As much as 10 percent of the world's population—and a much larger percentage of the world's poor—live in mountainous regions. In Central America, the Andean region, and the Caribbean, mountainous areas are home to between 30 million and 50 million people and provide almost half of the staple foods. In the Andean countries, mountain farming accounts for about 35 percent of the land area. In Peru alone, 1.6 million hectares are under cultivation at altitudes exceeding 2000 m.

Besides those living in the mountains, a further 30 percent of the world's population is affected by, or dependent on, mountain resources. Rivers such as the Indus, Ganges, Brahmaputra, Mekong, and Yangtze, which flow from the Himalaya-Karakoram-Tibet mountain complex, provide irrigation and drinking water for a large proportion of the vast population of South and Southeast Asia.

POOREST, LEAST DEVELOPED AREAS

In most countries, the mountainous areas are the poorest and least developed. In Peru, for example, 40 percent of the population lives in the mountains but accounts for only about 16 percent of the GNP. In the High Atlas Mountains of Morocco, infant mortality is about 50 percent greater than the national average. Mountain people in developing countries are predominantly rural and depend on agriculture, although in some areas forestry, mining, and tourism are important.

Historically, mountain communities have been comparatively isolated but self-reliant. Some do, however, have trade links either with other mountain communities or with lowland communities, and may even have access to land in non-mountainous areas. Strong social cohesion and organization have been prerequisites for successful farming. In recent years, however, improved communications, migration to the cities, increasing social mobility have weakened and disrupted traditional social structures. In many parts of the world, for example, mountain terraces and irrigation systems that had been maintained for thousands of years are falling into disrepair. At the same time, expanding mountain populations in many countries are putting increasing pressure on the fragile ecosystems.

For a variety of reasons, mountain agriculture has remained a subsistence activity for the most part. Opportunities for increasing cash income are usually limited to commodities that keep well, have high value, or are easily transported. Farm holdings tend to be small and fragmented. Fields, normally small and often terraced, are expensive to maintain and offer only limited possibilities for the use of animal power or machinery.

Individual farmers often have widely dispersed fields at different altitudes, enabling them to produce a wide range of crops and animals and to spread the workload over time. In addition to their own holdings, mountain farmers generally have access to communal pastures and sometimes to communal crop lands. In Afghanistan, farmers may work the lower hills in winter, but move to temporary dwellings at higher altitudes in summer to raise crops and graze their animals.

EFFECTS OF TEMPERATURE

Mean temperature drops with increasing altitude and poses special problems for mountain agriculture. It has been estimated that in Nepal the maturity of wheat and barley is delayed by about five days for each 100 m rise in elevation. In addition, the occurrence of regular frosts at certain altitudes limits crop production. Land above this frost line is normally used only for grazing although seasonal crop production is possible in some areas. The problems of cold are often exacerbated by strong winds.

Of almost equal significance to low minimum temperatures are the large swings in temperature between day and night (diurnal variations). In parts of the Andes, for example, diurnal variation in air temperature is regularly as much as 3°C.

The extent of seasonal temperature variation depends greatly on latitude and distance from the oceans. Near the equator seasonal changes are minimal compared with latitudes farther north or south. For instance, in parts of northern Mongolia, which is on the same latitude as central Europe, monthly mean temperatures can exceed 30°C in summer and they can plummet to a chilling -50°C in winter.

The transfer of agricultural technologies
from low-elevation temperate regions to high-altitude tropical ones with the same mean temperatures is often not possible because of the extreme diurnal changes. In addition, daylength requirements of temperate plant species are often not met in the tropics, even if temperature regimes are acceptable.

Other factors affecting mountain agriculture include higher levels of solar radiation and lower atmospheric pressures. The consequences of these are not well understood.

INADEQUATE SOIL MAPS

Mountain soils are highly variable, and frequently stony and thin. Soil maps are usually inadequate; indeed, more attention could be paid to producing maps to assist in land use planning. Furthermore, many of the international soil classification systems currently in use are of limited value. It might be useful for agriculturalists to pay more attention to the often highly developed classification systems of indigenous peoples.

Dr Mario Tapia, general coordinator of the Andean Farming Systems Project in Peru, supported by IDRC and the Canadian International Development Agency, points out that farmers in mountainous areas have had to develop soil management systems adapted to highly variable weather and topography. Their livelihood depended on it.

Terracing has made it possible to cultivate steep slopes, and the development of ingenious irrigation and drainage systems, such as the “cochas” of the Andes, has enabled farmers to grow crops in otherwise impossible locations.

