ICIMOD Methodology Workshop on Rehabilitation of Degraded Lands in Mountain Ecosystems of the Hindu Kush-Himalayan Region

Held at ICIMOD, Kathmandu, Nepal
May 29 - June 3, 1993

International Centre for Integrated Mountain Development (ICIMOD)
and
International Development Research Centre (IDRC), Canada

ICIMOD Workshop Series

The International Centre for Integrated Mountain Development began professional activities in September 1984. The primary concern of the centre is to search for more effective development responses to promote the sustained well-being of mountain people. One of the continuing activities of ICIMOD is to review development and environmental management experiences in the Hindu Kush-Himalayan Region. Accordingly, International Workshops are organised in major fields to review the state of knowledge and practical experiences and also to provide opportunities for the exchange of professional expertise concerning integrated mountain development. The reports published in this series are given below.

- **International Workshop on Watershed Management in the Hindu Kush-Himalaya**
  14-19 October, 1985, Chengdu, China
- **International Workshop on Planned Urbanisation and Rural Urban Linkages in the Hindu Kush-Himalaya Region**
  25-29 March, 1986, Kathmandu, Nepal
- **International Workshop on District Energy Planning and Management for Integrated Mountain Development**
  3-5 May, 1986, Kathmandu, Nepal
- **International Workshop on Off-farm Employment Generation in the Hindu Kush-Himalaya**
  17-19 May, 1986, Kathmandu, Dehra Dun, India
- **International Workshop on Mountain Agriculture and Crop Genetic Resources**
  16-19 February, 1987, Kathmandu, Nepal
- **International Workshop on Women, Development, and Mountain Resources: Approaches to Internalising Gender Perspectives**
  21-24 November, 1988, Kathmandu, Nepal
- **International Expert Meeting on Horticultural Development in the Hindu Kush-Himalayan Region**
  19-21 June, 1989, Kathmandu, Nepal
- **International Expert Meeting on Apicultural Development in the Hindu Kush-Himalayas**
  21-23 June, 1989, Kathmandu, Nepal
- **Regional Workshop on Hydrology of Mountainous Areas**
  11-15 December, 1989, Kathmandu, Nepal
- **Consultative Meeting on Mountain Risk Engineering**
  20-22 February, 1990, Kathmandu, Nepal
- **International Workshop on the Role of Institutions in Mountain Resource Management**
  1-4 May, 1990, Quetta, Baluchistan, Pakistan
- **Seminar on Rural Energy and Related Technologies in Nepal**
  26-28 March, 1991, Kathmandu, Nepal
- **International Workshop on Mountain Off-farm Employment**
  17-20 February, 1992, Kathmandu, Nepal

These Workshops were attended by experts from the countries of the Region, in addition to concerned professionals and representatives of international and bilateral agencies. A large number of professional papers and research studies were presented and discussed in detail.

Workshop Reports are intended to present the discussions and conclusions reached at the Workshop and do not necessarily reflect the views of ICIMOD or other participating institutions. Copies of the reports are available upon request from:

The Publications' Unit
International Centre for Integrated Mountain Development (ICIMOD)
G.P.O. Box 3226
Kathmandu, Nepal

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Organised
by the
Mountain Environmental Management Programme
of the
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Cover photograph: Degraded Mountain Farming Land in West Yunnan Province, China
Sweet Potatoes are Planted on the Highly Eroded Land

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Foreword

This report presents the highlights of an ICIMOD workshop on the Rehabilitation of Degraded Lands in Mountain Ecosystems of the Hindu Kush-Himalayan (HKH) Region held from May 29 - June 3, 1993, in Kathmandu, Nepal. Participants of the workshop were professionals from country collaborating institutions for the ICIMOD project funded by IDRC, Canada, on Rehabilitation of Degraded Lands in Mountain Ecosystems, being implemented in China, India, Nepal, and Pakistan, and some invitees from concerned government agencies, institutions, and NGOs in Kathmandu who contributed their expertise to the workshop.

The workshop was organised by the Mountain Environmental Management (MEM) Programme of ICIMOD. The programme is currently focussing on identification and promotion of sustainable options for improving degraded lands in mountain ecosystems that are being examined and tested in different field, case-study locations for their appropriateness for different mountain areas. In view of the wide heterogeneity of mountain ecosystems and solutions to the problems of land degradation in mountain areas, it was considered very useful for the collaborative agencies of the project to meet and discuss methods and alternative approaches identified for implementing the project in different field, case-study areas. In this respect, ICIMOD organised this workshop as an important initial activity for project implementation, to orient collaborating agencies on methodologies for actions to rehabilitate the degraded mountain lands in different mountain ecosystems in the region. It is believed that the workshop achieved objectives through close interaction amongst all participants, particularly during group discussions, to consolidate the methodological guidelines for rehabilitating degraded lands in mountain ecosystems. Outputs generated from the workshop will be most useful in guiding collaborative institutions of the project as they conduct case studies in the field locations.

I would like to take this opportunity to thank the International Development Research Centre (IDRC), Canada, for their generous support to the Mountain Environmental Management Programme of ICIMOD, especially for the efforts put in by Dr. Joachim Voss, Director of the Sustainable Productive System Programme, Environment and Natural Resources' Division of IDRC. Thanks are also due to Prof. Pei Shengji, Head of ICIMOD's MEM Programme, and to Ms. Jeannette D. Gurung for organising the workshop, as well as to other staff members from the MEM Programme of ICIMOD.

Dr. E.F. Tacke
Director General
ICIMOD

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Introduction and Objectives

ICIMOD and Its Programme on Environmental Management

The alarming environmental degradation of mountain habitats and the consequent decline in the standard of living of mountain communities in the Hindu Kush-Himalayan Region have been widely recognised over the last two decades. The establishment of the International Centre for Integrated Mountain Development (ICIMOD) about nine years ago was one of the reflections of this growing concern. During its eight-year period of actual operations, ICIMOD has had a good measure of success in functioning as a multidisciplinary documentation centre for integrated mountain development based on the systematic exchange of knowledge and experiences through an organised information network; as a focal point for the mobilisation, conduct, and coordination of applied and problem-solving research activities and for training; as well as a consultative centre to provide expert services on mountain development and resource management to the countries of the HKH Region.

ICIMOD's programme on Environmental Management is aimed at responding to the challenges of ecologically sustainable development of mountain environments. The main programme development activities have focussed on the Rehabilitation of Degraded Lands: Watershed Management, Mountain Hydrology, Landslides, and Biodiversity.

The Nature of the Problem

Mountains are an important source of water, energy, and biodiversity; they are a source of minerals, forest products and agricultural products, and of recreation. As a major ecosystem representing the complex and interrelated ecology of our planet, mountain environments are essential to the survival of the global ecosystem. Mountain ecosystems are, however, rapidly changing. They are susceptible to accelerated soil erosion, landslides, and rapid loss of habitat and genetic diversity. On the human side, there is widespread poverty among mountain populations and a loss of indigenous knowledge. As a result, most global mountain areas are experiencing environmental degradation.

The Hindu Kush-Himalayan Region, ICIMOD's mandated region, sustains approximately 150 million people from the eight countries of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. The lives of about three times that number of people are affected in the plains and river basins below. The hilly and mountainous areas of all these countries are caught in a vicious circle of underdevelopment - poverty, high population growth, environmental degradation, and deteriorating development prospects.

Degradation of mountainous ecosystems is a global problem, and the Himalayas constitute one of these threatened ecosystems. Environmental degradation in the Himalayan region is basically a product of human intervention into the uses of the various elements of natural resources, namely, land, forests, pastures, water, and minerals. The scale and dimensions of degradation have been further enhanced by ecological sensitivities, or fragilities, to disturbances, and the consequences of disturbance are often irreversible. The mountains of the Himalayas, which make vital contributions to agricultural production, are threatened by cultivation of marginal lands due to an expanding population; in many areas this is accompanied by excessive livestock grazing, deforestation, and loss of biomass cover.

Any type of land resource can be destroyed by inappropriate management practices, and rehabilitation of damaged land is easy in some cases and more difficult in others. Sloping lands with thin layers of topsoil, such as those found in mountain areas, with high intensity rainfall or high speed winds, are more difficult to rehabilitate when mismanaged than, for instance, lands with deep fertile soils on well-drained plains. Increased soil erosion, decreasing land productivity, frequent landslides, loss of biodiversity, and eventual desertification and abandonment are some of the commonly encountered land degradation problems in mountain areas.

Insofar as human interventions influencing land use in mountain areas are concerned, there are many. Population growth is often cited as a cause of land mismanagement, particularly in circumstances in which a rapidly increasing population has few non-land based income and employment opportunities. If commercialisation of agriculture is seen to be economically desirable, it is also being realised that technologies accompanying such commercialisation in mountain areas have overlooked resource degradation aspects

almost completely. In addition there are also complications arising out of tenurial arrangements that govern incentives and disincentives affecting resource conservation and exploitation. Inappropriate development policies also play an important role in determining how land is used - particularly in the context of how much degradation is permitted before concrete and corrective steps are undertaken.

The impact of land degradation extends very deeply into the economy and the environment. On public lands, the immediate impact is the loss of forest cover which directly affects fuelwood and fodder supply and, through changes in livestock output, influences household food and income levels. On private lands, the impact is seen in terms of lower output of different land-based products. The long-term effects on the ecosystems are even greater, resulting in irreversible loss of productive resources, options for survival, and habitable environments. While these are on-site effects, the off-site impacts of increasing land degradation and its economic consequences in mountain areas have not been given much attention so far.

The Need for Viable Solutions

In most areas of the HKH showing signs of land degradation, it is usually small farmers who are suffering. Given their extremely poor resource base, it seems sensible to argue that small farmers do not willingly destroy the basis of their survival. The search for solutions must therefore begin from an understanding of the land user's decision regarding the allocation of resources. Unfortunately the knowledge basis in this respect is very poor. Unless better understanding is developed of the users' perspectives and the options available, solutions are unlikely to be sustainable. Among the principal foci of this programme are the following: to systematically identify and document the land degradation problem, to make a comparative study of farmer options, and to identify land rehabilitation options in different mountain ecosystems.

The issue of land resource management is not just an environmental problem. If the problem can be traced back to basic economic, demographic, cultural, and technological forces, its solutions also lie in improved management of available natural resources, an efficient and productive farming system, a rapidly expanding infrastructural base, and expansion of non-agricultural employment opportunities such as tourism. Thus, in addition to improved land resource management activities, many of the solutions for better land resource management must come from inputs provided by other programmes. The Mountain Environmental Management Programme of ICIMOD focuses on some of the important natural resources of mountain areas, such as land, forests, water, watersheds, and biodiversity, in order to examine the problems and potentials of integrated mountain development.

Project on Rehabilitation of Degraded Lands

This project is to examine comprehensively the problems of degraded lands in different mountain ecosystems of the Hindu Kush-Himalayan Region. It's main objectives are:

- to develop a better understanding of the extent, forces, and processes underlying land degradation and
- to identify measures for restoring and developing degraded lands in different mountain ecosystems, by using options that are field tested and found to be economically, environmentally, and socially viable.

Alternative approaches to solving degraded land problems can be divided into three basic categories.

- Direct interventions in degraded lands, focussing on various types of land maintenance activities, changes in land use, and many other related on-site activities affecting soil erosion, land productivity, etc.
- Indirect interventions such as those dealing with development of suitable technology, reforms in land holding and tenurial structures, reducing population pressure, land use planning, and policy-related incentives or disincentives for promoting desirable land use.
- Interventions outside degraded lands focussing on off-farm employment, intensification of land use in other more suitable areas, and reduction of off-site impacts.

The role of any one of these three will vary from place to place, but all three of these should be carefully considered. Obviously, for on-site developments, the direct interventions are important and will account for all of the field work. The need for careful understanding of how farmers are using their land resource and the prevailing limitations to changes become critical when we consider alternatives. The other two types of intervention become more relevant when one is considering the long-term sustainability of land use. If policies continue to encourage mismanagement, any amount of on-site improvement will become ineffective after

some time. If alternative off-farm employment opportunities are not available, the growing population will increase pressure on limited land resources. It is therefore important to understand the need for and role of all these different types of interventions.

