PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON THE HIMALAYAN ENVIRONMENTS: MOUNTAIN SCIENCES AND ECOTOURISM/BIODIVERSITY

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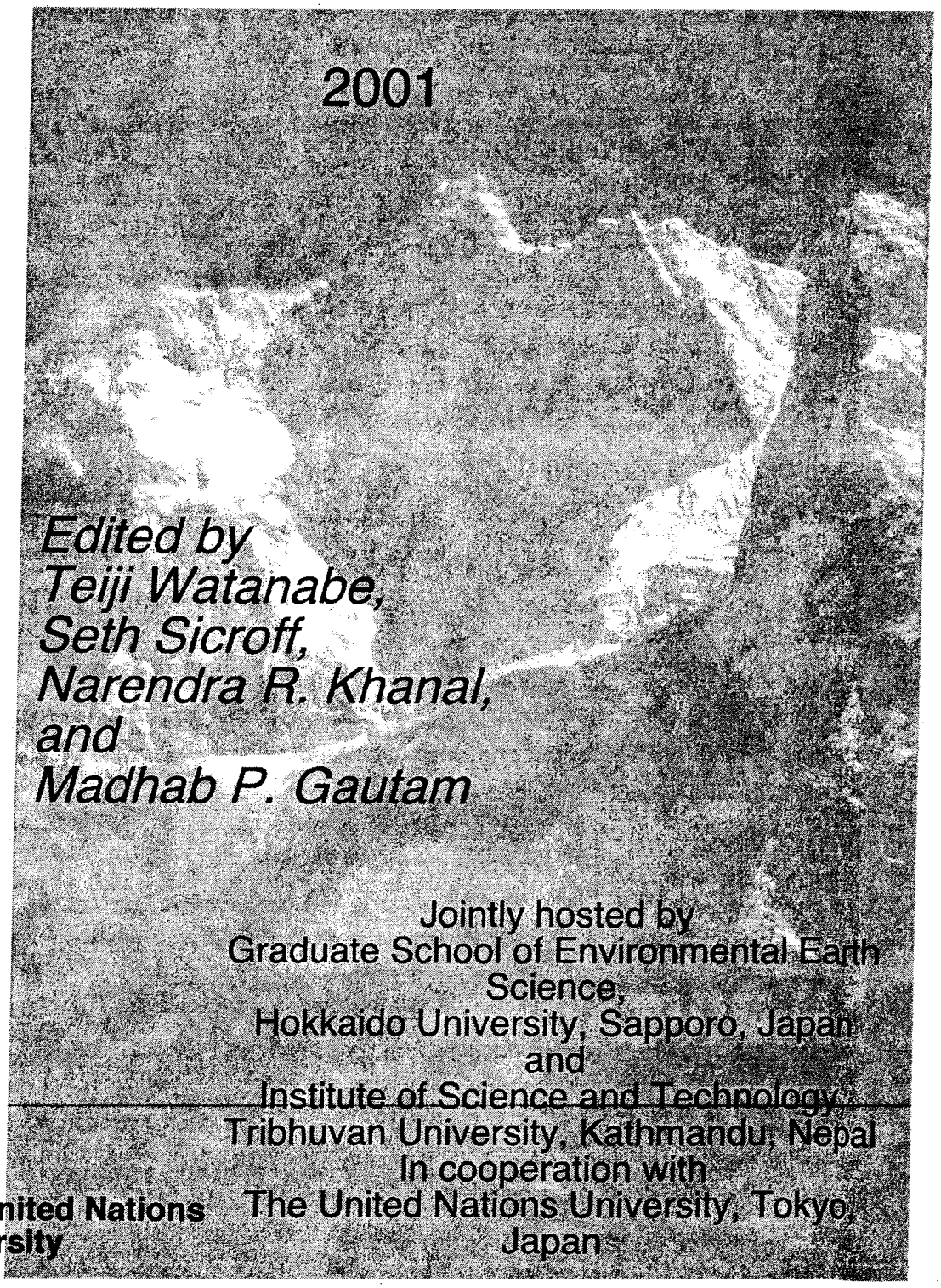

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and
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PREFACE AND ACKNOWLEDGEMENTS

After the first three-years of the collaborative field project on the environmental issues in Kanchanjunga Conservation Area, far-eastern Nepal, Tribhuvan University, Nepal and Hokkaido University, Japan strongly began feeling the need of communication among university researchers/students, governmental personnel, and NOGs'/INGOs' specialists. We believed that hosting an international symposium in Kathmandu would lead to fulfill the communication gaps.

