International Centre for Integrated Mountain Development
NEWSLETTER
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This issue of the ICIMOD Newsletter, as part of a new thematic approach (with a new look) to examining issues in sustainable mountain development in the HKH region, focusses on rangeland environments. So far, since rangelands are often remote, at high elevations, subject to harsh climates, and sparsely settled, they have largely been neglected by research and development agencies alike. Managing rangelands and planning pastoral development in the HKH region are challenging tasks. But at ICIMOD we believe there is ample opportunity to increase rangeland productivity, maintain and even enrich biodiversity, and improve the incomes and livelihoods of people dependent on rangeland resources. As a result, ICIMOD has embarked on a new programme that should bring more attention to the sustainable development of these vast areas and we are looking forward to working with our partners in the HKH and outside the region in this important field. I am grateful to our colleague, Mr. Daniel Miller, who wrote most of the rangeland articles in this issue and provided all the photographs.

Rangelands featured also high on the agenda of the meetings of the ICIMOD Board of Governors and the ICIMOD Support Group, which were held in Pokhara, Nepal, in the last week of November. Other subjects that were covered during the annual Centre's day were Tourism for Local Community Development and Soil Conservation and Soil Fertility Improvement. The Board approved the work programme and the budget for 1997 and, together with the Support Group, discussed in detail the process needed to develop the second phase of the Regional Collaborative Programme for the Sustainable Development of the Hindu Kush-Himalayas (RCP II). This is scheduled to commence in January 1999. I am also pleased to announce the appointment of five new Independent Members of the ICIMOD Board of Governors.

I hope very much that this mix of rangeland focussed articles with the regular "traditional" Centre News is to the readers' liking. Your comments will always be appreciated.

Egbert Pelinck
Director General

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RANGELANDS

Tibetan Wild Ass

Daniel Miller

RANGELANDS AND RANGE MANAGEMENT

Rangelands are defined as *"those areas of the world, which by reason of physical limitations — low and erratic precipitation, rough topography, poor drainage, or cold temperatures — are unsuited for cultivation and which are a source of forage for free ranging native and domestic animals, as well as a source of wood products, water and wildlife."*[1] This definition includes grasslands as well as shrublands and forest areas often used by grazing animals. The term '*range' implies broad, open unfenced areas over which grazing animals roam*; but as rangelands are more intensively managed, fences — once useful for distinguishing range from pasture lands — are to be found increasingly on rangelands.

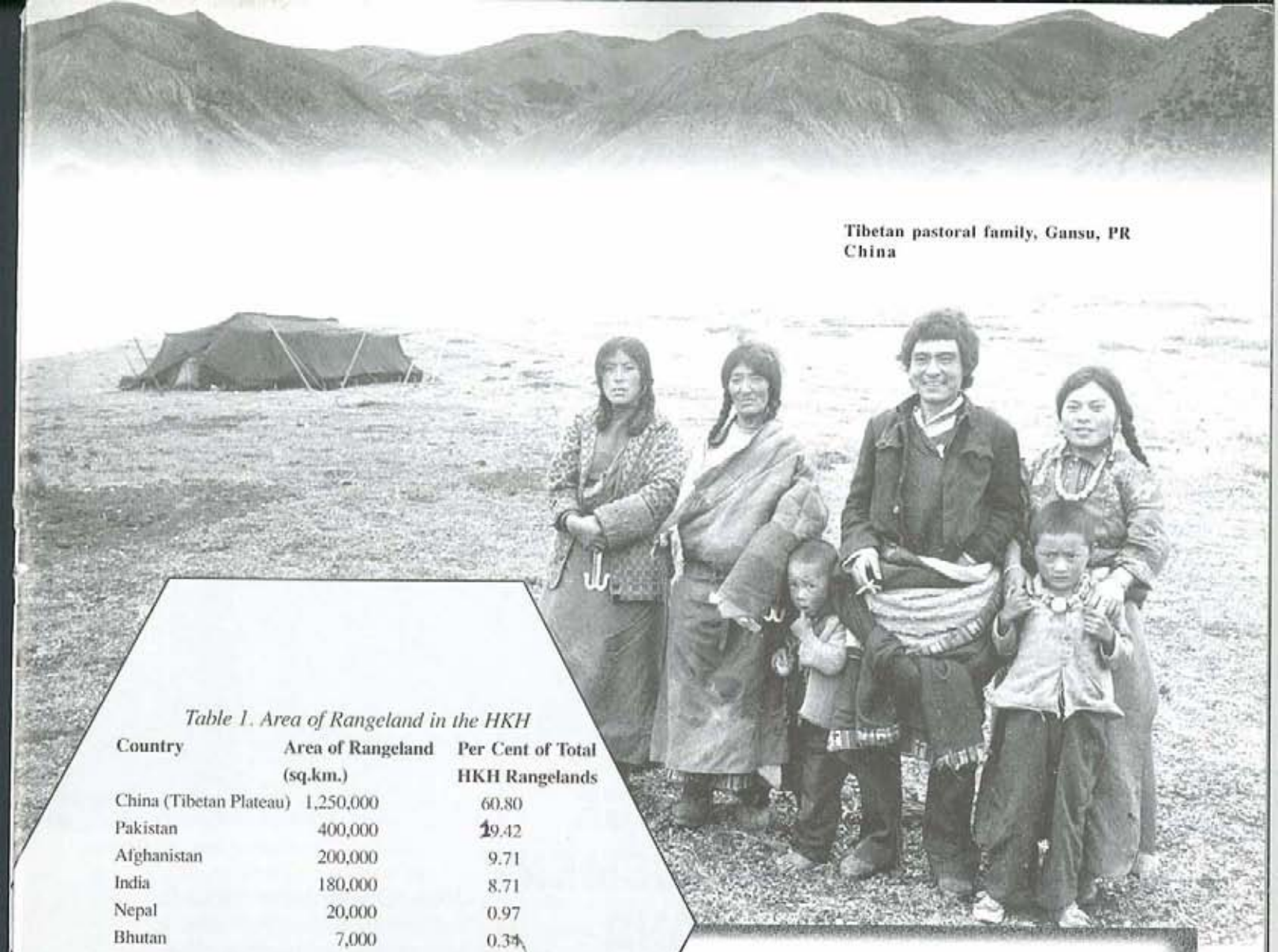
Rangeland ecosystems, in terms of land area covered (about 2 million sq.km.), encompass more territory than any other ecosystem in the Hindu Kush-Himalayan (HKH) region (see Table 1). No other ecosystem dominates the region as rangelands do. Rangelands are also unrivalled in terms of diversity. Extending from splendid, subtropical savannas in the Siwalik foothills to lush, alpine meadows in the Himalayan mountains and stretching on for 1,200 kilometres north across the spacious steppes of Tibet to the cold, dry deserts of the Kunlun mountains, the rangelands of the HKH region display a diverse assortment of plant communities, wildlife species, and various, distinct human cultural groups.

Despite their extent and importance, rangeland ecosystem dynamics in the HKH region are still poorly understood. Scientific data on ecological processes taking place throughout different rangeland types are limited, and the socioeconomic dimensions of the pastoral production systems are not well known. This lack of information limits the proper management and sustainable development of rangelands.

Range management is *"the science and art of optimising the returns from rangelands in those combinations most desired by and suitable to society through the manipulation of the range ecosystem."* Range management combines the biological, physical, and social sciences. It is biological because it deals with vegetation and the responses of animals which harvest the vegetation. It is physical because climatic, topographic, and hydrologic factors affect range use. It is social because the needs of society determine how range resources are used.

There is a tendency to emphasise the scientific aspects of range management, and, whereas science is vital, range management is more than a science. It is also an art, since range managers need to take the scientific information available and synthesise it into practical management plans. This requires the ability or perception to detect changes taking place on the rangelands and then the skill to adjust the plans to range use. This 'feel' for rangelands is what makes a good range manager and can only be acquired from spending considerable time in the rangelands, closely observing what is taking place.

Herders and horsemen, Dolpo, Nepal



Tibetan pastoral family, Gansu, PR China

Table 1. Area of Rangeland in the HKH

Country	Area of Rangeland (sq.km.)	Per Cent of Total HKH Rangelands
China (Tibetan Plateau)	1,250,000	60.80
Pakistan	400,000	19.42
Afghanistan	200,000	9.71
India	180,000	8.71
Nepal	20,000	0.97
Bhutan	7,000	0.34
Myanmar	760	0.04
Bangladesh	290	0.01
Total	2,058,050	100.00

China includes Tibet, Qinghai, Sichuan, Gansu, and Yunnan.

Why are rangelands in the HKH region important?

First, rangeland ecosystems make up the headwaters' environment for the major river systems in the region, and what takes place in these upper watersheds has far-reaching effects on downstream areas. The water from these rangelands will be of increasing importance in the future for hydropower development, as well as for agriculture based on irrigation at lower elevations. Second, rangelands provide habitats for numerous wildlife species, many of which are endangered, and for a wealth of plant species. Many plants are of medicinal value and other species may provide important genetic material for future economic use. Most of the mountain protected areas in the HKH are dominated by rangeland vegetation. Conserving the rich biological diversity of these lands is crucial for sustainable economic development, yet grazing-related issues are often the major management concern in mountain protected areas. Third, these vast grazing lands provide forage for grazing livestock. Since cultivated agriculture is not possible on the rangelands, grazing by domestic animals enables herding communities to convert otherwise unusable plant biomass into valuable animal products that are either consumed by the pastoralists themselves or sold for income. Fourth, rangeland ecosystems in the HKH region are becoming increasingly popular as tourist destinations. Tourism in mountain rangeland environments has the potential to not only improve the livelihoods of the local people, but it can also contribute to overall economic development.

1. Definitions obtained from Stodar, L.A., Smith A.D., and Box T.W. 1975. Range Management, McGraw-Hill, New York

Dancing with yaks, Dolpo, Nepal

Daniel Miller

RANGE MANAGEMENT AND PASTORALISM

NEW PERSPECTIVES AND THEIR IMPLICATIONS

Pastoralism in the Hindu Kush-Himalayan region is thousands of years old. The fact that numerous unique and, in many cases, prosperous pastoral groups remain to this day bears witness to the extraordinary diversity and resilience of the HKH rangelands, as well as to the sustainability of their resources if used wisely. In recent decades, however, many profound changes, with implications for the future of the rangelands and pastoral production systems, have taken place. These changes include the modernisation process itself, which has brought improved access and services to previously remote pastoral areas and increased demand for livestock products; the expansion of agriculture into rangelands and decrease in the amount of grazing land available; disruption in Trans-Himalayan trade networks which were often an important part of pastoral systems; and the expansion of the protected area system with increased regulations limiting livestock grazing.

These changes are transforming traditional pastoral systems and grazing use patterns on the rangelands. Keeping pace with these changes requires that those responsible for managing rangelands keep up to date with new concepts and technologies and incorporate new information as it becomes available in order to design more appropriate strategies and plans for sustainable development of rangeland resources. This article discusses some of the basic principles behind range management and outlines the new perspectives emerging on managing rangeland resources. Finally, the implications these new perceptions have on rangeland management are discussed.

Range Management Principles — Range Condition and Carrying Capacity

Since vegetation is the foundation for rangeland use, developing range management strategies and plans requires information about vegetation ecology and an understanding of rangeland ecosystem processes. Range science, which was largely developed in North America, generated principles and methods to describe the state of rangelands; rangeland management

was then based on these. One of the basic principles is range condition class, interpreted as how 'healthy' a particular range site is. This involves an assessment of the composition of vegetation at any given site and the degree of differentiation from an ideal climax plant community. The other major range management principle is carrying capacity.

The predominant management concern for rangelands is the control of rangeland degradation through the regulation of livestock numbers. The scientific basis for this concern is the concept of rangeland carrying capacity; the number of animals that can safely be allowed to graze without the range deteriorating. Carrying capacity estimates are normally based on assumptions about the impact of livestock on plants and plant succession. Heavy livestock grazing is thought to lead to a decline in range condition, and reducing or removing grazing pressure assumed plant successional processes would restore the range to its previous condition.

