A Report on the Causes and Effects of Landslides in Dhunche, High Mountain Himalaya, Nepal

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ABSTRACT

In recent years the debate concerned with the causes of the environmental degradation of the Himalaya has escalated. Polarised views, within this so called 'Himalayan Dilemma', focus on either human related causes or natural geological activities. The literature has been based on untested assumptions and 'western' theories, viewing the Himalaya from a 'macro level' perspective. It has been argued that this is due to a lack of factual data, particularly at the micro level.

This study sets out to analyse the causes and effects of landslides in a mountainous area. It focuses on a Tamang community in Dhunche village, set in the High Himalaya, Central Nepal. It assesses, through interviews with the local community and key stakeholders, the link between the environment (landslides), village community and government departments.

The study concludes that the landslides are due to a combination of both natural and human related causes. Human induced practices on the Himalaya cannot be ignored but must be placed alongside the specific natural geology and climate of that specific micro area. There are many 'micro scales' which make up the complex macro state of the Himalaya, only by understanding these micro scales will a better comprehension of the Himalaya and its problems be achieved.

Key words: Landslides; Himalaya; Nepal; Environmental Degradation Theory; Dilemma; Community; Tamang; Road construction; Tectonic activities; Precipitation; Subsistence farmers; Terrace agriculture.

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Professor Li Tianchi, ICIMOD, Nepal; Dr B.N. Upreti and Dr N.R. Khanal, Tribhuvan University, Nepal; Mr Niranjan Shrestha, Soil Conservation Officer, Rasuwa District, Nepal; Dr John Gerrard, Birmingham University, UK and Dr Rita Gardner, Royal Geographical Society, UK.

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ACRONYMS & ABBREVIATIONS

EDT	Environmental Degradation Theory
ICIMOD	International Center for Integrated Mountain Development
HMG Nepal	His Majesties Government of Nepal
GIS	Geographical Information System
GPS	Global Positioning System
MCT	Main Central Thrust
msl	mean sea level
SCO	Soil Conservation Officer
LDCs	Less Developing Countries

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Chapter 1

INTRODUCTION AND OBJECTIVES OF THE STUDY

1.1 Introduction

Historically, the Himalayan mountain range has attracted a mysterious and challenging fascination for the global community. This has focussed on its various assets, whether for cultural, religious, sport or flora/fauna purposes. The Himalaya separates India from Tibet along its north central and north eastern frontier and crosses five political boundaries, beginning from its north western point in Pakistan, along India, Tibet, Nepal and finally Bhutan.

In recent years a new focus has turned to the reports of the impending environmental fragility of the area with urgent and alarming consequences causing global media coverage to magnify the problems to such an extent that it has created a single Environmental Degradation Theory (EDT). This has been linked to 'Malthusian type' vicious circles – where poverty, death and environmental degradation are explained as products of population pressure on resources (Ross, 1998). This dominates the 'Development Paradigm'[1] which is often present in current policy decisions, particularly in Less Developing Countries (LDCs).

The counter argument is that not enough emphasis has been given to the natural dynamic, tectonic and climatic conditions (Wu & Thornes, 1995) and it is suggested that there is a lack of factual data which, according to authors such as Ives & Messerli (1989),

[1] Over the last 50 years population growth along with the constant concern that the world will run out of food to feed everyone has been listed high on the development agenda.

weakens the basis of the EDT argument. Also there is an over emphasis on the macro scale and very little on the micro scale.

Nepal has often been highlighted in the debates and it is recognised within the literature that natural hazards such as landslides are a problem for the country and its inhabitants.[2]

However, there seems to be a missing gap in research studies, examining the 'natural' geological instability and linking it with the socio-economic factors of the surrounding community. Therefore this study report aims to focus on this linkage with one particular community set in a mountainous area in Central Nepal and to analyse the causes and effects of landslides. The data gathered from the field study will be used to assess whether the human related causes and 'natural' geological activities are balanced or not.

1.2 Objectives of the Field Trip to Nepal

As mentioned in the introduction, the aim of this study was to test the validity of the claims made in Ives and Messerli's (1989) book *'The Himalayan Dilemma'* and the apparent EDT. It was also decided to choose an area which has not been notably studied with the intention of adding the results of the research findings to the growing databank which authors such as Ives & Messerli (1989), Hofer (1992), Lauterburg (1992), Chapman & Thompson (1995), Zurick & Karan (1999)[3].

[2] Eckholm (1976) Kienholz et al (1984) Ives & Messerli (1989) to name but a few.

[3] *"We need more integrated and interdisciplinary research projects and strategies to understand the interaction of natural and artificial processes. This must be a long term programme so that the effects of extremely dynamic land use change can be constantly monitored, even if great time intervals between action and effort influence the processes being measured."* (Messerli & Hofer, 1995: 86-7)

The field study took place in the area of Dhunche village, Rasuwa District set in the High Himalaya, Central Nepal north of Kathmandu. (Refer to Maps 1 & 2). Prior to visiting Dhunche it had been confirmed that landslides had been sited in the area.

Therefore the main objectives of the field trip were as follows:

- To observe, photograph and plot landslides in the area of Dhunche, which is close to a tributary of the Trisuli River.
- To age, define type and approximate size of landslide.
- To assess the causes of the landslides, by observing the surrounding environment and using local information/records and by speaking to the local community.
- To analyse the consequential effects of the landslides on the surrounding community and briefly to look at the perception of landslides from the perspectives of the local community who live in the unstable environment, by meeting and interviewing the local farmers/community.
- To assess if the results of the interviews differed greatly between men and women.
- To obtain the views from any Government official, resident in the village.

It is important to note that the conclusions of this report will be made on the basis of the fact that only one visit was made and during one season; the dry season. Further visits at various times of the year would be necessary in the future in order to build on the research already made.

1.3 List of Contacts

The following table lists the people who were contacted during the field study in Nepal and who gave valuable advice and information:

Table 2.2 *List of Contacts in Nepal*

NAME	POSITION	INSTITUTION	PLACE
Professor Li Tianchi	Hazard Mitigation Specialist	Mountain Natural Resources Division, ICIMOD	Kathmandu, Nepal
Dr B.N. Upreti	Geologist & Lecturer	Dept of Geology, Tribhuvan University	Kathmandu, Nepal
Dr N.R. Khanal	Geographer & Lecturer	Dept of Geography, Tribhuvan University	Kathmandu, Nepal
Mr N Shrestha	Soil Conservation Officer Rasuwa District	Dept of Soil Conservation & Watershed Management, HMG Nepal Ministry of Forest and Soil Conservation	Dhunche, Nepal

The following chapters will describe the analyses of both physical geological and socio-economic findings with a discussion of the combined results and conclusions that arise.

Chapter 2

PHYSICAL GEOGRAPHY: FINDINGS

2.1 Nepal

Nepal is set in the centre of the Himalayan arc, where almost one third is taken up of the mountain range, bordering with India and Tibet. The country spans approximately 885km east to west and the width varies from 130km to 255km north to south (Upreti & Dhitral, 1996). 86% of the country is mountainous terrain with the remaining area consisting of the lowland Terai in the south. Due to the complex mountain building processes, the Nepal Himalaya physiographic area has been divided into seven divisions (adapted by Upreti & Dhitral, 1996 from Hagan 1969). The sub divisions are broken down further into five subdivisions[4] as described in Table 2.1. These subdivisions are used to classify the landslide studies within this project.

From north to south:

Table 2.1: *Comparison of Physiographic Subdivisions of the Nepal Himalaya (used for the purpose of this project)*

Physiographic Units of the Nepal Himalaya		Location Example
Trans Himalayas	High Himalaya	Jomsom
Great Himalayas		
Fore Himalayas	High Mountain	Dhunche
Midlands	Middle Mountain	Kathmandu
Mahabharat Range	Siwalik Hills	Bharatpor
Siwalik Hills		
Terai	Terai	Nepalganj
Taken from Upreti & Dhital (1996)	*Taken from Survey Dept. HMG Nepal (1999)*	*Taken from Map 1*

[4] See Upreti & Dhital, 1996: 2-5 and Ives & Messerli, 1989: 22 for a more detailed description of Hagen and other authors.

