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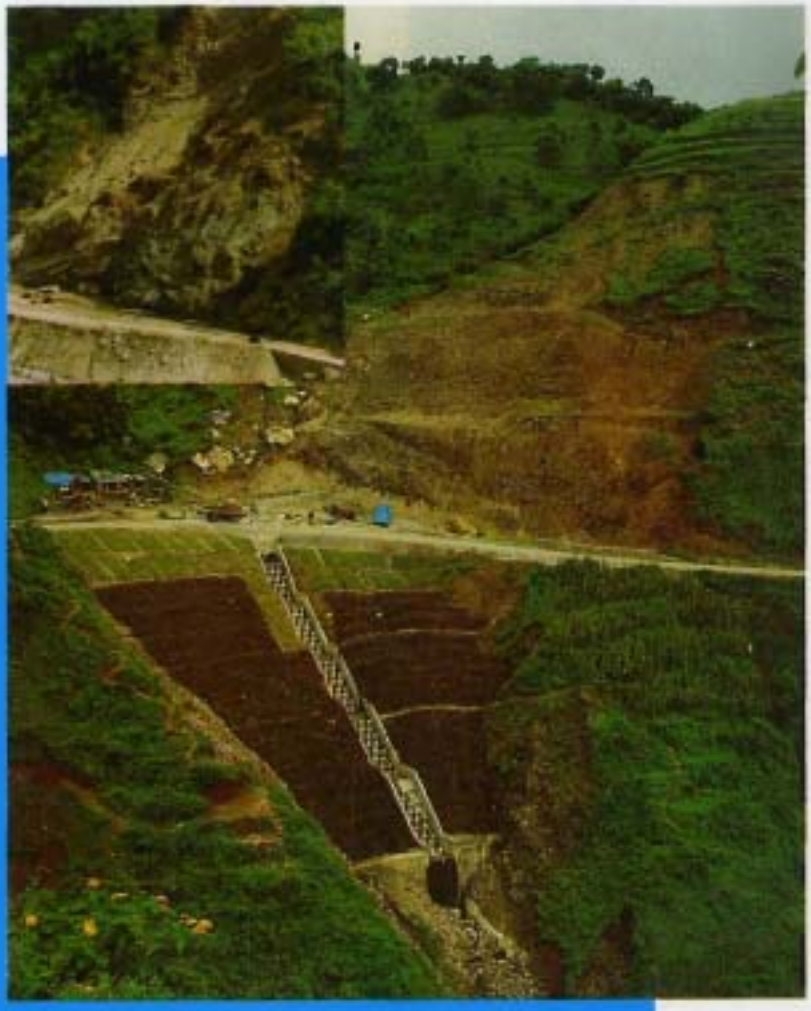
Landslide Hazard Management and Control in the Hindu Kush-Himalayas

A Report on the Regional Workshop
held in Kathmandu
July 12-14, 1995



Editors

S.R. Chalise
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Organised by
International Centre for Integrated Mountain Development
Kathmandu, Nepal

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Foreword

The inherent unstable nature of mountain areas is a well recognised fact. Steep slopes, unstable geology, and the intense monsoon rains combine to make the Hindu Kush-Himalayas one of the most hazard-prone areas in the world. Historical and anecdotal evidence from local people suggest that natural hazards of varying intensity occurred frequently in the past. However, in the Hindu Kush-Himalayan countries hazard-prone areas are increasingly being occupied for human activities as a result of population pressure as well as improved accessibility through roads and other infrastructural development. Consequently, natural and man-made disasters are on the rise and each event affects an even greater number of people than before. Floods and landslides during the monsoon season are the most common natural disasters affecting this region every year, resulting in great economic and environmental losses as well as causing a great deal of suffering.

Despite such scenarios, the present levels of understanding and analysis of disasters are very poor and databases are virtually non-existent. There are no monitoring activities, not even where they can be of direct benefit to project-related management activities. Also, investment in developing practical guidelines for managing such events and in forecasting has been inadequate.

It is with these concerns that ICIMOD has recently initiated a programme on Landslide Hazard Management and Control. Several activities have already been undertaken in this programme and the Regional Workshop was one of the major activities to develop linkages and establish a long-term relationship among institutions and experts engaged in landslide hazard mitigation and control from the Hindu Kush-Himalayan countries, as well as those from outside the region.

The primary concern of the Regional Workshop was to identify priorities for a regional collaborative training programme on landslide hazard management and control in accordance with the needs and priorities of the Hindu Kush-Himalayan countries. The present document shows that much progress has been made in this context. Many thanks are due to the participants who used their combined knowledge and experience in designing a number of concrete activities in the field of Landslide Hazard Management.

ICIMOD will implement these activities in close cooperation and collaboration with national institutions of the Hindu Kush-Himalayan countries, relevant UN agencies, and international institutions in close liaison with global initiatives and programmes, e.g., the International Decade for Natural Disaster Reduction (IDNDR).

On behalf of ICIMOD, I would like to express my sincere appreciation to the Government of Japan for the generous support for the Landslide Hazard Management Programme, including this workshop.

Egbert Pelinck
Director General
ICIMOD

Chapter 1

Introduction to the Workshop

The concern for the widespread poverty and degradation of the environment in the Hindu Kush-Himalayan mountains led to the establishment of International Centre for Integrated Mountain Development ((ICIMOD) in Nepal in December 1983. Since its establishment, ICIMOD has been actively involved in developing and implementing programmes and activities directed towards a better understanding of the complex and interrelated problems of environmental degradation and poverty in the HKH region in close partnership with the ICIMOD member countries and the donors.

Since its inception, ICIMOD has been promoting the development of a better understanding of the landslides hazards. Various activities have been completed so far; including several training programmes dealing with mountain risk engineering which has focussed on improving road construction along unstable mountain slopes, a review of landslide hazard management activities in China, and the field assessment of landslides and flood events in south-central Nepal following extreme climatic events during July 1993.

Regional Collaborative Programme for Sustainable Development of the Hindu Kush-Himalayas

In response to Chapter 13 of Agenda 21 of the UN Conference on Environment and Development: "Fragile Ecosystems: Sustainable Mountain Development" and the need for long-term and integrated approaches to deal effectively with the acute problem of poverty and developments in the fragile environment of the HKH, ICIMOD has prepared a Long-term Vision and Medium-term Workplan for Action in the Field of Sustainable Mountain Development. Three thematic programmes will focus on the following important issues: I) Mountain Farming Systems, ii) Mountain Natural Resources, and iii) Mountain Enterprises and Infrastructure.

ICIMOD'S Programme on Landslide Hazard Management and Control

One of the goals set by ICIMOD in its Mountain Natural Resources' programme is to "Improve the conditions of mountain resources and environments by halting, and eventually reversing, their degradation." Programme activities envisaged to achieve the above goal are directed towards:

- identification of measures to mitigate different types of natural hazards that perpetuate loss of natural resources;
- promotion of skills and methodologies for natural hazard assessment; and
- improvement of public awareness for better disaster preparedness in mountain areas.

ICIMOD's programme on "Landslide Hazard Management and Control" focuses on helping to protect valuable natural resources from different types of natural hazards. This programme is based on ongoing activities of ICIMOD which were introduced in 1994 with support from the Government of Japan.

The above-mentioned activities include the following.

I) Preparation of a state-of-the-art review on `Landslide Management and Control' in selected countries (China, India, Pakistan, and Nepal) of the HKH.
ii) A Regional Training Programme on Slope Instability Hazard Mapping using Remote Sensing and GIS.
iii) Preparation of a Climatic-Hydrological Atlas of Nepal based upon available information.

Of these three activities, the Regional Training Programme on Slope Instability Hazard Mapping using Remote Sensing and GIS was completed in 1994, while the other items will be finalised in 1995. As a follow up, a four-week training course in Landslide Hazard Management and Control is being designed and the first courses are scheduled to be held in 1996.

The Workshop

The Regional Workshop on 'Landslide Hazard Management and Control in the Hindu Kush-Himalayas' was organised by the Mountain Natural Resources' Division of ICIMOD. This was the first ever workshop discussing the problems and issues related to landslide hazard management and control in the Hindu Kush-Himalayan region. It was held at the ICIMOD Headquarters from July 12 to 14, 1995.

The major concerns of the workshop were to identify priorities for a regional collaborative training programme, to be implemented by ICIMOD, and to review the existing facilities and curricula for training in Landslide Hazard Management and Control in the Hindu Kush-Himalayan countries. In order to identify the priorities and relevance of such a training programme, and to share experiences of the member countries in this field, presentations of reviews and country papers on the current status of programmes and activities on Landslide Hazard Management and Control in the countries of the Hindu Kush-Himalayas were also included in the workshop.

The workshop was attended by 35 participants, including official representatives and/or experts from six ICIMOD member countries (Bangladesh, China, India, Myanmar, Nepal, and Pakistan) and experts from Japan, The Netherlands, Germany, and Switzerland.

In his welcome address, Mr. Egbert Pelinck, Director General of ICIMOD, highlighted ICIMOD's programme activities, particularly in the field of Landslide Hazard Management and Control. He expressed gratitude for support received from the ICIMOD member countries and the Government of Japan for the project activities.

In the inaugural speech, Chief Guest, Mr. S.N. Upadhyaya, Secretary, His Majesty's Government of Nepal, Ministry of Water Resources, emphasised the need for ingenuous selection and application of human knowledge to deal with the extraordinarily high hazard potential in the HKH mountains and expressed his appreciation of ICIMOD's efforts to develop a better understanding of the human and ecological processes in these fragile mountains. Speaking on the same occasion, Mr. M. Ishikawa, Minister, Embassy of Japan in Nepal, expressed his government's appreciation of ICIMOD's programme activities for sustainable development of the mountainous regions of the HKH and indicated that Japan is favourably considering increasing its support to the Landslide Hazard Management and Control project in the coming years.

On the first day of the Workshop, country reports were presented by representatives from Bangladesh and Myanmar as well as four review papers from China, India, Nepal, and Pakistan, commissioned by ICIMOD as part of the Landslide Hazard Management and Control Project, by their respective authors. This facilitated the critical review and examination of outstanding issues as well as the current status of the programme.

On the second day (July 13), after presentations of some invited papers, the workshop participants joined on a field excursion to the landslide monitoring station of the Water Induced Disaster Prevention Technical Centre (DPTC) of His Majesty's Government of Nepal at a site 19 km along the Kathmandu-Trisuli road, to become familiar with field level issues and problems. The field excursion was organised in collaboration with the DPTC.

Each day a few invited papers were also presented to highlight specific issues in order to emphasise the interdisciplinary nature and complexity of landslides and facilitate full discussion. The aim of the workshop was also to identify key issues and problems in Landslide Hazard Management and Control in the HKH to be included in the Regional Collaborative Training Programme in accordance with the needs and priorities of the countries of the Hindu Kush-Himalayan region.

