

## SESSION THREE

The participants met briefly in a plenary session prior to dividing into discussion groups. Professor S. Chalise chaired this brief session. The agenda for the day was planned to consider the following topics: 'Hazard Mapping Techniques for Landslide and Gully Erosion Control' were interrelated and that, therefore, these subjects would be discussed by one group, i.e., Group Two: 'Hazard Mapping and Soft Engineering'. Group One would discuss 'Understanding, Identification and Practical Implications of Glacial Quaternary Deposits in Nepal and the Hindu Kush-Himalayan Region'. Participants were allotted their groups and technical and language requirements assigned. The members of each group are given in Annex Three. The group discussions have been recorded in order to clarify how recommendations came about. As far as possible, speakers are identified.

# Part Three

When considering the group discussions and recommendations to be made, Professor Chalise asked the groups to follow a certain formula.

Based on the reports, the presentations, the discussions, and the field visit, what is the opinion of the group regarding:

1. the main achievements (conceptually and practically) of the work so far with Gully (i.e. benefit most from this work and how?
2. the major limitations of the work and, more specifically, in which areas?
3. what needs to be done next, which aspects (subject areas, methods, equipment, resources) and are these components available?
4. ICIMOD has a regional mandate, what are the main regional implications of this project, what should be done next for a regional programme (regional meeting, workshop or concerned agencies in the region for discussion etc.?

The groups were to conduct their discussions according to these points, formulate their recommendations, and present them at the final plenary session.

## SESSION THREE

The participants met briefly in a plenary session prior to dividing into discussion groups. **Professor Suresh Raj Chalise** chaired this brief session. He explained that, although originally it had been planned to divide the forum into three groups, after some consideration it had been decided that the subjects of 'Hazard Mapping' and 'Application of Community Oriented Erosion Techniques for Landslide and Gully Erosion Control' were interrelated and that, therefore, these subjects would be discussed by one group, i.e., Group Two: 'Hazard Mapping and Soft Engineering'. Group One would discuss 'Understanding, Identification and Practical Implications of Glacial Quaternary Deposits in Nepal and the Hindu Kush-Himalayan Region'. Participants were allotted their groups and technical and language rapporteurs assigned. The members of each group are given in Annex Three. The group discussions have been recorded in order to clarify how recommendations came about. As far as possible, speakers are identified.

In considering the group discussions and recommendations to be made, Professor Chalise asked the groups to follow a certain formula.

Based on the report, the presentations, the discussions, and the field visit, what is the opinion of the group regarding

- a) the main achievements (conceptually and practically) of the work so far; who is likely to benefit most from this work and how?
- b) the major limitations of the work and, more specifically, in which areas?
- c) what should be done next, which aspects (subject areas, issues, etc) need greater emphasis and are there components that should be reduced in emphasis? and
- d) ICIMOD has a regional mandate; what are the main regional implications of this present work? What should be the next step for a regional programme (regional meeting, invitation to concerned agencies in the region for discussion, etc)?

The groups were to conduct their discussions according to these points, formulate their recommendations, and present them at the final, plenary session.

## SESSION FOUR

### **Group One - Understanding, Identification, and Practical Implications of Quaternary Deposits in Nepal and the Hindu Kush-Himalayan Region**

**Dr. Pugin** was the Chairman for Group One and opened the discussions by stating that the problem should be solved by considering all the facts and fitting them into one of two models, i.e., a glacial model or a debris flow model. He added that the phenomenon they had been observing was not new, it had been found before. It should now be discussed. He opened discussion by suggesting that the group deal with the points in the guidelines for group discussion given by the Chair.

#### *Discussions*

**Dr. M.R. Dhital** pointed out that there was now a lot of information on Quaternary deposits between Balephi and the Friendship Bridge. This information was quite detailed, giving new inputs for new methods of enquiry and new applications in geophysics. In fact, seismic reflection was quite new in the context of Nepal since resistivity was the method that had been used in the past.

Some exchange took place among group members concerning the merits of old and new methods of analysis.

**Dr. Dibya R. Kansakar** stated that one of the main achievements had been that a new issue for further scientific research had been raised, because it was now essential that the possibility of glacial deposits at lower levels be examined. This would have a great impact not only on applications but also on science itself.