Activities

- Identification of Degraded Mountain Ecosystem Sites and Collaborating Institutions

  So far, four of the five research sites have been identified for purposes of the project. The sites were selected on the basis of ongoing land degradation and the extent to which it can be restored. Details on the sites are given in Table 1.

- Workshops

  In view of the wide heterogeneity of mountain ecosystems, including major differences in socioeconomic processes, it was considered to be very useful for collaborating agencies to meet and discuss alternative approaches to the problem. The first workshop was organised with this objective and discussed and recommended methodologies to be followed by participating institutions. A second workshop is expected to be held at the end of the programme in order to discuss the important findings and to put together a proposal for a training programme in techniques for restoring degraded lands, based upon the inputs developed in this Phase.

- Field-Work Based Case Studies

  Each of the participating countries/institutions representing different types of mountain ecosystems have selected sites that are considered to be degraded. The sites are being carefully studied for their current social, economic, and environmental characteristics. A systematic land use picture will be developed with the identification of different agroecological zones and their potentials for use. Over a three-year period, steps will be taken to improve land conditions. The measures will vary from place to place. All decisions and activities will be carefully monitored. A comprehensive case study will be prepared by a multidisciplinary team in Godavari (ICIMOD Headquarters' Complex). ICIMOD will also use its site in Nepal for directly organising and coordinating such a field-based case study. These case studies will be extensively discussed during a Workshop meeting to be organised at the end of the project.

- Development of Training Materials for Restoration of Degraded Lands in Mountain Areas

  Findings from programmes such as this, based upon evaluation of farmer activities and field testing of alternatives, provide a good basis for developing sustainable land use programmes and policies. These will have important implications for programmes in agriculture, forestry, watershed management, and many other sectors. One of the best ways of promoting useful ideas and techniques for improved land management will be through regular training programmes, either at a regional level or in specific countries. Such a training programme will be based upon inputs provided by the case studies. The second workshop will discuss this issue extensively and will provide a basis for developing a training programme on the restoration of degraded lands.

  Materials for dissemination purposes will focus on publication of relatively simple handbooks, video films, poster-pictures, and slides. The training programme itself, however, can be undertaken only at a later phase and not during this grant period.

Duration of the Study and Complementary Activities

The study covers a period of 36 months, starting from May 1992. After some preliminary work, based on available literature and information, was completed, field surveys were conducted by the project coordinators.

The methodology workshop reviewed the methods and approaches proposed here in the light of existing gaps in information and discussed and determined upon country specific issues and options to be explored in the country studies. Technologies and approaches for field-work based studies in different mountain ecosystems, which are considered to represent different degraded land types, were deliberated upon at the workshop.

Country collaborating institutes have initiated implementation at the selected sites. With the local people's active participation, the team will develop the experimental system(s) for implementation at the degraded land sites. Planting activities will begin in June 1993. Management and monitoring of the rehabilitation process on experimental trial

plots will be conducted during the two years after planting.

Expected Output

- Project Implementation Report
  - -Annual Progress Report
  - -Final Report
- Five Case Studies (4 country + ICIMOD)
- Two Workshop Reports
- Dissemination Materials such as Video Film (I), Poster Pictures, and Slides showing methods of restoring degraded lands in mountain areas.

Collaborating Institutions and Field Sites

The programme is being supported by a grant from the International Development Research Centre (IDRC), Canada. The research is being carried out in collaboration with institutions in China, India, Nepal and Pakistan.

Country-wise Collaborating Institutions for the Project are as follows.

China

- Kunming Institute of Botany, CAS
- Kunming Institute of Ecology, CAS
- Chengdu Institute of Biology, CAS

India

- G.B. Pant Institute of Himalayan Environment and Development, Almora, Uttar Pradesh

Nepal

- Users' Groups of Degraded Forest Lands, Kavre-Palanchowk District,
- Kavre Palanchowk District Forest Office, Bagmati Zone

Pakistan

- Pakistan Forest Institute, Peshawar

Field Sites in Four Countries of the HKH Region

Field sites for implementing action-research/demonstration on rehabilitation of degraded lands in different types of mountain ecosystems in the region have been selected in close consultation with, and through the active cooperation of, the local people/collaborating institutions/local authorities in China, India, Nepal, and Pakistan, as shown below.

Proposed Tasks for the Workshop

The objectives of the workshop were to: (1) Reflect on project-initiated activities and assess the current status of land degradation in mountain ecosystems in the HKH Region; (2) discuss methods and alternative approaches identified for each of the case study areas of the project; and (3) develop a detailed 2-year action plan for implementing the project in participating countries of the project.

Table 1: Field Sites

Country	China	India	Nepal I	Nepal II	Pakistan
• Name of Site and Location	• Damai Village in Baoshan of Yunnan alt. 1,380-1,526m	• Kausani in Almora U.P. alt 1,600-1,800m	• Godavari in Lalitpur of Bagmati 1,600m	• Panchkhal in Kavre-panchkhal of Bagmati 900-1,000m (2 separate sites)	• Five field sites have been surveyed in April and one site among the five will be decided upon by the concerned collaborating institutions
• Land Area for Planned Activities	• 150 ha sloping land	• 30 ha sloping land	• 3 ha sloping land	• 24 (7+17) ha sloping land	
• Land Ownership	• Community degraded lands and marginal farming lands	• Community degraded lands and institute demonstration land	• 3 ha sloping land at Godavari site under ICIMOD management	• Community degraded forest land	

Workshop Proceedings

The workshop proceedings can be subdivided into two parts: 1) reports on the experiences of individual country projects and 2) presentations on approaches and technologies for developing a consolidated methodology for the rehabilitation of degraded lands.

Country reports reflect the varying biophysical conditions of the project sites, socioeconomic status of area residents, government policies, and team capabilities (training, manpower, and financial resources). As this workshop was held in the initial months of the project's first phase, not all participants were familiar with ICIMOD's specific objectives and approach. Country reports, therefore, may be seen more as background papers rather than project descriptions.

The approaches and technologies presented may have or may not have been attempted by the country teams. The purpose of their inclusion in the workshop was to spark interest and discussion on their usefulness and appropriateness. It should be noted that ICIMOD has provided basic guidelines to be followed for rehabilitation of the sites, but that development of a more detailed model is a process requiring all participants to reflect on the learning acquired from mistakes and successes during the project period. Refinement of the guidelines can occur only in the second workshop. In the meantime, country teams should proceed to enact the approaches outlined by the guidelines as best they can, given their abilities and access to data, manpower, and other resources.

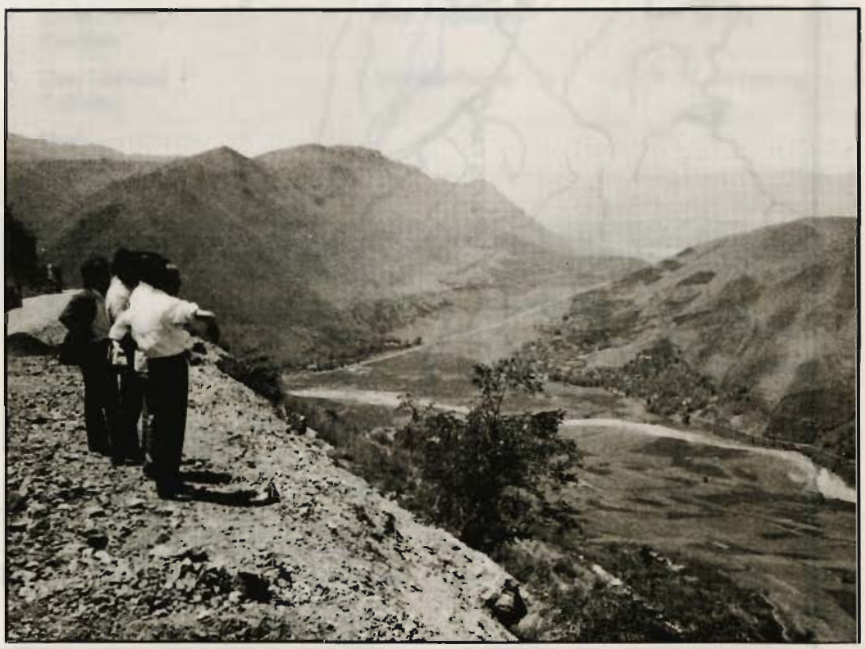
Country Reports

China

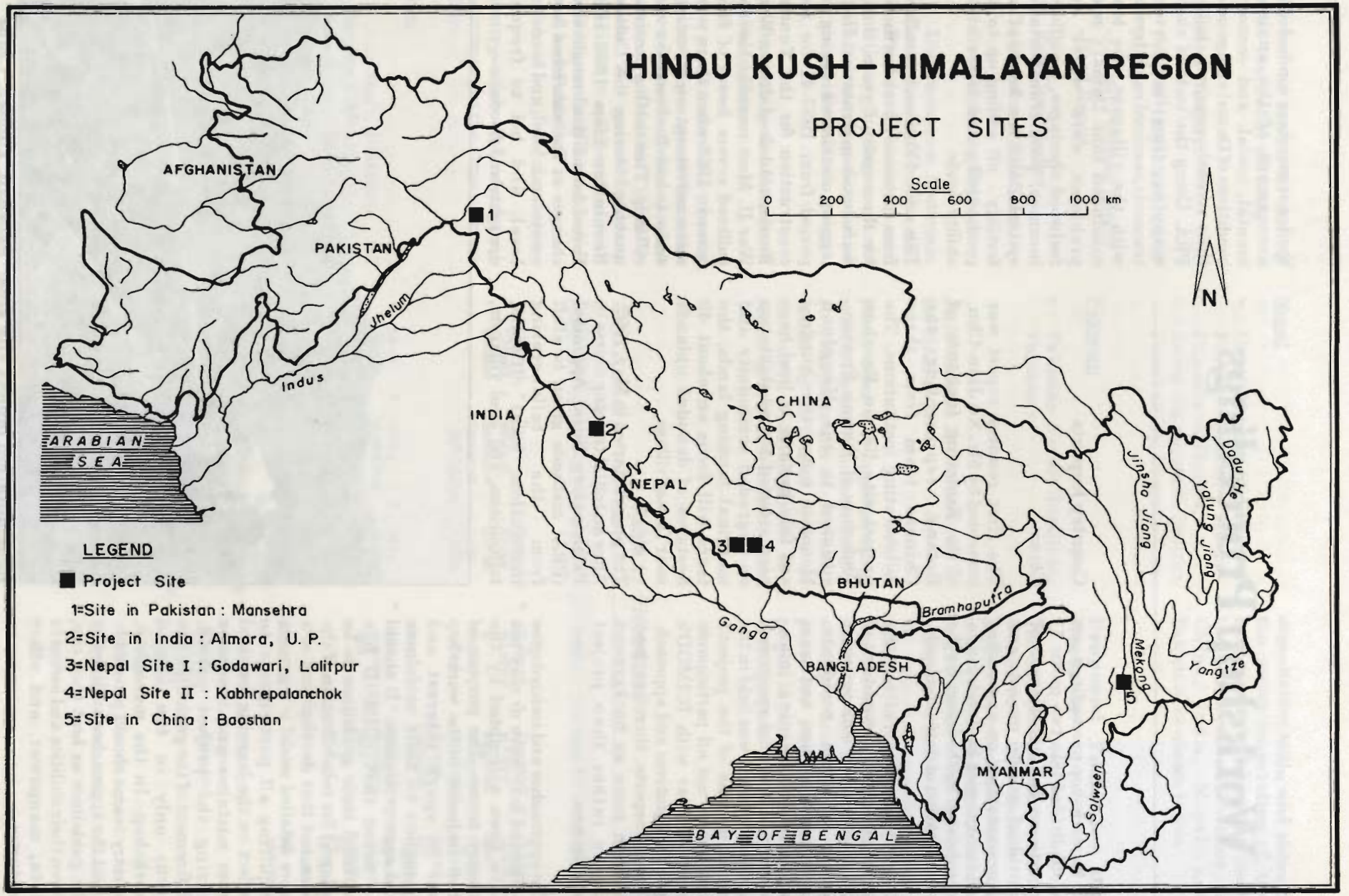
The first country report was presented by **Mr. Xu Jian-Chu**, of the **Kunming Institute of Botany**, representing the Chinese team from three collaborating institutions. The project site lies in Baoshan Prefecture of Yunnan Province, situated in the Hengduan Mountain range. One hundred and fifty hectares of land have been selected for rehabilitation on degraded community and marginal farming lands; the team will focus on about 40 hectares of denuded uplands near Damai village.

