

Chapter 3

Livestock in Mountain/Highland Production Systems: Challenges and Opportunities

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Introduction

Historically, livestock production systems have had a prime place in the economy of mountain and highland areas (in the following referred to simply as 'mountain areas'), because the features of livestock-crop mixed farming systems match to a high degree the constraints resulting from the specific characteristics of these areas (the mountain 'specificities'). However, the economic and environmental contributions and gains of livestock in mountain areas have been very much context specific. As the circumstances change, so does the extent to which these systems fulfil the local requirements. Increasingly, ecologically or biophysically driven livestock production systems are losing importance as a result of the changing, socioeconomically determined, circumstances in mountain areas.

This paper focuses on the role of, and ways to strengthen, livestock-based farming systems in the context of the changing socioeconomic circumstances in mountain areas. Livestock farming is described as a matching response to the features of mountain areas. The emerging trends in livestock production systems and the socioeconomic and biophysical environment influencing them are summarised. The paper concludes by advocating that the emerging positive trends in livestock production systems be identified and used as a basis for the transformation and sustainable development of livestock farming in mountain/highland areas. The focus is on livestock-crop mixed farming situations in areas with improved accessibility where the economic situation is gradually changing as a result of

market links. The paper mainly uses information and observations from the HKH region.

Mountain Specificities and Livestock Farming

Mountain areas are characterised by some specific features that we call ‘mountain specificities’. They include limited accessibility, a high degree of biophysical (and social) fragility, marginality, diversity, and specific niche opportunities including human adaptation mechanisms. Table 3.1 summarises these features, the factors creating them, their manifestations, and the implications for human activities and resource-use systems, i.e., the imperatives they set in terms of the

Table 3.1: Mountain specificities, their imperatives, and the matching attributes of livestock production systems in mountain/highland areas

Mountain Specificities	Imperatives and Corresponding Features of Livestock Production Systems
<p>1. Inaccessibility <u>Origin:</u> result of slope, altitude, terrain, seasonal hazards (and lack of investment to overcome them) <u>Manifestation and Implications:</u> isolation, semi-closed; poor mobility, high cost of mobility and infrastructures; limited extent and dependability of external links, trade, and supplies</p>	<p><u>Imperatives:</u> production centred on local resources, diversified production/ consumption activities, local resource regeneration, recycling, focus on high-value and low-weight/volume products <u>Livestock:</u> user and regenerator of local resources; contributor to diversification, high-value-low-weight products, and mobility of products; supplier of services/products in an isolated context</p>
<p>2. Fragility and Marginality <u>Origin:</u> result of combined operation of slope, altitude, geological, edaphic, and biotic factors; (biophysical marginality creating socioeconomic marginality) <u>Manifestations and Implications:</u> resource vulnerable to degradation, suited to low intensity uses; low carrying capacity, low input absorption, offers limited, low payoff, risky options; poverty, livelihood insecurity, and subsistence-oriented economy</p>	<p><u>Imperatives:</u> focus on low intensity, extensive type of land use; balancing conservation and production needs; diversification by mixed farming; local resource regeneration, recycling; risk reducing practices <u>Livestock:</u> contributor to fulfilling the above requirements; promoter and user of diversified activities; important source of inputs, income, insurance, and livelihood support for poor households; farming-forestry links</p>
<p>3. Diversity and Niche <u>Origin:</u> result of interactions between different factors ranging from slope and altitude to soils and micro-climates, well adapted vegetation and human practices <u>Manifestations and Implications:</u> a basis for spatially and temporally diversified and interlinked activities, favouring smaller over larger scale activities; source of niche products with a comparative advantage (e.g., timber, horticulture, hydropower)</p>	<p><u>Imperatives:</u> focus on diversified resource use and products and services with a comparative advantage; integrated use of temporally and spatially variable resources and opportunities; human adaptations shaped by above <u>Livestock:</u> production systems as user and promoter of diversification and means of harnessing niche opportunities</p> <ul style="list-style-type: none"> • High-value low-volume livestock products • Product mobility based niche micro-enterprises

Table 3.1: Mountain specificities, their imperatives, and the matching attributes of livestock production systems in mountain/highland areas (cont'd)

Mountain Specificities	Imperatives and Corresponding Features of Livestock Production Systems
<p><i>4. Human Adaptations</i> <u>Origin:</u> sustenance strategies in fragile high risk, low pay-off production environment; two-way adaptations sustainable under low demand conditions <u>Manifestations and implementations:</u> temporally and spatially diversified, location specific complex of activities with strong multiple complementarities, local institutional arrangements, group action</p>	<p><u>Imperatives:</u> promotion of resource use management systems facilitating adaptation of human needs to constraints and opportunities in mountain areas; balancing production and conservation needs. <u>Livestock:</u> production/management systems responding to the above imperatives through a range of multiple complementarities in which livestock play a key role.</p>

response required to ensure productive and sustainable use of mountain resources.