In Nepal, such phenomena have occurred up to 2,400 metres. The latitudinal effect is also there. Notwithstanding, this finding is a first for this part of the Himalayas. It is a big issue and needs to be studied further. There are doubts because glacially good landforms are not preserved, yet the deposits are there indicating past glacial activity.

**Dr. M. R. Dhital** rejoined that the findings had direct implications on infrastructural development. The scientific content of the report was good, grain size analysis and geophysical interpretations had provided good data. One model had been proposed and the team had good evidence to support it.

**Dr. C.K. Sharma** stated that the research had opened up a new idea; the idea of looking at glacial deposits, particularly in valleys.

Until now, Quaternary deposits from GLOFS only had been studied. This work suggested that they should be looking at older glaciation. If one were to ask what the benefits would be, the answer would be that the country will benefit. Road and hydropower departments in particular should look into these deposits. Hydropower sites would have to be more carefully selected.

**Dr. B. P. Upadhya** stated that the conceptualisation in the past had been that there were glacial deposits at depth in the lower regions. Is this concept still valid? Was the material glacial or fluvial? The conceptualisation needed verification. We had to be very clear. Was this a concept or was it merely anticipation? He suggested that more study would be necessary to clarify these points for the sake of validating the concept and giving more rationale to its validity.

**Mr. Narendra Khanal** stated that the work had succeeded in identifying channels, or implications of geohydrological channels. The impacts and the benefits of this would mainly apply to the Department of Roads and the Department of Hydrology, no matter whether the deposits found were due to glaciers or rivers.

Dr. Andre Pugin, at this point, summarised the points that the group should be looking at. He stated that the project had used new methods or improvements of old methods in the first phase and had, hence, found new facts in Northern Nepal. Consequently, the discussion was concerned with whether the new model was glacial or fluvial and what would be the implications in practice.

**Dr. B.N. Upreti** stated that, further north, the material differed from that in the south. The material was very thick and fragile north of Balephi, and this would be a problem for road alignment. Methods of hazard mapping were very important. When the Lamosangu-Jiri road was built, it was the first time that mountain risk engineering methods had been used, now hazard mapping of a larger area had been done and the methodology improved. This should now be applied to other areas. He suggested that the work had led to improvements in hazard mapping and that new parameters had been established in geophysics and geology in the area. He appreciated the relationships formed and the sharing of knowledge between Swiss and Nepalese scientists. Dr. Upreti said he looked forward to further participation.

**Mr S.R. Pant** added that there had been improvements in geophysical methods and that it was the first time the seismic reflection method had been used in Nepal on Quaternary deposits.

Dr. C.K. Sharma noted that, since the work had only been carried out in the Bhote Koshi and Sunkoshi area, it should be carried out in other areas also, probably in East Nepal. Findings there would substantiate the work already carried out. This work should be carried out over a limited period of time and systematic glacial mapping should be carried out.

There was an ensuing discussion about the difficulties involved in glacial mapping, although the moderator noted that geological maps were available and these could provide a start. The group consensus was that glacial and morphological maps were a must and that the maps should be updated. Geophysical data needed confirming and every effort should be made to do so.

Dr. B.P. Upadhaya mentioned what he considered essential in terms of further work. He said that ages of the rocks were not known and climatic and drainage data had not been confirmed. He saw work to fill these gaps as essential in any future project phase.

**Dr. S.K. Manandhar** mentioned that the graphical representations needed redrawing. Dr. Pugin agreed. Mr. Manandhar asked if Dr. Pugin believed that the deposits of the huge boulders from Jurikhet *Khola* to Bhainse had been by debris flow. Dr. Pugin replied that this had to be seen within context and that he believed they had been.

Dr. M.R. Dhital said he felt that the project should have taken the work of others into consideration. For example, he quoted Sue Downing's work on Glacial Lake Outburst Floods in 1982. Dr. Dhital read an excerpt from Ms. Downing's work. He added that two of the figures in the report appeared to be from this publication but he was unsure of the referential background. He went on to note that since most of the channels were v-shaped, this would surely denote fluvial not glacial origins of the channels. He believed that further study was needed in order to confirm the findings and that, in doing so, previous studies should be taken into full consideration. All deposits from Dolalghat to the Friendship Bridge should be mapped and confirmatory drilling should be carried out in one place at least to confirm the nature of the buried material. Dr. Dhital suggested that a comparative study should be carried out in the *Terai* where similar deposits (which are not glacial, however) can be found. He thought that confirmation of the clast was essential. Also essential was that prominent glaciologists should be brought in and their opinions sought.