The project started in May, 1992. After an initial training course in Participatory Rural Appraisal (PRA) methods given to staff from the collaborating institution, local officials, technicians, and local villagers, the team members conducted an assessment of the environmental, social, and economic conditions of Damai village using their recently acquired skills in PRA. Using the tools of sketch mapping, time-line history, transects,seasonal calendars, etc with the villagers, the team concluded that Damai's main problems were water and fuelwood shortages, insufficient incomes, poor transportation systems, and low levels of soil fertility - all adding up to low productivity and low sustainability levels.

This area of Yunnan has suffered from sustained forest destruction for thousands of years, during wars between dynasties. Heavy logging continued during the period from 1937-41 for road construction for the Yunnan-Burma road used during World War II. Most recently, the area suffered severe losses of forest cover in 1958 when there was a mass movement on a national scale to cut fuelwood for steel refining. This cutting continued unabated during the Cultural Revolution from 1966-1976. Forest denudation brought about changes at the watershed level, ecosystemic level, and household level, and led to frequent droughts and floods.



Rehabilitation project site area: Baoshan, Yunnan, China


HINDU KUSH–HIMALAYAN REGION
PROJECT SITES
Scale
0 200 400 600 800 1000 km
N
AFGHANISTAN
PAKISTAN
Jhelum
Indus
ARABIAN SEA
INDIA
CHINA
NEPAL
BHUTAN
Bramhaputra
Ganga
BANGLADESH
MYANMAR
BAY OF BENGAL
Salween
Mekong
Yangtze
Jinsha Jiang
Yalung Jiang
Dadu He
1
2
3
4
5
LEGEND
Project Site
1=Site in Pakistan : Mansehra
2=Site in India : Almora, U. P.
3=Nepal Site I : Godawari, Lalitpur
4=Nepal Site II : Kabhrepalanchok
5=Site in China : Baoshan

Problems identified through PRA techniques were grouped under the headings of: forest denudation, land mismanagement, weak institutions, and low incomes. For each of the causes contributing to these problems, the team has come up with measures for rehabilitation. These measures include engineering controls, vegetative restoration, improved farming practices, strengthening of institutions, and provision of income-generating opportunities.

The team has constituted a committee of farmer representatives and local officials which has completed the construction of contour lines and canals, for the purpose of planting multipurpose tree species, and furrows between the contour lines for planting nitrogen-fixing shrubs and crops. Broad-leaved species will be planted in the upland area, and tree crops for income generation will be planted on the lower slopes during the next rainy season. A nursery has been established, and palm trees and forage crops planted along terraces for bank stabilisation. Soil samples have been analysed and three runoff plots set up for monitoring purposes. Farmer-to-farmer visits are planned for later this year.

A series of slides demonstrated the severe degree of overgrazing and complete lack of forest cover in some areas of the site.

India

Dr. B.P. Kothyari of the G.B. Pant Institute of Himalayan Environment and Development in Almora, Uttar Pradesh, presented the report of the work completed by his team to date. Dr. Kothyari stressed that the project had just begun in March 1993, so that he would draw on experience from similar projects of his Institute to present the report.

The selected site is located in the Kosi Valley in the Almora District in the Kumaon Himalayas, approximately one km from the village of Katarmal, at an altitude of 1,600-1,800 metres. The hilly landscape consists of both abandoned agricultural terraces as well as community lands previously used as community pasture lands until the early 1970s.

The approach of the Institute team is to first understand the causes of degradation, then restore the land to its original state through the application of a technology package developed by the Institute. As determined by the team, the reasons for land degradation in this area are: migration, land fragmentation, annual clearing of shrubs, tree cutting, fire, soil nutrient erosion, decreased water resources, reduced soil fertility, and land abandonment. This information was obtained through household survey techniques and through census data.

Table 2: Measures for Rehabilitation of Degraded Land Identification of Problems

Problems	Forest Denudation	Land Management	Weak Institutions	Low Income
	• Surface Erosion	• Crude Farming Practices	• Weak Regulations	• Poverty
	• Mud-Rock Flow	• Over Fuelwood Collection	• Unstable Policies	• Less Farming Input
	• Flooding	• Over-Grazing		
	• Drought			

Measures	Engineering Control	Vegetative Restoration	Improvement of Farming Practices	Enforcement of Institutions	Income Generation
	• Checkdam	• Nursery Development	• Contour Cultivation	• Tenure Security	• Cash Crops/Trees
	• Reservoir Rehabilitation	• Communal Reforestation	• Alley Cropping	• Farmer Participation	• Home Garden
		• Multipurpose Hedgerows	• Organic Fertiliser	• Community Participation	
		• Biogas Demonstration	• Crop Rotation		
			• Soil-Water Conservation and Soil Fertility Enhancement		
			• N-Fixing Trees/Crops		

Water-harvesting technology is being used in Almora, U.P., India, at one ICIMOD rehabilitation project site

The Institute has a standard methodology through which to rehabilitate degraded lands, and it includes the following steps: mapping; determination of soil genesis; determination of site characteristics; soil and land amendment through application of manure; selection of plant species, with input from villagers; collection of hydrological data; collection of data on soil microbial components; introduction of cash crops; selection of inputs, such as manure, water, and microbes; and monitoring the improvements.

In summary, the Institute's programmes for rehabilitation are based on three components of research, development for protection measures and soil and water improvements, and education for awareness amongst local inhabitants. The team has planned for the initial five years of project activities and hopes that the work can be sustained over a ten-year period.

Nepal - Site I, ICIMOD Complex Site, Godawari

A report made on the progress at one of the two sites in Nepal, the ICIMOD Complex at Godawari, was presented by **Mr. Bal Ram Bhatta**, an ICIMOD staff member. This 30 hectare plot, just 15 km southeast of Kathmandu, was provided to ICIMOD by the Government of Nepal to develop for trials and demonstration purposes. Once well stocked with valuable tree and other plant species, the forest has been degraded to one of fewer and less useful species through continuous removal of desired trees, grazing by livestock, and fire. Hardy, agressive, 'useless' weed species now dominate the area which still has maintained organically rich soils.

The site can be physiographically divided into three distinct ecological zones, each of which is to be managed differently:

- flat land/ valley floor for intensive farming - consisting of weedy vegetation on rich soils of swamp and grasslands, this area is to be used for floriculture, horticulture, fisheries, apiary, nurseries, etc;
- intermediate gentle slope area for conservation farming/ agroforestry (SALT I, II, III and IV) - using models of SALT technologies, this area will be planted with fruits, vegetables, medicinal plants, fodder trees, shrubs and grasses, cash crops, and nitrogen-fixing hedgerows; and
- high steep slopes for forestry - this area will be intensively managed as a natural forest to encourage natural regeneration and improvement of stand quality. Harvesting and utilisation techniques will be tested here as well.

In addition, watershed management and water harvesting technologies will be applied and monitored at various points throughout the area.

On-site demonstration of fruit-tree planting at the Kavre site, Nepal

To date, the ICIMOD team has completed mapping exercises and has begun the baseline surveys on soils and biomass. A nursery has been established, and the area is being protected through a combination of measures of biofencing, social fencing, and guards. Work has begun on the preparation and planting of SALT models.

Nepal Site II - Kavre District

Prof. Suresh Raj Chalise of ICIMOD presented the report on Nepal Site II which consists of two sites in Kavre Palanchowk District, east of Kathmandu. Both sites are seriously degraded due to changes in land use that occurred in the 1960s, when malaria was brought under control and forests came under the pressure of large-scale movements of people from the uplands. Since then, indiscriminate felling of trees and open grazing by livestock has prevented the recovery of these forests, resulting in large pockets of highly degraded lands within this district of Nepal.

A key factor in the selection of these areas for rehabilitation measures was the keen interest shown by local residents to participate in such efforts. Support from the District Forest Officer and from a Mountain Resource Management project (associated with ICIMOD) in the area were also attractions for choosing these sites. After considerable deliberations were made on how to best ensure people's participation, it was decided that the most appropriate collaborating institution would be the two local Users' Groups formed to manage the forests; as is allowed and promoted by recent HMG forest legislation. The Users' Groups have already started to protect the area from grazing and illegal encroachment and will be responsible for implementation of the Project's activities.

A workshop was held to train members of the Users' Groups in PRA methods and on how to identify and prioritise the key problems which should be addressed by the project. Other training sessions have focused on the use of A-frames to establish contour lines, and on nursery establishment and management. Both groups have set up nurseries through voluntary contributions of labour. Baseline surveys, including those of socioeconomic conditions, will be carried out soon.

Villagers collect litter from community forest land for compost, Kavre Palanchowk, Nepal

Prof. Chalise emphasised the importance of keeping in mind the issue of long-term sustainability when designing and implementing rehabilitation programmes. Technical support and guidance, an improved supply of basic need items, possibilities for cash income sources, and uses of new technologies are the appropriate forms of assistance that this project can provide to the Users' Groups of Kavre Palanchowk District.

Pakistan

Due to the late arrival of Pakistani participants, the country report for Pakistan was presented by **Mr. Balaram Bhatta** of ICIMOD. Mr. Bhatta had recently returned from an initial visit to Pakistan to develop the project proposal with staff members from the collaborating institute, the Pakistan Forest Institute (PFI) in Peshawar.

The site selected for the project is at Bagar Mung, in the Mansehra District, falling in the catchment area of the Tarbela Reservoir on the Indus River. Reservoirs and dams being constructed on this river are endangered by high siltation rates from the degraded watershed areas of the Indus and Jhelum rivers.

Preliminary work on the topographical survey has already begun. A vegetation survey will also be conducted, and a soil and land use map prepared. Water flow and sediment yields will be monitored at the outlet of the catchment. Climatic data are available from a nearby meteorological station, and rain gauges will be set up within the catchment area.

Different treatments will be provided according to the slope, soil condition, current land use practices, and owners' wishes concerning lands within sub-catchment areas. Options for project activities include: terrace improvement, multi-purpose tree planting on terrace risers, sloping agricultural land technologies (SALT) with horticulture and nitrogen-fixing species, pasture improvement with grasses and fodder trees,

timber tree planting. checkdam construction, fish pond construction, and apiculture.

The project team will consist of seven staff members with expertise in various technical subjects and watershed management. Buildings, laboratories, and library facilities are available in Peshawar and at Shinkiari near the project site.

