Chapter 2

The Sustainable Development of Mountain Regions: A Paradigm Shift and New Considerations

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Introduction

At present society, and especially decision-makers, still appear not to be paying sufficient attention to the development of mountain ecosystems. After the Rio Summit it became clear that we need not only to pay much more attention to the mountains but also to follow up with concrete actions the agreements made in Chapter 13 of Agenda 21 (UNCED 1992). Researchers have organised a number of initiatives. Initially the focus was on linking efforts on a regional basis. Thus the consortium CONDESAN was successfully organised for sustainable development of the Andean ecoregion, and the East African Highland Initiative for the African highlands. Later the interregional 'Global Mountain Forum' was organised through a series of meetings involving NGOs, donor agencies, and other stakeholders. Although the scientific community has been active in following up previous agreements, there is still a need to promote a more concerted approach involving all stakeholders if effective efforts are to be made to ensure the sustainable development of mountain regions. In this paper, we describe the reasons for the urgent need to dedicate substantial research and development efforts to mountain areas, and discuss some of the collaborative research in which ILRI is currently playing a major role. The paper focuses on three topics:

- the sustainable development of mountain ecosystems, key issues, and challenges;
- some research and development experiences, with particular reference to the collaboration between ILRI and ICIMOD, CIP, farmers' associations and NGOs; and

- identification of some appropriate issues for R&D in sustainable mountain development.

The Sustainable Development of Mountain Regions: Issues and Challenges

Mountains and highlands are among the most important, but also neglected, ecosystems in the world. Some 10% of the world's population lives in mountain areas (UNCED 1992, Chapter 13), more than half of these in the Hindu Kush-Himalayas, Andes, and African Highlands. Survival of these people and the cultures they represent is dependent on the effective management of the natural resources in the mountain ecosystems. At the same time, this natural resource management affects vastly more people than those just living in the mountains. More than half the world's population is dependent on mountain resources in some form. Mountain and highland areas are a source of food and other agricultural and livestock products, and of water, energy, timber, and mineral resources, as well as being a major repository of the world's biodiversity.

Mountain ecosystems have certain characteristics resulting from their topography and altitude. In the Andes these have been described as follows (Tapia 1996).

- *Complexity* — mountain ecosystems are complex, in the Andes alone six sub-regions and eighteen ecological zones can be found in the area above 1,500 masl.
- *Diversity* – of the 103 life zones that exist in the world, 60 are present in the Peruvian highlands, indicating the enormous diversity of mountain ecosystems.
- *Lack of accessibility* — mountain regions generally have poor access and act as barriers to the transit of people and goods. This lack of accessibility is related to their high altitude and difficult topography, which hinder the development of transport infrastructure such as roads, railways, and airports.
- *Fragility* — mountain ecosystems are often fragile and particularly prone to soil erosion.

These characteristics are not limited to the Andean Region, rather they are typical of all mountain areas. The problem of soil loss, for example, is common to all mountain areas. In the East African Highlands of Ethiopia it is estimated that about 2.5 million cubic metres of soil is lost per annum. If this trend continues, over one-third of the farmland, belonging to 10 million farmers, will be denuded by 2010. The loss of soil is aggravated by the removal of manure, which is used as fuel for cooking purposes, which in turn contributes to loss of soil fertility. Lack of alternative energy sources for cooking such as electricity or gas, is another critical issue, in Ethiopia as elsewhere. The result of this soil erosion and loss of soil fertility is that agricultural production in Ethiopia is decreasing by 3% per annum, at a time when the population is

increasing by 2.9% per annum. This is a dramatic situation, and one indication of why we need to pay more attention to mountain ecosystems.

Another important characteristic of mountain regions is 'marginality', and marginalisation of the inhabitants. Policy and decision-makers based in lowland areas frequently ignore the needs of the highlands, which are often regarded as backward and unimportant. There is often a tremendous inequity between the incomes of people in the highlands and lowlands, even in countries where poverty is prevalent in all areas. Thus the per capita annual income in the Peruvian highlands is 200 dollars, whereas the national average is 1,200 dollars. In Ethiopia, where most people live in the highlands, the average annual per capita income is only 100 dollars. In Asia, some of the poorest people of the world live in the mountains. In China, 100 million people living under the absolute poverty line are inhabitants of mountainous regions. There is a negative cycle linking natural resource degradation, low agricultural productivity, poverty-driven migration, malnutrition (in particular of women and children), limited education, and poor health which can lead to social disruption and political violence, as witnessed in several Andean countries and elsewhere. It has been estimated that 22 of 34 major armed conflicts during the last 3 years involved people living in mountain areas. Sustainable mountain development is a *sine qua non* for breaking this negative cycle and incorporating mountain regions and people into the mainstream of national and regional development.

