Ecological guidelines for balanced land use, conservation and development in high mountains

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IUCN/UNEP/WWF

1977

Keywords: mountains, conservation, forests, development, tourism, recreation, land use, soil conservation, water resources, policies, guidelines.

Preface

The high mountains of the world represent one of the most extreme environments on our planet. Yet they are of immense value to mankind as sources of food, fibre, minerals and water; and they are rich in a variety of living natural resources. Though mountainous regions stand above their surroundings, usually more densely populated plains, they are linked to them in numerous ways, economically, socially and ecologically. They have the appearance of permanence and isolation; in reality they are fragile regions whose welfare is bound up with that of the adjoining regions.

These guidelines have been produced for those who have to make decisions on the development of high mountains. It is hoped that they will help ensure that the resources of such areas are used in accordance with ecological principles, and thus enabled to support, and sustain, development in the regions affected, avoiding the destruction of soils, forests, water catchments and wildlife resources which has been such a marked feature of the mismanagement of many mountain regions in recent years.

The guidelines were commissioned by the United Nations Environment Programme (UNEP) and prepared in collaboration with the International Union for Conservation of Nature and Natural Resources (IUCN) by Duncan Poore and Ray under UNEP/IUCN projects FP/11037504 and FP/11107901. Additional financial support was received from the World Wildlife Fund (WWF).

The guidelines represent the outcome of a long period of consultation, and have drawn upon the experience of IUCN over the years. The guidelines were reviewed in draft at a national conference on the Conservation of High Mountain Resources held in Canterbury, New Zealand in November 1977*, sponsored by the Government of New Zealand and organized with the support of IUCN and UNEP. At that conference many constructive suggestions were made for the improvement of the text and the draft guidelines were revised and expanded. Following the conference, the New Zealand Government

decided to use the guidelines as a basis for developing a national policy for the management of mountain areas.

IUCN, UNEP, the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the Food and Agriculture Organization of the United Nations (FAG) are members of the Ecosystem Conservation Group (ECG). Through consultation within this framework, special attention has been given to relating these guidelines to UNESCO's Man and the Biosphere (MAB) Programme on mountains.

UNEP has commissioned IUCN (under UNEP/IUCN projects FP/11037504 and FP/11107901)-the World Wildlife Fund is also providing financial support-to prepare the World Conservation Strategy, to be launched in March 1980. The Strategy is documented by accompanying Sourcebooks, the first volume of which, concerning terrestrial ecosystems, is in preparation. This volume will contain a chapter on mountain ecosystems. Publication is scheduled for 1980.

UNEP's Information Referral Service, INFOTERRA, can, on request, help governments and others identify sources of additional information relevant to land use, conservation and development in high mountain areas.

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INTRODUCTION

The main objectives of this document are to encourage those responsible for the conservation, management and development of high mountain areas to take ecological considerations into account, and to follow the principles and criteria required to achieve an environmentally sound approach to the use of these areas. High mountains in this context are considered to be those with a considerable area above the attitudinal limits to tree growth, but attention is also directed to areas below the tree line in such mountains.

High mountain areas can be found in all latitudes and in all continents. Such areas occur in many developing countries, sometimes as isolated mountains, such as in East Africa, or in massive mountain chains, such as in South America.

A pressing need in many parts of the world-including high mountain areas-is to improve the quality of life while providing the base for a stable and continuing prosperity. The speed of social and economic change presents governments with problems of unusual complexity in planning the best allocation and management of land; and these problems are further complicated by growing shortages of raw materials and rising costs of production throughout the world. In such circumstances it is tempting to make rapid capital out of resources that are readily available or to adopt forms of exploitation or use which have been successful elsewhere but have not been sufficiently tested under local conditions. It may often be unwise to do so.

Ecological knowledge can help guide development in several ways; in the better identification of opportunities to make the best long-term use of the land*; in drawing attention to situations where care must be taken if deterioration or other undesirable side effects are to be avoided; and, thus, in providing the decision maker with a more complete framework in which the lasting costs and benefits of any policy or action can be accurately estimated.

(* "Land" should be understood throughout the guidelines to include "water" except where the sense requires otherwise.)

The earlier, therefore, that ecological knowledge is taken into account, the better the use that will be made of local resources in the process of development and the less the danger of costly mistakes or long delays while projects are assessed and reformulated. Perhaps most important, the ecologist can call attention in advance to courses of action that are likely to lead to any lasting or irreversible deterioration of the resource.

The input of ecological knowledge should, therefore, be early and positive. Ecologists should be intimately associated with the formulation of national objectives and policies as well as during more detailed and technical stages

such as drafting legislation, planning the allocation of land to various uses or designing development projects. If the ecological contribution is made at these early and formative stages, its positive and constructive nature will be most evident. If, however, it is delayed until specific actions for development are actually being planned, it is very likely to contain elements of caution and constraint. Any proposal (whether for new laws or regulations or for a particular development project) should be accompanied by an assessment of its environmental impact so that unforeseen and damaging consequences may be avoided.

Public consultation is useful in ensuring that policies and decisions are based on as wide a foundation of knowledge and views as possible, while also making the public aware of the whole range of environmental issues involved. The importance of education in the broadest sense cannot be overestimated; for it is only by having a public fully alert to environmental matters and well informed about them that the operation of ecological guidelines will gain wide acceptance.

Ecological predictions can only be made on the basis of facts and these are often incompletely or imperfectly known. Research and survey are certainly necessary in some instances to provide the information necessary to take wise decisions. But there is often a temptation to collect information for its own sake and to be reluctant to take decisions on knowledge already available. The guidelines frequently stress the need for facts and the assessment of facts before taking action; this should be interpreted as meaning sufficient facts for the kind of decision to be made. This is a matter of fine judgement which can only be resolved by discussion between those who have to make the decisions and the appropriate specialists-and will vary from case to case.

Each development is in itself a form of experiment. As far as possible, therefore, each project should include provision for "monitoring"-checking at periodic intervals the way in which the development is affecting the environment and the extent to which the predictions made beforehand are justified. If well designed, this process is invaluable in assembling the facts that are necessary to improve the quality of future decisions. But monitoring can be both time consuming and costly. The procedures adopted should, therefore, be designed economically and the variables to be measured chosen with the express objective of using past experience to improve future planning.

The cardinal rules are:

WISE ALLOCATION TO VARIOUS USES

HIGH STANDARDS IN CHANGING FROM ONE USE TO ANOTHER

HIGH STANDARDS OF MANAGEMENT

Important textual note

The Guidelines are set out as follows:

The principle: in *italics*.

An explanation of the principle-where necessary

The specific guidelines derived from the above. These are numbered.