The last day of the workshop was devoted to group discussions. The main purpose of these discussions was to identify priorities for a Regional Collaborative Training Programme to be implemented by ICIMOD. This was facilitated by the presentation of a paper with proposed course details prepared for ICIMOD by Professor Li Tianchi of China. After detailed discussions, the workshop made the recommendations given in Box 1.

Box 1: Recommendations of the Regional Workshop on Landslide Hazard Management and Control in the Hindu Kush-Himalayas

1. The workshop unanimously endorsed the Draft of the Regional Collaborative Training Programme on Landslide Hazard Management and Control with some suggestions for modifications.

2. The workshop agreed that the target group for the first training should be middle-level professional and that the training should be held at ICIMOD, Kathmandu.

3. For future training on Landslide Hazard Management and Control the workshop also recommended that target groups should include:

   (a) policy and decision-makers;
   (b) middle-level professionals;
   (c) technicians; and
   (d) local communities/farmers.

   ICIMOD should, therefore, also consider organising training for the other three levels of the target groups, apart from the training it is organising for middle-level professionals as endorsed by the workshop.

4. To further strengthen capacities in the region, regional training may be held in rotation at appropriate institutions in the member countries and country specific training may be organised by ICIMOD in collaboration with national institutions.

5. The participants urged ICIMOD to continue its role as the regional focal point and collaborate and coordinate regional efforts on training and other activities in cooperation with institutions from the HKH countries, as well as with those from outside the region (e.g., Japan and The Netherlands).

6. National Working Groups on Landslide Hazard Management and Control should be established in the HKH countries. National Focal Points (NFP) should coordinate national-level working groups and their activities. Such NFPs should also act as repositories of data and information, and they should preferably be located in autonomous institutions as they might be able to function more efficiently than in other institutions. ICIMOD should coordinate activities at the regional level and, if possible, provide support for the capacity building of NFPs for efficient functioning.

   In connection with this, the DPTC in Nepal and the Ministry of Science and Technology in India were identified as focal points. For other countries, it was agreed that more work may be necessary to identify focal points. The Workshop urged ICIMOD to strengthen the technical and professional capacities of focal points.

7. The workshop also recommended that appropriate regional training in GIS and Remote Sensing be organised for landslide hazard mapping.

8. Governments of the HKH countries should make available the relevant data (e.g., rainfall, seismicity) and information (including topographical maps, aerial photographs and geological maps) required for landslide hazard management and control studies to their National Focal Points (NFPs).
   Similarly they should also facilitate exchange of data, including maps (e.g., on a scale of 1:250,000) at the regional level, in view of the availability of such data maps and information from sources outside the region.

In the chapters that follow the main highlights of each session of the workshop are presented.

Chapter 2

The Inaugural Session*

Mr. S. N. Upadhya, Secretary, HMG/N, Ministry of Water Resources, was the chief guest at the inaugural session. Other invitees were Mr. M. Ishikawa, Minister, Embassy of Japan and other guests.

Welcome Address by Mr. Egbert Pelinck, Director General, ICIMOD

Welcoming the participants on the occasion of the inauguration of the 'Regional Workshop on Landslide Hazard Management and Control in the Hindu Kush-Himalayas'. **Mr. Egbert Pelinck**, the Director General of ICIMOD, stated that the regional workshop was one of the activities undertaken by ICIMOD under the project on Landslide Hazard Management and Control. The project was introduced in 1994 with the financial support of the Government of Japan. For this he expressed grateful thanks to the Government of Japan, and added that the support had enabled ICIMOD to introduce systematic activities on various aspects of landslide hazard management and control.

Mr. Pelinck reiterated that the degradation of mountain environments in the HKH, whether due to natural or man-made processes, was of vital concern to ICIMOD. Hence, since its very inception, ICIMOD had undertaken studies and activities that contributed to the understanding of this degradation and of ways to halt it. He informed the audience that some of ICIMOD's first publications dealt with the problems of erosion, sedimentation, floods, glacial lake outburst floods (GLOFs), and landslides.

Mr. Pelinck further added that landslides are not only the most frequent disasters but also the ones that recur annually during the monsoon, causing widespread loss of life, property, and infrastructure (the two latter being built at great cost in the hills and mountains). The HKH mountains probably had to face the worst combination of a very fragile and young geology, very steep slopes, and intensely high monsoon rainfalls confined to a few summer months. Hence, the mountain environments of the HKH are inherently unstable and prone to disasters such as landslides.

Talking of the rapid economic transformation, he stated that, apart from the natural factors and processes that cause disaster, the HKH region was receiving major infrastructural constructions, such as roads, dams, and reservoirs, and these could continue to increase in the following decades. Experience across the HKH countries had shown that landslide incidence, as a result of badly planned infrastructural development occurred throughout the region and was a matter of great concern, because expensive investments were wasted without achieving the desired objectives. Landslides also added to the high cost of maintenance of such infrastructures when located in the wrong place or designed without adequately taking into account the requirements and limitations of the physical environment. He further stated that once landslides had occurred, the cost of stabilisation was very high. For example, for China's mountain railways, the cost of stabilising one large landslide was found to be as high as USD 1.7 million.

Local factors contributed as much, he stated, and increasingly, it was also poverty that was the cause of landslides. Poor farmers were forced to cultivate on steep and unstable slopes, thereby contributing to mass wasting and landslides.

The combined effect of these three causes of landslides was human misery, economic loss, and environmental degradation. And these were the very reasons why ICIMOD was involved in landslide hazard mitigation and management. It was a mountain specific issue addressing the dual problems of poverty alleviation and environmental conservation -- the two reasons for which ICIMOD was established.

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* The Inaugural Session was actually the second session of the Workshop. The sequence of reporting has been altered in the document to ensure continuity of the topic.

It is in this context that ICIMOD had introduced its activities on Landslide Hazard Management and Control. Four state-of-the-art reviews on landslide management had been completed for China, India, Pakistan, and Nepal. A Climatic Atlas for Nepal was being prepared. ICIMOD had also organised a Regional Training Programme on Slope Instability Mapping Using Remote Sensing and GIS in 1994.

Mr. Pelinck stated "*In addition to providing a unique update to our knowledge about landslide hazards in the Hindu Kush-Himalayas, this Regional Workshop is also the first step towards developing a Regional Collaborative Training Programme on Landslide Hazard Management and Control in the HKH. With your joint experiences, we have a unique forum for sharing knowledge from both within and outside the HKH region and for identifying key areas for training in accordance with the needs and priorities of the regional countries of the HKH. ICIMOD is also keen to help develop collaboration among national institutions from the HKH countries, as well as among institutions from the HKH and the developed world, so that state-of-the-art methods and technologies can be used to solve the problems of the HKH within such a collaborative and cooperative programme.*"

He once again expressed gratitude that, in response to the invitation, leading experts from six regional member countries of ICIMOD and from Japan, the Netherlands, Germany, and Switzerland were present. He hoped that the deliberations and recommendations would help to develop a truly useful and practical training programme on landslide management and control and wished the participants a very fruitful stay.

He also expressed grateful thanks to Mr. S.N. Upadhyay, Secretary, Ministry of Water Resources of HMG/N for the keen interest and strong support of the Ministry and to the Government of Japan for their financial support to carry out the project.

Address by Mr. M. Ishikawa, Minister, Embassy of Japan

Expressing his happiness in speaking to this unique forum of experts from different disciplines, **Mr. M. Ishikawa**, Minister, Embassy of Japan, said that, while the participants from the HKH region and outside the region share knowledge on a common concern of landslide hazard management and control, the result would not only benefit Nepal but the whole of the HKH region. Noting that the countries in the region had been experiencing landslides mainly due to heavy rainfall and the presence of fragile mountain slopes, he said it was sad to note that each year about 400 people died in the Himalayan region due to landslides, and this represented 30 per cent of the total deaths worldwide, annually due to landslides. The economic losses caused by landslides had been increasing every year, and thus was a global concern, he emphasised. Landslides can set back the economic development processes of the regional countries. Giving the example of Japan where damage to public facilities caused by landslide have been in the range of 0.3 per cent to 1.5 per cent of the GNP in the past decade, he stated that it had become increasingly common to seek counter measures to reduce such losses in all countries.

Noting the contribution of ICIMOD, since its inception in 1983, on sustainable management of fragile mountain areas in the HKH region, he said that, in the last three years of his stay in Nepal, he had had the pleasure of interacting with ICIMOD and discussing possible ways to improve awareness on landslide management and control measures. Mr. Ishikawa said that he was happy to recommend ICIMOD to his government for assistance. The present assistance to ICIMOD was the first time the Government of Japan had assisted an NGO in this region.

Hoping that ICIMOD would continue to play an important role in translating output from research activities into practical implementation in its regional countries, through various collaborating national agencies for landslide hazard management and control, he said that although it was a challenge, ICIMOD would be successful because of its integrated approach. The first step towards landslide hazard mitigation was to understand the nature of landslide phenomena and the current status of programmes and activities on landslide hazard management and control in the HKH.

Mr. Ishikawa concluded by saying that while continued and extensive dialogue between the participating experts from various countries were expected to help formulate guidelines for landslide hazard management and control in the HKH region, the Government of Japan, apart from funding the project,

had also supported ICIMOD's activities by providing Japanese expert on the subject since last year. He stated that the Government of Japan was considering increasing its support to ICIMOD.

Inaugural Address by the Chief Guest, Mr. S.N. Upadhyay, Secretary, HMG/N, Ministry of Water Resources

Welcoming the experts, **Mr. S.N. Upadhyay**, Secretary, Water Resources said that the workshop was very appropriate, topical, and timely.

Thanking the delegates from outside the region, he expressed appreciation for the genuine concerns demonstrated by ICIMOD and friendly nations abroad in preserving the unique but fragile ecosystems of the Hindu Kush-Himalayas and the wellbeing of its hardy inhabitants.

Landslides and debris flow, released by torrential rain or seismic activity impacting unstable slope material, had been a common feature and cause for apprehension from the perspectives of human security, livelihood, and infrastructural development for most of the Hindu Kush-Himalayan region. Mr. Upadhyay stated that landslides were a major problem in Nepal where an average of more than one landslide per sq.km. has been recorded in the Middle Mountains, Mahabharat *Lekh*, and the Siwaliks, i.e., the most densely-populated areas. Excessive rainfall in the monsoons, snowmelt, and earthquakes form the most common triggers for dam-forming landslides in a wide range of physiographic settings, resulting in phenomena such as temporal glacial lakes and ephemeral ponding of rivers, sometimes with catastrophic consequences. The combination of elevation, tectonics, rock types, and climate had rendered such hazards, to a large extent, to be "natural" in origin, but destabilising factors, such as deforestation, road and canal alignments, were also aggravated.