Approaches and Technologies

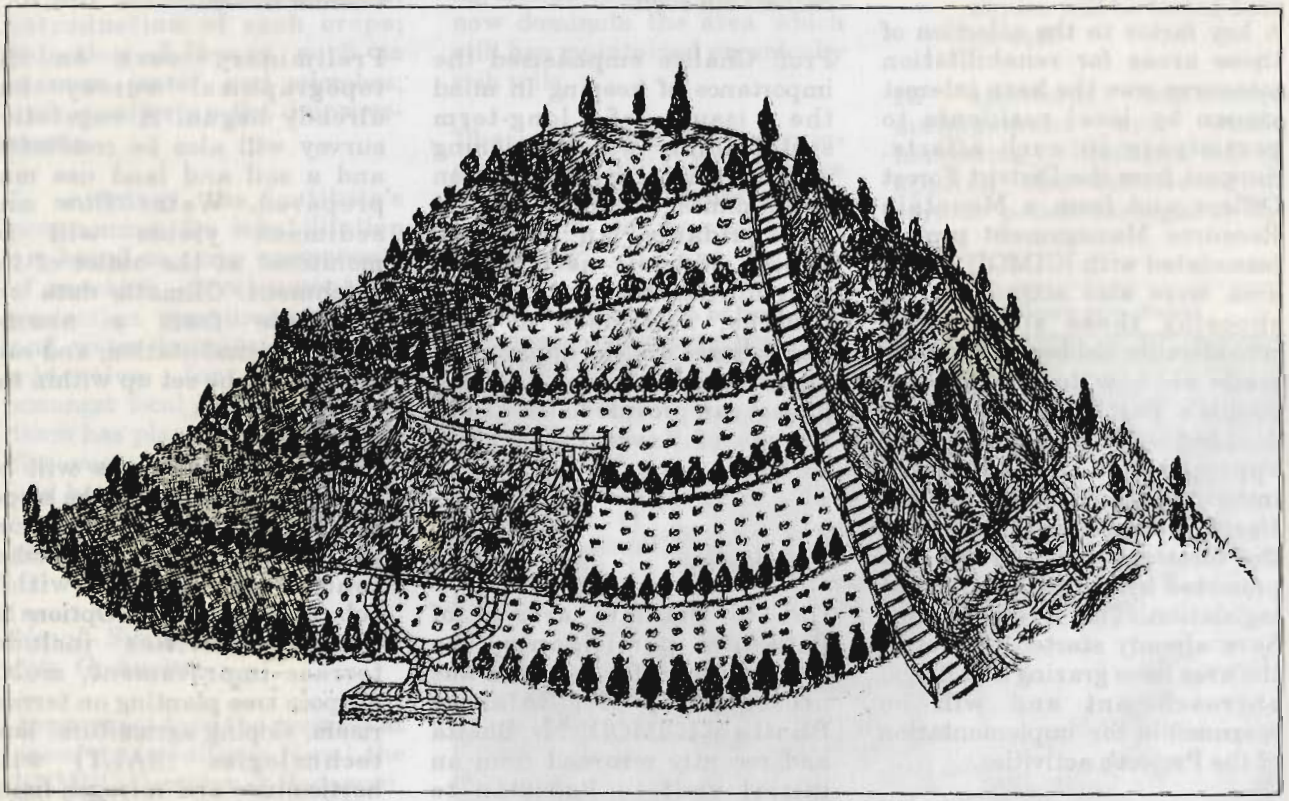
Nepal Mountain Resources' Management Project and Methodologies Adopted for Monitoring Soil and Water Erosion in the Project Area

Mr. P.B. Shah, Coordinator of this Cooperative Research Project, began his presentation with slides demonstrating the project site and its activities. The Jhikhu Khola watershed, some 40 km east of Kathmandu lies in a densely populated area where land use has been intensified through a triple cropping regime on valley land, accompanied by a high level of fertiliser and pesticide use. With sponsorship by IDRC, this research project was initiated to identify and quantify soil erosion, hydrological/sedimentation, and soil fertility processes in relation to land-use changes. Since its inception in 1988, the Project has compiled a considerable inventory and process-oriented data base for initial evaluation by setting up a climatic, hydrological, sediment, and erosion monitoring programme; conducting socio-economic surveys using Rapid Rural Appraisal techniques; and using a Geographic Information System (GIS). A multidisciplinary team was assembled to conduct the research.

Data on water flow, sedimentation, and erosion were evaluated at three levels: watershed (11,000 ha), sub-watershed (600 ha), and erosion plot (0.01 ha). A separate monitoring system was set up for each component.

Mr. Shah explained that sediment originates from the following sources: upland cultivated fields; degraded lands; stream banks; long-term storage areas, such as paddy fields; and non-agricultural structures such as roads and irrigation canals. Outward sloping terraces contribute significantly to sediment loads.

Sediment is transported through drainage networks and human manipulations, with differing rates according to the season, year, or event. Measurements of water, sediment movement, and erosion are collected at hydrometric stations throughout the basin. Erosion plots were established on sloping terraces to monitor rates of soil erosion from site-specific areas with differing slope, aspect, land use, and landform. Detailed site surveys were carried out at 10 cm contour intervals for soil analysis, cropping sequences, fertiliser application, and response, etc.



Trial Plots

Water Storage and Harvesting Technology for Rural Development in the Indian Himalayas

Dr. B.P. Kothyari of the G.B. Pant Institute of Himalayan Environment and Development shared the experiences of his Institute with water storage and harvesting methods through a slide and talk presentation. Emphasising that technologies must be simple, cost-effective, productive, and acceptable to local residents, he pointed out that sloping areas limit the potential for water harvesting. Water can be stored for limited domestic use - not for irrigation purposes.

By constructing tanks with sloped walls appropriate to hill conditions, water for use in nurseries, tree plantations, and vegetable gardens on degraded lands can be provided, even during the dry season. The simple addition of water can raise the productivity levels of vegetables and fodder trees and grasses significantly. Dr. Kothyari presented a series of diagrams detailing the construction of such water harvesting tanks and the sedimentation tanks which are built alongside them.

A new technology for nurseries has also been used and promoted by the Institute, employing seedling trays instead of the commonly used plastic bags. This technology was found to reduce the amount of soil required and to cut transportation costs. Post-transplantation survival rates were also found to be higher with seedlings from the seedling trays.

Biological Technology for Rehabilitation of Degraded Mountain Lands Caused by Soil Erosion and Debris Flow in Yunnan, China

Prof. Qiu Xue-Zhong of the Kunming Institute of Ecology presented many slides of the project site in Nanjian County, Dali Bai Prefecture, of northwest Yunnan, showing how biological control methods have been incorporated into traditional engineering approaches to control debris flows.

The slides showed the extreme degradation of the area and the damage caused by the mud and rock flows. Since 1990, a team of experts has been attempting to contain several deep gullies through various alterations of checkdams built with local materials of bamboo, stones, and vegetation to halt their spread. Trial plots of introduced species of *Eucalyptus, Cassia siamea, Cajanus cajan, Acacia mearnsii*, shrubs, and grasses have been established along the contour lines; bamboo is planted in the gully bottom. Sedimentation tanks have been constructed every 100 sq.m. in the trial plots.

Social Aspects of Rural Resources' Management

Hand-in-hand with biological and engineering techniques to regenerate degraded lands is the need for social methods to understand and address the conditions and concerns of local residents. **Ms. Jeannette Gurung** presented some of the methods used to gain the participation of local villagers in planning, implementation, and monitoring of project activities.

Most degraded lands belong to the category of common property resources (CPRs). These lands have lost their productivity because of growth in population and consumption rates, exploitation by persons from outside the community, and breakdowns in the management controls traditionally enforced through consensual regulations, traditional leaders, cultural taboos, and so on. As the resource is continually subjected to these and other pressures over time, the CPR is degraded, the indigenous practices and controls over its use are abandoned and forgotten, the communities themselves cease their conservation-oriented practices, and the cycle spirals downwards.

It is only through the will and actions of community members themselves that these lands can be made productive again. Therefore, their participation in projects right from the beginning is imperative for successful results. This has been proven after a history of failures in such

Group Discussion

projects around the globe has shown how mere technical measures applied to land rehabilitation have neither been effective nor sustainable.

It is important for project staff to identify the appropriate actors to involve in project decisions. They must determine who is in control of the land, who makes decisions related to its use on a daily and long-term basis, and who depends on its products. Often it is the poorest of the community who are most dependent on CPR resources; women in this region are often the users and decision makers. These groups should be brought fully into the process, as should leaders of local organisations, community leaders, and those who possess knowledge related to the traditional ways of managing the land.

The staff of rehabilitation projects can use various methods to understand the community's resources and structures, and to establish rapport with them. PRA provides a set of tools for and guidelines on how to communicate with rural people. The process of identification and development of users' groups has been described by the Nepal Australia Community Forestry Project in its publications. Participatory Assessment methods provide for maximum participation by community members in assessment of their own problems, identification of solutions, and monitoring of results. A review of indigenous knowledge related to resource management is a method through which one can learn about the knowledge base on which to build with new technologies. This can best be conducted with the assistance of 'key informants' from different groups of users. Farmers can then be introduced to a 'menu' of new technologies from which they can select those with which to experiment. Income-generating activities can be introduced to provide immediate incentives to participants and to assist the poorer users. Mushrooms, honey, fruits, nuts, mulberry leaves, resin, medicines, fibres, and craft items, have been harvested from CPR land throughout the HKH Region to bring in significant cash resources to mountain communities.

Prerequisite to this people-oriented approach, however, is the reorientation of project staff to be responsive to the needs of local people. Skills in communication are required, as well as a degree of respect for the knowledge and lifestyles of rural people. Community participation does not mean "getting those people to do what we want."

Action Research for Community Forestry

One social method for involving people in the rehabilitation process was described by **Mr. Bill Jackson** of the Nepal-Australia Community Forestry Project (NACFP). Action Research has been adopted by this forestry project in Nepal as a learning process approach for translating concepts and plans into action for rural development.

Action Research is a participative method involving local people and requiring deliberate and conscious reflection on project experiences so as to learn from errors and make changes in plans accordingly. It is a holistic approach to a problem, allowing for the variation and complexity that characterise social systems and for the incorporation of local people's perspectives that may otherwise go unheeded.

The NACFP began in 1978 with a conventional approach to establishing plantations , then shifted in the 1980s to a participatory development-from-below approach by focusing its efforts on bringing villagers into the planning and implementation process. After observation and reflection, another shift occurred with the realisation that the objective of improving community forest management by local users was still not being met. As the staff experimented and looked for factors limiting their success, they recognised several other aspects that required attention, and developed plans and models accordingly.

Mr. Jackson concluded that, because action research can embrace both the hard sciences and soft sciences, it is a valuable approach to problems related to human - natural environment interactions.

Sloping Agricultural Land Technology (SALT)

Sloping Agricultural Land Technology (SALT), a soil conservation-oriented farming system developed in the Philippines, was described by **Mr. Bal Ram Bhatta**, as one technique to rehabilitate degraded lands. SALT is an agroforestry technology to diversify farming on hilly lands and increase biomass production through simple, low-cost practices. It aims to reduce soil erosion and build up soil fertility levels through propagation of nitrogen-fixing tree, shrub, and grass species and slope stabilisation measures. Different models of SALT have been developed to meet the priority needs of specific sites for crops (SALT I), livestock and fodder (SALT II), forestry (SALT III), and multipurposes (SALT IV).

ICIMOD introduced SALT in Ningnang County, Sichuan Province, China, as an experimental pilot project which began in 1991. The project area, covering 7.8 ha of degraded land, has been planted with nitrogen-fixing trees on the contours as hedgerows and cash crop species in between the

contours. This technology has now spread to farmers outside the project area.

Mr. Bhatta emphasised that SALT is not intended to replace the terrace system, such as that predominant in much of the HKH Region; rather it is a system to improve the productivity of lands above those terrace lands where terraces cannot be constructed and maintained.

Permaculture Techniques

Mr. Raju Shrestha of INSAN, Nepal, gave a slide presentation on the principles and techniques of permaculture as an approach to a return to sustainable agriculture suitable for degraded lands in the HKH Region. INSAN has developed three demonstration farms for permaculture to serve as research and demonstration sites and to provide seeds and advice to local farmers. It carries out training on permaculture design on a regular basis.

Questions/Discussion from Workshop Participants

Questions from the participants following the presentations on technologies and approaches were on the comparison of erosion levels between terrace farming and SALT systems; the selection of proper species for the hedgerows of SALT models; the costs of constructing water harvesting tanks; the type and effectiveness of fencing used by the NACFP; and the wisdom of the new technology for seedling propagation which may not provide sufficient good soil to justify the plantation of seedlings on difficult sites; the production of fodder plants from the confined land areas of the project sites in terms of a larger number of livestock; and the costs of landslide control technologies, as well as the costs of biogas technology.

A request was made for suggestions from the Chinese participants on practices which could be used in other country projects. Suggestions were as follows:

- select deep-rooted, drought-resistant species which are fast-growing; indigenous species and are preferred due to their resistance to harsh conditions;
- experiment first with selected species in the first year before wide-scale promotion and use local well-adapted species for cash-generating plantation.
- transport fertile soil or compost into the planting holes before planting, use large-sized seedlings for planting; investigate seed-germination rates before sowing if direct planting of seeds is carried out in the field;
- place fertile soil in the contour lines and plant indigenous grasses there, building ground cover with grasses and shrubs in the first year of the exercise as a key to the control of soil erosion; and
- use improved biogas technology which is available in China - a one-family biogas facility costs only two hundred US Dollars for construction.