Landuse policy and allocation of land to various uses

The high mountain* regions of the world present very special opportunities for balanced land use and conservation; yet they have their own particular problems. If properly managed they can maintain a diversity of human cultures and can present opportunities for the pursuit of ways of life that cannot readily be achieved in less rigorous environments.

(* For the purpose of this document, high mountains are considered to be those with a considerable area above the attitudinal limits to tree growth, but attention is also directed to areas below the tree line in such mountains. The mountain system is considered as a whole, the parts of which will be affected by activities taking place at any altitude. Greater attention to detail is given to conditions at higher elevations, since these are unique to high mountains, whereas at lower elevations conditions approximate to those found more extensively elsewhere.)

High mountain areas are characterised by low temperatures, often with strong contrasts between day and night, causing rapid physical weathering of the rock. This, with the prevailing strong relief, leads to a dynamic environment, constantly subject to change by rock fall, avalanche, frost heaving, the action of glaciers, landslips and often, in the newer mountain chains, by geological processes such as volcanism or earthquake. Dynamism is the order of the day in high mountain areas.

Precipitation usually increases from below upwards as far as middle altitudes and then decreases higher up. Much may be as snow. Permanent snow beds and glaciers often cover large areas and the remaining ground is strongly influenced by seasonal snow beds and occasional avalanches. According to the regional climate there may be long periods of cloud cover but, when cloud is absent, radiation is usually high and rich in ultraviolet.

Because of the sharp relief and the great contrasts in altitudes, high mountain areas are very varied in local climate, topography, vegetation and animal life,

providing opportunities for many different kinds of land use in a small compass and often a natural landscape of great beauty. Biologically, they can be regarded as islands in a sea of lowlands, separated from each other by barriers across which their characteristic plants and animals have been unable to migrate. They contain, therefore, like isolated islands, an unusually high number of endemic species that is species that are found nowhere else.

Isolation has also, at least until very recently, been one of the principal influences affecting mountain peoples. Separate communities have grown up in valleys separated from one another by high passes or formidable gorges, with little opportunity for cultural or genetic interchange. Each has a particular and distinctive culture and way of life and, often, characteristic physical traits. This isolation and the hard environment have led to a high degree of self-reliance and independence of spirit.

Because they are cut off in this way, many mountain communities have been largely self supporting and labour intensive, depending to only a limited degree on external trade. The opening up of communications, which has given them access to markets, has also facilitated migration out of the mountains and opened the areas to visitors.

These changes, together with the change in expectations brought about by radio, television and increased contact with the world outside, have caused a revolution of values. As a result, most high mountain communities are in a state of rapid transition. In these circumstances it is most important that developments in these fragile environments should be guided by the best ecological judgement.

Although these guidelines are directed particularly towards high mountain regions, these are inextricably linked with adjoining lowland areas. Not only do the mountains, by their mere physical presence, influence the lowland climate, but land use in the mountains may have a marked influence on the regime of lowland rivers, on the frequency and severity of peak floods and on the deposition of silt. Furthermore, trade with the plains, communications between mountain and valley and the influx of tourists have a profound effect on the economics and social structure of mountain communities. The problems of the mountains cannot, therefore, be treated in isolation.

In any well planned development, the allocation of land for particular uses is basic. It should attempt to match objectives to the resources available; and avoid using resource capital as a substitute for income. If well done, such allocation assigns to each desirable use a proper share of the most appropriate lands available, the end result being potentially more valuable than any known alternative.

A prerequisite for this is the formulation of national objectives for the various uses to which the land is to be put. This essential step should be followed by an evaluation to determine the degree to which different land areas are suited for and will tolerate the various potential uses. This may do much to prevent conflicting claims for the use of land, and afford a positive way of developing the land to the best lasting advantage.

In this respect the importance of analyzing ecological systems cannot be overemphasized. Such analysis may include the construction of mathematical simulation models representing the ecological and physical dynamics of a high mountain related to the human actions most commonly associated with development in such areas.

Once land has been allocated and used for certain purposes, it is often, though not always, impossible to reverse the process and restore it to its earlier state. This may be because we do not know how to do so or because it is too expensive. The wise allocation of land is, therefore, of the highest importance for it will ensure the best immediate use and the least possible restriction of future use.

In this connection it may be helpful to consider the degrees of change to which the original, natural ecosystems may be subjected-as follows:

Primary, unmodified ecosystems (i.e. ecosystems in their unaltered state).

Modified ecosystems, e.g. forest managed for production of timber or other produce; for wildlife; recreation; grasslands managed for domestic stock; cycles of shifting cultivation in balance with their environment.

Transformations in which the natural ecosystem is totally removed and replaced by trees (forest plantations, fruit or cash crop), arable or pastoral farming, or structures (roads, towns, reservoirs, mines, etc.).

Degradation of site by erosion, invasion of weeds species etc.

If areas are suitably chosen with proper respect for their ecological characteristics, modifications and transformations can be carried out with no loss of fertility; and indeed the capacity of a site for a chosen use may be greatly enhanced-for example by terracing and irrigation. But, as it is either impossible or very expensive to return to an earlier use, it should be recognised that many decisions to transform or modify are for practical purposes irreversible. Misallocation or mismanagement may, of course, lead to such degradation that the value of the site for all uses is permanently impaired.

Wise and successful allocation of land depends on facts which may be best supplied by environmental resource surveys. In this connection, the importance

of training in interdisciplinary research and in environmental impact assessment procedures, with particular emphasis on developing countries, should be stressed.

For *agriculture and plantation forestry*, the main prerequisites are knowledge of the climate and soil, the relative importance of these varying according to circumstances. For the *management of natural forests for timber production* the present composition of the forest and its potential for adequate regeneration are important. For the *management of natural grasslands* for raising domestic stock the composition of the grassland should be known and the ways in which it will react to different grazing regimes and techniques for improvement. In all three, accessibility to markets and availability of labour has to be taken into account. For *natural areas which are to be retained and managed as such* it is their present vegetation and fauna, the extent to which they are either unique or representative of important ecosystems, and their intrinsic characteristics that are important. Each area may also have environmental characteristics which make it suitable for other forms of development such as mineral extraction, dam or road construction, the siting of new towns, etc.

Where detailed surveys of climate, soils, vegetation and fauna, mineral resources, topography and hydrology are available, these may, with suitable interpretation, supply the required information. If such surveys are not already being carried out, they should be started as soon as is feasible. Of particular importance is the early setting up of a regional meteorological network and the systematic collection of relevant statistical information (on population, health, hydrology, etc.).