Dr. D.R. Kansakar said that the new model had not been compared with the existing model (fluvial cf. glacial), samples from

neighbouring areas had not been examined, and that samples were mainly from the Bhote Koshi Valley. Features from side tributaries should be examined and deposition on all sides of the valley should be compared. Why had the gneissic boulders on the side walls not been given as examples? There had also been no inference concerning identification of different glacial periods. This would have been helpful. Detailed sedimentological studies of different stages of glaciation were not given.

Taking all this into consideration, he said that the study area in Nepal should be extended. It should then be extended to the Hindu Kush-Himalayan region and extensive expert discussions held. He asked if this new concept could be proved. He stated that to do so would necessitate the use of new techniques and new methods.

Dr. Pugin apologised to the group because it had not been possible to make the full report available before the workshop. He believed that some of their misgivings would be answered when they read the full report.

Discussions under point 'd' were concerned with recommendations. These were to go to the final plenary session for consideration by both groups and finalised at that point. With this in mind, the recommendations of Group One have not been given here. It was, however, unanimous among the group members that further work in this area was essential. Dr. C.K. Sharma was keen on the idea of ICIMOD calling together a multidisciplinary conference to discuss the findings. He also felt that, since ICIMOD was already involved in this work, perhaps it could constitute a multidisciplinary committee from Nepal; a core group that should always be kept informed on the progress of the work. The applied side of the science should always be closely allied with ICIMOD.

**Professor S.R. Chalise** pointed out that, although he agreed that a leading organisation should house the core group, it should not be ICIMOD. ICIMOD could facilitate and support the core group, but it was not in a position to house it.

This led to quite a lot of discussion about who should house the core group; Tribhuvan University, the Water and Energy Commission Secretariat (WECS), the Disaster Prevention Technical Centre (DPTC), or the Mountain Risk Engineering (MRE) unit at Tribhuvan University. Dr. M.R. Dhital pointed out that the MRE unit of the Department of Geology had proved its worth. It had many prominent scientists and government representatives on its board and was quite capable of housing such a core group.

Group members were unanimous about the core group and discussion ensued about where the funding could come from. There were various suggestions; Global Environmental Facility (GEF), Economic Commission for Asia and the Pacific (ESCAP), Swiss Development Cooperation (SDC), European Economic Community (EEC), International Commission on Erosion and Sedimentation (ICES), and so on. The Swiss Development Cooperation was the organisation that everyone agreed on. It was a question of whether SDC was in a position to help.

Recommendations from this group were unanimous, and the group disbanded to attend the final session of the workshop.

### **Group Two: Hazard Mapping and Soft Engineering**

**Mr. Alexis Wagner** chaired the group discussions which opened with the following points. In Nepal, major efforts had to be made to carry out more work on Quarternary deposits because most landslides occurred on Quarternary deposits. There was a need to

- identify how to introduce the study of Quarternary geology;
- discuss the implications when infrastructure is built in Nepal;
- receive some input from the Department of Roads' (DOR) on-going extension programme for landslide stabilisation; and
- suggest alternative use of land that has been stabilised – agriculture, horticulture, or a more whole and integrated forestry - also put a group of local people in charge of the project.

The main objective was stabilisation and identification of an instrument to cope with landslides in the future. There was a consensus that hazard maps were essential to achieve this and that they were not the same as geotechnical maps. Any road construction undertaken without hazard mapping would be prone to landslides. Most roads/highways, even Arniko Highway, had been constructed without studies, except in the case of the Gaighat-Okhaldhunga road for which hazard maps were prepared.

**Mr. P. Rohner** added that hazard maps would be a part of the study and that it would also include geomorphological and aerial studies which would be conducted before any infrastructural development took place. Mr. Khanal suggested that, since most slides are induced by rains, hydrometereological studies should be undertaken at higher altitudes.

Mr. Wagner said that, granted that the hydrological study was essential, they had no existing data. In the project, they had taken the river flow into account – the hydrological approach. Therefore, he recommended that, while the need for hazard maps was stressed,

they also needed to take hydrological data into account, and this applied to all watershed areas. For hazard mapping, the catchment area had to be defined.