The science of range management adapted carrying capacity concepts to grazing systems on the rangelands. The responsibility of range managers was to try to balance livestock grazing pressure with the natural regenerative capacity of range plants. By knowing the range condition class, the proper use factor, or the amount of forage to leave to allow plant nutrients to be restored, and taking into account distance to water, slope steepness, and other factors, carrying capacities for a particular range or pasture could be determined. Livestock numbers and/or the time of year animals were allowed to graze were then manipulated to influence rangeland condition. Grazing practices normally tried to maintain or, ideally, improve range condition. This managerial approach is derived from the concepts of plant succession, rangeland condition, and carrying capacity.

New Perspectives

The relevance of these range management concepts and traditional approaches, largely developed in North America, for planning livestock use on rangelands in pastoral systems in the developing world are being questioned. It is being suggested that alternative management practices need to be designed. These concepts developed primarily in what is termed equilibrial ecosystems; areas where climatic variability is not very high, and where it was believed livestock grazing was the major factor affecting vegetation.

Ecological research in the last decade in semi-arid rangelands, where climatic variability is high and ecosystem functions very dynamic, suggests that most arid and semi-arid range ecosystems function as non-equilibrial systems. In these areas, plant growth and rangeland productivity were found to be more functions of climate than of livestock stocking rates, and the effect of livestock on range vegetation more sporadic than continuous.

In the semi-arid regions of the pastoral areas of East Africa, where much of this seminal work was carried out, it was concluded that rangeland dynamics are largely controlled by frequent drought and that the pastoral system operates far from the equilibrium most of the time. Research in the arid areas of Australia also showed that the range ecosystem was highly dynamic and climate-driven over time, and that the system was better described in terms of its variability than by an average value. Researchers concluded that the concept of carrying capacity was not very useful. Where ecosystems are highly dynamic, as is often the case in pastoral areas, accurately estimating carrying capacity proves to be difficult.

Where then do non-equilibrial dynamics occur? Some researchers have indicated that, when the coefficient of variation of annual rainfall is greater than 30 per cent, the ecosystem will generate these non-equilibrial dynamics. Others suggest that areas that receive less than 300-400mm of rainfall annually will operate as non-equilibrial systems. These are thought to be relevant estimates for the dry tropics, but it remains to be determined what rainfall levels determine non-equilibrial dynamics in dry temperate areas where diverse patterns of dynamic

behaviour may also occur. It has also been pointed out that in dry, cold regions, where grazing lands are subject to severe blizzards (e.g., Tibet) rather than, or in addition to, droughts, non-equilibrial dynamics may occur.

Another new perspective is the concept of relatively stable, multiple vegetation states with thresholds or transitions between these vegetation states. The concept differs markedly from the traditional paradigm of plant succession. In this new view, plant succession does not proceed in an orderly, directional process whereby one group or community of plant species replaces another over time until the climax vegetation is reached. Rather, vegetation changes to a certain state and then stays there instead of moving to another successive stage, even without grazing. Only some perturbation, such as fire or severe drought, will allow the vegetation to proceed to another stable state. This new concept provides a new framework for rangeland monitoring and management and offers promise for improved analyses of range condition.

Pastoral development policy throughout the world has largely adopted the 'mainstream view' which maintains that traditional pastoral practices are backward and need to be improved. In recent decades, however, pastoral production systems have been viewed more and more as a highly efficient exploitation strategy for living in a harsh environment where cultivated agriculture is not possible.

Over hundreds of years, pastoralists in the HKH region have acquired intricate ecological knowledge and understanding of the pastoral ecosystems in which they live and upon which their livestock production economies depend. Local climatic patterns and key grazing areas were recognised, allowing herders to select favourable winter ranges that provided protection from storms and sufficient forage to bring animals through times of stress. Forage plants that had special nutritive value were identified; other plant species were known for their medicinal properties or as plants to be avoided since they were poisonous. A wide diversity of livestock and grazing management techniques were employed that enabled herders to maintain the natural balance of the land they were dependent upon. Complex forms of social organisation developed within nomadic society that aided allocation of rangeland resources and, through trade networks with other societies, secured goods not available from the pastoral system.

This expanded appreciation for the complexity and ecological and economic efficacy of traditional pastoral systems is encouraging. It provides hope that the vast indigenous knowledge herders possess will be better understood and used in designing new interventions. Greater awareness of the need to understand existing pastoral systems should also help ensure that the goals and needs of pastoralists are incorporated into new programmes and that they become active participants in the development process.

Challenges for the Himalayan Region

New perspectives about the functioning of rangeland ecosystems raise interesting challenges for research and management in the HKH region. Such concepts provide a valuable framework for organising new and exciting range research programmes. Are the HKH rangelands dynamic ecosystems? Do they function as non-equilibrial systems? In parts of the Himalayas and the eastern part of the Tibetan Plateau, annual rainfall is greater than 400mm and equilibrial dynamics probably rule the system, but do the periodic snowstorms these areas are subjected to mean that non-equilibrial dynamics assert an influence? What about the drier, colder areas of northwest Tibet where rainfall is less and blizzards frequent? Will conventional methods of range management work there? Large expanses of Balochistan in Pakistan are semi-arid rangelands. Is vegetation there influenced more by variable climatic factors or livestock grazing? Can the carrying capacity concept really be adequately applied to these ecosystems?

In North America, range condition classes and carrying capacity estimates were generally derived from detailed measurements of soil types and range vegetation, combined with information on the proper use factor of key forage plants and use of the range by livestock. In the HKH region much of this information does not readily exist. Since it is difficult to estimate carrying capacity accurately in the highly dynamic ecosystems where pastoralism takes place, the relevance of the carrying capacity concept for planning livestock stocking rates in such environments is debatable. How then should range managers tackle the problem of regulating livestock numbers in pastoral areas in the Himalayan region when such information does not exist?

The difficulty of applying carrying capacity concepts means the notion of 'opportunism' is gaining favour as a management approach to livestock production in pastoral systems. An opportunistic approach, instead of considering 'average estimated carrying capacity', establishes the annual grazing strategy on that year's forage production. This allows pastoralists to adjust livestock

numbers to the spatial variability of forage, establish a better distribution of livestock to forage availability, and enable increased production. Opportunism, in this context, requires a rapid response to grazing opportunities, high herd mobility, and rapid destocking or restocking as grazing conditions change. Opportunistic strategies in pastoral systems mean that pastoralists have to capitalise on the range resources available during good seasons and to exploit outside resources during lean seasons.

Researchers have noted that, if this is the case, then the most important development intervention for pastoralists may be to reduce isolationism and forge better links between pastoralists and external resources. This means facilitating the movement of goods and livestock through trade or marketing systems and external economies which can consume and distribute products to and from pastoral areas as they become available.

Opportunistic strategies for managing livestock and range resources are not new to pastoralists. Traditional pastoral management systems in the Tibetan and Himalayan region were designed around mobility and the tracking of favourable forage conditions. Official endorsement of opportunism does not, therefore, require substantive changes in existing livestock production systems, but it does require improvements in marketing channels. By assisting in the movement of livestock and livestock products to markets, herders' incomes and access to goods can increase and their dependence upon the local pastoral environment for subsistence can decrease.

Analysis of the ecological and social processes at work is a key challenge for researchers working in pastoral ecosystems. Another important challenge will be to determine which aspects of indigenous knowledge systems and traditional pastoral strategies and techniques can be used to design new interventions. Pastoral specialists will also have to ensure that research findings are incorporated while forming new policies and development programmes.

Conclusions

Rangeland ecosystems in the HKH region are very dynamic systems. The modernisation process taking place, even in previously remote pastoral areas, is augmenting dynamic processes. Those involved with managing rangelands in the region, and they include herders, researchers, extensionists, and policy-makers, need to make the best use of the information available and new ideas emerging about rangeland ecosystems. There is also a growing acknowledgment of the need to explore beyond the conventional wisdom of many of the traditional range management concepts in order to manage rangeland resources more effectively. Some of the fresh perspectives on range ecology outlined above raise a whole new range of questions about the functioning of HKH rangelands and traditional pastoral systems. They also suggest new, creative approaches to designing more sustainable pastoral development strategies in the future.

CONSERVING BIODIVERSITY IN THE HKH RANGELANDS


Daniel Miller

The Hindu Kush-Himalayan (HKH) region, as elsewhere in the world, is experiencing an unprecedented loss of species. With each species lost, a part of the world's genetic heritage disappears. The innumerable species that make up the HKH biological diversity construct an intricate life support system upon which man relies.

The HKH rangeland environments and their biological resources play a critical role in the region's overall economic development and in people's well-being. Pastoralists rely directly on plants, water, animals, and other natural resources found in the rangelands for their livelihoods. Other people, both those residing in rangeland environments and in adjacent areas, are also directly or indirectly dependent on rangeland resources. The conservation and management of the biological diversity of HKH rangelands are essential elements in sustainable mountain development.

Rangeland Biodiversity

Stretching for 3,500km from the desert mountain steppes of Afghanistan in the west to the lush, alpine meadows in Yunnan Province of China in the eastern Himalayas, the rangeland ecosystems of the HKH encompass an enormous area, estimated to cover about two million sq. km. Within such a vast region, rangelands differ considerably in plant community structure, depending on altitude, climate, rainfall, soil, and the uses they have been subjected to by people and their animals. Each different range type has its own unique assemblage of plants and animals.

Situated at the confluence of five major biogeographical subregions — the Mediterranean and Siberian of the Palaeoarctic realm and the West Chinese, Indo-Chinese, and Indian subregions of the Oriental realm — the rangeland ecosystems of the HKH are rich in biodiversity. In terms of plants, a number of floristic regions are found in the region, and the percentage of endemics is large. In some rangelands, floral diversity is very high. For example, in alpine meadows of the central Himalayas of India and Nepal, it is not uncommon to find 30 plant species per square metre. The HKH rangelands also possess remarkable resiliency. There are numerous examples in which overgrazed ranges have recovered simply by protecting them from being grazed.

Rangelands also provide habitats for a wide variety of wildlife, especially ungulates, or large grazing mammals. From the Oriental realm came ungulate species such as takin, musk deer, goral, and serow. From the Palaeoarctic realm in Tibet came the Tibetan antelope, Tibetan gazelle, blue sheep, Tibetan wild ass, and wild yak. From the Mediterranean realm, we find ungulates like urial, markhor, argali, ibex, and red deer. The Himalayan tahr, which probably evolved in India, also inhabits the rangelands. A number of other species from the Oriental realm, more characteristic of subtropical grasslands, can also be found in low elevation rangelands: black buck, *nilgai*, swamp deer, hog deer, *chital*, gaur, sambar, and muntjac. These ungulate species, share the rangelands with a host of other birds and mammals, and a number of the ungulates are important prey species for large predators such as snow leopards, which are endangered.

When considering rangeland biodiversity, one usually thinks of flowering plants and wild animals, yet an important aspect of biological diversity is also the domestic livestock species. These animals have evolved over centuries and adapted to the varying environmental conditions. They exhibit numerous, unique adaptive traits and resistance to diseases, and these characteristics have enabled man to exploit rangeland resources.

The genetic diversity of the wild and domesticated plants and animals found in the rangelands is a valuable resource. All of the food that mankind consumes comes from them. The wildlife found on the HKH rangelands includes the wild relatives of domestic animals that have fundamentally changed

human civilisation. The genetic pool of species found may hold important keys for improving livestock, developing new crop varieties, curing disease, and numerous other benefits to mankind as yet undiscovered. Certain traits found in domestic livestock breeds may be beneficial in increasing the productivity of improved livestock. Finally, the tourist industry in the HKH region is based, in part, on the attraction of the rangelands' wildlife and magnificent mountain landscapes.

Major Issues

Conservation of biological diversity in the rangelands of the HKH is confronted with a number of issues. First, one of the main issues is the loss of wildlife habitat. Habitat loss and degradation have been especially severe on the lower elevation rangelands where human population pressure is the greatest. Much of the original rangeland ecosystem in the subtropical zone has been replaced by agriculture. Where rangelands are still found in subtropical areas they have been so disturbed by man and livestock that most of the original vegetation has disappeared. Second, with the loss and degradation of habitat, wildlife populations have also declined. The land simply cannot support wildlife any longer. Third, overexploitation of medicinal plants, especially in the alpine regions, is eroding the biological diversity. Although good data are not available, it is widely believed that in many areas, the harvesting of medicinal plants is no longer sustainable. Fourth, despite the fact that most wildlife is officially protected, illegal killing is still widespread and threatens remaining populations. Finally, the lack of information on rangeland ecological processes is a major issue. Despite their extent and importance, rangeland vegetation dynamics are not well known. Apart from a few key species, the ecology of many of the wildlife species and the interactions between wildlife and livestock are not well understood yet. This lack of data hampers the effective management of rangeland biodiversity.