The table shows that livestock production, as a part of mixed farming systems, offers several opportunities and options that match well with the imperatives of mountain specificities. For example, a key requirement resulting from the isolation imposed by limited accessibility is for diversified activities based on local resources and regeneration and recycling of these resources. Livestock within mixed farming systems help meet these requirements. The focus on high-value, low-weight/volume products, and movement of products through animal migration, are other features of the semi-closed mountain situation in which livestock play a key role.

Similarly, the fragility of mountain resources calls for a low intensity, extensive type of land use, and the combination of intensive and extensive types of land use. Resource regeneration and upgrading are other ways of combating fragility. Raising livestock as an integral part of mixed farming systems fulfils these requirements and if properly managed represents the best user of the fragile resources. The functions of livestock as a provider of energy (draft, fuel, nutrients) and of organic matter for crops are also well recognised.

Finally, diversification of resource use and production and consumption activities is a key requirement of sustainable resource use in mountain areas. Livestock can be both a promoter and user of diversified opportunities and production systems. Raising livestock is one of the diversification strategies used by farmers and contributes towards reducing risk and enhancing income and livelihood support. Livestock also offer certain niche opportunities for mountain areas and are an important component of human adaptation to diverse mountain conditions.

The above examples illustrate the high degree of convergence between the imperatives of mountain conditions and the features and functions of livestock production systems which have led to the prime position of livestock raising in mountain farming systems.

Livestock as a Facilitator and User of Multiple Complementarities

There is another more concrete way of understanding the crucial role of livestock in mountain resource management and production systems. This approach sees the sustainability of environmental resources and the security of community livelihoods in mountain areas as being facilitated by a range of 'complementarities' between different resource-use systems and their associated activities. Traditional livestock production systems have facilitated and harnessed these complementarities. In order to understand this aspect better it is useful to consider what is meant by the term 'complementarity'.

Broadly speaking, complementarity between two (or more) entities, activities, or resource-use systems implies a relationship in which conditions such as the following are fully or partially satisfied.

- The sum of the outputs (or performance levels) of the two activities (entities) is higher than the total of the two conducted separately.
- The output of one activity serves fully or partially as an input for the other and vice versa.
- The input needs and output flows of the two activities are non-covariate, i.e., they do not vary in the same direction or degree in space or time and thus do not compete.
- The two activities make use of different components of the same natural or economic resource base.
- The two activities through their structural and operational features are able to meet the different concerns and objectives of the agency/entrepreneur undertaking them and thus to satisfy the overall basic goals.

There are multiple complementarities that play a crucial role in ensuring environmental stability and the security of people's livelihoods in mountain areas. They can be identified by looking at features in mountain areas like resource-use systems and people's adaptation strategies (including farming systems) in terms of the features outlined above. A few are listed below.

- Complementarity or convergence between the situations determined by the specific characteristics of mountain areas and features of the resource use systems, including livestock production and farming systems

- Complementarity between production activities; institutional arrangements directed towards meeting environmental concerns and the need to secure livelihoods through diversification and inter-linked activities; resource regeneration and recycling; and other measures facilitating production and resource protection
- Complementarity between production activities based on common property resources (CPR) like pastures and private property resources (PPR) like private farm lands
- Complementarity (balancing) between intensive and extensive land uses (examples include linking of annual and perennial plant-based activities, crop-fallow rotation, and indigenous agro-forestry)
- Complementarity between activities and enterprises and the seasonal and spatial variability of resources and production flows
- Complementarity between activities with a subsistence orientation and production of niche-based cash crops

These complementarities show the ways in which the systems for using mountain resources have evolved traditionally to ensure both environmental stability and security of livelihoods in mountain areas. Their extent and manifestation varies from region to region, but the broad thrust and patterns can be seen in many different mountain areas and countries (Yadav 1992; Hagos and Pender 1999; Delgado et al. 1999; Tulachan and Neupane 1999).