The importance of gender issues in mountain regions has been stressed by many observers. It is estimated, for example, that in the Andean countries women produce, process, or sell up to 80% of all food. Gender issues are also important in the context of the role of livestock in mountain systems. Livestock are not only important in terms of food and fibre or wool production, they have multiple functions, many of which are particularly important for women, children, and the aged. Livestock not only provide protein and energy, they are a source of micronutrients like vitamins A and B_{12} and zinc and iron required by pregnant women and children for the normal development of learning abilities. Raising livestock is also one of the main ways in which the poor, and particularly women, can build up assets and savings to finance education, medical care, and other important household requirements. Livestock are also important for the recycling of nutrients (through the use of manure), as well as providing power for traction and a means of transport in the absence of roads and airports.

Quite frequently, research and development endeavours have failed as a result of using a sectoral and top-down approach. Holistic, multidisciplinary, participatory approaches are required. One of the key requirements of any approach is to understand the rationale of the peasants and farmers in the area targeted, which may

frequently appear to be in conflict with common academic knowledge. Failure to understand can lead us to make big mistakes in trying to improve traditional systems. For example, on first view the common practice of farmers in the Andes of cultivating down a slope and sowing a large mixture of low-yielding local potato varieties in a single plot appears technologically unsound. Academic wisdom suggests cultivating across the slope and sowing high-yielding varieties. On closer examination it is clear that the farmers' strategy is primarily concerned with reducing the high and somewhat unpredictable climatic risk by cultivating along a temperature gradient and spreading frost and moisture stress using varieties with a different stress resistance in the same plot. Once we understand what people are doing and why, we are in a better position to propose improvements. Understanding of the farmers' rationale is best achieved by using a truly participatory and unprejudiced research approach.

It is also important to realise that we quite often try to solve problems by introducing technology options without paying attention to promoting an enabling environment for these technologies. Technologies are important, but so are appropriate policies that enable the sustainable development of mountain regions.

Some Research and Development Experiences

Vertisols (heavy clay soils with very poor drainage) cover 43 million hectares of the East African Highlands. These mountain regions have high agricultural potential but the actual productivity is very low, the land is under utilised because the soils are waterlogged for several months a year so that the growing season is short and late. Cultivation is difficult, the manual labour involved creates tremendous drudgery for women and children. ILRI has been working together with the Ethiopian Agricultural Research Organization (EARO), Alemaya University, the Ministry of Agriculture, the NGO Global-2000, and ICRISAT to improve the management of this heavy clay soil. Some successful implements have been developed, such as the broad bed maker currently used by several thousand farmers. With this implement, drainage is improved and waterlogging is reduced, allowing early planting and an extension of the growing season. Yields of wheat and other grains have increased by 50-100% and two crops per year can be grown. In addition, soil conservation and fertility is improved – the better soil conditions allow legumes to fix between 50-155 kg N per ha per year – and erosion is reduced. A further advantage is that more crop residues are available as feed for livestock, an increase of 150% in the areas studied. It seems likely that the same technology can be used in similar areas in the Andes, although this has not yet been tested. This would represent a case of trans-regional technology application.

The impact of new technologies on human nutrition and health is a priority concern. In Ethiopia, ILRI has shown that households that have introduced improved cross-

bred animals have better nutritional levels, particularly of women and children, than those that have kept the traditional local cows. The evidence is provided by the existence of a reduced incidence of xeroftalmia as a result of higher intakes of Vitamin A, and fewer cases of diarrhoea in children. The improved nutrition results from the fact that more milk is produced by the crossbred cows and the women use this to increase household milk consumption and not simply to increase milk sales.

Improved nutrition does not always follow as a result of the introduction of new technologies, however, it is also necessary for informed decisions to be taken by the family, particularly the women. In Kenya a recently completed adoption study on the use of crossbred cows in the coastal region showed that households with crossbred cows had an additional income of 50 dollars per cow per month, but there was no effect on nutrition as most of the additional production was sold not consumed. Crossbred cows do not create additional labour demands for women and children. But the results suggest that educational nutrition programmes, particularly oriented to women, should be used to make people aware of the benefit of using some of their increased production to improve household nutritional status.

Recently ILRI has started a project on Agro Ecosystems Health, funded by the International Development Research Center, Canada. The project uses a participatory approach to link human needs, agriculture, and the environment. It is implemented jointly with EARO, the Ethiopian Health and Nutritional Research Institute, and various NGOs and farmer communities. It is being conducted in two watersheds in Ethiopia. The project links natural resource use with crop production, livestock production, and agro-forestry. A mathematical simulation model is used to predict the economic output of technologies, the impact on income and nutrition, and environmental impacts such as nitrogen fixation and soil conservation. Preliminary results provided by running the model without constraints indicate that current technologies can increase farmers' income by 50% but at the same time would increase soil erosion by 34%. One practical recommendation from this study is that stratification of the watershed should be used to enable incomes to be increased while at the same time reducing soil erosion. Such a stratification of land use would involve agroforestry in the upper hills, livestock production without grazing in the mid-hills, and intensive cereal production in the flatlands. This type of watershed stratification has to be based on both community organisation and policy intervention. Credit is one of the key elements in this particular scheme, it is needed to make sure that farmers have access to the improved technologies.

Some other initiatives have been implemented in other mountain areas. One such is the CONDESAN initiative in the Andean Region, which is coordinated by the International Potato Center (CIP) with strong participation by ILRI as a partner.

