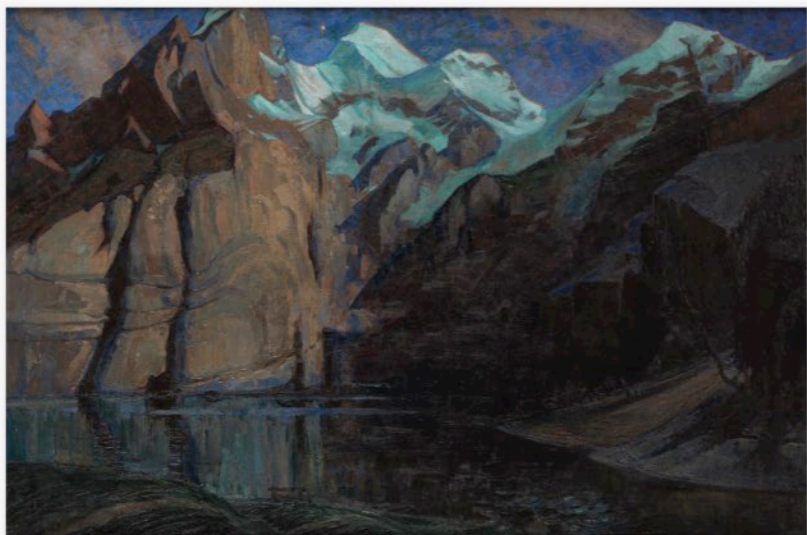

Nature & Environment



'Nocturne des Alpes', Hilda Hechle, 1935?, oil on canvas, 92cm x 138 cm.
The Blumisalp group from the Oeschinensee. *(Courtesy of the Maas Gallery)*

ALTON C BYERS

The Greening of Khumbu

Past, Present and Future in the Himalayan Environment



Imja valley, Khumbu as seen from the upper slopes of Kongde Ri (6187 m).
(L N Sherpa)

Perhaps the time is not so far distant when travel agencies will include tours to the highest mountain in the world in their itineraries.

Erwin Schneider, 1963

During the 1970s and early 1980s, it was commonly assumed by the development community that the Himalaya were approaching catastrophic levels of environmental degradation, linked primarily to growing contemporary human and livestock populations. Landscapes throughout the mountain world were said to be experiencing unprecedented increases in deforestation, overgrazing, and the terracing of marginal land. In turn, these phenomena were claimed to be responsible for promoting near-crisis levels of fuel wood shortages, soil erosion, slope instability, geomorphic hazards, and major watercourse siltation. Catastrophic consequences were predicted within 20 years, including the loss of all forest cover in Nepal by the year 2000.

Although the origins of the 'Himalayan crisis' models are obscure, the writer Erik Eckholm is usually credited with synthesizing the popular and



Far left: Podzolic palaeosol, or old, buried forest soil, found above the Khumjung monastery in what is now a shrub-grassland of cotoneaster, dwarf rhododendron, and juniper shrub. Note the pale-colored east horizon, indicating former moist forest conditions. (Alton Byers)

Left: Podzol, or actively developing moist forest soil, within a fir-birch-rhododendron forest on the trail to Debouche, below the Tengboche monastery. (Alton Byers)

growing concerns of the day in his seminal 1976 book, *Losing Ground*. In a chapter aptly titled 'Refugees from Shangri La', Eckholm describes the conclusions of a 1974 International Workshop on the Development of Mountain Environment' conference in Munich that warned of '... the irretrievable loss to human use of the developing world's mountain resources – in some cases within one or two decades [i.e., the 1980s or 1990s] – unless the present rate of deforestation and land mismanagement can be halted ...'.

Although supported by little quantitative or long-term data, a widely accepted paradigm for the international development community was established that became the foundation for dozens of multi-million dollar conservation projects throughout the Himalaya-Hindu Kush region. Especially during the 1980s, these well-meaning projects were typically designed to 'reverse the trends of environmental degradation' through tree planting, the introduction of simple but 'appropriate' technologies such as improved cook stoves, and improved land management techniques.