With such background, the International Symposium on the Himalayan Environments: Mountain Sciences and Ecotourism/Biodiversity was organized by both institutions, Graduate School of Environmental Earth Science, Hokkaido University, and Institute of Science and Technology, Tribhuvan University.

More than 120 specialists from twelve countries participated the opening session. Mr. Naveen Prakash Jung Shah, Vice-Chancellor of Tribhuvan University and His Excellency, Mr. Mitsuaki Kojima, Japanese Ambassador to Napal addressed the inaugural speech.

Special lecture session had two key-note lectures by Ms. Junko Tabei, Japanese mountaineer known as the first woman to scale the summit of Mount Everest in 1975 and the first woman to climb the Seven Summits on the globe; and by Prof. Jack D. Ives, author of "*The Himalayan Dilemma: Reconciling Development and Conservation*" and the founder of journal, "*Mountain Research and Development*". The opening session was followed by 19 poster presentations, and then by oral presentations on the second and third days: more than 40 papers were presented at the oral session and 9 papers were presented at the special sessions.

This proceedings volume contains 29 papers presented at the symposium. All authors, reviewers, and editors are thanked for contribution, especially within extremely limited time.

Publication of this volume was possible with the special understanding and financial support by the United Nations University in Tokyo: Dr. Libor Jansky of the United Nations University (UNU) is thanked for all efforts. This symposium was also a part of the Global Mountain Partnership Programme of the UNU, which targets the International Year of Mountains 2002. The symposium participants actually agreed to have further activities in the Nepal Himalaya in 2002.

We are grateful to Honorable Advisor, Advisory Committee members, and Supporting Organizations for their time and efforts, with which this symposium was possible.

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- Japan Wildlife Research Center
- Think Himalayan Environments-Japan
- Hokkaido University
- Tribhuvan University

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Yaks carrying trekkers' matériel in Sagarmatha National Park (front) and Mount Jannu, Kanchanjunga Himal from the air (back). T.W.

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Proceedings of the International Symposium on the Himalayan Environments:
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Himalayan Environment and Tourism
Panacea for Poverty Alleviation of Process of Delusion?

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ABSTRACT

It is now four decades since the Himalaya was recognized as a world-class opportunity for development of tourism. This recognition was based on the oft-stated combination of unsurpassed scenery, flora and fauna, a climate characterized by two dry seasons, an immense array of colourful ethnic minority peoples with remarkable sense of hospitality, and innumerable architectural treasures. Binding this great range of assets together is the spiritual and mystical allure of the world's highest mountains.

Where do we stand forty years later? There are two extremes to tourism development - the wide open approach, best exemplified in Nepal, and the tightly controlled form characteristic of Bhutan. In neither instance does tourism provide a panacea for poverty. It takes little imagination to understand why this is so. Yet the potential remains. Can the political courage be developed to ensure that at least a more equitable share of the undoubtedly large profits of tourism trickles down to the lower economic levels of society? Some possibly unpalatable suggestions are made that, if adopted, could result in substantial improvement.

KEYWORDS: Environment; tourism; poverty; alleviation; International Year of Mountains

INTRODUCTION

In less than two years (2002) we will celebrate the International Year of Mountains. This is an event that was set in motion in November 1997 when the United Nations General Assembly approved by acclamation a motion placed before it by the Ambassador of Kyrgyzstan. It is perhaps no coincidence that shortly thereafter the UN General Assembly approved a motion that also identified 2002 as the International Year of Ecotourism. This is fortunate because mountains and ecotourism are closely interrelated; it is especially true for tourism and the Himalaya.

