Landscape Change in the Nepal Hills

Evidence from Lamjung

Harka Gurung

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by
Harka Gurung

International Centre for Integrated Mountain Development (ICIMOD)
Kathmandu, Nepal
August 2004

Credits: All the photographs were taken by the author except 11A which was taken by D. Messershmidt

Cover: The study area, Taranche (945m), is 25km south of Himalchuli (7,893m) on right. On the left is Ngadichuli (7,513m) labeled as Peak 29 by surveyors of 1925-27 and officially named Ngadichuli in 1983. Thulnagi (3,115m) in middle distance and Usta ridge on right foreground. December 2001.

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Foreword

Landscape change in the mountains, including changes in land use, forests and agriculture, architecture, and dwelling areas continues to be the subject of debate and the basis for development investment. Uncertainty over past conditions and rates - and even directions - of some landscape change continue to fuel discussion and drive the need for better documentation and analysis.

Juxtaposing views of the past with the present provides a fascinating method to uncover historical change and speculate on future trends. Repeat landscape photography, especially when done by the same observer, and especially when done by a highly trained and keenly observant professional, provides us with this unique opportunity.

Dr. Harka Gurung, renowned geographer, historian, planner, policy-maker, author, adventurer, and spokesperson for the excluded ethnic groups of the Himalaya, has brought together this extraordinary collection of repeat photographs and observations. A native of the area featured in the documentation, this publication draws on over forty years of his work in the Himalaya.

Photographs and observations such as those presented in this publication give us an objective basis for testing our current theories of land degradation, deforestation, and urbanisation. In this context, lack of change where we expected it can be as revealing as confirmation. While the sample of publications does not claim to be based on anything other than Dr. Gurung's personal and professional interest and opportunity, we believe that it represents a valuable contribution to our understanding of the on-going changes in the Himalayan mountains. ICIMOD is pleased to publish this work.

J. Gabriel Campbell, Ph.D
Director General
ICIMOD

Acknowledgements

The field research for this study was supported by ICIMOD. I wish to thank Dr. Gabriel Campbell, Director General, and Dr. Binayak Bhadra, Director of Programmes, for their interest in the present study. In Lamjung, Til Bahadur Gurung of Tanklichok and Sant Kumar Bhandari of Taranche assisted in the field work. Narendra Khanal helped in airphoto interpretation and Pawan Ghimire in cartographic work. New ERA staff, Bhoj Kumar Shrestha, Sanu Raja Shakya, and Geeta Shrestha, provided secretarial assistance. I thank them for their cooperation. I also would like to thank Greta Rana for her editorial support, Dharma R. Maharjan for layout design, and Asha K. Thaku for the maps.

- Harka Gurung

Abstract

There has been much discussion on the state of the Himalayan environment with a tendency to highlight increasing land degradation. This investigation focussing on a hill area in Lamjung presents a very different ground reality regarding landscape dynamics in central Nepal. The study findings are based on evidence from repeat photographs and field observations extending over four decades. The monograph includes numerous maps and diagrams dealing with geology, geomorphology, climate, vegetation, and land use in the study area. The approach is oriented more towards visual and graphic presentation than verbal description.

Glossary / Abbreviations

bari	The term is derived from bar (fence) to refer to the enclosed area of homestead for fruit and vegetable production. It literally means in-field, therefore, it is wrong to equate it with pakho (unirrigated field)
bazaar	A settlement with commercial services
bensi	Valley bottom
caste	Hindu social division according to the ritual status of a person by birth
Central Hills	Subtropical hill zone
danda	Hill range or ridge
deorali	Saddle, convergence of two ascents
ethnic	A social group with a distinct language, religious tradition, culture, and native area
FINNIDA	Finnish International Development Agency
gaon	Village or rural settlement
Higher Himalaya	Geological term for structural formations over-riding the Main Central Thrust
Himal	A mountain range with permanent snow
kharchari	Tax on alpine pasture
kharga	Alpine pasture for summer grazing
khet	Irrigated land with horizontal terraces
khola	River, stream
LRMP	Land Resource Mapping Project
lekh	High ridge with snow in winter
Lower Himalaya	Geological term for structural formations below the Main Central Thrust and above the Main Boundary Thrust
Main Boundary Thrust	Major geological fault or unconformity that separates the Sub-Himalaya (Siwalik Zone) from the Lower Himalaya
Main Central Thrust	Major geological fault or unconformity that separates the Lower Himalaya from the Higher Himalaya
Midland	This refers to the hill zone of Nepal across the country. Kawakita[*] called it 'Lowland' with reference to its low elevation relative to the main Himalaya and Mahabharat Lekh. Hagen[**] referred to it as 'Midland', and this definition has been adopted by many others. It can be equated with the pahar (hill) zone.

[*] Kawakita 1957, p. 7

[**] Hagen 1961, pp. 38-39

muri	Volumetric measurement for grain, equivalent to 2.40 bushels
Ngadi	The name of a river that has been spelled diversely. The quarter inch (1:253,000) map of the Survey of India (1925-27) rendered it as 'Musi' (Figure 13). The one inch map (1:63,360) of the Survey of India and that of the Land Resource Mapping Project render it 'Nyadi'. The FINNIDA map (1:50,000) spells it as 'Nadi' (Figure 5). The name is derived from a combination of Nga (ritual hand-drum) and 'ti' (broken) to mean 'broken drum' according to a Gurung legend.
pahar	Hill with no snowfall
pahara	South-facing or sunny aspect (comparable to the the French term 'adret' and the German 'Sonnenseite')
pakho	Unirrigated or rain-fed field with outward sloping terraces
ropani	Area measurement equivalent to 5,476 square feet, 1 hectare = 19.7 ropani
sinyala	North-facing or shady aspect (comparable to the French term 'ubac' and the German 'shattenseite')
Sardar	Originally a term for an army commander, later it became the term for the highest ranked official in the Nepalese bureaucracy.

Note: In general throughout this text the Sanskrit term Himalaya, normally used specifically geographical/ geological area, rather than the English language derivative, Himalayas, is used.

Editorial note

Page numbers for references cited are given in the reference list, not in the text. An exception is made in the case of op. cit. citations.

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Chapter 1
INTRODUCTION

The term landscape, 'landschaft' in German or 'lantschap' in Dutch, is used to refer to a section of land which the eye can view. It also has two cultural variants, as the representation of natural scenery in painting and as improving the appearance in gardening. Essentially, landscape is inclusive of the natural backdrop as well as cultural imprints on it. Various factors contribute to the change in landscape. In pristine areas, modification occurs over time due to natural processes. In places of human impact, variations can bear a regional stamp. Take the contrast of city-scape in two intermont valleys as determined by local materials: Kathmandu Valley, with an abundance of lacustrine soil, has brick buildings while Pokhara Valley, filled with outwash boulders, has stone structures. The ochre tone of the former and gray-white facade of the latter place give a distinct character to their landscape.

In the Himalaya, there is a tendency to highlight the physical grandeur and ignore human endeavour. Yet, the flights of field terraces carved out of steep hill slopes are the toil of generations. Some environmentalists even consider these as profane human intrusion. One early botanist to visit Nepal observed that:

> *"all along the Himalaya cultivation is most intense in it (sub-tropical belt), and more distinctly cuts off the upper forests from the lower forests than any other feature"* (Burkill 1910).

He was obviously referring to the Schima wallichii-Castanopsis indica forest zone. In rural areas, agricultural land use is an essential feature of the landscape. Human use of adverse topography is exemplified by:

> *"The terraced fields of Nepal, which stretch several hundred meters upward from the bottom of the valley up to heights of 1,500m and give the landscape its typical character…."* (Haffner 1992).

Landscape appreciation, therefore, needs to encompass the totality of the physical setting and human endeavour thereupon.

The purpose of this study is to enquire into the landscape change in a hill area of central Nepal. The aspects covered are landform, land use, and cultural features based on temporal data extending over four decades. This chapter introduces the study area, methodology used, and data sources. The second chapter deals with the physical geography of the area based on aerial photographs. The third chapter on land use is also derived from aerial photographs. The fourth chapter presents visual evidence with use of terrestrial photographs at two time intervals. The fifth chapter is a recapitulation of study findings along with reference to some other case studies. The concluding chapter attempts to arrive at some explanation of the dynamics of landscape change.

1. The Study Area

The area for this study includes the immediate environs of the confluence of Marsyangdi river and Ngadi* Khola in Lamjung district (Figures 1 and 2). The choice of area was purposive due to this researcher's familiarity with the place as a native. Familiarity, of course, does not necessarily mean objectivity. The same locality perceived as a dense woodland in childhood may appear less so when one is an adult. Therefore, it is difficult to ascertain whether the writer's observation on forest depletion quoted below was based on reality or influenced by the prevalent notion at the time of writing (Gurung 1966).

> "*Forest areas I knew as a boy two decades ago were now mere shrubland due to overgrazing or had been converted into cropland. And inspite of the extension of cropland at the cost of forest, there were recurrent periods of food shortage. The main reason contributing to this situation seemed to be the increase in population and consequent environmental stress.*"

The writer also reminisced about his village that:

> "*Taranche was strung between two dangers; landslide above and flooding of the fields on the banks of the Marsyangdi, during heavy rains* (Gurung op. cit)."

Table 1: Elevation Zones, Lamjung

Zone	Area (km^2)	Per cent
1. Above 6,000	24.2	1.4
2. 4,500 – 6,600	90.7	5.4
3. 3,500 – 4,500	210.0	12.4
4. 2,500 – 3,500	287.3	17.0
5. 1,500 – 2,500	417.0	24.7
6. 1,000 – 1,500	348.0	20.6
7. 500 – 1,000	292.8	17.3
8. Below 500	20.9	1.2
ALL	**1,691**	**100.0**

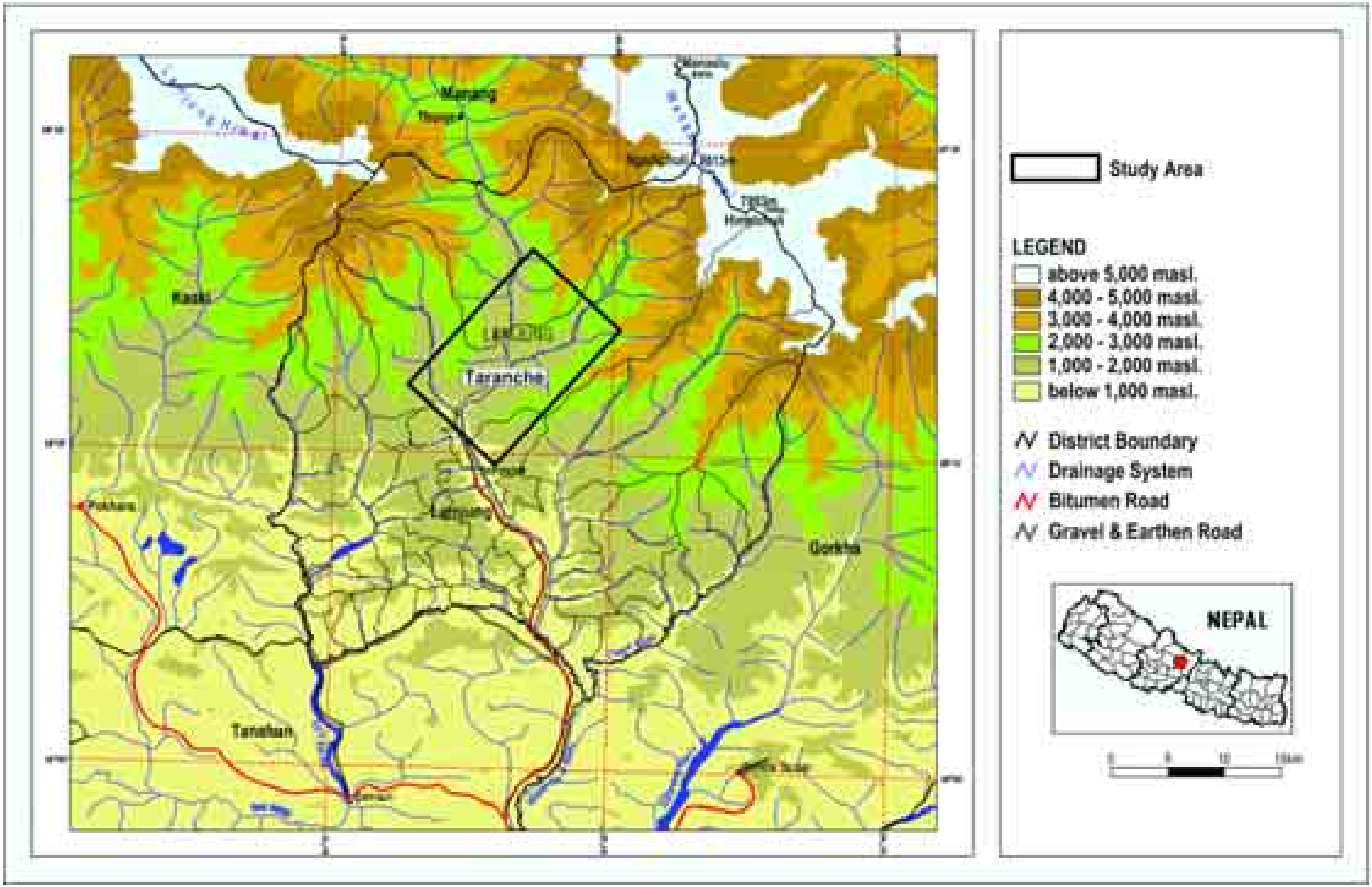
Source: MENRIS 1998

In a way, this enquiry incorporates some re-evaluation of one's own perceptions against the ground reality.

The above, subjective consideration on the choice of study area also turned out to be a fortuitous one from the view of relief contrast of the district where the study area is located. Of Nepal's 75 districts, Lamjung along with adjoining Kaski, Gorkha, and Sankhuwasabha in the east have the maximum elevation range. Of the total 1,691 sq.km area of Lamjung district, 45.3% of the land surface lies between 1,000 and 2,500m (Table 1). The

* See Glossary

Figure 1: Lamjung district



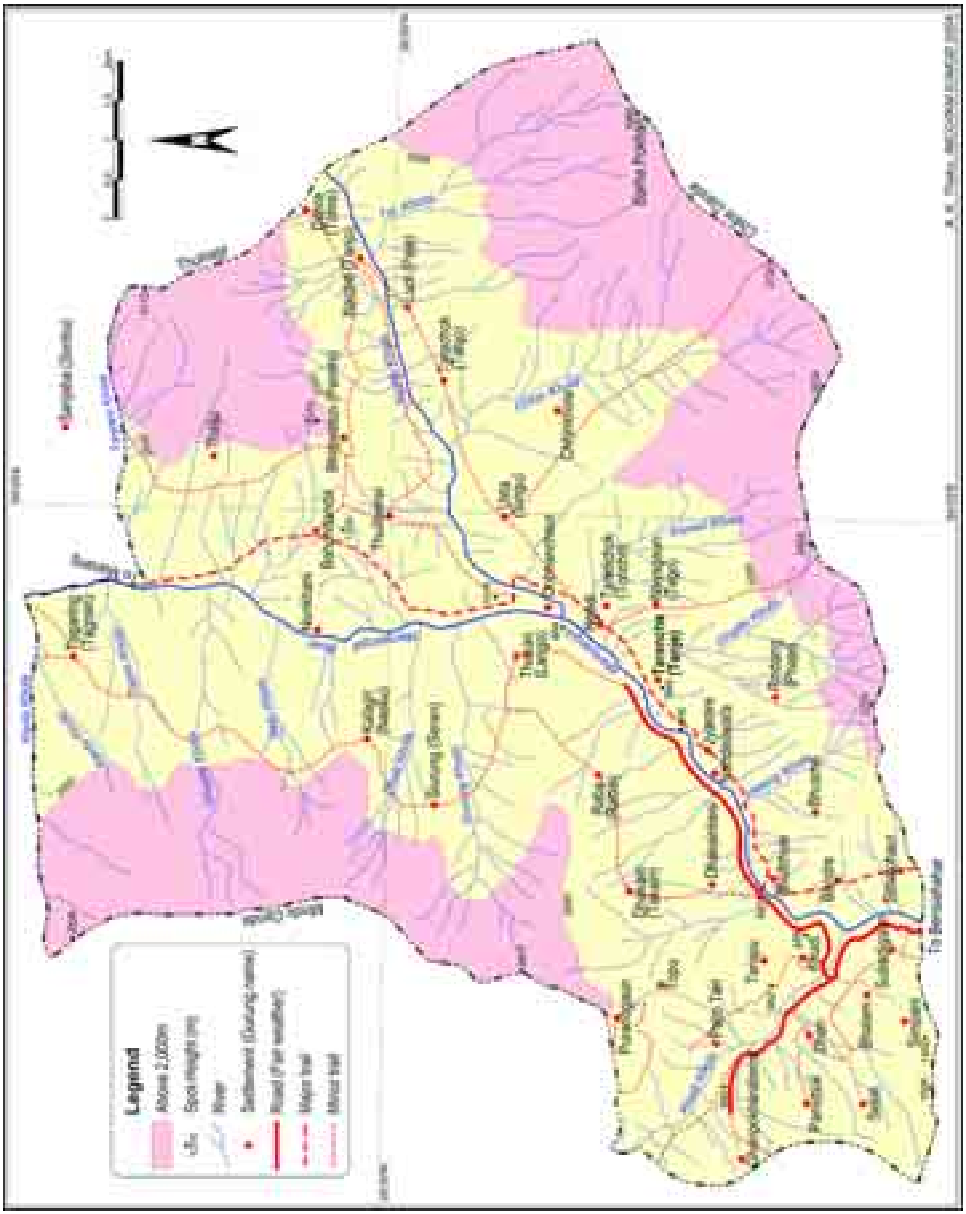


Figure 2: Marsyangdi - Ngadi confluence

higher elevation area from 2,500 to 6,000m is 34.8% and the lower area from 500 to 1,000m is 17.3%. At the extremity are 20.9 sq.km below 500m and 24.2 sq.km above 6,000m.

