for skill development

There are very few technicians with the knowledge and skill to run a dairy. Furthermore, whatever skill and knowledge there is remains limited to public sector technicians. Private entrepreneurs who have started dairy/milk processing businesses of their own have largely relied on knowledge by 'word of mouth' and observation. Shortage of technicians in urban-based factories (for ice cream production for example) is such that they have to pay heavily to hire a limited number of qualified technicians, and smaller businesses cannot even afford them. Present small-scale businesses serving the inaccessible areas produce products of inconsistent and/or poor quality due to lack of training. There is not a single training facility in milk processing and product development in Nepal. The National Dairy Development Board (NDDB) (Nepal) should take the initiative for establishing a National Dairy Training Facility in the country.

- Increase processing capacity to match milk supply

Milk holidays are affecting hill and mountain regions, while production is increasing year by year. Only milk that can be handled is being collected. The number of processing plants has to be increased to absorb the surplus.

- Encourage milk product diversification for urban markets

Diversification can be extended to different varieties of ice cream, yogurt, and flavoured milk drinks (like milkshakes).

Integration of Gender Concerns

Reiteration of the Problem

In Nepal, women contribute 70 per cent of the work in raising livestock and are more knowledgeable than men about treating sick animals (Sharma and Awasthi 1993; Tulachan 1994). In spite of this, women are excluded from extension, marketing, credit, and

other activities critical to increasing livestock productivity and income (HMG/ADB 1993).

Women's needs (for time-saving technology, for example) are not considered when conducting research, nor is the extension education system tailored to women farmers. Despite the fact that women farmers contribute an equal share of the work in raising livestock, their knowledge and ideas on problems have hardly entered mainstream perception; it is only men who have a say.

Use of child labour is common in livestock feed/fodder collection as well as in grazing. It is mostly female children ranging from seven to 13 years, who are engaged in taking animals to graze in nearby forests and on support land. During the rainy season, the boys and girls of this age group are involved in cutting and carrying green grasses and field weeds from crop fields. Children are also engaged in collecting dung from open common property land. In spite of the wide recognition of the role of women in livestock economy, gender insensitivity in planning and in activities related to livestock development still prevails.

Strategies

- Internalise gender concerns in livestock planning
- Develop and promote drudgery-reducing technologies for women and children
- Increase contribution of livestock to women; enhance gender equity

Potential Options/Approaches

- Formulate policies with women and children farmers in mind

Sensitisation of local institutions regarding gender needs and the active involvement of women staff/knowledgeable women farmers are essential if useful programme activities are to be formulated. Participatory approaches should be taken, with explicit emphasis on the problems and potential of women and children.

- Develop and promote drudgery-reducing technologies for women and children

Out-migation and seasonal migration from the hills have resulted in a shortage of farm labour. Able-bodied men, particularly, have been migrating to cities and towns for off-farm

employment. This is due to the increases in wages for labour outside the farm. Women, children, and senior citizens are left behind to tend livestock; and rearing these livestock using the stall feeding option demands labour. Approaches to overcoming labour constraints at the household level should conside labour-saving, time-saving, and drudgery reducing technologies. Indeed, research and development in the livestock sector should focus on this area.

- Improve livestock contribution to gender equity

Micro-livestock (small ruminants and poultry) have been contributing to direct income for women. The option of small ruminants offers more autonomy in decision-making, and thus empowerment to women. Women are more easily involved in the sale and purchase of goats and chickens. They make decisions and have more control over financial transactions with these classes of livestock than with large ruminants.

Promotion of Micro-Livestock for Marginal and Disadvantaged Farmers

The 'visible' classes of livestock, namely, buffaloes and cattle, are the most talked about components of the livestock sector in the middle hills. Little attention, however, is given to micro-livestock such as goats and poultry. They have been an important source of immediate cash income for every household in the hills. In the mid-hill/mountain areas, the number of households raising stall-fed goats is increasing. In the field survey areas, almost 80 per cent of the households were found to be raising two to six goats. Restrictions on open grazing has led to stall-feeding becoming a common practice. Fodder trees are lopped and fed to these animals.