The steep, mountainous, and unstable terrain, often combined with dense settlement and intensive farmland, was exposed to the ravages of landslides. At the same time, low-lying lands were vulnerable to floods and shifting river courses owing to excessive erosion and siltation.

The economic and social survival of many communities in the region often depended on a fragile balance of geologic processes. He urged that reliable forecasting methods be established so that timely evacuation or protection of populations could be effected before disaster strikes.

Mr. Upadhyay wished the regional workshop and deliberations every success and hoped that it would provide concrete proposals. He also hoped that the discussions would focus on preparing databases on geo-technical, socioeconomic, and institutional aspects through national/international collaboration.

He expressed appreciation for the efforts carried out by ICIMOD to establish a better understanding of the fragile mountain ecology and also for the collaborative efforts of the Water Induced Disaster Prevention Technical Centre of His Majesty's Government of Nepal for initiating the process of landslide monitoring and instrumentation on certain controlled sites in Nepal.

Chapter 3

Session One: Country Review Papers/Country Reports

The first session was chaired by Dr. M. Banskota, Deputy Director General, ICIMOD. In this session four country review papers and two country reports were presented.

Introduction to the Workshop -- S. R. Chalise

Welcoming the delegates on behalf of the ICIMOD Director General, Mr. Egbert Pelinck, who was unable to attend this session, **Professor S.R. Chalise** mentioned that the workshop brochure provided a brief background on the ICIMOD programme activities on Landslide Hazard Management and Control, that was launched in 1994 with the support from the Government of Japan. State-of-the-art reviews on landslides were prepared during 1994 by, eminent experts from China, India, Pakistan and Nepal, he said. He expressed happiness that Professor Takeshi Ito, who had played a key role in the formulation of the project, was present at the workshop.

Explaining the ICIMOD plan, Professor Chalise stated that one of the major activities envisaged for 1995 was to develop and organise a Regional Collaborative Training Programme for Landslide Hazard Management and Control in order to help develop the necessary capabilities in the countries of the HKH. He emphasised that ICIMOD could be the link institution to establish collaboration between institutions from the regional countries and developed world so that state-of-the-art knowledge and tools could be made accessible to deal with the most commonly-faced disaster of landslides in this region.

The main objective of the workshop, he said, was to identify the priority issues and key elements for a Regional Collaborative Training Programme which complemented national initiatives in the field by establishing close collaboration between national institutions from regional as well as developed countries such as Japan and the Netherlands. Undoubtedly, he said, the experiences of the eminent experts present would help to achieve this objective. He thanked ITC Netherlands for their interest, and noted that Dr. Niek Rengers, the Vice Rector of ITC was a participant at the workshop.

Professor Chalise outlined the programme as follows: the first day-presentation of four state-of-the-art reviews from China, by Professor Li Tianchi; India, by Dr. V. C. Thakur; Nepal, by Drs. Upreti and Dhital; Pakistan, by Drs. Malik & Farooq and country reports from Bangladesh, by Col. Rahim; and Myanmar, by Maj. T. S. Tun. A few invited papers were also to be presented. This was expected to help identify critical issues in landslide hazard management and control in the HKH, he said.

During the second day, discussions would be continued to identify priorities for the Regional Collaborative Training Programme with a paper by Professor Li Tianchi and two other papers on this theme to familiarise participants with the field realities and practical problems. A field trip had also been organised in collaboration with the Water Induced Disaster Prevention Technical Centre of HMG Nepal on the same day.

On the third day there would be a plenary session to help identify the key issues for group discussion and specific recommendations. These recommendations would provide the substance and basis for the Regional Collaborative Training Programme. He concluded by starting that the final and most important output of the workshop was the recommendations which would shape and guide future activities.

Presentations of Country Review Papers

o Li Tianchi, China

Presenting the country paper **Professor Li Tianchi** highlighted the frequency and magnitude of landslides and economic losses due to them in China. Annually, damage worth approximately two billion USD was caused by landslides and mass movement activities in China. He also described the processes and effects of landslides by presenting slides taken from different parts of China. Different types of mass movement caused by torrential rains and earthquakes and damage to infrastructure, e.g., railway lines, roads, irrigation canals, dams, and buildings, was shown. He pointed out that not all landslides were dangerous, but some were really dangerous depending upon the speed and distance travelled. Once landslides occurred, they were very costly to control.

The techniques adopted for mapping landslides in China depended upon the purpose of the exercise: ranging from large-scale landslide susceptibility mapping for land use and city planning to regional landslide mapping for roads and water resource development. Professor Li emphasised the need to adopt an **integrated area approach** and **bio-engineering methods** to deal with the mitigation of landslides. He described the model and parameters used to predict landslide occurrences, rates of movement, and retrogression. He concluded that landslide damage can be minimised if proper attention was given to avoidance and preventive work for landslide stabilisation.

o V.C. Thakur, India

Presenting the country report for India, **Dr. V.C. Thakur** suggested that the frequency of landslide occurrence had been increasing in recent years due to increasing anthropogenic activities and infrastructural development in mountain areas. He further pointed out that removal of forest cover and unplanned development activities were the major human-induced causes behind the increased incidence of landslides. Assessment of physical parameters, such as geology, rainfall, seismic activities, and vegetation cover in landslide occurrences, showed that there was a strong relationship between frequency of landslides and heavy monsoon precipitation, geological faults, and earthquakes. Many landslides and extensive damage occurred at the time of heavy precipitation in various years, e.g., 1911, 1914, 1968, and 1973. It had been observed that more landslides had occurred along two major thrust lines. A large number of landslides were initiated and reactivated in 1905 in Kangra when an earthquake with a magnitude of 8 on the Richter scale occurred. Similarly, an earthquake with a magnitude of 6.6 on the Ritcher scale in 1991 in Uttarkashi activated more than 47 landslides and reactivated more than 16 old landslides.

Different parameters and rating techniques used by different offices for hazard zonation were also described in the presentation, and it was pointed out that there was a need for the various institutions involved in landslide study and management to coordinate. Different control measures such as surface and subsurface drainage, retaining walls, and self supporting and soil stabilisation techniques adopted by concerned authorities were also described. Dr. Thakur also emphasised the need for an integrated interdisciplinary approach to dealing with the problems associated with landslides.

Discussions

During the discussions, **Dr. Anbalagan** from the University of Roorkee stated that India had been developing an Indian Standard Code (ISC) to rate different parameters for preparation of a hazard zonation map at least on a regional scale of 1: 50,000.

Dr. Rengers from ITC highlighted the fact that the parameters and rating technique for hazard zonation depended upon the objectives and the scale of mapping. Detailed maps (large-scale) of slope instabilities and landslide hazards needed specific input data on various aspects and from specific localities and might not be valid for the whole areas there was a wide diversity in geology, lithology, and climate. It was suggested that the weighted rating system developed by the United States Geological Survey (USGS) for hazard zonation be adopted.

o *M.H. Malik, Pakistan*

Presenting the country report for Pakistan, **Dr. M. H. Malik** highlighted the complexity of environmental conditions due to diverse geology, lithology, climate, and tectonic activities. He pointed out that geological factors, including structural discontinuity, i.e. orientation and roughness, were the major controlling factors in landslide occurrence. Beside these, seismic activities, heavy precipitation, and over use of dynamite at the time of road construction, mining, and quarrying were other factors responsible for triggering slope instability. He pointed out that landslides mostly occurred in late monsoon (July and August) when soils became fully saturated. He also highlighted the fact that social pressure had been increasing in the region due to an increase in frequency of landslides in recent years.

Professor Qasim Jan from Pakistan also described both the natural and human-induced causes of mass movements in the country. He pointed out that landslides had increased substantially in the past 30 years in Pakistan. He noticed that the Nangaparbat massive is rising by more than five mm/yr causing intense rockfalls and a subsequent increase in the damming of rivers.

o *B.N. Upreti and M.R. Dhital, Nepal*

Presenting the country report for Nepal, **Dr. B. N. Upreti and Dr. M. Dhital**, briefly described the geology, geomorphology, climate, seismic activities, and spatial distribution of landslides in the country. They explained the parameters and rating technique applied in hazard zonation. They stated that the hazard rating technique suggested in the Manual for Risk Engineering published by ICIMOD had been followed for the study. They emphasised the need for field verification of hazard maps and for updating rating scores based on the field situation. It was pointed out that both hazard mapping and landslide stabilisation activities had just started in the country. It was also suggested that priorities should be given to areas of high infrastructural development, and those that threatened human settlements, while preparing hazard maps.

Country Report Presentations

o *M.A. Rahim, Bangladesh*

Col. M.A. Rahim from Bangladesh, presenting the Bangladesh country report, pointed out that since the hill region accounted for seven per cent of the total area of Bangladesh, landslides were not the prominent natural hazard compared to other natural hazards such as floods, droughts, cyclone, and tidal surges. However, small-scale landslides were quite common in these hills.

He briefly described the geology, geomorphology, and climate of the country. The studies related to landslides and their management aspects were still in a primary state in Bangladesh. Three types of slope failure such as lateral spreading (bulge), rotational and transnational slides, and block failure had been identified. He pointed out that the main causes of such failure included geology, relief, rainfall, wind action, vegetation, and human activities; and remedial measures consisted of structural measures for slope retention and drainage, slope flattening/terracing, and plantation. Three types of institutions involved in landslides control and management are research organisations, academic institutions, and development agencies such as military engineers, local government authorities, road and highway departments, local government engineering departments, and the Bangladesh Water Development Board.

He concluded that, due to the increase in human activities and rapid deforestation in the hilly regions, the problems of landslide hazards were gradually becoming serious and the current workshop would provide opportunities to share the experiences of countries prone to landslide hazards. He further recommended that there be a focus on research activities in order to avoid landslide hazards and promote training activities for disaster management personnel in rescue operations.

Major Tun, in his country statement, described the topography, hydrology, forestry, and geological conditions of Myanmar.

He mentioned that in Myanmar too, as in the other countries of the region, most landslides occurred during the rainy season in mountainous areas. Damage due to landslides in rural residential areas were minimal but usually they interrupted local communication systems and affected railroads and motor roads, thus causing a lot of economic damage and hardship to the local people. Engineering measures, such as retaining walls, were built in potentially dangerous areas and biological control of landslides through plantation of trees on mountain slopes were also used. In mountain areas, slash-and-burn agriculture was discouraged, especially in landslide susceptible areas.

Discussions

During the discussions, it was expressed that slope instability and landslide hazard maps were essential for sustainable development of mountain areas. However, mapping was still in the preliminary stages and confined only to selected localities. Moreover, hazard maps were produced only after a major disaster and mainly for academic exercise. It was rarely used as a tool by planners, designers, decision-makers, and construction engineers. So, there is a need to make the users aware of the usefulness of hazard maps.