But, where such detailed surveys are not available, there are short cuts which will provide very valuable information. Much can be accomplished by the use of remote sensing or by air photography. Vegetation surveys can also be valuable for regional planning. These proceed from the premise that vegetation, especially undisturbed vegetation, gives a good general measure of climatic conditions and thus of the potentialities and limitations of an average site for various kinds of land use. Within each zone there are, of course, extreme sites where the nature of the soil overrides or compensates for the influence of climate, and offers special potentialities or imposes special constraints. In most circumstances knowledge of both climate and soil is necessary to assess capability reliably.

Guidelines

Once the various uses to which land is to be allocated have been clearly identified in national landuse policies, decisions on the designation and allocation of land for various uses should conform to these policies and be based on as much relevant information as possible.

The proper identification of potential uses and an understanding of each different kind of land-its separate "capability" for different uses and the constraints which must be observed when it is manipulated for productive purposes-is necessary in order that the merits of alternative patterns of development may be compared.

1. When they are not already available, national and regional resource surveys should be undertaken as soon as possible to provide the facts (for example, on social needs and social structure, climate, topography and land form, soils, vegetation and fauna, mineral resources and hydrology). As the information from such surveys is never complete, the best use should be made at all times of data already available.

2. When detailed surveys are not available much use can be made of remote sensing, and of vegetation as a measure of climatic and soil characteristics. The results of these are complementary to, but no substitute for, detailed land based surveys.

3. Capability or potential should be assessed separately for each possible use or value of the land. For example: potential for mineral extraction, agriculture, timber production; suitability of settlements, roads, dams, various forms of recreation or tourism; intrinsic value for conservation as examples of ecosystems; to preserve genetic resources of plants and animals; as beautiful landscapes; or as sites of historical or archaeological value.

4. Existing surveys may need to be supplemented or reinterpreted in the light of new knowledge and changing social priorities.

The development of any region should be planned as a whole in order to make the best present and future use of available resources through a comprehensive and integrated approach to development.

In some instances the most suitable unit may be the catchment, in others a mountain massif containing parts of a number of catchments. It may also be valuable to consider units related to people, such as the mountain area supplying the markets of a city or providing recreation for its inhabitants.

Planning should provide for foreseeable requirements and should be based on the present and likely future needs of the community as determined by its chosen life style.

Decisions which are damaging to the lasting potential of natural resources are often taken under conditions of stress.

5. Any action contrary to the inherent capability of the land should be resisted.

6. Before changing or exploiting the original ecosystem, for example by the felling or major harvesting of forest produce, an assessment of the possible final use of the land should be made in order to enable proper phasing and planning for development. Among these uses should be considered the enhancement of recreational opportunities.

The environmental effects of alternative courses of action and legislative proposals should be assessed in advance in order to ensure that longterm costs do not outweigh short-term benefits.

7. National interests must be balanced against the interests of any special groups in the community.

8. The effects of alternative courses of action on the region in question, its surroundings and, in particular, on the whole catchment area of any affected river system must be evaluated through an "environmental impact assessment" or other appropriate means.

Planning should be undertaken as far as possible in consultation with those likely to be affected. This may have to be done gradually and by stages.

9. Local consultations should be initiated at each stage of planning in order that the full social costs and benefits of alternatives may be evaluated.

Land which is capable of many uses should be retained unaltered as far as possible in order to maintain the widest possible choice for future generations whose needs and skills may be different. The greatest care must be taken over any decision that will lead to irreversible change.

Conditions may change in such a way that the original resource would have proved more valuable than that which has replaced it. For example: agricultural land rather than a reservoir; a unique example of natural forest rather than degraded grassland.

10. In the course of landuse planning it may be decided to leave areas untouched in order to have a reserve of unallocated land.

11. Land for protective uses, such as catchment protection, erosion control, nature reserves or national parks, should, on the other hand, be allocated specifically for these purposes.

12. Before deciding to modify or transform untouched areas, every consideration should be given to alternatives. For example, adapting to more productive uses areas that have already been changed; intensification of existing uses; using areas for more than one purpose if these are compatible.

Arrangements should be made, as part of the planning process, to monitor and evaluate the effects of any major development.

The result of this evaluation may be used, if necessary, to modify the course of development and will provide experience to guide future ventures.

13. Significant variables, including those listed in guideline 3, should be observed and the effects of development evaluated.

Allocation, conflicts and multiple uses

In the previous section it has been emphasized that society has a number of possible uses for any area of land or water, and that the allocation of areas to such uses is of the highest importance if they are to be used wisely. It may be decided to keep the land in its natural state because of its intrinsic values, to manage the natural ecosystems as a source of food or raw material (by hunting, forestry or grazing) or to use the soil for other purposes.

High mountain areas are valuable:

a) as water gathering grounds both for the lower mountain slopes and for the plains;

b) as a source of hydroelectric power;

c) because they yield natural produce such as timber, pasturage and wild animals which may be cropped;

d) as examples of geological formations and physiographic processes;

e) as samples of natural ecosystems containing the genetic resources of plants and animals of the region;

f) as natural landscapes, often untouched, which offer great opportunities for the appreciation of beauty, for outdoor recreation and for wilderness;

g) as repositories of traditional cultures and ways of life; and

h) for the development of tourism.

Land will normally, therefore, be allocated for uses associated with one or more of these. Such uses may be complementary to one another but they also often compete. For example, it is usually possible to protect forests whilst using them for scientific research, education and recreation, provided that part remains completely protected and the use of the rest is regulated so that it is consistent with the primary aim of protection. Indeed, as well as being a

reserve of genetic material, these areas must serve the interests of science, education and recreation. But these interests will suffer if the protective function is neglected.

In addition to allocation, therefore, it is crucial to be clear and explicit about objectives of management.

Guidelines

Where it has been decided that an area should be allocated for a protective use, this should in all cases take priority over other uses.

Other uses-for example extraction of timber, overgrazing or excessive use by the public-can easily damage irreversibly the protective value of a forest or grassland.

14. For each allocated area a primary objective of management should be stated and any other uses which are incompatible with the primary use should not be allowed. Land as yet unallocated should be clearly distinguished as such.

15. Within the constraints set above, the use of areas in the fullest interest of the community should be encouraged and imaginative ways should be devised of providing for secondary uses.

Soil conservation

Soil forms as a result of the action of vegetation and climate on the rocks or rock debris. In high mountain areas the main agents in the formation of soil are physical. Rocks are broken down by the extreme changes in temperature between night and day; by the freezing and thawing of water; by the action of gravity in rock falls and soil creep; and by the grinding action of glaciers. The main characteristic of most high mountain soils is their instability and the relative scarcity of the finer soil fractions, especially the clays, which are characteristic of soils developed in conditions that are at the same time warm and moist, where chemical weathering predominates. High mountain soils are kept by these intense physical processes in a juvenile state.