CONDESAN is a consortium of about 50 research and development institutions covering a wide range of partners, including international centres, national programmes, NGOs, universities, local authorities, and farmers' associations. A main theme of the CONDESAN agenda is the improved management of natural resources in the Andean eco-regions. One of the methodological approaches used is to combine social and biological sciences to improve understanding of the diverse land use systems and to propose improvements. Consultation round tables are organised with the different stakeholders in order to identify the problems and opportunities and the type of collective action required. CONDENSAN uses computer simulation models in order to assess the feasibility of proposed interventions and the potential biological, economic, social, and environmental impacts. An important aspect of its work is the analysis of policy and technology issues. The research agenda includes studies on the use of credit, on nutrient cycling in crop-livestock systems to improve soil fertility, on the reduction of the risks resulting from climate variability, and on forage availability and milk production. Some of the strategic research makes use of computer-based simulation models for *ex ante* impact analysis. The results of these analyses provide the inputs for policy research such as those related to the use of credit to promote increases in milk production and sales, household incomes, and farm assets. As an example, these studies have shown that use of a revolving credit scheme makes it possible to double the milk production per cow per day with a credit recovery rate of 92%. This information is currently being used for development projects in Ecuador.

ILRI is collaborating with several other international centres in research and development projects in mountain ecosystems. Collaboration with ICIMOD started in 1998. One of the first studies initiated was the characterisation of livestock-based systems, followed later by a rapid appraisal of market-oriented smallholder dairies. The methodology developed by ILRI in Africa is being used in three countries in the Hindu Kush-Himalayas: Nepal, Bhutan, and Northern India. We have also conducted studies to characterise trends in crossbred animals in Himachal Pradesh in Northern India.

Some Issues for Research and Development for Mountain Regions

There is a general agreement that holistic approaches are needed for effective research and development, given the complexity of social, economic, and biophysical interactions. An additional issue that must be kept in mind is that empowerment of mountain communities is an urgent requirement for development. This empowerment can result from participation, education, and information. Participation is a key issue. Quite often we try to solve the problems of others, but

first the people concerned need to identify their own problems and aspirations and consider the possibilities for working together towards solutions.

Transport infrastructure is a key requirement in mountain regions because, without access to markets, development of mountain communities will be almost impossible.

Provision of services such as energy, education, and health is critical.

Policy and technology interventions are required. Experience indicates that technology alone is not enough to promote sustainable development. Policy interventions, some other off-farm solutions, and the development of alternative livelihoods for farmers should complement the introduction of new farm technology. Production to consumption approaches are required that include value-added activities such as agro-industries. We believe that dairy production is one of the best entry points to development because of the many advantages that dairy has in producing a constant income for farmers and improved nutrition.

It is also necessary to understand mountain-lowland relations. Mountain ecosystems produce goods and services and experience demographic and social processes that have a significant spill over effect on adjacent ecoregions. For example, we need to have a much better understanding of the causes and effects of migration. Economists like to think that migration is a way of reducing the pressure on mountain ecosystems, and they look at the economic value of generating additional income for mountain people. However, migration also has social costs as people are displaced to foreign environments. The interaction between regions has to be clearly understood in order to deal with problems at the root.

A wide array of new tools is available to help us in finding solutions for problems in mountain areas, and they should be employed to the full. These new tools include geographic information systems, computer-based modelling, information and communication technologies, and better methods for participatory research and development.

In order to define a crop-livestock systems' research and development agenda, it is important to characterise the mountain ecosystems, promote the trans-regional analysis of experiences, foster community organisation and empowerment, and include gender analysis. All stakeholders, both within and outside mountain regions, should be included in a participatory manner, for if we make the mistake of not taking into consideration all stakeholders we will miss the opportunity to take effective action.

Policy for natural resource management is also critical, and our view of some resources needs to be broadened for this. For example, the narrow view sees mountain grasslands as feed for animals and ignores the role that grasslands and rangelands play in conserving the environment and rendering environmental services. We have to pay much more attention to the role that mountain grasslands play in carbon sequestration, nutrient cycling, and water capture and conservation, as well as in biodiversity conservation.

We have to work much more on developing information systems for extrapolating knowledge from one region to another. One of our proposals is to build synergies among the different institutions attending this symposium. We should not recreate initiatives, we already have some initiatives that are working well and we should use and strengthen these to avoid diluting resources. The Global Mountain Program (GMP) co-coordinated by CIP is one large umbrella that we could use in order to define a joint programme of collaboration.

We should conduct prospective studies on sustainable mountain development. Developing scenarios to analyse the consequences of not initiating immediate action is a compelling way of prompting initiatives. These studies have to be aimed to reach decision-makers as well as investors in research and development to persuade them that unless we do something we will suffer consequences, and these consequences will affect the people in the lowlands as well as those in the mountains.

We have to be much more active in raising public awareness by informing people of the costs and benefits of action and inaction in social, economic, and environmental terms.

Finally, if we do not consider the points mentioned above, we will not be able to provide proper livelihoods for future generations. And we should not forget the importance of native cultures in the mountain regions.

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