Concluding the session, the Chairperson, **Dr. M. Banskota**, raised some issues concerning landslide control and management and opined that due attention should be given to economic aspects such as cost and benefit analysis of the activities; use of indigenous knowledge and bio-engineering or ethno-engineering practices; and training for sensitisation of the local people to hazards while designing programmes for landslide control and management.

Chapter 4

Session Three: Invited Papers

Session Three was chaired by Professor S.R. Chalise. In this session, three of the invited papers were presented. Additional papers were presented in Session Five.

o *A Statistical Study of Landslide Disasters in the Snowy Regions of Japan -- T. Ito*

Professor T. Ito from Akita National College of Technology, Japan, in his presentation described the methodology and techniques used for the preparation of potential landslide hazard maps and highlighted the differences in the processes of landslide occurrences in hot, humid, and cold regions. He pointed out that frequent landslides had been taking place during specific seasons and in specific geological areas. In snowy regions, the occurrence of landslides was specifically in the snow melting season (mainly March to April). He also observed that the frequency of landslides in the study area had been increasing gradually in recent years, especially near big cities, due to the changes in land use practices.

o *Risk Mapping for Landslide Hazard Management in Sukhidang Area, Kumaon Himalayas, India -- Dr. Anbalagan*

In his paper, **Dr. Anbalagan**, from the University of Roorkee, India, highlighted the importance of slope instability and landslide hazard maps for sustainable development, particularly in such a geologically and ecologically fragile ecosystem as that of the Hindu Kush-Himalayas. He described the procedure and rating schemes used for the preparation of landslide hazard zonation maps (LHZ) and risk assessment. "Risk is a function of hazard probability (Hp), which is mainly based on the basic causative factors of slope instability and the damage potential (Dp), i.e., the nature of the damage likely to occur." Damage might be in the form of loss of life and injuries and/or loss of land and properties. He pointed out that the risk assessment exercise would help to identify the priority areas of hazard management. He presented the case of the Sukhidang area in the Kumaon Himalayas. He also presented a risk assessment matrix based on the degree of potential hazard and damage. He suggested different short-term and long-term remedial and control measures for mitigation of the risk of natural hazards. He recommended focussing research work on protective measures such as biotechnical, soil nailing, chemical grating, reinforced earth, and geotextiles.

He recommended that terrain, or the geology, would be more appropriate units of measurement rather than slope facets for the assessment of landslide hazards and risks.

o *Status of Landslide Hazard Management in Nepal -- A. Dixit*

Mr. A. Dixit from Nepal briefly described the general causes of increased landslide hazards in the country. Due to high relief, intense neo-tectonic activities, highly anisotropic and fractured geology, poor engineering design and lack of maintenance of infrastructures, and increasing human activities on mountain slopes, the incidence of landslide occurrences had been increasing. He briefly discussed the availability of a database for landslide hazard mapping and the efforts experienced so far by the government on landslide inventory and mapping. He focussed on the work of government and non-government organisations related to the mitigation of natural hazards in the country. Lack of pre-disaster mitigation activities, lack of coordination among various agencies, and lack of programmes for creating public awareness were some of the problems associated with effective hazard management and control. He also discussed potential target groups and types of training required for better management and effective control of landslide hazards. These included decision-makers, middle-level administrators, and senior and junior technical manpower. He also highlighted the role to be played by regional and international agencies such as ICIMOD and UNDP in strengthening government capabilities through training programmes and workshops.

Concluding the session from the chair, Professor Chalise highlighted the need for coordination and collaborative work. He also emphasised the need to reach agreement on rating schemes and methods for the preparation of landslide hazard mapping, and the need for field verifications of such maps and their practical usefulness. He also briefly introduced the activities of ICIMOD in the field of landslide hazard management control in the Hindu Kush-Himalayan region.

Chapter 5

Session Four: Priorities for a Regional Collaborative Training Programme

Session Four was chaired by **Dr. V.C. Thakur**. Two papers were presented in the session: the first paper outlined the proposed regional collaborative training programme (A detailed schedule of the training course and time period for individual chapters is presented in Annex 1.) This was followed by a paper on the monitoring activities of the Disaster Prevention Technical Centre (DPTC).

o *Guidelines and Proprieties for a Regional Training Course on Landslide Hazard Management and Control in the Hindu Kush-Himalayan Region -- Li Tianchi*

Professor Li presented the proposed outline for a training course on the above-mentioned subject. He suggested that the number of trainees should not exceed 15-20 persons, with backgrounds in either hydrology/meteorology, forestry, civil or rural engineering, and with experience in landslide hazard management and control. The training is to be conducted over four weeks including a weeklong field work. A list of the resource persons required to conduct the training has also been given in the paper. The ICIMOD complex has been proposed as the site for theoretical classes, and five different landslide areas have been proposed as field sites.

Discussions

After the presentation, there was a discussion on various issues. It was felt by some participants that incorporation of certain sections from the Mountain Risk Engineering Hazard publication, for instance, the section on stability analysis, would be important for the training.

The possibility of some institutes/universities including this training programme as a post-graduate degree was also discussed. It was felt by some that the selection of trainees for such a programme should be by the focal points identified for landslide hazard mitigation/ investigation work.

o *Landslides in Nepal - I. Kitahara*

The second paper, presented by **Mr. I Kitahara**, was on "Landslides in Nepal". An introduction to the monitoring methods employed by the DPTC in its various study sites was given in the presentation. The 'model sites' of the DPTC are in three different areas: at a distance of 19 km along the Kathmandu-Trisuli road and on the right bank of the Tinau River at Butwal. The DPTC has used moving pegs and extensometers for monitoring the surface movement of landslides, tiltmeters for measurement of potential ground fluctuations, and the use of guideline tiltmeters and wired-bed dislocation meters for subsurface (underground) displacement. Most of the equipment used is either locally-made or imported from Japan.

Discussions

Many questions were raised after the two presentations. One participant doubted whether real landslide slip zone identification of large depth with a 50cm probe was possible. Use of pictometers instead of measurement on boreholes by water logger was suggested along with the use of guideline tiltmeters instead of using a bed-dislocation meter. The problem of management and coordination of equipment was also raised.

It was suggested that selection of the candidates for training would need to keep in mind the academic and professional background of the candidates, including age. Suggestions were made to include

stereo plotting in the course. It was also expressed by some participants that, in the case of hazard assessment, the possibility of occurrence needed to be further emphasised. The relevance of groundwater temperature survey and water quality analysis was questioned by some participants, as it was felt that these were not directly concerned with landslides. Some suggested that, as all participants to the training may not be of the same academic background, very simplified methods of stability analysis, such as the slice-method, should be included.

The need to look into the economics of on-site and off-site hazards of landslides was also thought to be important. Some participants requested that avalanches and glaciology should be included in the course.

On behalf of ICIMOD, it was stated that the course would be an integrated one and useful to the main disciplines related to landslides. Collaboration with interested and concerned institutions from different countries of the Hindu Kush-Himalayan region would be maintained in organising the course.

It was suggested that courses for the technician's level and for policy/decision-makers were also essential. It was expected, however, that after completion of training, the trainees would be able to train junior technicians.

Some of the participants suggested that a chapter on statistical analysis should be included. Professor Li explained that the course had been designed primarily for mid-level officers working in the field of landslides, and opined that further courses for others, e.g., policy-makers would be important.

The Chairman suggested that rock mechanics and remote sensing should be included in the course. He suggested age criteria for the trainees; and that they should be 35 years and below.

After concluding the session, **Mr. B. Tiwari** (DPTC) briefed the participants on the field visit.

Chapter 6

Field Visit to the Site on the Kathmandu-Trishuli Road

Later in the day, the participants visited the DPTC landslide monitoring site on the Kathmandu to Trishuli road. Mr. E. Pelinck, the Director General of ICIMOD also visited the site with the participants. The visit was coordinated by Mr. B. Tiwari and Mr. I. Kitahara of DPTC.

Box 2: Background Information to the Landslide Site 19 km along Kathmandu-Trisuli Road

The landslide is located at 19.5 km along the Kathmandu-Trisuli road at Okharpauwa, about one hours drive from Kathmandu. The landslide was activated after the excessive rainfall of 1962 and stabilised afterwards. The landslide was re-activated after the rainfall of 1979 and was further aggravated by the earthquake of 1989.

The landslide has damaged more than 100m of the 70km long Kathmandu-Trisuli Road. The length and extent of the damage is increasing each year. Many cracks can be seen on the surface, the number and extent of which are increasing continuously after every monsoon period. Plenty of water throughout the area, inclined trees and electrical poles, many scars at the crown and sides are the typical landslide features of the area. The scale of the landslide is about 300m x 100m.

The quarrying of stones at the bottom of the site (upper side of the road), an unlined irrigation canal and roadside drain on the landslide surface, leakage of water from supply pipes, and seepage of water from the upper catchment of the landslide are the major causes of the increase in land movement. Fortunately, the landslide is situated on barren land and there is no other infrastructure except the road below the landslide area. But the collapse of the landslide may block the Kathmandu-Trisuli Road and important tourist spots e.g., Kakani and Dhunche, can also be cut off.

At the request of the Department of Roads, the Water-induced Disaster Prevention Technical Centre (DPTC) has been monitoring the landslide as one of its model monitoring sites and it started to install monitoring equipment in July 1992. Monitoring equipment was installed to observe land movement on the following dates:

Equipment	Numbers	Period
Rain gauge	1 unit	July 1992
Tiltmeter	1 unit	July 1992
Extensometer I	1 unit	July 1992
Extensometer II	1 unit	Sept 1993
Moving pegs	2 rows	July 1992

Following the installation of the equipment, data have been collected and analysed regularly. A topographical map on a scale of 1:500 was prepared in 1992. One 30m deep vertical core boring was carried out on the roadside to reveal the geological strata. After monitoring the moving pegs for one year and observing the cracks, the whole landslide was divided into five major blocks.

Data from the installed equipment have been collected regularly. Collected data from June 1993 to August 1994 have been analysed to establish the relationship between displacement and rainfall. The potential ground fluctuation by inclinometer and displacement by extensometer have been correlated to rainfall data. Total maximum displacements of the land mass within a fourteen month period in horizontal and vertical directions were 3.577m and 1.107 m respectively. As revealed by the bore log, the deepest slip surface of the lowest block of the landslide is situated at a depth of 17 to 18m from the roadside.

Ground and surface water are found to be the major causes of landslides. So the most effective protective measure has been determined as efficient drainage of such water. Perfect surface and subsurface drainage works in conjunction with a designed toe wall may be sufficient to stabilise the slide mass. Soil fill and plantation at the lower limb of the slide mass will probably have a beneficial effect as well.