The study area is dominated by Himalchuli (7,893m) that lies only 25km north of Taranche (945m), focus village of the study (Figures 1 and 3). This means an extreme gradient with a loss of 278 metres to a kilometre. However, most field observations are confined to elevation ranges from 781 to 1,800m (Zones 5,6,7 of Table 1) where human habitation is more pronounced.

2. Methodology and Data

The study approach adopted was basically one of landscape appreciation through geographic method. This involved the use of aerial and terrestrial photographs and field observation (Annex A)combined with interviews on local history. The investigation was carried out at two levels of spatial hierarchy. The first hierarchy is a reconnaissance transect of a wider extent. This covers an area of nearly, 10,000 hectares of land along the 20km length of Marsyangdi Valley from Khudi to Tagaring and another 7km along Ngadi Valley from Dobhanchaur to Naiche (Figure 2). The second hierarchy is a more detailed coverage of 320 hectares of land around Taranche village (Figure 4). This smaller area is bounded by the Marsyangdi to the west, Sisneri Khola to the north, Hwang Khola to the south, and scarp slopes below Nayagaon and Rindang (Figure 2). Most settlements within the study area were visited to ascertain their household size and ethnic composition (Annex A). Landscape change in the above two areal hierarchies was assessed on the basis of various data sources as described below.

a. Aerial photographs (1958 & 1996): The two sets of aerial photographs are those of the Survey of India (1958) at a scale of 1:40,000 and of the FINNIDA (Finnish International Development Agency) Project (1996) at a scale of 1:25,000 (Figure 3). Both airphoto sets were taken for the purpose of preparing topographic maps. They represent a time interval of 38 years but precise comparison to assess change is hampered by the difference in scale. The information on river terraces, landslides, and land use was based on the interpretation of these airphotos.
b. Topographic maps (1960 & 2001): Survey of India as well as FINNIDA Project map sheets covering the present study area have similar longitudinal and latitudinal extent: 84°,15' to 84°30E and 28°15' to 28°30' N. The Survey of India map sheet (West No. 3 district, No. 71 D/7) is at a scale of 1:63,360 (one inch). The FINNIDA Project map sheet (Bahundana, No. 2884-10) is at a scale of 1:50,000 (half the scale of the source airphoto). The former has a contour interval of 100 feet and the latter of 40 metres (Figure 5). Both sets of topographic maps indicate major land-use types in colour: forest (green), cultivation (yellow), and settlement and trail (red).
c. Terrestrial photographs (1962-2002): The third data sources utilised to evaluate landscape change were photographs of the same place taken at an interval of four decades (Chapter 4). Most of these repeat photographs were taken by the

Figure 3: Taranche aerial photographs

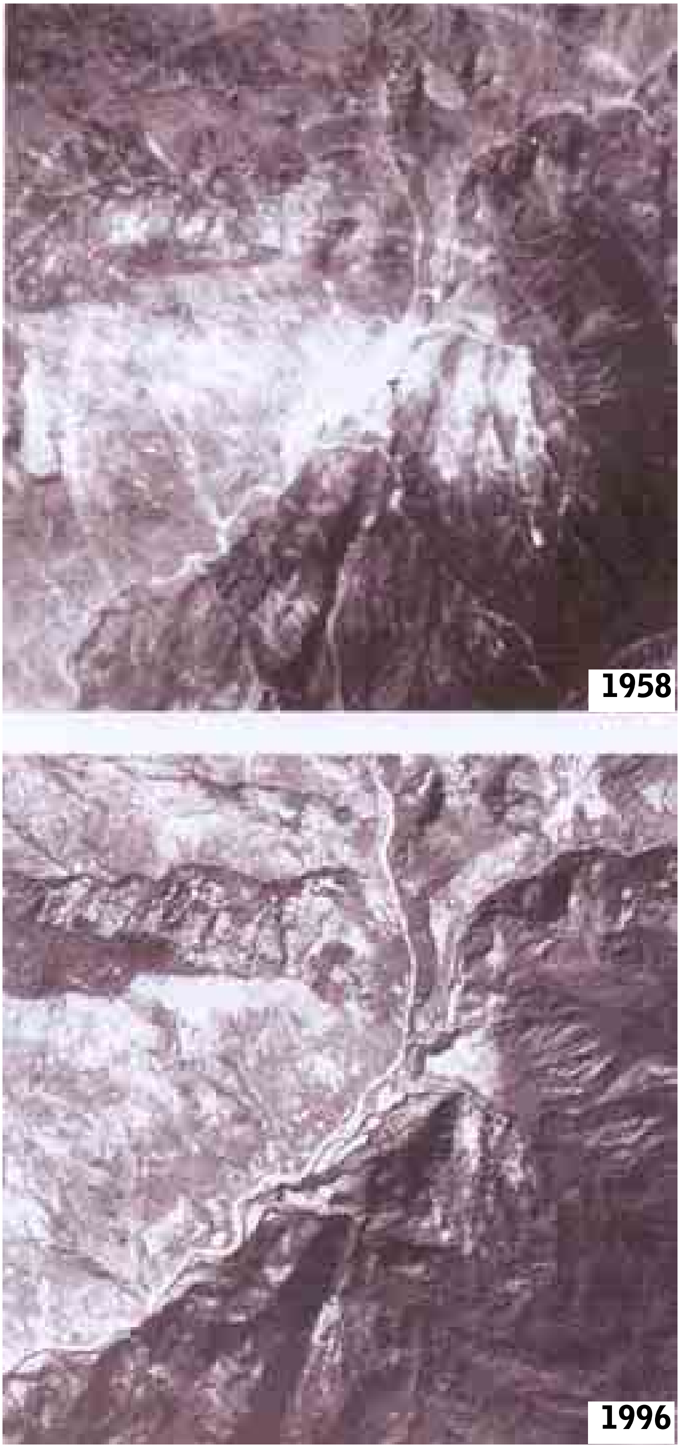


Figure 4: River terraces, Taranche

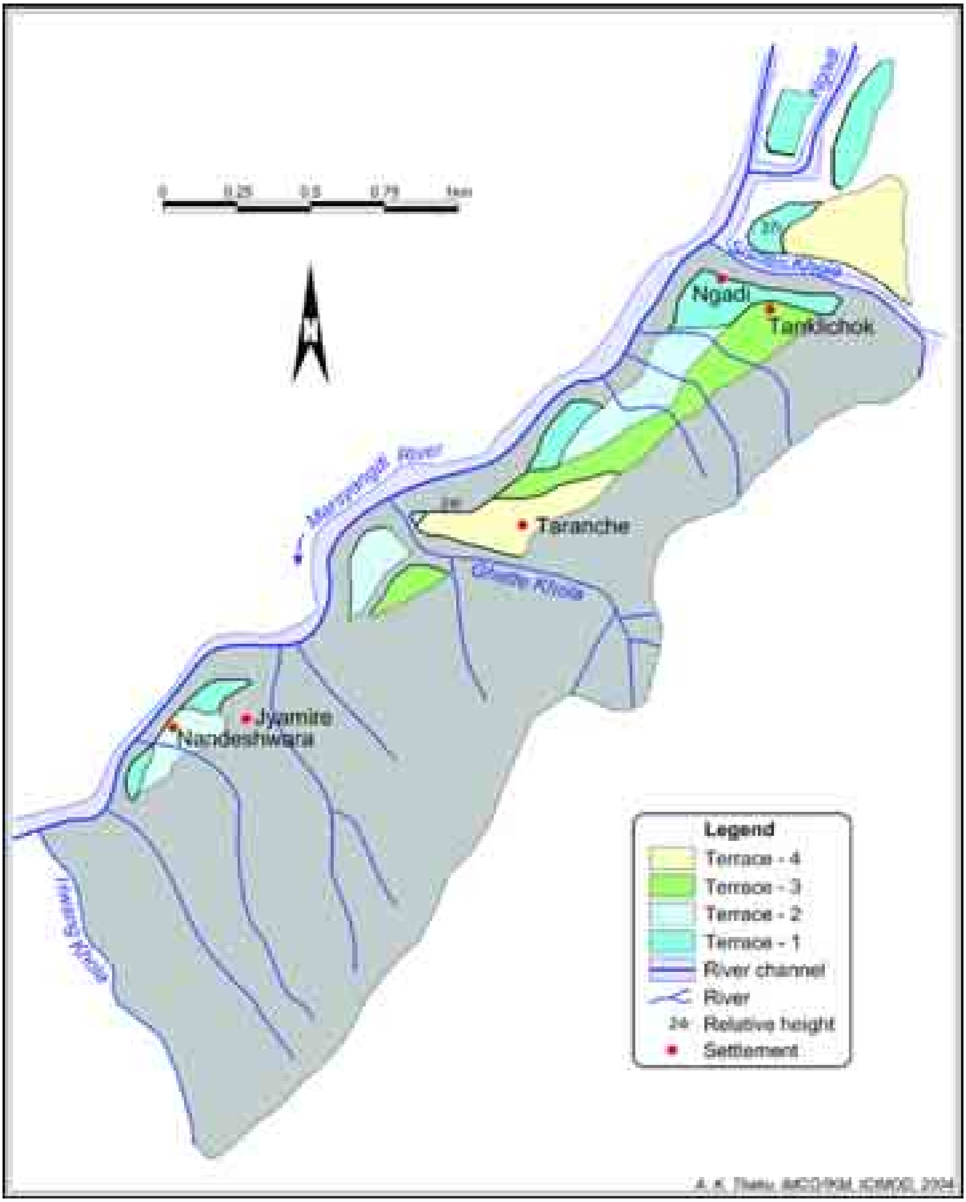
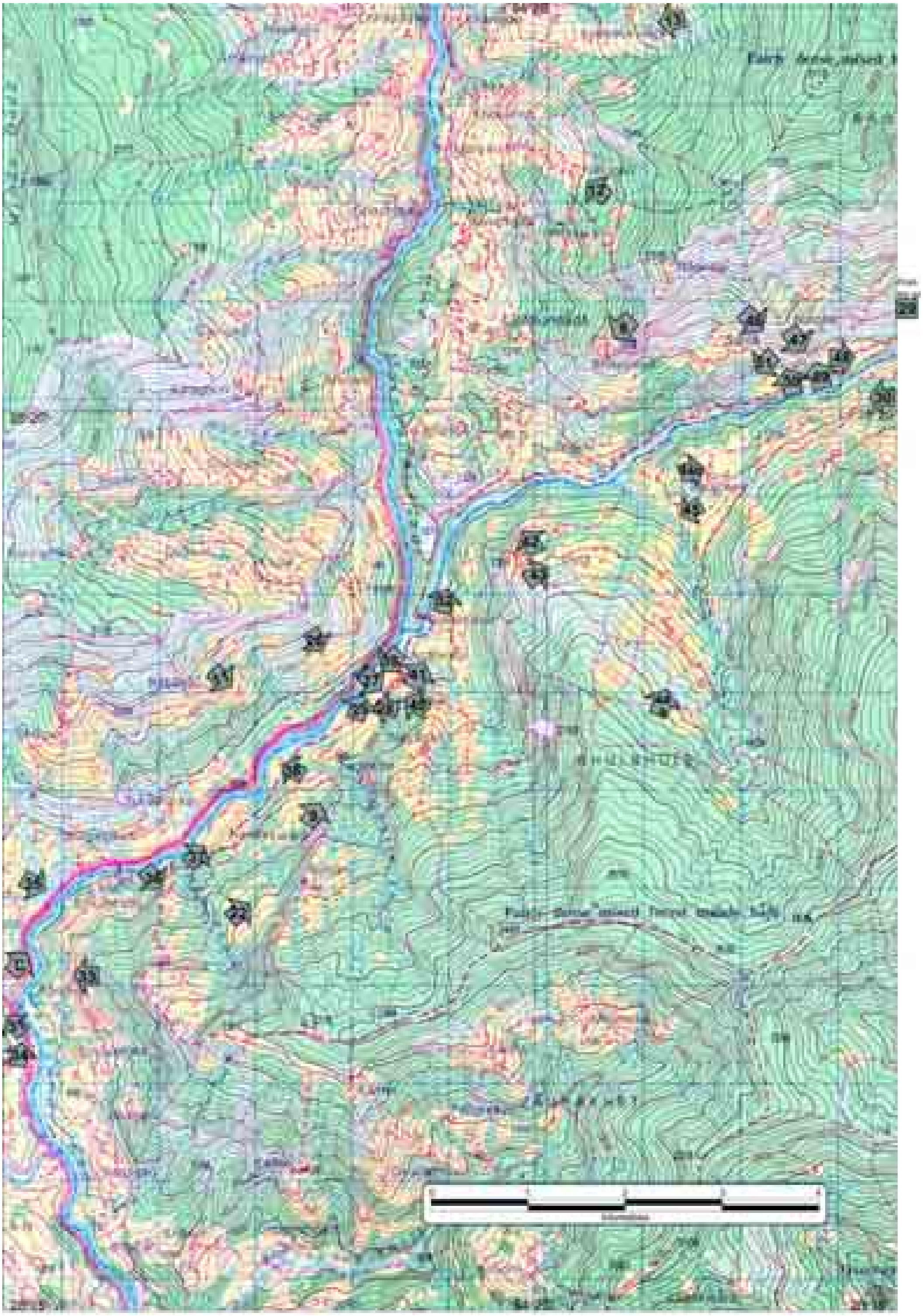


Figure 5: Topographic map with photo index



researcher during two visits to the area from 10-31 October and 18-28 November 1962 and during the winters of 2000, 2001, and 2002. A few are of later date to highlight particular changes. Although the repeat photographs do not match the season, they do provide an objective situation of physical and cultural features at the two time intervals. Supplementary repeat photographs not cited in the text are given at the end of Chapter 6.

d. Personal observations (1946-2002): The researcher left Taranche in December 1946 for schooling in India. Since 1955, he has made frequent short visits to his village. The latest ones were in the December - January months of 2000, 2001, and 2002 in the course of field work for this study. Such personal observations span over 56 years, but this source may have some propensity for subjectivity.

Chapter 2
GEOMORPHIC EXPRESSION

This chapter deals with the physical setting of the study area on aspects of geology and landform, including a critique of two land-system classifications of Nepal. Assessment of geomorphic change is restricted to the extent of landslides as evidenced by the set of aerial photographs (1958 & 1996) and repeat photos (1962-2002).

1. Geology

Landform is the surface expression of geomorphic processes of degradation operating over the geological foundation. The high relief contrast of the study area is matched by the area's geological diversity. The Himalayan structural geology is marked by two major thrust faults. One is the Main Boundary Thrust (MBT) which separates the Sub-Himalayan and Lower Himalayan zones and the other is the Main Central Thrust (MCT) that separates the lower Himalaya and Higher Himalaya. It is significant that the latter, MCT, traverses through the northern part of the study area (Amatya and Jnawali 1994). This major structural uncomformity is marked by a hot spring, as elsewhere, at Nunkhani (Figure 6). The MCT in Marsyangdi area has a east-west strike with a northerly dip varying from 15° to 40°.

This tectonic line represents a contact zone whereby the higher pre-Cambrian formation is thrust over the Lower Palaeozoic formation. The former one is known as the Higher Himalayan crystalline or Himalayan gneiss zone. The latter one is called then Lower Himalayan or Midland formation (Colchen et al. 1986). The Himalayan crystalline formation is composed of highly metamorphosed rocks of gneiss, quartzite, and marble. In places, it is intruded with granite and sillimanite.

The Midland formation below the MCT is composed of unfossiliferous clastic rocks of phyllite, limestone, quartzite, and sandstone. Around the study area, the succession is represented by phyllite and a sub-ordinate amount of sandstone with distinct graded bedding, and they gradually change downwards into a slate-rich succession (Ohta and Chiba 1973). Those nearer the MCT are rich in calcareous dolomite. The geological cross-section of this schist formation (BB) has numerous dykes and sills between Nunkhani and Khudi (Figure 6). There are two intrusions of calcareous dolomite (GU) north of the Marsyangdi-Ngadi confluence. Taranche village is entrenched by dykes of calcareous dolomite (RD) north and south of it respectively, whereas Khudi lies over quartzite exposure (G). South of it extends a broad formation of meta-sediments composed of schist, phyllite, and sandstone.

Figure 6: Geological map (after Colchen et al.)

2. Landform

There have been two exercises with regard to land classification of the Nepalese topography. The first attempt based on landsat images was to demarcate ecological land units with emphasis on their watershed condition (Nelson et al. 1980). It designated the highland area of Nepal into three zones: Middle Mountain, Transitional, and High Himalayas. Accordingly, the Lamjung area, including the locale of the present study, was labelled the Central Transitional Mountain System (II. D. 1).[1] The Transition zone was defined as:

> *"land between the heavily used hills of the Middle Mountains and the sparsely populated High Himalayas"* (Op.cit, p.49)

within the elevation range of 750 to 3,200m. The lower Middle Mountain Zone was placed south of the Marsyangdi-Khudi confluence, outside the study area.

The second attempt at land classification was made by the Land Resource Mapping Project (LRMP) based on aerial photographs (Carson et al. 1986). The output was three sets of maps on land systems, land capability, and land use. The boundaries of the land systems were based on the ecological land units mentioned above with minor modifications. However, there was some divergence in the nomenclature used by the two studies as given below.