Numerous protected areas have been established in the HKH region. Many of these, especially at higher elevations, encompass rangeland ecosystems, so there is hope that much of the biodiversity will be conserved. However, rangeland ecosystems of the subtropical and lower temperate zones are very poorly represented in the current protected area network. These have been the most severely affected by man, and yet, since they are centered where the greatest human population and agriculture are located in the HKH region, they may possess some of the most valuable genetic resources for improving agriculture in the future. Including representatives of these lower elevation rangeland ecosystems within a protected area system is of paramount importance.

One of the principal management concerns in protected areas in the HKH region is livestock grazing. Most of the protected areas have populations of pastoralists, who, with their livestock, have been grazing in the areas now set aside as protected areas for centuries. Protected area management plans have usually been developed without taking the needs of herders and their livestock into consideration. As a result, the complex interactions of herders and their livestock are poorly understood. Conservation of wildlife and wildlife habitat should be one of the foremost aims in protected areas, but the pastoralists as an important aspect of the cultural heritage of these areas should not be ignored. Livestock management concerns should be integrated into management plans for these areas. Overgrazing by livestock is an issue, and a serious issue in some areas, but wildlife and livestock can co-exist in many rangeland areas if a multiple-use approach is taken that considers the needs of both wildlife and livestock. Livestock grazing, if it is well managed, can actually serve to promote plant biodiversity in some rangeland areas. Developing multiple-use management plans means that much more attention

Wild yak skull, Chang Tang Wildlife Reserve, Tibet

to the needs of herders and their livestock and the active participation of pastoralists in planning and implementing conservation programmes will be needed.

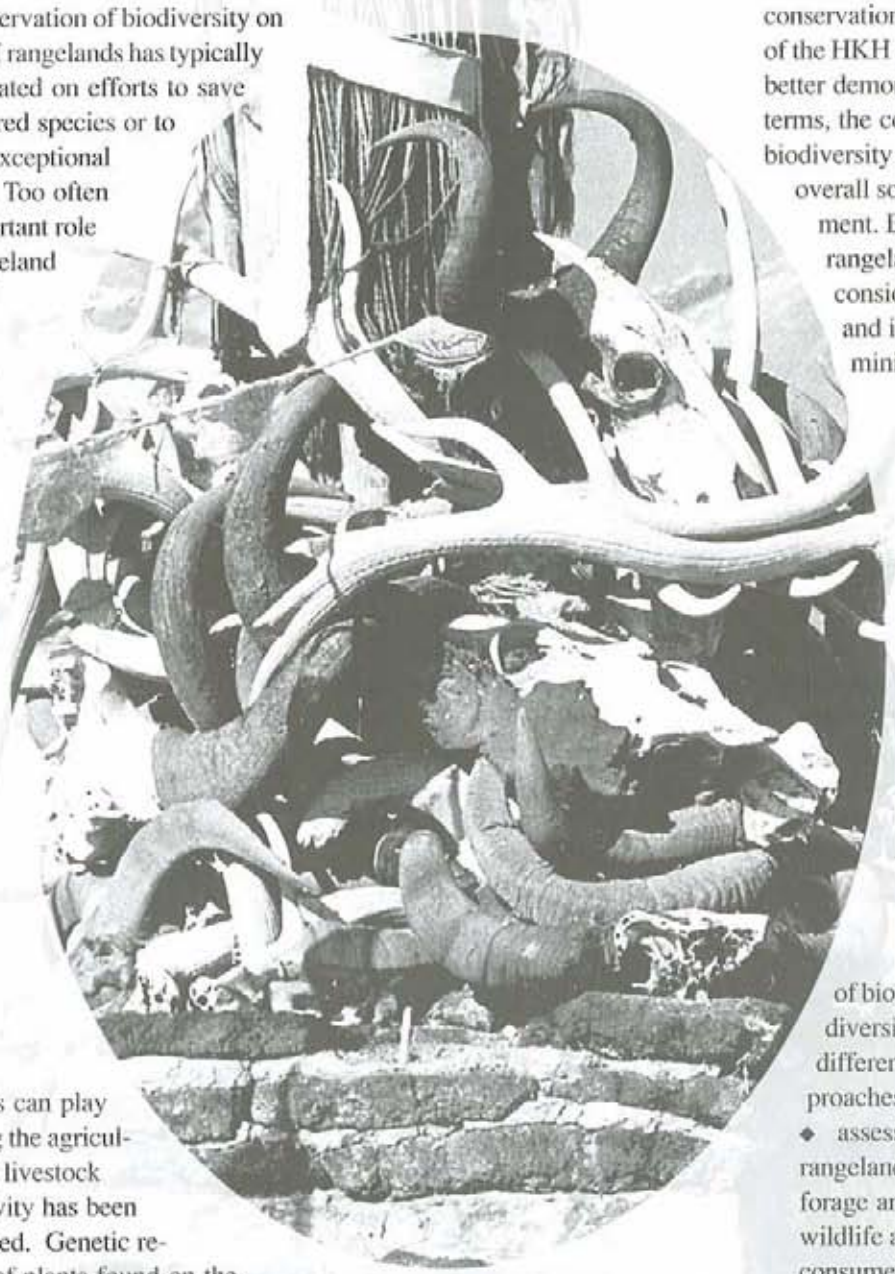
Conservation of biodiversity on the HKH rangelands has typically concentrated on efforts to save endangered species or to protect exceptional habitats. Too often the important role that rangeland resources can play in raising the agricultural and livestock productivity has been overlooked. Genetic resources of plants found on the rangelands have the potential to improve grain yields and increase forage productivity. The vast gene pool of native breeds of domestic animals can be used to improve livestock productivity. If the entire spectrum of biological diversity is to receive due consideration, conservationists will have to take a more holistic approach to managing rangeland biodiversity.

Challenges

Conserving rangeland biodiversity of the HKH is a very challenging task. Many rangeland areas are remote and working conditions are difficult. Information about basic rangeland ecology is limited, yet managers are still expected to develop management plans. Throughout the rangelands, efforts are needed to resolve grazing-related issues; a task requiring sociological skills that biologists often lack. Current policies and strategies for rangelands will also have to be refined as more information about rangeland ecology, biodiversity, and pastoral production systems becomes available.

Policies for more effective conservation of biological diversity of the HKH rangelands will have to better demonstrate, in economic terms, the contribution this biodiversity makes to the region's overall socioeconomic development. Economic valuation of rangeland resources requires consideration of both direct and indirect values. Determining the economic value of biological rangeland diversity can use three different but related approaches. They are:

- assessing the value of rangeland products — such as forage and meat, both from wildlife and livestock — that are consumed directly without passing through a market ('consumptive use value');
- assessing the value of products that are commercially harvested, such as livestock products, wildlife products, and medicinal plants ('productive use value'); and
- assessing the indirect values of ecosystem functions, such as watershed protection, regulation



Shrine to endangered species, Lho Manthang, Mustang, Nepal

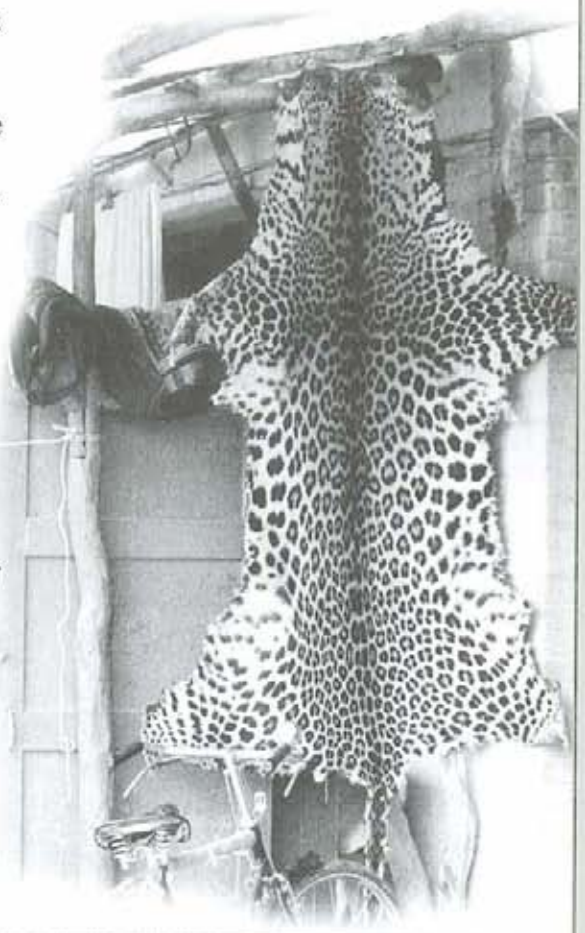
of climate, production of soil, scientific research, and birdwatching ('non-consumptive use value'), as well as the intangible values of preserving options for the future ('option value') and simply knowing that certain species exist on the rangelands ('existence value').

Assessing the benefits and costs of preserving biological resources provides a basis for determining the total value of rangeland ecosystems. Since the value of rangeland resources is often considerable, conservation of rangeland biodiversity in the HKH should be regarded as a form of economic development.

Making the case for rangeland biodiversity conservation is complicated because of the subtle nature of the rangeland ecosystem. To the untrained eye, rangelands appear to be simply dominated by an uninteresting cover of grasses. Yet, it is often the intricate differences in the rangelands that help explain ecosystemic processes. Learning to detect these subtle changes in the landscape requires acute observation and a willingness to spend considerable amounts of time in the field. Finding the time to be in the field observing ecosystemic processes, especially on remote rangelands in the HKH, is a challenge in a day and age when sitting behind a computer doing GIS (Geographic Information Systems) and remote sensing analysis is often more interesting to many people.