Discussions at the Field Site

After reaching the model site the participants observed the damage to the road caused by the landslide. Some participants asked for a demonstration of how the extensometer recorded land movement. It was felt by some that as an extensometer only gives the surface movement, it might be necessary to have some equipment for subsurface movement monitoring. For surface movement, the suitability of moving pegs was agreed to the adequate. It was suggested to either embed the tiltmeter glass in concrete or to screw in the concrete to control the separation of glass after vibration.

Some participants suggested that monitoring the upper catchment of the landslide area might be necessary to determine the seepage pattern. As the equipment installed in the area is insufficient for detailed monitoring of the landslide, it was suggested that more extensometers at various locations of the landslide blocks might be necessary.

Some of participants thought that more involvement of the local people in monitoring would ensure protection of the equipment. It was unanimously decided that mitigation measures should also include the local people.

Participants at the Workshop

Landslide along the Tribhuvan Rajpath

Session Five: Issues and Priorities for Training

Session Five was chaired by Professor T. ITO. Three papers were presented on the theme of the session.

Landslide Hazard Mapping For Sustainable Development -- N. Rengers

Dr. N. Rengers from ITC (The Netherlands) firstly described the relevant work being carried out by ITC, which is supported by the Dutch Government as a part of its contribution to international development. At ITC, geo-information management, which includes collection and use of integrated data generated through GIS and remote-sensing (such as maps and reports) to assist various development and research programmes, is an important part. At present the institution has over 12,000 alumni worldwide and 300 fellowships are given to developing countries under the Netherlands' Fellowship Programme every year.

Landslide hazard mapping using remote-sensing aerial photography -- one of several research thrusts at ITC which has been supported by several other agencies, including the World Bank, the European Economic Commission, the Asian Development Bank, and UNESCO among others. In South America, a course in landslide hazard mapping was conducted by ITC; and also a course at ICIMOD, recently. Many other special courses were planned for later in the year, such as one on Glacial Lake Outburst Floods in Nepal; this will be held partly in Nepal and in the Netherlands in collaboration with ICIMOD and Tribhuvan University.

Dr. Rengers described the various scale maps, the methods used to compile and their usage.

Commenting on the proposed training programme curricula, he suggested that, as well as emphasising increased geo-technical knowhow, it is also vital to create awareness about the issues among policy-makers and the general public. A legal framework for hazard management was also of great importance. Preparation of appropriate decision support documents (such as landslide hazard zonation maps) is of utmost importance for this.

Dr. Rengers emphasised the use of GIS and remote-sensing as tools to support work on landslide hazard management. He reminded the participants that this decade had been designated the 'International Decade for Natural Disaster Reduction' (IDNDR) and that the Dutch Government had been asked to play a major role in this. He mentioned that certain countries, e.g., the Philippines had already asked the Dutch Government for assistance in natural disaster management.

Landslide Hazard Mapping : Scale and Objectives -- H. Yagi

Dr. Yagi mentioned that aerial photographs on scales of 1 : 20,000 to 1:40,000 were sufficient to detect landslide topography and to prepare a landslide distribution map over a large area. It had become possible to detect a disastrous zone prone to landslides in a country by overlapping a landslide distribution map on geomorphological (relative relief) and geological maps.

Aerial photographs of at least 1 : 10,000 are required in order to create hazard maps of 1 : 5,000 or more when development schemes were to be implemented on a civil works site. After classification of a slope into facet units, quantitative evaluation of the stability of each facet should be carried out by superimposing other thematic maps, such as a detailed geological map showing structure and lithology , conditions of slope surface layers and topographic conditions in and around the facet.

Evaluation of Landslides under the Effect of Stochastic Factors -- Mr. Lou Xiangdong

In his presentation, **Mr. Lou** described the effects of rainfall, earthquakes and their combined effects in calculating the probability of landslides occurring on a particularly vulnerable site.

The presentation was based on a case study of a site near a proposed dam site of the Three Gorges' Project. The area in which the dam is being built is also prone to landslides, and a study to identify the risk sites had already been conducted.

In the past, with correct predictions of landslides, evacuation of a town near the river had taken place, and the town was later buried under a landslide.

The study looked into Huanglashi landslide, where cracks had appeared on a site in 1989, arousing fears that a landslide would occur. To evaluate the probability of landslide hazards due to earthquakes, the study used SARMA NON-VERTICAL SLICE ANALYSIS, a statistical method. Analysis of extreme rainfall events was undertaken and a threshold value for rainfall for the landslide calculated.

After the presentations, the partcipants held discussions on three different interlinked themes. To facilitate the discussions, Dr. Banskota posed some questions to the participants to be considered in the working groups. The three working groups were on the themes: Group I: Inventory Database including, Socioeconomic Aspects and Institutional Collaboration, Group II: Processes, Tools, and Techniques (both diagnostic and remedial conventional/modern) and Group III: Curricula and Training Materials.

Box 3: Points for Consideration for Group Discussions

1. Definition of a `Landslide': How narrow, how wide? (only Landslide or also other mass wasting/erosion processes)

2. Inventory/Database: Minimum Needs/Priorities (Socioeconomic ?) Uniformity (Acquisition) Exchange : National/Regional Focal Points, Data Management/Computerisation
   Who should collect, monitor ?
   Data needs of different target groups - general and specific purposes ?

3. Processes, Tools and Techniques
   Key Processes:
   Conventional/Modern Tools and Techniques: Diagnostic (e.g., Remote Sensing and GIS) including role of indigenous knowledge
   Prevention/Remedial/Control Methods/Techniques

4. Curricula/Training Material
   - Ongoing/Available/New Needs/Priorities
   - Target Groups: Middle-level professionals
     Others ?
   - Focal Institutions: National/Regional
   - Extent of Integration in Teaching Institution
   - Institutional Collaboration: National/Regional/International

Chapter 8

Session Six: Presentations on Recommendations on Priorities for the Regional Collaborative Training Programme by the Three Working Groups

The Chairperson for this session was **Professor A. Herrmann**. The presentations in this session were made by the chairpersons of the three working groups after extensive discussions in each group.

Presentation by Group I on an Inventory Database (Including Socioeconomic Aspects and Institutional Collaboration (at National, Regional and International Levels)

Professor Qasim Jan, Chairperson of Group I, presented the recommendation on "Inventory Database (including socioeconomic aspects and institutional collaboration at national, regional, and international levels)". The presentation given by this group is presented in Box 4.

After the presentation, there were discussions on the recommendations. It was queried whether the government should provide the aerial photographs and topographic maps to the focal point after identification of the focal point. It was suggested that the government can easily provide small-scale photographs (1:25000). It was also suggested that the selected focal points should make the citizens aware. It was stated that, in the case of Pakistan, most of the areas are unsurveyed. One of the participants requested use of the database format already developed by international experts and used in some offices of Nepal. Finally, the chairman remarked that not only the aerial photographs, but any kind of data are difficult to access. So, the regional working group should think about this. The government is responsible for data, but an individual taking part in this type of programme will receive the benefit from another country's data.

Box 4 : Presentation by Group I

1. Definition of 'Landslide': To be broadly defined, Varnes 1978 was cited as a possible definition. The Group decided not to include soil erosion in this definition.
   The landslide classification to be based on three base widths
   a. Landslides with base widths greater than 50m
   b. Landslides with base widths of 10-50m
   c. Landslides with base widths less than 10m
2. Important information for the Inventory/Database
   a. For mega-scale:
      Location
      Size
      Possible Causes
      Triggering Phenomena
      Rainfall
      Seismicity
      Damage: Socioeconomic
      Source of Information
      Date/history
   b. For regional scale:
      Geology
      Lithology and structure
      Slope/relief
      Hydrogeological
      Seismicity
      Rainfall data
      Water conditions
      Land use
      Vegetation cover
   c. For detailed map
      Geology
      Topography including slope profile
      Groundwater conditions
      Surface water conditions
      Anthropogenic - Settlement

Presentation by Group II on 'Processes, Tools and Techniques (Both Diagnostic and Remedial Conventional/Modern)'

Dr. Renger, the chairperson of Group II, presented the recommendations of the working group. The presentation made by this group is summarised in Box 5.

Some of the participants enquired whether soil scientists were also included in the target group or not. It was clarified that they were not a priority group as usually soil scientists were trained under an agricultural department and were more concerned with productivity aspects of the soil than landslide studies.

Box 5: Presentation by Group II

1. Landslide definition: wide preferred

2. Support of proposed programme
   General remarks:
   - Target group
   - civil engineers, geologists (geotechnical background)
   - period of course - post monsoon
   - include experience of participants' presentation + discussions

3. Content of subjects in general
   - not educational curriculum, in general focus on relevance for landslides
     more in example form than systematic
   - good state-of-the-art reports with ample reference for further studies

Specific comments

Ch 1: More geology (by differentiation)
Structural, Engineering geology, Rock mechanics

Ch 3 - Quick inventory techniques
- GIS + RS only some examples showing possibilities and limitations
- Parameter mapping

Ch7 - Discuss use of existing hazard zonation maps
7.2 - Fluvial processes + protection techniques, embankments etc,
7.3 - Include surface protection with shotcrete
7.4 - Include this section in 7.1

Special course for landslide hazard zonation mapping on regional scales
- RS techniques
- GIS techniques
- good data set are available

target groups - geoscientists
- geotechnical engineers
- planners

resource group- planners
- economists
- cartographers

Presentation by Group III on Curricula and Training Materials (Professional/Technician Levels)

The third recommendation on behalf or Group III was presented, by **Professor Li Tianchi**. The presentation is summarised in Box 6.

It was suggested that stereographic analysis be included. Four types of target group, i.e., planners, professionals, junior technicians, and farmer were suggested. Suggestions about the number of participants (not more than 20) were given. Some of the participants suggested the inclusion of hazard and risk only and deletion of the assessment process. It was explained that assessment of a landslide dam is a very complex and tough topic and its investigation is almost impossible; therefore, this topic should not be given a separate chapter. The importance of the geophysical method of investigation was also discussed. The effectiveness of the geophysical method was discussed in detail with examples.

Finally, the chairman remarked that water quality analysis was important in identifying the failure phenomenon. The chairman also requested the working group to work together in close collaboration with IDNDR activities in the Region .

The chairman of Group III, Professor Li Tianchi, promised to incorporate the comments of the participants in recording the session. Other members of the group included N. Awan, M. Banskota, S. R. Chalise, M. R. Dhital, A. Herrmann, G. S. Pokhrel, T. S. Tun, and B. D. Shrestha

The group comments would be incorporated when finalising the guidelines. ICIMOD was also interested in coordinating different focal points and building their capacities.

It was requested that recommendation be sent to each government and that they should be requested to nominate autonomous organisations to act as focal points for each participating country.