Workshop group discussion

Field Trip

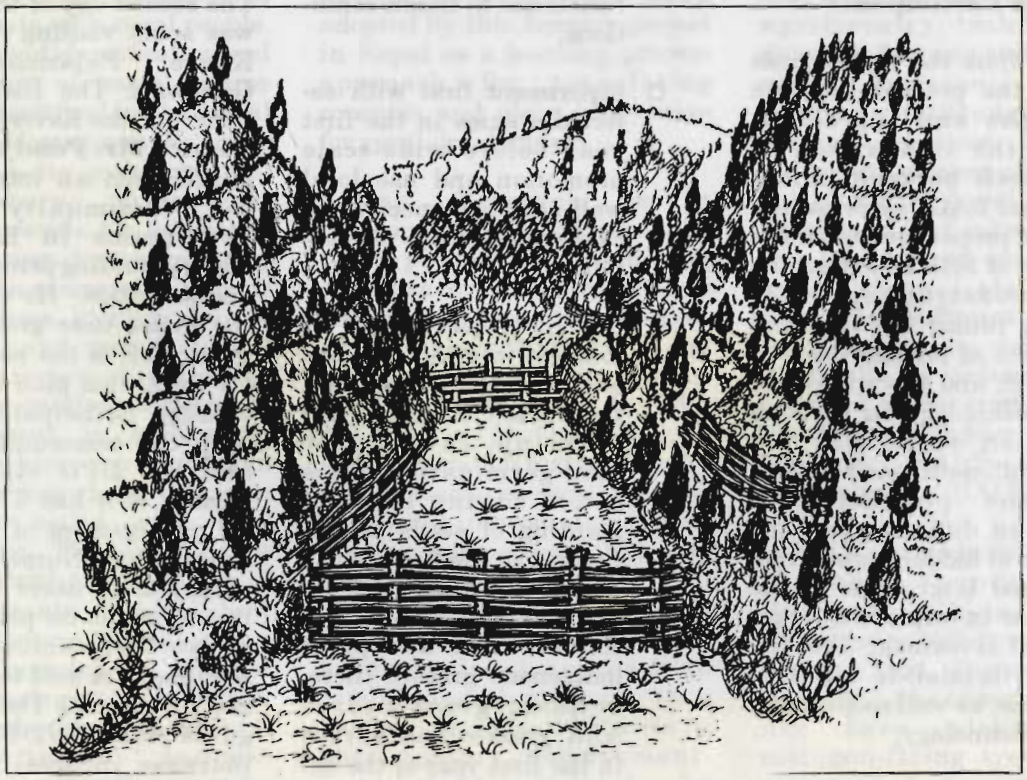
The second day of the workshop was spent visiting field sites in Kavre Palanchowk and Godawari. The District Forest Officer of the Kavre Palanchowk District, **Mr. Poudyal**, gave the participants an introduction to the Community Forestry Programme in Kavre - its history, guiding principles, goals, and activities. He stressed that the forest user group management plan is the starting point for work; this plan is developed through participatory methods with the community members and the DFO staff. Kavre District now has 77 such plans for management of 1,300 ha by user groups. Nurseries are also managed by users to meet the requirements for plantation and private land plantings (for which seedlings are sold to farmers for one rupee each). The programme goals for 1992-93 were to increase income- generating opportunities and to support small farmers.

Following the briefing, participants journeyed to one of the ICIMOD project sites in Kavre, stopping along the way to view a sacred forest protected entirely by local residents. Prof. Chalise briefed the participants on the rationale behind selection of the site as well as on the on-going collaboration with the Forest Users' Group in implementing the project. The soil erosion testing station of the Mountain Resource Management Project was observed as well. From there, the group travelled to Godawari to view ICIMOD activities on the site of the ICIMOD complex. **Prof. Lu Rongsen** gave a presentation, summarising activities to date and those planned for the future development of the site. Participants demonstrated an interest in a number of introduced and local species planted on two types of agroforestry plots. Some participants suggested that the Godavari site is not regarded as "degraded land" but "degraded forest" and that emphasis must be placed on biomass production and cash-generating production for demonstration purposes.

Workshop participants visiting the ICIMOD field site at Godavari

Working Group Presentations

After two days of plenary sessions and a one-day field trip, working group discussions were organised on the following two days. Three working groups were engaged in methodological discussions with the purpose of consolidating methods and measurements for project implementation and monitoring. Reports from each working group were presented at the workshop. These reports are outlined on the following pages.



Bamboo Checkdam

Working Group I: Method of Baseline Studies and Methodologies of Monitoring

This group recommended that the following data be collected for baseline surveys and monitoring.

□ Mapping of the Project Area

- Location Map1:10,000 (for all project sites)
- Contour Map(Topographic Base Map) 1:1,000 contour intervals - optional depending on the availability of expertise and original maps
- Site Plan Map 1:500 specific map if any 1:200 (special purpose optional) for comparison

□ Soil and Water Status

- Soil

a) *Physical Characteristics*

i) Soil texture
ii) Soil type (colour, description of horizon, classification)
iii) Soil depth
iv) Bulk density
v) Infiltration, water holding capacity or field capacity
vi) Soil moisture

b) *Chemical Characteristics*

		Optional
i)	Soil pH	
ii)	Organic Carbon%	
iii)	Total N	
iv)	Total Phosphorous	P_2O_5 total or available
v)	Potassium	K_2O
		Micro/trace elements

Soil analysis from three depths
(i) 0-10cm; (ii) 11-20cm; (iii) 21-30cm

At least 10 samples from each site according to standard methodology

c) *Biological (Microbial)*

		Optional
i)	Fungal	Population of dominant species, and changes over the project period
ii)	Bacterial	
iii)	Actinomycites/symbionant	

Sampling of the soil from 0-10cm

d) *Earthworm Population*

i)	Population count	20 x 20 x 10cm quadrant
ii)	Costs	5 replicates

□ **Water**

- Availability of water in any form: (spring, river, etc)
  i) Within the study area
  ii) Near the study area

Quality

Record water discharge rate - regularly (high and low flows)
Qualitative test - toxicity

- Storage Management (water harvesting and storage technology)

□ **Inventory of Existing Bio-species and Biomass Production**

- Inventory

a) Flora - ground cover and trees

i)	Density	
ii)	Frequency	For grasses - 1 x 1m
iii)	Abundance	
iv)	A/F ratio	Random sampling, quadrant
v)	Relative density	
vi)	Relative frequency	Trees - 50 x 50 m
vii)	Concentration of dominance	

b) Fauna - dominant species, base line information
c) Ethno-botanical information: use all available relevant data and information, history

- Biomass Production

a) Ground flora	Sampling size will be similar to (a)
b) Trees and shrubs	inventory of flora

Biomass production should be from the following resources:

i) leaves
ii) stem (branches and fuelwood)
iii) wood (timber)
iv) underground (root, tuber)

□ **Hydro-meteorological data collection**

- Data source may be
  i) National agencies
  ii) Recording station at the site or in close vicinity (that area)

Parameters; follow national standards
- Temperature
- Precipitation
- Humidity
- Disasterous events
  - high intensity rainfall and disasters induced
  - hailstorms
  - snow
  - high winds

These events may be measured by approximation according to local farmers of the affected area. Note past history of above events.

Rain collectors to record rainfall patterns and pH variation (acid rain)

Optional Recording/Equipment
- Automatic recording station
- Radiation, sunshine hours
- Wind speed
- Soil temperature

Hydrology

A. Monitoring and Data Collection
   - Streamflow - measurement at regular intervals
   - Sediment output - sediment traps
   - Soil erosion plots - not less than $10m^2$

Optional

- Sediment traps in gullies
- Bedload traps
- Water analysis (rainwater)
- Tipping bucket

Recording should be done by a technician from that area.

□ **Socioeconomic Data of the Site Village**

- Dependency of the villagers/users on the project site or nearby area for:
  - fodder (grass)
  - fuelwood
  - timber
  - leaf litter
  - minor forest products (sal leaves, mushrooms, etc)

- Human population
  - Livestock population/composition
  - For this, secondary information/data should be used

□ **Indigenous Management of Natural Resources**

- Religion
- Culture
- Ethics

-Rules and regulations of local institutions and their effects
-Indigenous technology regarding management of the resources and their effects

□ **Video Film Record**

- A complete sequence should be recorded from project initiation to project termination
- Photos should be used to record changes
- The film should be self explanatory
- The film should record main activities
- Final editing will be completed by ICIMOD

Discussion: Several participants questioned the need for detailed surveys as proposed by this working group. It was suggested that items should be prioritised, and others listed as optional, given the available time and resources. The need for simple technologies was brought up, so as to identify replicable approaches, but the role of research was also appreciated. As a compromise, it was suggested that activities/parameters be listed as either required or optional, given the requisite resources. The costs of such research must also be kept in mind.

Group II: Socioeconomic Aspects of Rural Resources' Management

The second group presented an overall rationale and strategy for measurement of socioeconomic factors, then gave a list of some possible variables and indicators by which to measure them.

A. Why discuss social aspects?
B. What are the social variables to measure?
C. What are the indicators for monitoring?
D. What strategies should we use for collection and use of social data?

A. Collection of socioeconomic data for three purposes

- To provide the project team with an understanding of the community
- To provide baseline data for monitoring and evaluation
- To provide opportunities for maximum interaction with the community in order to gain their participation

B. Variables	C. Indicators
• Number and composition of households	• Members of the household contributing income or labour, or consuming household resources, and their sex and age
• Ethnic affiliation and homogeneity	• Members belonging to which ethnic groups or castes; religion, language, cultural facts of ethnic group
• Education/literacy levels	• Education levels, ability to read and write
• Landholdings	• Size of privately-managed holdings and spatial arrangement
• Tenure system for private and common lands	• Government-regulated and informal system of land ownership and use
• Water resources	• Water availability
• Food self-sufficiency levels	• Food levels are in excess, sufficient, shortage, or chronic shortage
• Income sources and levels	• Sale of products and handicrafts from forests; wealth ranking by observable characteristics, i.e., type of roofs and windows, radios, etc.
• In and out-migration	• Number of members engaged in temporary and permanent in- and out-migration and time spent outside community; remittances sent home
• Labour availability	• Seasonal calendar and labour demands; length of time required to collect load of fodder/fuelwood now versus before the Project
• Off-farm opportunities	• Off-farm activites engaged in by community members and income received
• Marketing system	• Nearness of markets; what is purchased and sold there by whom? exploitation by middle men
• Transportation and communication accessibility	• Roads, communication resources
• Energy sources	• List of energy sources and amounts consumed
• Use of forest resources	• Headloads of fodder/fuelwood comsumed; percentage collected from private versus common lands
• Pressure from outside on forest resources (nomads, markets, refugees)	• Cases of conflicts
• Livestock numbers and types	• Number and type of fodder-consuming animals per household; nutritional status of livestock; milk production; changes in feeding and grazing practices over time; change in percentage of feed harvested from private versus common lands over time

B. Variables	C. Indicators
• Local organisations/institutions	• Presence of local organisations and their ability to enforce sanctions, or change them as required
• Local leaders or authorities	• Reliance on outside sources, i.e., police, for conflict resolution
• Government or non-government offices providing extension services to community	• Project/staff, extensionist working in project area and services provided
• Political pressure	• Signs of political activism
• Participation by actual users	• Attendance at group meetings of members of subgroups, i.e., women, poor, landless; their roles in decision-making during planning and implementation; how many households receive benefits?
• Equity in decision-making and distribution of benefits amongst users of degraded land	• Who gets what and how much at harvest time? Are different subgroups of the community satisfied with their share?
• Cultural and religious factors	• Cultural taboos, values that affect behavior related to conservation and use of natural resources
• Attitudes of local people regarding project activities	• Interest in forest conservation; availability of other sources of forest products; evidence of adoption of technologies on private lands by farmers' own initiative; people's perceptions of change over time; has life become easier or more difficult?