The above list can be illustrated with many examples. For the purposes of this chapter, we have selected examples showing situations in which livestock production plays a crucial role in promoting and harnessing the complementarities. These are summarised in Table 3.2. The main aim is to identify shifts in the complementarities and their causative factors that are affecting the role of traditional livestock production systems in mountain areas.

The Changing Scenarios: Emerging Imbalances

Traditional livestock production systems acquired their prominent position in mountain areas as a result of their central role in promoting and harnessing the complementarities described above. Thus, if there are changes in the factors and processes creating the above complementarities, the role and importance of the livestock production systems in mountain areas will also be affected. Similarly, if the structure and function of the livestock production systems are altered, this will affect their dependence on and contribution to the different complementarities. For example, the complementarity between extensive and intensive land use is reduced through intensive cropping supported by increased

Table 3.2: Livestock production as a promoter and user of multiple complementarities in mountain areas¹

Complementarities that are strengthened and used by traditional livestock production systems	Factors and processes causing a breakdown of the complementarities
<p>Convergence between the situations determined by the specific characteristics of mountain areas and features of livestock production systems (see Table 3.1)</p> <p><u>Manifested in</u> production and consumption systems focusing on local resource use, regeneration, recycling, diversification and interlinkages, crop-fallow rotation, and low resource-use intensity that are conducive to and supported by livestock based mixed farming</p>	<p>Improved accessibility; lower land per person and land:livestock ratios; intensification of resource use; reduction in diversification; changes in niche opportunities</p> <p><u>Consequences</u> Reduced dependence on local resources and inputs, accompanied by a reduced need for recycling; reduced diversification; shift from subsistence to market orientation; changes in livestock management systems; demand-driven changes</p>
<p>Mutual satisfaction of environmental concerns and livelihood security through production practices and institutional arrangements for extensive, but productive, land use</p> <p><u>Ensured by</u> balancing intensive and extensive land uses; farming-forestry livestock links; diversified, biomass dominated, production systems; the role of livestock in facilitating and harnessing the above</p>	<p>Increased pressure on resources; priority of short-term production gains over conservation; public interventions delinking livelihood security from environmental stability</p> <p><u>Consequences</u> Reduced role of biomass and grazing-based livestock production systems; increased use of external inputs; availability of other sources of sustenance; emerging narrow specialisation</p>
<p>Complementarities between CPR and PPR based activities</p> <p><u>Manifested by</u> moisture and nutrient flows from CPRs as support lands for private crop lands and a source of fodder for draught animals; complementary use of annual and perennial plants; supplementary employment and income from other CPR products; crop-fallow rotation; livestock productively helping in facilitating the above links</p>	<p>Land distribution policies and other interventions leading to a decline in CPRs and traditional management systems, and availability of alternatives that substitute CPR functions</p> <p><u>Consequences</u> Decline in both the area and productivity of the grazing base for livestock causing shifts in management practices that are reflected in the changed size and composition of animal holdings; increased stall feeding; use of external inputs; and changed economics of livestock farming</p>
<p>Complementarities between seasonally and spatially varied activities to make use of resource diversity</p> <p><u>Manifested by</u> different land uses and different crops in different seasons; different categories of animals with grazing rotations and seasonal migration; the role of animals as both an asset and a source of income to meet seasonal variability and risks</p>	<p>With the changed economic and institutional situation, availability of substitutes for traditional strategies (like diversification) to meet variability and risk and to harness diverse opportunities</p> <p><u>Consequences</u> Role and operation of livestock production systems changed, focus on livestock as a source of perennial income insurance; reduced seasonal variability in animal production as a result of intensive management practices</p>

¹Based on inferences from different studies cited in this chapter.

external inputs, or a reduction in crop-fallow rotations, and this will lead to marginalisation of the role of livestock in productively balancing extensive and intensive land use. Similarly, if the livestock production system is transformed by intensive management and, for example, increased use of processed external feed, the system will become less dependent on extensive grazing and local biomass (a dependence which is helpful for productively balancing conservation and production needs).

The types of changes outlined above appear to be taking place in a number of more accessible mountain areas (Tulachan and Neupane 1999). They are leading to changes in the nature and magnitude of the factors and processes that create and require the described complementarities, and this in turn is influencing the traditional role and importance of livestock production systems in these areas. At the same time, the structure and functions of the livestock systems themselves are slowly changing, which is tending to reduce both their dependence on and contributions to various complementarities. In the following, I will describe some of these changes in more detail as a basis for identifying the future directions for livestock development strategies in mountain areas. First I will summarise changes in the objective circumstances that affect traditional livestock farming and production systems, and then I will focus on the implications.