Within the context of this symposium it may help to focus our objectives if I provide some historical background behind the now rapidly growing awareness of the importance of mountains to the well-being of the World and human society at large. I should add that this will be a highly personal and, therefore, biased approach. Others would stress different factors and differ on the relative importance of the various events.

Evolution of Himalayan Tourism: 1950 - 2000

Two-season tourism began to develop rapidly in the Alps shortly after World War II. The Himalaya remained far off the beaten track for another two decades. The pre-World War II Himalayan mountaineering and exploration rapidly reconstituted itself after 1945, even as the political scene began to change. The ascent of Everest in May 1953 remains the historic pinnacle, although the same decade witnessed the so-called "conquest" of the other giants: Annapurna, Nanga Parbat, Kangchenjunga, Cho Oyu, K-2, and so on: a truly golden age. Where was I in May 1953? - an undergraduate of Nottingham University, England, preparing for the university's first arctic expedition. One of our colleagues marched in the Coronation procession of Queen Elizabeth II. The coincidental news of Hillary's and Tensing's success was electrifying. Bill Murray, Honorary Vice-President of our student exploration society, earlier that year in order to raise funds for our student expedition, had given a public lecture on the 1951 Everest

Reconnaissance he had made with Eric Shipton. We went to Iceland as budding glaciologists literally jubilant; we returned shattered as two of our colleagues had perished in the crevasses of Iceland's highest mountain. The planned 1954 expedition was imperilled - we were saved by the intercession of Bill Murray and another famous Himalayan pioneer, Jack Longland, and by the understanding of our university's Vice-Chancellor, Bertram Hallward, fortunately a member of the Alpine Club. I mention this only to illustrate my very early personal, if tenuous, link between Iceland's glaciers and the Himalaya. Many others, however, found that they had similar connections.

Himalayan mountaineering in the 1950s and 1960s called for increasingly large numbers of porters and high-altitude Sherpas. This may be described as the first stage in the introduction of trekking tourism, but one that is still unfolding as Junko Tabei, my distinguished preceding speaker, has so well illustrated. As the Himalaya progressively opened to foreign visitors mountain tourism followed closely, becoming a juggernaut over the subsequent thirty years. Initially there was little concern for associated environmental impacts nor for the possible disruption of mountain minority cultures. It was assumed that the in-rush of tourists would be a major factor for improving foreign balance of payments of such countries as Nepal and that there would be a "trickle-down" effect whereby mountain poverty would be alleviated. How this would happen, to my knowledge, has never been specified.

Certainly, many mountain families and communities have experienced significant material gains, although this statement itself will remain a conundrum in the absence of an adequate definition of "poverty". However, many more have not gained materially and have paid a heavy cultural and environmental price. I will take up this point more fully later on.

While mountaineering remained for some time the primary channel for change for those communities that lay astride the approaches to the major peaks, tourism in its many guises came to exert dominant impacts within about two decades of the ascent of Everest. Even in the Khumbu tourism exceeds mountaineering as a force for change and today tourists outnumber inhabitants by a factor of about 6 to 1; the way of life has changed completely for most of the Sherpa.

Similar trends have characterized most of the great mountain arc from northwestern Pakistan to Yunnan, China. The timing has not been synchronous. Politics and military strategy have played an important role. Kashmir, for instance, opened and partially closed again. As Sino-Indian tensions relaxed, Ladakh experienced the juggernaut. Hunza and the Karakorum opened following completion of the essentially military Pakistan-China highway. Bhutan remained elitist, allowing only small numbers of affluent tourists to follow carefully circumscribed itineraries. The Kumaun and Garhwal, in particular, accommodated an enormous increase in pilgrims to Himalayan sacred sites, as well as recreationalists, while Tibet's Mount Kailas witnessed the inflow of multi-purpose multitudes. The Assam Himalaya and northern Myanmar remain problematic in terms of access and security, yet only in the last decade the Hengduan Mountains of Yunnan have experienced such a rapid growth in tourism as to create the appearance of an act of desperation to "catch up". Has the nadir now been attained, with Kathmandu becoming a running sore of crowded noise, air pollution, and disquieting architecture?