Population and cultivated areas in Nepal have dramatically increased since the 1950s due to amongst other factors, the improvement of health care, particularly in the once malarial infested Terai (Ives & Messerli, 1989). The Middle Mountains remain the most densely populated area of Nepal due to the mature landscape, low hills and river valleys (Upreti & Dhital, 1996). The case study area actually falls into the High Mountain zone in Central Nepal. Later in this chapter comparisons will be looked at of similar studies south of Dhunche, which fall into the Middle Mountain zone.

2.2 High Mountains, Central Nepal

The High Mountain zone or Fore-Himalayas as defined by Hagan (1969) is less populated than any of the lower zones and generally covered by forest. The Main Central Thrust (MCT) is located to the south of the High Mountain zone. The MCT is the weak junction where the Indian plate slid under the Asian plate causing the Indian plate to shatter and crush (CSE, 1991). A study carried out near a section of the MCT in the Indian Himalaya suggests that due to the constant movement and therefore fragility of the area any disturbances such as heavy precipitation, explosions and even vibrations from heavy transport can cause eruption and landslides (Kimothi & Juyal, 1995).

The lithology of the High Mountain area mostly comprises of metamorphic rock such as schist and gneiss and crystalline rock from the ocean bed (Upreti & Dhital, 1996; Ives & Messerli, 1989; Shreshta, 2000).

2.3 Dhunche Village

The study area was set around the village of Dhunche, Rasuwa District, which is located within the High Mountain region, north of Kathmandu (28°06'N, 85°18'E). It is on a north east facing slope, 2012msl and within the boundaries of the Langtang National Park. To the north west far below the village runs the Trisuli river with the Trisuli Khola tributary (Plate 15) running north west to south east between Dhunche and the facing hillside where the road bends round towards Thulo Bharkhu village. The tributary is accessible at the east end of the village through a forest area. A water mill has been built on the edge of the river and serves the local community for grinding wheat into flour.

Dhunche lies at a short distance south of the MCT, although the area is also called the 'MCT Zone' by some authors. Higher up on both sides of the Trisuli valley the MCT crops out (Upreti, personal communication, 2000).

Dhunche village is predominantly a subsistence farming community (Plate 14) but since the construction of a road some 10 years ago, it also serves as a trekking stopover for tourists between the Langtang Range and Kathmandu. The main street consists of trekking lodges and commercial shops and businesses. Directly below the road, lies the original village where the farming community live in a dense maze of narrow paths and steps. Above the main street are official and governmental office buildings and residential compounds including a police station with an attached prison.

The population according to the National Census of 1992 was 2042 of which 881 were female and 1161 were male (Shrestha, personal communication, 2000). There were no recent figures available, to compare with the 1992 census, in order to ascertain the rate of population growth particularly during the last ten years since the road was constructed.

More than 95% of the population of Dhunche are Tamang (Shrestha, personal communication, 2000). Tamangs (Plate 16) are one of the largest ethnic groups in Nepal whose origins lie in Tibet (Tamang means “horse trader” in Tibetan). They are primarily farmers but are also well known for their portering skills, particularly when accompanying trekking groups and expeditions. They are devout Buddhists and prayer flags, shrines and stupas are main features of the villages (Gibbons, 1991) (Plate 17).

2.4 Road Construction

Although the road was initially built to access mining exploration sites further north at Somdang (which is where the road ends) it also opened up access for the village to Kathmandu via Trisuli Bazaar. In fact Dhunche has replaced Trisuli Bazaar as the trekking starting/finishing point. During the trekking seasons the road now sees daily busloads of tourists going to and from Kathmandu as well as the lorries transporting food supplies. The road itself is a dirt track as far as Trisuli Bazaar and from then on to Kathmandu it has recently been tarmacked.

However in its relatively short life it is visibly deteriorating (Plate 12). The supports are cracking and collapsing and landslides are occurring along the upper and lower sides. This strongly implies poor engineering and the use of cheap materials.

Road construction in the Himalaya is a problem aggravated by the fact that in general planners, designers and aid grants come from other countries such as China, Switzerland, India and USA together with their ‘western’ perspectives. As a result they may only bring experience of their own country’s environmental problems, without a real understanding of the local geological aspects, precipitation or seismic activity of the

particular area in the Himalaya. They then leave Nepal without the assurance of sufficient training and maintenance resources. After care of the roads is normally not included in the development aid budget and is therefore the responsibility of Nepal. Politics, economics and corruption also highly influence the planners and designers (Li, personal communication, 2000).

There is also a certain amount of 'money changing hands' with the construction companies in relation to who wins the tender for building the roads. Budget and timing is also a constraint. Cheaper materials are used and the timing is restricted which results in not enough physical supports/structures being built on both the upper and lower sides. Even construction methods are critical as it has been observed that in area just outside of Kathmandu, heavy machinery and explosive materials such as dynamite have been used to cut the roads out of the rock (Gerrard, personal communication, 2000). The unregulated blasting carried out loosens the rock and soil and when the monsoon arrives it washes it all away thus causing landslides. There is such evidence on the road from Trisuli in the Langtang region where many landslides have occurred along the road (Li, personal communication, 2000). Mr Niranjan Shrestha, Soil Conservation Officer of Rasuwa District, stated that the Soil Conservation Project were currently treating a particularly large landslide on the roadside about 5-8km before Dhunche (Shrestha, personal communication, 2000).

2.5 Causes of Landslides

Similar to the varied classifications of landslides, there are several breakdowns of causes for example by Dikau *et al* (1996), Jones (1992), and Crozier (1986). Simply put,

Jones (1992:120) suggests *"…all slopes are under stress due to the force of gravity. Should the forces acting on a slope exceed the existing strength of the materials that form the slope, then the slope will fail and movements will occur"*. Either internal changes (e.g. chemical weathering) and/or external changes (e.g. slope loading or shocks/vibrations) can affect the forces. However, it is important to note that the two groups of factors can be influenced by human activity. Jones (1992:120) continues *"…although landslides are a natural phenomena and are a normal feature of landscapes experiencing dissection, their magnitude, frequency and geographical distribution have been considerably modified in recent centuries by human intervention"*.

Specific causes relating to the case study area are listed below and are from the proceedings of a mid-level technician training program held in Kathmandu, Nepal in February 2000. The program was given to Soil Conservation Officers by the Department of Soil Conservation & Watershed Management in association with the Disaster Management Program, Japan International Co-operation Agency.

Causes of Landslides

1) Landslide Triggers

(i) Cloud burst (200-1000mm/day)

(ii) Uncontrolled flow of water on slope surface from over flooded steep gullies.

(iii) Toe cutting may activate failure by overtopping of rock blocks or slides in colluvium.

(iv) Earthquake

(v) Blasting

(vi) Flash flood due to glacial lake outbursts

2) Causes

A) Man Made Causes

(i) Deforestation

(ii) Blasting quarrying

(iii) Hill cutting

(iv) Irrigation of paddy fields, water storage ponds

(v) Undermining, tunnelling

(vi) Vehicle vibration in hill roads

B) Erosion Process

(i) Blocking of natural drainage

(ii) High flow velocities in steep gullies

C) Pore water pressure

D) Geological conditions

(i) Mineral composition, rock type, structure etc

(Shrestha B.D, 2000)

Chapter 3

INDIVIDUAL ANALYSIS OF OBSERVED LANDSLIDES

3.1 Observed Landslides around Dhunche Village

Eleven landslides were observed in the vicinity of Dhunche village, one of which was in the nearby village of Thulo Bharkhu. Two were rock slides relatively close to rivers, two were only visible from a distance and as a result no measurements were possible, three were on the road to Thulo Bharkhu and the remaining four were on the outskirts of Dhunche village near the agricultural land. None were particularly near any residential area or buildings.