- The falling degree of convergence between the situations determined by the specific characteristics of mountain areas and features of livestock production and farming systems

There has been an increase in the intensity of land use, at the cost of diversification, as a result of improved accessibility and the associated market linkages, public interventions, and population growth. As a result several systems of resource use in mountain areas in which livestock occupied a prime place have been marginalised or discarded. These include the primacy of local resources in production and consumption (resulting from the semi-closed situation), and the associated focus on such things as diversified interlinked enterprises, resource regeneration, and recycling. There has been a marginal shift from a subsistence orientation to a market orientation of activities, with production of horticultural and other high-value crops as well as livestock. The changes in livestock production can be seen in terms of the changing size and composition of animal holdings, feeding practices, the use of external inputs, output disposal patterns, and an overall decline in the dependence of livestock on complementarities.

- Decline of environmental concerns and common property resources

Livestock farming has been both a facilitator and a user of the complementarities between the activities and practices related to environmental protection and securing livelihoods on the one hand and CPR-PPR based activities on the other. These

complementarities are manifested in the balancing of intensive and extensive land-use systems, seasonally and spatially diversified land-based activities, the use of commons as support lands for nutrient and moisture flows for crop lands, the existence of supplementary sources of biomass for fuel and fodder, and the generation of income and employment.

Following the introduction of various land distribution policies and related public interventions, with programmes encouraging land-use intensification and a greater focus on short-term production gains compared to resource conservation, local concern for environmental resources has declined. This has led to a decline in the **availability and extent** of CPRs and shrinkage of the resource base for livestock (Jodha and Shrestha 1990). At the same time, the changes in livestock production systems (holding size, composition, input structure and output destinations, intensive management practices) have reduced the need for local biomass and its regeneration or recycling for livestock production.

- **Changing motives and mechanisms**

The changes indicated above reflect aspects of an overall transformation process that has characterised mountain economies and societies in recent decades and is a response to the gradual changes in objective circumstances in mountain areas resulting from their increased physical, administrative, and market integration with the outside world. The goals, structure, and function of production, consumption, and exchange activities (including those involving livestock) are slowly changing. Some of these changes may not be fully compatible with the traditional patterns of resource use and the role of livestock production systems therein. At the same time restoration of the traditional patterns may not be possible in the rapidly changing context. In order to retain the benefits of the traditional systems in the changed context, future strategies for livestock development in mountain areas should focus on the rationale of the traditional arrangements rather than their specific forms or practices (which are rooted in subsistence-oriented low productivity systems) and try to integrate these into new approaches to livestock development. It is helpful to look first at the comparative features of the traditional and newly emerging livestock production systems in mountain areas (Table 3.3).

Harnessing the Emerging Trends

Table 4.3 broadly summarises the emerging changes associated with livestock production in the mixed farming context in mountain areas. Various field-level studies (Jodha and Shrestha 1990; Negi 1990; Saini et al. 1996; Chand 1996; Tulachan and Neupane 1999) document these changes in different parts of the HKH region. The key inferences from these changes, which form the basis for thinking about future livestock development strategies, are summarised in Table 3.4 and discussed in more detail below.

Table 3.3: Features of the traditional and new livestock production systems in mountain areas

Key features	Production systems involving livestock	
	Traditional	Modern
Key driving forces	Multiple complementarities between resource use and production systems for security of the environment and of livelihoods in a subsistence context; livestock as an integral part of mixed farming systems	Shift towards market orientation; high income-generating approach to animal production; livestock a part of mixed farming systems but with changing components and management patterns, reduced dependence on grazing
Objective circumstances	Semi-closed, subsistence-oriented adaptations to the constraints and opportunities created by the mountain conditions, livestock as a part of the adaptation strategies	Changed circumstances in terms of the external physical and market links influence the goals, structure, functions, and management of animal-based enterprises
Structural and management aspects	Higher animal-land ratios; larger animal holdings (both as an asset and a defence against risk); mixed categories (cattle, buffalo, goats, others); high proportion of unproductive and less productive animals, high dependence on open grazing	Gradually reduced animal holdings; changed structure; smaller proportion of unproductive and less productive animals; focus on high yields; stall feeding; external, processed inputs; improved product processing and marketing
<u>Inputs</u>	Crop by-products; biomass from CPRs; limited external feed; low private costs; labour as main family input	Shift towards use of external processed feed and external services
<u>Outputs/ services</u>	Source of organic manure and draught power for farming; supplier of food, fuel, fibre, and cash income for families	Traditional contributions continued with increased emphasis on high-value products and cash income
Functions in a wider context	Key role in satisfying environmental concerns in fragile mountain areas while contributing to sustenance needs by maintaining extensive, biomass-centred land uses and contributing to resource regeneration and protection; (visible decline of above services with increased numbers and overgrazing).	Livestock emerging as a high payoff component in slowly transforming mountain economies and becoming less a part of conscious efforts towards environmental conservation; economic benefit becoming the key concern