Particular	Ecological Land Units (Nelson et al.)	Land Systems (LRMP)
Major unit	Zone	Region
Component	Region	System
Macro hierarchy	Transition Zone	High Mountain

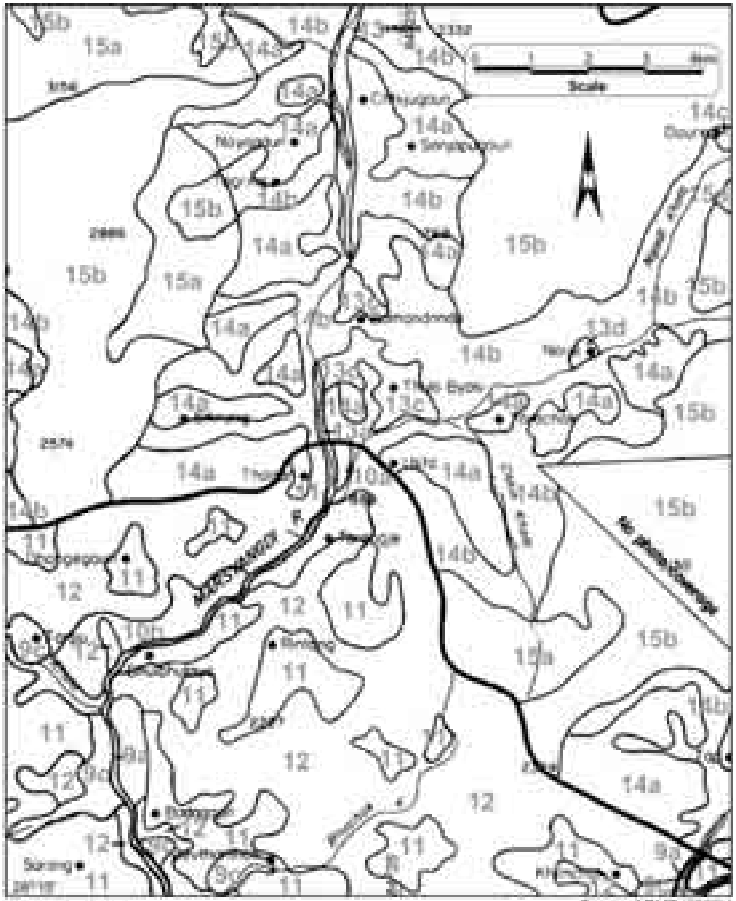
The southward shift of the High Mountain Region boundary in the LRMP map placed the study area's northern part in the High Mountain Region and its southern part in the Middle Mountain Region (Figure 7). Accordingly, the study area includes land systems 9,10,11,12 (Middle Mountain) and 13, 14 (High Mountain).[2]

In fact, the above so-called High Mountain Region land system is more characteristic of the sub-tropical zone, as described by the ecological land units' study, than the temperate mountain zone. The land systems' report states that:

> *"Physiographic regions (Terai, Siwaliks, Middle Mountains, High Mountains, and Himal) are well recognised by Nepalese geographers, geologists, foresters, soil scientist and agronomists alike"* (Carson et al. 1986).

1 Op. cit, Land system map of Nepal (East sheet), Scale c. 1:500,000
2 Land system map, sheet No. 71 D/17, see Figure 7

Figure 7: Land systems (after LRMP)



Source: LRMP (1986)

Legend

High Mountain Region

15b Past glaciated, very steep slope >30°

15a Past glaciated, moderate to steep slope <30° - Above arable zone

14b Past glaciated, steep to very steep

14a Past glaciated, moderate to steep - Below arable zone

13d Ancient alluvial terraces

13c Fans

13b Recent alluvial plain

13a Active alluvial plain

Middle Mountain Region

12 Mountain terrain, steep to very steep slope >30°

11 Mountain terrain, moderate to steep slope <30°

10b Terraces, dissected

10a Ancient lake/river, non-dissected

9c Alluvial fans

9b Alluvial plains

9a River channel

The above observation is incorrect since the terms used for the three highland zones are geographically inappropriate (Gurung 2000). The distinction between 'Mountain' and 'Himalaya' is spurious as both refer to snow ranges in the Nepalese context. The epithet of 'high' to them is superfluous whereby the label 'Middle Mountain' becomes redundant. The 'Middle Mountain' zone of Nelson et al. (1980) and the same region for Carson et al. (1986) actually relates to the hill zone/region. In fact, there are Nepalese terms that recognise the distinction between the hills with no snow as 'pahar', ranges with winter snow as 'lekh', and ranges with permanent snow as 'himal'. In the study area, in land systems designated as 13 and 14 (High Mountain Region), there is no snowfall even in winter (Figure 7).

The dominant landforms of the study area are three high ridges and their lateral spurs (Figure 2). They have a homoclinal structure with north-dipping rock strata (Figure 8) and present a hog-back profile of scarp face to the south. Marsyangdi River has carved a deep valley trending due south until Dobhanchaur. Thereafter, its NW-SE trend is aligned to that of the tributary Ngadi Khola, NE-SW, suggestive of the fault structure. The amplitude of relief from the Marsyangdi floodplain to the enclosing ridges on average exceed 530 metres around both Nunkhani and Taranche. Such a steep declivity is, however, tempered lower down by a series of river terraces. Thick deposits of diluvial and alluvial materials along major rivers are a characteristic feature of landform in the central hills of Nepal (Dollfus and Usselman 1971; Gurung 1965/2002). These were deposited during the Quaternary period and have since been eroded into stepped terraces which are called 'tar'. The one at Tarkughat, 24 kilometres downstream from the present study area, has four levels of river terraces (Dollfus and Usselman 1971).

Two approaches have been adopted to describe the numerous river terraces of the study area. That is, they have been grouped into two levels (upper and lower terraces) for the meso scale area and elaborated into four levels for the focussed area at Taranche. At the meso scale, the terraces appear as distinct level surfaces at various elevations above the floodplain (Figure 9). The upper or ancient terraces are extensive in both the Marsyangdi and the Ngadi valleys. They are particularly pronounced at Baisthopla, Thulibensi, Taranche, and Khudi (Figure 10). The lower level terraces are restricted to limited areas, notably between Dobhanchaur and Khudi.

There is an increase in elevation difference between the upper terrace and river level progressively upstream. These range from 78 metres at Khudi, 95 metres at Taranche, 116 metres at Ustabensi, 132 metres at Nemane, to 164 metres at Baisthopla. The terrace surface is inclined southwards or downstream. The Baisthopla terrace is 265 metres higher than the Khudi terrace, 12 kilometres south with a gradient of 22 metres to a kilometre. For the same distance, the gradient of the river is about 18 metres per kilometre. This indicates that the rate of down-cutting by the river was much higher when the terraces were deposited than at present.

In contrast to the patchwork of terraces at the macro-scale, those at Taranche constitute an extensive landform. These are very well displayed in Figure 8 as seen from the

A. October 1962

B. March 2002

Figure 8: Taranche area from the north: Bhirpustun (1,888m) provides a panoramic view of the study area: Taranche (T) and Tanklichok (TK). Usta (U), Nayagaon (N), Rindang (R) and Bhusme (B) are located on a north-facing dip slope (Figure 8A). The 2002 photo shows a new bazaar at Dobhanchaur (D) on either side of the Ngadi bridge (Figure 8B). A run-of-the river barrage of the upper Marsyangdi project will be sited between Dobhanchaur and Ngadi Bazaar. Ustabensi (910), left of Dobhanchaur, had no houses until 1976.

A. October 1962

B. January 2002

Figure 9: Taranche area from the south: The study area on the left side of the Marsyangdi (M) with Himalchuli in the background. Taranche (T) and Tanklichok (TK) localities can be seen on high river terraces in the middle distance (Figure 9A) Further beyond are Usta (U) and Bhirpustun (B), the Marsyangdi gorge west of ‘B’, and Ngadi Khola between ‘B’ and ‘U’. The January 2002 photo has similar cumulus clouds over Thulnagi (Figure 9B). Some houses in Taranche (T) have tin roofs while the landslide scar near Tanklichok (TK) is much subdued. Ngadi (N) is a new bazaar settlement on the alluvial fan of Sisneri Khola. Note the river terraces below Usta and Bhirpustun.

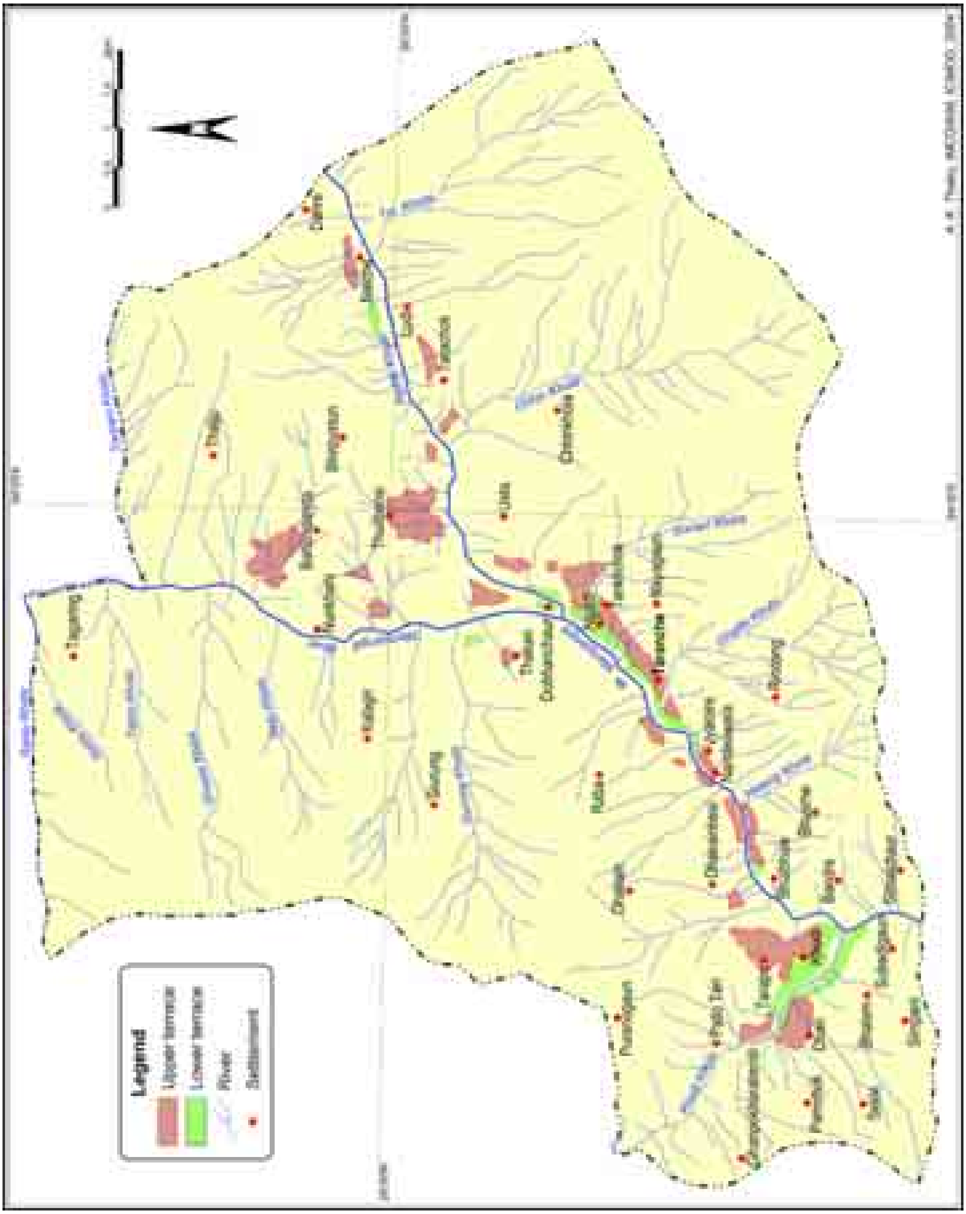


Figure 10: River terraces, Marsyangdi - Ngadi

north. Despite their intricate pattern, four levels of terraces can be recognised (Figure 4). The oldest terrace, level 4, at Taranche village is about 95 metres above the river level (Figure 11). Terrace-3 extends northward with two subsidiary levels and terminates at Tanklichok. Terrace-2 is to be found as discontinuities at Sera, Sirubari, and Nandeswanra. Terrace-1 is similarly spread out at four locations. There is wide variance in the elevation difference between the terrace levels indicating fluctuation in the duration of deposition and uplift stages. All the terrace levels slope towards the south. Their gradient varies from 15 to 20 metres per kilometre, which is less than at the macro-scale due to their restricted linear extent. Of the 320.5-hectare area of Taranche locality, 15.3% is terrace land. The area by respective terrace levels is as given in Table 2.

Table 2: Taranche terraces

Level	Hectare	%
Terrace – 4	7.9	16.1
Terrace – 3	15.2	31.0
Terrace – 2	15.4	31.4
Terrace – 1	10.6	21.6
Total	**49.1**	**100.0**

3. Landslides (1958-1996)

The study area is a land of steep slopes except for the river terraces and alluvial fans. Landslides are a vivid manifestation of surface erosion in which the degree of slope is an important factor. Aerial photographs taken in 1958 show that the study area is replete with landscape scars with remnant images of two catastrophic events. The first one was the major earthquake of 15 January 1934 which precipitated the landslide at Tagaring. It occurred on a dip slope (Figure 12) and originated in temperate oak forest (Figure 13). This large landslide was still active when a mountaineer saw it in 1950 on the way to Manang and made the following perceptive observation (Tilman 1952):

> "*Whether it takes place little by little or in one swift calamity, soil erosion is generally attributed to man's careless greed, his idleness or neglect. It would not, I think, be fair to blame the people of these villages on the Himalayan fringe for the frequent landslides which occur there. In turning the steep slopes into fruitful field they have neither been lazy nor neglectful. Such slopes, of 30° or 40° or more, are laboriously built up in terraces from 10 to 30 ft. wide, whose retaining walls may be from 5 to 15 ft. high, according to the angle of the slope. I have not counted them, but I can well believe there might be a couple of hundred of such hard-won fields on a hillside particularly favoured in soil and aspect whose every foot is put to use. The task of building must be spread over years and their maintenance calls for constant labour over and above that of routine farming. One might say that on such hill sides the forest should never have been cleared, in which case the country must be left uninhabited, or that belts of trees should have been planted which would imply first the giving up of their goats by villagers.*"

In 1958, Tagaring landslide still covered an area of 787 hectares extending over two kilometres (Figure 14). The 1962 situation was no better with new slumps at its head (Figure 13A).

A. 1971/72 by D. Messerschmidt

B. March 2002

Figure 11: Taranche from the west: Taranche (T) locality perched on a high terrace between the Marsyangdi (M) and Ghatte Khola (G). The school area (S) had three Gurung and six Chhetri houses that were swept away by the landslide of 22 July 1955. Six Chhetri perished and Gurung households shifted to Tanklichok (Figure 31). The site was donated to a primary school established in April 1956. The 1971/72 view from Raba (1,600m) shows the landslide below 'S' to have stabilised with shrub vegetation (Figure 11A). The school was upgraded to a high school in 1998. A recent photo shows houses with tin roofs and much improved vegetation cover on steep slopes (Figure 9B). Also visible are four levels of river terrace.

Other events that triggered many small landslides in the area were the heavy monsoon of 1954 and cloudburst of 1955. The slides were more pronounced on the north-facing slopes along the dip of the rock strata. These were in the Chhin, Sisneri, Ghatte, and Hwang valleys (Figure 14). At Taranche, a landslip from Terrace-4 to Terrace-1 swept away nine houses in which six persons perished (Figure 11A). The 1933 Tagaring landslide had caused some households to migrate to Taranche. The 1955 calamity at Taranche, in turn, initiated the outmigration from this village to Chitwan.

According to the 1958 airphoto, land affected by landslides covered 390.3 hectares or nearly 4% of the study area. Of this, Tagaring alone accounted for one-fifth. In 1958, the area had a proliferation of landslides as the legacy of the 1955 cloudburst. By 1996, the situation had changed significantly with only a few landslide exposures. The major one at Tagaring had become stabilised (Figure 13B). In the intervening 38 years, the landslide area declined from 390.3 to 0.4 hectares, a reduction of 90%. Thus, the proportion of slide affected land declined from 4.0% in 1958 to 0.4% in 1996 in the study area. The immense slide at Tagaring showed only three scars (Figure 15). There were some remnants left in Chhin and Sisneri Khola, whereas most others had become stabilised. Some new ones in Ghate Khola, Dhod Khola, and Thakan village, west of the Marsyangdi, were of very limited extent. Overall, the study area showed less land degradation in 1996 than in 1958. This aspect is confirmed by the visual evidence recorded for the period 1962-2002 (Chapter 4).

A. March 1962

B. October2002

Figure 12: Tagaring landslide from the south-east: Tagaring landslide was precipitated by the great earthquake of 15 January 1934 (Figure 12A). The slide actually commenced in the oak forest (2,400m). Its debris blocked Marsyangdi River for some days and submerged a flourishing salt-brine at Nunkhani. Four decades later (Figure 12B), the main landslide has stabilised but smaller ones appear across paddy terraces on the left. Figure 14 provides the frontal view of the slide area.

A. October 1962

B. March 2002

Figure 13: Tagaring landslide from the east: Frontal view of the landslide from Sanjaba (1,800 m). The head of the slide in the oak forest and Tagaring village (T) hemmed in by slide scars (Figure 13A). Forty years later, the main landslide has stabilised with vegetation on the north-facing slope and fields on the opposite side (Figure 13B). Old clumps of trees around Tagaring (1,456m) are no more conspicuous and the lower slide is now covered with vegetation. The paddy terraces on the bottom left belong to Sanjaba, a Gurung village opposite Tagaring.