However, challenges to the 'Himalayan crisis' scenarios began to emerge by the mid 1980s, primarily from the academic community. Largely initiated by publication of the paper 'Uncertainty on a Himalayan Scale', authors Michael Thompson and Michael Warburton questioned the lack of quantitative data and case studies in illustration of the negative trends, as well as the reliability of popular figures and statistics being used to illustrate the problem.

By the early 1990s, however, the 'Himalayan crisis' debates began losing steam. The programmatic focus of most donors began to shift from government-led natural resource management initiatives, to those emphasising locally led community forestry, biodiversity conservation and new protected area programs. (Climate change would not surface as an issue for another decade.)

However, it should be added that a wide range of new mountain-oriented organisations and programs emerged as a result of the 'mountain crisis' debates, publicity and impact. They included: the establishment of the International Centre for Integrated Mountain Development (ICIMOD) in 1984;



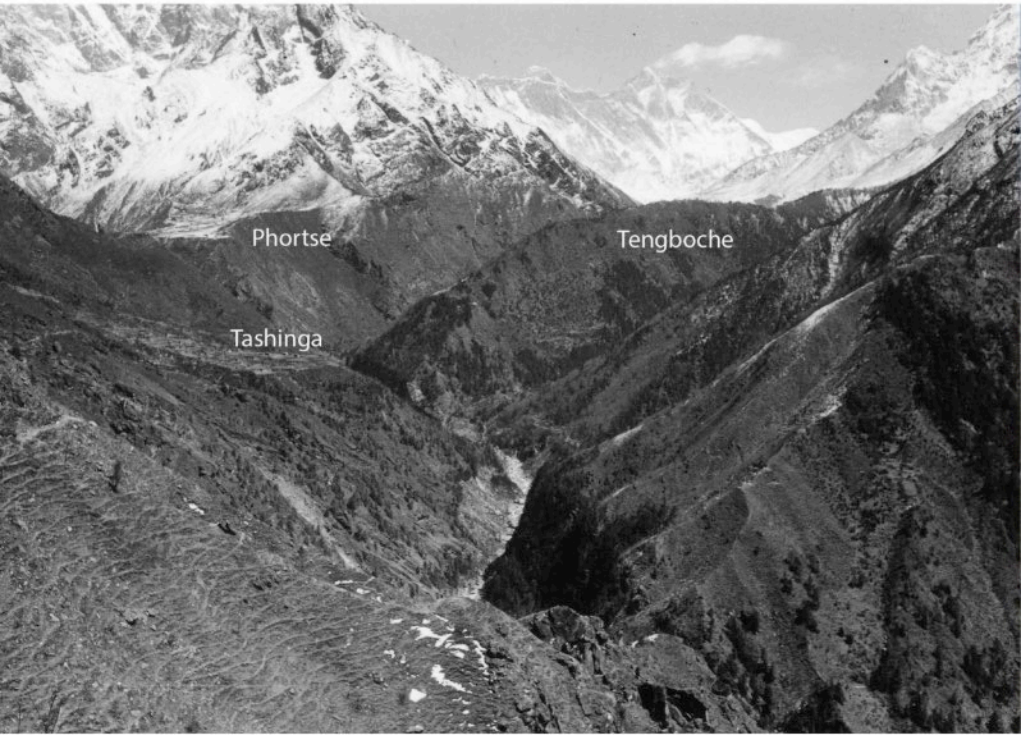
The Imja Khola valley seen from the lower slopes of Thamserku (6608m). Results of soils and pollen analysis suggest these predominantly south-facing hill slopes were covered by cloud forests of fir-birch-rhododendron until about 2,000 years ago. Tree cutting and burning in the interests of converting the forests to pasture land began 2,000 and 5,000 years ago, most likely by non-Sherpa ethnic groups from the south. Between 400 to 800 years ago, about the time of Sherpa arrival, the open woodlands were converted to shrub-grasslands on the south-facing slopes seen today. (*L N Sherpa*)

the inclusion of mountains within the UN's 1992 Rio Earth Summit action plan for the 21st century (known as *The Mountain Agenda*, or *Chapter 13 of Agenda 21*); creation of the Mountain Forum in 1995; and establishment of FAO's Mountain Partnership in 2002. In a recent paper on geographical scholarship in Nepal, geographers Elsie Lewiston and Galen Murton also point out that critiques of the 'Theory of Himalayan Degradation' in the 1980s may have also paved the way for policies in support of community forestry programs that emerged in the early 1990s, in addition to a new focus on the value of traditional and indigenous knowledge.