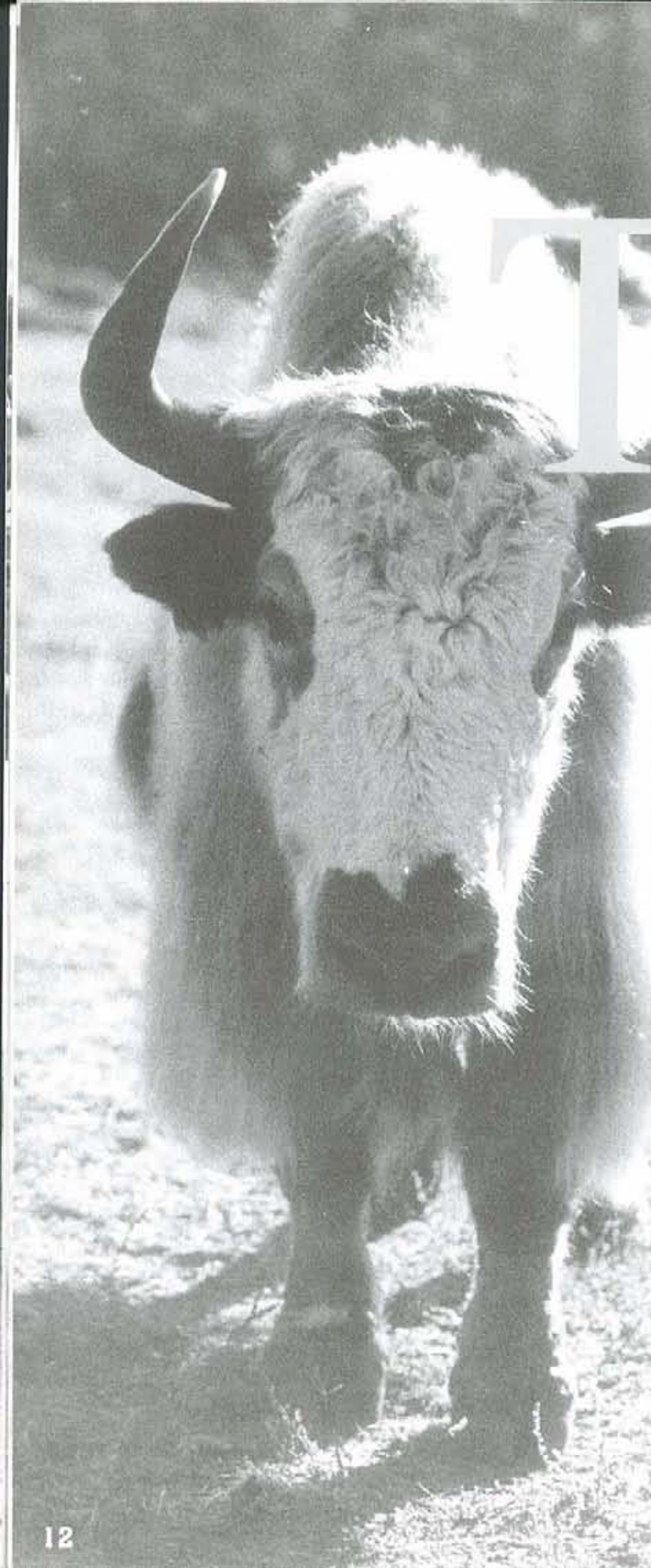
Conclusions

The fact that extraordinary wildlife populations can still be found on the HKH rangelands bears witness to the remarkable diversity and resilience of these ecosystems. Rangelands are under increasing pressure from an expanding human and livestock population, but, properly managed, they can continue to provide an essential habitat for wild plants and animals, as well as grazing land for livestock production. Conservation and development strategies for rangelands must aim to maintain the condition of the rangelands and protect biodiversity. To achieve this goal, it will be necessary to design development programmes that take the needs of wildlife and the aspirations of the local people who share the rangelands with wild animals into account. Developing such programmes requires a much better understanding of rangeland ecosystem dynamics, increased knowledge of pastoral production systems, more thorough analysis of the constraints and opportunities for improving rangeland biodiversity, and modifications in policies and current approaches to management. These actions are crucial for conserving biodiversity and ensuring sustainable pastoral development in the face of growing threats from modernisation.



Rangeland Biodiversity on the Chang Tang Wildlife Reserve in Tibet

The Chang Tang Wildlife Reserve of Tibet, encompassing about 300,000sq.km., includes one of the last, largely undisturbed rangeland ecosystems in the world and provides a habitat for numerous wildlife species, several of which are endangered and endemic to the Tibetan plateau. Rangelands in the Reserve can be categorised into three major types: alpine steppe, desert steppe, and alpine meadow. Rangelands are spatially heterogeneous, ranging from patch to landscape scales in composition and productivity. Although limited in overall plant species' richness, the rangelands are nevertheless diverse and provide a habitat for six wild ungulate species, as well as a variety of birds, small mammals, and large predators including the snow leopard and the Tibetan brown bear. The six wild ungulates include the *chiru*, or the Tibetan antelope; Tibetan gazelle; Tibetan argali; blue sheep, *kiang*, or the Tibetan wild ass; and wild yak. Tibetan gazelles are selective feeders, concentrating on forbs. Tibetan antelopes, blue sheep, and argali are mixed feeders, consuming both graminoids and forbs while, the wild yak and Tibetan wild ass consume mainly grasses and sedges. The Chang Tang is coming under increasing pressure from nomads and their livestock; illegal hunting, especially of the Tibetan antelope; and the threat of oil drilling and gold mining. Despite these pressures, the rangelands can continue to provide habitats for wildlife as well as grazing for livestock if properly managed. This will require innovative management plans that take into account the needs of the wildlife as well as the needs of Tibetan herders and their livestock.



CONSERVATION AND MANAGEMENT OF YAK GENETIC DIVERSITY

Daniel Miller & David Steane

The yak is one of the most important animals found on the rangelands of the Hindu Kush-Himalayas (HKH). Totalling about 12 million animals, yaks provide milk and milk products, meat, hair and wool, and hides and are used as pack animals and for draught purposes. Yaks also provide dung, which is used for fuel, in an environment where firewood is not available. Without the yak it is doubtful if man could survive in these harsh, high altitude grazing lands. As such, the conservation and management of yak genetic diversity are essential for the sustainable development of these rangelands.

Recently, ICIMOD, with the cooperation and support of the FAO Regional Office for Asia and the Pacific, organised a workshop in Kathmandu that brought together yak specialists from the region. The purpose was to share information about yaks and examine existing yak production systems and, specifically, to discuss measures that could be taken to improve the management and conservation of yak genetic diversity. This article highlights some of the findings from that workshop and discusses measures that could be taken to ensure that the yak's unique genetic diversity is conserved and managed as a means of improving yak production in future.

Wild Yaks and Their Conservation

Any deliberation on the conservation of yak genetic diversity must start with a discussion of wild yaks. Domestic yaks, which were first domesticated about 4,000 years ago, are descendants of the wild yaks that once roamed throughout the Tibetan Plateau. Early explorers in Tibet estimated their numbers in the millions. Currently, only an estimated 15,000 wild yaks survive, and these remnant populations can be found only in the most remote parts of the Tibetan Plateau in China, faraway from the hunters' guns.

Wild yaks are a vital ingredient to the biological diversity of the rangelands of the Tibetan Plateau. Without the wild yak, the rangeland ecosystem will have lost one of its characteristic species. No other animal so evokes the wild beauty and raw energy of the Tibetan landscape. Standing almost two metres tall, wild yak bulls can weigh up to a tonne, and their horns are so large that they are used as milk pails by nomads.

Wild yaks are not only important in terms of biodiversity, but their preservation is also imperative for improving the productivity of domestic yaks. Wild yak genetic resources are receiving increasing attention in cross-breeding programmes with domestic yaks. In China, efforts have been carried out for some years now to collect wild yak semen from captured bulls and to then artificially inseminate domestic yak cows. Research results clearly demonstrate that the offspring of wild yaks are larger and more productive. The demand for wild yak semen, both in China and in neighbouring countries, is growing.

Unfortunately, however, wild yak populations are facing considerable danger and are threatened with extinction. The greatest threat to the remaining wild yak populations is from illegal hunting. Despite the fact that wild yaks are officially protected under the Chinese wildlife protection legislation, poaching of wild yaks still takes place and wildlife authorities are ill-equipped to control hunting. With the establishment of the Chang Tang Wildlife Reserve in northern Tibet, one of the major wild yak refuges is officially protected, but other wild yak populations in Qinghai Province are still at risk. Information on the overall distribution and status of the remaining wild yak populations is also still limited. Preserving the remaining wild yak populations and developing a better understanding of their ecology should be important aspects of any strategies for conserving yak genetic diversity.

Domestic Yak Production - and Management Issues

Domestic yaks are found throughout the high altitude pastoral areas of the HKH and are an important means of livelihood. Yak production systems vary widely throughout the region. In some areas, herders maintain yaks only and, in other areas, both yaks and yak-hybrids are kept. In many instances, sheep or both sheep and goats are raised along with yaks. Whatever the case, herders, over thousands of years, have determined the optimum mix of different animal species given the environmental conditions under which they have to operate. (Figures 1 & 2) The wide range of yak production practices that exist is a testimony to the diverse animal husbandry skills Tibetan herders have acquired and the unique adaptations they have made to survive in an environment where crop agriculture is not usually possible.

Despite these adaptations and skills, yak production today faces numerous problems. Yak production systems are often constrained by inadequate forage, especially in the winter, and this leads to poor nutrition, health-related problems, and reduced fertility. In many areas, these problems are exacerbated by increasing livestock numbers, and this places more pressure on the rangelands, often leading to overgrazing.

There are now serious rangeland degradation problems in some areas, placing the yak in jeopardy. Many of the current yak breeding practices lead to inbreeding, which lowers heterozygocity, reduces fitness (poorer reproductive capacity and poorer survival), and lowers yak performance - a possible reason why the wild yak provides real improvement when crossed with the domestic breed. Although access to many yak-raising areas is improving with modernisation, yak herders are still marginalised with inadequate social services and outlets to markets for their animal products. Finally, yak production systems, and especially their socioeconomic characteristics, are still poorly

David Steane - Chief Technical Advisor, Conservation and Use of Animal Genetic Resources in Asia and the Pacific, FAO, Bangkok

Figure 1: Livestock Herd Composition (% of Total Animals) for Different Counties on the Tibetan Plateau

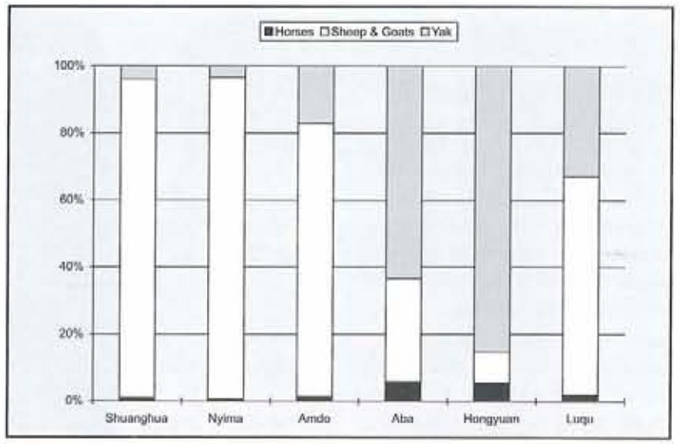
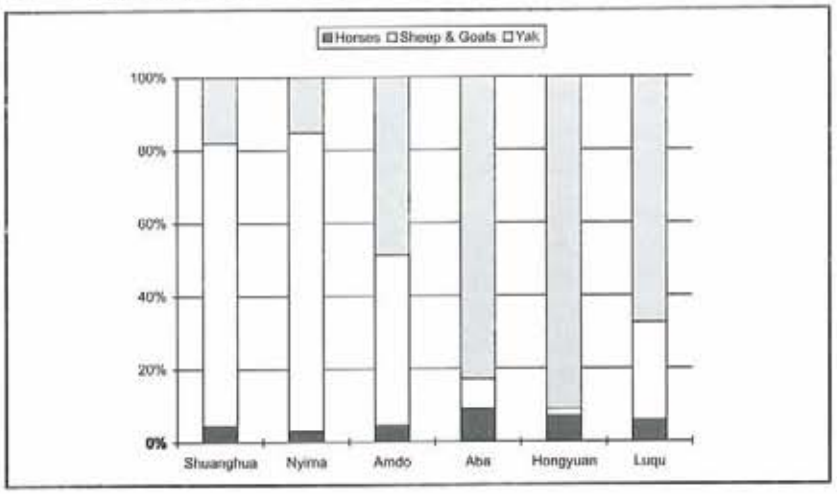


Figure 2: Livestock Herd Composition Based on Sheep Equivalent Units (% of Total Sheep Equivalent Units) for Different Counties on the Tibetan Plateau



understood by researchers and planners. This often results in inappropriate yak development programmes. All of these issues together combine to create considerable challenges to improving yak productivity.

Yak Genetic Diversity

Over the centuries, yak herders have bred yaks and developed numerous, local yak types, often recognised as distinct breeds with different characteristics. However, there is little scientific data available about the genetic variation that exists between these breeds. The existence of different yak breeds may be the solution to developing a yak conservation policy and a new genetic programme for commercial practice. One crucial research issue is that of determining if the different breeds are the key to genetic diversity.