Figure 14: Landslides, Marsyangdi - Ngadi, 1958

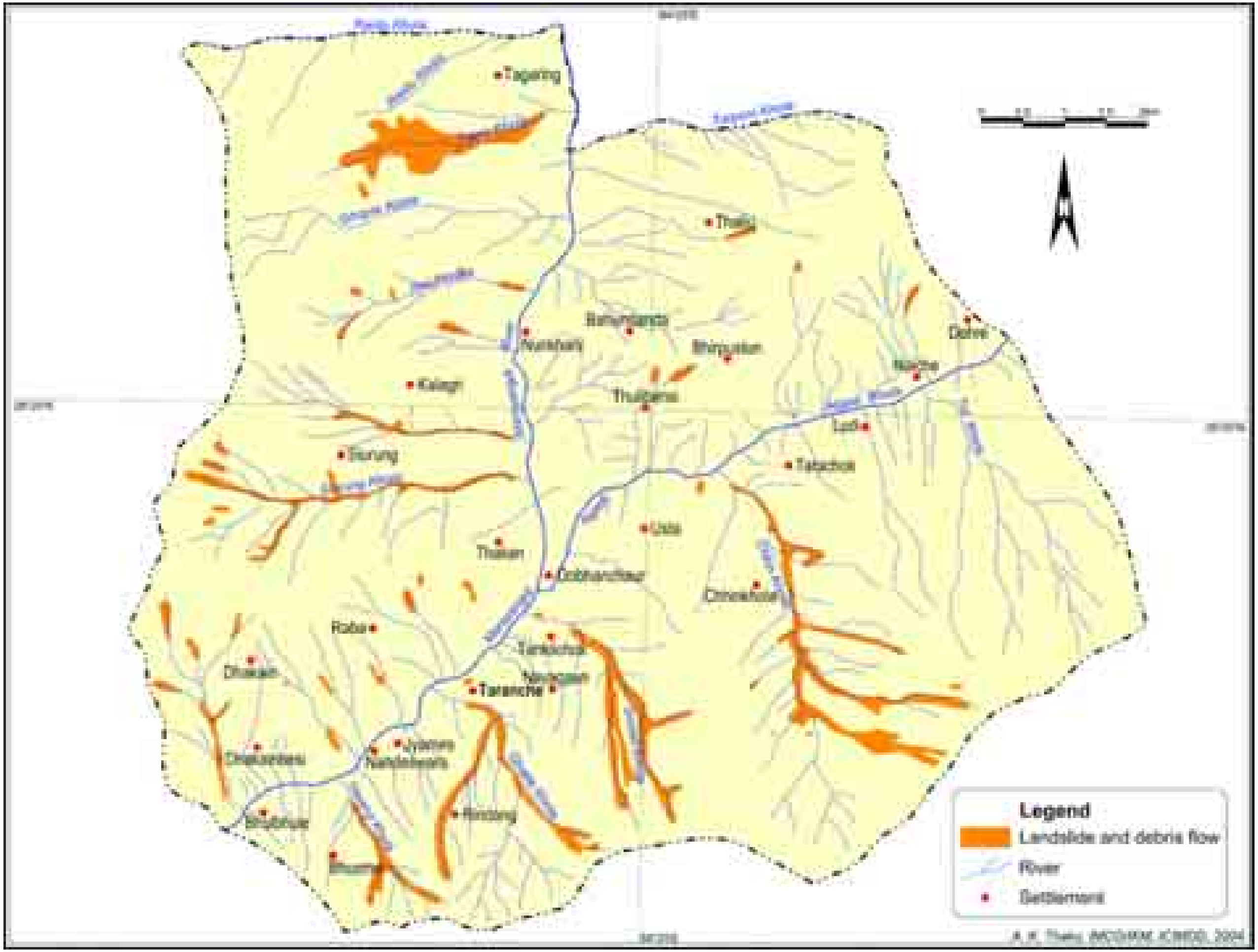
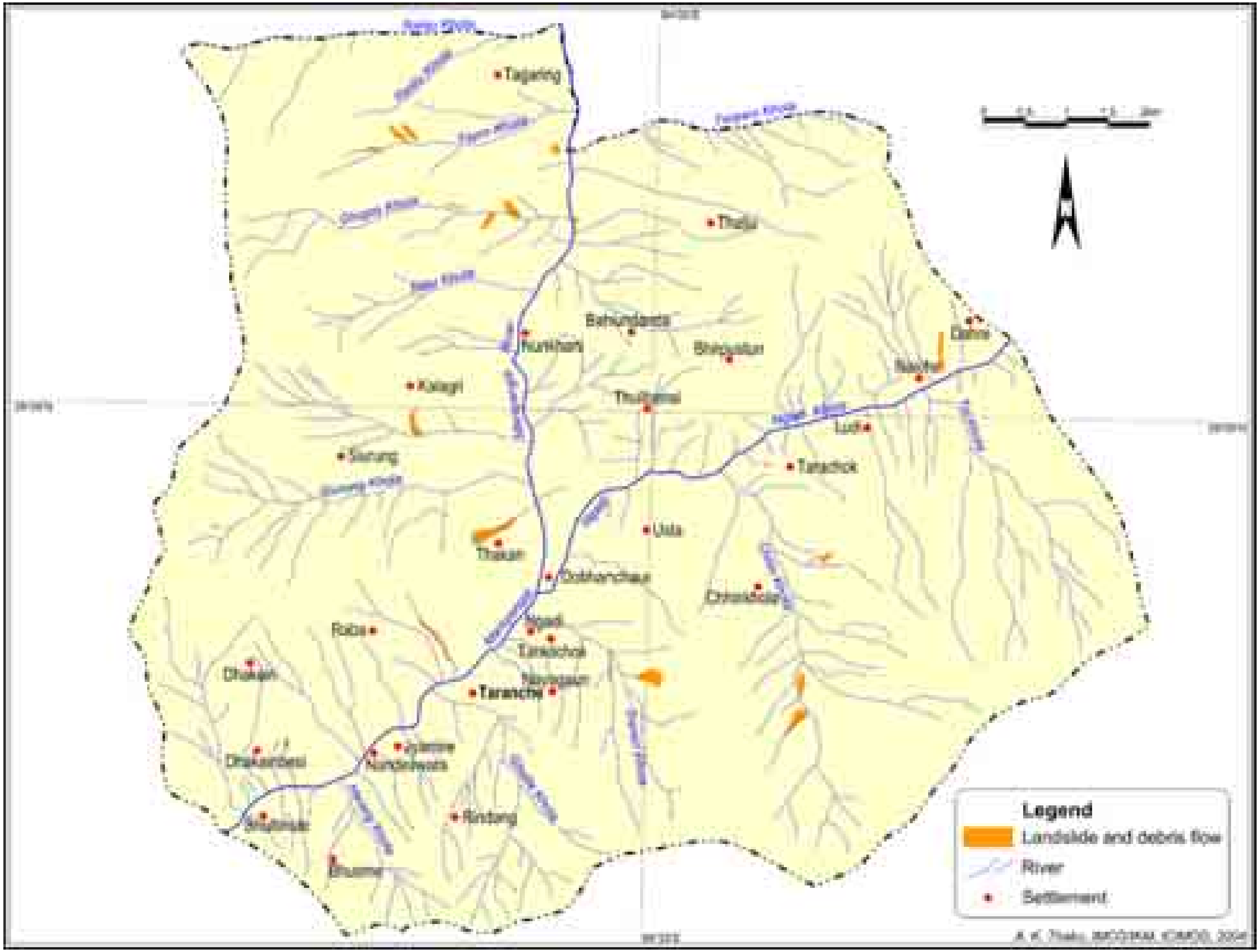


Figure 15: Landslides, Marsyangdi - Ngadi, 1996



Chapter 3
LAND USE

This chapter commences with a description of the climate and vegetation in the study area. These environmental factors are followed by an assessment of land-use change over nearly four decades.

1. Climate and Vegetation

Climate: The climatic data are based on records of two observation stations within the study area. One was located at Nunkhani (1,030m), once a flourishing salt-brine on the left bank of the Marsyangdi (Rayamajhi et al. 1946). Another one is located at Khudi (859m), about 12 kilometres downstream from Nunkhani (Figure 2). The records of the former refer from 1943-46 in Nepalese months and the latter from 1965-98 in Gregorian months. These data have been used for local comparison despite their temporal disparity.

Although Nunkhani is 171 metres higher in elevation than Khudi it has a slightly higher annual average temperature (Table 3). This discrepancy is due to the locational factor. Khudi lies in an open valley while Nunkhani is in a deep gorge. Both places have high temperatures in July and low ones in January (Table 3 & Figure 16). The discrepancy between maximum and minimum temperature is 11.3 C° for Nunkhani and 12.1 C° for Khudi. Nunkhani has comparatively higher temperatures during the months from March to May. Temperature difference between the two places is most pronounced in December. Temperature variation is also highest at both stations during December.

The average annual rainfall varies from 2,534.9 mm at Nunkhani to 3,317.7 mm at Khudi (Table 4). Both places record their lowest rainfall during December (Table 4 & Figure 17). The maxima period occurs in July at Khudi and September at Nunkhani. The wettest period at Khudi occurs during June-August while it is from July-September at Nunkhani. The latter place recorded more rainfall during January, April, and September through November than at Khudi.

The study area has high temperatures during the summer. Winter is mild as snowfall occurs only on high ridges above 2,000 metres. Monsoon rain is also plentiful with a brief westerly shower in winter. Thus, the climate is suited to year-round crop cultivation. The only limitation is the occasional hailstorm during the Spring and Autumn.

Figure 16: Temperature at two locations

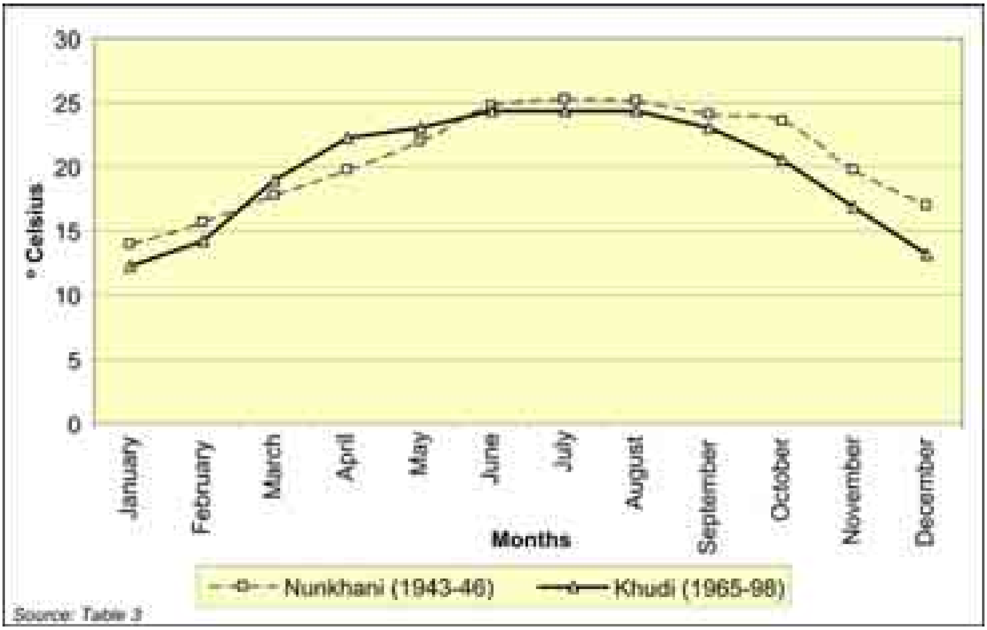


Table 3: Temperature at t wo locations

Nunkhani 1943 -46a		Khudi 1965 -98b	
Months	**Celsius**	**Months**	**Celsius**
1. Pus (mid-December/mid-January)	14.0	January	12.3
2. Magh (mid-January/mid-February)	15.6	February	14.2
3. Falgun (mid-February/mid-March)	17.7	March	18.9
4. Chaitra (mid-March/mid-April)	19.8	April	22.2
5. Baisakh (mid-April/mid-May)	22.0	May	23.0
6. Jetha (mid-May/mid-June)	24.7	June	24.3
7. Ashar (mid-June/mid-July)	25.3	July	24.3
8. Sharwan (mid-July/mid-August)	25.1	August	24.4
9. Bhado (mid-August/mid-September)	24.1	September	23.0
10. Asoj (mid-September/mid-October)	23.6	October	20.5
11. Kartik (mid-October/mid-November)	19.8	November	16.9
12. Mangsir (mid-November/mid-December)	17.0	December	13.1
Annual Average	**20.7**	**Annual Average**	**19.8**

Sources: a. Rayamajhi et al, 1946
b. Dept. of Hydrology & Meteorology of HMG Nepal

Figure 17: Rainfall at two locations

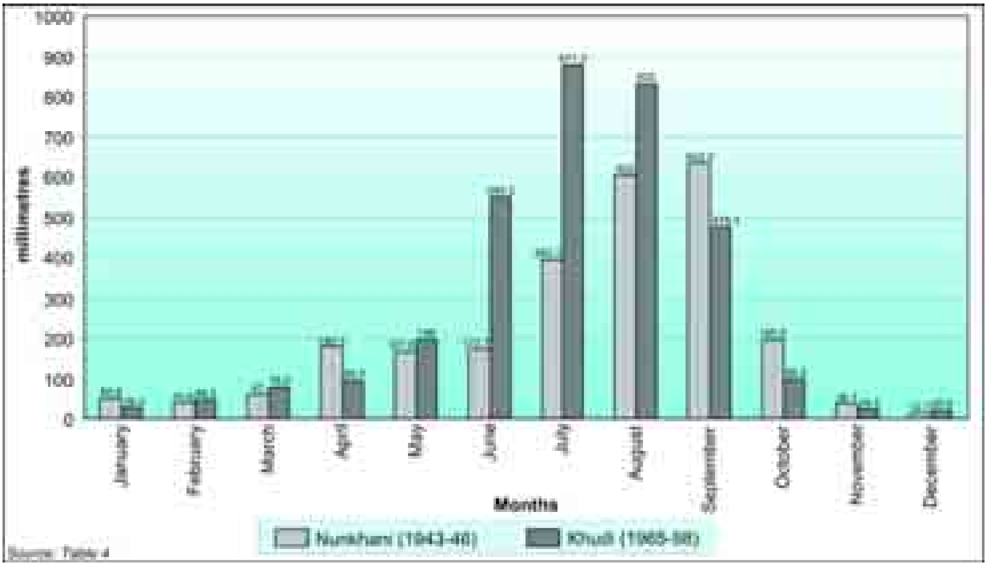


Table 4: Rainfall at t wo locations

Nunkhani 1943 -46a		Khudi 1965 -98b	
Months	**mm**	**Months**	**mm**
1. Pus (mid-December/mid-January)	50.8	January	26.4
2. Magh (mid-January/mid-February)	40.6	February	48.2
3. Falgun (mid-February/mid-March)	61.0	March	78.5
4. Chaitra (mid-March/mid-April)	180.3	April	95.5
5. Baisakh (mid-April/mid-May)	167.6	May	198.0
6. Jetha (mid-May/mid-June)	172.7	June	548.3
7. Ashar (mid-June/mid-July)	393.7	July	877.2
8. Sharwan (mid-July/mid-August)	602.0	August	832.0
9. Bhado (mid-August/mid-September)	632.5	September	475.4
10. Asoj (mid-September/mid-October)	195.6	October	99.3
11. Kartik (mid-October/mid-November)	38.1	November	24.9
12. Mangsir (mid-November/mid-December)	12.7	December	20.9
Annual Average	**2,534.9**	**Annual Average**	**3,331.7**

Sources: a. Rayamajhi et al, 1946
b. Dept. of Hydrology & Meteorology of HMG Nepal

Vegetation: The study area lies just above the tropical *Shorea robusta* (sal) forest zone. Thus, most of it is in the sub-tropical wet forest zone with *Schima wallichii* (chilaune) and *Castanopsis indica* (katus) as the indicator plants (Figure 18). This zone is superseded at about 1,900 metres in elevation by lower temperate forest of *Rhododendron arboreum* (gurans) and *Quercus lamellosa* (phalat). Since Zones 5 and 6 of the ecological map (Dobremez & Jest 1970) are virtually the same, the study area represents only two forest zones: tropical (7) and lower temperate (6). Forest zone boundaries in the ecological map shown are too much aligned to the contour line. In reality, floral composition differs much according to the aspect. Thus, south-facing slopes (pahara) have drier plant species while north-facing slopes (sinyala) have a richer variety of shade-loving plants.

Schima wallichii and *Castanopsis indica* are both East Himalayan species and extend into the humid parts of the central hills (Stainton 1972). Thus, *Schima-Castanopsis* forest is most conspicuous at 1,000-1,900 metres elevation in the study area. It is not, however, very extensive since the level corresponds with the zone of maximum cultivation. The lower section of this forest has *Bauhinia variegata* ('koiralo'), *Berberis* spp. *leontice* ('kaphal'), *Rhus acuminata* ('bhalayo'), *Acer oblungum* (pirpire), *Cretaegus crenulata* (ghangaru) and *Berberis nepalensis* ('chutra'). Higher up, the common associates are *Fraxinus floribunda* ('lankuri'), *Juglans regia* ('okhar'), *Michelia champaca* ('chanp'), and *Alnus nepalensis* ('utis'). *Pandanus furcatus* and other species of wet mixed forest are common in shaded gulleys.

Quercus lamellosa is an East Himalayan oak species and occurs abundantly in the lower temperate zone of the study area (Op cit. pp.89-91). It predominates at 1,900-2,500 metres. Since this elevation zone lies above the cultivation zone, such oak forest forms a continuous belt above the sub-tropical forest and below upper temperate forest. *Quercus lamellosa* forest has dense undergrowth of shrubs such as Hydrangea, Viburnum, ferns and of *Arundinaria* (nigalo) in shady places. The trees are festooned with epiphytes, orchids, and mosses.

2. Land-use Change (1958-1996)

The Land Resource Mapping Project (LRMP) defined land capability as the inherent capacity of land to be productive under, and sustain, specific management methods (Carson 1986). Its mapping exercise combines three criteria: class, sub-class, sub-division. The classes are based on the degree of slope, sub-classes on temperature regime, and sub-divisions as moisture regime. Accordingly, valley bottoms of the study area are classified as Class II Au or land with 1-5° slope, sub-tropical and sub-humid (Figure 19).[3] The lower hill slopes are placed in Class III, with 5-30° slope and sub-tropical (A) to warm temperate(B) sub-class. The higher slopes are in Class IV with over 30° slope and sub-tropical (A) to warm temperate (B) sub-class. The moisture regime is humid for warm temperate and sub-humid for sub-tropical sub-classes.