Population pressures have led to a widespread clearing of forests for fuel and for agriculture, and increasing numbers of animals have overgrazed many areas. Both deforestation and overgrazing have increased soil erosion, possibly the single most important hurdle to future exploitation of many mountainous regions.

Actual measurements of erosion losses are scarce. The direct effects of different factors (such as soil type, agricultural practices, animal species, and crop cover) on erosion in the world’s mountain areas are still only poorly understood. What is known is that the downstream effects of erosion—namely, silt deposition, severe flooding in the wet seasons, and lower-than-normal water levels in the dry seasons—are sometimes more serious than the effects of erosion on agriculture in the mountains themselves. Clearly, a great deal of research in this area is still needed. One promising avenue is agroforestry. Greater attention to the beneficial role and potential of trees in mountain environments could have important and far-reaching consequences. (See pages 6-9.)

Typical of mountain agricultural systems is the diversity of crops grown. In one village in Nepal and Peru it is not uncommon for villagers to have fields spanning an altitudinal range of more than 1000 m.) Crop diversity is also one of the farmer’s strategies for reducing risk in the face of a harsh and highly variable climate.

Many unique crops and animals have been selected in, and for, mountain conditions. Dr Tapia points out that in areas where meat and milk were historically scarce, the domestication of grains with a superior protein content made for a well-nourished population. Crops such as quinoa, karnilu, oca, ullucu, and mashua improved the daily diet of the Andean people. In Nepal wheat, naked barley, buckwheat, amaranthus, lathyris, peas, and lentils are widespread.

Certain livestock species and breeds are also well adapted to mountain conditions. The llama and alpaca are camels that graze in the Andes at altitudes of up to 5000 m. The hardy yak is widely distributed in mountain areas of Tibet and surrounding countries. Unfortunately, much of this diversity is rapidly being lost. The reasons are growing population pressures, an increasing demand for crops for the urban market, and competition from high-yielding modern cultivars. Indeed, the situation in many areas is considered grave. Urgent measures are being taken by various organizations to ensure these irreplaceable genetic resources are collected and maintained.

DIVERSITY REDUCES RISK

This diversity of crops, both within and between species, is partly explained by the multitude of elevation-related ecological niches in and around mountain villages. (In Nepal and Peru it is not uncommon for villagers to have fields spanning an altitudinal range of more than 1000 m.) Crop diversity is also one of the farmer’s strategies for reducing risk in the face of a harsh and highly variable climate.

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TRADITIONAL TECHNOLOGIES ENDANGERED

Over thousands of years, mountain farmers have developed technologies uniquely suited to their environment. The farming systems of the Andes, for example, are among the world’s most complex. But many traditional technologies are now in danger of being lost because of social change. They were originally efficient and able to support the existing population densities, but today, unfortunately, they cannot sustain the larger populations.

However, the possibility of using fertilizers and other inputs, as well as the introduction of new crop and livestock species and breeds, are creating new agricultural opportunities in mountain regions.

LITTLE RESEARCH AND TRAINING

The agricultural research community has generally neglected mountain areas in favour of the plains which have greater food-production potential and are often more densely populated, richer, and politically more influential. Training has followed a similar pattern, emphasizing intensive flatlands production strategies, including the use of machinery and high-input technologies. The result has been more steady economic progress in the plains than in the mountains.

In recent years IDRC has provided increasing support to research and training in mountain areas—the Andes, Ethiopia, the Nepalese mountains, and the highlands of northwestern Thailand. In the Andes, the work of an informal network of projects has helped to improve the lot of farmers in several areas by making available higher-yielding varieties of crops such as quinoa and faba beans. Although the work is still at an early stage, it has shown national governments that their research and development strategies in mountain regions need to be re-examined.

On the international level, there is an increasing recognition of the need for more research. The International Centre for Integrated Mountain Development (ICIMOD), for example, has been established to address the complex development needs of the vast Himalayan region.

Although scattered around the globe, mountain ecosystems have many features in common. The sharing of scientific information and the exchange of genetic materials could contribute substantially to their advancement. With this in mind, ICIMOD will host a workshop on mountain agriculture in early 1987, with IDRC support. Appropriately, it will be held in Kathmandu, Nepal, a lofty perch where, it is expected, the scientific panorama will be as expansive and inspiring as the visual one.

Such scientific exchanges, as well as continued government and donor support for research, should lead to more productive and stable environments for the millions of people who live in the mountainous regions of the world.

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