Below follows a breakdown analysis of the findings from a physical geographical perspective. Chapter Four will discuss the socio-economic findings of the research and how the landslides affected the community in that sense.

It is important to note that the age of the landslide is based on the information supplied by the villagers. The Soil Conservation Officer of Rasuwa District, Mr Niranjan Shrestha had only been posted in Dhunche for just eighteen months and so recommended the villagers knowledge would be more accurate.

The soil and rock types of the area and in particular at the sites of the landslides are coarse sand (Shrestha, personal communication, 2000) and rock samples taken from the sites were confirmed as being mica schist (some with garnet) and gneiss (Gerrard, personal communication, 2000).

Landslide 1: Rock Slide by Trisuli Khola River

Landslide Type: Rockslide (translational).

Location: Set in the forest area at end of the village on the trekking route to Gosainkunda. Just above the south side of the Trisuli Khola river, and the village water mill (although not damaged).

Age/Year (approx.): 2 years (1998)

Season: Summer monsoon

Height (approx.): 30m high above the footpath and 40m below towards the river.

Map 3 Reference: 1 ■

Picture Reference: Plate 1

Cause and Effect: According to information gathered by villagers living and working in the immediate area, the slide was triggered during a particularly intense precipitation, which caused flooding. The hill slope form above the footpath is steep set in forested area and below it concaves until it reaches the rivers edge (south side) where shrub vegetation is growing amongst the boulders. At this point the river (which runs perpendicular to the slide) runs down stream/slope to meet the Trisuli and is full of huge boulders and rocks. The footpath, which cuts across the slide, has been cleared, although it is still relatively unsafe with course loose sandy soil and rocks and represents a sloping ledge. A new heavy precipitation torrent could destabilise the slide further.

Landslide 2: Rock slide by the Trisuli Khola Bridge

Landslide Type: Rotational rockslide

Location: On the roadside leaving Dhunche village, near the bridge which crosses the Trisuli Khola river.

Age/Year (approx.): 8 years (1982)

Season: Summer monsoon

Map 3 Reference: 2 ■

Picture Reference: Plates 2-3

Cause and Effect: According to information supplied by the villagers of Dhunche, this landslide occurred during a high precipitation. The road had been blocked and it is clear that the road support is badly damaged (Plate 2). Above the fall is farm and shrub area. The outline of a much earlier and larger slide can be seen above the scarp of the present one, which is now covered in shrub.

Landslide 3: Rock slide at Thulo Barkhu Village

Landslide Type: Rockslide (translational).

Location: At the far end of Thulo Bharkhu village (approx. 8km by road from Dhunche), near a water mill.

Age/Year (approx.): 2 years (1998)

Season: Summer monsoon Map Reference:

Map 3 Reference: 3 ■

Picture Reference: Plate 4

Cause and Effect: Information regarding this slide came from a Tamang family farming on a small piece of land by the Trisuli Khola river (near the water mill) in Dhunche but who actually lived in Thulo Bharkhu. This particular slide occurred during a particularly intense precipitation, which had flooded the river and consequently swept away the water mill. According to the Tamang farmer, this had happened three times. The slide leads down to a bend in the road where there is still evidence in the form of

loose rocks, sand and water tracks, that the landslide/flood crossed the road following a downhill stream. The stream is gradually creating a gully. Further uphill, where the newly re-built mill is, the area is laden with piles of large loose rocks.

Landslide 4: Road to Dhunche (1)

Landslide Type: Rotational slide

Location: The upper slope above the road on the north side of the Trisuli Khola river returning to Dhunche from Thulo Bharkhu village (after the Buddhist stupa).

Age/Year (approx.): 2 years (1998)

Season: Summer monsoon

Height (approx.): 25m high

Map 3 Reference: 4 ■

Picture Reference: Plate 5

Cause and Effect: According to information supplied by villagers interviewed in Dhunche. This is one of three slides, which occurred at the same time during the monsoon season. This is the largest of the three with mainly sand, small loose rocks and stones. There is evidence of a continued trail of loose soil and stones on the opposite side of the road where the slide has continued down the slope towards the river. However, the connectivity with the river would not be so great due to the great height between the road and the river. In addition the downward slope was covered with shrub and trees.

Landslide 5: Road to Dhunche (2)

Landslide Type: Rotational slide

Location: The upper slope above the road on the north side of the Trisuli Khola river returning to Dhunche from Thulo Bharkhu village.

Age/Year (approx.): 2 years (1998)

Season: Summer monsoon

Height (approx.): 20m+ high

Map 3 Reference: 5 ■

Picture Reference: Plate 6

Cause and Effect: The second of the three slides as described above but smaller than the first.

Landslide 6: Road to Dhunche (3)

Landslide Type: Rotational slide

Location: The upper slope above the road on the north side of the Trisuli Khola river returning to Dhunche from Thulo Bharkhu village.

Age/Year (approx.): 2 years (1998)

Season: Summer monsoon.

Height (approx.): 5-7m high

Map 3 Reference: 6 ■

Cause and Effect: The third of the three slides as described in Landslide 4 but the smallest of all three. This slide was quite a distance away from the first two, but similar in form.

Landslide 7: Below Dhunche village (1)

Landslide Type: Rotational debris slide

Location: Below the main village of Dhunche, near the cultivated area.

Age/Year (approx.): 2 years (1998)

Season: Summer monsoon.

Map 3 Reference: 7 ■

Picture Reference: Plate 7

Cause and Effect: This slide started among shrub area and next to cultivated terraced *bari* fields growing wheat. It had obviously affected part of the fields, as there was evidence that the outer wall running down slope of the terraces and several of the lower terraces had newly built stone walls. The road passes at the end of the terraced fields where the slide continues across the road and down slope for a further 80km (approx.). At the bottom of the slide the area is covered in larger shrub bushes and trees and some residential buildings. The debris consists of course grey soil and small mica schist rocks. This was the only landslide where it was accessible to take a three point (triangular) co-ordinate measurement from the top of the scarp down to the road side.

Landslide 8: Below Dhunche village (2)

Landslide Type: Rotational debris slide

Location: Below the main village of Dhunche, near the previous landslide.

Age/Year (approx.): 1 year (1999)

Season: Summer monsoon. (June)

Height (approx.): 160-200m high

Map 3 Reference: 8 ■

Picture Reference: Plate 9

Cause and Effect: According to information supplied by a woman working at the nearby Government run Agricultural Centre, this landslide occurred the previous June

during a heavy cloudburst. It is longer and in parts wider than Landslide 7, with larger rocks and boulders. The rock and soil types were as the previous landslide.

Landslide 9: Below Dhunche village (3)

Landslide Type: Rotational debris/rockslide

Location: Below the main village of Dhunche.

Land use (prior): Shrub/barren area.

Age/Year (approx.): 15/16 years (1985/6)

Height (approx.): 150m (width: 50m)

Map 3 Reference: 9 ■

Picture Reference: Plate 8

Cause and Effect: By far the largest and widest of those observed and accessed, although it is in relatively inaccessible shrub area. The slide is full of huge boulders and rocks, some of which are loose and unstable. According to one farmer the landslide swept away a cow shed which had belonged to his family. Plate 8 illustrates the size of the width in relation to the author who is in the centre of the picture.

Landslide 10: High above road to Thulo Bharkhu

Landslide Type: Possible soil flow

Location: High above the road to Thulo Bharkhu (near Landslide 6) but only visible from Dhunche village.

Land use (prior): Shrub and forest area.

Height (approx.): 300m from top to road.