[3] Map sheet 71 D/7, scale 1:125:000, see Figure 19

Figure 18: Ecological map (after Dobremez 1970)

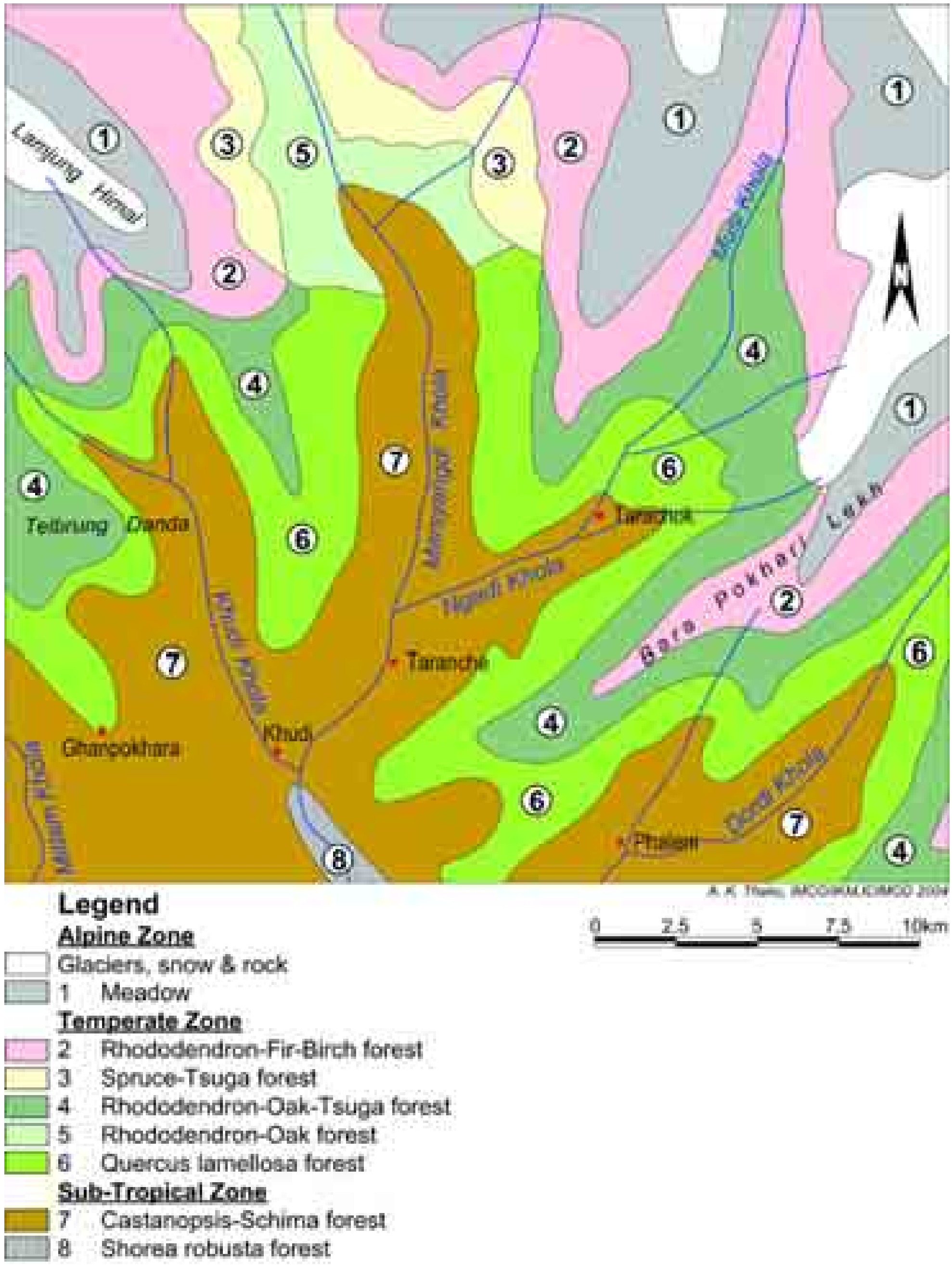
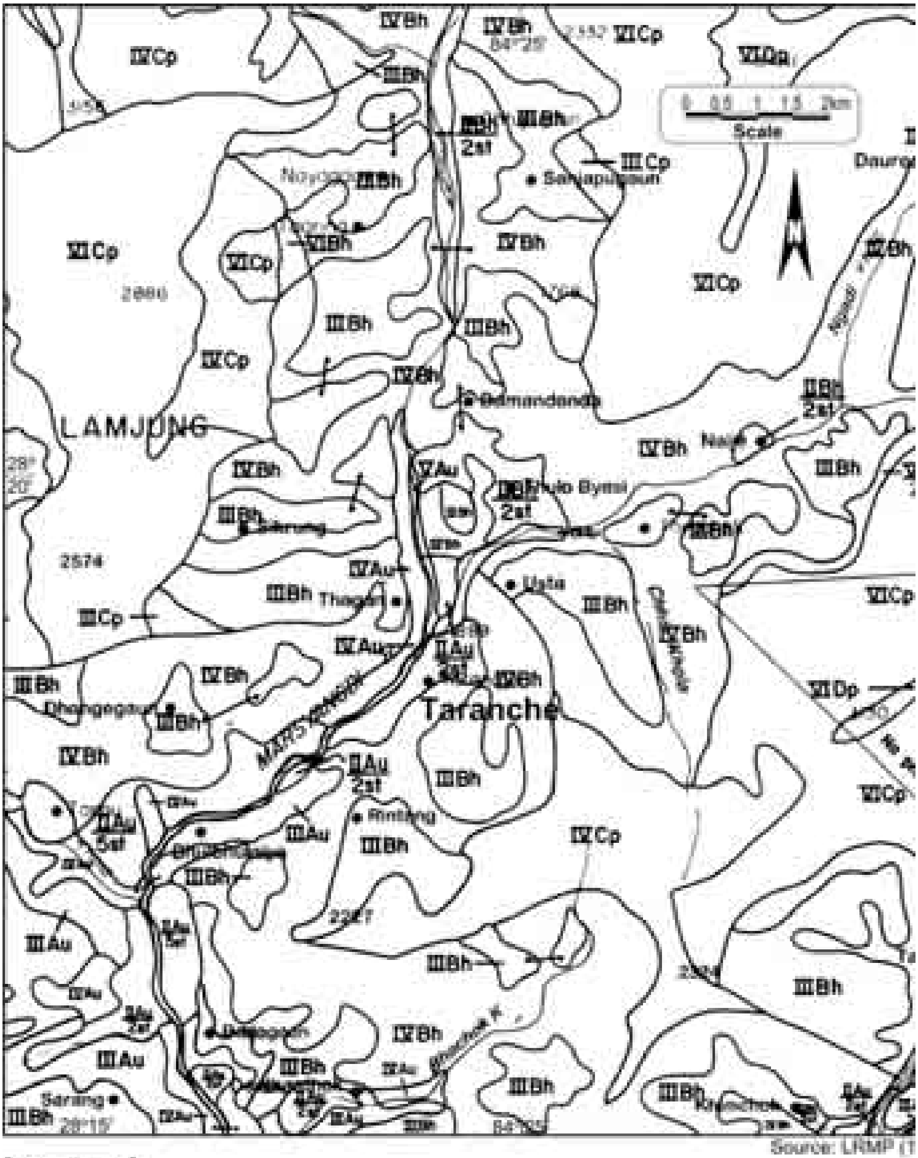


Figure 19: Land capability (after LRMP 1989B)



Legend

Class	Sub-class	Moisture regi
VI (Slopes 40° - 50°)	D Alpine (3000 - 4500m)	p (perhumid)
VI (Slopes 40° - 50°)	C Cool temperate (2000 - 3000m)	p (perhumid)
V (River Terrace)	A Sub-tropical (<1000m)	u (subhumid)
IV (Slopes >30°)	B Warm temperate (1000 - 2000m)	h (humid)
IV (Slopes >30°)	A Sub-tropical (<1000m)	u (subhumid)
III (Slopes 5 - 30°)	B Warm temperate (1000 - 2000m)	h (humid)

The Land Resource Mapping Project also prepared land-use maps with such major categories as (1) cultivation land, (2) grazing land, (3) forest land and (4) non-agricultural land. For the hills, cultivated lands were differentiated as level terraces, sloping land, and abandoned. Forest lands were differentiated by cover type (coniferous, hardwood, shrub, and other combinations). Grazing lands were differentiated into six ecological zones (sub-tropical, warm temperate, temperate, cool temperate, sub-alpine and alpine). The LRMP category of 'grazing lands' is problematic as such use of land transcends other categories: upland forest in summer and fallow cultivated land in winter. In fact, land categorised as 'grazing land' by LRMP includes grass and scrub land adjacent to the forest land. Therefore, it would have been more appropriate to designate this category as 'grass shrub' and not as 'grazing' land.

Land-use assessment for the present study is based on five major categories. These are: (1) cultivated land, (2) forest land, (3) shrub/grass, (4) rocky slope/landslide, and (5) river channel. Cultivated land includes farm land in active use as well as left fallow. The distinction between forest and shrub/grass land is based on the vegetation density rather than relative height of trees. Thus, areas with a combination of trees and dense undergrowth were classified as forest land. There may be some degree of error in delineation between forest and shrub land due to poor resolution of the 1958 airphotos. However, there was no such problem in distinguishing between cultivated and non-cultivated areas. Airphoto interpretation was the primary source of information for land-use interpretation and classification.

However, the difference in scale between the 1958 photos (1:40,000) and those of 1996 (1:25,000) posed a problem in comparison since the former were of smaller scale and of poor resolution (Figure 3A). The existing land use in 1958 and 1996 and their change during the 38-year time internal are presented at two spatial levels: (a) the Marsyangdi-Ngadi confluence area and (b) the Taranche focus area. The former covers an area of 9,887 hectares of land and the latter 320.5 hectares.

<u>Marsyangdi-Nagdi Confluence</u>: The scale and level of resolution of the two photographic sets influenced land-use interpretation and classification. The number of major categories was kept the same for the purpose of comparison. However, delineation of land-use categories is comparatively more precise for 1996 than 1958. In 1958, shrub and grass land constituated the most extensive category, covering 43% of the study area (Table 5). This type of land use was dominant on hill slopes whatever their elevation or aspect (Figure 20). Forest land came next with 30.8% coverage of the study area. Such land use was more pronounced on steeper slopes and very extensive on higher ridges above the cultivation zone. Cultivated land came third in areal extent with 22.8% coverage. This land-use type occupied the valley bottom with river terraces and hillsides with gentle to moderate slopes. Rocky slopes and landslides were in restricted areas with 2.1% coverage and river channels even less (1.3%).

The 1996 airphotos at a larger scale with superior resolution provide a better precision in land-use delineation. Thus, Figure 21 has much smaller areal units of use types compared to Figure 20. In 1996, forest land became the dominant land-use category

Figure 20: Land use, Marsyangdi - Ngadi, 1958

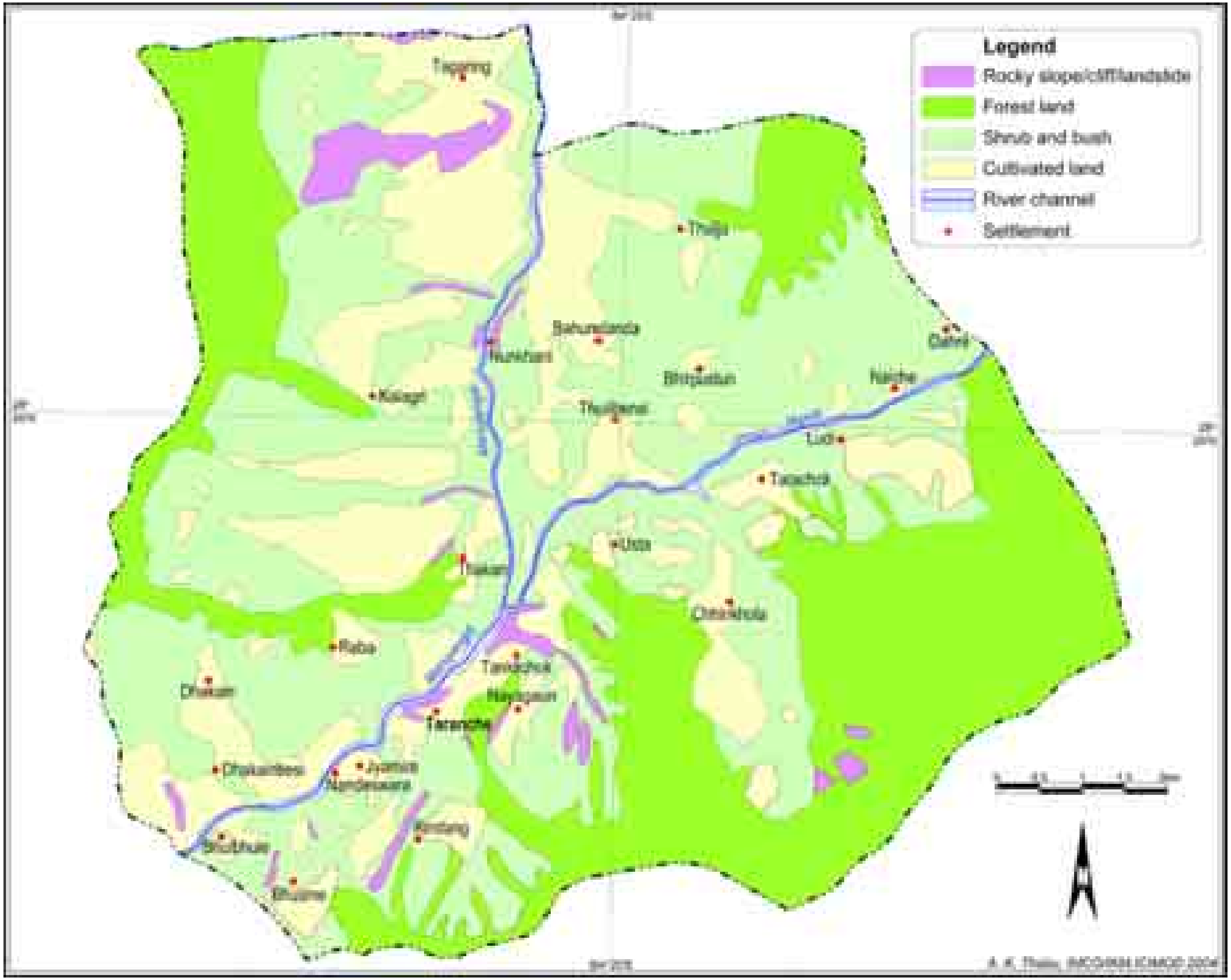
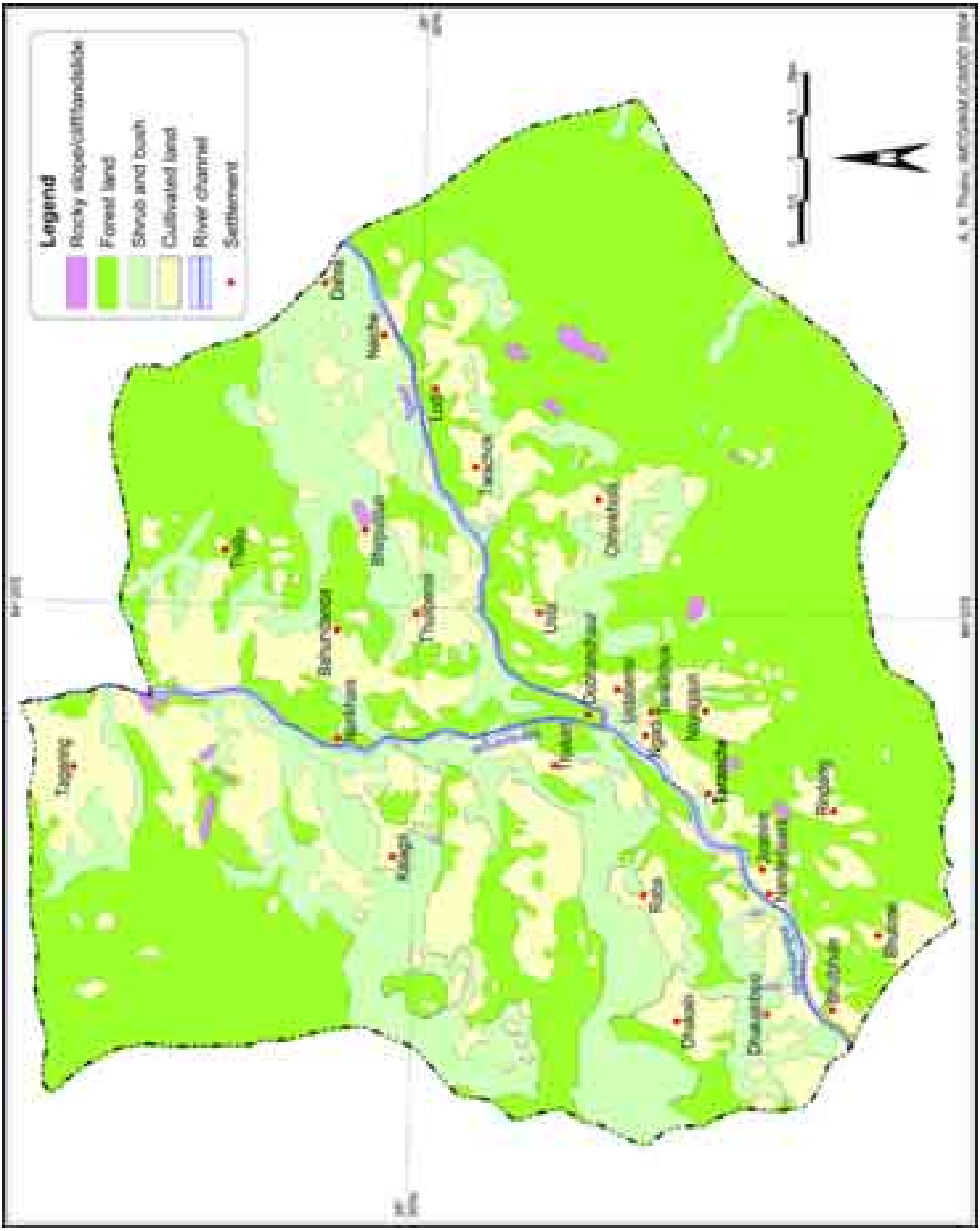


Figure 21: Land use, Marsyangdi - Ngadi, 1996



and covered half of the study area (Table 5). As in 1958, such land use occurs mostly on high ridges, particularly those facing north, and on slopes that were shrubland in 1958. Cultivated land occupies second place in areal extent, claiming about a quarter of the study area. This land-use category is prominent in valley bottoms and on gentler slopes, whatever their aspect. Shrub and grassland that predominated in 1958 declined by half and covered 21.9% of the total area in 1996. This land-use category was noted mostly in the buffer zone between the cultivated land and forest land. By 1996, rocky slope and landslide land surface had declined by 80% (Table 5). Land surface as river channel had increased by 18.7% since 1958.