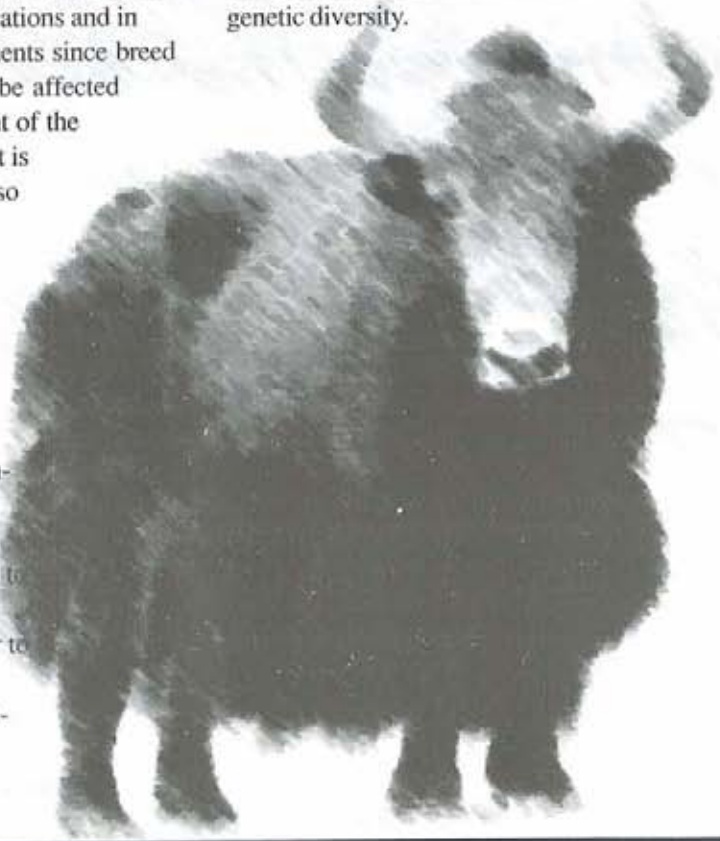
Different yak breeds exist for the most part in different areas of the vast HKH region. To date, no proper genetic comparison has ever been made between these different breeds in terms of their performance and general attributes. Therefore, it is still not known to what extent the breeds differ genetically and for which attributes. All that is known is that they appear to differ, to a greater or lesser extent, in their general appearance. It is necessary, therefore, to measure performance (milk yield, meat, and fibre), survival, and reproductive capacity among the different breeds to determine how much one breed differs from another. Research is required to compare yak breeds and crossbreeds to find out if the breeds differ genetically.

Such a programme would have to compare several yak breeds in one location under identical conditions and management. Ideally, it would be best to repeat the experiment in several locations and in different environments since breed comparisons may be affected by the environment of the location in which it is conducted. It is also essential that an experiment of this nature be long-term, lasting for at least 15 years, in order to obtain an assessment of crossbred performance and to allow pure breeds introduced into the trial to pass through one generation in order to acclimatise.

Yak breed comparisons and the crossing of yak breeds would be very valuable for identifying yak genetic diversity and would provide a scientific basis for yak genetic conservation plans and, probably more importantly, for the development of improved breeding plans for yak herders to follow. This could, eventually, lead to improvements in yak performance and hopefully even ensure the long-term survival of the yak and the yak-herding culture which it supports.

Conclusions

The yak is a unique animal endemic to the Tibetan Plateau. Conserving the remaining populations of wild yaks should be a priority consideration for biodiversity conservation programmes. Domestic yak production practices will continue to be one of the major means of supporting pastoral populations on the high altitude HKH rangelands. The demand for yak products will continue to grow as economies expand in the region. This means that greater attention to improving the management of rangelands, upon which yak production is based, is needed, and that research programmes should be introduced to assess yak genetic diversity. While yaks are not a major species globally, their presence in this unique environment is crucial to human survival and to the maintenance of genetic diversity.



PROFILES OF RANGELAND INSTITUTIONS IN THE HKH REGION

Gansu Agricultural University

Gansu Agricultural University, located on the northeastern edge of the Tibetan Plateau along the banks of the Yellow River, in Lanzhou in Gansu Province, was founded in 1946. It is one of the foremost institutes of higher learning in China for rangeland management and livestock production, giving special emphasis to pastoral systems in the Tibetan Plateau region. The University has three departments dealing with rangelands and livestock: Grassland Science, Animal Science, and Veterinary Medicine. The Grassland Science Department and the Gansu Grassland Research Institute compose the Pratacultural Institute under the University.

The Pratacultural Institute is comprised of four teaching and research sections, eight laboratories, six field experimental stations, and one seed-testing centre. The Department regularly publishes three journals in the field. It has 75 experts associated with it and is led by Professor Ren Jizhou, an academician from the Chinese Academy of Engineering, and Professor Hu Zizhi, both renowned specialists in the field of rangeland ecology and pastoral production. Scientific research conducted by the Department is acknowledged among the most prominent achievements in the rangeland field in China.

In addition to research, the Grassland Science Department has trained numerous professionals (about half of the students in this speciality in China having graduated from the Department). Since 1953 when advanced training in grasslands began, 1,300 students with BS degrees and 117 students with Masters' degrees, and 22 students with Ph.Ds have graduated from the Department. Many of the senior officials in provincial animal husbandry departments in Gansu, Qinghai, Sichuan, Yunnan, and the Tibetan Autonomous Region are graduates of Gansu Agricultural University.

The University is well established as one of the leading institutes in China for promoting sustainable development of the vast rangelands of Western China. With increased emphasis on pastoral development on the Tibetan Plateau, the University, and especially the Grassland Science Department, should play a greater role in organising research into developing improved rangeland and livestock production systems and in training future range professionals to work in the region.

Gansu Agricultural University, Anning District, Lanzhou,Gansu Province, P.R. China 730050. Tel: 0086-931-7668011. Fax: 0086-931-7668010

Arid Zone Research Centre

The Arid Zone Research Centre (AZRC) is a federal agricultural research organisation and is part of the Pakistan Agricultural Research Council's (PARC) network of agricultural support agencies with a national mandate. Established in 1974, the AZRC has its head office in Quetta, the capital of Balochistan Province, which is located in the western dry mountain region of Pakistan. The AZRC also has a network of institutes in the other three provinces of Pakistan. These institutes are located at Bahawalpur (Cholistan desert) in Punjab, at Umerkot (Thar desert) in Sind, and at Dera Ismael Khan (northern mountains) in the North West Frontier Province.

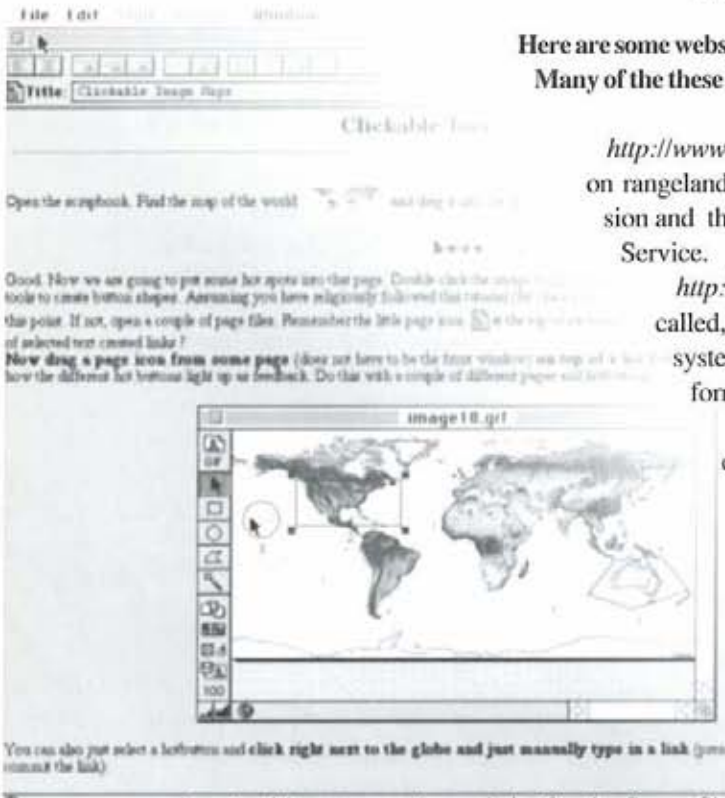
The main departments of AZRC are: i) Range-livestock ii) Dryland Crop and Water Research, iii) Agricultural Economics, and iv) Extension and Communications. The AZRC and its network institutes has a team of well-trained scientists, mostly from universities in the USA, UK, and Australia. In the area of range-livestock the centre has four Ph.Ds and one MS, while four scientists are pursuing their Ph.Ds in different overseas' universities. In the department of Crop Sciences and Water Harvesting Technology, the centre has two Ph.Ds and five MS scientists, while two are pursuing Ph.Ds in foreign universities. In Agricultural Economics, one Ph.D and three MS scientists are working, while one is pursuing his M.Phil at an overseas' university. In the department of Extension and Communications, two MS scientists are serving the centre, while one scientist is pursuing his MS at an overseas' university.

The main objective of this center is to carry out agricultural research and generate appropriate technologies for improving livestock and crop production in the arid and semi-arid areas of Pakistan. In addition, the AZRC is involved in an ongoing programme for monitoring rangeland resources.

The AZRC welcomes collaborative research programmes with national and international agencies. In addition, the centre also provides technical assistance for the development of research programmes for those institutions and agencies that are interested.

Arid Zone Research Centre, Brewery Road, Quetta, Baluchistan, Pakistan. Tel: 92 82 826728, Fax: 92 081 841006

Rangelands on the Web



Here are some websites that can be surfed for information pertaining to rangelands. Many of the these websites also contain links to other relevant sites.

http://www.ucop.edu/ahrhome/coop-ext/htoc.html - This has "fact sheets" on rangelands developed by the University of California Cooperative Extension and the U.S. Dept. of Agriculture's Natural Resources Conservation Service.

http://agronomy.ucdavis.edu/calrng/pub.htm - This is a newsletter called, "Rangeland Communities" a newsletter about rangeland ecosystems, people and management put out by the University of California Cooperative Extension.

http://cnrit.tamu.edu/SRM - website for the US-based Society for Range Management

http://www.ars.usda.gov - website for the Agricultural Research Service of the US Dept. of Agriculture

http://www.forages.css.orst.edu/ - website for the Forage Information System maintained by Oregon State University

http://www.agnic.org - website for the Agricultural Network Information Centre

http://www.ncanet.org/ - website for the US-based National Cattleman's Association

http://eol.jsc.nasa.gov/ - website for the Space Shuttle Observation Project Database of Photographic Information and Images of NASA in the USA. Excellent way to view photographs, from space, of the HKH region.

http://www.cisein.org/TG/LU/degred.html - excellent overview and background information desertification and land degradation, with lots of links to further information including several pertinent online articles uploaded by CIESIN.

http://www.sn.no/greenpeace/cunep04.html - this 1993 fact sheet from UNEP's Information Unite on Climate Change is interesting because of its focus on links between climate change and desertification.

http://www.fao.org/waicent/faoinfo/sustdev/EPdirect/EPan005.ht - more background information on desertification as a global problem, from FAO's SD - DIMENSIONS web pages.

http://www.nasm.edu:1995/ - an "electronic exhibit" on drylands, sponsored by UNEP and the Smithsonian Institute. With numerous photographs, this attractive, basic introduction to drylands' issues around the globe especially nice for children.

Forthcoming Events

The International Affairs Committee of the US-based Society for Range Management will be organising an international symposium on '*Privatisation of the World's Rangelands: Consequences for Sustainable Societies*' to be held in conjunction with the *51st Annual Meeting of the Society for Range Management* from February 8-13, 1998, in Guadalajara, Mexico. Rangeland and pastoral specialists, especially those working in developing countries, are encouraged to attend and present papers. For more information please contact Dr. Thomas Thurow, Dept. of Range Science, Texas A&M University, College Station, Texas 77843 USA, email: t-thurow@tamu.edu

The Second International Congress on Yak will be held in Xining, Qinghai Province, P.R. China from September 1-4, 1997. The Congress aims to provide a forum for delegates from yak-raising and non-yak-raising countries to discuss sustainable yak production, exchange scientific information, deepen mutual friendship and strengthen cooperation.

For more information contact: Professor Han Jianlin, Executive Secretary, International Yak Information Centre, Gansu Agricultural University, Lanzhou, Gansu 730070, P.R. China. Fax: 86-931-766-8010 or Dr. Han Xingtai, Qinghai Academy of Animal and Veterinary Sciences, No. 43 Ningzhang Rd, Xining, Qinghai 810003 P.R. China Fax: 86-971-513-5080

Key Documents on Rangelands

Bedunah, D. and Sosebee, R. (eds), 1995. *Wildland Plants: Physiological Ecology and Developmental Morphology*. Denver, Colorado: Society for Range Management

Behnke, R.; Scoones, I; and Kervin, C. (eds), 1993. *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas*. London: ODI.

Cai, L. and Wiener, G., 1996. *The Yak*. Bangkok, Thailand: FAO Regional Office for Asia and the Pacific.

Goldstein, M. and Beall, C., 1990. *Nomads of Western Tibet: The Survival of a Way of Life*. Hong Kong: Odyssey.

Jina, P.S., 1995. *High Pasturelands of Ladakh Himalaya*. New Delhi: Indus Publishing.