So what about the 'crisis in the mountains' scenarios of the 1950s through the 1980s? Were they really based upon 'myths, misunderstandings, and misinformation', as forester Larry Hamilton of the East-West Center maintained? Or could they have been based upon actual fact, or at least triggered by certain social and biophysical conditions that may have existed at the time, over 70 years ago?

In retrospect, I think that the answer is, yes, the early development practitioners probably had good reason to be concerned. Although the linkages between farming marginal land and increased monsoon river siltation levels were a bit of a stretch, it's hard to believe that the early foreign and Nepali experts couldn't recognise a potential problem when they saw one. The more I view Toni Hagen's films of his journeys through Nepal in the 1950s and 1960s, re-read Harka Gurung's *Landscape Change in the Nepal Hills*, or flip through Facebook's 'Old Photos of Nepal' page, the more I see hill slopes that look vastly different from the ones seen today. There were fewer trees, more land was under terraced cultivation, there was much less infrastructure, and overall the landscapes look more stressed and less resilient.

In fact, a 2019 study by the East-West Center showed that forest cover in Nepal between 1992 and 2016 increased from 26 percent to 45 percent,



View of Tashinga, Phortse, and the Tengboche hill from the trail to Namche in 1956. (*F Müller*)

based upon the use of comparative Landsat satellite images. According to a recent article by Kathmandu-based journalist Peter Gill, this has primarily been the result of the success of Nepal's community forestry programs, coupled with the massive outmigration of predominantly young men to the Middle East since the early 2000s.

That is, with the change to community-based forestry management in the late 1990s, and the growing role of remittances as a source of family income, Nepal's forests became not only more sustainably managed, but there were also fewer demands upon their resources (e.g. the collection of fodder and fuel wood, which had exerted such strong pressures in the past). Land that was formerly farmed or grazed was now allowed to return to second-growth forest.

However, many scientists believe that Nepal's commendable increase in tree cover has not been accompanied by an equivalent restoration of biodiversity and forest function. Cardamom plantations have proliferated throughout the country since the early 2000s, bringing in much-needed income but at the expense of the removal of much of the sub-tropical forest understory and, as a consequence, wildlife and native plant habitat.



View of the Tengboche hill in 2018. Note the considerable expansion of forest and woodland coverage (letters a to f) upon both the north and south-facing slopes of the Imja Khola. (*L N Sherpa*)

The proliferation of new roads throughout Nepal is now being linked to an unprecedented over-exploitation of rare and medicinal plants because of the easier access provided to formerly remote sites, as well as to increases in landslide frequency, slope instability and river siltation. Lewiston and Murtun point out while ‘outmigration and land abandonment [have] contributed to absolute forest coverage, it has also contributed to declines in soil fertility and increases in invasive species’ that in turn impact biodiversity.

Paralleling the development of the ‘Theory of Himalayan Degradation’, the Sagarmatha (Mount Everest) National Park was frequently cited as a representative case study of historical landscape stability, followed by contemporary landscape change and degradation, in the high Himalaya. Historically, this interpretation maintained that major landscape transformations (i.e. the large-scale conversion from the virgin forests and wilderness that the first Sherpa found, to the shrub-grasslands found on most south-facing slopes today) were the result of 500 years of settlement, population growth and pasture expansion by the ancestors of the Sherpa people. Despite this, ran the argument, ecological stability predominated because of the effectiveness of indigenous management systems.