Increase in Mountain Awareness: 1950 - 2000

The successful ascents of most of the Himalayan giants in the 1950s produced a flurry of books (expedition accounts) that certainly accentuated Western public mountain awareness. This was more akin to promotion of adventure enthusiasm, however, both actual and armchair, rather than any increase in understanding. Today's great concerns with environmental deterioration, loss of biodiversity, and harmful

effects on still isolated mountain communities were virtually unimaginable at the time. Within academia the small group of anthropologists, biologists, geographers, and geologists, for instance, slowly expanded but their mountain involvements were largely esoteric.

Twenty years passed before the United Nations Conference on the Environment (Stockholm 1972) caused a widespread awakening to environmental deterioration and the dangers of the growing economic gap between North and South. Yet even at Stockholm mountains did not merit a footnote in the voluminous spate of publication, although dozens of countries responded by creating new ministries of the environment. Several academic associations with a focus on mountains had come into existence. Most notable in the long run was the International Geographical Union's Commission on High-Altitude Geoecology, established in 1968. But the commission's early years were devoted largely to academic research. Nevertheless, there must have been a lot of personal and individual growth in concern over the long-term consequences of the many changes that were occurring. Thus, with the initiation of UNESCO's Man and the Biosphere (MAB) Programme in 1973, there appeared to be rapid and easy recruitment of 'experts' into all twelve of the main projects; it is MAB Project 6 (study of the impact of human activities on mountain ecosystems) that most concerns us here.

MAB Project 6 activated applied mountain research and training in many countries, but especially in the Alps, the Andes, and the Himalaya. As early as 1974 its core members joined forces with colleagues from India, Germany, and the United States under the auspices of the German Foundation for International Development (GTZ - Munich, 1974) with the Himalayan environment as focal point (Müller-Hohenstein 1974; Lall 1981). Indirectly the Munich meeting led to the founding of ICIMOD in Kathmandu in 1984. Applied inter-disciplinary mountain research flourished across the Alps and, when the United Nations University was established in 1975, it was not long before key components of MAB- Project 6 were grafted on to the new university's project: Highland-Lowland Interactive Systems (subsequently to become: Mountain Ecology and Sustainable Development). And as an outgrowth of UNU, IGU, and UNESCO MAB-6 it was possible to create the International Mountain Society in 1980 and its quarterly journal, Mountain Research and Development (MRD), the following year (Ives 1981).

While MRD served as the primary outlet for UNU's applied mountain research, it also attracted submissions worldwide and provided a focal point for the growing amount of independent mountain research. The UNU project concentrated initially on the Himalaya and northern Thailand (Ives and Messerli 1981; Chapman and Sabhasri 1983). Later, with substantial support from Swiss Development Cooperation, it expanded to Ethiopia, East Africa, the Andes, western China, Tajikistan, and Madagascar.

One of the major issues of the Himalayan research during the 1980s was the challenge to the assumption that subsistence farmer-driven deforestation was leading to devastating soil loss and landsliding in the mountains and to siltation and catastrophic flooding in Gangetic India and Bangladesh. This broad topic became the focus of an international conference held in 1986 at Mohonk Mountain House, New York State (*The Himalaya-Ganges Problem* - Ives and Ives 1987) and to the controversial book: The Himalayan Dilemma: Reconciling development and conservation (Ives and Messerli 1989). These developments also led to a liaison between the small group of mountain scholars(self-styled as *Mountain Agenda*) and Maurice Strong, Secretary General of the United Nations Conference on Environment and Development (UNCED). This proved to be a substantial factor in gaining a place for mountains in AGENDA 21, the major publication deriving from the 1992 Rio de Janeiro Earth Summit (UNCED).

Chapter 13 of AGENDA 21 (Managing fragile ecosystems - Sustainable mountain development)

became the corner stone of the enormous post-Rio growth in mountain awareness. It led inexorably to Rio-Plus-Five at the UN General Assembly in New York in 1997 (Messerli and Ives 1997) and provided important support for designation of 2002 as the International Year of Mountains. The international preparations for IYM are being facilitated by FAO (see web site at HYPERLINK http://www.mountains2002.org/guide/default.htm).