Picture Reference: Plate 10

Cause and Effect: According to villagers the cause was due to slope gradient pressure and high precipitation during the monsoon. Also it started during the road construction period and is continuing.

Landslide 11: Below Dhunche village

Landslide Type: Earth slump (?)

Location: Far below Dhunche village and only visible from the road to Thulo Bharkhu.

Age/Year (approx.): 25+ years

Picture Reference: Plate 11

Cause and Effect: This is a huge what can be described from a distance as an earth slump but could also be described as a debris slide. Few people of the village could give much information about its age or even existence. A journalist gave an approximate age of 25 years but some stated it was much older. The main point in agreement was that it was still continuing. This has a high connectivity with the river even though there is a great distance between the two, the steep drop lands directly in the river, close to the main Trisuli river. In Plate 11 there is evidence of the land having been previously cultivated and terraced. This then raises the question to one of the points from the environmental degradation theory that terraced land causes landslides. However it is argued in the literature that landslides can be triggered by unmanaged land and this could be an example.

Chapter 4

SOCIO-ECONOMICS: THE SURROUNDING COMMUNITY

4.1 Linking the Effects of the Physical Geographical Factors of the Landslides with the Socio-economics of the Community

In the previous chapters the landslides were examined on an individual and physical basis. Now however, they will be analysed as a whole and link the effects they caused with the socio-economic aspects of the local community. Because as Jones (1992:117) points out that although it is often only the larger and less frequent catastrophic landslides which make the headlines and attract international attention, the smaller and more frequent slope movements which, cumulatively impose at least as great, if not greater, cost to human society. Jones (1992) also highlights the fact that the largest landslides occur in mountainous areas, which to a degree have a limited impact on human society in contrast to more highly populated areas. A disaster is only invariably a disaster when human life is at risk (Bradnock, lecture, 1999).

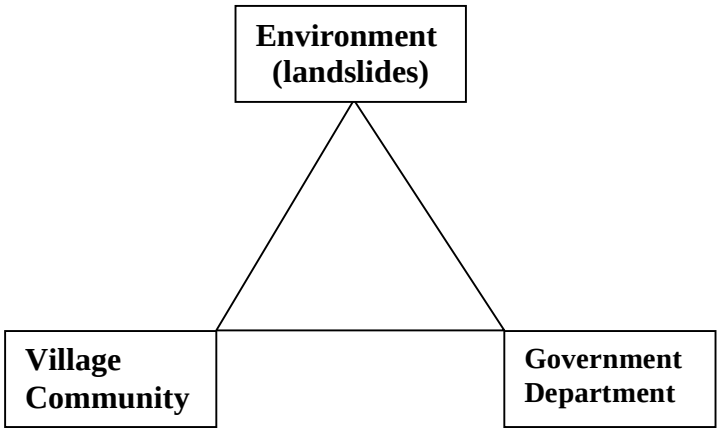
When studying the 'Himalayan Dilemma'[5] debate there are either claims on the state of the Himalayan region based on inaccurate data or the focus is on the need to obtain accurate 'hard factual' data to counter the argument. The Himalaya is too big and complex a region to generalise as a whole.[5] What has been confirmed is that greater emphasis is needed to focus on the 'natural' geological aspects of the area and not just magnifying the human induced factors such as deforestation. However, what seems to be missing is discovering how the causes of disaster or destruction affect the communities

[5] See Ives & Messerli (1989), Thompson & Warburton (1988), Chapman & Thompson (1995) and Wu & Thornes (1995) for detailed discussion.

living in these 'high risk' zones and what can be done to improve both the socio-economic conditions without dramatically increasing the pressure on the 'naturally' fragile environment. This is based on the knowledge/assumption that population growth has and will continue to increase and governments will want to pursue the path of economic development irrespective of the consequences.

The case study at Dhunche reveals a triangle of three major parties[6] each with their own (un)written agenda, one party of which is largely unpredictable and uncontrollable namely the 'environment'. This leaves little choice for the remaining two parties but to adapt and work round the unstable circumstances.

The triangle consists of:



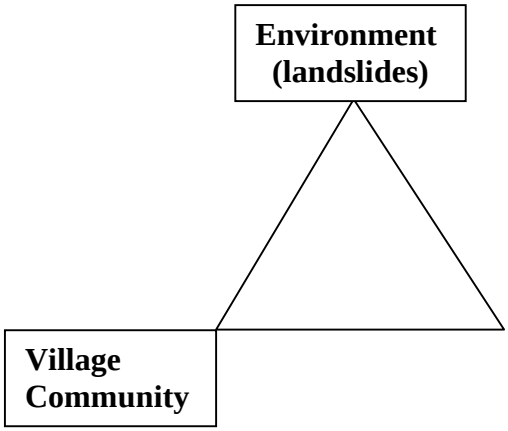
In the context of this case study, the unstable aspects of the environment are the landslides.

The following sections will discuss the links between the parties involved. Firstly, the link between the landslides (environment) and the community will be assessed followed by the Soil Conservation Department, Government of Nepal and the actions

[6] It is acknowledged that there are other stake holders which contribute such as national government agencies, industrial companies and tourists for example.

they take to ‘stabilise’ and prevent the landslides. Thirdly the perspectives of the villagers and the Government representative will be compared. Finally the ‘triangle’ will be analysed as a whole.

4.2 Linking the Effects of the Landslides with the Socio-economic Aspects of the Local Community of Dhunche



At first glance of the causes and effects of the eleven landslides observed (as shown in Chapter 3), none were of a dramatic and devastating calibre to warrant historical recording. From the information obtained from villagers there were no casualties or fatalities to either human or working animal. It also seemed that the majority of the landslides occurred away from residential or cultivated land. Therefore it could be assumed that they were of little significance. But as Jones (1992) emphasised the cumulative factor has a greater effect on the community. This theory was confirmed after interviewing the villagers of Dhunche. Here follows a brief introduction of each section of the community, based on observations carried out during the case study visit in April 2000.

For the purpose of this study the community of Dhunche can be divided into three socio-economic groups:

a) Subsistence farmers; b) Tourism traders (hoteliers, guides etc and c) Government officials.

4.2.1 Subsistence Farmers

The subsistence farmers are from the Tamang community and live on a 'hand to mouth' basis. The majority has to find additional work to support their families throughout the year. Wheat and maize are the main crops grown, with smaller plots of potatoes, sugarcane and mustard. Women are seen on a daily basis collecting fuelwood in the nearby forests. A few of the families own livestock such as buffalo, cattle, goats and chickens. The animals live in the same compound as the farming families, invariably guarded by dogs. The children have access to the village schools, which have newly constructed buildings funded by national/international aid organisations.

4.2.2 Tourism Traders

Whether the community were initially in favour of the road being built or not, it is assumed that they had little choice. With the road came development opportunities in the form of tourism trade. Trisuli Bazaar was the previous stopover for trekkers to the Langtang range but currently it is used only to serve the nearby Nuwakot trekking route. As a consequence tourist related business has built up in Dhunche where there are approximately ten trekking lodges, who compete on a daily basis for business when the buses arrive from Kathmandu. Tourists normally stay overnight before continuing their journey and they often contract guides and porters via the lodges. Many young boys from the village are employed in the lodges to cook, clean and serve. From observations there

does not seem to be much integration among the farmers and the business traders apart from seeing men gathered round various ‘gambling tables’ in the main street.

4.2.3 Government Officials

Apart from the staff at the Soil Conservation Officers, no other government officials were seen in the village. However, there were several large compounds further up the hillside, above the main street, which housed official departments and residences.

4.2.4 Assessing the Link

The common and important link for all three groups is the road. It is the link for food, trade, tourism and transport coming into the village from Kathmandu. It is also the most common element, which is most disrupted and damaged by the landslides. 53% (Table 4.1(b)) of the people interviewed highlighted the road being blocked and therefore preventing transport from passing, as a significant problem. In particular those directly involved in the tourism trade were only concerned with landslides when the road was closed.