Mohammad, N. 1989. *Rangeland Management in Pakistan*. Kathmandu: ICIMOD.

Pearson, C. and Ison, R., 1987. *Agronomy of Grassland Systems*. Cambridge: Cambridge University Press.

Ren, J.; Zhu, T.; and Guo, B., (eds), 1986. *An Atlas of Rangeland and its Main Plant Resources on the Qinghai-Tibet Plateau*. Beijing: Agricultural Publishing House.

Sandford, S. 1983. *Management of Pastoral Development in the Third World*. London: ODI.

Schaller, G., 1977. *Mountain Monarchs: Wild Sheep and Goats of the Himalaya*. Chicago: University of Chicago Press.

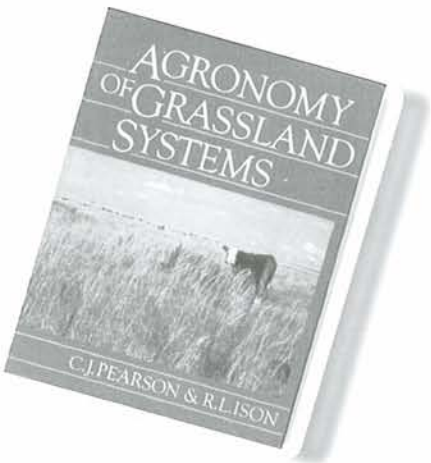
Stevens, S., 1996. *Claiming the High Ground: Sherpas, Subsistence, and Environmental Change in the Highest Himalaya*. Delhi: Motilal.

Stoddart, L., Smith, A., and Box, T., 1975. *Range Management*. New York: McGraw Hill.

Vavra, M., Laycock, W., and Pieper, R. (eds). 1994. *Ecological Implications of Livestock Herbivory in the West*. Denver, Colorado: Society for Range Management.

West, N. (ed), 1996. *Rangelands in a Sustainable Biosphere. Proceedings of the Fifth International Rangeland Congress*. Denver, Colorado: Society for Range Management.

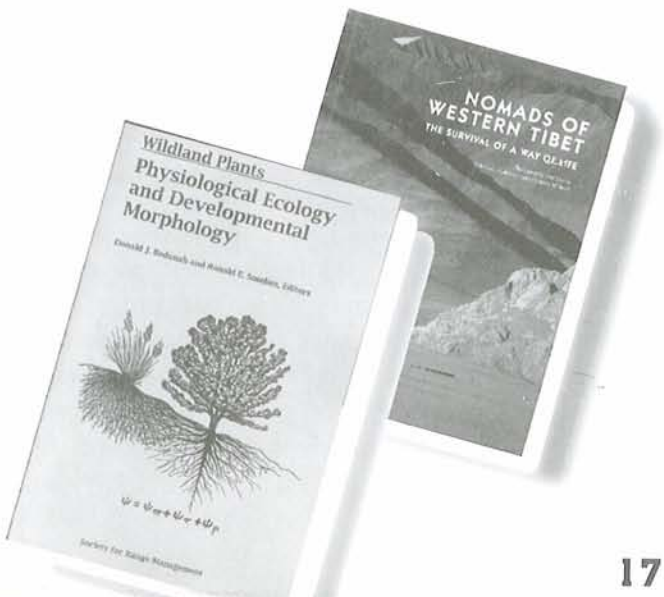
Zhang, R., Han, J., and Wu, J. (eds), 1994. *Yak Production in Central Asian Highlands*. Proceedings of the First International Congress on Yak. Lanzhou, P.R. China: Gansu Agricultural University.



Bibliography on Rangelands, Forages, Livestock and Pastoralism, ICIMOD, 1997,136 pp.

This is another among the series of Bibliographies that the ICIMOD Library has been publishing. This volume contains a total of 443 titles, including monographs, articles from books and journals, and proceedings of seminars and workshops.

All references have been arranged under specific fields of study, viz., Rangelands - Ecology, Management, and Development; Forage and Pasture Development; Tree Fodder, Agroforestry, and Fodder Development; Livestock Production, Management, and Development; and a few references under Pastoralism and Pastoral Development. They appear country-wise, beginning with countries from the Hindu Kush-Himalayan Region and then those outside the region. A short abstract of the titles included have been provided hoping that this proves to be a useful reference tool for those interested in the field.



Centre News

Second Regional Collaborative Programme

In order to ensure further relevance and utility of ICIMOD's activities, we have begun a decentralised and participatory process to plan and develop the '*Second Regional Collaborative Programme for the Sustainable Development of the Hindu Kush-Himalayas*' which will become operational from 1999 and continue until 2002. We seek to build this programme on the priorities of UNCED's Agenda 21, Chapter 13 (Fragile Ecosystems: Sustainable Mountain Development), and the development needs of the Hindu Kush-Himalayas. The RCP-II should be able to encompass critical areas in which a Centre like ICIMOD should be involved. Although questionnaires have been distributed to relevant institutions and individuals, both in the region and outside, any further inputs or suggestions or further enquiries are welcome.

Board and Support Group Meeting

The twenty-fourth Meeting of the ICIMOD Board of Governors and Sixth Meeting of the ICIMOD Support Group, took place in Pokhara, Nepal, from 25 to 29 November 1997.

ICIMOD's unique style of governance calls for a close interaction between representatives of the governments of the Regional Member Countries, Independent Members of the Board, and the donor community, represented by the ICIMOD Support Group. The meetings followed the same structure and sequence as adopted for the first time in 1996, i.e., that both groups were provided with the same type of information during an initial Centre's Day, which was followed by a meeting of the Support Group and subsequently by the meeting of the Board, which took notice of the recommendations made by the Support Group.

The most significant decision made by the Board was the appointment, at the recommendation of the Support Group, of the following five new Independent Members of the Board who will assume office during the next meeting. They are:

Prof. Zhao Qiguo	- China
Mr. R. Rajamani	- India
Dr. H. Gsanger	- Germany
Dr. (Ms) K. Inmann	- Austria
Mr. J.W.F. Cools	- The Netherlands

Other important decisions that were made were the approval of the report for 1996, the proposed work plan and budget for 1997, and the extension of the contract of the present Director General, Mr. Egbert Pelinck, until February 2000. The Board elected Mr. U Than Nwai of Myanmar as Chairman of the Board for 1997 and decided to hold its next meeting in Gilgit, Pakistan, at the kind invitation of the Goverment of Pakistan. Prior to and following the meetings, field visits were made to areas of Western Nepal, with particular focus on district-level planning, labour-intensive road construction, integrated watershed management, and village-level agricultural extension.

New Support to ICIMOD

Regional Collaborative Programme (RCP) for the Sustainable Development of the Hindu Kush-Himalayas (1995 - 1998)

The Governments of SWEDEN and FINLAND have joined the Regional Member Countries and five other European countries as principal donors to the RCP; the Government of Sweden, at an annual level of approximately $200,000 for a three year period, and the Government of Finland, at an annual level of $165,000 for a two year period. ICIMOD is also very happy with the 50% increase in the contribution of the Government of INDIA, which now stands at $45,000 per year.

Projects

The International Development Research Centre (IDRC) of Canada has approved the implementation of a new project " *Electronic Networking for Sustainable Development*". This project started from April 1997 and will have a duration of two years.

Several other short-term studies and training courses have also been approved for additional funding by the Canadian International Development Agency (CIDA) (on energy and watershed management) and by FAO (on watershed management).

Over the past four months numerous activities were undertaken in all the four mandatory activities that ICIMOD's statutes prescribe us to do: i) documentation and information exchange, ii) research, iii) training, and iv) advisory services. In the follwing pages this is reflected in the reports on workshops and seminars, the travels undertaken by ICIMOD staff in the region and beyond, recent publications, and visitors to the Centre.

Workshops, Seminars, and Training Programmes

It is no longer possible to report on all the meetings that ICIMOD is organising throughout the year. However, those of innovative character or otherwise significant are mentioned here.

"The establishment of the International Centre for Integrated Mountain Development (ICIMOD) at Kathmandu in 1983, and its very successful operation ever since as the first international organisation to address problems of mountain development, is testimony to the growing realisation that mountains are more than just silent, elevated wonders on earth. Indeed, they are money in the bank for now and all times."

Honourable Minister for Foreign Affairs, HMG/Nepal, Dr. Prakash Chandra Lohani, at the closing ceremony of the *'Dissemination Seminar on Harnessing the Eastern Himalayan Waters'*.

Electronic Networking for Sustainable Development

As an information centre, starting in April, ICIMOD embarked on a two-year project to facilitate research by improving electronic networking capabilities among institutions in Nepal and in ICIMOD's member countries. By the end of the project period the following outputs are expected.

- Consolidated research information on a joint web site
- A network of electronically-linked research and development institutions that has development information to share with others
- A demonstration 'drop in' internet site at ICIMOD

The project will assist in the building up of expertise in selected mountain research centres in the HKH countries in Internet publishing tools and technologies and on repackaging information for publication on the World Wide Web.

Contact: Shahid Akhtar, Head, DITS
e-mail: shahid@icimod.org.np

Mountain Environment and Natural Resources' Information Services (MENRIS)

The *Second Space Informatics' Seminar for Sustainable Development* with the theme of Mountain Resources' Management was held in Kathmandu, Nepal, from 2 to 6 December, 1990 in collaboration with the United Nations' Centre for Regional Development (UNCRD), the National Space Development Agency (NASDA) of Japan, and the Ministry of Population and Environment of His Majesty's Government of Nepal. The main objectives were to share experiences and information about advanced earth observation technology and its applications to mountain environment and resources' management, to discuss future strategies for promoting remote sensing and GIS, and to provide 'hands on' training to selected participants from the region.

Main Recommendations of the Space Informatics Seminar

- The annual space informatics' seminar should be continued with more focus on integration of geoinformatics and socioeconomic data.
- A ground receiving station should be constructed.
- NASDA should adjust its policy in order to distribute Japanese satellite data to users at marginal cost.
- An open data policy should be adopted.
- A decentralised Regional Information Centre should be established.
- National human and institutional communication networks should be established in the developing countries.
- More focussed, targetted, and specialised training should be continued.
- CD-ROMs with various application models using Remote Sensing and GIS should be developed for education and training.

The seminar had three parts. (1) Paper presentations and group discussions; (2) A workshop on 'hands on' training; and (3) An exhibition on state-of-the-art technology. A total of 110 participants from ICIMOD member countries and from other institutions and organisations involved in planning the seminar attended the deliberations.

Mountain Enterprises and Infrastructure

Meeting of the Mountain Tourism for Local Community Development Project was held in Kathmandu from the 3rd to the 5th of March 1997. The Meeting brought together members of the study teams from India, Nepal, and Pakistan to (i) discuss the revised case studies particularly highlighting the themes and action plans developed for the micro-case study locations, (ii) discuss and finalise the outline and framework for the four training modules elucidating how and where the case study and other material would be used, and (iii) discuss and finalise an outline of the curricula for the training indicating times allocated for each theme, purpose, and objective as well as audio-visual and other materials that will be used in the training.

As part of the project, nine micro-case studies representing different ecological zones of the Hindu Kush-Himalayas were undertaken in Nepal, India, and Pakistan. These case study materials and other studies undertaken during the first phase of the Project are being used to develop awareness and training material for four categories of target audience, namely, policy planners in tourism and related areas; programme designers and implementors of tourism-related programmes from the government, NGOs, and the private sector; local community organisations, community workers, local level NGOs, and entrepreneurs (including women); and visitors. Draft training modules were presented by the study teams, and, based on the discussions, a common framework for the development of consolidated training modules was developed as an outcome of the meeting. The country study teams will be completing the development of training modules and manuals including the training material in the next three months. The pilot training will commence from the month of June 1997.

For details of the programme please contact Dr. Pitamber Sharma, Mountain Enterprises and Infrastructure Division, ICIMOD. email: pitamber@icimod.org.np.

Mountain Natural Resources

The Hindu Kush-Himalayan Forum for Forest Conservation and Management (HIFCOM) Executive Meeting was held in New Delhi from 26 January to 1 February. The meeting was the fourth in this process which was initiated in June 1995 by the Participatory Natural Resources' Management Programme workshop in Himachal Pradesh. The HIFCOM Executive committee had last met in Kathmandu in September 1995 and this meeting in New Delhi was to review last year's progress and to evolve an action plan for the future.