Table 5: Land-use change, Marsyangdi -Nagadi confluence

Land Use	1958		1996		Change	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Shrub & Grass	4,254.4	43.0	2,164.9	21.9	+2,089.5	-49.1
Forest land	3,044.7	30.8	5,135.0	51.9	+2,090.3	+68.7
Cultivated land	2,258.3	22.8	2,399.2	24.3	+140.9	+6.2
Rocky slope & landslide	207.5	2.1	43.0	0.4	-164.5	-79.3
River channel	122.2	1.3	145.0	1.5	+22.8	+18.7
Total	**9,887.1**	**100.0**	**9,887.1**	**100.0**	-	-

Source: Airphotos 1958 & 1996

The most significant change in land use from 1958-1996 was in the increase of forest land against shrub and grass land. Thus, forest land increased by 68.7% while shrub/grass land decreased by half. Cultivated land did increase but only marginally. The decrease in shrub/grass land is due to less pressure from grazing. The increase in forest land is due to improvement of shrub/grass into forest land along with abandoning of some cultivated land Figure 22). Another important change has been in the reversal of degradational and aggradational land forms. In 1958, rocky slope/landslide surface was 1.7 times more extensive than river channels. By 1996, the latter exceeded the former type by 3.4 times (Table 5).

<u>Taranche Locality</u>: The Taranche locality between Sisneri Khola and Hwang Khola covers an area of 320.5 hectares east of Marsyangdi River. In 1958, the most extensive land-use type was cultivated land covering 44.4% of the locality (Table 6). These were mostly on the river terraces (Figure 23&24). Next to this type, shrub/grass accounted for 35.7% of the land use. Forest land was confined to steep slopes to the east with 10.9% of the area. Area covered by river channel was 5.4% and that by rocky slope/landslides 3.6% of the locality area. The latter type was mostly along the escarp faces of Taranche and Tanklichok river terraces.

By 1996, there was a dramatic increase in forest land that now covers 48.2% of the locality area (Table 6). This was mostly due to the drastic reduction in shrub and grass land from 114.5 to only 6.5 hectares. Moreover, cultivated land area decreased by 2.6%. There was also reduction in area of both river channels and rocky slope/ landslides. The Taranche landslide of 1955 had become stabilised as shrubland. Some

January 2002

Figure 22: Abandoned fields, Deurali: Deurali paddy fields lie an hour's walk from Tanklichok. The irrigation channel from Hwang Khola was dug across a rock face and the area yielded over 100 bushels of paddy. Its 32 ropanis of land has nine Gurung owners of which six have outmigrated. The fields have been abandoned since 1986 due to a shortage of labour. The field terraces are now overgrown with *Alnus nepalensis* and ferns.

of the fertile paddy land at Bimire has now been converted into the built-up area of Ngadi bazaar (Figures 25 & 26). Cultivated land above Hwang Khola at Deorali has been abandoned and colonised by *Alnus nepalensis* (Figure 22). Thus, coverage of non-cultivated land in the locality increased marginally from 55.6% in 1958 (Figure 23) to 56.8% in 1996 (Figure 24). Overall, natural landforms have become more stabilised and vegetation cover has improved. On the other hand, cultural landscape evinces much rapid change owing to improvement in transport access.

Table 6: Land-use change, Taranche

Land Use	1958		1996		Change	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Cultivated land	142.2	44.4	138.5	43.2	-3.7	-2.6
Shrub & Grass	114.5	35.7	6.5	2.0	-108.0	-94.3
Forest land	35.1	10.9	155.2	48.5	+120.1	+342.2
Rocky slope & landslide	11.4	3.6	4.3	1.3	-7.1	-62.3
River channel	17.3	5.4	16.0	5.0	-1.3	-7.5
Total	**320.5**	**100.0**	**320.5**	**100.0**	-	-

Source: Airphotos 1958 & 1996

Figure 23: Land use, Taranche, 1958

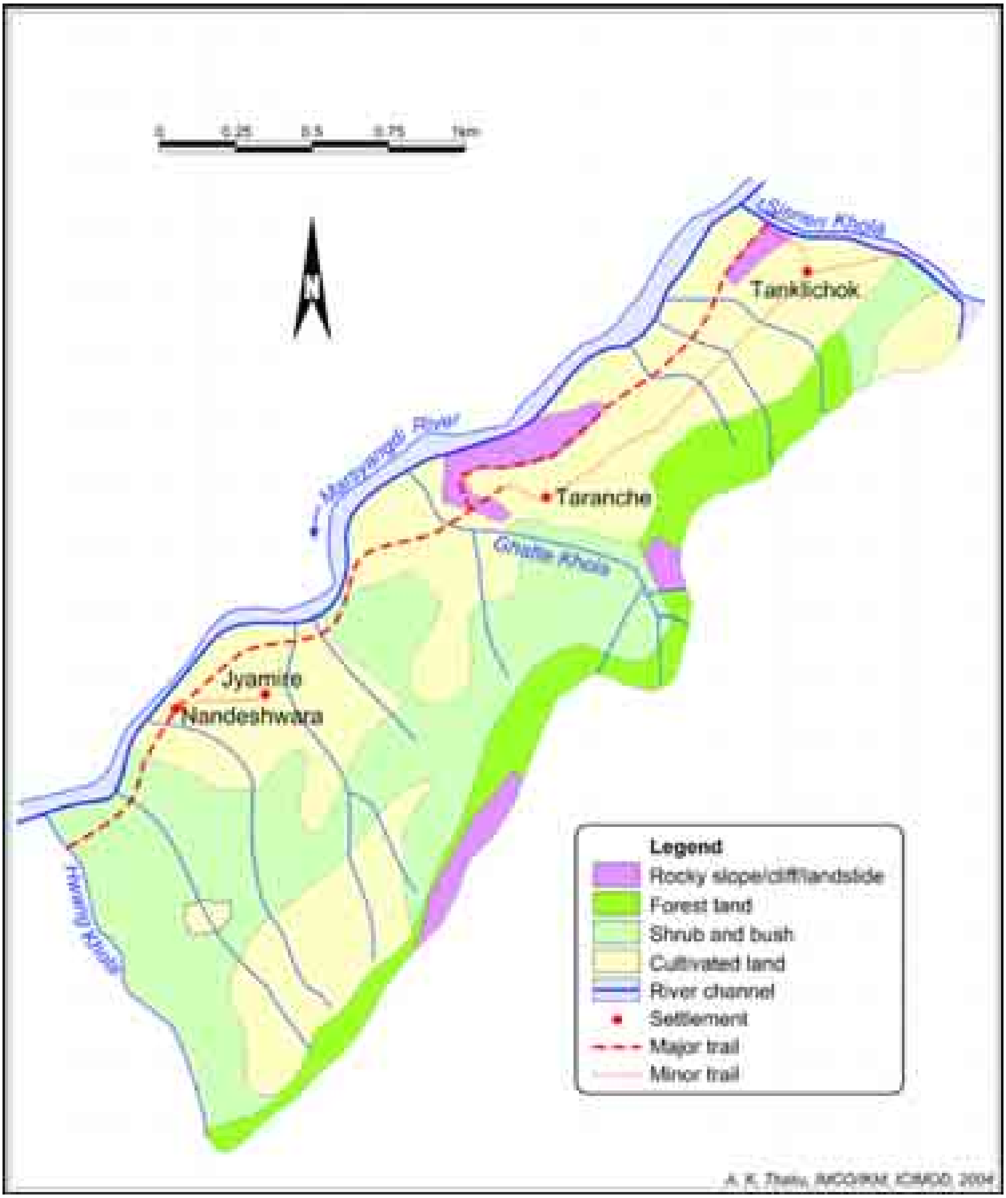
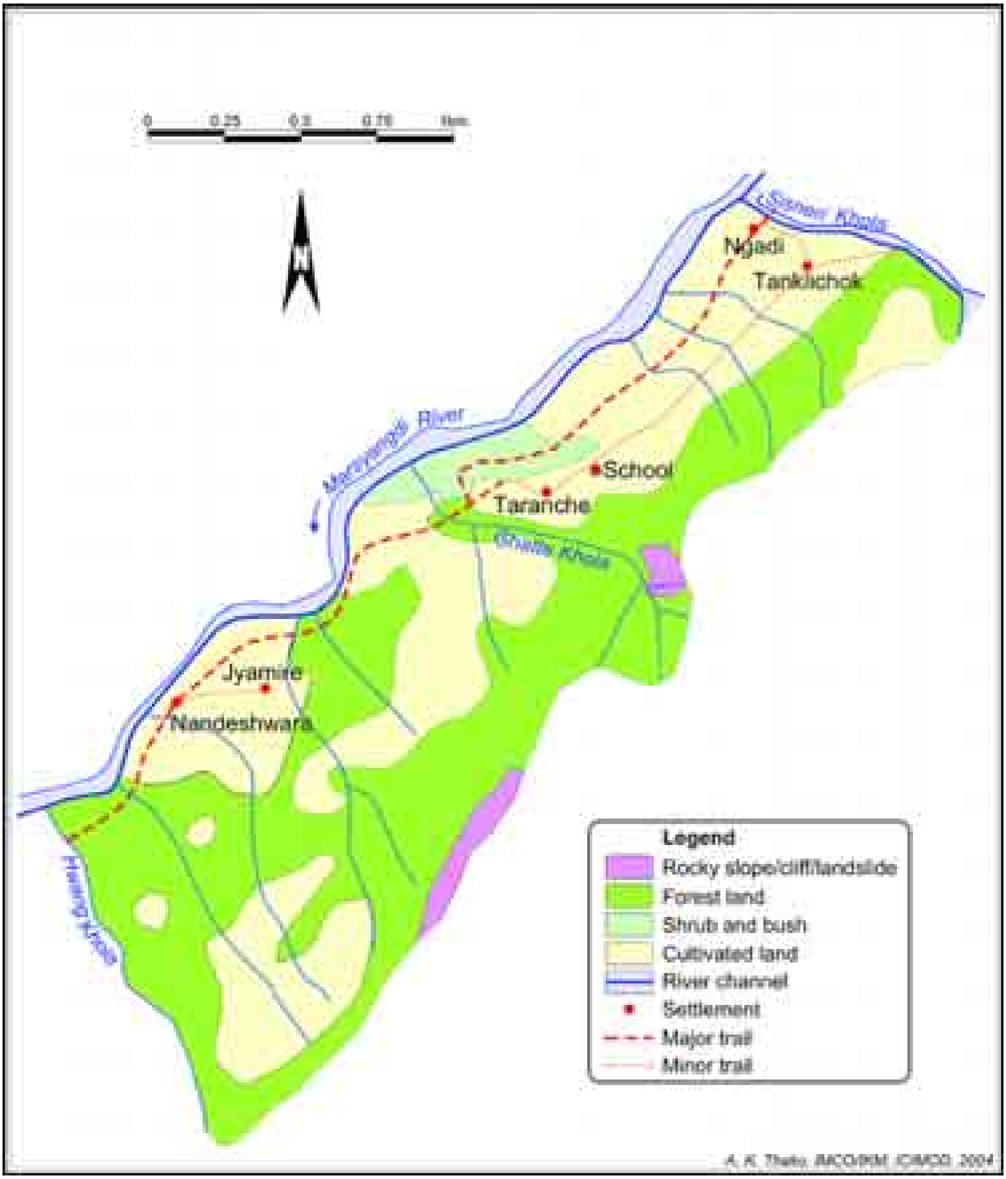


Figure 24: Land use, Taranche, 1996



A. November 1962

B. January 2002

Figure 25: Bimire from the south: Bimire fields on the fan deposit of Sisneri Khola. In 1962, the place had no houses although the Manangi used to winter in temporary sheds (Figure 25A). The first permanent settler in 1976 was a Manangi. Since the opening of Manang for trekking in 1978, the place has acquired numerous tourist lodges and shops (Figure 25B). A recent construction boom is apparent from the solid structures of Figure 25B (2002) that were thatch huts a year earlier (see page 45, this volume). It lies a quarter km. south of the Marsyangdi (M) and Ngadi Khola (N) confluence (884m).


January 2001

Figure 26: Ngadi Bazaar and Tanklichok: Ngadi Bazaar on either side of Sisneri Khola in a linear pattern along the trail to Manang. Tanklichok on the higher river terrace below Chiyabari (C), the site of the 1988 landslide. Sisneri Khola feeds two irrigation channels to the lower terrace fields. It also had a water mill, but this has been superseded by a 10-horsepower rice mill operated with electricity since August 2001.

Chapter 4
VISUAL EVIDENCE

Change has a temporal dimension and its parameters differ according to the elements that make up the landscape. Cultural forms change and even transform within a comparatively short time span. On the other hand, landform changes are slow as dictated by natural processes. Even in the case of the latter, the pace of change varies from place to place as noted below (Fort 1998-99).

> *"These changes, related to superficial geomorphology (i.e., landforms), are usually not perceptible at human scale because they involve processes which occur over a longer time scale than human life. Yet, in the Central Himalaya of Nepal, the natural erosion forces are so active that their impact can be assessed by comparing the same landscape observed at different times."*

Photographs of the same place taken at different time intervals provide a useful record for assessing the extent of change. Such repeat photographs with terrestrial perspective complement vertical airphoto images. The earlier photographs of the study area were taken by the researcher during 10-31 October and 18-28 November 1962. Four photographs, Figure 11A (1971/72), Figure 27A, Figure 28A (1988), and Figure 29 (1989), from the latter dates are included to highlight certain aspects. Also, Figure 30 from 1962, Figure 29 from 1989, and Figure 22 from 2001-2002 with no repeat photos have also been inserted for illustrative purposes. Twenty-nine repeat photographs were taken between December 2000 and March 2002 (see the group of supplementary photos following Chapter 6). Thus, the time interval for most photographs is 40 years (1962-2002). The view-points from where the photographs were taken are indicated on the topographic map (Figure 5). This researcher was intrigued with the poorer quality of later photographs. The earlier ones were taken with an ordinary Voiglander camera using Kodachrome slide film. The latter ones were with multi-lense Asahi Pentax and Nikon cameras using Kodachrome-II print film. Despite the sophisticated tools, the later three winter attempts failed to match the clarity of the earlier ones. This could be due to the timing (autumn skies after the monsoon are more clear) rather than environmental pollution.

A. November 1988

B. January 2002

Figure 27: Chiyabari landslide: This slope east of Tanklichok, known as Chiyabari because of the *Osyris arboreal* bushes used for tea, collapsed on 24 August 1988 and killed five persons. The photo (Figure 27A), taken three months later, shows the source of slope failure and boulder-strewn rubble. The place is now overgrown with secondary vegetation while the lower section has been reclaimed for paddy cultivation (Figure 27B).

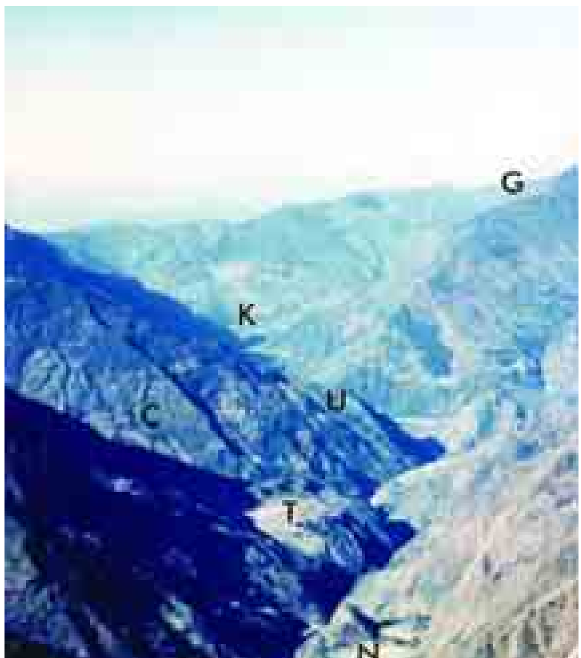
A. November 1988

B. March 2001

Figure 28: Bimire: The Chiyabari landslide flooded the paddy fields of Bimire with sand, pebble, stone, and boulders (Figure 28A). Fourteen years later, the damage is not apparent after reclamation (Figure 28B). Instead, the new encroachment on cultivated land is for construction of tourist lodges. These are at the southern end of Ngadi Bazaar (Figure 25B), a staging-point for mule caravans and trekkers to Manang since the late 1970s.

October 1989

Figure 29: Naiche from the air: The village (1,300m) sited on the ridge slope west of the confluence of the Ngadi and Tonjo Khola. The landslide (S) that started on the 1st September 1989 and recurred in July 2001 damaged some fields. There are shady slopes east of the Ngadi with dense forest cover. (see figures 45 and 46 for a terretial view of the village from the West).