At lower altitudes, as temperatures increase, more mature soils have the opportunity to develop wherever the topography allows some measure of stability. These soils show deeper weathering and contain finer particles. They develop characteristic layers (soil profile) and the surface is often rich in partially decayed organic matter. The patterns of soils in most High Mountain areas are complex, related to parent material (hard or soft, basic or acidic), topography, distribution of water, snow and ice, precipitation and the annual and diurnal march of temperature.

At all altitudes much soil movement occurs naturally and the effects of man's activities are insignificant in relation to those of natural physical processes. But the potential effect of management (or mismanagement) becomes greater at lower altitudes and especially in those areas within the forest zones where more mature soils have been able to develop. These are vulnerable to erosion; with their loss, much of the potential productivity of the site disappears and the development of new soils is a very slow process at these altitudes.

In some areas, indeed, much of the vegetation and most of the soils seem to have disappeared when man first exploited them, and they will only be restored, if at all, by long periods of rest or by active revegetation.

The critical areas for attention in the high mountains are, therefore, those soils which are well developed and which remain relatively stable under the full cover of natural vegetation. In these, accelerated erosion often of very serious proportions can be caused by mismanagement.

The erosion of soil by water is caused when rainfall is so intense that the soil cannot absorb it by infiltration. It then runs over the surface as sheets or is concentrated in runners and streams, carrying soil particles with it. Once gullies have formed they will continue to eat back at their heads into previously un-eroded soils.

Generalisations are difficult in this field, but it may be helpful to identify three kinds of action that should be avoided:

a) exposing to direct rainfall those soils into which water infiltrates with difficulty;

b) anything (such as animal tracks or footpaths, road drains, logging tracks, faulty terraces) which canalizes the flow of water over erodible soils; and

c) any treatment of soil (such as trampling) which reduces its capacity to absorb water rapidly.

Because of the dominance of physical weathering in the formation of high mountain soils, their capacity to absorb water is usually high and the greatest danger is usually caused by canalization.

Guidelines

The proper conservation of soil should be an aim in all land-use policies. All uses of the land should, therefore, be carried out in such a way that accelerated soil erosion does not take place and that the potential of the soil is not diminished. If land use is to be changed, priority must be given to measures to prevent erosion.

Soil in the right places is a valuable and often almost irreplaceable resource; in the wrong places it seriously affects water quality and can cause great damage. Once erosion has started, it is difficult and expensive to control. The natural development of new soil is usually a very slow process and soil can be replaced artificially only at great energy cost. Every effort should go, therefore, into preventive conservation. Accelerated erosion does not occur under protected natural vegetation.

16. Areas prone to accelerated erosion should be identified. Such are: soils into which water infiltrates with difficulty; areas which contribute to the surface flow into streams; the margins of stream beds; and areas in which water is likely to emerge as springs.

17. If it is proposed to change the land use or the management of vegetation in a catchment, particular attention must be paid to preventing erosion in these erodible areas by incorporating any necessary measures in the design. Particular care should be taken to avoid canalizing the flow of water on erodible soils.

18. Prevention and control of accelerated erosion can be achieved at least expense through the protection of natural vegetation. Where this is not possible, a combination of engineering and biological methods of erosion control should be used.

19. Where existing landuse practices contribute, or have contributed, to accelerated soil erosion, every effort should be made to bring this under control and to rehabilitate the catchment.

20. Many high mountain regions have long supported human populations who have developed effective techniques for erosion control. Wherever appropriate, the application of these techniques should be encouraged or extended, rather than new and unfamiliar methods introduced.

21. Since both engineering and biological techniques for controlling erosion (terracing, contouring, cover cropping, strip cropping, etc.) require a high degree of technical skill, experts who are either traditionally or professionally qualified should be involved at an early stage in the planning and execution of developments in high mountains.

Water conservation

High mountains provide the principal water catchment areas (or watersheds) for much larger geographical regions. Rainfall is usually greater at middle altitudes than in adjoining lowlands or at the highest elevations, and water from mountains provides the source of most rivers and streams on which lowland peoples depend for water supplies. The quality, quantity and timing of

water yield from mountain catchments are therefore of considerable social and economic importance.

Land use in the catchment can have great effects on the quality of water by its influence on the amount of silt that reaches the rivers and by pollution of the water supply. These questions are dealt with in guidelines 1621 and in guidelines 5758; all of which should be followed in the interests of high water quality.

The effect of land use on the quantity and timing of water supply is much more difficult to evaluate. Very broadly, water falling in a catchment takes one of two paths, by surface or by underground routes, sometimes changing from one to the other. Flow above ground is more rapid and subject to greater fluctuations than that below. As it moves below the surface some water is held in the soil and from there may be lost by evaporation from bare surfaces or transpiration from plants.

In general, the greater the proportion of water that takes the surface route, the more intense the fluctuations of supply, especially in a small catchment. In a large catchment irregularities tend to even out or to be reduced by a storage effect in the lower parts of the channel, if this has a large cross-section. The details of the processes are highly complex and still incompletely understood. The detailed behaviour depends very much on the intensity and duration of rainfall or snowmelt, and on the size, morphology and soils of the catchment in question.

Different kinds of vegetation transpire at different rates (in general, forests and scrub use more water than grassland). Under certain conditions of rainfall and evaporation the kind of vegetation can have a significant effect on water yield.

Because of these complexities it is particularly difficult to make useful generalizations about ways in which the management of vegetation can be used to optimize the yield of water. There is no real substitute for proper catchment studies. In general, however, measures that increase the proportion of water that take the surface route will tend to increase fluctuations in supply. Such would be the kinds of canalization of flow referred to in the section on soil erosion above or the total loss of soil storage capacity by serious erosion.

In many instances engineering installations will be necessary to regulate and control water flow in the interests of irrigation, power, and industrial and domestic use. The life of these will be longer, and the cost of installation and maintenance less, if the catchment above them is well managed. The maintenance or restoration of good vegetation cover plays an important part in this.

Guidelines

In planning for development in high mountains, the effect of the proposed development on the quality, quantity and reliability of wafer yield should be given first consideration, and measures should be taken to ensure that these qualities are not harmed. When harm has already been caused by past misuse every effort should be made to repair the damage.

22. Where areas are vital for the safeguarding of water supplies, watershed conservation should be given priority over all other uses. Secondary uses should be limited to those that are fully compatible with water quality and yield.

23. Any new development should be carried out in such a way that it causes as little adverse effect as possible on the quality and yield of water. This includes any proposed new uses, such as cultivation, replacement of forest or development of tourism, or changes in management such as the increased use of pesticides and fertilisers. Any such change should be made only after careful evaluation and with expert guidance.

24. Where water catchments have been damaged by past misuse, every effort should be made to encourage good land use, to restore the cover of vegetation through reafforestation and, where appropriate, to undertake works for erosion control and stream channel management.