While milk provides regular cash flow (on a daily basis), goats and chickens are 'liquidate-in-need' assets. Poultry provides a quick source of cash income. Women take them to market towns where they sell them easily and return home with the required household items bought from the cash. Small ruminants, in comparison to large ruminants, e.g., buffaloes, are a less risky investment for resource-poor farmers since they require a smaller amount of capital.

Credit schemes for raising goats are operating very well in most parts of the middle hills of Nepal, mostly run by various NGOs. The default rate for small loans for micro-livestock (especially in the case of women's groups) is also very low, indicating its success.

Presently, there are no marketing problems for goats. Petty goat traders roam around villages looking for goats to buy. They then walk them to the markets for sale. On the other hand, rural areas in the hills and mountains do not raise poultry on a commercial scale. Rural households raise local poultry as scavenging birds, and their size is small. On average, a farm household raises four to ten chickens. The marketing of local chickens has not been a problem. Petty traders in poultry travel around villages, buy poultry, and carry them to market centres. The problem is that farmers are not getting as much return as they could had they organized their markets. Thus in order to make micro-livestock a remunerative enterprise, the focus should be on organized marketing in farmers' groups.

Thus, there is considerable scope for developing micro-livestock to help improve the income levels of resource-poor farmers. In inaccessible areas, priority should be given to goat raising as goats can walk to markets. Also, with urban consumers' increased levels of disposable income, demand for goat meat has been increasing steadily. Small-scale poultry production with 200–500 birds, that can be managed using family labour, can be promoted in areas that have access to roads and wider markets. However, food supplies and veterinary services must be assured. Such programmes can be developed and implemented to target resource-poor farm households in particular.

Strategies

- Allow wider inclusion of micro-livestock in policy agenda
- Encourage government and non-government organizations to introduce schemes that provide credit support for disadvantaged groups
- Enhance the productivity of goats

Potential Options/Approaches

- Promote micro-enterprises for women based on goat and poultry raising

Credit provision for such enterprises is necessary. Micro-enterprises can be encouraged through formation of savings' and credit groups for women.

- Provide training for women for small-scale poultry raising

Such programmes should equip women entrepreneurs with the skills and knowledge needed to manage health and feed requirements for poultry. They also have to be linked to the necessary support services such as veterinary support and easy provision of feed concentrate.

- Organize farmers in marketing their live animals and products

Formation of women's groups to market goats and poultry can be encouraged. These groups can be associated with savings' and credit associations for women and marginalised farmers.

- Establish a regular and reliable marketing network

Links between producers and markets should be better facilitated. A proper market information system is essential to guarantee regular sales. In addition, community savings' and credit systems should be strengthened to expand goat production at the household level and disadvantaged groups and marginalised farmers should be organized for the production and marketing of poultry and eggs

Improvement of Soil Fertility through Better Management of Livestock and Forage Crops

Reiteration of the Problem

Livestock contributes to the maintenance of soil fertility. However, there is still a lot of scope for contributing to the sustainable management of soil through better management of livestock. In a semi-stall-fed system, about 46 per cent of manure produced during the daytime is lost while animals are grazing in the forest or on community fallow land (Bajracharya 1998). Even in an entirely stall-fed system, potential fertilizer is lost due to poor housing structure, inefficient FYM preparation and inappropriate application methods.

Strategies

- Improve the efficiency of the nutrient cycling of the crop-forest-livestock system
- Integrate new components into the system of 'win-win' technologies (nitrogen-fixing fodder trees and leguminous forage) for fodder, fertility, and conservation

Potential Options/Approaches

- Disseminate knowledge and technologies for efficient nutrient recycling

Effective dissemination of information on nutrient loss in the stall-fed system and ways to prevent loss is necessary. The importance of N-rich legume feed and N-content of animal excreta for quality FYM production needs to be emphasised.

- Promote legume integration in mixed crop-livestock farming systems

Legume integration directly contributes to soil fertility maintenance.Approaches for increasing legume integration can include the following steps:

- dissemination of information on N-fixing activities of legumes and their importance in soil fertility improvement;

- identification of promising legumes for specific farming systems;
- incorporation of indigenous knowledge on locally available legume species and exploration of suitable new legume crops and trees; and
- provision of support in getting the required inputs and services.