D. Strategy

- Assemble Project Team from different disciplines
- Train team in PRA methods, communication techniques, participatory approaches for:

collection of baseline data using:
- PRA techniques
- secondary data sources
- observation
- informal interviews
- identification of and meetings with user groups (subgroup meetings sometimes required)
- identification of and interviews with key informants
- random sampling method to cross check data and gain more specific, quantifiable data
- understanding of indigenous knowledge

gaining people's participation through:
- PRA, identification of problems and solutions with community members
- planning for activities with them
- building on indigenous knowledge
- providing immediate benefits to them, even if not directly linked to project objectives
- providing continual training opportunities, both on-site and with cross-farm visits
- proceeding slowly with simple technologies
- flexibility

Discussion: Again, participants raised concerns about the time and financial resources needed to undertake such thorough assessments. However, one participant noted that, with the inclusion of local people on the team, and the use of PRA methods, the collection of such data would not be as lengthy as it appeared to be. It was added that time with villagers was also necessary to build trust and rapport and could be used for data collection as well.

Group III: Technologies for Land Rehabilitation of Degraded Mountain Ecosystems

Group III outlined the information needed for baseline surveys and presented considerations in the choice of technologies to be promoted. Some suggested technologies, both biological and engineering, were also described.

- **Baseline survey**
  - **Soil**
    - Texture; sand, silt, and clay
    - Structure
    - Organic matter
    - Micro-/Macro-Organisms
    - Colour (to determine predominant elements)
    - Depth
  - **Water**
    - Precipitation
    - Groundwater
    - Natural springs
  - **Slope Degree**
  - **Aspect**
  - **Altitude**
  - **Vegetation**
    - On site
    - In surrounding area
  - **History Of Land Use**
  - **Pressure On Site At Present**
    - Grazing
    - Mining
    - Collection of biomass
    - Lack of alternative sources
  - **Land Tenure**
  - **Local Institutions**
    - Level of participation
    - Interest in management
- **Considerations For**
  - A. **Biological Technologies**
    - Agroforestry
    - SALT
    - Agriculture
      - intercropping
      - mixed cropping
      - crop rotation
      - earthwork
      - mulching
      - planting pattern
    - Mixed species' afforestation
    - Division of landscape demands

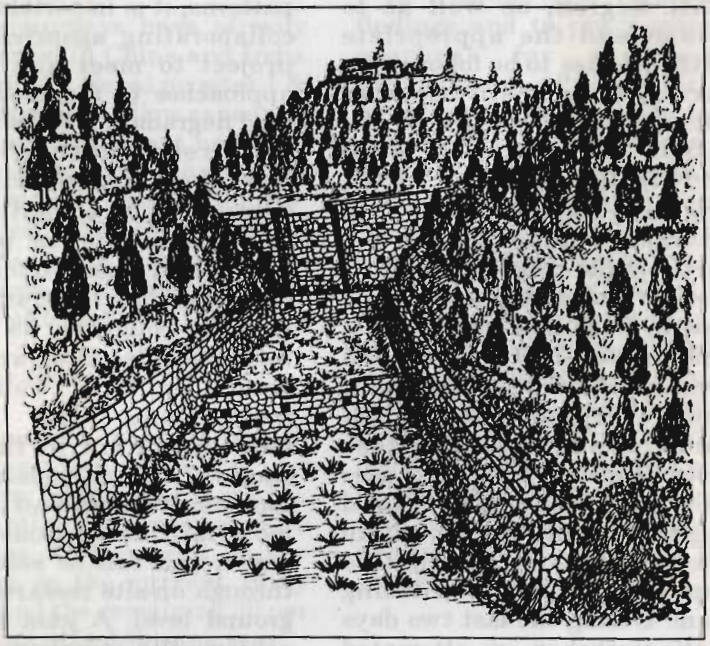
Table 1: Technologies

Biological	Engineering
Sustainable	Small-scale
Locally acceptable	Simple
Species	Transferable
• Multipurpose	
• Deep-rooted	Use of locally available materials
• Diversified	
• Fast growing	Must be integrated with biological techniques
• Specific to successional stage	
• Local	Low costs
• Nitrogen-fixing	
• Good quality seeds, saplings, cuttings	
• Compostable	
Composite Technique Implementation	

- B. Engineering Technologies

  - Checkdams
    - Bamboo - stone - wire
    - Stone-masonry
  - Diversion channels
  - Drop structure
  - Trenches
  - Water Harvesting
    - catchment ponds
    - recharge groundwater

Discussion: One participant from Nepal noted that, in the Community Forestry Project, technologies were limited to simple ones, since by law they must be implemented by the local user groups. Again, the suggestion was made to prioritise lists of activities for research, limiting them to those necessary. A different view was expressed by those who believed that "rehabilitation" of land required a rigorous research approach. The baseline survey listed in this group presentation can be seen as supplementory suggestions to the Group I presentation.



Concrete Checkdam

Workshop Conclusion and Workplan Proposed for 1993-1994

In bringing the workshop to a close, Project Coordinator, **Prof. Pei Shengji** of ICIMOD presented the highlights of major issues discussed and the proposed activities for 1993-1994. Comments and discussions related to the workshop and the workplan proposed followed the presentation.

Conclusion of the Workshop

The objective of the workshop was to bring together all the participating institutions of the project from the region to meet and discuss alternative approaches to the problems of land degradation in the mountain ecosystems of the HKH Region, as well as to recommend the appropriate methodologies to be followed by participating institutions to implement the project on the actual field sites of each participating country. In the first three days of the workshop, interaction amongst all the participants was encouraged through presentation of status reports from case study areas, visits to Nepal Sites I & II, and presentations on approaches and technologies from participants and invitees around a common theme: causes and consequences of land degradation in the mountain ecosystems and alternative approaches to rehabilitating them. During the last two days of the workshop, we attempted to consolidate methods for and measurements of project implementation and monitoring through group discussions which covered: (1) methods of baseline studies and methodologies for monitoring; (2) socioeconomic aspects of rural resource management; and (3) technologies for the land rehabilitation of degraded mountain ecosystems. A review of the highlights of issues presented at the workshop is given below along with a 1993-1994 workplan, revised on the basis of discussions held throughout the five days.

Formulating the Network for Involving All Countries Participating in the Project

In view of the wide heterogeneity of mountain ecosystems and the major differences in socioeconomic patterns, it is important for the collaborating agencies of the project to meet and discuss approaches to the problems of land degradation and strategies for rehabilitation. This workshop has provided an opportunity for all participating institutions from the region to access and share information concerning land degradation in different countries, as well as methodologies that are being used by the concerned institutions for project implementation in the early stages. Land degradation is a common problem faced in all the mountain ecosystems of the region and can be solved only through on-site research at the ground level. A joint effort to achieve the objectives of the project through all the collaborating institutions has brought up a number of methodological issues that were discussed at the workshop. These include the composition of baseline studies of the field site, community participation, appropriate technologies for land rehabilitation on the actual field sites, and methods for monitoring the conditions of the project site. From the country status reports presented and the discussions that followed, methodological issues were identified and discussed. Not all details of the approach have been worked out; some require further study. We have, however, moved the project implementation into the field-work stage and commenced networking amongst ourselves.

Use of Proper Technology Identified for Project Implementation and Monitoring

From country reports and technical reports presented at the workshop, technologies for land rehabilitation, using both formal knowledge and indigenous knowledge, and methods for monitoring land degradation and rehabilitation in the mountain ecosystems have already been proposed and discussed by participants. In view of the nature of the project and its limitations, we must keep in mind the importance of the use of proper technology. Collaborative institutions may have their own research interests that could be also integrated into the technologies identified at the workshop. The application of practical technologies for soil erosion control, enhanced soil fertility, and the generation of farmer-needed products from the degraded lands are the priorities. Research components must reflect the objectives of the project; data and information collection should be designed in line with the purpose of rehabilitating degraded lands.

The definitions of land degradation and rehabilitation need also to be addressed. For example, the Nepal site I at Godavari is basically forest land

that has degenerated into shrub land. Some participants suggested that the site is not degraded land because it is covered with shrub vegetation; others suggested that the Godavari site is useless land like a 'green desert' without much productive use and can therefore be considered to be degraded forest land. However, this workshop was not able to address in detail these issues of terminology.

The Consolidated Methodologies as Guidelines for Implementing the Project

One of the important outputs from this workshop is the consolidation of methodologies, as generated during the last two days of group discussions. Participants generally agreed with the guidelines for country collaborating institutions, as a whole, to be followed in the field-based case studies. Some participants suggested that guidelines for baseline studies should be comprehensive enough to include all biophysical elements. Others doubted that this would be possible due to constraints of time and funding. A solution to this problem would be to categorise the elements of the baseline survey into required and optional compo- nents, giving some flexibility to each country collaborating institution to make their own decisions.

Guidelines for socioeconomic aspects of rural resource management were also consolidated at the workshop. The work in this area has been rather weak to date; it is important for us to improve. The use of PRA methodologies for site surveys in China and methodologies used in community forest development in Nepal, as introduced by participants, are good examples of these aspects.

Both biological and engineering technologies for rehabilitation were outlined as guidelines for the project. According to different field sites and conditions, implementation of these technologies must be locally acceptable and ecologically suitable. Indigenous knowledge should be incorporated, for instance, by use of local species for fodder, fuelwood, hedgerows, fruit, and timber; by use of local materials, such as bamboo and rock for construction of simple checkdams; and by use of small-scale water harvesting technologies.

Proposed Workplan for Project Implementation in 1993-94

As the project is six months behind the schedule agreed to by the donor agency, IDRC, and ICIMOD, the real challenge for ICIMOD and country collaborators is to advance project implementation activities as quickly as possible, especially as planting activities on the field sites must be mostly completed in this monsoon season. The main points of the workplan appear below.

Baseline Studies

Baseline surveys have already been started in China and India and partly in Nepal on sites I & II. Pakistan will follow as soon as the project agreement has been approved by the concerned government departments. Completed baseline studies for all field sites are expected by September 1993 (except for the site in Pakistan).

Planting Activities

In the second year of project implementation, seedlings and land were prepared at four sites for planting. We proposed to complete 70 per cent of the planting in the current rainy season and the remaining 30 per cent during the following year.

Supporting Activities

The construction of water harvesting, checkdam, and energy-saving infrastructures, and training in related technologies at site locations, will be carried out during the second half of this year.

Monitoring System

Monitoring of project implementation should commence at the same time as planting in June-July, 1993. Soil-erosion control plots should be established on all field sites by no later than December 1993.

A database for managing the project should be established at each collaborating institution by October 1993.

Annual progress reports from country collaborating institutions should be submitted to ICIMOD by the 1st of December each year. The final report should be submitted by March 1st, 1995.

Second Workshop of the Project

A second workshop of this project was planned for the end of Phase I to discuss the important findings and to put together a proposal for a training programme (Phase II) for restoring degraded lands, based upon the inputs developed in this phase. Some participants suggested that the second workshop be held in China because implementation work on the China site was started first and the site is relatively larger than others in terms of the land involved (150ha) and villagers involved (136 households of farmers). However, the final decision for the timing and venue of this workshop will be made next year, depending upon the progress made in field implementation.