Everyone who participated in the interviews (except for one woman who did not know about the landslides) were aware of the occurrence of landslides and 69%, more importantly viewed them as a serious problem not just to them as individuals but to the community as a whole. In fact among the men and women both emphasised to a great extent, the seriousness the landslides caused but the women were particularly concerned about how the landslides impacted on the community. 73% of the men (Table 4.1(a)) had experienced loss of farmland as a result. One farming family had lost 50% of their crops over the last three years, this is a crippling loss for poor subsistence farmers, especially as cultivated land in the area is not abundant. It has been stated that in some parts of the

Himalaya such as Kakani district Central Nepal, some landslides have been beneficial for re-terracing purposes and even purposefully triggered in order to create new terraces for cultivation (Ives & Messerli, 1989: 89). However when asked about any benefits arising from the landslides such as re-terracing in the area of Dhunche the farmers found no beneficial use to them whatsoever. According to the farmers, the landslides were seen to start in the shrub/barren land areas, which then affected the agricultural areas. This seemed to be accurate for the majority of landslides observed except for landslide 11, (Plate 11) above the scarp of the slide, on the top slope of the hill old and unused terraces are still visible.

The overall major complaint of the farmers is the lack of economic support from the Government and poverty in general. Without financial assistance they are unable to set up measures to either prevent or repair damage caused by the common occurrence of landslides. For example they specify that stones are needed to build walls but that no money is available for this basic infrastructure. If an individual farmer loses crops or property or even land there is no help or compensation from the community or Government. They are left to struggle and repair the damage themselves.

Table 4.1(a)

Top 5 of the Most Important Issues Among Women & Men in Relation to the Landslides
(Resulting from the Interviews in Dhunche & Thulo Bharkhu, April 2000)

	WOMEN	%		MEN	%
1.	Landslides are a problem for the whole community.	64	**1.**	Landslides are a serious problem in general.	77
2.	Landslides create transport problems.	57	**2.**	Landslides have swept away farmland.	73
3.	Landslides have swept away farmland.	57	**3.**	Landslides create transport problems.	50
4.	Landslides are a serious problem in general.	57	**4.**	Landslides are a problem for the whole community.	50
5.	Landslides are a problem for the individual farmer.	29	**5.**	Landslides have swept away property.	45

(% = percentage calculated on 14 women and 22 men respectively)

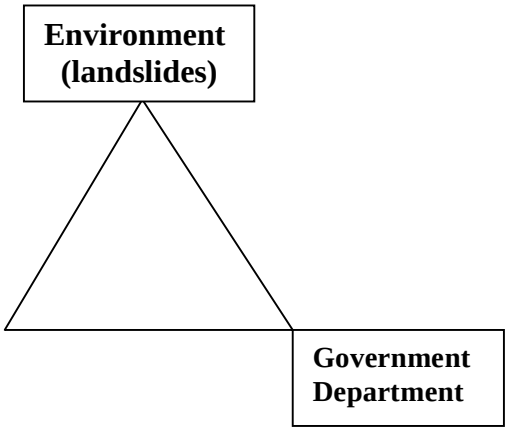
Table 4.1(b)

Top 5 of the Most Important Issues in Relation to the Landslides
(Total of Men and Women Together)
(Resulting from the Interviews in Dhunche & Thulo Bharkhu, April 2000)

	TOTAL	%
1.	Landslides are a serious problem in general.	69
2.	Landslides have swept away farmland.	67
3.	Landslides are a problem for the whole community.	56
4.	Landslides create transport problems.	53
5.	Landslides have swept away property.	33
6.	Landslides are a problem for the individual farmer.	33

(% = percentage calculated on a total of 36 people)

4.3 Actions Carried out by the Soil Conservation Department, Rasuwa District



The Soil Conservation Department, Rasuwa District is mainly involved in sub watershed management. Which involves the regulation, management and control of the use of water in the catchment area. The district has a population of 36,768 (as at 1992 census supplied by Shrestha, personal communication, 2000). The main problem the department faces is low resources and manpower. In addition they administer the extension programme which is regarded as an important project in order to disseminate information and awareness.

The Rasuwa District Integrated Project began more than 5 years ago, it was seen as a top down approach to development. One main problem was the lack of a participatory approach i.e. the project would provide the resources and the community saw it only as a way of earning money through employment. They did not see it as their project, therefore there was no incentive to participate to control the problem of landslides etc. They only participated for wages not control. As a result there was little or no awareness of the risk and seriousness of landslides. The Project has since scaled down the input in terms of supplying everything. It is now working towards a more

participatory approach, where the Project would contribute 40,000 Nepalese rupees (equivalent to approximately £377) per year per landslide and the community would match the amount so that a real integrated project would ensue.

However the Project recognises that it is to provide input in the sense of:

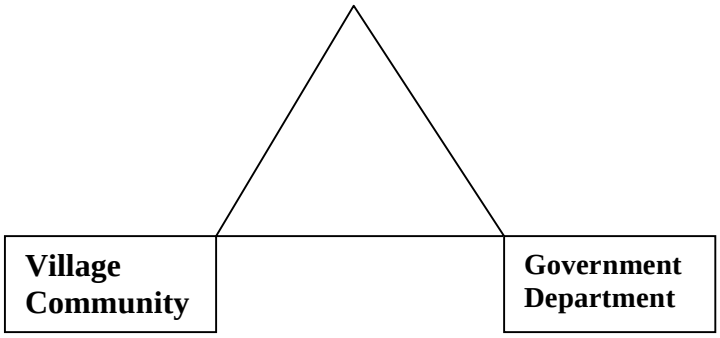
- Wire boxes
- Technical assistance
- Finance

When treating landslides, the Project's control and management measures would depend on the seriousness of the slide. For severe landslides, wire boxes (which are built locally) are 'filled' with stone walls and built across the path inside the main body (Plate 13). For less serious ones vegetative measures are used (similar to the bioengineering projects which are taking place in many parts of Nepal, (Li, personal communication, 2000).

The Project advocates that the farmers themselves should control/provide for themselves when a landslide directly affects them. However, if the farmer has no resources to treat the damaged area then it will provide financial and technical support. There are also 'On Farm Conservation Projects' which is a package of prevention/control methods. For example on *bari*[7] land they advise dry wall construction and vegetation cover. Depending on the area, the best vegetation cover is a multi-purpose grass, which covers the area quickly. It is particularly practical as it not only conserves the soil and protects the land, but also provides fodder for livestock.

[7] *Bari* and *Khet* are terms to describe different types of agricultural terraces. *Bari* is rain-fed agriculture – with a gentle outward facing slope to improve drainage thus allowing the water to drain without causing soil loss. An example of a crop grown on *bari* land is wheat.
Khet is irrigated agriculture – with inward facing terraces, the water concentrates on them and allows the creation of paddy land/ seasonally flooded land. An example of a crop grown on *khet* land is rice (Wu & Thornes, 1995).

4.4 Perspectives of the Soil Conservation Officer in Contrast with the Views of the Villagers of Dhunche



The perspectives of the Soil Conservation Officer, Rasuwa District: Mr Niranjan Shrestha believes that the two general causes of landslides in the Nepalese context are:

1. Natural causes: geological fragile area and high rainfall over a short period of time - 4 months during the monsoon period, the rest of the 8 months are dry. The rainfall is therefore not equally distributed throughout the year.