• Promote farm agroforestry

Agroforestry systems for soil conservation and sustainable livestock production have to be promoted. Agroforesty also allows a reduction in the farmers' work burden and avoids over-exploitation of common forest and grassland.

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Annexes

Annex 1: **Human Densities on Cultivated Land and Livestock Stocking Densities in the Field Study Districts of Nepal**

Parameter	Nepal District Average	Kaski District	Parbat District
Human numbers per hectare of cultivated land	6.6	7.9	7.7
LSUs per hectare of agricultural, forest and grazing land (indicator of pressure on aggregate feed resource)	0.90	1.42	1.64
LSUs per hectare of forest and grazing land (indicator of pressure on CPR)	0.84	1.33	1.62
Number of buffaloes per hectare of cultivated land	1.19	1.64	2.67

LSUs = Livestock units

Annex 2: **Distribution of Human and Livestock Pressure across the Hill Districts of Nepal**

District	Human pressure per hectare of cultivated land	Human density per sq km	Livestock pressure on cultivated land *(average number of livestock per hectare of cultivated land)*		Livestock pressure on forest and shrubland (average number of livestock per hectare of *forest and shrubland)*	
			Buffalo	Cattle	Buffalo	Cattle
Parbat	7.7	291	2.67	2.11	2.49	1.96
Kaski	7.9	145	1.64	1.46	0.67	0.60
Dolakha	5.9	79	1.17	2.60	0.36	0.81
Solukhumbu	4.5	29	0.93	2.01	0.19	0.41
Rasuwa	5.8	24	2.52	3.67	0.31	0.44
Dadeldhura	5.4	68	0.98	3.56	0.16	0.59
Kalikot	5.6	51	1.12	3.54	0.17	0.53
Myagdi	5.2	44	1.82	3.07	0.42	0.70
Taplejung	4.4	33	1.16	2.68	0.23	0.53
Bajhang	5.1	41	1.15	3.52	0.28	0.84
Surkhet	6.2	92	0.94	3.41	0.19	0.69
Sankuwasabha	4.4	41	0.92	2.53	0.00	0.14
Udaypur	6.3	107	0.81	3.07	0.21	0.78
Panchthar	4.3	141	0.68	1.54	0.49	1.10
Darchula	6.3	44	2.06	4.81	0.42	0.97
Ilam	5.1	135	0.51	2.00	0.24	0.93
Salyan	5.3	124	0.70	4.08	0.30	1.76

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Annex 2: **Distribution of Human and Livestock Pressure across the Hill Districts of Nepal** (cont'd)

District	Human pressure per hectare of cultivated land	Human density per sq km	Livestock pressure on cultivated land *(average number of livestock per hectare of cultivated land)*		Livestock pressure on forest and shrubland (average number of livestock per hectare of *forest and shrubland)*	
			Buffalo	Cattle	Buffalo	Cattle
Dhankuta	4.4	164	0.65	2.37	0.60	2.15
Syangjha	7.8	252	2.89	3.01	3.44	3.59
Dhading	6.3	144	2.00	2.99	0.95	1.43
Baglung	7.2	130	2.44	2.41	0.84	0.83
Argakhanchi	7.5	152	2.81	2.40	0.93	0.80
Palpa	6.5	172	2.13	2.39	1.09	1.23
Dailekh	5.3	125	1.30	2.54	0.59	1.15
Gorkha	6.1	70	1.55	2.11	0.57	0.78
Baitadi	6.4	132	2.10	3.42	0.84	1.37
Kabhre	8.9	232	1.83	2.93	0.90	1.44
Khotang	4.6	136	1.32	2.11	0.78	1.25
Gulmi	8.5	232	2.63	2.52	1.98	1.91
Tanahun	6.7	173	1.44	2.70	0.68	1.28
Accham	5.0	118	1.45	2.41	0.65	1.08
Ramechap	4.7	122	1.39	2.12	0.84	1.28
Rukum	5.5	54	1.82	3.21	0.93	1.63
Pyuthan	6.2	134	1.81	3.07	0.70	1.19
Lamjhung	5.3	91	1.67	2.57	0.57	0.88