The foregoing is a much abbreviated account and there were many additional partners who have worked together to ensure the popularization and politicization of the *mountain problematique*. The Mountain Forum and The Mountain Institute are closely linked key components with an electronic communications system now functioning worldwide. Inevitably, all these activities have highlighted the Himalaya and have helped underpin the mandate of ICIMOD in the region.

Why Are Mountains Important to a Changing World?

This question has received much attention over the past decade. However, because it is highly relevant to the scope of the present symposium, the main points will be reiterated briefly. The list is a long one. First, in terms of sheer extent, mountains occupy about a fifth of all terrestrial space and provide the basic life support for about a tenth of humankind. When the resources of the mountains are taken into consideration, especially water and hydro-power, but also minerals, forest products, pastures, and medicinal plants, their relevance is heightened. Next, it must be realized that mountains account for much of the world's biodiversity and well as its cultural diversity. Their dramatic landscapes are the inspirational source for many of the world's religions. When secular inspiration, the widespread need for adventure, and general tourist amenities are added, it can easily be claimed that mountains make a vital contribution to the well-being of more than half of the world's human population.

There are equally impressive negative aspects that also affect both the inhabitants of the mountains as well as millions living far downstream on the adjacent plains. Poor management of mountain environments, natural hazards, contentious international frontiers, combine to produce destructive impacts on a very large scale. What is perhaps surprising is not that the last decade, leading up to the International Year of Mountains, has produced such an extensive upsurge of interest in and concern for mountains, but that this awareness took so long in coming.

From the foregoing outline it is apparent that unbiased assessment of the extensive resources available in the mountains of the world and assurance for their wise management are crucial if any degree of sustainable mountain development is to be attained. The need for a comprehensive understanding of mountain opportunities and problems is pressing. This presupposes a broad and reliable scientific base with widely available data. It also requires the reasoned analysis of prevailing mountain myths or preconceived assumptions that have distorted mountain development efforts in the past and many of which continue to have a deleterious effect today. The disproportionate incidence of warfare and/or the expenditure of vast resources on so-called defence is especially regrettable. This ranges all the way from active aggression to the passive deployment of military personnel and equipment that, at the very least, will cause substantial environmental and social disruption. Illicit production and trade in narcotics has engendered its own arena of warfare and widespread disruption; institutional self-legalization of ethnic conflict, leading to the forced expulsion of large numbers of "unwanted citizens" and their accumulation as refugees, is by no means unknown in the Himalaya. Of equal importance, and often intricately associated with the aforementioned forms of mountain destruction is the widespread corruption apparent at all levels.

These large mountain problems all impinge directly or indirectly on development of mountain tourism. There is extensive investigation currently underway to examine the various impacts of tourism itself. As indicated above, many of these impacts are highly negative with results including a widening gap between rich and poor, environmental and cultural disruption: in sum - massive exploitation. The apparent need to invent the term "ecotourism" and the attempt to distance it from "mass tourism" is self-evident. But, as is widely recognized, various authorities push for the exploitation of mountain peoples and landscapes under the guise of "ecotourism" that even cursory investigation can show up as a falsehood. These cynical aspects, however, also stand in contrast to many sincere and constructive developments.

Many specific examples of false and constructive "ecotourism" could be provided, but I think that would risk pre-empting to a degree the debate that the main paper sessions of this symposium will generate, so I will restrict myself to the general statement of concern.

CONCLUSIONS

Given all the uncertainties, as well as the tumult of rapid development, what steps should be taken to help tip the balance toward an "ecotourism" that produces beneficial results?