- The scale of the aerial photo maps should be 1:25,000.
- The hydrometeorology of the catchment needs to be defined and for this hydrology and geology have to be assessed, therefore, geophysics is important and geophysical instruments should be used.
- Land-use maps are also needed.
- Cadastral maps are needed but are difficult to find.
- Previous reports, i.e., documentation, need to be consulted.

Mr. Wagner added that, during preparation of hazard maps, a scale of 25,000-50,000 should be used to be consistent with regional mapping.

**Mr. Pradeep Mool** said that all the maps of Nepal were being digitised by ICIMOD.

**Mr. Wagner** explained how the designs for stabilisation structures would be established. Hazard maps were useless for prefeasibility, so at this point topographical maps would be used. Following this, hazard mapping would be carried out and a detailed study done. A design would be decided upon as a consequence. Mountain Risk Engineering (MRE) prefeasibility was a part of this procedure.

It was asked whether any drilling and draining would be required during the preparation of hazard maps. Mr Wagner explained that these would be required in catchment areas and roads sometimes, but, by and large, they would use geophysics which gave them some information on the content and formations under ground. He added that geophysical investigation was new in Nepal.

There was a general consensus that people's participation should be maintained. They should know what the project was doing, in fact, they should be motivated to maintain the watershed.

Mr. P. Rohner raised some pointed questions that needed to be addressed. *"Whenever we reach a catchment area site for a hydroelectric scheme, he said, there are never any hazard maps, if any they are on different scales. Also, we need to sort out who keeps the maps and who are the users."*

Mr. Wagner said that the hazard maps should be shared by all, from the forester to the engineer, and they should be comprehensible and not too technical.

A question was raised about the data on demographic distribution. Mr. Wagner said that, in an area under demographic pressure, these were essential. He referred to the work carried out with the Hindi village demographic data. He added that the details of the hazard maps changed with the requirements depending on whether they were to be used for a road or a dam. The main aspects of the study were geology, hydrology, forestry, and land use. Land use was assessed for hazard mapping and not from the income/output perspective of crops or anything else.

It was agreed that, in the initial stages, an economist/sociologist should be involved and that the following would be required.

- Topographical map
- Aerial photos
- Geological maps
- Land-use maps
- Hydrometeorological data
- Geophysical survey

It was recommended that line agencies should maintain documents. It should also be made clear which agencies were involved and in what way.

It was recommended that Quarternary studies and hazard mapping should be introduced into the curriculum at the Department of Geology of Tribhuvan University. Most of the training material was already available. Mr. Wagner said they should start with the topographical map and come out with their own hazard maps. Prior to this, a month-long training course for trainers could be organised. This would make hazard mapping an ongoing technique.

For Soft Engineering Techniques, Biotechnical Engineering, and Drainage, Mr. **Rohner** gave the example of Bhutan's on-the-job training of labourers as very fruitful. It was stated that the farmers needed to be motivated to participate.

**Mr. Wagner** said that for community-oriented soft engineering techniques five slides for direct penetration had been selected, and farmers could be trained near the road corridors.

One participant suggested that DOR engineers could train farmers in the Bhote Koshi catchment area. It was also suggested that the DOR work be linked with the Swiss Development Cooperation's (SDC) work.

It was added that since the DOR could not go beyond the road corridor, it would be advisable to involve the District Development Committee (DDC) and the Village Development Committees (VDCs) where most of the irrigation and infrastructural construction took place without hazard mitigation considerations.

**Mr. M. Upadhy**a of the Bagmati Watershed Project brought out some pitfalls. In one instance, a landslide area they were working on was very small and, to stabilise the landslide, the adjoining land had to be acquired at a high rate. This would sometimes tempt the farmers to induce a landslide for the sake of the money.

It was also recommended that there should be coordination between the Department of Roads, Department of Mines and Geology, and the Department of Soil Conservation. It would be advisable to form a Steering Committee and connect the project to an agency, so that it could be replicated and propagated on a long-term basis.

The general recommendations were finally agreed upon for presentation at the final session.

## **SESSION FIVE: PLENARY DISCUSSIONS, CONCLUSIONS, AND CLOSURE**

The organisation of this Session was fluid in the sense that the closure followed on directly from the plenary discussions without a break. Since recommendations were not altered, but rather reinforced, during the plenary discussions, comments by the plenary session were preceded by the group recommendations as **finalised** and **accepted** by the plenary.