Combined with:

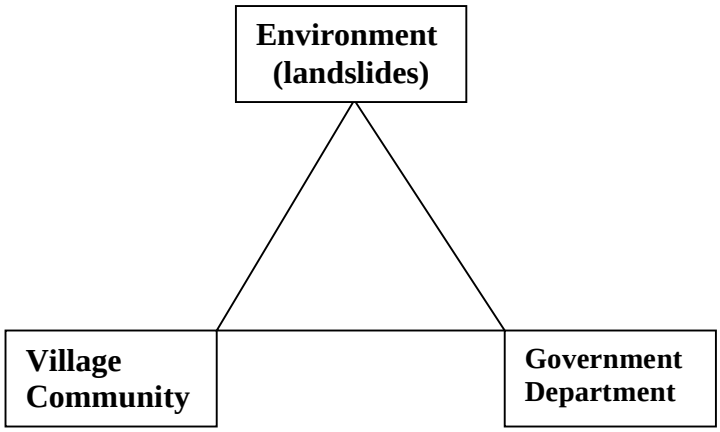
2. Man made causes: growing increase in population and livestock and the need to fulfil the demand of resources. Therefore timber for houses and fuel and fodder for livestock all collected and taken from the forest areas.

Therefore as a result of deforestation there is no vegetative cover, which results in landslides. He feels that there is not enough awareness of the landslide problem as the population increase demands fuel for energy. In particular when the road was constructed it attracted other people to move to the village and the 'main street' was developed with shops and hotels. However he suggests that the perception among the communities have

been changing (from complacency to concern) as the landslides have directly damaged their fields and property. Therefore there is only a reaction when something happens. It is felt that previously there was complacency especially regarding landslides. This was due to the fact that there were fewer people living in the villages and consequently had access to more land. If a landslide affected a farmer's land then he/she would simply farm elsewhere. Now the farmer and the land are restricted. According to the Soil Conservation Officer, the perception in the villages is that landslides are *"totally due to the natural causes therefore they do not make any/enough effort to counter them"* (Shrestha, personal communication, 2000). However through education in the form of illustrated posters, leaflets and training programmes awareness of conservation efforts is developing.

Generally, the villagers do view the main causes of landslides as being 'naturally' induced (precipitation and geological fragility) and that it is an old problem which they have no control over due to where they live. However, they do feel 'trapped' in the economic sense, in that they cannot afford to set up prevention or treatment measures in the manner they would like. There is also a feeling of 'abandonment', particularly among the male villagers, towards the Government in general. On the subject of economic development they were asked if the saw any benefits from the tourism trade filtering into the community. These, many stated were not equally distributed, only the hotels benefited and the only way the farmers profited was seasonally, by selling their produce to the hotels.

4.5 Assessing the Triangle: Environment (Landslides), Village Community, Government Departments



It is clear that the landslides are a serious worry for the village community but not in the sense of fear of living in such an unstable environment, but a case of fear for their livelihood. For example economic fear, that they would not be able to provide the basics for their families. As they see it, little assistance is coming into the village so it must be difficult for them to put the larger scale of events into perspective (Figure 4.1).

The Soil Conservation Officer however, can see the macro scale more clearly, because his remit covers a wider area. In addition he admits that he has been influenced by the literature and in particular the film *"Fragile Mountain"*[8] produced by Sandra Nichols (1982). With which Ives & Messerli (1989: 2) claim has "*the most startling visual presentation"* they also note that the film was made with substantial financial support from the World Bank and other agencies. It was during this time that the Environmental Degradation Theory really took control until Thompson and Warburton (1988) and Ives & Messerli (1989) balanced the debate. It is therefore understandable that the Soil

Conservation Officer prefers caution. It is also encouraging that the Department's approach is of a more participatory method. A question therefore arises on the restrictions and constraints placed upon the Department by the Government and how the Government is influenced by economic development and international aid agencies.

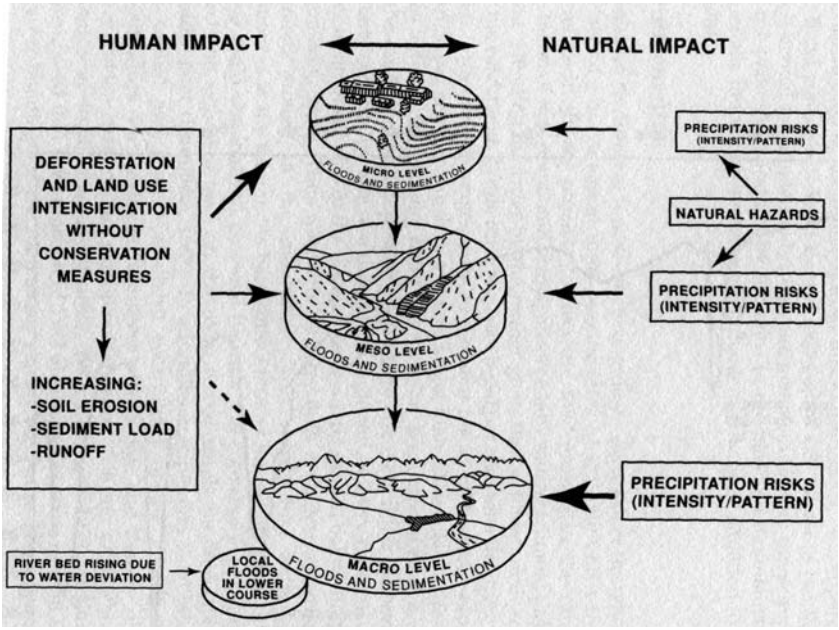


Figure 4.1 *Scales of Research, An Integrated Approach*
(Messerli & Hofer, 1995:84)

4.6 Physical Geography and Socio-economic Factors Combined

Map 3 illustrates the landslides plotted on a section of the map, which was used in the field. The road is marked as two red lines and the trekking path is marked in dotted red lines. Six out of the nine plotted landslides appear on or close to the road. This together with the photographic evidence of the deteriorating road supports, implies that the there is a link between the cause of the landslides and the road. In addition it also

[8] The film is a highly visual depiction of flooding, soil erosion, landslides and the problems farmers and those living on the plains and mountains experience. Although the film is in Hindi it is not an obstacle for

proves the point that the landslides cause a disruption for transport which affects the community as a whole.

From the information supplied from the villagers, almost all the landslides occurred during the summer monsoon rains and in particular during intense torrential periods. The land becomes over saturated and with the weak pressures placed on the slope forces the movement.

4.7 Comparison of Other Studies

It is interesting to see the comparison between terrace agriculture in the Middle Hills and the Higher Himalaya (Plates 18-19). Studies carried out both in the Kakani area (Ives & Messerli, 1989) and the Likhu Khola watershed (Gerrard, personal communication, 2000) which are relatively near to Dhunche offer stark contrast in land type and management. For example the terraces in the Middle Mountains are lusher, particularly as they are lower down the valley close to the river. Also the landscape is less barren, compared to Dhunche. In the Likhu Khola study area only the higher areas show a similar environment. The reasons are due to steeper slope angle, weathering regime and a harsher climate in general, water availability (due to the steep slopes) and a shorter growing season. This highlights the complexity of the Himalayan mountain region with such diverse 'pockets' of micro climates/zones.

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the viewer.

Chapter 5

CONCLUSION

The aim of this report was to examine both sides of the argument of the EDT. The EDT basically blames the increase in escalating natural hazards with population growth and subsequent pressure on ‘natural’ resources. Based on the field study carried out on a ‘micro scale’ area set in the High Himalaya mountains, the causes of the eleven landslides observed were due to both ‘natural’ geological activities as well as possible human related causes.

The ‘natural’ components consist of tectonic activities (which is possibly stronger in this area as the MCT is situated close by), unpredictable precipitation levels during the summer monsoon months and the steepness of the slopes. The possible human impact could well be the result of poor planning and construction of the road and unmanaged or abandoned agricultural terrace fields.

Therefore it is necessary to not only look closely at the physical geography of the area but to take into account the socio-economics of the surrounding community. Because the needs and actions of the community would, in the long term have a knock on effect on the environment despite the fact that the area constantly faces uncertainty. If both factors can be assessed at one time this will lead to a more balanced view for future planners, developers and international aid agencies.