Annex 3: **Livestock Production and Management in a Subsistence Mixed Crop-Livestock Farming System**

Livestock Class	Main Uses	General Management System	Specific Phase	Specific Feeding Strategy	Quality of Nutrition
Cattle	Traction, milk, manure	Rainy Season Stall fed with cut and carry green grass and field weeds	Dry Cattle	Crop residues and grasses: no feed grains	Sub-optimal
			Bullocks at work	Some kundo (cooked feed grain), crop residues and green grasses	Near-optimal
		Winter A few hours of grazing during the day, stall fed crop residues in the evening	Lactating cows	Crop residues and green grasses, kundo twice daily	Near-optimal
Buffalo	Milk, meat, manure, traction	Summer Short hours of grazing, stall-fed cut-carry green grasses and field weeds	Dry buffaloes	Crop residues and grasses: no feed grains	Sub-optimal
			Lactating buffaloes	Crop residues and green grasses, kundo twice daily	Near-optimal
		Winter A few hours of grazing during the day, stall fed crop residues in the evening			

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Annex 3: **Livestock Production and Management in a Subsistence Mixed Crop-Livestock Farming System**

Livestock Class	Main Uses	General Management System	Specific Phase	Specific Feeding Strategy	Quality of Nutrition
Goats	Meat, manure	Summer Short hours of grazing and stall feeding Winter Grazing on fallow lands, roadsides, and water canals	Adult goats	Tree fodder, green grass	Sub-Optimal
			Young goats	Tree fodder, green grass, and some grains	Near-optimal
Sheep	Meat, manure	Grazed all year round		Green grasses, crop residues (when not grazed)	Sub-optimal
Swine	Meat	Stall fed all year round		Kitchen waste, some grains	Near-optimal
Poultry	Meat, eggs	Scavenging all year round		Some grains	Sub-optimal

Source: Adapted from Tulachan (1989 and1994)

Annex 4: **Milk Hauling Distances for Milk Collected from Different Areas around Parbat to Kusma Chilling Centre**

Place:	Milk Chilling Centre; Kusma	Means of transport:	porters (35)
Person in charge:	Abadh Kumar Jha	Officals:	2
Established:	May 16 2052 BS	Cooperative associations:	5
Capacity:	3,000 litres		

Cooperatives	Distance	Amt.of milk	# farmers	% from cow	% from buffaloes
Jyadi	1 hr walking distance	240	150	100	
Patichaur	Bus 10km	132	100	100	
Laxmi	1½ hrs w.d., ½ hour bus	40	50	50	50
Laleswor	½ hour bus	81	55	40	60
Phalebas	3 hrs w.d.	106	85	75	25
Gahatepokhara	2 hrs w.d.	65	45	60	40
Devisthan	2½ hrs w.d.	38.5	20	100 (mixed)	100
Kurgha	4 hrs w.d.	42	31		100
Namuna	½ hr bus, 1½ hrs w.d.	29	35	50	50
Deurali	5 hrs w.d.	8	5		100 (local)
Shivalaya	2½ hrs w.d.	50	35		100

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Annex 4: **Milk Hauling Distances for Milk Collected from Different Areas around Parbat to Kusma Chilling Centre**

Cooperatives	Distance	Amt.of milk	# farmers	% from cow	% from buffaloes
Janahit	4½ hrs w.d.	16	12		100
Atmairbhar	3 hrs w.d.	41	40	60	40
Fedi	3 hrs	30	225	40	60
Janabikash	3½ hrs	9	5		100

w.d = walking distance

Annex 5: **Ecological Dimensions of Sustainability Related to Livestock, Himachal Pradesh**

I. Micro-Level Indicators from the Transformed Areas

	Indicators	Process of Change and Implications
1.	Decline in the livestock population	The decline in the livestock population per household, along with the complete switchover to stall feeding, has reduced the pressure on natural resources. The quality of livestock has also improved, leading to higher yields. These changes augur well for the ecology and environment of the area.
2.	Abandoned land	There is no abandoned land; in fact every inch of land is used. Marginal and steeply sloping lands have been brought under apple cultivation.
3.	Land under irrigation	Almost all the land is under irrigation. The irrigation scheme is functioning well and is managed by the Department of Irrigation and Public Health.
4.	Water from natural sources	There is no perceptible change in the amount of water available from natural water sources. In fact, the pressure on these sources has lessened because of the provision of piped water to all villages.
5.	Frequency of landslides and soil erosion	There is no visible increase in the frequency and intensity of landslides. Apple cultivation has helped to check landslides and soil erosion. The cropping intensity has declined. The orchards have thick grass cover which protects the soil.
6.	Support land	The amount of support land in terms of pasture and grassland available per hectare of agricultural land has declined to 0.11 hectares.