Namche Bazaar, Kunde and Khumjung villages as seen from the slopes of Thamserku (6608m) in 1956. Note the bare, treeless hillslopes above Namche Bazaar (photograph by E Schneider).



The same scene in 1984. Note that in the interim period the Syangboche airstrip (b) had been constructed, as well as the first rock-walled enclosure above Namche that had recently been planted with seedlings. Forests in the vicinity of Kunde (c) appear to have changed little (Alton Byers).

Contemporary issues such as increasing forest loss, uncontrolled grazing and accelerated soil erosion were encountered or exacerbated only since the late 1950s. Factors of influence, according to most studies, included the imposition of nationalised forest policies in 1957, the consequential breakdown of traditional indigenous management systems, impacts caused by Tibetan refugee who arrived in the early 1960s, misunderstandings associated with the park's establishment in the 1970s, the rapid growth of tourism and various other factors.

In 1984, I spent 10 months in Khumbu as a PhD candidate in geography from the University of Colorado at Boulder, in part to test the credibility

of these widely accepted scenarios of degradation. Based in the village of Khumjung, I and my botanist-geologist wife, Elizabeth, had ample opportunity to examine each of the various claims of landscape change and disturbance in some detail. It also gave us the opportunity to talk to people, take detailed measurements and photographs, and sometimes just to stare at the forests and mountains in front of us for hours, thinking about change. Several of our conclusions regarding the popular historic and contemporary landscape change and degradation scenarios are described below.

Historical Landscape Change

Were the Sherpas really the first people to inhabit the Imja valley, crossing the Nangpa La (5806m) from Tibet some 500 years ago? Did they really find a thickly forested wilderness before them, stretching from today's Thame village to Namche Bazaar, to Tengboche, to the treeline at Pangboche? And were they really the ones who cleared the south-facing slopes from Thame to Pangboche of their original forest cover?

According to the region's soils, which are capable of telling their own story the short answer is probably not. Trail cuts, cattle wallows and slumps along the trail from Thame to Pangboche do indeed reveal old, buried soil formations that were formed under moist cloud forest conditions and not the dry shrub-grasslands found today. Such 'podzols' are characterised by a distinctive 'E' or grey horizon (Figure 3) that has been leached of its iron and other mineral content from the constant seepage of water. Podzolic soils are still common today within the thick, fir-birch-rhododendron forests surrounding the Tengboche monastery, and can be seen at trail cuts from Tengboche to Debouche.

By identifying the pollen species found in the different soil horizons, collecting and dating the lumps of charcoal found at various depths and identifying the tree species represented by each piece of charcoal, we were able to re-construct the vegetation history of the Khumbu valley over the past several thousand years. And the results were surprising.

In brief, the pollen, charcoal and soil records suggest that moist and closed forest conditions did indeed exist some 2,000 years ago on today's south-facing shrub-grasslands. These forests became more and more open as the centuries went by, as indicated by increasing abundances of disturbance-loving bracken ferns. An abundance of charcoal throughout all soil horizons attests to the frequent use of fire as a forest-clearing tool.

The final conversion from open woodland to shrub-grassland took place between 400 to 800 years ago, meaning that while most books still maintain that the Sherpa were the valley's first inhabitants, beginning with their immigration from Tibet some 500 years ago, our data suggested that people had been visiting and burning the forests on the south-facing slopes of the region for at least 2,000 years, and perhaps as much as 5,000 years ago. Thus, what the original Sherpa settlers saw when they first entered the Bhoté Kosi and Imja valleys was probably *not* a continuous cover of fir-birch-rhododendron forest throughout the valley, upon both its north- and south-facing slopes.



Namche Bazaar, Kunde, and Khumjung in 1995. An additional enclosure above Namche Bazaar (a) has been built in the interim. Mendaphu hill (b), site of the national park and army base, is beginning to darken with tree growth, although all trees were cut down in the following year because of security concerns related to the Maoist insurgency. (*Alton Byers*)

Rather, what they found was even better: more forest cover than seen today, for sure, but also ample pasture land as a result of a thousand or more years of cutting, burning and grassland expansion by people living in the valleys directly to the south, quite possibly from the area of Rai settlements such as Bung. Sherpa oral traditions speak of certain ruins in the Khumbu alpine zone as belonging to ancient Rai livestock herders, and Rai *dami* (healers) still travel to Khumbu to find certain medicinal and ritual plants. Over the next several centuries, the Sherpa would make their own modifications to landscapes throughout the entire region to produce the prospects seen today.