**Professor S.R. Chalise** chaired the plenary discussions and the concluding session. He opened the session by explaining that the recommendations from each group would be put to the plenary session for discussion and finalised. He requested **Dr. Pugin** to present the report and recommendations from Group One.

Dr. Pugin explained that Group One had been very well organised and had kept to the schedule of the four points suggested by the Chair. The recommendations from Group One were put to the plenary.

### **Group One Recommendations**

- Further morphological mapping should be carried out.
- Outcrop sedimentological analyses should be undertaken.

- Dating should be carried out.
- All references should be drawn together and comparative glacial and fluvial theories should be discussed more extensively in the presentation.
- Further geophysical investigations should be undertaken.
- More geophysical investigations should be made downstream and the extent of the channels examined (perhaps also could be made with areas in the south, e.g., Narayanghat)
- Other valleys should be investigated
- Climatic analyses should be carried out.
- Further work should involve both Nepalese scientists and other earth scientists from the region and then from the rest of the world; following this a conference should be held.
- Tribhuvan University should have a Quarternary geology curriculum.
- In relation to point nine, if these findings have lateral extensions, ICIMOD should invite multidisciplinary experts from the region to a workshop.
- A core multidisciplinary group from Nepal (including different users) should be constituted. This group should be kept informed of progress. ICIMOD could facilitate this.
- ICIMOD should be closely involved in the applied side of these research findings.
- Suggestions for organisations to house a core group include the MRE unit of Tribhuvan University, Department of Geology, WECS, and DPTC.
- Suggestions concerning donors that could be approached: SDC, ESCAP, ICES, and EEC if linked to MRE.

Discussions on the recommendations were helpful. **Dr. Pant** from Group One added that Paleo-valleys should be explored also from downstream of the Sunkoshi and Balephi confluence.

**Mr. Alexis Wagner**, who had been the coordinator for Group Two, said that he felt drilling was beyond the financial means available. It had been tried along the Arniko Highway. Dr. Pugin commented that if an organisation working in applications had the necessary equipment then the university could use it. There should be better coordination between research and application.

**Dr. B.N. Upreti** drew everyone's attention to the importance of maps. He mentioned that two new hydro projects were in the offing and that, in that context, the maps produced by the project were important. He also stated that the question of glacial or non-glacial deposits was still going on. If one went tens of kilometres further up and if one could explore further upstream, across the border for example, then perhaps the findings could be confirmed.

**Professor Li Tianchi** thought that it was a good idea to carry out research 30 to 50km across the border.

Mr. Wagner said that this would mean that they would need visas and a letter from the Chinese Academy of Science. Professor Li did not think this would be a problem, and Professor Chalise remarked that this was an area in which ICIMOD could facilitate.

**Mr. Patrick Kilchenmann** asked if anyone had estimated how much time would be needed? Dr. Pugin replied that, presuming the money could be found, they could extrapolate from the Kodari Valley. They could also be selective according to the finances available. Mr. Wagner felt that the current study was a pilot study and wondered how feasible it was to go beyond the catchment. Dr. Pugin emphasised that study of one or two other valleys was important for research. Professor Li added that it would be good if money were to be made available for two or three other valleys. It might be too early to start at this juncture, but if results were taken from the one catchment area it would provide them with a model and standards for the other valleys. Dr. Upreti reminded them that the idea to extend had arisen from the initial controversy over the Quaternary deposits. It wasn't that every valley needed to be studied, just one or two and comparison of sediments. Dr. Kansakar added that, perhaps, they would be very lucky if they could find definite confirmation of the findings. Perhaps it was important to establish the findings.

Continuing on the point of future studies, **Mr. P. Rohner** stated that, at present, only a small area was mapped. They had to look further up. It would be greatly appreciated if those who were going to do the study had the opportunity to see parts of the area further upstream. He wondered if it would be possible, since ICIMOD did not stop at the border, for ICIMOD to facilitate this? Mr. Wagner said he was in full agreement with this point of view. Professor Chalise stated that it should be possible and Professor Li concurred. Mr. Rohner noted that Switzerland and China had always maintained very good relations.

Dr. Upreti said that they should begin to discuss the next phase and the scale of work as soon as possible. This should be planned out

on as fine a scale as possible. Even if there was no evidence of glaciers along the valley, as one goes further north one sees the same disasters and hazards as those caused by glaciers in many places. If this work could be concretely based in China also, it would only take a few weeks to relate upstream to downstream glacial deposits.