October 1962

Figure 30: Ngadi Valley from the north: A panaromic view taken from Prepron (c. 2,400m). Naiche (N) and Tarachok (T) fields are on high river terraces while Usta (U) is on a ridge. Usta and Chimkhola (C) fields are on a north-facing dip slope. Naiche is inhabited by Gurung, Tarachok by Chhetri, Usta by Ghale, and Chimkhola by Tamang. Ghanapokhara (G) at 2,192 m has now been abandoned with its inhabitants settled in the Khudi (K) area.

Chapter 5
DISCUSSION

The introductory section made the case for considering the totality of the landscape encompassing both natural and cultural features. There is, however, immense difference in the pace of change between these two. Mass wasting of elevated land surface and valley deposition or bank-cutting are geomorphic processes with a longer time scale. On the other hand, effects of human intervention on the landscape become noticeable with immediacy. There is yet another difference. Natural processes that shape landforms have a cyclical nature while cultural forms exhibit linear and progressive development. These are evident from a reconstruction of sample events in the study area spanning eight decades (Annex B).

Geomorphic processes are very forceful in such an area of high relief and become evident from periodic trigger events. The chronology of natural events stamped in local memory were of three types: landslide, bridge collapse, and flood damage. The landslides affecting settlements occurred in 1934 (Tagaring), 1955 (Naiche, Taranche), 1988 (Tanklichok), 1989 (Naiche), and 2001 (Naiche). Bridge damage by river under-cutting of their foundation occurred in 1964 (Bhulbhule) and 1975 (Khudi). The lowland fields of Taranche were destroyed by unusual floods of Ghatte and Sisneri streams in 1921 and 1978. Each time, the boulder-strewn lands were reclaimed as prime paddy fields. Similarly, part of the Bimire rice land was destroyed by the Chiyabari slide in 1988, but repaired soon after (Figure 28A).

A significant cultural process that impacted the landscape of the area was upgrading of transport infrastructure. It had three sequential stages: improved suspension bridges, introduction of mule transport, and extension of the vehicular road. In the past, Khudi and Bhulbhule were centres for winter trade of mountain products from Manang. The construction of a steel suspension bridge at Khudi in 1930 (Figure 31) established its central function with a Sanskrit school, Ayurvedic dispensary, and the brick rest-house (Annex B). In the 1950s, the place had a post office and health post added. Change in bridge site also had much influence on the location of commercial (bazaar) settlements. At Khudi and Bhulbhule, it led to the decline of old sites and development of new ones. Dobhanchaur emerged as a new settlement in 1987 and the of Ngadi bridge was shifted a kilometre downstream (Figure 32).

The second sequence in transport development was improvement of the track to Manang. In 1972, the Remote Area Development Board commenced upgrading the

A. October 1962

B. December 2001

Figure 31: Khudi Bazaar (859m): The suspension bridge with the 'Henderson of Aberdeen' trademark across Khudi Khola dates from 1930. The bazaar at the bridge-head had shops, a police post, post office, and Ayurvedic dispensary. There is a substantial house beside the field with three storeys and a slate roof (Figure31A). The suspension bridge was damaged in 1975 and replaced by a new one in 1978 half a kilometre upstream. Since then, the latter bridge-site has more new settlers and the old bazaar has declined. The substantial house has now a corrugated tin roof (Figure 31B). The Gurung owner migrated to Chitwan after selling it to a Tamang ex-serviceman.

A. October 1962

B. January 2002

Figure 32: Ngadi Khola: Above Dobhanchaur. The suspension bridge supported by the boulder on the right was built with Swiss assistance in 1954 (Figure 32A). On the left is the east declivity of Nemane river terrace. The old bridge was dismantled in 1988 when a new one was sited at Dobhanchaur (Figure 8A). There is no vegetation degradation on Nemane terrace slope (Figure 32B).

trail through the Marsyangdi gorge as a mule track. By the late 1970s, the route became operative for mule transport. This mode of transport not only affected porter work but also discouraged cultivation of winter crops along the main trail.

The third stage of transport development was extension of the road from Bensishahar. A jeepable road reached Khudi in 1993, Bhulbhule in 1996, and opposite Taranche in 1999. Although operative only during the winter dry season, transport costs for consumer and construction materials were drastically reduced. The latter also influenced change in the house type, e.g. cement structure and corrugated tin roof. A malaria control programme initiated in the late 1960s and transport improvement thereafter encouraged new settlements in the lowlands. Ngadi-bazaar and Ustabensi had their first permanent settlement in 1976 while a chain of tea-houses and shops has sprung up along the road and mule track.

The earlier air photographs and later terrestrial photographs used for landscape appreciation span a period of 44 years. Based on the interpretation of this visual evidence and field observation, some conclusions regarding landscape change can be drawn. Such observations are related to aspects of geomorphology, land use, and transport infrastructure. Most landslides have become stabilised, including the major one at Tagaring. Some new ones of a minor scale are noted given the steep slopes in the area. All landslide sites around Taranche are now overgrown with vegetation. The most significant land-use change has been in the increase of forest land through overgrowth of shrub vegetation. Cultivated land increased only marginally while some away from settlements was found abandoned. Thus, the study area appears much greener now than in the past. Transport structures had varying impact on the landscape. Bridge siting has led to emergence of settlements at new locations. Mules have displaced human porters for long distance transport. Road construction opened gashes on hillsides through excavation and affected some forest and cultivated land. However, vehicular traffic has facilitated cheaper transport of goods such as foodgrains and kerosene. Food import has led to a decrease in dependence on local products, while cheap kerosene has provided an alternative to fuelwood.

Land-use change in the study area over the last four decades shows marginal increase in cropland while forest land gained significantly. This scenario is contrary to the prevailing notion of widespread deforestation in the Nepal hills. Therefore, it seems pertinent to enquire into the factors that induce such change in the landscape. Most discussions on land degradation attribute increasing population pressure on limited resources, e.g. forest depletion through cropland expansion (Macfarlane 1976). Population pressure is certainly an important factor in shaping the landscape. However, population growth at local or regional level has its own dynamics, being low or high, that determine the pace of temporal change in the landscape. Therefore, the valid question posed with regard to the erosion problem in the Nepal hills - crisis of environment or crisis of explanation (Blaikie & Brookfield 1987). This diagnostic question has been raised also on the wider perspective of the Himalaya (Ives and Messerli 1989).

The problem can be better understood only with more rigorous field investigations based on a temporal perspective. One might refer to some local studies that provide insights into landscape change. A ground truth verification of terrestrial photos with an interval of 24 years (1962-1984) of Khumbu area revealed that overall forest cover was not significantly altered nor were there any significant changes in geomorphic nature (Byers 1987a). A follow-up study indicated little change regarding forest removal and subsequent geomorphological damage that had occurred since the 1950s and contemporary surficial activity within most lower altitude shrub/grassland and forest areas were low.

> *"Findings emphasize a landscape and surficial stability that directly counters the alarming statements of scientists, developers, tourists and management authorities"* (Byers 1987b).

Gorkha (neighbourhood of Potharithok) south of Lamjung, has a long history of human settlement. The place has environmental problems associated with overuse of natural resources. These are accentuated by inequality in land access due to social discrimination and the response of the small farmers has been to practice an extremely intensive form of land use (Muller-Boker 1992). There is acute shortage of farm labour despite increasing population. Yet, the traditional farming system that is suited to the environment continues and is optimally adapted to the natural resources and their potential (Pohle 1992).

Gulmi and Arghakhanchi districts lie in the sub-tropical hill zone far west of Lamjung. It has been demonstrated that deforestation in this area is not a recent phenomenon as a consequence of demographic growth. It had been going on for a long time and the situation seems to have reversed over the last three decades with increasing tree plantation in the fields. For a long time, peasants have cleared the trees, but have found new solutions to using land. Until now there has been a constant adjustment between collection and the replacement of resources. Hence, it is not environmental destruction but evolution which is a more appropriate concept; and there is nothing which proves that this evolution is catastrophic (Smadja 2000).

The case of Palpa is based on photo comparison such as the one done in the present study. The time lapse between the photo series is 65 to 75 years. The early photographs pre-date by over half a century the spectre of 'losing ground' (Ekholm 1976) or the film documentary 'The Fragile Mountain'. In fact, there was no change in the overall structure of the Palpa landscape. The then forest was already residual and not very dense and there were abandoned fields as well. Since then, there has been no massive deforestation but rather a 'nibbling' on the fringe: some sloping fields have returned to heath land, grazing grounds have not been converted into cultivated fields, and erosion damage has been minor.

> *"Taking into account population density and environmental constraints, the apparent stability of mountain sides rather than their degradation is surprising"* (Smadja 1998-99).

The report observes that there have been no major upheavals in the landscape of south Tansen since the beginning of the century.

Chapter 6
EXPLANATION

Perspectives on settlement history and demographic trend are useful to arrive at a better understanding of the processes of landscape change. The Central Nepal hills has been a land of contest between the indigenous tribals and Hindu (Khasa) migrants from the west since the 15th century onwards. The former practised hunting, pastoralism, and swidden farming while the latter came with field terracing and irrigation technology. Palpa, Gulmi, and Arghakhanchi, inhabited by the Magar, faced the frontal wave of this Hindu onslaught and were subdued by the early 15th century. Then followed a Hindu intrusion into the Gurung country of Kaski and Lamjung. The Ghale ruler of Lamjung was defeated by a Hindu (Thakuri) prince, Yasobrahm Shahi, in 1548 A.D. Thus, the valley bottoms of the Marsyangdi suitable for paddy were settled by the caste people. Kusumakar Ghimire, a Bahun who guided the first Thakuri ruler of Lamjung on the Muktinath pilgrimage was given a grant of paddy land from Simalchaur to Ghermu in Marsyangdi Valley (Thapa 1984). The displaced Gurungs of Ghermu were allowed to resettle there after offering an annual tribute of nine 'doko' (load basket) and nine bundles of brine-salt (op. cit. p.357).

In 1782, Lamjung was defeated by Gorkha, a collateral of the former established in 1559. Bhakti Thapa (1741-1815) was born in Lamjung at Dhakaibensi near Khudi (Figure 2). He was a Sardar (commander) in the western front during the Anglo-Nepal War (1814-16) and killed during the attack on Deothal fort (RNAH 1992). Of the various land grants he received in Lamjung in 1795, Lampata (100 muri khet) and Bimire (40 muri khet) were within the present study area (op. cit. p.159-160). Given the traditional pattern of land occupancy, the indigenous Gurung were confined to higher elevations while the sub-tropical valleys were occupied by migrant caste people. However, there were incidents of conflict between Bhakti Thapa's Chhetri descendents with the Ghale of Usta and Gurung of Tagaring in which the Chhetri prevailed.

Thus, the study area has long been settled by pastoral Gurung and agriculturist caste people. By the 19th century, an increasing number of Gurung also began to settle in the lowland valleys (Macfarlane 1976). This represented their economic transition from dry crop farming to irrigated paddy (Messerschmidt 1976). Since then exclusive use of eco-zones by ethnic/caste groups, Ghale and Gurung in the temperate highlands and caste people in the sub-tropical valleys, became diffused. Though the Ghale retained their customary rights on alpine pastures, livestock of lowlanders had access to these on payment of user charges based on how many head of cattle were grazed. This pasture monopoly known as 'kharchari rakam' (pasture tax) was abolished only in 1973 by the Kharga Land Act.

The most important impact on the Nepalese landscape, particularly in the hills, was the policy of the government to encourage cropland extension to increase land revenue. This is very evident from the following statement (Collier 1928).

> *"The present policy of the Government is:*
>
> *i) to replace forest by cultivation wherever conditions for cultivation and human habitation are favourable;*
>
> *ii) to prohibit the removal of forests where the climate is too unhealthy, and where crops can only be grown with the risk of loss of life or vigour of the cultivator;*
>
> *iii) to insist on large extensive clearings, so that the depredations of wild animals are reduced and the climate improved; and*
>
> *iv) to realise in full the value of the forests cut and replaced by crops*."

The rationale put forward for this was that the history of mankind in Nepal had been in many places a story of struggle against forests and their wild denizens. It was claimed that such a

> *"policy must be pursued for many years before there need be the slightest grounds for fearing that sufficient forest will not remain."*

Thus, forest clearing for crop cultivation was encouraged with only a nominal revenue on 'pakho' (unirrigated) land. Much has been made about the negative effect of forest nationalisation in the late 1950s, that loss of community control led to massive encroachment. In fact, forest depletion had been a long established process in the hills whether nationalised or not. It was later the concern for conservation that forest land was brought under state control. Thus, the Forest Act 1960 had provisions for prohibition of tree-felling, cultivation, harvesting, grazing, and removal of products from the government forest. Such restrictions could not have been policed in most hill areas against the increasing pressure. Thus, expansion of forest land in recent decades is not due to government control, environmental concern, and even community forestry but rather due to decreasing population pressure in hill areas. The dynamics of this are related to the relative size of population available for the exploitation of such a natural resource.

It seems relevant to consider land ownership change in a sample area before dealing with the demographic trend. This local sample is based on the land records of Taranche village spanning 54 years — 1933 to 1986 (Gurung forthcoming). The number of sites of registered land decreased for 'pakho' (unirrigated) and increased for 'khet' (irrigated) land indicating intensification in land use (Annex C). The number of land owners more than doubled due to household increase as well as more sharing of ownership within the same household for property assurance and to evade land ceilings. 'Pakho' land-owners increased only by 23.2% while for ‘khet’, the increase was 91.7%. The area of ‘khet’ expanded by 160% through both irrigation extension as well as an improvement in cadastral survey. The sample locality now has more ethnic diversity due to in-migration. Ethnic groups owned 5.3 time more ‘khet’ in 1986 than in 1933, indicating their income advantage from army service and remittance compared to the caste groups who are mostly engaged in farming.

The population dynamics of the study area can be better appreciated in the context of the central hill region in which Lamjung is located. This region has been the traditional source for Gurkha recruitment since the 19th century and available census records show a high proportion of absentees abroad. Out of the total absentees from Nepal, the share of the region was 48.5% in 1952/54, 45.8% in 1961, and 50.3% in 1981 (Gurung 1989b). Absentees abroad from this region more than doubled from 95,992 in 1954 to 220,598 in 1981. Again, according to a population pressure index (PPI) exercise based on 1971 statistics, Lamjung was one of the overpopulated districts in

Table 7: Outmigration from central hill

Census	Outmigrants	Percent of total from Nepal	Net migration
1961	38,632	21.5	-32,632
1971	140,642	27.7	-110,890
1981	150,104	14.4	-87,532
1991	306,821	21.6	-276,369

Source: Gurung 1989b, pp. 41-42 and Gurung 2001, pp. 18-20

Nepal (Shrestha 1982). The central hill area, which includes Lamjung, had the second highest PPI value next only to the region around Kathmandu (Gurung 1989b). Thus, the central hill region has been a major source of outmigrants (Table 7).

The consequence of outmigration is well reflected in the low population growth trend of Lamjung district. During the period from 1961-91, Nepal’s population doubled from 9.4 million to 18.5 million. For the same three decades, Lamjung’s population increased only by 35.3% (Annex D-a). In 1961, Lamjung had a higher population density, 77/km^2, than the national average of 64/km^2. By 1991, the situation had been reversed. Persons added per km^2 during 1961-91 was 62 for Nepal compared to only 13 for Lamjung. This was not due to the difference in fertility and mortality rates but to migration. Outmigration has been the dominant trend in Lamjung. Both in 1961 and 1991, the extent of outmigrants was twice as high for Lamjung than the national level (Annex D-a).

The earliest population data available for Lamjung are for 1941, but pre-1952/54 census data are considered unreliable. Subsequent censuses indicate a very low population growth rate for the district. Its population actually declined by 2% during 1954-61 (Annex D-b). This may be attributed to considerable outmigration after the heavy monsoon damage in Lamjung during 1954-55 and the opening of Rapti Dun for resettlement in 1954. Population increase during the following two decades of 1961-71 and 1971-81 was between 7 to 9% compared to 23 to 30% for the country. In the last decade (1991-2001), the population increase was 25% for Nepal and only 15.3% for Lamjung.

Such a depressed growth trend can be attributed to sizeable outmigration. This is also evident from the instance of Taranche village at the local level based on anecdotal data. According to 1933 land records, there were hardly any land owners outside the village. The 1986 land records showed 12 out of 167 or 7.2% living outside the area. A survey of 90 Taranche households in 2002 indicated that 61 out of 519 persons or 11.8% were absent outside the village. Outmigration not only implies a lower level of population increase but also availability of less manpower. Another factor that has reduced the work force is the diversion of younger population into the school system. According to the 2001 census, Bhulbhule VDC (Village Development Committee) (including Taranche) had a total population of 3,286 (CBS 2001). Of these, 1,458 or 44.4% were of school going age (over 6 yrs.). Those attending school were 865 or 26.3% of the VDC population. Similarly, of the 519 total population of Taranche surveyed in 2002, 137 children, or 26.4 of the total, were attending school (Gurung, forthcoming). This represents a considerable withdrawal of population from the labour force and has an implication on manpower available for natural resource extraction.

The scenario of an enhanced state of natural vegetation in the study area may be explained in the following manner. Local population has certainly increased during the period (1958-2002) corresponding to the duration considered for landscape change. However, the given population increase needs to be qualified with two considerations. First, the rate of population growth itself has been very low. Second, a sizeable proportion of the population was excluded from manpower available due to both outmigration and withdrawal into schools. The net effect was a shortage of labour to attend to farm activities. Farm productivity is basically maintained by recycling plant nutrients through livestock grazing to yield field manure. Animal herding and collection of leaves for mulch demand considerable labour. Labour shortage has led to a drastic decline in Iivestock transhumance in the study area with the chain effect of decline in manure availability, decreasing crop productivity, and abandonment of fields distant from the village. Such abandoned fields are being colonised by the natural vegetation from which they were originally wrested. Shortage of labour in turn has meant a lower level of extraction and less imposition on natural resources with the consequence of enhanced vegetation regeneration. Meanwhile, extension of modern transport has facilitated import of a variety of goods that replace local products. There is also the time lapse between the fast intrusion of large-scale manufactured goods and slow development of indigenous potentials. Therefore, the changing landscape in the central hills is the outcome of the interplay between natural and cultural processes in which the former remain dominant even if the latter seem more apparent.