Box 6: Presentation By Group III

1. The group discussed the following topics
   - Definition of a landslide
   - Curriculum/training material

2. The UN definition of a landslide was recommended to be appropriate to follow

3. The group discussed the availability of formal training programmes in different countries and it was found that no such programmes existed in most of the countries, apart from China

4. The proposed training curriculum outline for Middle-level Professionals was found to be appropriate. The following changes in the outline were recommended:
   a) Introduction of the Hindu Kush-Himalayan Region in Chapter I
   b) Rearrange the content of Chapter 2
      2.1 Definition
      2.2 General dynamics of lab process
      2.3 Landslide types and classification
   c) Chapter 3: Include "Stereographic Analysis"
   d) Chapter 4: Include Definition of Hazard and Risk
   e) Chapter 5:- Delete "Underground Temperation Survey"
      - Spell out seismic refraction and electric resistivity survey under 5.3
   f) Chapter 6: Include "rock slide" analysis, back analysis

Other Target Groups

5. The group recommended that training programmes should be developed and implemented also for the following target groups
   - Managers, decision-makers, policy-makers
   - Junior technician level
   - Farmer level

6. Focal Institutions
   a) The group emphasised the need for focal institutions in each country
   b) ICIMOD should act as a regional focal institution

7. The group strongly urged the integration of landslide studies into academic curricula

8. International collaboration

Chapter 9

Session Seven: Plenary Session

Mr. E. Pelinck, Director General, ICIMOD, chaired this session. The final recommendations were presented by Professor Herrman, the chairperson of the previous session.

Presentation of Final Recommendations

Professor Hermann, who had chaired the previous session, summarised the presentations made by the three groups earlier in the day. He stressed that this was a very first step and hoped that further collaboration and activities would prove the workshop's success. He added that there was a broad agreement on the objective of the workshop and on the definition of a landslide which was to be outlined broadly. There was also agreement on the target group for the selection of trainers who were professional practitioners of landslide hazard management and control in order to support planning and decision-making. There was also broad agreement on the curricula with some amendments. The main components of the agreement concerned building and sharing a database and production of maps using GIS and remote sensing as well. In addition to production of maps, the available information should also be used for other usable products.

Professor Herrman highlighted the participants' recommendations that ICIMOD should be a coordinator for the different national focal points. ICIMOD's capacity to offer computer facilities for generating a database was also highlighted. He said that everybody agreed on the importance of national focal points for national inventories and landslide research.

He recommended that this working group collaborate under an international work such as the International Hydrological Programme (IHP) of UNESCO for the hydrological working group.

Discussions

Dr. Rengers felt that in all participating countries enough expertise was available, but ICIMOD could give guidance for the curriculum framework. The same course given at ICIMOD could be used in national agencies, and ICIMOD could ensure quality. ITC would like to support with training materials, if required.

Prof Chalise thanked Dr Rengers, Dr. Thakur, Dr. Anbalagan, Professor Li, and others for supplying training materials from their institutions.

Mr. Tiwari and Mr. Dixit both felt that, for Nepal, DPTC could be designated as the focal point.

Dr. Anbalagan said that the University of Roorkee had been conducting courses for the professionals and, recently, for administrators as well. For example, the magistrates from the hill districts were being trained for crisis management and planning. This was being organised at the National Academy of Administration at Mussoorie. Roorkee University has an infrastucture and facilities for conducting such courses and had already conducted courses in the past. Course training materials had already been made availabe to ICIMOD. The University also had over 40 computer programmes for various landside situations which could be used for academic and research purposes. About 15 to 20 such programmes were already available at ICIMOD. He added that they would welcome any further collaboration.

Professor Li mentioned that the Chinese Academy of Sciences had established a research foundation for the study of landslides and debris flow and substantial investments had been made. The project was currently in the second phase: and work on a database inventory, mechanics and dynamics of landslides, processes, and new techniques for landslide control was taking place. More than 10 institutions were involved in this project. He suggested that this could be the possible national landslide focal group for China.

As for training in ICIMOD member countries, Chengdu Institute for Mountain Hazards and Environment could be considered as a venue as it had facilities and the ongoing work could be a part of the training course. The institute also had simulation models and three observation sites for debris flow and landslides which could be used for training.

Dr Thakur said that Wadia Institute has already conducted training on structural geology for south Asia and that they had good infrastructural facilities and over 60 scientists. In addition to the work on landslides, the institute was also involved in the study of active faults. Although he thought that the focal point for India could be the Ministry of Science and Technology, he also offered to assist and collaborate.

Remarks on Behalf of the Participants -- Col Rahim

On behalf of the participants, **Colonel Rahim** from Bangladesh said that the workshop had clearly identified causes of landslides, and had looked into the need to look at landslide managment and control as an interdisciplinary task with integration of field-level workers and theoreticians. Offers of training at international and national centres were very useful, he added. He thanked ICIMOD for organising the workshop and stated that he had benefitted enormously from the discussions.

Colonel Rahim said that the recommendations from the workshop should be made available to policy-makers and decision-makers.

Mr. Awan from Pakistan also thanked ICIMOD for the successful workshop.

Concluding Remarks by the Chairperson

Concluding from the Chair, **Mr Pelinck** said that the workshop had clearly defined what the term landslide meant, the target group for training, the curriculum, the need for a database and for sharing of data, the role of national agencies, and the importance of a regional working group.

He added that more awareness on a general level and at the decision-makers' level was also important. The training programme that was reviewed at the workshop focussed more on medium- level practioners, but the need to involve policy-makers and more members of the general public was also felt. He hoped that, in future activities, they would also be included.

Talking about the national focal points, Mr. Pelinck stated that in countries without a clear focal point, a broader working group to incorporate all organisations might be a suitable approach. He assured the participants that the workshop proceedings would be published and sent to their governments and to partner institutions throughout the region.

He thanked the participants for their various offers to host the regional course. In preparing a two to three years' programme regional and national courses would be looked into. As for the course venue, Mr Pelinck said that the first course would be held at ICIMOD. A long-term programme focus would be planned. He suggested that courses could be repeated and rotated for regional and national training purposes, and could be held where the trainees were located with trainers coming from outside.

Mr Pelinck thanked all the resource persons and all participants for their active discussions and involvement.
ICIMOD's aim, Mr Pelinck said, was to maintain and restore the environment and work towards alleviating poverty. Capacity-building and training were also important tasks for ICIMOD. The proposed curriculum was such that it could be translated into national programmes.

He said, that ICIMOD's role was to act as an intermediary for partner institutions, and that intermediaries were necessary in order to get the message across to the governments and the people.

Mr Pelinck concluded by stating that all the objectives of the workshop had been met. He reiterated that ICIMOD would be looking forward to further collaboration with all.

Annex 1
Proposed Training Curriculum

A. BACKGROUND

The Hindu Kush-Himalayan Region is one of the largest mountain areas in the world. The rugged mountain topography is geologically young, subject to frequent erosion, abundant and intense monsoon rainfall and frequent earth tremors which contribute to severe landslide problems. Landslides particularly cause a heavy toll and economic losses through the destruction of houses, roads, bridges, farmlands, and public buildings. On the other hand, large-scale deforestation, unplanned urban growth, and badly-engineered mountain roads accelerate the landslide process in the region. It seems that this region is one of the most landslide disaster-prone areas in the world. There is, therefore, an urgent need to develop human resources for the management and control of landslide disasters in the region.

B. OBJECTIVE

Many individual factors can contribute to landslides or to slope instability. Acting in combination, these factors provide a wide variety of controlling processes and landslide types. There is, therefore, no single method for managing landslides or unstable terrain; a variety of techniques are needed.

The objective of this training course is to assist middle-level professionals concerned with planning and implementation of landslide hazard mitigation activities. This will be provided through practical information supported by examples from a wide variety of landslide situations and advanced techniques in landslide monitoring and landslide mapping. However, the landslide hazards in each country are unique and it is impossible to provide a step-by-step solution which could be applied in any specific case.

C. OUTLINE OF THE TRAINING COURSE

Chapter 1. Introduction

Physical setting of the Hindu Kush-Himalayan Region:

- Geology
- Geomorphology
- Climate
- Hydrology
- Earthquake activity

Chapter 2. Basic Principles of Landslides

2.1 Landslide types and movement processes
- 2.1.1 Definition
- 2.1.2 Classification
  - Falls
  - Topples
  - Slides
  - Rotational slides
  - Translational slides
  - Spreads
  - Flows : debris flow, mud flow, earth flow
  - Complex movement

2.2 The general dynamics of landslide movement

2.2.1 Mechanics of landslide movement
2.2.2 Factors affecting slope stability
- Factors contributing to an increase in slope stability
- Factors contributing to a reduction of slope stability

Chapter 3. Landslide Inventory and Mapping

3.1 Landslide identification

3.2 The types of landslide maps

3.3 Techniques of landslide mapping

3.3.1 Landslide inventory
3.3.2 Landslide aerial photo interpretation
3.3.3 GIS techniques for landslide mapping
3.3.4 Geographic Positioning Systems (GPS) techniques for landslide mapping

Chapter 4. Landslide Hazard Assessment

4.1 Office evaluation of existing landslide data

4.1.1 Maps and reports
4.1.2 Aerial photograph analysis
4.1.3 Sources of support research
4.1.4 Office assessment of landslide hazard

4.2 Field evaluation

4.2.1 Landform
4.2.2 Overburden
4.2.3 Bedrock lithology and structure
4.2.4 Geological processes on the slope
4.2.5 Hydrology and Geohydrology
4.2.6 Vegetation

4.3 Final landslide hazard assessment

Chapter 5. Site Survey of Complex Landslide (detailed landslide investigation)

5.1 Aerial-photo interpretation and mapping

5.2 Underground temperature survey

5.3 Seismic prospecting

5.4 Surface measurement by extension meter and tiltmeter

5.5 Survey earth displacement and slip surface or failure zone by drilling, pipe strain gauges, inclinometer, movement meter.

5.6 Groundwater survey, including surveying groundwater pressure (water level) acting on the slip surface, groundwater prospecting, groundwater tracing, groundwater simulation, pumping test.