Extension of the Project

In view of a six month delay in commencing project activities, it will be necessary to extend the

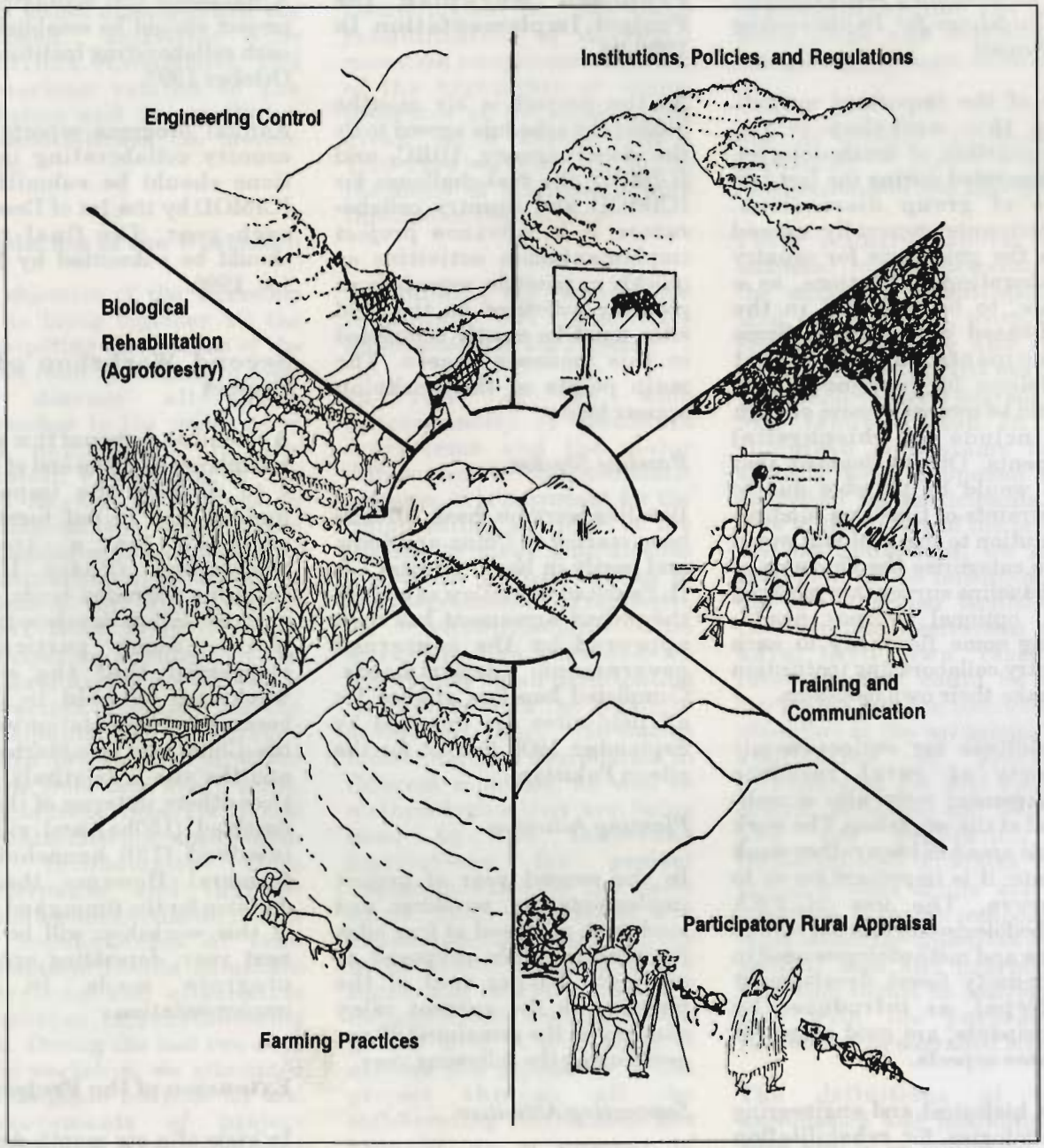
project for another four months to the end of April 1995. A proposal for extension of the project will be submitted to IDRC, Canada, in due time after the workshop. A proposal for the second phase of the project was suggested by all collaborating institutions. It is necessary for ICIMOD to formulate a formal proposal and submit it to IDRC in early 1995.

Comments from participants on the concluding session of the workshop and the proposed workplan for 1993-94 were positive. Participants from the Pakistan Forest Institute (PFI) have extended their willingness to collaborate with the project once their Government approves the project.

The Closing Session

Dr. Tacke closed the five-day session with his congratulations to the participants and a reminder of the urgency of commencing with planting activities during the current rainy season.

In his review of ongoing work at the ICIMOD Complex at Godawari, Dr. Tacke remarked that, although not a seriously degraded area, Godawari provides an opportunity for recognising the potential of the site for increased use and productivity through more intensive management. In closing, he thanked the participants for their hard work and deliberations.



Integrated Rehabilitation of Degraded Lands in Mountain Ecosystems

Appendix 1

ICIMOD Methodology Workshop on Rehabilitation of Degraded Lands in Mountain Ecosystems of the Hindu Kush-Himalayan Region
May 29 - June 3, 1993
Kathmandu, Nepal

PROGRAMME SCHEDULE

MAY 29, 1993: Participants arrival at Summit Hotel which is about 3km away from the ICIMOD office

MAY 30, 1993

09:30-10:30 a.m. Registration at ICIMOD Conference Hall

10:30-11:15 a.m. **Session I** **Opening Session** Chair: Dr. E.F. Tacke

- Opening remarks from Dr. E.F. Tacke, Director General, ICIMOD
- Brief Report on ICIMOD Project on Rehabilitation of Degraded Lands in Mountain Ecosystems of the HKH Region by Prof. Pei Shengji

11:15-11:30 a.m. Tea Break

11:30-12:45p.m. **Session II: Country Reports: 20 minutes for each report and 10 minutes for discussion**

Chair: Prof. Pei Shengji
Rapporteur: Ms. J. D. Gurung

- Country Report from China by Mr. Xu Jian-Chu, Kunming Institute of Botany, CAS, China
- Country Report from India by Dr. B.P. Kothyari, Institute of Himalayan Environment & Development, India

12:45-1:45p.m. Lunch Break

2:00-3:30 p.m. **Session III: Country Reports (continues)**

- Country Report from Nepal Site I (Godavari) by Mr. B.R. Bhatta, ICIMOD
- Country Report from Nepal Site II (Kavre) by Prof. S.R. Chalise, ICIMOD

3:30-3:45 p.m. Tea Break

3:45 - 5:00 p.m. Country Report from Pakistan

- General Discussion and Comments on Country Reports
- Concluding Remarks by Chairperson

6:30 p.m. Reception and Dinner at Summit Hotel

MAY 31, 1993 **Field Trip** Organiser: Prof. S.R. Chalise & Mr. B.R. Bhatta

09:30 a.m. Participants leave for Kavre site by bus from ICIMOD office

10:30-11:00a.m.	Visit District Forest Office, Kavre. Mr. B.R. Paudyal gave a presentation on Community Forest Management in the Kavre Palanchowk District.
11:00-12:30a.m.	Visit to Kavre site and Nepal Mountain Resource Management Project Site in the same area. Professor S.R. Chalise and Mr. P.B. Shah briefed participants respectively on site activities.
12:30-1:30p.m.	Lunch at Dhulikhel Mountain Resort
1:30p.m.	Leave for Godavari Site from Dhulikhel by bus
3:00-4:00p.m.	Visit Godavari site; during the visit Prof. Lu Rongsen briefed participants on site activities
4:00p.m.	Leave for ICIMOD office from Godavari site.

JUNE 1, 1993 **Session III: Approaches and Technologies**

Chair: Prof. Pei Shengji
Rapporteur: Ms. J. D. Gurung/Ms. Charla Britt

9:30-11:00a.m. Presentation on Technologies and Approaches that are used for Rehabilitation of Degraded Lands in different Mountain Ecosystems.
20 minutes for each presentation and 10 minutes for discussion

- Mr. P.B. Shah: Nepal Mountain Resources' Management Project and Methodologies Adopted for Monitoring Soil & Water Erosion in the Project area
- Dr. B.S. Majila: Water Storage & Harvesting Technology for Rural Development in the Indian Himalayas
- Prof. Qiu Xue-Zhong: Biological Technology for Rehabilitation of Degraded Mountain Lands Caused by Soil Erosion and Debris Flow in Yunnan of China

11:00-11:20a.m. Tea Break

11:20-12:45a.m. **Session III: Approaches and Technologies (contd.)**

- Ms. J. D. Gurung: Social Aspects of Rural Resources' Management
- Mr. W.J. Jackson: Methodologies for Forest Users' Groups in Nepal
- Mr. B.R. Bhatta: Sloping Agricultural Land Technology (SALT)
- General Discussion on methodologies that are being used at different sites in the Project Areas

12:45-1:45p.m. Lunch Break

Session IV: Working Groups

Working Group I Methods for Baseline Studies and Methodologies for Monitoring

Convener: Dr. B.P. Kothyari
Rapporteur: Mr. P.B. Shah

- Mapping the Project Area
- Soil & Water Status
- Inventory of Existing Bio-Species and Biomass production

Working Group II: Socioeconomic Aspects of Rural Resources' Management

Convener: Mr. Xu Jian Chu
Rapporteur: Ms. Jeannette D. Gurung

- Local Organisation
- People's Participation
- Community Forest Management
- Food Production
- Cash Generation and Marketing Linkages
- Cultural Aspects of Resource Management

Working Group III: Technologies for Land Rehabilitation of Degraded Mountain Ecosystems

Convener: Mr. B.R. Poudyal
Rapporteur: Ms. Charla Britt

- Biological-control Technology on Degraded Land
- Agronomic Technology on Critical lands
- Engineering Rehabilitation Technology on Degraded Lands
- Water-harvesting Technology
- Agro-forestry Technology
- SALT

1:45-5:00p.m. Working Group Session in three meeting rooms (Tea Break at 3:30 p.m.)

7:00-9:00p.m. Video film show at ICIMOD Conference Hall
Organiser: Prof. Lu Rongsen

1. Seabuckthorn
2. Biological Control of Debris Flow & Soil Erosion

JUNE 2, 1993: Working Group Session (Continued)

9:30-11:00a.m. Group Discussion and Consolidation

11:00-11:20a.m. Tea Break

11:20-12:45p.m. Group Discussion and Consolidation

12:45-1:45p.m. Lunch Break

2:00-3:30p.m. **Session IV: Reports from Working Groups**
Chair Person: Prof. Pei Shengji

1. Working Group I: Report by Mr. B.P. Kothyari (25 minutes)
   Comments and Consolidation (25 minutes)
2. Working Group II: Report by Ms. Jeannette D. Gurung (25 minutes)
   Comments and Consolidation (25 minutes)

3:30-3:50p.m. Tea Break

3:50-5:00p.m. Session IV Continues

3. Working Group III: Report by Prof. Chalise (in 25 minutes)
   Comments and Consolidation (25 minutes)
4. Conclusion of the Session: Chairperson

JUNE 3, 1993	Workshop Closure Chairperson: Dr. E.F. Tacke
9:30-11:00a.m.	1. Proposed Workplan for the Project in 1993-94, by Project Coordinator, and Comments on Proposed Project Work Plan 2. Remarks from Director of Programmes, ICIMOD 3. Concluding Remarks from the Chair
11:00-11:30a.m.	Tea Break
11:30-12:45p.m.	Individual activities with ICIMOD staff members
12:45-2:00p.m.	Lunch at ICIMOD Guest House
2:00-3:30p.m.	Participants visit the ICIMOD MENRIS facilities and receive GIS Briefing
3:30-4.00p.m.	Tea Break
4:00 p.m.	Participants' Departure

Workshop participants

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- Prof. Lu Rongsen
- Mr. P.B. Shah
- Ms. Jeannette Denholm

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LIST OF WORKSHOP PAPERS

China: Country Reports

- Participatory Rural Appraisal for Project on Rehabilitation of Degraded Lands in Mountain Ecosystems - A Report from Damai Village, Baoshan, P.R. China. Prepared by Kunming Institute of Botany, CAS, China.
- Rehabilitation of Degraded Lands in Mountain Ecosystems: Project Progress Update Report of Baoshan Site in China. Prepared by Kunming Institute of Ecology, Chengdu Institute of Biology, CAS.

India: Country Report

- Status Report on Mountain Ecosystem Rehabilitation/ Restoration in the Himalayas. Prepared by Kothyari, B.P. et al., G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, India.

Nepal: Country Report Site I

- Site I, ICIMOD Complex site, Godavari, by Mr. B.R. Bhatta

Nepal: Country Report Site II

- Rehabilitation of Degraded Lands in Mountain Ecosystems, Country Report: Nepal Site II, by Prof. S.R. Chalise

Pakistan: Country Report

- Project Proposal for Rehabilitation of Degraded Lands in Mountain Ecosystems of the Pakistan Himalayas

Approaches and Technologies

- Methodology Adopted for Monitoring Soil and Water Erosion, by P.B. Shah
- Action Research for Community Forestry - The Case of the Nepal Australia Community Forestry Project, by W.J. Jackson
- Sloping Agricultural Land Technology (SALT): A Suitable, Sustainable Technology for the Environmental and Economic Development of Poor and Degraded Mountain Ecosystems, by Bal Ram Bhatta.
- The Biological Control of Mountain Torrents and Mud-Rock Flow in Nanjian County, Yunnan Province of China, by Qiu Xuezhong.