Table 3.4: The emerging trends in livestock farming in mountain areas

Major changes	People's responses	Implications for future strategies
Reduction in grazing space, overgrazing, and resource degradation; reduced possibility of support from forests and common lands	Reduction in size of animal holdings; changes in composition of animal holdings with diversification and focus on more productive animals such as high milk yielding animals; increase in stall feeding; production of fodder crops; use of external processed feed	Need to enhance the process by promoting high productivity animals (e.g., upgrading breeds, new introductions); to improve fodder production, quality and availability of feed, and local processing of feed; to provide health facilities; to develop the infrastructure needed to support the above; and to build human capacity and organisations of producers

Table 3.4: The emerging trends in livestock farming in mountain areas (cont'd)

Major changes	People's responses	Implications for future strategies
Incompatibility between the land-extensive, local resource centred, subsistence-oriented, low productivity and earning livestock production systems and the emerging transformation process led by increased accessibility and increased desires and need for cash income following exposure to the outside world.	Market orientation, changes in management involving selection of high-yielding animals; changes in inputs and outputs; processing; and market links Focus on high payoff opportunities and value adding options; new set of complementarities (e.g., intensive livestock management and intensive high-value crops)	Need for infrastructural support systems, human skill enhancement, and support of institutional arrangements to help sustain market orientation and high level of efficiency and productivity Infrastructural, institutional and extension support and technologies for crop-animal links must be appropriate in the changed context
Focus on making livestock production an effective component of a high payoff mix of family enterprises	Changed management and choice of animals and inputs; demand-driven outputs; processing and marketing through group activities	Need to integrate high payoff crop and fodder varieties and high payoff animal enterprises, and to evolve new forms of complementarities
Non-viability and reduced efficacy of practices based on natural biomass and centred on local resources only	General indifference towards and disregard of traditional practices focused on natural biomass and environmental concerns	Need to search for positive environmental elements in the new systems (complementarities between the systems and environmental needs)

Shrinking grazing space

The traditional resource base, that is the grazing area for livestock, is shrinking rapidly as a result of the rising population and the extension of crop growing to areas hitherto occupied by grass and shrubs. This trend will lead to further degradation of the remaining grazing land unless the actual amount of grazing is reduced, either by lowering the number of livestock or increasing stall feeding. Evidence from the field shows that farmers are slowly beginning to respond to the emerging crisis in the following ways.

- Reducing the size and changing the composition of animal holdings (e.g., reducing the proportion of less productive animals like cows with low milk yields and draught animals, increasing the number of buffaloes and goats, introducing rabbits and poultry)
- Increasing the extent of stall feeding, increasing own production of fodder and feed, and using external inputs such as processed feed, nutrients, and veterinary services. These trends have been seen in several areas with better access. The intensively-managed livestock production systems have positive links with other new market-oriented components of farming systems such as horticulture, vegetable production, and planting of high-yielding fodder crops.

Future strategies should build upon these trends by strengthening the links described and improving the quality of animals and of inputs like fodder and processed feed. Promotion of quick maturing and high-yielding fodder species is an important element in the promotion of intensive livestock management systems and should be given high priority.

Emerging market orientation of livestock farming

The second major set of changes characterising mountain livestock is closely related to the above and stems from the increasing market orientation of the livestock production systems. This market orientation is reflected in such things as a 'profitability approach' to the intensive management of livestock, the increased marketing of products such as milk, the development of small, local processing units, and the use of external inputs. It is both a result and a cause of the changes indicated above and represents the farmers' response to the changing situation in mountain areas that have become accessible. These changes are a part of the overall process of transformation in mountain areas following their improved physical and market integration with wider areas.