25. If engineering structures are needed for flood control, irrigation, hydropower or other purposes, their construction should be linked with the full range of measures needed for sound watershed management.

26. The full development of any water resource must be accompanied by a properly conducted hydrological investigation. This should establish the mean and design flood flows for the system and investigate the incidence, duration and severity of droughts (periods of water deficiency). It should also take into account environmental and social factors in weighing up the costs and benefits of the system.

Forest uses

The slopes of high mountains in less arid or in humid regions support a variety of forest types, usually distributed in attitudinal zones, and each with its own complement of species. Many of these forests contain trees suitable for use as commercial timber, wood for local construction and fuel, and other species yielding useful forest products, including foods and medicine. They provide an indigenous source of energy. Forests provide a habitat for wild animal life, itself a natural resource of great value. Forests provide a basis for recreation and tourism, as well as a retreat and shelter for people. They hold soil in place and further its formation and development. They also moderate local climates,

decreasing the effects of wind, modifying temperatures and humidity and checking avalanches. Despite these obvious advantages and benefits, mountain forests in the developing world are disappearing at an alarming rate, and with this disappearance wildlife, soils, and water regimes are threatened. In the industrialized world also mountain forests are under serious pressure, sometimes from poorly adapted logging practices, from fire and overuse, and from landuse conflicts.

Forests have a capacity for regeneration which permits a sustained yield to be taken from their products. This regenerative capacity, however, should not be overestimated. Primary, or old-growth, forests of long-lived trees have qualities and values which are rarely replaced in second-growth stands no matter how well these are managed. Where practicable, sustained yield is dependent on careful forest management and on the degree of care exercised during the removal of timber. In some forest types, however, sustained yield programmes are a hope not a reality. In seasonally dry forests, fires are a potential menace to forest survival, and on the arid fringes of forest lands, burned-over forests may not regenerate. Forest plantings of native species are a means for ensuring a sustained yield of wood, but not necessarily of other forest benefits. Forest plantings of exotic species represent a sacrifice of those values associated with native forests for a yield of plantation products but, by providing these, they may meet an important economic need and release pressure from forests of indigenous species. Forests can be replaced with other vegetation, such as pasture, but this requires careful management if it is to be maintained and often represents a loss of potential productivity. Forest lands can sometimes be converted to productive farming lands, but such conversion must take into account the nature of the soils involved and the management necessary to maintain their fertility.

Guidelines

When an area is to be managed for the production of timber or other forest produce, including wildlife, this should be done in such a way that the potential for maximum sustained yield is maintained and the resource capital is not depleted.

The relative values of the various products may change from time to time and new uses may be discovered. Some areas of managed forest, for example, have an important supplementary value as a habitat for wildlife, which may provide a significant source of food, of revenue from exploitation and of reserve stocks of the species concerned. They may also be valuable for recreation or contribute to the beauty of the landscape. A forest which still retains its varied potential can best respond to changes in demand.

27. Such forests should be managed according to the best principles of silviculture and in such a way that the natural composition and structure are altered no further than is necessary.

28. Management should be directed at getting the best total return from all forest products consistent with maintaining or enhancing its potential.

29. Extraction of forest products should be balanced by forest growth. This applies equally to timber cutting, fuel gathering, and all consumptive uses of other forest products. In mountain forests this rule should be applied locally as well as regionally.

30. Where soils are prone to erosion, the value of the forest for maintaining soils should take precedence. Special attention should be paid to the protective role of trees along stream channels. Removal of trees for any purpose should be permitted only where disturbance of ground cover and soil can be minimized.

31. Where forests must be opened to permit regeneration of desired species, the size of the cutover plot should be the minimum necessary to accomplish regeneration, and in all cases should be surrounded by stabilized vegetation.

32. Forest roads and tractor trails are a serious source of erosion and disruption to water regimes. Such transportation networks should be carefully planned and executed with engineering skill to minimize adverse impacts.

33. Samples of the indigenous forest communities of plants and animals should be preserved (see guidelines 5964), as a standard against which change can be measured and as a reservoir of genetic material.

34. Where forest is managed to produce a sustained crop, every effort should be made to make the most of the recreational opportunities it provides and of its contribution to the beauty of the landscape.

35. Conversion of forests to other land use or vegetation should be carried out only after careful analyses of long-term ecological and economic costs and benefits, and in no case should be undertaken unless there is a high probability for successful establishment and maintenance of the proposed land use.

The production of timber and other forest produce both from native forests and plantations should be planned to meet predicted demands, including those for fuelwood and other local uses.

The forest is abused when demand exceeds supply. The need for fuelwood, for example, can under certain circumstances make very large inroads. The development of plantations (either of native or exotic species) can play an

important part in meeting demands and, at the same time, will reduce pressure on those areas of forest which should be protected. It may also enable areas of forest to be kept in reserve for future land allocation. The provision of adequate local fuel will reduce dependence on imported sources of energy.

1. The management of native forests and the development of plantations should be planned together in order to meet predicted demands for timber and other forest produce without overexploiting the native forests or interfering with their protective roles. Predicted timber requirements should take account of local needs for fuelwood. When the viability of the forest is threatened by fuelwood collection, special plantations should be established near the site of demand but outside the forest, and alternative sources of fuel should be developed (e.g. big-gas).

37. To conserve native forests, new plantings should be made on abandoned land or other suitable sites outside the forest. Such plantings need not be confined to blocks of plantation.

Use as range or pasture

Throughout the temperate zones and in many parts of the tropics high mountain pastures are of great importance in the local economy. The large numbers of domestic livestock grazed there include lowland species and breeds as well as those, such as the llama, alpaca and yak that are specially adapted to high mountains. In some regions the pastoralists involved move seasonally with their herds to high mountain regions, returning to lowland pastures for wintering. Elsewhere, when snow does not accumulate, as in part of the Andes and Tibet, high mountain pastures are used throughout the year, since some forage remains available at all seasons. Even in highly industrialized regions such as the Alps, the seasonal movement of livestock to mountain pastures is of both economic and cultural significance.

Unfortunately, in many high mountain regions, as the numbers of people and livestock have grown and traditional methods of pastoralism have been abandoned, the range lands have become grossly overused with severe consequences for their productivity and with serious repercussions on forest regeneration, wildlife, soil stability and the water regime. Deterioration has proceeded so far in some areas that an ecological threshold has been passed and recovery of once productive pastures is not technically possible. Experience in many parts of the world, however, has shown that mountain pastures and rangelands can be managed, with skill, in such a way that they continue to provide, over many centuries, a source of income and way of life for the people who depend upon them. In some regions, moreover, their productive capacity can be greatly increased by improvement followed by suitable management.