It became clear that the level of interest in formalising HIFCOM remains high. However, there are several complex steps that have to be gone through before the institution becomes a reality. In addition, it is important to access funds so that the momentum which has been built up over the last eighteen months can be sustained with some practical programme activities.

Following the Meeting, some of the participants went to selected forestry institutions in Dehradun, namely, Indian Council for Forestry Research and Education (ICFRE), Indira Gandhi National Forest Academy (IGNFA), Forest Survey of India (FSI), and the Wildlife Institute of India (WII).

HIFCOM: Main Highlights

- The participants endorsed the concept of HIFCOM and agreed that it was time to formalise the mechanism as soon as possible so as to move from talk to action. The Nepal group had already drafted a constitution and had taken legal advice.
- The Mission Statement evolved at the last meeting was re-endorsed and the group evolved the main objectives of HIFCOM and also identified specific activities.
- The draft constitution was discussed in great detail and changes have been suggested.

One of the important activities of the Hindu Kush-Himalayas' Ethnobotany Programme is to organise national training workshops in each of the participating member countries. The *National Training Workshop on the Application of Ethnobotany and Community Development* for Nepal was organised in collaboration with the King Mahendra Trust for Nature Conservation and the Central Department of Botany, Tribhuvan University. It was held from January 6 to 13, 1997 in the Nepal Conservation Research and Training Centre of the KMTNC, Sauraha. For field observation, the outer Shivaliks area, north of Tadi, in the Shaktikhor Village Development Committee area, was selected. Twenty young ethnobotanists participated in the Workshop, which imparted knowledge on the following.

- Documentation of traditional botanical knowledge and ethnobotanical inventory
- Application of a systemic approach, institutional approach, participatory approach, field techniques, and community-based research on ethnobotany
- Assessment of the impact of human interaction on the use and management of plant resources
- Quantitative evaluation of botanical resources and the micro-environment
- The application of ethnobotany in the sustainable use and conservation of potential plant resources for community development

From October 24 to November 9, an advanced-level Training Programme on *Beekeeping Management and Queen Rearing* was organised at the *Krishi Nirantarta Sansthan* (Institute for Sustainable Agriculture) in Bhaktapur. Training was imparted to eight participants from the project sites at Jumla, Dadeldhura, and Bhaktapur and to four from other NGOs. Later, from 21 to 31 December, a Training Course on *Strawhive Making* was provided for 15 interested farmers at the same institution. Another training programme that focussed on *Modern Movable Frame Hive Beekeeping* was organised for 11 trainers from 10 NGOs from the far-western region from 24 to 30 December. On 14 February, a one-day *Strawhive Making* Training Programme was also organised for an Austrian visitor and a Nepali beekeeper.

A three day meeting was held from Feb. 24-26, 1997, with the researchers from *ICIMOD's Gender, Environment and Sustaibnable Livelihoods Project and UNESCO's Indigenous Knowledge, Gender and Development Project*. Present were the two project coordinators, four ICIMOD researchers, and six UNESCO researchers. The objective of the meeting was to share progress to date (the researchers also submitted their interim reports), to discuss problems or areas in which the researchers required more assistance from the research coordinators, and to determine the messages that should be conveyed in video production. Sites for shooting the footage for the video and logistical limitations were also discussed.

The group came up with an impressive list of the external factors that impinge on the traditional cultures of these indigenous mountain communities, including those that affect gender relations, and also the adaptations that communities have devised to incorporate or resist these exogenous factors. Final reports will be submitted in late July, after the completion of a writing workshop for all the researchers. The video should be completed by mid-September, 1997.

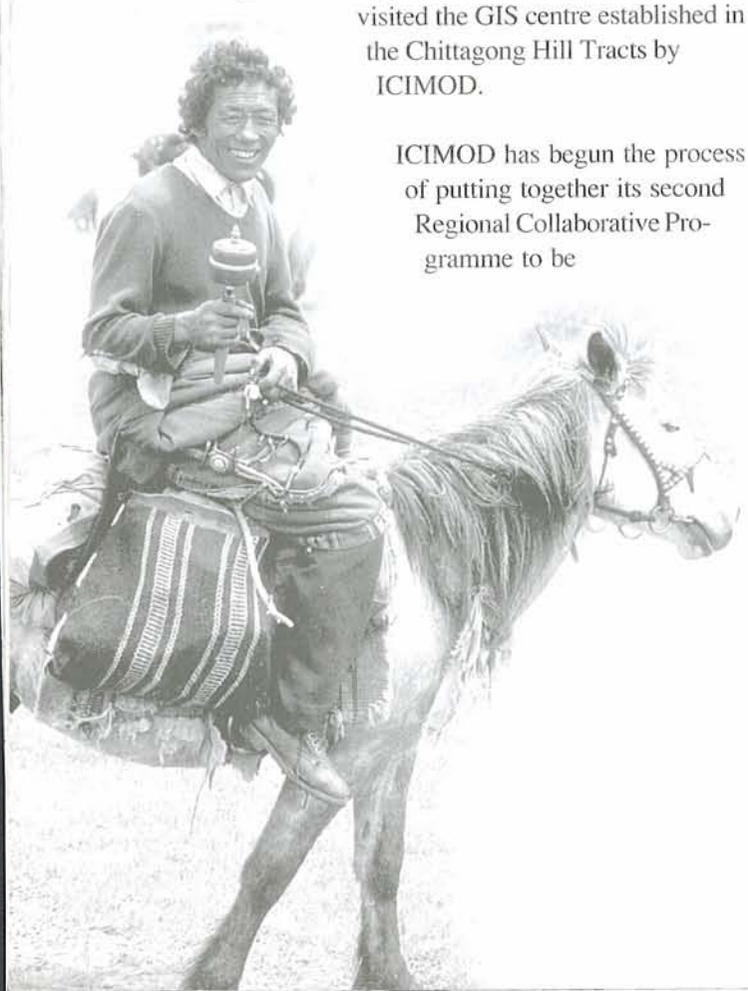
A one month internship on agrobiodiversity was undertaken for three participants: Mr. Nyima Tashi, from the Tibet Autonomus Region, China; Mr. R. K. Maikhuri of the G.B. Pant Institute in India; and Mr. D.P. Lohar of the Nepal Agricultural Research Council. The participants and staff of MFS were very pleased with the outcome of this first full-fledged internship and more are envisaged on different subjects.

TRAVEL NEWS: Broadening Linkages in the Region

BANGLADESH

From 7 to 13 November, *Dr. Tang Ya* travelled to Dhaka and Chittagong, primarily to review the progress made by the Appropriate Technologies for Soil Conserving Farming Systems' (ATSCFS) Project. He observed that the progress on and monitoring of the sites were satisfactory but that more training would benefit the extension workers, technicians, and farmers. There are 65 farm families engaged at the project site in Khagrachari. Overall, responses from both national institutions and the local people are good.

MENRIS is in the process of developing GIS databases for the Hindu Kush-Himalayas and the one on Nepal has been completed. *Mr. Birendra Bajracharya* from MENRIS visited various relevant institutions in Bangladesh from 30 January to 6 February to see what is being carried out in the field of GIS and what data are available in digital and analog form that can be incorporated into the Bangladesh database. The Local Government Engineering Department and Surface Water Modelling Centre provided digital copies of their database while others have promised to send them following a formal request from ICIMOD. He also visited the GIS centre established in the Chittagong Hill Tracts by ICIMOD.



ICIMOD has begun the process of putting together its second Regional Collaborative Programme to be implemented from the beginning of 1999. In this context, inputs in the form of questionnaires are being sought from all potential partners. From 9 to 16 February, *Dr. S. Zahir Sadeque* went to Bangladesh to follow up on this process and visited various collaborating institutions, the focal point, and relevant agencies. The overall response was very positive.

CHINA

Mr. Egbert Pelinck visited China from 24 October to 2 November, primarily to participate in the Second High-level Round Table Conference on China's Agenda 21 but also to meet the ICIMOD Board Members. The Conference discussed the progress made since the first conference as well as a revised list of priority projects. Mr. Pelinck formally indicated ICIMOD's interest in supporting 'Capacity Building for Sustainable Agriculture' and 'Establishing a GIS Facility'. He also expressed interest in 'Biodiversity Assessment and Monitoring'. The meeting was rather unique as it brought more than 50 government institutions together with donor organisations, the private sector, and some NGOs. Taking the advantage of this unique opportunity, Mr Pelinck held bilateral discussions with representatives from various organisations, both on the specific projects that were the subject of the Conference as well as on other issues related to ICIMOD.

Prof. Li Tianchi visited Yunnan and Sichuan in connection with the preparations for and initiation of the second training programme on mountain risk engineering. He also followed up on the preparations for RCP II in Sichuan and Tibet.

Prof. Pei Shengji visited Yunnan in connection with the preparation for a training course on bamboo and rattan, to be jointly organised later this year with IPGRI. He also followed up on RCP II in the Province.

In China, *Dr. Tang Ya* visited the various project sites and briefed a number of institutions on the ICIMOD ATSCFS Project. The Chengdu Institute of Biology has shown its willingness to jointly organise the final review and planning workshop of this project, while others showed a keen interest in collaboration.

INDIA

To meet the policy-makers in the Department of Forests and to explore the possibilities of programme linkages for Participatory Natural Resources' Management in the hill districts of Uttar Pradesh, *Mr. Anupam Bhatia* visited Lucknow from 22 to 26 December. He observed the recent developments that had taken place in the forestry sector. Discussions with foresters revealed an extremely high level of interest in collaborating with ICIMOD, especially in participating in the Hindu Kush-Himalayan Forum for Forest Conservation and Management (HIFCOM), in holding a Workshop on Participatory Forest Management in UP, and in organising cross visits and information exchange.

After completion of the Gender and Development Fact Finding Mission reports, *Jeannette Gurung* travelled to Sikkim and Darjeeling from 10 to 17 November in order to identify potential partner and network individuals and organisations for the Gender Capacity Building Programme. In Sikkim, the Rural Development Department expressed their keen interest to involve women more actively in their programmes, particularly those related to agriculture. In Darjeeling, it was obvious that they are very much in need of expertise on how to frame appropriate policies and programmes for mountain development.

Later in December, on her way back from Pakistan, *Jeannette Gurung* dropped by in Delhi to discuss the areas of collaboration in the context of gender issues in agriculture with the Division of Agricultural Extension, Indian Council of Agricultural Research. Discussions with the Director General led to the identification of two main areas of collaboration - building up the curriculum of the Bhubaneswar Institute, developing a similar course for the mountain regions of India, and organising orientation and training programmes for the women of these areas. Towards the end of January, *Prof. Chalise* also went to New Delhi to follow up on programme activities to be undertaken in 1997 in connection with the projects on Landslide Hazard Management and Control and HKH-FRIEND. While in Delhi he also discussed possible collaboration and participation in the Meeting on Water Harvesting to be held in China in April.

Mr. Egbert Pelinck led an ICIMOD team consisting of *Prof. Pei Shengji*, *Dr. T. Partap*, and *Dr. P. Tulachan* to North East India, where they visited Nagaland, Arunachal Pradesh, Assam, and Meghalaya. They noted great interest in closer collaboration with ICIMOD, both in the field of information exchange, exchange visits with other countries in the HKH, and the introduction of new technologies and participatory natural resources management systems as alternatives to the traditional "*jhum*" or shifting cultivation.

MYANMAR

In order to monitor the progress and provide technical support to the Eastern Himalayan Biodiversity Management Project being implemented (in collaboration with the Forest Department of the Government of Myanmar) in Myanmar, *Prof. Pei Shengji* visited the Piduang Wildlife Sanctuary in Kachin State from 17 to 20 January. Two meetings, one in Piduang Village, which was attended by about 100 villagers and the other in Malika Village attended by 15 villagers, were organised by the local project team. A PRA Orientation Training Course was also conducted at Piduang Village School for 55 participants. A training course on Research and Documentation of Indigenous Knowledge in the Context of Biodiversity Resources' Management was also conducted and a final meeting to discuss future work programmes was held with the Department of Forests. During his visit, he also attended the Planning Meeting of the ICIMOD-IPGRI Training Course on Ex Situ Conservation of the Genetic Diversity of Bamboo and Rattan.