COMPOSITION OF DISCUSSION GROUPS

Group I: Methods of Base-line Studies and Monitoring Methodologies

Venue : Conference Room

Group Members

- Dr. B. P. Kothyari (Convener)
- Mr. P. B. Shah (Rapporteur)
- Mr. B. R. Bhatta
- Prof. Yang Qi Xiu
- Prof. Pei Shengji
- Prof. S. Chalise (Part-time)

Group II: socioeconomic Aspects of Rural Resources' Management

Venue : MENRIS Meeting Room

Group Members

- Mr. Xu Jian Chu (Convener)
- Ms. Jeannette Denholm (Rapporteur)
- Mr. W. J. Jackson
- Dr. B. S. Majila (Part-time)
- Prof. Pei Shengji (Part-time)
- Dr. S. Z. Arifeen

Group III: Technologies for Land Rehabilitation of Degraded Mountain Ecosystems

Venue : MFS Meeting Room

Group Members

- Mr. B. R. Paudyal (Convener)
- Ms. Charla Britt (Rapporteur)
- Dr. B. S. Majila
- Prof. Tong Shaoquan
- Prof. Lu Rongsen
- Prof. S. Chalise
- Dr. M. Hanif
- Mr. R. Shrestha
- Prof. Qiu Xue Zhong

ABSTRACTS OF METHODOLOGY PAPERS

Participatory Rural Appraisal for the Project on Rehabilitation of Degraded lands in Mountain Ecosystems - A Report from Damai Village, Baoshan, P.R. China - Kunming Institute of Botany

The author of this paper provides the reader with background information on the biophysical and socioeconomic details of the site selected for this rehabilitation project in the west of Yunnan Province. The information was gathered by using Participatory Rural Appraisal methods. The PRA methods were used to gain an understanding of the problems and opportunities presented by these degraded lands and to formulate action plans for their rehabilitation in order to relieve poverty.

Over 90 per cent of Yunnan Province, China, consists of mountainous and sloping terrain with slopes of more than eight degrees. An area of approximately 18.7 million hectares is classified as marginal land, caused by over-logging, over-grazing, inappropriate farming practices, and natural disasters.

Forest cover was significantly altered by three major events in China's history. The war against Japan, resulting in military invasion in the 1940s; the national mass movement for steel refining in 1958; and the massive cutting of forests for timber and fuelwood during the cultural revolution decimated this area's forests. In addition to these factors, the increasing demands of the growing population for food, fuel, timber, and even cash income placed additional strain on the forest resources. Crop residues replaced fuelwood, fodder shortages led to overgrazing of pasturelands, and mismanagement of uplands led to further deterioration.

The biggest problem identified by the community was that of water supplies. Only one-third of paddy rice land is irrigated, and from a distant source; this causes continual conflicts amongst farmers. Small ponds and reservoirs often dry up, and a serious drought in 1992 caused a drop in food production by 40 per cent.

Fuelwood shortages are faced by two-thirds of the population. Unable to access fuelwood from government reforested lands, farmers spend a lot of time collecting small pieces of wood and digging up stumps. One half of the households buy fuelwood from the market. The need for fuelwood for tobacco curing intensifies the problem.

Most uplands have been abandoned due to grazing pressures and the unproductivity of soils there. This has brought about a decrease in the number of livestock held by households interviewed.

Soil erosion and mud-rock flows commonly cause damage to paddy fields and houses in Damai village. Severe gullies and landslides can be seen in the upland areas.

Cash incomes are derived from the sale of sugarcane and livestock. However, sugarcane market prices are not high, and livestock is often affected by diseases. Off-farm work is also an important source of cash.

Ecological Environment and Mud-Rock Flow in Nanjian County of Yunnan Province - Kunming Institute of Ecology

Researchers at the Kunming Institute of Ecology surveyed degraded sites in seven counties within Yunnan Province to select one for detailed investigations and the application of ecological engineering methods for rehabilitation work. They selected Nanjian County and have presented here a description of that site.

Nanjian County is situated in northwest Yunnan, in the southern part of the Dali Bai nationality Autonomous Prefecture. People of the *Yi*, *Han*, *Bai*, and *Miao* nationalities inhabit this region.

Nanjian town is located at the base of two mountains, on a plain of ten square kilometres, with Nanjian river threading its way through the centre. Due to mud-rock flows, the riverbed is elevated above the surrounding farmland, which is rich and fertile due to alluvial soils. Previously, the area was forested with evergreen broad-leaved trees. Historical factors and population pressures have brought about forest degradation and soil erosion, resulting in the formation of mud columns with scattered pine trees on mountain tops. Despite the barren conditions, farmers continue to cut grass and trees here, dig plant roots, and graze their livestock.

Huge gullies have formed, bringing down torrents of rock, mud, and water during monsoon rains. In 1986, this debris

inundated the first floor of a department store in the town and damaged roads, fields, houses, and bridges in the valley. The safety of town dwellers is threatened whenever a rainstorm occurs.

The severe degree of mud and rock flow here causes the development of different types of land formations - steep walls, deep gullies, clay poles, etc.

The Kunming Institute of Ecology team has already begun to collect specimens, establish nurseries, and identify biological-cum-engineering methods of controlling mud-rock flow damage and restoring the land to be recovered with plants and eventually restoring productivity.

Action Research for Community Forestry: The Case of the Nepal Australia Community Forestry Project - W.J. Jackson

In this paper, the author defines action research and describes it in the context of rural development by presenting a case study from a community forestry project that seeks to involve people in their own development.

While there are numerous definitions of action research, the common feature is the intertwining of research with action through a conscious and deliberate cyclical process of observing, reflecting, planning, and acting. It involves social systems in which the researcher is a part, seeking out practical solutions to problems with the participation of villagers, and allowing the researcher to learn of different world views and opinions. The author describes various models of action research, providing figures and diagrams to supplement his characterisations.

A key step in the process is the reflection on the situation which can challenge assumptions on which project planning is based. The author describes a key shift in the focus of NACFP that came about during the process of deliberate reflection, bringing about the formulation of new concepts and their testing. Early phases of NACFP held a predominant concern with the creation of resources (plantations), first through a technocratic, top-down approach then through a participatory, bottom-up approach. Once the project team realised, through action research, that the objective of community forestry to improve the management of local forests was not being met, the shift was made to focus on the management of existing and new forests rather than the establishment of plantations. This new concept was then tested and refined.

Further enquiries led to an understanding that local administrative units of the Government were inappropriate institutions for effective management of local forests and, sometimes, produced conflicts and inequities at the village level. The concept of 'users groups', based on usufruct rights to forest resources, emerged from the subsequent reflections of the staff. This finding led to the focus on forest user groups as the new entity responsible for management. Both the Master Plan for the Forestry Sector, Nepal (1989), and the recently approved Forest Act of 1993 acknowledge the user group as the focus for community forestry in Nepal.

Many of the issues of community forestry development are social rather than technical, making the problems unclear to forestry staff. Because action research can embrace both the hard and soft social sciences, it is a valuable approach when dealing with problems between people and the natural environment as, for example, in rehabilitation projects.

Sloping Agricultural Land Technology (SALT): A Suitable, Sustainable Technology for the Environmental and Economic Development of Poor and Degraded Mountain Ecosystems - B.R. Bhatta

SALT is a soil-conservation oriented farming system developed in the Philippines in the late 1970s. It is described by the author through definitions, diagrams, and species' lists in this paper. Its suitability to mountain characteristics and their implications are presented in tabular format; universal elements of SALT systems and elements present in SALT systems of the HKH Region are described in the document.

SALT is a relatively simple, practical, low-cost and environmentally appropriate method of diversified farming on hilly lands for the sustained production of biomass at different altitudes and with minimal soil erosion. Under the SALT system, degraded slopes are divided into strips of land for cultivation and separated by double hedgerows of leguminous trees or shrubs planted along contour lines. These hedgerows act as erosion barriers to stabilise slopes, increase soil fertility, and provide fodder, fuelwood, and biomass. Numerous combinations of annual and perennial species are possible, with or without livestock and forestry components. Three basic types of SALT systems can be distinguished: SALT I is a crop-based system, SALT II is a livestock-based system with emphasis on fodder crops, and SALT III is forestry-based, often practised on steeper and higher slopes.

SALT systems can contribute to increased productivity through higher yields, resulting fro[illegible]n nitrogen fixation and hu[illegible]n availability due to mulchi[illegible]aus second contributing fa[illegible]ng. A higher level of diver[illegible]co[illegible] is a farming system, [illegible]sity in the and harvestin[illegible]g of diversified crops are st[illegible]aggered throughout the year, complemented by livestock and forestry enter-

prises. This results in better utilisation and efficiency of both land and labour; it also ensures income generation throughout the year.

SALT systems have the potential for improving farming systems in the HKH Region, but they require trials and demonstrations on steeply sloped terraced lands before being widely promoted. This system can provide many advantages over conventional farming systems typical of the HKH Region, for example:

- steep-slope farming without need for terracing
- multiple benefits through diverse species, regular incomes
- nutrient recycling and soil protection
- versatile, multi-storey planting
- relief of dependence on common property for livestock feed.

ICIMOD has initiated an action-cum-research project to test SALT on degraded lands in Sichuan Province, China, as an initial site. It is hoped that, if successful, SALT systems can be introduced to farmers throughout the HKH mountains.

Methodology Adopted for Monitoring Soil and Water Erosion - P.B. Shah

The author describes a research project that was undertaken to examine soil erosion, hydrological/sedimentation and soil fertility processes in relation to land-use changes in the Jhikhu Khola watershed, east of Kathmandu. Intensive mapping and monitoring were carried out from the beginning; the initial work involved basic resource mapping (topography, geology, land use, geomorphology, soils, active erosion) and setting up a climatic, hydrological, sediment, and erosion monitoring programme using Rapid Rural Appraisal methods and a Geographic Information System to evaluate the data.

Water flow, erosion, and sedimentation are key processes in the study of resource sustainability in Nepal. Removal of topsoil is a fundamental problem in soil management, and sedimentation downstream causes siltation problems in irrigation channels and hydropower generating reservoirs, leading to increased flooding of fertile lowlands. Although the role of natural forces in the Himalayas is not to be ignored, human-induced erosion is also a major cause of the degradation. Irrigation, road construction, slope modification, fodder and litter collection, and grazing are just some of the causes of soil movement and sedimentation.

There are no standard techniques for conducting quantitative studies of erosion rates in the Himalayas, because of the unusual physiographic setting, the enormous magnitude of these processes, extensive terracing of slopes, and extreme variations in microclimatic conditions. Therefore, the methodology of this research necessitated the establishment of separate monitoring systems for the watershed, sub-watershed, and erosion plot components of the system. Water flow, erosion, and sedimentation were evaluated for each of these components. Data so far analysed show that most of the erosion results from a few intensive storms, primarily occurring in the early and late monsoon season.

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Founding of ICIMOD

The fundamental motivations for the founding of this first International Centre for Integrated Mountain Development were widespread recognition of the alarming environmental degradation of mountain habitats and the consequent increasing impoverishment of mountain communities. A coordinated and systematic effort on an international scale was deemed essential to design and implement more effective development responses to promote the sustained well-being of mountain communities.

The establishment of the Centre is based upon an agreement between His Majesty's Government of Nepal and the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) signed in 1981. The Centre was inaugurated by the Prime Minister of Nepal in December, 1983, and began its professional activities in September, 1984.

The Centre, located in Kathmandu, the capital of the Kingdom of Nepal, enjoys the status of an autonomous international organisation.

Participating Countries of the Hindu Kush-Himalayan Region

- **Afghanistan**
- **Bangladesh**
- **Bhutan**
- **China**
- **India**
- **Myanmar**
- **Nepal**
- **Pakistan**

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