There are, of course, sensitive areas where it may be necessary to exclude domestic stock altogether. But even in these it may be possible to crop wild herbivores and obtain a sustained yield from them. Indeed this may sometimes be ecologically, socially and economically preferable to introducing domestic breeds. The possibility should also be considered of combining domestic and wild animals, and of farming previously undomesticated herbivores.

Areas such as national parks, other protected areas and biosphere reserves, which have been protected, or have been able to recover, from misuse often contain luxuriant vegetation; and can be used as a demonstration of potential productivity and of the number of animals best adapted to the habitat that an area in good condition can carry without damage.

Guidelines

The stocking of rangelands in high mountain areas with domestic animals must be planned and regulated so that the grazing lands can support the numbers proposed without the long-term loss of productivity of either plants or animals.

Mountain rangelands have a carrying capacity for grazing animals. This is determined by the annual production of green growth, over and above what is required for the metabolism of the plants involved and the maintenance of their health and vigour. With care much of this excess plant production can be cropped by wild or domestic animals without damage to the vegetation. Excessive use, however, impairs the capacity of the plant for maintenance, growth, and reproduction and leads to its death or even the disappearance of the species. Range plants vary in their palatability to animals, their nutritional value, and their capacity to withstand grazing. Excessive grazing, even when not sufficient to create bare ground, can shift the species composition of rangelands toward less palatable or nutritious species. This results in lowered carrying capacities, and reduced animal growth and reproduction.

Mountain rangelands present special problems because of the instability of many of their soils. Since plant cover must be adequate to prevent soil erosion- and, in areas prone to such occurrences, resistant to the impact of avalanches- and since soil compaction has serious consequences, carrying capacities are lower than on similar areas of flat land. Excessive grazing must be avoided, as well as too much trampling of moist ground and the formation of bare tracks or trails. This involves control of not only livestock numbers but also livestock movements.

The problems of managing mountain rangelands become more severe as aridity increases and both rainfall and plant growth become less dependable. On drier mountains carrying capacities are lower and fluctuate markedly from year to

year. Control of livestock numbers and movements becomes not only more important but also more difficult to achieve.

38. Any development aimed at the improvement of pastoral economies must be based on the availability of forage, the stability of pastoral ecosystems and an ability to control livestock numbers and use. Without these provisions, development will produce at best ephemeral gains followed by serious social and environmental losses.

39. Where conditions are suitable, the lasting productivity and carrying capacity of mountain grasslands should be increased by adopting agricultural techniques designed to raise crop yields and livestock performance.

40. Opening up of new mountain pastures (e.g. through water development or vegetation conversion) should only be carried out where there is a reasonable guarantee that numbers of livestock and patterns of use can be controlled.

41. Where mountain grazing lands are subject to marked fluctuations in climate, and consequently in annual productivity, stocking rates must always be more conservative than where productivity is more consistent from year to year. Provision of forage reserves for drought years or arrangements for rapid reduction in stocking rates should be built into long-term planning for pastoral economies in such areas.

42. A number of areas representative of the various rangeland ecosystems should be preserved and protected from grazing to serve as benchmarks against which changes outside may be measured and evaluated.

43. Mountain areas frequently contain important mountain wetlands (lakes, swamps, mires and bogs). Because of their inherent biological interest and their vulnerability, quite apart from their role in soil and water conservation, they should be carefully protected as part of the overall management of the mountain area.

Where grasslands have been so overgrazed that their productivity and stability have been impaired, the pressure on them should be reduced to restore their productivity.

This may be accomplished in a number of ways: by reducing total numbers of stock, reducing the period of grazing or by adopting different patterns of animal movement and rangeland use.

44. Where range has been overgrazed, advice should be sought from trained range managers familiar with the ecological conditions of the area and management should be adjusted according to their advice. It should include rest or retirement from grazing where necessary.

45. Reduction of grazing pressure in mountain rangelands can often be assisted by development of irrigated pastures in valleys, by expansion of hay production, by use of crop stubble on farming lands, or provision of forage from lowland areas.

Especially in arid and semiarid regions, nomadic grazing and transhumance (seasonal movement of livestock to another region.) often make the best sustained use of grazing lands; these traditional practices should not be changed without very good reason.

Serious problems in mountain range management have often resulted from interference with traditional patterns of livestock movement and use.

The sustained cropping of wild indigenous herbivores, alone or in combination with domestic stock, should be adopted where domestic stock alone will cause deterioration of the range. Introductions of non-indigenous animals should be avoided.

The indigenous wild herbivores are adapted to make use of the range without deterioration. In extreme conditions they are often the only species that can do so; and elsewhere they may provide an alternative to domestic stock that is ecologically, economically and socially desirable. Introductions of non-indigenous wild animals, on the other hand, have proved in almost every case to be ecologically disastrous, the species becoming uncontrollable and doing great damage.

46. The management of indigenous wild animals for sustained cropping should be based on scientific research and regulated to provide the best yield of meat, other products or trophies as appropriate.

47. Where indigenous wild animals are to be managed as a renewable natural resource under a programme involving sustained yield cropping, those people whose lands support wildlife, or whose livelihood is most affected by wildlife conservation measures, should be the first to benefit economically from sustained yield cropping and should be closely involved in its planning and direction.

48. Regulated commercial game recovery on high mountain areas is accepted as a valuable control measure, and conflict between commercial and recreational hunting should be avoided by appropriate planning, including zoning.

49. Non-indigenous wild animals should not in general be introduced. Where such introductions are contemplated or where introduced wild animals already exist within the country concerned, the decision to spread them further afield

should only be made after the most stringent scientific enquiries into the likely effects.

Agricultural conservation

High mountain regions include areas where many different crops can be grown which are not suited to the more uniform ecological conditions of adjoining lowlands. Farming is often the main basis of the economy of mountain peoples, who have traditionally maintained a high degree of agricultural self-sufficiency. The continuation of this should be encouraged. Nevertheless, the problems of steep slopes, the often extreme climatic conditions and the remoteness of markets make mountain agriculture potentially risky, and special measures are inevitably required if productivity is to be maintained, environmental damage minimized and an acceptable standard of life assured.

Most human populations which have long been adapted to high mountain life have developed traditional methods for maintaining agricultural productivity and for preventing environmental damage, since without this continued occupancy of the region would have been impossible. With the increase of populations and the impact of outside cultures, however, these practices have sometimes been abandoned with serious environmental consequences. Improvements in agriculture should be based on a sound knowledge of traditional practices and on the ecology of mountain systems. In particular, with few exceptions, systems which depend on massive use of farm machinery or on great quantities of imported energy or materials are likely to be counterproductive in mountain regions. High cost systems should be avoided unless there is a stable market for high value products, and there is thus a reasonable certainty that excellent standards of land management can be maintained.