Dr. Pugin said that the upper catchment had already been studied by Chinese scientists. First they should meet with them. The Chinese had good publications on Quaternary deposits

Discussions on the recommendations of Group One concluded and consensus was reached. The Chair then invited Mr. Alexis Wagner to report on the work of Group Two.

Mr. Wagner commenced his report by reading out the recommendations from Group Two. The recommendations were in two parts: 'Hazard Mapping' and 'Application of Community Oriented Soft Engineering Techniques for Landslide and Gully Erosion Control'.

## **Group Two Recommendations**

### *Hazard Mapping*

- Hazard maps are needed for water catchment management and infrastructural projects (canals, roads, dams). Hazard maps permit the identification of hazard zones which have to be assessed in detail with geotechnical investigation.
- Design of infrastructure and water catchment management should be carried out on the basis of /after consultation of the above-mentioned maps.
- Training in hazard mapping would be the responsibility of teachers-trainers in the context of future use. For implementation, it is recommended that the Department of Geology of Tribhuvan University become the responsible body.
- It is recommended that a group of geologists, engineers, foresters, hydrologists, agriculturalists, and geophysicists, as resource persons, link up with other specialists, e.g., socioeconomists and environmentalists.

### *Application of Community-Oriented Soft Engineering Techniques for Landslide and Gully Erosion Control*

- It is recommended that stabilisation of landslides and gullies damaging the farm land and threatening the roads be carried

out as on-the-job training for farmers, civil engineers, foresters, geologists, hydrologists, agriculturalists, and geophysicists.

- It is recommended that responsibility lie with the Department of Roads and the Ministry of Local Development to work in collaboration with each other in this field.

A lot of discussion ensued. There were many opinions and suggestions. Certain participants thought that HMG/Nepal certainly did not have sufficient gauges. Others believed that topographical maps posed a problem ; they were usually on a scale of 1:50,000 whereas 1:10,000 to 1:25,000 was usually the more reliable range for hazard work. Aerial photos also should be 1:25,000.

There was some discussion about the definition of a corridor, was it one or two kilometres? Some participants thought it should be two kilometres on each side of the road.

It was stated that Quaternary deposits should be mapped, but participants pointed out that this had been covered in the recommendations of Group One. Hydrometeorology should also be taken into account for hazard mapping and use should be made of land-use maps and cadastral survey maps. Regarding the hazard mapping, it was agreed that, in this context, it was up to geophysicists to define the parameters.

In general, it was agreed that all points raised were comprehended within the recommendations given. However, there was some discussion about identifying an organisation for the core group recommended. Many participants thought it should be housed at the Department of Geology, Tribhuvan University. In any case, it was decided that the discussion could not be concluded at that time, and that the onus could perhaps lie with ICIMOD to convince or identify a likely organisation.

**Dr. C.K. Sharma** stated that, unless the government was involved, nothing would get done. He wondered if the Department of Mines and Geology could do the geological mapping since they had money and manpower. He also felt that the responsibility of building more hydrological stations should be with the Department of Hydrology and Meteorology. How could the SHIVA dambreak model be transferred to them, for instance? Dr. Sharma was also dubious about the capabilities locally for using the 500,000 rupees per annum allotted by the Local Development Department to Village Development Committees. He observed that, unless they had technical manpower, they would not be able to use this money appropriately.

Mr. Wagner stated that the Department of Geology of Tribhuvan University would be trained in SHIVA methods. It was quite acceptable that the Department of Mines and Geology should be involved, but a teaching core was essential in the first instance. When the teachers at Tribhuvan University had been trained, they could then train people from the Department of Mines and Geology. Training teachers was of primary importance. The course should become a curriculum item.

Some discussion ensued about the maps themselves. **Mr. Narendra Khanal** said he thought that high precipitation zones should be marked and included in hazard maps. Mr. Wagner agreed but said that it should be integrated, and this was the reason why a multidisciplinary core group was essential; a hazard map could be improved at any time.