For example this study has shown that the present deteriorating state of the road supports and the construction methods used (such as blasting) can automatically increase pressure on naturally vulnerable steep slope forms.

The link between the environment (landslides), village community and Government department also highlights the need for a clearer/improved understanding of each party's agenda. Thus generating a flexible participatory approach that would combine the needs of the community with economic development in an unstable environment.

Environmental degradation seems to become an issue when it affects human population zones. However, due to the complexity of the Himalayan region micro scale studies are essential, as it has been shown that one study area differs dramatically from another area which is located relatively close by.

What must always be considered and put into perspective, is that geological activity has caused the land to constantly change and has been doing so for millions of years. Human intervention on the land, which although must not be discounted and during the short history of development has made an important impact with both positive and negative outcomes, cannot be completely blamed for the environmental degradation that is seen to be increasing in the Himalayan region.

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Appendix 1

Summary in Percentage Order of Comments
Interviewees made Relating to Landsldies (Dhunche, Nepal, April 2000)

	Total Group (Men & Women)	%
1	Landslides are a bad problem.	69
2	Landslides have swept away cultivated land.	67
3	Landslides are a problem for the whole community.	56
4	Landslides create a transport problem.	53
5	Landslides have swept away property.	33
6	Landslides are a problem for the individual.	33
7	The main cause of landslides is rainfall.	28
8	Damaged land must be repaired but is expensive.	22
9	New landslide sites are not used for cultivation.	19
10	Landslides are a common occurrence.	19
11	Village community do not get help/aid.	19
12	The main cause of landslides is the natural geology.	17
13	Individual farmers have to help themselves.	17
14	There is no economic support from the Government.	17
15	Landslides mainly occur during monsoon.	14
16	Landslides swept away village mill.	11
17	Landslides are an old problem.	8
18	The landslides generally start in the 'jungle' (non-cultivated land).	3
19	Do not know anything about landslides.	3
	36 people interviewed	

	Women	%
1	Landslides are a problem for the whole community.	64
2	Landslides create a transport problem.	57
3	Landslides have swept away cultivated land.	57
4	Landslides are a bad problem.	57
5	Landslides are a problem for the individual.	29
6	Landslides mainly occur during monsoon.	21
7	Landslides have swept away property.	14
8	Landslides swept away village mill.	14
9	The main cause of landslides is rainfall.	14
10	Landslides are an old problem.	14
11	Do not know anything about landslides.	7
12	The landslides generally start in the 'jungle' (non-cultivated land).	0
13	New landslide sites are not used for cultivation.	0
14	Landslides are a common occurrence.	0
15	The main cause of landslides is the natural geology.	0
16	Village community do not get help/aid.	0
17	Individual farmers have to help themselves.	0
18	Damaged land must be repaired but is expensive.	0
19	There is no economic support from the Government.	0
	14 women interviewed	

	Men	%
1	Landslides are a bad problem.	77
2	Landslides have swept away cultivated land.	73
3	Landslides create a transport problem.	50
4	Landslides are a problem for the whole community.	50
5	Landslides have swept away property.	45
6	The main cause of landslides is rainfall.	36
7	Landslides are a problem for the individual.	36
8	Damaged land must be repaired but is expensive.	36
9	New landslide sites are not used for cultivation.	32
10	Landslides are a common occurrence.	32
11	Village community do not get help/aid.	32
12	The main cause of landslides is the natural geology.	27
13	Individual farmers have to help themselves.	27
14	There is no economic support from the Government.	27
15	Landslides swept away village mill.	9
16	Landslides mainly occur during monsoon.	9
17	The landslides generally start in the 'jungle' (non-cultivated land).	5
18	Landslides are an old problem.	5
19	Do not know anything about landslides.	0
	22 men interviewed	

Plate 1: Landslide 1 Rock Slide by Trisuli Khola River

Plates 2-3:
Landslide 2
Rock Slide Near the Trisuli Khola Bridge

Plate 4: Landslide 3 Rock Slide at Thulo Bharku Village

Plate 5:
Landslide 4
Road to Dhunche (1)

Plate 6:
Landslide 5
Road to Dhunche (2)

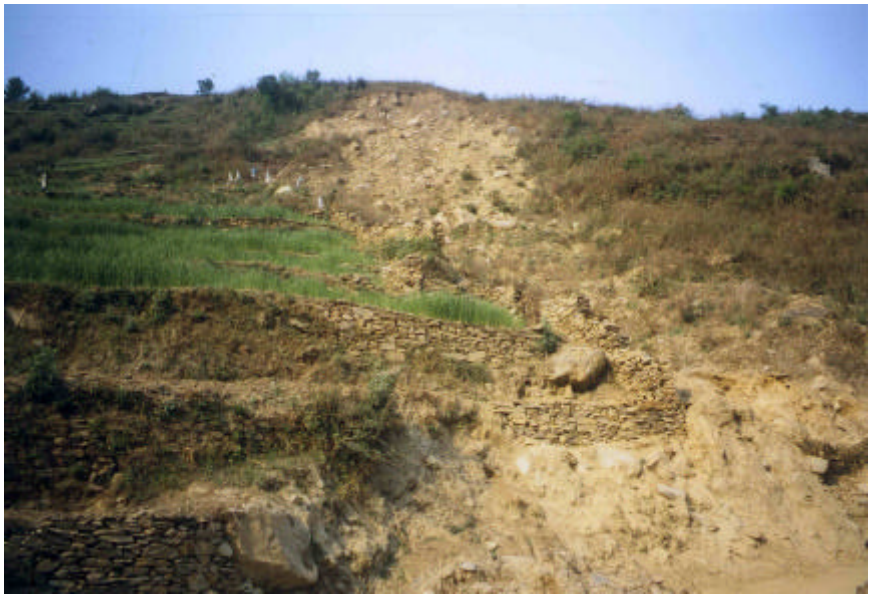


Plate 7: Landslide 7 Below Dhunche Village (1)

Plate 8: Landslide 9 Below Dhunche Village (3)

Plate 9: Landslides 7, 8 & 9 Below Dhunche Village (1-3)