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Annex 5: **Ecological Dimensions of Sustainability Related to Livestock, Himachal Pradesh**

II. Micro-Level Indicators from the Non-transformed Areas

	Indicators	Process of Change and Implications
1.	Decline in the livestock population	The livestock population has declined over time. Milk production has also declined for two reasons. First, because of the decline in grazing land and the availability of fodder; and second, because of the low quality of livestock.
2.	Abandoned land	There is no abandoned land.
3.	Land under irrigation	There is no irrigation.
4.	Water from natural sources	There has been no perceptible change in the amount of water available from natural sources.
5.	Landslides and soil erosion	There has been no noticeable increase in the intensity and frequency of landslides and soil erosion, thanks to the measures adopted by the farmers, e.g., terracing, bunding, and avoiding cultivation on steep slopes.
6	Support land	The amount of support land in terms of pasture and grassland has declined over time. One hectare of agricultural land has 0.45 hectares of support land, which is much less than desired. It is, however, much higher than in the transformed areas.

Source: Sharma (1996)

Annex 6: **Changing Links to CPRs in Areas of Transforming Animal Production Systems**

Change Parameters	Subsistence Production System	Transforming to Semi-commercial Systems and New implications for linkages to CPRs
Herd size	Stagnant (more or less)	Getting Smaller Less of animals per household and per unit area of natural resource base.
Feeding management	Combination of grazing and stall feeding	Increasing cases of exclusive stall feeding. Use of external inputs (concentrates) Linkages to CPR weakening, due to decrease in total reliance on forest/grazing land
Quality of animals	Low yielding local breed, with relatively more of them in the herd compared to semi-commercial systems	More improved breeds kept, e.g., improved buffaloes replacing local cattle or improved cows replacing local cows Improved milch buffaloes are not grazed for fear of losing milk output. Animals are stall-fed and need quality feed (concentrates); increasing external input thus decreases reliance on CPRs.
Diversification	No diversification. Farming systems composed of traditional food grain production with typical livestock component (local cattle, local buffaloes, goats/sheep).	Becoming more diversified. High-value crops, such as vegetables and fruit, generate more income than solely relying on traditional food crop/livestock production. Income from these options gives farmers an incentive to reduce the number of livestock. Such income also makes the purchase of external inputs (concentrates) affordable, needed to sustain high yielding animals. Livestock Pressure on CPR weakened

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Annex 6: **Changing Links to CPRs in Areas of Transforming Animal Production Systems**

Change Parameters	Subsistence Production System	Transforming to Semi-commercial Systems and New implications for linkages to CPRs
Draught animals	Numbers decreasing, practice of sharing/ hiring becoming common	Numbers decreasing. Horticulture is replacing field crops, tillage requirements are decreasing (HP) Fewer draught animals result in reduced pressure per unit resource base. Also, less tillage results in less erosion
Human labour	Decreasing. Out-migration/ seasonal migration for off-farm employment, increasing commitment to send children to school is having the overall effect of reducing human labour available for keeping livestock (feeding, grazing, fodder grass, and collecting leaf litter). Labour constraint limits expansion of herd size even if feed resources (for some) are unlimited. Weakening impact on natural resources due to less head of livestock	

Annex 7: **A Day in the Life of Phul Maya Thingsa, a 17-year old Tamang Girl**

AM

6:00	Woke up and left for the mill to grind corn
7:15	Returned from the mill
7:20	Morning wash, cleaned and prepared buffalo shed
7:45	Rested and watched the morning dairy crowd
8:20	Cut corn stalks for the buffalo
8:45	Rested beside fire and ate leftover rice
9:15	Left for private *pakho* (upland)
10:30	Began collecting fodder