5.7 Water quality analysis.

5.8 Soil test : Laboratory test and *in situ* test.

5.9 Meteorological and hydrological surveys : rainfall observation, snow cover survey, thaw survey.

Chapter 6. Stability Analysis of Landslides and Unstable Slopes

6.1 Basic concepts

- Objectives of slope stability analysis
- Slope failure

6.2 Slope stability analysis methods

6.2.1 Common assumptions for analysis
6.2.2 Circular sliding surface-slice method
6.2.3 Circularsliding surface-simplified slice method (Swedish or Fellenius method)
6.2.4 Circular sliding surface-Bishop's generalised slide method

6.3 Practical application of slope stability analysis

6.3.1 Practical application
6.3.2 Application problems of slope stability analysis
- shear strength
- porewater pressure
- sliding surface

Chapter 7. Measures for Management and Control of Landslide Hazards

7.1 Avoidance works

7.1.1 Avoiding existing landslides and unstable slopes
7.1.2 Avoiding landslides caused by construction
- landslides caused by road construction
- landslides caused by irrigation canal construction
- landslides caused by dam construction

7.1.3 Scheduling building activities

7.2 Prevention works

7.2.1 Construction techniques
7.2.2 Controlling blasting
7.2.3 Use of cuts and fills
7.2.4 Benching techniques
7.2.5 Drainage construction and ditches
7.2.6 Culvert management
7.2.7 Gully management
7.2.8 Riprap revetment

7.3 Stabilisation measures

7.3.1 General concepts
- method selection criteria
- preconditions for stabilisation measures
- method selection consideration

7.3.2 Surface water drainage

8.5 Forecasting debris flow

8.5.1 Basis and foundation
8.5.2 Prediction method of rainfall-induced debris flow

Chapter 9. Assessment and Mitigation Measures of Landslide Dam Failure Disasters

9.1 Formation and classification of landslide dams

9.2 Assessment of floods from landslide dam failure

9.3 Physical measures to improve the stability of landslide dams

Chapter 10. Institution

10.1 Role of government agencies and research institutions

10.2 Role of central, provincial, and local government

10.4 Role of NGOs and scientific societies

10.5 Development of regional and international network

10.6 Professional development

Chapter 11. Participation of Local People in Landslide Hazard Mitigation

11.1 Guidelines to inhabitants of landslide affected area

11.2 Participation of local people in landslide hazard mitigation.

D. A FRAMEWORK FOR THE TRAINING COURSE

1. Number of Trainees

Considering the equipment/computers etc to be used for the training course, 15-20 trainees of the middle-level professional category from the HKH Region should be the limit.

The trainees will be recruited from line agencies and concerned institutions. Their academic backgrounds may be varied (geologists/geomorphologists, hydrologists/meteorologists, foresters, civil engineers, rural engineers). However, all of them should have been involved in Landslide Hazard Management and Control in their country.

2. Duration of the Training Course

3-4 weeks' training course is primarily designed to integrate theoretical training with field work or experience:

- 2-3 weeks through theoretical training in the classroom and
- 1 week of field work in the surrounding area. This should also include study in the field at sites of landslide monitoring and control.

3. Resource Persons Required for Training

The approach to management and control of landslide hazards is multidisciplinary. The following resource persons are needed to achieve a multidisciplinary approach.

- One geologist/geomorphologist with practical experience in landslide classification and mapping
- One geotechnical engineer with practical experience in detailed site investigation and landslide prediction
- One civil engineer with practical experience in landslide control
- One biological engineer familiar with landslide and soil erosion control by means of small-scale biological engineering methods
- One geologist/geomorphologist familiar with landslide dam studies
- One hydrologist/meteorologist familiar with landslide and soil erosion

4. Training Site

The ICIMOD complex, Kathmandu, Nepal, can be arranged as the site for theoretical classroom training.

According to the "Technical Proposal for Landslide Control and Management of the Hindu Kush-Himalayan Region" prepared by the Japanese experts, Professor Ito Takeshi et al. (1993) for ICIMOD, the following landslides surrounding Kathmandu can be used for landslide field trips.

1) The rock landslide located near Barabise along the Kodari Highway
2) The Bungamati landslide composed of lake sediments, located in Lalitpur District, 13 km south of Kathmandu.
3) The Champi landslide located on the terrace of the Nakhu Khola River, 12km south of Kathmandu.
4) The Nagarkot landslide composed of completely weathered phyllite, located in the farmous tourist hilly resort, 27km east of Kathmandu.
5) The colluvial landslide (a landslide model site), located at Okarpauwa in Nuwakot District, 19.5km along the Kathmandu-Trisuli Road.

E. TRAINING MATERIALS

The training materials should be prepared before starting the training course. These will include all materials directly linked to the training course. A compilation of relevant manuals and publications is, therefore, necessary. Among the several publications, the following are recommended and presently available at ICIMOD.

Mountain Risk Engineering Handbook, ICIMOD, 1991, Kathmandu, Nepal.

Watershed Management Field Manual-Landslide Prevention Measures, 1988. FAO Conservation Guide 13/4, Rome, Italy.

Review Paper on Landslide Hazard Management and Control from the regional countries, ICIMOD (in revision).

The Ministry of Water Resources/His Majesty's Government of Nepal, Water Induced Disaster Prevention Technical Centre and Japan International Cooperation Agency, 1994, A Manual on Landslides, Kathmandu, Nepal.

Megh Raj Dhital; Narendra Khanal; Khadga B Thapa, 1993. The Role of Extreme Weather Events, Mass Movements and Land Use Changes in Increasing Natural Hazards. Kathmandu, Nepal: ICIMOD.

Brian Carson, 1985. Erosion and Sedimentation Processes in the Nepalese Himalayas. Kathmandu, Nepal: ICIMOD.

Jack D. Ives, 1986. Glacial Outburst Floods and Risk Engineering in the Himalayas, Kathmandu, Nepal: ICIMOD.

Urs Schuffner, 1987. Road Construction in the Nepal Himalaya: The Experience from the Lamosangu - Jiri Project. Kathmandu, Nepal: ICIMOD.

Li Tianchi, 1990. Landslide Management in the Mountain Areas of China. Kathmandu, Nepal: ICIMOD.

Birendra B. Deoja, 1992. Sustainable Approaches to the Construction of Roads and Other Infrastructure in the Hindu Kush-Himalayas. Kathmandu, Nepal: ICIMOD.

Water and Energy Commission Secretariat, His Majesty's Government of Nepal, 1987. Erosion and Sedimentation in the Nepal Himalaya. Kathmandu, Nepal: WECS and ICIMOD.

The following materials need to be prepared in detail.

- Landslide types and movement processes
- Landslide mapping
- Landslide hazard assessment and landslide forecasting
- Landslide dam: formation, processes, and mitigation of landslide dam hazards
- Detailed landslide investigation
- Measures for management and control of landslide hazards
- Participation of local people in landslide hazard mitigation

E. Summary and Timetable for the training course, ICIMOD

References

Ito Takeshi, Yatabe Ryuichi and Takashi Jiro, 1993. Technical Proposal for Landslide Control and Management in the Hindu Kush-Himalayan Region (draft project document) for ICIMOD, Kathmandu, Nepal.

Ministry of Water Resources, HMG, Nepal. Water Induced Disaster Prevention Technical Centre, 1994. Final Report on the Master Plan for the Landslide at 19km along the Kathmandu-Trisuli Road, Kathmandu, Nepal.

E. Proposed Timetable for the Training Course, ICIMOD

Week 1

Date	9.00-9.50	9.50-10.40	11.00-12.00	13.00-13.50	13.50-14.40	15.00-16.00/ 17.00
Monday	Registration		Opening: Introduction of Participants	Introduction to the Training Course	Chapter 1 Introduction to the HKH: Geology	Chapter 1 Introduction to the HKH: Geology
Tuesday	Chapter 1 Introduction to the HKH: Geomorphology	Chapter 1 Introduction to the HKH: Geomorphology	Chapter 1 Introduction to the HKH:Climate and Hydrology	Chapter 1 Introduction to the HKH:Climate and Hydrology	Chapter 1 Introduction to the HKH: Earthquakes	Chapter 1 Introduction to the HKH: Earthquakes
Wednesday	Chapter 2 Basic principles of landslides: landslide types and processes	Chapter 2 Basic principles of landslides: landslide types and processes	Chapter 2 The dynamics of landslide movement	Chapter 2 The dynamics of landslide movement	Chapter 3 Introduction to landslide inventory and mapping	Chapter 3 Techniques of landslide mapping: landslide inventory
Thursday	Chapter 3 Techniques of landslide mapping: Aerial photo interpretation		Chapter 3 Techniques of landslide mapping: basic GIS techniques		Laboratory exercise on aerial photo interpretation	
Friday	Chapter 3 Techniques of landslide mapping GIS techniques		Chapter 3 Techniques of landslide mapping: GPS techniques		Chapter 3 Exercise on the preparation of a landslide hazard map based on aerial photos	
Saturday	Field trip to landslide area					
Sunday	Advanced reading					
Coffee: Lunch:	10:40 to 11:00 and 14:40 to 15:00 12:00 to 13:00					

E.Proposed Timetable for the Training Course, ICIMOD

Week 2

Date	9.00-9.50	9.50-10.40	11.00-12.00	13.00-13.50	13.50-14.40	15.00-16.00/ 17.00
Monday	Chapter 4 Landslide hazard assessment: office evaluation	Chapter 4 Landslide hazard assessment: field evaluation	Chapter 4 Landslide hazard assessment: final assessment	Laboratory exercise on the preparation of a landslide hazard map by GIS techniques		
Tuesday	Chapter 5 Detailed landslide investigation			Laboratory exercise on the preparation of a landslide hazard map by GIS techniques		
Wednesday	Chapter 5 Detailed landslide investigation			Chapter 6 Stability analysis: Analysis methods		
Thursday	Chapter 6 Stability analysis: Practical application of slope stability analysis			Laboratory exercise on stability analysis		
Friday	Chapter 7 Measures for management and control of landslide hazards: avoidance work			Chapter7 Measures for management and control of landslide hazard: stabilisation measures		
Saturday	Field trip to landslide area					
Sunday	Advanced reading					

F. Summary of the Training Curriculum

Week 3

Date	9.00-9.50	9.50-10.40	11.00-12.00	13.00-13.50	13.50-14.40	15.00-16.00/ 17.00
Monday	Chapter 7 Measures for management and control of landslide hazards: stabilisation measures			Chapter 7 Measures for management and control of landslide hazards: stabilisation measures and protection works		
Tuesday	Chapter 8 Landslide forecasting, predicting where the landslide will occur, monitoring and warning system			Chapter 8 Landslide forecasting: forecasting landslide timing and predicting the extent of rapid landslide motion		
Wednesday	Chapter 8 Landslide forecasting: Forecasting : Rainfall-induced debris flow			Chapter 8 Landslide dam failure disasters and their mitigation		
Thursday	Chapter 10, 11 Institution and guidelines to inhabitants of landslide affected areas			Chapter 11 Participation of local people in landslide hazard mitigation		
Friday	Landslide database	Guest lecture : GIS at ICIMOD		Project briefing and grouping the trainees		
Saturday	Advanced reading					
Sunday	Preparation for field study					

F. Summary of the Training Curriculum

Week 4

Date	9:00-9:50	9:50-10:40	11:00-12:00	13:00-13:50	13:50-14:40	15:00-16:00/17:00
Monday	Project work on causes and types of landslides at selected field sites					
Tuesday	Project work on management and control of landslides at selected sites					
Wednesday	Project work on management and control of landslides at selected sites					
Thursday	Report preparation of project work					
Friday	Report preparation and submission of project report					
Saturday	Closing ceremony and certificate distribution					
Sunday	Departure to home country					

Annex 2
Workshop Schedule

Kathmandu, 12 - 14 July, 1995: *Venue - ICIMOD Conference Hall*

First Day - 12 JULY, 1995 (WEDNESDAY)

09:00 - 09:30 **REGISTRATION**

09:30 - 13:15 **Session One : Country Review Papers/Country Reports**

Chairperson : M. Banskota, Deputy Director General, ICIMOD

Rapporteurs : N. Khanal/P. B. Shah

- Introduction to the Workshop -- S. R. Chalise
- Landslide Hazard Mapping, Control and Forecasting in China -- Li Tianchi
- Landslide Management and Control in India -- V. C. Thakur

11:00 - 11:15 *Tea/Coffee Break*

Session 1 (contd..)