The following supplementary photos by the author are, given on the following pages, not cited in the text.

A. October 1962

B. March 2002

Figure 33: Marsyangdi-Khudi confluence from the east: Khudi Bazaar (B) on the left bank of the Khudi Khola (K). Above, on the right side of the Marsyangdi River (M), is an enclosure with a mango grove. Tankeswar Mahadev shrine and a brick-and-tile rest-house (R) were established there in 1932 by Subba Narjang Gurung who had a monopoly on the salt trade (Figure 33A). On the second terrace opposite the bazaar, a Sanskrit school (S) was established in 1930. A gravel road from Bensishahar reached opposite Khudi in 1993 (Figure 33B). The mango grove site has a high school (H) established in December 1967. The old trail above it is now superseded by a new road. Roadside tea-shops appear on the second river terrace while sal forest remain undisturbed.

A. October 1962

B. February 2000

Figure 34: Marsyangdi-Khudi confluence from the south: The mango grove and the old rest-house beside the Marsyangdi (Figure 34A). The rest-house is now dominated by a high school building (Figure 34B). The dirt road across the shrubby slope was constructed in 1999 and terminates opposite Ngadi Bazaar. Tea houses appear on the earlier rice-fields in the foreground. The 42-kw Upper Marsyangdi Project powerhouse will be located at Khudi.

A. October 1962

B. March 2002

Figure 35: Bhulbhule (820m): The place, named after a spring, had some shops and a bridge across the Marsyangdi (Figure 35A). The bridge collapsed in 1964 after the anchor boulder was dislodged by the river. The bazaar was shifted to a new bridge site (1968) upstream. [and the old place now has only VDC building (Figure 35B)]. The scarp slope behind is at the head of the waterfall (Figure 36).

A. November 1962

B. December 2002

Figure 36: Sinyale Chhahara: The 61-metre waterfall is above the main trail beyond Bhulbhule (Figure 36A). The source is Hwang Khola that marks the southern boundary of Taranche. No change in landscape after 40 years except in the water volume during November and December. It used to generate one kilowatt of electricity (1997) but was abandoned after the extension of the Marsyangdi power grid-line to the area in 1999. The hibiscus flower in the latter photo belongs to a nearby tea-house (Figure 36B).

A. November 1962

B. December 2002

Figure 37: Nandeswanra: Beyond the rice fields are Usta ridge on the right, Thulnagi (3,115 m) in the centre, and Ngadichuli and Himalchuli on the horizon (Figure 37A). In the latter photo, cumulus clouds block Ngadichuli. *Sapium insigne* (foreground) and *Artocarpus lakoocha* (middle distance) trees are prominent in both pictures. The only change is a cement-plaster house on the right (Figure 37B).

A. October 1962

B. January 2002

Figure 38: Opposite Sirubari: Gashes on the ancient alluvial deposits of the Marsyangdi are prominent. Above these is a horizontal band of rock intrusion (Figure 38A). Forty years later, the erosion faces have stabilised with vegetation (Figure 38B). The new road alignment parallels below the band of rock intrusion. The ficus tree amidst the terrace fields below the road has less foliage.

A. October 1962

B. March 2002

Figure 39: South view from Bimire: River terraces on both sides of the Marsyangdi affected by landslide. The one on the left is the toe of Taranche terrace (945m), also visible in Figure 39. Figure 39B shows the landslides to have stabilised and covered by vegetation. The high ridge to the left, Bhusme (1,700m), has a Tamang hamlet with potato as the main crop. The river is more entrenched, with a new flood plain on its left bank.

A. October 1962

B. January 2002

Figure 40: Tanklichok from the east: Houses of three Gurung families displaced from Taranche (Figure 11 on page 19) by the landslide in 1955. Seven years later, thatched houses stand in high relief above millet fields. On the slope beyond are the paddy terraces of Thakan village (Figure 40A). The houses now have tin and slate roof and are shrouded by planted trees (Figure 40B). The paddy fields on the slope are abandoned and the scarp slope to the left has vegetation cover. Across it traverses a motorable road from Khudi.

A. October 1962

B. January 2002

Figure 41: North view from Tanklichok: Landslide scar on the south face of Ustabensi terrace. On the edge are *Artocarpus lakoocha* trees planted for leaf fodder (Figure 41A). The ranges with snow, left (3,256m) and right (4,721m), are in Manang district. Figure 41B shows the old scar covered by grass. Most of the fodder trees remain intact. Planted bamboo in the foreground . There is much less snow on the ranges even in January.

A. October 1962

B. January 2002

Figure 42: Thulibensi from Usta: Thulibensi in the foreground and Bahundanda (1370m) on the middle distance ridge. The latter place is the northernmost settlement of the Bahun in Marsyangdi Valley. Also visible are landslide scars beyond Bahundanda (Figure 42A). Four decades later, clumps of shade trees at Bahundanda are gone being replaced by tin-roofed shop houses (Figure 42B). Bahundanda was connected with the Marsyangdi Project electricity grid in 2000 and then extended to Thulibensi in 2001. The landslide scars in the far distance are less apparent.

A. November 1962

B. January 2002

Figure 43: Ngadi Valley from the south: Himalchuli (7,893m) and the villages of Naiche (N) and Tarachok (T) from Usta (1,391 m). The middle distance ridge is Prepron (P) where herds of sheep and goats from Naiche are taken during summer (Figure 43A). Ngadi Khola flows from left of the ridge and is joined by Klinri Khola from the right. A landslide is (S)above Naiche on the left. Forty years later, that landslide has stabilised but a new one appears further down (Figure 43B). Himalchuli range is hidden behind clouds and there is no significant change in forest extent. Prepron was the site from which the photograph in Figure 30 was taken.

A. October 1962

Figure 44: Naiche from the south-east: Tarachok (T) in the foreground and Naiche (N) in the middle distance. Headwaters of Ngadi Khola below Ngadichuli (7,871m). A fresh landslide on the slope west of Naiche (Figure 44A). Figure 44B shows this landslide path overgrown with vegetation and a new one commencing from the woodland above the village. It dates from the 1st of September 1989. Its damage is apparent in Figure 29 (see page 46).

B. January 2002

A. November 1962

B. March 2001

Figure 45: Usta from the north: Ghale village of Usta (1,391 m) perched on a ridge with fields on the north-facing dip slope (Figure 45A). A dense forested slope, right of Usta (U), is across the Marsyangdi above Thakan (T). Field terraces in the foreground belong to the Tamang of Chimkhola. The latter photo (Figure 45B) has poorer visibility due to the Spring haze. The forest patch on the left has new extensions of cropland. Note the north-dipping slope above Thakan (T).

A. October 1962

B. January 2002

Figure 46: Naiche from the west: The view from about 1,600m shows the compactness of the Gurung settlement (Figure 46A). Naiche village has seven clans dominated by the Kromje. All the houses have thatch roofs and the Salmalia tree (X) in the field centre has the village shrine (Figure 50 of this volume) The three Kami (K) houses of 1962 were relocated east of Ngadi Khola. Many houses now have corrugated sheet roofs (Figure 46B). The old Kami neighbourhood now has a primary school (S). A cemetery (C) is on the ridge to the right.

A. October 1962

B. January 2002

Figure 47: Naiche from the west: This close-up view shows the compact structure of the Gurung village. Houses are thatch-roofed and most are double-storeyed. The Kami (K) houses are segregated from the main village (Figure 47A). Four decades later, the village profile shows some change. The village had a fire in 1988 which damaged most houses. Now, of the 53 houses, 38 have tin roofs (Figure 47B). The large building structure replacing old Kami houses is the school (S), built with assistance from a Japanese mayor in 1999.

A. November 1962

B. January 2002

Figure 48: Naiche fields: man and woman in traditional Gurung dress winnowing rice (Figure 48A). Stacks of paddy straw in the middle distance and Ngadi defile in the background. The latter scene (Figure 48B) of the same place with animal sheds on the left and Ngadi Khola on the right. There is no particular change in the extent of forest cover.

A. October 1962

B. January 2002

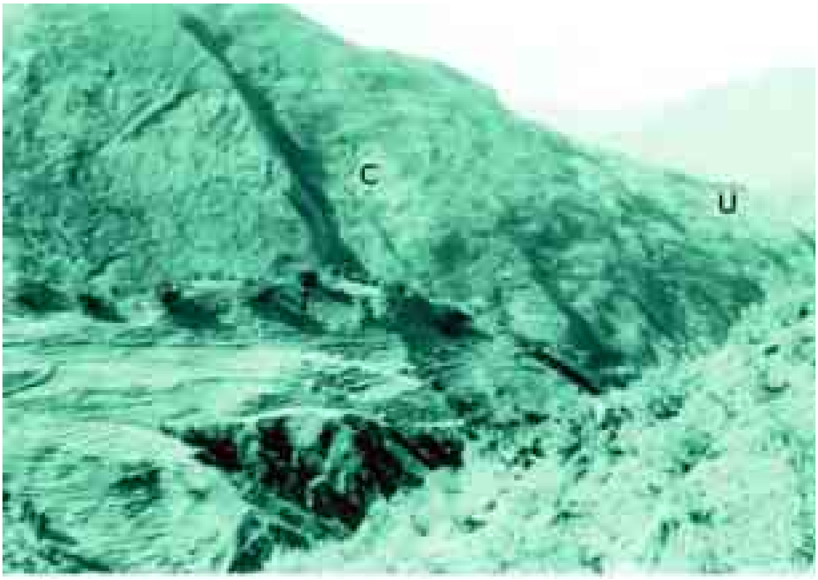
Figure 49: Naiche fields: ripening paddy and *Salmalia malabarica* tree with the village shrine (Figure 49A). Steep rocky slope and a seasonal stream in the background. The stream is a mere trickle in January. Four decades later, the shrine tree has thinner foliage (Figure 49B). The harvested fields have alpine style animal shelters so that livestock can be kept there to fertilise the fields on the spot during December and January.

A. November 1962

B. January 2002

Figure 50: Naiche shrine: The base of the *Salmalia malabarica* tree has a stone pedestal for the shrine. The two boys on it are in their traditional dress. The author is in front (Figure 50A). Four decades later, the children are in more cosmopolitan apparel and the author is 40 years older (Figure 50B). The paddy straw is kept on stilts as animals graze in the village during December-January

A. October 1962



B. March 2002

Figure 51: Tarachok from the north: South view from the trail between Naiche and Bhirpustun. Tarachok (T) in the middle distance and Chinkhola (C) and Usta (U) in the background (Figure 51A). There is little change in the Tarachok (1394m) landscape. Some fields in Chinkhola have been abandoned (Figure 51B). Two Christian sects are in conflict among the Chhetri community of Tarachok.

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Annex A: Profile of Settlements, 2001

See Figure 2 for location

Settlement (Gurung Name)	Average Elevation (Metres)	Site Location	Households	Dominant Social Group
A. South of Ghatte Khola				
1. Nandeswanra	880	Lower terrace	7	Gurung (ethnic)
2. Jyamire	940	West-facing foothill	5	Gurung (ethnic)
3. Rindang (Phaje)	1,520	North-facing slope	21	Gurung (ethnic)
B. Between Ghatte Khola and Sisneri Khola				
4. Taranche (Tanje)	945*	Upper terrace	39	Chhetri (caste)
5. Ngadi Bazaar	840	Alluvial fan	29	Mixed
6. Tanklichok (Toncho)	900	Upper terrace	22	Gurung (ethnic)
7. Nayagaon (Tego)	1,350	North-facing slope	51	Gurung (ethnic)
C. Ngadi Valley				
8. Ustabensi	1,000	Upper terrace	7	Ghale (ethnic)
9. Usta (Singu)	1,391*	Ridge	54	Ghale (ethnic)
10. Chhinkhola	1,500	North-facing slope	15	Tamang (ethnic)
11. Tarachok (Tahjo)	1,355	Upper terrace	69	Chhetri (Caste)
12. Ludi (Paje)	1,570	West-facing slope	15	Tamang (ethnic)
13. Dahare (Tohare)	1,870	East-facing slope	14	Tamang (ethnic)
14. Naiche (Tonjo)	1,300	Upper terrace	53	Gurung (ethnic)
15. Bhirpustum (Painthi)	1,888*	South-facing slope	52	Ghale (ethnic)
16. Thulibensi	1,150	East-facing terrace	85	Chhetri (caste)
17. Dobhanchaur	910	Lower terrace	40	Mixed

* Spot-height
Source: Field visits

Annex B: Chronology of Events

Year	Natural	Cultural
1921	Ghatte Khola, Sisneri Khola flood, Taranche	
1930		Steel suspension bridge, Sanskrit school, Ayurvedic dispensary, Khudi
1932		Shivalaya and rest-house, Khudi
1934	Tagaring landslide	Tagaring migrants to Taranche
1954	Heavy monsoon	Ngadi bridge, near Nemane chautara
1955	Moonsoon cloud-burst, Taranche landslide	Post office, Khudi, Taranche migrants to Chitwan
1956		Primary school, Taranche
1959		Health post, Khudi
1964	Bhulbhule bridge damaged by Marsyangdi	
1967		High school, Khudi
1968		Bhulbhule bridge at new site (supstream)
Early 1970's		Improvement of Manang trail
1975	Khudi bridge damaged by Khudi Khola	
1976		Ngadi and Ustabensi settlement
1978		Opening of Manang for trekking
1978		Khudi bridge at new site (upstream)
Early 1980's		Mule caravans to Manang
1987		Ngadi bridge shifted to Dobhanchaur (downstream)
1988	Tanklichok landslide	Fire damage, Naiche
1989	Naiche landslide	
1993		Jeep track, Khudi
1996		Jeep track opposite Bhulbhule
1997		Mini hydroplant, Bhulbhule
1999		Jeep track opposite Taranche, electricity at Taranche
2000		Electricity, Bahundanda
2001	Naiche landslide	Rice mill, Taranche

Source: Field interviews

Annex C: Taranche Land Record

Particulars		1933	1986	Change		Remarks
				Unit	%	
1.	Registered land (No)	81	72	-9	-11.1	By site location
	- Pakho locations	60	40	-20	-33.3	
	- Khet locations	21	32	+11	52.4	
2.	Land owners (No)	75	167	+92	122.7	
3.	Social composition of land owners (No)	5	10	+5	100.0	
	- Caste group	4	4	-	-	Sarki out, Bahun in
	- Ethnic group	1	6	+5	500	All five are in -migrants
4.	Land owners (No)					Most owners have both khet and pakho land
	- Pakho	220	271	+51	23.2	
	- Khet	144	276	+132	91.7	
5.	Khet area (Ropani)	330.3	858.8	+528.5	160.0	Subjective in 1933
	- Caste owned	226.0	292.7	+66.7	29.5	
	- Ethnic owned	104.3	566.1	+461.8	442.8	
6.	Land tax (Rs.)	141.0	196.51	+55.51	39.1	
	- Pakho	19.46	73.30	+53.84	270.7	
	- Khet	121.54	269.81	+148.27	122	

Source: Harka Gurung 'Lando wnership Change in Lamjung, 1933 -1986', Forthcoming

Annex D: Lamjung Population Trend

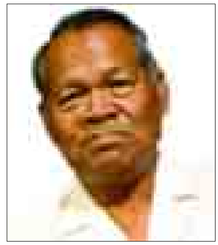
a. Comparison with Country			
Aspects	**Unit**	**Lamjung**	**Nepal**
Population increase, 1961 -91	Percent	35.3	107.9
Population density, 1961	Persons km^2	77.4	64.0
Population density, 1991	Persons km^2	90.8	125.6
Absentee population, 1961	Persons	10,927	386,824
% of total population, 1961	Percent	8.3	4.1
Absentee population, 1991	Persons	9,083	658,290
% of total population, 1991	Percent	6.6	3.6

b. Decennial Change

Census Year	Population	Decennial Change	Change %	Remarks
1941	107,543	-	-	Unreliable census data
1954	133,627	+26,084	+24.3	Heavy monsoon (1954,1955)
1961	130,935	-2,692	-2.0	Chitwan resettlement continues
1971	140,226	+9,291	+7.0	Malaria eradication programme
1981	152,720	+12,494	+8.9	Road to Bensishahar
1991	153,697	+977	+0.6	
2001	177,149	+23,452	+15.3	
1961-1991	-	(+46,214)	+35.3	

Source: Various censuses, Central Bureau of Statistics

About the author



Harka Gurung graduated with a B.A. Hons. (1959) from Patna College, Patna; a Post Graduate Dip. Geog. (1961) and Ph.D. (1965) from the University of Edinburgh. Academic assignments include Demonstrator, University of Edinburgh (1963-64); Research Fellow, School of Oriental and African Studies, University of London (1964-66); Lecturer, Tribhuvan University, Kathmandu (1966-68), and Visiting Fellow, Population Institute, East-West Center, Honolulu (1984-85). He served the Nepal Government as Member and Vice-Chairman, National Planning Commission (1968-78); Minister of State for Education, Industry and Commerce (1975-77); Minister of State for Tourism, and Public Works and Transport (1977-78). He has done consultancy work for HMG/Nepal, ADB, ESCAP, IDRC, IFAD, IUCN, UNICEF, UNDP, UNESCO, UNRISD, USAID, and The World Bank. Dr. Gurung is author of numerous books and papers. Main areas of professional interest include demography, planning, environment, geography, and tourism. He has been a Board Member of the Lumbini Development Trust, International Centre for Integrated Mountain Development (ICIMOD), and International Institute of Educational Planning (IIEP/UNESCO). His last assignment (1993/98) was as the Director of the Asia and Pacific Development Center, an inter-governmental organisation based in Kuala Lumpur, Malaysia. He is associated with New ERA consultants, Kathmandu.

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