Plate 10: Landslide 10 High Above Road to Thulo Bharkhu

Plate 11: Landslide 11 Below Dhunche Village

Plate 12:
Deteriorating Road Supports

Plate 13:
Treatment of Landslides

Plate 14: Agricultural Terrace Fields, Dhunche Village

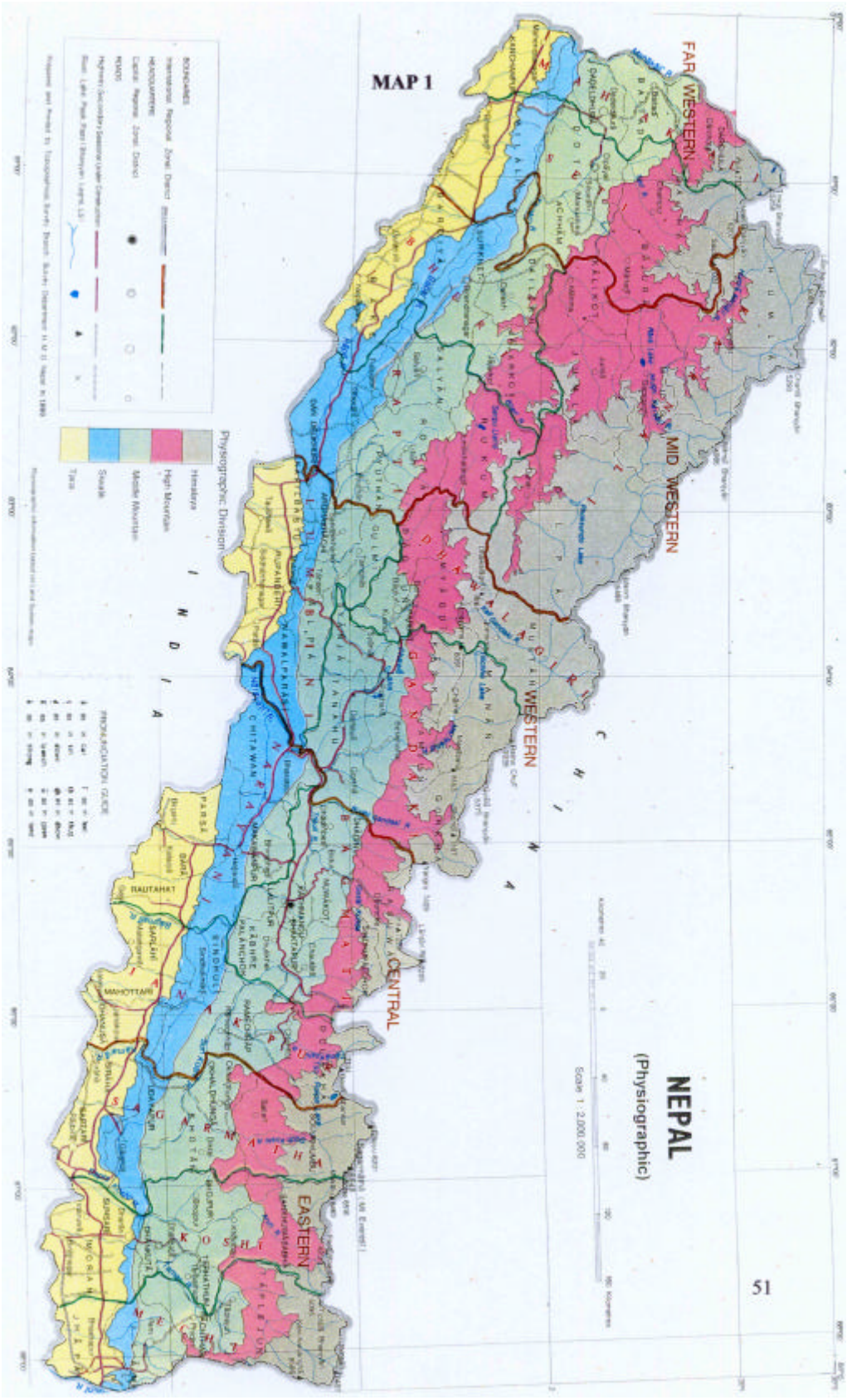
Plate 15:
Trisuli Khola River (view from the bridge), Dhunche

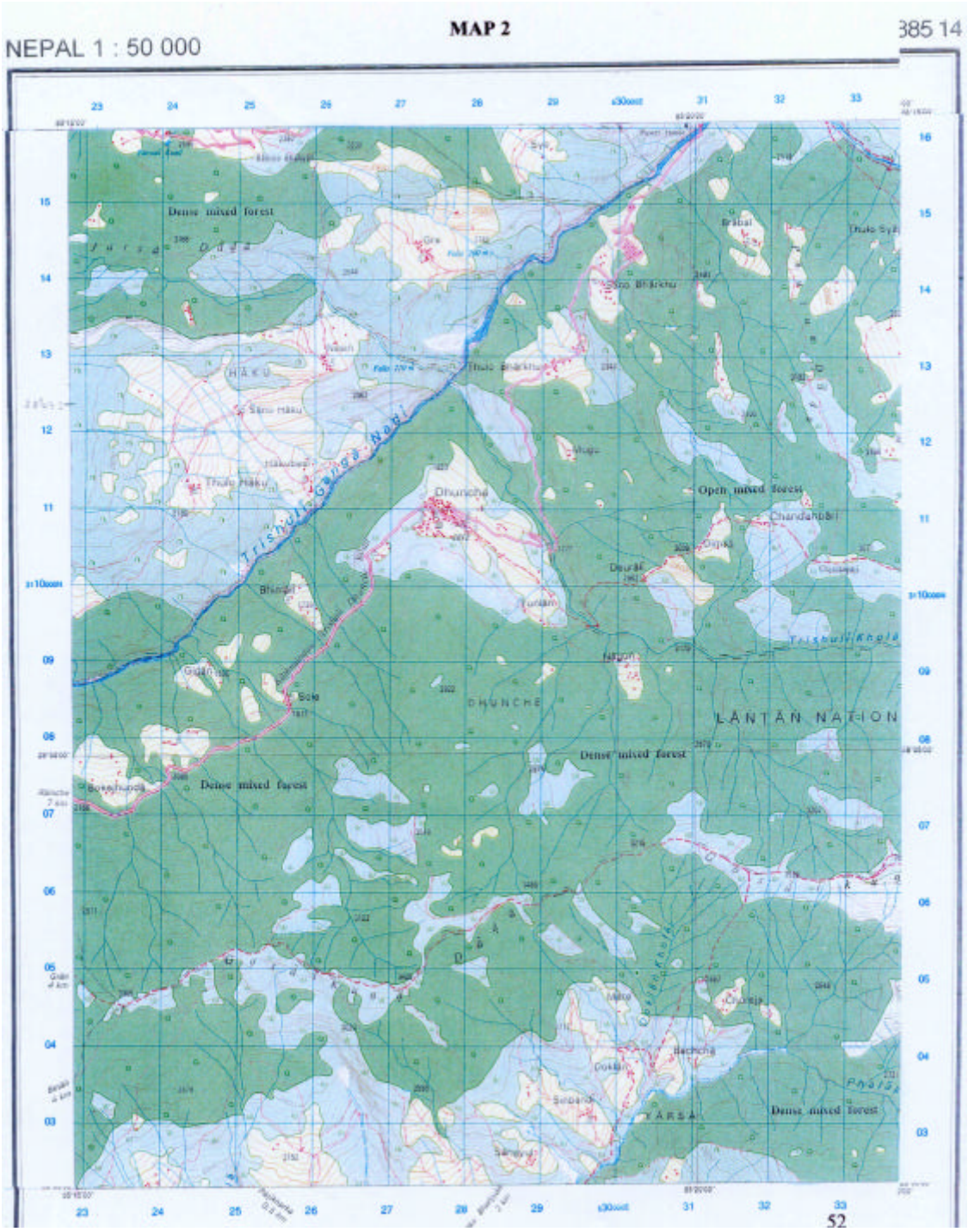
Plate 16:
Tamang Women
Dhunche Village

Plate 17:
Road to Thulo
Bharkhu Village
With Buddhist Stupa
and Prayer Flags

Plate 18: Terrace Fields, Dhunche Village, High Mountain Himalaya

Plate 19: Terrace Fields, near Tigaon Village, Middle Mountain Himalaya


MAP 1
NEPAL
(Physiographic)
FAR WESTERN
MID WESTERN
WESTERN
CENTRAL
EASTERN
INDIA
CHINA
Physiographic Division
Himalaya
High Mountain
Middle Mountain
Siwalik
Tarai
51


NEPAL 1 : 50 000
MAP 2
385 14
Dense mixed forest
Open mixed forest
Thulo Bhakhu
Thulo Haku
Dhunche
Trishuli Ganga Nadi
DHUNCHE
LANTAN NATION
Dense mixed forest
Dense mixed forest
Dense mixed forest
Bechche
YARSA
52

MAP 3

Dense mixed forest
Open mixed forest
Dhunche
DHUNCHE
Thulo Bharkhu
Sano Bharkhu
Thulo Haku
Sano Haku
HAKU
Syo
Gre
Nesin
Bhimali
Sole
Gigan
Deurali
Nagun
Lunlan
Chandan
Doklan
Bachcha
Sirpanda
Mere
Chareja
YARSA
LANTAN
Brabal
Bokajhunda
1
2
3
4
5
6
7
9