NEPAL

From January 14 to 17, *Dr. A. A. Junejo* travelled to Butwal to hold discussions with the authorities of Development Consulting Services regarding the preparation of information manuals on Mini- and Micro-Hydropower (MMHP). One manual has already been prepared and suggestions regarding the contents of the remaining four manuals were discussed and an outline formulated. The possibility of making a video film documentary about the various aspects of MMHP plants was also discussed.

PAKISTAN

The initial activities under the second phase of the Capacity Building for Mini- and Micro- Hydropower Project were to identify focal partner agencies in each of the participating countries and to assess their capabilities, needs, and willingness to collaborate. In this connection, *Dr A. A. Junejo* travelled to Peshawar and Chitral from 11 to 17 October and visited various agencies and individuals as well as MMHP plant sites. Discussions with them have helped select potential partners and assess the level of collaboration required or forthcoming.

From 18 to 25 October, *Dr. Tang Ya* visited Pakistan to review the progress of the ATSCFS Project. He observed a marked difference between the site and the adjacent area, especially in terms of production. The local project team reported that more and more local people were visiting the site and asking for planting materials to test and apply similar approaches on their own lands. Together, *Richard Allen*, our Land Use

Planner and Soil Scientist, and *Dr. Tang Ya* visited two valleys in the Siran River region where soil erosion and fertility decline were observed to be serious. An integrated project on management of natural resources there was considered essential to help rehabilitate the area and also to help to understand issues and options for similar environments in the HKH region.

From 17 to 24 November, *Daniel Miller* visited Pakistan and travelled to Gilgit in the Northern Areas. He visited KARINA and the Aga Khan Rural Support Programme to observe potential sites for rangeland activities. In Islamabad, Mr. Miller also visited officials of the National Aridlands' Development and Research Institute.

To follow up on the work of the four researchers on the Fact-finding Mission carried out to understand the situation in terms of gender and development in Pakistan and Afghanistan, *Jeannette Gurung* and *Dr. Shaheena Malik* went to Peshawar, Quetta, Muzaffarabad, and Islamabad from 1 to 13 December. Along with information on the status of work in Pakistan, they also gathered a lot of information on Afghanistan through meetings with a number of organisations concerned with Afghanistan and by visiting the refugee camps.

From 17 to 30 December, *Prof. S.R. Chalise* visited Islamabad, Quetta, Peshawar, Swat, and Lahore to identify institutions and experts for future collaboration in the project activities pertaining to Water Harvesting, HKH-FRIEND, and Landslide Hazard Management and Control. He visited a number of institutions as well as development sites of relevance and held extremely useful discussions in terms of planning future collaborative programmes on the above issues.

An ICIMOD team, comprising of *Dr. Pitamber Sharma*, *Dr. Kamal Rijal*, *Dr. Pradeep Tulachan*, and *Dr. Shaheena Malik*, visited Pakistan in January to assess issues relating to development and environmental conditions in the mountain areas of Pakistan as inputs to the ADB consultancy on developing 'Recommendations on Sustainable Development of Mountain Areas of Pakistan'. The team held extensive discussions with relevant officials and experts in governmental and non-governmental organisations, donor agencies, research institutions, and consulting firms in Islamabad, Quetta, and Peshawar and also visited a number of development sites. The team has compiled the relevant information, and the report is being prepared.

Dr. Shaheena Malik visited Pakistan twice in connection with the preparation of a study on appropriate technologies for dry and cold areas.

Linkages Beyond the Region

The Director General, *Mr. Egbert Pelinck*, participated in a meeting of the Task Force on Chapter 13 of Agenda 21 in Italy, after which he continued to Canada, where he participated together with *Prof. Pei Shengji* in the World Conservation Congress of IUCN and chaired one of the sessions of the workshop on protected mountain areas. In Canada he also had useful meetings at the Headquarters of CIDA and IDRC.

The 5th Conference on the Technology of Effective Microorganisms (EM) was held by the Asian Pacific Natural Agricultural Network in Sara Buri, Thailand, from 8 to 12 December. *Dr Tang Ya* attended the meeting from ICIMOD. Two current ICIMOD Board members (Dr. Zafar Altaf and Dasho Dr. Kinzang Dorji) and one new independant Board Member (Prof. Zhoa Qiguo) also attended the Conference. According to the presentations made, EM has shown very promising results in compost-making, suppressing malodor, and improving the growth of crops and horticultural plants. While ICIMOD should continue testing this technology, all its consequences have to be documented over a long period before it can be widely advocated.

On his way to China on 30 December, *Dr. Tang Ya* spent two days in Bangkok meeting staff at International Board for Soil Research and Management (IBSRAM) and the Soil and Water Conservation Society to discuss technical training and soil erosion monitoring activities.

At the invitation of the Director of the Austroprojekt, *Mr. K. K. Shrestha* went to Vienna and Lunz am See from January 7 to 18. There he finalised the budget planning of the beekeeping project for 1997 and 1998. The proposal to host the next Asian Apiculture Association conference in Kathmandu during March 1998 was welcomed, and the future work activities of and requirements for the project were discussed.

In January, at IDRC's invitation, *Mr. Shahid Akhtar* visited Singapore to participate in a week-long familiarisation programme on Pan Asia Networking - a network established by IDRC in Asia that involves a whole host of countries/institutions that have projects with IDRC. It helped in the understanding of the processes involved in electronic marketing of information resources followed by PAN. He also had discussions regarding ICIMOD's project proposal on Electronic Networking submitted to IDRC. He visited the Asian Mass Communication Research and Information Centre (AMIC) which is an organisation that has extension programmes and activities throughout Asia

dealing with modern and traditional communication technology. He then went to Bangkok where he visited a number of communications and training related organisations; with which useful contacts can be made for future work in these fields.

Mr. P.B. Shah, visited Bangkok, Nan, Thailand, from 29 January to 2 February to attend the Management of Soil Erosion Conservation Consortium Assembly Meeting organised by the IBSRAM. At the Consortium, progress to date after the first consortium was presented, and a final project proposal to set up a Model Watershed for Monitoring Impacts was discussed and developed for presentation to the ADB. Reports of the site selection mission and the country reports were also presented. A field visit helped to enlighten the participants on the main biophysical and socioeconomic problems of the watershed research stations. As a follow-up, four working groups were formed to undertake specific tasks.

From 9 February to 3 March, an ICIMOD team, led by *Dr. Mahesh Banskota* and including *Dr. Tej Partap*, *Mr. Pramod Pradhan*, and *Mr. Pradeep Mool*, visited the Netherlands, France, and England, primarily to explore possibilities for short - and long-term collaboration with selected research and training organisations. In the Netherlands, after extensive interactions with the International Institute for Aerospace Survey and Earth Sciences (ITC) - a leading agency for the application of GIS and Remote Sensing- an MOU was signed for future collaboration between the two. The team also visited the International Agricultural Centre and the University of Wageningen and briefed the Ministry of Foreign Affairs on the projects being supported by the Netherlands' Government. The meeting at the centre for International Support of National Agricultural Research (ISNAR) provided a good opportunity to discuss each others' activities and to explore the possibilities for future collaboration. At UNESCO, the team discussed various ongoing programmes that had benefitted from UNESCO support. The final meeting was held with Dr. Colin Rosser, the first director of ICIMOD.

Mr. Daniel Miller attended the 50th Annual Meeting of the Society for Range Management (SRM) in Rapid City, South Dakota, USA, from February 14 to 21 and participated in the International Affairs' Committee Meeting of Society for Range Management while at the Annual Meeting. He then went to Cleveland, Ohio, and met Dr. Melvyn Goldstein, Director of the Tibet Research Centre at Case Western Reserve University.

Prof. Beek and the ITC team engaged in discussion with Dr. Banskota and the ICIMOD team

RECENT PUBLICATIONS

MNR, 1996. ***Community Forestry: The Language of Life***. Report of the First Regional Community Forestry Users' Group Workshop. Ktm, Nepal: ICIMOD. 77 pp.

The title of this document is an eloquent expression by one of the participants of how community forestry has gained importance in planning for sustainable mountain development.

The participants identified a number of key issues that would be necessary to make community forestry an effective mechanism for sustainable mountain development. These included evolving strategies for strengthening local institutions, establishing national and regional networks to increase learning and to exchange knowledge, building conceptual understanding of advocacy, and augmenting the role of community institutions in influencing policy. Strategies that will give women and the resource poor more control over natural resources' management received particular attention.

The forum went beyond being an opportunity to share experiences and identify barriers to community forestry and also evolved constructive approaches and strategies for the future.

We hope that this workshop report will be useful to a wide audience of policy-makers, practitioners, and community-based institutions in their collective goal of sustainable and equitable development of mountain areas.

H.R. Sharma, 1996. ***Mountain Agricultural Development Processes and Sustainability - Micro-level Evidence from Himachal Pradesh, Indian Himalayas*** - MFS 96/2, Ktm, Nepal: ICIMOD. 68pp.

The present study was undertaken in Kullu District of Himachal Pradesh (India) to examine the effects of mountain agricultural development processes on livelihood options and their implications on sustainability. The micro-evidence indicates that, while the process of agricultural transformation does not affect the number of livelihood options adopted by the households, their quality in terms of households and per worker earnings improves significantly. The data also show that the transformation based on harnessing the local niche, in consistency with mountain specificities, tends to be more sustainable and have positive effects on the quality of life, equity, and the natural resource base.

MENRIS, 1996. ***Application of Geographic Information Systems (GIS) and Remote Sensing (RS): Training Manual for Managers.*** (*Vols. I & II*), Ktm, Nepal: ICIMOD. Vol I, 324 pp. & Vol II, 149 pp.

MENRIS, 1996. ***Geographic Information Systems (GIS) and Their Application: Training Manual for Policy-Makers***. Ktm, Nepal: ICIMOD. 233 pp.

These two volumes and the Training Manual for Policy-makers are printed versions of training procedures used by ICIMOD's Mountain Environment and Natural Resources' Information Service (MENRIS) for GIS and RS training programme organised throughout the HKH Region.

Due to the difficult topography of mountain regions, their inaccessibility, and lack of an accurate information base, the decision-making process and implementation of development plans often do not meet the desired expectations. The inherent diversity, marginality, and varying biophysical and socioeconomic values present great impediments to the use of Geographic Information Systems (GIS). Despite widespread use of GIS in the global context, in mountain environments it is somewhat limited. The lack of experience in handling truly three-dimensional GIS, given the prevailing technology, and dearth of trained manpower and accurate multi-sectoral data hinder appropriate application.

The document highlights the usefulness of the technology as a planning tool as well as its potential applications. It emphasises the need for coordination and complementary approaches amongst institutions for database development, database standards, and exchange of information. It is expected that the manual will be able to fulfill ICIMOD/MENRIS's facilitating role for promoting information exchange on modern technologies useful for sustainable development of mountain areas.

MEI, 1997. ***Regional Experts' Meeting on the Development of Micro-Enterprises in Mountain Areas.*** Ktm, Nepal: ICIMOD. 56 pp.

This report summarises the discussions held at a meeting of regional experts held on July 25 and 26, 1996. The purpose of the meeting was to discuss the development of micro-enterprises in mountain areas, to exchange views concerning future interventions, and to examine the nature and scope of studies needed before implementing such interventions. Three focal areas of discussion are covered: i) diversification and commercialisation of mountain economies: the context of the development of micro-entreprises;

ii) nature, status, and problems of mountain enterprises: some national, sub-regional, and sectoral perspectives; and iii) women entrepreneurs and participation of women in micro-enterprises. A workplan - consisting of a programme of studies - is discussed and recommendations are given.

H. Trapp and P.K. Mool, 1997. ***Lamjung District Information System for Local Planning and Assessment of Natural Resources Using GIS and RS Technology***. Ktm, Nepal: ICIMOD. 225pp.

This paper describes a study resulting from teamwork between the Rural Development through Self-Help Promotion-Lamjung Project of HMG Nepal, German Technical Assistance, and ICIMOD to build up the district information system of Lamjung pertaining to the natural and infrastructural situations through the use of GIS and RS technologies. The ensuing database is meant to assist development planners and decision-makers to improve area-specific planning and programme monitoring.

The study provides a wealth of data not only on forest cover and land use but on infrastructure and the availability of and accessbility to services in the district. The study is illustrated by maps and has a number of useful, corroborating annexes.

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