**Dr. M.R. Dhital** said he wished to express his appreciation of ICIMOD for the interaction they had been facilitating over an appreciable period of time. He mentioned ICIMOD's work on mountain risk engineering and in training in GIS. He also wished to draw people's attention to the fact that, although many were sceptical about the relationship between Tribhuvan University and the government, there was no need to be. Currently, the Mountain Risk Engineering unit was training six engineers from the Department of Roads in bio-engineering. They had a pool of trainers and were willing to impart training wherever needed. The MRE Unit had a good reputation and had always received excellent cooperation from the government, government officials sat on its Committee. Anyone from Tribhuvan University could be called into the MRE Unit. Dr. Dhital stated that the EEC was very interested in this Unit as well as the ODA. It had got off to a good start and thanks were due to ICIMOD for this. People were sceptical in the beginning, but now it was doing well.

Professor Chalise brought the discussions to a close by stating that the point concerning whether Tribhuvan University should be entrusted in Phase Two of the project, if there was to be one, had been well answered. Since there was no further discussion on any of the points, he suggested that the workshop conclude. He, therefore, handed over the chair to **Mr. Egbert Pelinck**, Director General of ICIMOD.

Mr. Pelinck opened the discussion once more for final conclusions and recommendations. Dr. Pugin and Mr. Wagner rebriefed the plenary on the recommendations made by the two groups.

Mr. Pelinck then addressed the plenary. He remarked that he wished to thank them all. The workshop had been interesting, at times

controversial, which made it more interesting. He thanked, in particular, Mr. Pius Rohner of SDC for spending so much of his valuable time attending the workshop. *"Hopefully,"* Mr. Pelinck said *"this is an indication of his interest in the second phase."*

Mr. Pelinck thanked Professor Chalise for his constant attention to the organisation of the workshop. He said that he, personally, had been grateful for the opportunity to share in the discussions. He regretted not being there a 100 per cent of the time and that he could not participate wholly intellectually in all subject areas, but he had learned quite a bit about geology and a lot about the commitment of the participants present. He believed the interest of all had been captured by the amount of information they had all received on the first day. He was very grateful to the team of consultants for all the work they had undertaken in both gathering and analysing data. Over the period, a lot of information had been gathered on Quaternary geology. He assured the participants that ICIMOD was always interested when something in Nepal is of interest to other countries in the region.

He understood the need for follow-up and the need for the involvement of a number of parties. ICIMOD should also play a role. It became even more interesting when things in a document were translated into action. ICIMOD could not compete with big donors, but, if needed, it was interested in other organisations and national institutions; in strengthening national capacities in the Hindu Kush-Himalayas.

Mr. Pelinck said he was pleased to hear that Tribhuvan University and other line agencies were interested in further involvement. National Training needs should be looked at. This, of course, needed money, but money could be found if one had a good programme. ICIMOD could be a facilitator in getting the needs across to potential donors and would make every effort to identify donors.

Mr. Pelinck was highly appreciative of the role of SDC. He said that the SDC had given ICIMOD a small grant on the occasion of the U.N.'s International Decade for Natural Disaster Reduction (IDNDR) and this had enabled them to begin to make inroads. He thanked Mr. Wagner and Dr. Pugin also. He stated that it was obvious that they had put in a lot of overtime that was actually free time. A lot of dedication had gone into this work and it showed in the excellent results.

**Mr. Pius Rohner** of SDC thanked Mr. Pelinck and Professor Chalise for the work carried out by them in coordinating the workshop. He thanked Mr. Wagner for his spirit and push and Dr. Pugin for coming from his work at the University of Geneva to take part in the research.

He thanked all the participants for their enthusiasm and, in particular, all those who had worked in the field.

It had been an interesting time and an interesting pathway had been opened up. There were a few little stones in the path, because he could not at that moment commit anything. The decision would have to be made by SDC. He assured everyone of his commitment. Mr. Rohner stated that there was a great deal of interest in the Arniko Highway which lay almost entirely in the project area. He reminded everyone that, in future, district roads would be built, and these would also need geologists not only engineers.

Mr. Rohner's final point was pertaining to disaster relief. He assured them that the Swiss relief mechanisms would be ready to help Nepal in any way possible in the event of a disaster. They were fully aware, in this respect, that disaster not only needed help and relief mechanisms but also prevention mechanisms. Small disasters had probably more human-related implications than big ones. "As for the future," he said, "I am optimistic."

Mr. Pelinck closed the workshop with the following statement.

*"That remark brings us to the end of the workshop. Ending on a positive note is the best way to end. Thankyou all for taking part. We will write a report and keep you informed. Thankyou."*