PM

12:30	Brought fodder home
12:40	Went into hut and cut corn stalks for buffalo
1:15	Fed fodder to buffalo
2:00	Sat down to eat lunch of rice and curry
2:15	Washed plate and other dishes
2:20	Mixed pre-packaged buffalo feed in lukewarm water and fed buffalo, Put out fodder for goats
2:50	Left for Paribas (government) forest
3:50	Arrived and started looking for fuelwood
5:15	Arranged fuelwood sticks into a bundle and began walking home
6:00	Arrived home and milked buffalo
6:30	Prepared dinner

Annex 7: **A Day in the Life of Phul Maya Thingsa, a 17-year old Tamang Girl**

7:15	Ate dinner
7:30	Washed utensils
8:00	Started shelling corn
9:30	Finished shelling corn, left it to dry for next day. Began cutting corn stalks for next day's buffalo feed.
10:15	Rested, had cigarette
10:30	Went to sleep

Source: Bhatt *et al.* 1994

Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
1. Population Growth	↑	• More demand for milk, meat; high pressure on both private and common land • Greater pressure for resources needed for livestock management • Demand for livestock products may increase and also may increase as income generation activity. • Reduction in feed availability for livestock • If the purchasing power is not high, livestock development may go down. • Difficult to manage because of feed scarcity
2. Land Fragmentation	↑	• Decrease in number of draught animals required per farming family • Increased livestock pressure per unit of land • Challenge to meet fodder/ feed demand or must buy concentrate feed • Difficult to raise improved livestock
3. Farm Size	↓	• Pressure of livestock on farmland • Need to manage fodder/ feed demand from both economic and sustainability aspects • Difficulty in raising large ruminants • Feed scarcity due to decrease in support land and cultivated land
4. Livestock Holding	↓	• Declining soil fertility, draught power, reduced interdependent LS systems-transhumance benefitting lowland farmers • Emphasis on commercialisation • Promotion of productive animals • Better health care, feed availability • Because of land fragmentation (small land sizes), high pressure

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
5. Cropping Intensity	↑	• Possible increase in crop residues but reduced time for *in situ* manuring • More feed (by-products) for animal feeding • More cash crops should be grown • Promote crops with high fodder/forage value • Need more manure therefore better FYM management, check losses of nutrients in system
6. Land Use Pattern	◆	• Likelihood of increased conversion to agricultural land; double/ triple cropping, reduced winter pasture for migrant herds • Seek balance from the perspective of sustainable feed availability-livestock productivity • Changes in land use pattern due to stall-feeding practices
7. Crop Diversification	↑	• Attempt legume integration to increase livestock protein intake • Legumes contribute to sustainability • Less time for livestock management • Only near market areas • Less availability of traditional feed, more use of concentrate feed, less animals/HH

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
8. Draught Power Requirement	↓	• Will release resources for other livestock production • Surplus cattle may increase and have an effect on management strategies • Perhaps not in all areas • Cropping intensity increased • Requirement for draught power may increase or decrease depending upon type of farming system, need for draught power also decreases with mechanisation
9. Livestock Contribution to Farm Economy	↑↓	• Where? Horticultural areas decrease, dairy areas increase • Increase in commercialisation — a positive development • Complex — depends on type of livestock, prevailing market prices, market facilities, etc • This is increasing in actual terms • Promote complementary and supplementary activities • An increase in contribution would help better management as livestock would be seen as economically worthwhile

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
10. Use of CPRs Control of CPRs by Community	↓ ↑	• User groups to be encouraged/strengthened • Enabling policy environment is required for community forestry development • Balanced means of harvesting fodder/feed from CPRs without degrading them is a challenge • Environment improved • More intensive management of livestock and replacement of cattle by buffaloes
11. Soil Fertility	↑↓	• Triple cropping system can decrease fertility but fertility on *khet* has increased. • On average, soil fertility is decreasing. • Soil fertility is decreasing due to insufficient/ improper nutrient supplementation • Legumes to be incorporated into cropping systems • We may have to attempt FYM management and improvement • Stall feeding should be promoted so fertilizer is not lost when grazing • Soil fertility declining which results in less production of quality fodder and crop residue
12. Use of Private Land for Fodder Supply	↑	• Commercialisation and productivity will rise • Improvement if higher income generation (opportunity cost to land) • Research on appropriate fodder or forage grass development suitable for marginal lands • Assured supply of feed, more nutrition, etc • Raise productive animals only • Signs of improved livestock farming • More intensive care and management of quality animals