Because mountains provide the water supplies both for themselves and for the adjoining lowlands, and are the source of pure water for fisheries, the greatest care is necessary in the use of pesticides and other toxic chemicals and in the disposal of agricultural effluents.

In many mountain areas shifting cultivation has presented serious problems, resulting in forest destruction, soil depletion, erosion and ultimate land abandonment. Some traditional forms of shifting cultivation can be in balance with their environment and, where such still remain; there is no ecological reason for changing them. But often the cultivation is carried out by new colonists or the traditional balance has been upset by increase in population or outside influences. In such instances a carefully planned and phased transition to settled agriculture is necessary.

Guidelines

50. Mountain slopes should not be developed for cultivation unless satisfactory measures can be taken for control of erosion.

51. Agricultural development should take into account the particular ecological and social conditions of mountain environments which often make the use of lowland oriented techniques undesirable and, in particular, work against the success of methods based on continued heavy imports of energy or materials.

52. Advantage should be taken wherever possible of traditional methods of agricultural conservation; these should be maintained and fostered in those situations where they can continue to be effective, and should be built upon in any new developments.

53. Attention should be given to the conservation and enhancement of stable and productive rural landscapes that have a long history of human occupancy, both for their intrinsic merit and as models for development of other areas.

54. Particular attention should be given to the development of alternative technologies for mountain farms, which will make the best possible use of locally available resources (such as water, solar and wind power, and organic wastes) for both energy and material needs.

55. For support of agricultural populations, the establishment of small enterprises using local resources and craftsmanship should be encouraged.

56. Wherever possible development should provide for diversity in agriculture and in landuse patterns.

57. Use of toxic chemicals for the control of agricultural pests should be permitted only after careful and sale of all toxic products should be carefully controlled by competent authorities.

58. Great care should be taken in the disposal of agricultural effluents.

Conservation of relatively undisturbed ecosystems, wild genetic resources and physiographic features

The high mountain regions of the world support many species of plants and animals which are not found elsewhere and are often confined to one particular mountain region. These often form unique communities of great scientific interest and environmental value. A high percentage of the world's endangered species of mammals also are high mountain forms, inhabiting open areas which offer minimum protection against hunting, or being forced by seasonal migration into concentration areas in which their vulnerability is

increased. The misuse of mountain rangelands and forests is destructive to endemic species of plants. Special measures need to be taken to guarantee the survival of wild species and natural areas, and these should be considered in any planning for high mountain development. Mountain areas often contain outstanding examples of geological formations (stratigraphy, folding, faults, volcanism, etc.) and of physiographic processes, for example geological erosion and deposition, and glaciation.

The protection of the species and areas which comprise the natural heritage of the mountain regions is ultimately the responsibility of the peoples of the region and their governments. However, because of the universal interest in natural areas and wild species, the international community has a particular responsibility for providing assistance, where needed, to those areas which lack the technical skills or financial resources to provide for effective nature conservation.

Wild species and areas can be protected through the establishment of special areas of reserves or national parks within which their exploitation is prevented. Such protected areas in high mountains have many values beyond wildlife conservation (e.g. watershed and soil conservation), and their usefulness for scientific research, public education, and ecological demonstration is potentially high. However, the protection of wildlife requires more than a system of parks and reserves. Legislation and regulation must also govern the use and conservation of wildlife outside specially protected areas. Since wildlife is potentially, at least, a renewable natural resource, such legislation can provide for equitable, reasonable, and sustainable use of wild animals and plant resources. This would permit an economic return to the people of the area, while ensuring that such returns will remain available into the foreseeable future.

In the long run what is essential for wildlife conservation is a public attitude that is favourable to wildlife and will permit its conservation in any area, from city to wilderness, where its presence is not detrimental to necessary human activities. Such an attitude can only be created by sensitive, culturally oriented programmer of information and education.

Guidelines

As an integral part of planning, provision should be made for the protection of suitably large examples of natural ecosystems and of populations of plant and animal species together with sites illustrating the principal geological and physiographic features and the processes at work in the landscape. These should be supplemented by the protection of a larger number of smaller areas representing the full local variety in ecosystems and species.

These are an important resource and should be maintained as a reservoir of continually evolving genetic material, for their cultural, scientific and educational value, as samples of outstanding or typical natural landscapes, as a reservoir of wild animals and plants which may enable them to be cropped in surrounding areas, and as samples of unchanged communities to provide controls against which the changes brought about by other forms of land use may be measured and assessed. It is important to maintain samples for these purposes even on potentially rich agricultural soils.

59. An assessment should be made of the intrinsic value of land in relation to the conservation of flora, fauna and natural ecosystems (suggested classes for such a capability classification are given in the Appendix.).

60. In specific situations, where there are areas of outstanding and possibly unique value, high priority should be given to their protection and this should be given preference over other forms of land use.

1. The involvement of local people in the planning and establishment of conservation areas is essential to their long-term protection. Those people who are most directly affected by the establishment of such areas should be the first to share in their economic benefits and returns, such as through employment in the reserves, or in income from activities based on the reserves.

62. The size and characteristics of the areas protected should be related to the needs of the plant and animal communities that they are intended to protect. In the case of the large reserves, areas should be chosen to include examples of different ecosystems, representing, for example, different attitudinal zones on a mountain or gradations of climate. The smaller areas should be chosen to include as large a variety of types as possible.

63. Wherever possible areas set aside to safeguard samples of natural ecosystems should be surrounded by buffer zones taking advantage of physiographic and other natural protective features. These should be maintained under natural vegetation but can be used for any form of economic land use which does not interfere with the integrity of the protected area.

64. The objectives of management for such protected areas should be carefully defined and adhered to. They should include maintaining part of the area completely undisturbed as a standard for comparison; but in the remainder, use for scientific study, for education and for recreation should be encouraged, provided that these uses do not conflict with the primary purpose of protection.

65. There should be a management plan for each protected area, and the course of management should be monitored to assess whether the original objectives were reasonable and the management has been successful.

In planning the overall development of any area, provision should be made for the migration of animals and dispersal of plants between protected areas.

When the land surrounding protected areas becomes intensively used, these are left as "islands" and are very vulnerable to such external changes as fluctuations in climate. The danger of losing species can be lessened by making reserves larger and more varied, or by regulating land use in the areas between reserves so that migration is possible.

Management of land outside protected areas should be carried out in such a way that reasonable populations of indigenous wild plants and animals can survive in it.

This, by maintaining variety including both predator and prey species, may often prevent any of these species from becoming pests. It also serves to keep up populations of the species themselves.

66. Developments involving the use of lands or waters which support wildlife, and in particular endangered species, may require modification to allow for the survival and welfare of those species affected. This applies in particular to forest and rangeland development, and to the construction of dams and reservoirs.