First, the widespread recognition of the enormous potential for an appropriate tourism can be taken as a given. An apparently simplistic solution is to provide sustained encouragement for governmental, NGO, and international agency efforts to increase access to resources by local communities. By this I mean the facilitation of local decision-making and a strong degree of internal control of development. This will probably require a range of legislation to reduce exploitation, to curb corruption, and to provide fiscal instruments to ensure access to bank loans by local people. These few general suggestions are by no means new, nor will they be easy to put into effect. I am sure that this will be demonstrated by the presentations to follow on efforts to develop appropriate tourism in Nepal's sector of the Kangchenjunga region and by the discussion that will be provoked. The question posed in the title to my presentation allows for no immediate answer. There has been much delusion and a very chequered record of poverty alleviation. Yet the opportunities are real. It is to be hoped that the imminence of IYM - 2002 and the challenges and opportunities that are encompassed will allow for a beneficial outcome.

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Climbers' Impact on the Natural Environment in Mountain Areas and Environmental Conservation: Present Situation of Wastes Left by Climbers in the Mount Everest Region

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ABSTRACT

This study presented data concerning climbing expeditions in the Mount Everest region from 1921 to 1999, including the number of participants. The amount of garbage and human excreta stemming from these teams as well as from trekkers was estimated. Some measures were also recommended for the consideration of His Majesty's Government (HMG) of Nepal regarding climbing practices and regulations in the Himalaya.

KEYWORDS: Mount Everest; climber; garbage; trekker; human wastes; urine; nature conservation

INTRODUCTION

I became the first woman and the 38th person to reach the summit of Mount Everest in 1975. At that time, to stay alive on the climb was the largest concern, and I left equipment including tents and ropes at the high altitudes. In those days, no climbers believed that such abandoned equipment would create environmental problems. As a result of the increase in the number of mountain climbers as well as the improvement of mountaineering equipment, garbage abandoned on the high peaks has become a significant environmental issue. Today there is growing awareness of the importance of using our mountain areas in a more sustainable fashion.

As a mountaineer, I felt uncomfortable regarding this issue. Furthermore, in spite of the accumulation of scientific studies on the natural and social environments in the Nepal Himalaya (eg, Bjønness 1980; Fürer-Haimendorf 1984; Brower 1991), there have been very few scientific studies concerning the garbage issue there or elsewhere among the high mountains of the world. In order to aspire to sustainable use of the mountains, we must obtain basic data. Therefore, I undertook research at the graduate school of Kyushu University, Japan, on the relationships between mountaineers (including trekkers) and garbage (including human wastes), focusing on the Mount Everest region in the Nepal and the Baltoro Glacier area of the Pakinstan Himalaya; I also reviewed general problems of overuse of amenity resources in Nepal and Japan, and examined regulations pertaining to garbage in mountain areas around the world.

This paper, based on my Master's thesis (Tabei 2000a), addresses garbage and human waste issues in the Mount Everest region. For the study, I (1) collected the materials about Mount Everest climbing expeditions, including the party size, from 1921 to 1999; (2) estimated the amount of garbage and human excreta stemming from the climbing expedition parties and trekkers; and finally (3) made recommendations to His Majesty's Government (HMG) of Nepal and to the expedition organizers themselves regarding the future of climbing.

METHODS

The number of the Mount Everest climbing parties and summiteers was drawn from data reported by Tsunemichi Ikeda for climbs from 1921 to 1997; and by Elizabeth Hawley for climbs from 1998 to 1999.

Tsunemichi Ikeda for climbs from 1921 to 1997; and by Elizabeth Hawley for climbs from 1998 to 1999. The data were compiled by decade: pre-1970s, 1970s, 1980s, and 1990s.

The amount of garbage was estimated by comparing figures for loads carried in and loads carried out. These data were collected by means of a questionnaire, interviews, and field measurements. The questionnaire was sent to 42 Japanese climbing parties which had been to Mount Everest from 1969 to 1998; questions covered the number of participants, and the total weight of loads carried in and out. Thirty-eight parties responded. Climbing parties from all over the world who were on Mount Everest in 1999 were also questioned in the field.

I weighed garbage derived from trekking groups between Lukla to the Everest Base Camp from 12 May to 2 June 1999, and between Lukla and Syangboche from 20 to 25 November 1999.

The amount of solid excrement by climbers was calculated on the basis of the data on the total number of climbers/trekkers and the duration of stay. Similarly the amount of urine discharged on the glacier by climbers and Sherpas was also calculated.