Future livestock development strategies in mountain areas should also focus on strengthening these trends. In particular they should help ensure the viability of market-oriented livestock production systems in the competitive market context whilst ensuring that any negative environmental side effects are minimised. Some of the elements that should be given priority are

- improvement of the quality of animals (choice of animals and breeds) to ensure high productivity;
- improvement of the quantity and quality of both unprocessed and processed inputs;
- development of processing and marketing facilities and an overall infrastructural and institutional support system to overcome the constraints imposed by mountain specificities;
- promotion of the organisational and institutional arrangements and enhancement of the human capacities and skills needed to run livestock production as a modern market-oriented enterprise; and
- promotion of group action and federating arrangements involving different groups and areas (essential to overcome the limitations created by the unavoidably smaller scale of the individually-run enterprises in mountain areas).

Bypassing of environmental concerns

One important aspect of the present transformation process is a general disregard for or indifference to the environmental services offered by traditional farming systems, and in particular livestock production systems, in mountain areas. The new livestock

production systems tend to offer fewer 'environmental services'. In traditional systems, these 'services' are related to facilitation of the maintenance of fragile slopes under natural vegetation (by offering a productive use through grazing and thus reducing the likelihood of resource degrading use-intensification by growing crops); production of organic manure to maintain soil fertility; production of an alternative fuel supply (reducing the need for wood as fuel); and acting as a medium for ensuring effective farming-forestry linkages. The new market-oriented livestock production systems are still integrated in crop-livestock mixed farming, but the extent of the environmental services is generally lower. Future livestock development strategies will need to address this area of concern.

The new systems also have some positive environmental effects, however. For example, increased stall feeding is likely to reduce the pressure on overcrowded grazing land. This may help in regenerating the pastures and commons. The overall reduction in and changed composition of animal holdings (with fewer but better quality animals producing more) is likely to have a similar effect since most of the new, more-productive animals are stall fed to ensure high productivity and profitability. Stall feeding should also increase the availability of organic manure as a fertiliser for farmland.

In order to ensure that the sum of environmental effects is positive, it will be necessary to strengthen the new initiatives through infrastructural, institutional, and technological measures that make small and diversified animal holdings with intensive management (through stall feeding) more attractive and profitable options. The specific areas in which R&D can play an important role include the promotion of high-yielding, early maturing, multi-season fodder species; the promotion of fodder feed processing; and improvement in the animal breeds responsive to intensive management.

Sensitising Market Oriented Livestock Production Systems to Mountain Specificities

In order to increase the degree of compatibility between the new intensive market-oriented livestock production systems and environmental concerns, it is necessary to go beyond the issues mentioned above. One way of approaching this is to try to make the market-oriented livestock production systems sensitive to or compatible with the mountain specificities described at the beginning of this chapter. Whereas the socio-economic (including demographic and institutional) circumstances in mountain areas are changing rapidly, the basic biophysical condition of these areas has remained broadly unchanged. New developments need to be sensitive to these unchanged conditions or they may prove environmentally and economically non-sustainable. The factors that make activities more durable and productive in the mountains can be

identified and internalised on the basis of past experience and evidence (Jodha 1997). These should be taken into account when designing new livestock development strategies in mountain areas. Three important issues are discussed below.

- Diversified and interlinked resource-based activities have been a key attribute of sustainable production systems in mountain areas. In the context of market-oriented livestock systems, this would require integrating cropping, livestock, and agroforestry activities, with diversification, more intensive management, and high productivity. Intensification of only one component whilst disregarding the others might not prove sustainable. In other words, all the components of farming systems will have to be made more management intensive if the intensified livestock systems are to remain compatible with the other components. R&D has an important role to play in developing such new diversified and inter-linked production systems.
- The dependence of livestock on local resources will continue to be an important factor, notwithstanding improved accessibility and market links. Thus conservation and efficient use of resources, including recycling and processing, will continue to play an important and integral role in the management of livestock production systems. R&D efforts should be focused on the improvement of the traditional methods related to these. The quality of animals and composition of animal holdings are important when considering the efficient use of scarce resources, and an area in which R&D and institutional support can play an important role.
- The last issue relates to harnessing of gains from external links – through market and other accessibility. A number of policy and programme interventions will be necessary to ensure fuller and equitable gains from market links, and ensure there is no backlash from unequal highland-lowland economic links. These include creation of a physical infrastructure that includes processing and marketing facilities; institutional arrangements, including local ownership of local commons; group action and federating arrangements for input disposal and output supplies (including price support); and capacity building of the local communities. These changes will help in reducing the marginality and vulnerability of mountain communities while enabling them to participate in the competitive market.

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