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
13. Use of Chemical Fertilizer	↑	• In areas close to markets where they can afford to buy-declining soil health due to decrease LS no • For crop production-more agricultural by-product (feed for animal) • More crop residues • This is not, however, going to change the need for organic matter. • Remove subsidy on chemical fertilizer • Potential for fodder cultivation, increased agriculture by –product and also for reduction in livestock number • Feed/fodder production and availability may be higher but should think from environmental perspective • Less dependence on animal products for manure, thus keeping less no. of animals
14. Use of Concentrate Feed	↑	• Only in market areas • Because farmers are keeping animals for commercial purposes • Only in commercial production and mainly for poultry • Training should be given to farmers on how to make better concentrate feed using locally available resources • Depends on purchasing power of household • Because less fodder is available and increased number of improved animals • For more productive animals • Less degradation of natural resources and highly dependent on external markets

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
15. Purchase of Improved Buffaloes (demand driven)	↑	• Mainly supplied from Indian/external market. Policies to supply them locally are needed • Support large livestock with good health facilities • Livestock raising is becoming a commercial activity. Buffaloes generate income so farmers are encouraged to buy them. • A minus point is that some good characteristics of our local breeds may be lost. • We need to provide more concentrate feed as per its production. • Purchase of the animals is increasing in and around agri-roads. • Better management and care of buffaloes to produce high milk yield needed
16. Preference for Improved Cows	↓	• Demand is decreasing near markets for milk –not that there was great demand before. • Depends on management skill levels because improved cows are harder to raise. • Decreased preference among smallholder farmers and in remote areas without proper veterinary services. Supply of improved breeds of cows should be limited to areas accessible by road and for semi-commercial production. • In Himachal, preference for these animals has increased, and this is also encouraging stall feeding. • We may lose some good aspects of improved breeds as demand dwindles. • Demand has not decreased in all areas and can be seen, for example, in Ilam there are no buffaloes to be seen, only cows • Increase in milk-shed area • The situation is the result of poor extension services from DLS/NGOs.

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
17 Gender Workload	❍	• Improved breeds increase women's work unless enough farm fodder is available. • So in marginal HH, increased workload may discourage the activity. • Need national level data representation of different agro-ecological zones, as well as an overall social and economic perspective. • Women shoulder a larger burden of the work of managing livestock compared to men. Their workload should be reduced and their contribution and knowledge recognised • Both sexes should have equal participation in livestock raising • As the commercialisation or crop intensity grows, women will be increasingly loaded down with work. Proper technology should be introduced to help lighten the workload. • Educate people about the amount of work put in by women compared to men.
18 Gender Decisions	↑	• Men tend to benefit from the sale of dairy produce, men often get the training rather than women.
• Gender Equity	↑	• There is more gender-balanced livestock management in terms of the role of men and women in all kinds of activities.
• Gender Knowledge/ Skills		• Increased participation by women will help to increase productivity. • This will be true only in a semi-commercial production system. • Effective management and job sharing — and better animal health

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
19. Social Equity	↑↓	• Only in those areas where intensive external support is provided but in areas where no support is provided, still little equity. Requires social and integrated perspective and practical implementation strategy on how to go about it. • Knowledge base is under-utilised. Women should be provided with more opportunity in all programmes. • Increased cash income for dairy milk has increased women's access to cash; and better animal management follows. • There is little change in social equity. There should be clear guidelines to help the poor implement workable livestock management strategies. • Small landholders are more averse to taking risks and find it difficult to invest. • Benefits mostly restricted to large farmers. Small farmers and the disadvantaged section of society must also benefit. • Women, poor consumers/farmers are benefitted by increased milk availability, better nutrition at the household level.

Participating Countries of the Hindu Kush-Himalayan Region

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

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