Contemporary Landscape Change

So what about the claims of widespread deforestation of the Khumbu's remaining forests since the 1950s?

In addition to the quantitative methods used in our study, such as erosion plot monitoring or groundcover sampling, repeat photography provided a valuable qualitative method for better understanding changes in the physical and cultural landscape over time.

The technique itself is simple: find an older photograph, or series of



By 2018, all of the exclosures above Namche (a through e), as well as those located in Kunde and Khumjung (f through h), were covered with trees.
(*L N Sherpa*)

photographs taken over a period of time of a landscape, glacier or village. Find the precise photo-point used by the original photographer and replicate the historic photograph as accurately as possible in terms of season, time of day, weather and camera equipment. (Using identical lenses as the original photographer is hardly ever possible, but good substitutes can be made with modern digital cameras.) If changes between the photo pairs are apparent, for example changes in forest or ground cover, then ground truth verification is critical to the most accurate understanding of events or processes leading up to that change, usually by establishing sampling plots in the area of question. Oral testimony from local residents can add tremendous insights to when, why and how the changes occurred. Literature reviews, especially of older books written by early scholars, climbers and scientists in a region, can be extremely valuable as well as a source of additional historic photographs. Time-lapse satellite imagery and aerial photography can provide additional insights to more recent changes that have occurred, particularly with phenomena such as receding glaciers, growing glacial lakes, large-scale deforestation and other major features.

In brief, replication of photographs taken of Khumbu landscapes by the early climber-scientists of the 1950s suggested that, in contrast to

catastrophic levels of land degradation reported in the literature, much of the Khumbu was still well forested, resilient and rebounding. Landscapes that appear to be 'degraded', such as the shrub-grasslands of concern to researchers of the 1970s and 1980s, were in fact highly modified as a result of centuries of grazing and pasture expansion. However, although heavily modified they were also quite stable in a geomorphic sense, thanks to the 'geomorphic glue' provided by dwarf rhododendron, cotoneaster and shrub juniper species which bound the soils to the slopes.

Additionally, in at least a dozen repeat photography expeditions to Khumbu between 1984 and 2018, I was able to document a steady return of forest cover throughout much of Khumbu. For example, Figure 5 shows a view of Phortse, Tashinga and the Tengboche hill from the Namche trail in 1956, taken by the Swiss-Canadian glaciologist Dr Fritz Müller while on his way to the Khumbu glacier. Figure 6 shows the same scene again in 2018, where considerable growth of colonising *Pinus wallichiana* upon the south-facing slopes to the left, and fir-birch-rhododendron upon the more northerly facing slopes to the right, is clearly visible.

What have been the reasons for such a dramatic re-growth in trees, both here and elsewhere in Khumbu? Paralleling Nepal's experience in general with outmigration and changing lifestyles, Khumbu's economy today has shifted nearly completely from the agro-pastoralism and trade of the pre-1950s to one based today almost entirely upon tourism. Climbers and scientists were the primary visitors to the region throughout the 1950s, with adventure tourists trickling in from the early 1960s. Tourism to the region grew steadily in the decades that followed, from 20 visitors in 1964, 5,000 per year in 1980, to 20,000 per year in 2000. Annual numbers ebbed and flowed through the decades depending upon national and international events, dropping dramatically during the Maoist insurgency (1996-2006), after the Palace Massacre (2001) and following the 2015 earthquake, but rebounding within a year or two afterwards. Tourist numbers reached a remarkable 60,000 per year in 2019 (not including support staff, which easily doubles the total), dropping to nearly zero as a result of the Covid-19 pandemic and cessation of all tourism in March 2020. As my book went to press (2021), most lodge owners in Khumbu were waiting out the pandemic, making repairs and buying supplies, in anticipation of a post-vaccine return of tourism at some point in 2021 or 2022.