RESUTLS

Change in the Number of Climbing Expeditions and Trekkers to the Mount Everest Region

During the 48 years from 1921 to 1969, the total number of parties to Mount Everest was 29. The number has increased rapidly since then (Table 1): 27 expeditions arrived in the 1970s alone; the rate accelerated in the 1980s and 1990s; and by 1999 attained the total stood at 5,690 climbers, including 1,177 climbers who actually scaled the summit of Mount Everest.

The number of trekkers visiting Sagarmatha National Park is shown in Figure 1. At present more than 20,000 trekkers visit the area per year. The trend in the number of trekkers corresponds to the rapid proliferation of lodges (Figure 1). The first lodge was opened in Namche Bazar in 1971, and by 1978 seventeen lodges were operating in the region (Stevens 1993). The number of lodges increased from 83 in 1991 to 157 in 1996 (Watanabe and Sugawara 1998).

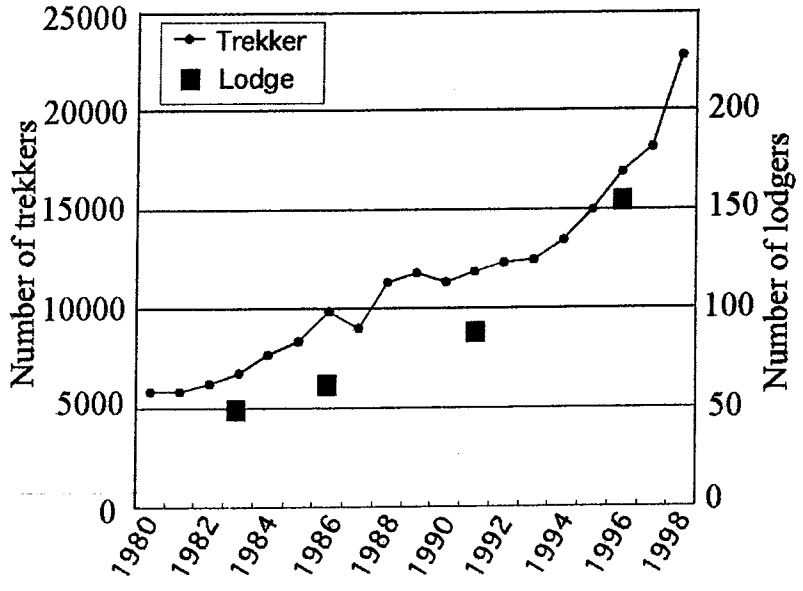

Figure 1. *The number of trekkers to Sagarmatha (Mount Everest) National Park and of lodges constructed in the park Trekkers' data are from Ministry of Tourism (1998). The number of lodges for the entire park area is from Stevens (1993) and Watanabe and Sugawara (1998).*

Table 1. *The number of climbing parties, members, and summiteers to Mount Everest*

Year	Number of parties	Total number of members	Total number of summiteers
- 1969	29	485	24
1970-79	27	607	78
1980-89	144	1858	181
1990-99	303	2740	875
Total	503	5,690	1,177

Data until 1997 were compiled from those by Ikeda (unpublished).
Data in 1998 and 1999 were from those by Hawley (unpublished).
The total number of summiteers (1,177) is by Hawley, which is different from the summed number (1,158).

Garbage Left by Mountaineers

Table 2 summarizes the results obtained from 38 Japanese climbing parties to Mount Everest. It is clear that the weight of the loads carried into the area has been decreased. This decrease is due to the improvement of the equipment.

Table 2. *Summary of the weight of load carried in by 38 Japanese climbing parties to Mount Everest*

Date	Total number of members	Total number of sherpas	Total weight of load carried in (tons)	Weight of load carried in per member (kg)
1970s	176	229	104.5	594
1980s	346	390	186.1	538
1990s	178	237	83.2	467
Total	700	856	373.8	534

Data were derived from 38 Japanese parties to Mount Everest between 1969 and 1998.
'The 1970s' includes the parties from 1969 to 1979, and 'the 1990s' includes those from 1990 nto 1998.