- Landslide Management and Control in Pakistan -- M. H. Malik/S. Farooq
- Landslide Studies and Management in the Nepal Himalayas -- B. N. Upreti/M. Dhital

12:35 - 13:15 Country Reports

- Landslide Hazard Management and Control in the HKH in Bangladesh Perspective -- M. A. Rahim
- Country Report from Myanmar -- Than Sein Tun

13:00 - 14:30 *Lunch Break*

14:30 - 15:15 **Session Two : Inaugural Session**

Rapporteur : S. Karki

- Welcome Address by Mr. Egbert Pelinck, Director General, ICIMOD
- Address by Mr. M. Ishikawa, Minister, Embassy of Japan
- Inaugural Address by Chief Guest Mr. S.N. Upadhyay, Secretary, HMG/N, Ministry of Water Resources

15:15 - 15:45 *Tea/Coffee Break*

15:45 - 17:00 **Session Three : Invited Papers**

Chairperson : S. R. Chalise
Rapporteurs : N. Khanal/P. B. Shah

- Landslides in the Snowy Regions of Japan -- T. Ito
- Risk Mapping for Landslide Hazard Management in the Sukhidang Area, Kumaon Himalayas, India -- R. Anbalagan
- Status of Landslide Hazard Management in Nepal -- A. Dixit

Second Day - 13 JULY, 1995, (THURSDAY)

9:00 - 10:30 **Session Four : Priorities for a Regional Collaborative Training Programme**

Chairperson : V. C. Thakur
Rapporteurs : M. R. Dhital/B. Tiwari

- Guidelines and Priorities for a Regional Training Course on Landslides Hazard Management and Control in the Hindu Kush-Himalayan Region - Li Tianchi
- Landslide Monitoring by the DPTC in Nepal -- I. Kitahara/B. Tiwari

10:30 - 11:00 *Tea/Coffee Break*

11:00 - 11:15 Introduction to the field visit -- B Tiwari, DPTC

11:15 Departure for a Field Visit to Landslide Monitoring and Control Sites along the Trishuli Road (DPTC site)
(Packed lunch. Return to hotel by 15:00hrs.)

19:00 *Reception/Dinner*

JULY 14, 1995 (FRIDAY)

09:00 - 10:30 **Session Five : Issues and Priorities for Training**

Chairperson : T. Ito
Rapporteurs : P.B. Shah/ S. Karki

Presentations :
- N. Rengers: Landslide Hazard Mapping For Sustainable Development
- H. Yagi: Landslide Hazard Mapping : Scale and Objectives
- Lou Xiangdong: Evaluation of Landslides under the Effect of Stochastic Factors

10:30 - 10:45 *Tea/Coffee Break*

10:45 - 13:00 **Session Six : Group Discussions and Recommendations on Priorities for a Regional Collaborative Training Programme**

Group I : **Inventory Database (including Socioeconomic Aspects and Institutional Collaboration [National/Regional/International]**

Venue : Conference Hall

Chairperson : M. Qasim Jan
Rapporteurs : B. N. Upreti/S. Karki

R. Anbalagan, T.Ito, P.Pradhan, M. A Rahim, P.B. Shah, P.Sharma, M. L. Shrestha, B. Tiwari

Group II : **Processes, Tools and Techniques (both diagnostic/ remedial; and conventional/modern)**

Venue : MFS Meeting Room

Chairperson : N. Rengers
Rapporteurs : P. Mool/N. Khanal

I. Kitahara, A. Koirala, M. H. Malik, K. P. Pandey, Pei Shengji, V.C. Thakur, Lou Xiangdong, J. Zimmermann

Group III : **Curricula and Training Materials (Professional/Technician levels)**

Venue : MEI Meeting Room

Chairperson : Li Tianchi
Rapporteurs : H. Yagi/A. Dixit

N. Awan, M. Banskota, S. R. Chalise, M. R. Dhital, A. Herrmann, G. S. Pokhrel, T. S. Tun, B. D. Shrestha

13.00 - 14.00 *Lunch*

14:00 - 15:00 **Session Seven** : **Plenary Session**

Presentation and Discussion of Group Recommendations

Chairperson : A. Herrmann
Rapporteurs : P. B. Shah/B. Tiwari

- Presentation of Group Recommendations by the Chairpersons from each group

15:00 - 15:45 **Session Eight** : **Concluding Session**

Chairperson : E. Pelinck, Director General, ICIMOD
Rapporteurs : H. Yagi/S. Karki

- Presentation of final recommendations
- Remarks on behalf of participants
- Concluding remarks by the chairperson

Annex 3
List Of Participants

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Annex 4
List of Papers Presented at the Workshop

- Landslide Hazard Mapping, Control, and Forecasting in China**
  - Li Tianchi
- Landslide Management and Control in India **
  - V. C. Thakur
- Landslide Management and Control in Pakistan**
  - M. H. Malik/S. Farooq
- Landslide Studies and Management in the Nepal Himalayas**
  - B. N. Upreti/M. Dhital
- Landslide Hazard Management and Control in the HKH: Bangladesh Perspective
  - M. A. Rahim
- Country Report from Myanmar
  - Than Sein Tun
- Landslides in the Snowy Regions of Japan
  - T. Ito
- Risk Mapping for Landslide Hazard Management in Sukhidang Area Kumaon Himalayas, India**
  - R. Anbalagan
- Status of Landslide Hazard Management in Nepal
  - A. Dixit
- Guidelines and Priorities for a Regional Training Course on Landslide Hazard Management and Control in the Hindu Kush-Himalayan Region
  - Li Tianchi
- Landslide Monitoring by the DPTC in Nepal
  - I. Kitahara/B. Tiwari
- Landslide Hazard Mapping for Sustainable Development - N. Rengers
- Landslide Hazard Mapping : Scale and Objectives - H. Yagi
- Evaluation of Landslides under the Effect of Stochastic Factors - Lou Xiangdong
- Field Excursion Guide to the Landslide at 19km along Kathmandu-Trishuli Road - B. Tiwari

** forthcoming publications as MNR Discussion papers

PRESS RELEASE
12 July 1995

Experts Meet to Identify Critical Issues and Problems in Landslide Hazard Management and Control in the HKH

Steep slopes, unstable geology, and intense monsoon rains combine to make the Hindu Kush-Himalayas (HKH) one of the most hazard-prone areas in the world. During the monsoons, floods and landslides of varying magnitude are the most common natural events affecting this region every year. These events will continue to occur in the future because of the nature of these environments. The present level of systematic understanding and analysis of these natural events is very poor. The database is limited. Monitoring activities are not regular even when such monitoring can be of direct benefit to projects.

Appropriate land-use and construction activities, increasing awareness of potential dangers in hazard-prone areas, more comprehensive assessment of watershed conditions and their implications for development activities, and incorporation of these considerations into development projects and different economic activities will assist in better preparedness against increasing natural hazards.

ICIMOD, since its inception, has been promoting efforts to develop a better understanding of landslide hazards and a number of activities has been completed so far. These include several training programmes dealing with mountain risk engineering, improving road construction on unstable mountain slopes, review of landslide hazard management activities in China, and field assessment of landslides and flood events in south central Nepal, following the extreme climatic events of July 1993.

With support from the **Government of Japan,** ICIMOD commenced further activities in the field. Four state-of-the-art reviews on landslide management have been completed for China, India, Pakistan, and Nepal. A Climatic Atlas for Nepal is being prepared, and a Regional Training Programme on Slope Instability Mapping using Remote Sensing and GIS was organised in 1994.

From 12-14 July, 1995, ICIMOD's Landslide Hazard Management and Control Project under the Mountain Natural Resources' Programme is hosting a Regional Workshop on Landslide Hazard Management and Control in the Hindu Kush-Himalayas. About 30 participants from the countries of Bangladesh, Bhutan, China, India, Japan, Myanmar, Nepal, The Netherlands, and Pakistan are expected to attend the Workshop.

A major concern of this workshop is to identify specific priorities for a regional collaborative Landslide Hazard Management Training Programme which ICIMOD is going to implement.The main objectives are:

- to review the current status of programmes and activities on Landslide Hazard Management and Control in the countries of the Hindu Kush-Himalayas;
- to review the existing facilities and curricula for training in the field of Landslide Hazard Management and Control in the Hindu Kush-Himalayan countries; and
- to develop a regional training programme in this field in accordance with regional priorities.

By sharing experiences among experts from both within and outside the HKH region and identifying key areas for training in accordance with the needs and priorities of the regional countries of the HKH, ICIMOD is attempting to further strengthen national capacities for Landslide Hazard Management and Control.

ICIMOD

Founded out of widespread recognition of degradation of mountain environments and the increasing poverty of mountain communities, ICIMOD is concerned with the search for more effective development responses to promote the sustained well being of mountain people.

The Centre was established in 1983 and commenced professional activities in 1984. Though international in its concerns, ICIMOD focusses on the specific, complex, and practical problems of the Hindu Kush-Himalayan Region which covers all or part of eight Sovereign States.

ICIMOD serves as a multidisciplinary documentation centre on integrated mountain development; a focal point for the mobilisation, conduct, and coordination of applied and problem-solving research activities; a focal point for training on integrated mountain development, with special emphasis on the assessment of training needs and the development of relevant training materials based directly on field case studies; and a consultative centre providing expert services on mountain development and resource management.

ICIMOD WORKSHOPS

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

Workshop Reports are intended to represent 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, as well as a Catalogue of all of ICIMOD's Publications, are available upon request from:

The Publications' Unit
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PARTICIPATING COUNTRIES OF THE HINDU KUSH-HIMALAYAN REGION

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

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