67. The use of poisons in the control of indigenous predatory animals should be stringently controlled. While effective protection of flora or vulnerable wildlife habitat may require the use of poison against harmful animals, great care must be exercised to avoid risks to non-target species.

The preservation of wild plant genetic resources in natural protected areas should be supplemented by documented collections in botanic gardens, arboreta and seed banks.

This will provide an additional insurance against extinction in the wild but is no substitute for preservation in protected areas. It is impracticable to provide for all species within collections, and natural evolution cannot continue under these conditions.

Natural beauty, recreation and tourism

High mountain areas are often distinguished for their great natural beauty and for the scope they offer for outdoor recreation of all kinds, from the purely contemplative appreciation of nature to active sports such as climbing, hill

walking and skiing. For many they provide solitude in beautiful and undisturbed natural surroundings; others enjoy more gregarious activities. These values are not always compatible with each other.

Because other economic resources are scarce and contact with markets is difficult, it is natural to turn to advantage these special features of high mountain areas by encouraging more intensive tourism. If carefully planned and executed, this can lead to a satisfactory and harmonious blend with the more traditional indigenous occupations. But if it is not, tourist development can be as damaging to mountain environments and culture as the worst of any landuse practices.

The economic and social changes which take place with the improvement of communications and introduction of tourism are farreaching. Tourism which is oriented toward observation of local cultures and ways of life can be quickly destructive of both. A great danger lies in the abandonment or modification of traditional ways in favour of supplying the demands of the visitors. This can lead to a total dependence of local people on continued tourism, and severe economic stress if tourists cease to arrive in the expected numbers. The pressure of tourists on local resources-food, fuel, water, sanitary facilities, artifacts of various kinds-can put a greater stress on local productivity and environmental stability than would be brought about by an equivalent numerical increase in local populations. The demands of tourists for imported food or other products can lead to growing dependence of local people on similar imports, with the loss of their capacity for self-sufficiency.

Once facilities have been provided it is difficult to control numbers. Many of the particular values that tourists come to seek may be destroyed if too many try to enjoy them. The best way to limit numbers is to regulate the provision of facilities.

Guidelines

High mountain areas should be subject to special control over planning and development.

This will ensure that all developments are handled sensitively in such a way that they do not spoil the values it is wished to preserve, and are guided by authorities interested in the long-term social, economic and environmental wellbeing of the communities and countryside to be affected, rather than those who expect immediate economic gain from the development. Such guidance is most likely to be followed if local people are involved in the consideration of development policies.

68. Resource inventory and capability surveys for recreation in the high mountain zone should be carried out. These should be within the framework of

wider land capability surveys and should preferably adopt a catchment or regional approach.

69. Such resource and capability surveys should be based on an identification of the various kinds of recreation for which there is, or might be, a demand.

70. Careful economic evaluations should be carried out for planned developments taking into account the full, long-term, ecological, social and economic effects. This is especially important in relation to the expansion of commercial tourism.

Most high mountain areas have striking natural features and beautiful and varied scenery. Everything possible should be done to carry out development in such a way that these are maintained or enhanced.

Many of the identified recreational values depend on the beauty of the natural features of mountain areas. These can be most important in making full use of the potential for recreation. In the eyes of many, and in some places, the natural beauty can be enhanced by works of man, provided that these are well planned and sensitively executed.

71. A primary objective in high mountain areas should be to preserve their scenic character. Areas of high scenic value should be identified and zoned in terms of their own intrinsic properties.

72. All proposed developments should be examined critically to ensure that they do not detract from the qualities of the scene.

73. New man generated landscapes should be designed to give a pleasing effect, in keeping with the surrounding natural landscape.

Special consideration should be given to the possibilities of zoning high mountain areas for various kinds of recreation and tourism.

Since some recreational activities are incompatible with one another, require different kinds of country and interact in various ways with other forms of mountain land use, zonation provides the most effective way of maintaining the wellbeing of the mountain land and enabling as many as possible to enjoy it.

The provision of all facilities (roads, railways, paths, ski-lifts, houses, hotels, restaurants, etc.) should be planned so that, while meeting the needs of the local population, they do not encourage or allow more visitors than the area can accommodate or the land can carry without harm.

All countries have difficulties reconciling the needs of the tourist industry with scenery and habitat preservation and with the recreational, social and cultural needs of local populations. These difficulties can be greatly eased by careful planning in which local people are closely involved.

74. Hotels and other facilities for the tourist industries should be close to, but not within, areas of the highest scenic value or of greatest significance for nature conservation.

75. Effective access and daily transport should be provided between such facility centres and the areas of high scenic value.

76. In planning transport, preference should be given to other means than privately owned motor cars.

77. The multiplication and extension of roads in high mountain areas should be avoided.

78. The construction of tourist facilities in high mountains should be encouraged to use natural materials and coloring, and of a height to harmonize with the surroundings.

Efforts should be made to educate the public to appreciate what the mountains have to offer and how the planning and management of mountain areas can contribute to maintaining and enhancing these values.

79. Suitable areas of high mountain lands should be designated for use for educational purposes provided that these and associated facilities do not conflict with the wellbeing of the mountain land.

80. Educational areas should provide for the active use of mountain lands of low scenic and natural conservation values.

81. "Minimum impact codes" should be developed for the recreational users of high mountains, who should be encouraged to observe these scrupulously.

Appendix

Categories of land use in relation to the conservation of flora, fauna and ecosystems

1. Natural ecosystems unmodified or hardly modified by human activity. (A sample of these should be maintained inviolate: if disturbed, their integrity is seriously and perhaps irreversibly impaired.)

2. Semi-natural ecosystems in which conservation should be the primary purpose of management, but which are consistent with or depend on other forms of land use in varying degrees. (Areas in which animals or plants may be cropped as a resource should be included here.)

3. Areas which should not necessarily be conserved as total ecosystems, but which are necessary to provide for the whole or part of the life cycle of particular organisms.

4. Areas in which other uses should predominate, but in which the conservation of wild plants and animals can be ensured by various management expedients.

5. Areas in which the wildlife interest is so low or other uses are of such importance that conservation of flora and fauna should be confined to ensuring the health of the land and preventing irreversible deterioration.

Printed in Switzerland by Corbaz S.A., Montreux

Notes to readers

The Mountain Forum would like to thank the World Conservation Union (IUCN). For permission to include this document in Mountain Forum Online Library.

This document was prepared by UNEP/IUCN/WWF Consultants for the United Nations Environment Programme (UNEP), Nairobi, Kenya the International Union for Conservation of Nature and Natural Resources (IUCN), Gland, and Switzerland the World Wildlife Fund (WWF) Gland, Switzerland.