Diets and lifestyles have also changed considerably in the past two decades as the result of easily available imported foods. Likewise, the use of dairy and other products from yak and yak-cattle crossbreed herds is decreasing as more convenient imported milk, cheese and synthetic materials become readily available. While yaks and crossbreeds continue to be used as pack animals from Namche to Everest Base Camp, their numbers are far fewer than they were a generation ago and, as a result, their pressures upon the landscape have decreased as well.

The Sherpa have long practiced an effective system of communal natural resource management characterized by the designation of *shingo nawa*,

or forest guards, within each community. Geographer Stan Stevens, author of *Claiming the High Ground*, believes that these indigenous and historic conservation ethics were not as negatively impacted by the nationalisation of forests in 1957 as some scholars would believe, which could explain another reason why forests have rebounded in Khumbu. At the same time, forest management regulations imposed by the national park, starting with the park's creation in 1976, have likely had beneficial impacts as well. Forester Nick Ledgard, who supervised the Himalayan Trust nursery and plantation projects in Khumbu for over 30 years, believes that fire suppression, as a result of decreased livestock populations and annual pasture burning, may also have contributed to the rapid rebound of forests.

Since 1981, active forest regeneration programs have been conducted by the national park, the government of New Zealand and local communities, leading to a significant increase in forest coverage. Hundreds of thousands of fir, juniper, pine and other native species have been raised in nurseries located throughout the park and then planted in ex-closures in the vicinity of major villages. Forty-five plantations totalling some 165 hectares have been planted since 1981. Figures 10 to 13 trace the establishment and growth of tree plantations in the vicinity of Namche Bazaar.

Finally, climate change, especially warmer temperatures and increasing rainfall in Khumbu, may have facilitated more rapid tree growth in combination with the decreasing pressures of pack animals and fuel wood collection. In fact, recent studies in the Everest region are demonstrating how with increased temperatures and ascending snowlines, alpine vegetation is expanding upward to higher altitudes. Treelines, the interface between sub-alpine forest and alpine ecosystems, are also ascending to higher altitudes as a result of warming temperatures and decrease in cattle pressures. And glacial deposits newly exposed by melting ice are now being colonised by alpine wildflowers.

So once again, what about the c1970s statements of an environmental crisis in Khumbu? Were they wrong? Several of the claims made at the time were clearly overstated; von Furer-Haimendorf's observation, that 'whole hillsides [above Namche Bazaar] which were densely forested in 1957 are now [1975] bare of tree growth,' is simply not supported by the photographic evidence. One glance at Figure 7 shows that there were no 'forested hillsides above Namche Bazaar' in 1956. As mentioned, my own soil erosion research found that while many hill slopes may look 'degraded' and 'erodible', they are in fact quite stable in a geomorphic sense thanks to the soil binding quality of the local shrubs and vegetation.

But in general, the physical and social scientists visiting Khumbu from the 1950s to the 1970s were there at a time when things were far different than they are today. Local people were much more dependent upon forest resources than they are now; livestock and grazing pressures were much higher. Villagers were still recovering from the impacts of forest nationalisation that were enforced in the late 1950s. And an influx of Tibetan refugees resulted in additional pressures upon local resources and resource

use for years. All of this translated into landscapes that at the time were under much more stress than they are today, where tourism has steadily replaced much of the previously agro-pastoral pressures upon the landscapes.

How the Sherpas of Khumbu deal with the relatively new and rapidly expanding problems of solid and human waste management, freshwater contamination and overcrowding, all directly linked to the growth in tourism, remains to be seen.

But, after 500 years of regularly adapting to changing political, economic and environmental trends, I'm sure that they'll figure it out.

• Adapted from the second edition of *Khumbu Since 1950*, by Alton C Byers and Lhakpa Sonam Sherpa, ECS Press, Kathmandu, 2021.