If the weight of the load carried in and out varies according to country of origin, our generalizations might be inaccurate. According to field interviews with six Everest climbing parties in 1999, the average load carried in for each member in all six parties was estimated to be 450 kg, whereas for the Japanese parties it was 467 kg. Since data for the Japanese parties seem fairly typical, we relied primarily on these data for our generalizations.

Although the amount of the load per member has decreased recently, this does not mean that the situations are ameliorating: the problem is the accumulation of the garbage.

Table 3 shows the data with which I calculated the amount of garbage left in the area by the climbing parties to Mount Everest. The data shown in Table 3 are derived from the answers provided by 25 Japanese climbing parties to Mount Everest from 1968 to 1998. These groups provided figures for the total weight of the materiel (ie, garbage) that they left in the area (C in Table 3); however, we may suspect that respondents have minimised their estimates of what was abandoned; the result should be treated as a conservative estimate.

The weight of garbage left per member (D in Table 3) is calculated to be 0.051 tons, from which we may extrapolate that the total minimum weight of garbage left by all climbers to Mount Everest until 1999 (5,690 persons, Table 1) is 290 tons. The actual weight of garbage left in the area, however, seems to be larger than 290 tons. When the materiel carried in and out is divided into non-consumable items (eg, tent,

sleeping bag) and consumable items (eg, food, kerosene), we can obtain different figures. The total weight of non-consumable materiel carried in (E) and out (F) was 141.859 tons and 70.750 tons, respectively (Table 3). Therefore, 71.109 tons (E-F) was the estimated weight left in the area (G). The weight of garbage from non-consumable materiel per member (H=G/A) would, therefore, be 0.146 tons. Similarly, the total weight of consumable materiel carried in (I) was 125.504 tons. This study regarded 20 percent of I as the total weight of consumable materiel (ie, garbage) left in the area (J), such as left food and plastic tapes for packing. The weight of garbage from consumable materiel per member (K) is now calculated to be 0.051 tons (=J/A). As a result, the total weight of garbage per member (L) added to the weight of non-consumable and consumable garbage (H+K) is estimated to be 0.197 tons, which is likely to be the maximum weight.

Table 3. *Summary of the weight of load carried in and out by 25 Japanese parties to Mount Everest, and the calculated weight of garbage left per member* *Unit for weight: ton*

Total number of members (A)	486
Total weight of load carried in (B)	272.067
Total weight of load left (C)	25.015
Weight of garbage per member: min (D)	0.051
Total weight of non-consumable load carried in (E)	141.859
Total weight of non-consumable load carried out (F)	70.75
Total weight of non-consumable load left (G=E-F)	71.109
Weight of garbage from non-consumable load per member (H=G/A)	0.146
Total weight of consumable load carried in (I)	125.504
Total weight of consumable load left (J=Ix20%)	25.101
Weight of garbage from consumable load per member (K=J/A)	0.051
Total weight of garbage per member: max (L=H+K)	0.197

With the minimum and maximum weights of garbage per member above, the total garbage left in the area by all climbing parties to Mount Everest until 1999 (5,690 persons, Table 1) is calculated to be between 290 tons (0.051 tons/member x 5,690 persons) and 1,127 tons (0.198 tons/member x 5,690 persons).

Garbage Left by Trekkers

The weight of the garbage left by trekking groups going to the Everest Base Camp in spring 1999 was actually measured in the field (Table 4). From the grand total (34.72 kg) for six trekkers and 19 days, the average weight of the garbage was calculated to be 305 grams per trekker per day. Similarly, the average weight of the garbage from the autumn groups going to Syangboche was calculated to be 221 grams per trekker per day, based on the measured weight of the total garbage (17,680 grams in total for 16 trekkers and five days).

The average length of trekkers' stay in the area was calculated to be 17.6 days (n=796) over the period from 1990 to 1994 by Watanabe (1997). The total number of trekkers to the area in 1998 was 21,896 according to the SPCC statistics (Figure 1). Therefore, trekkers left 85.2 to 117.5 tons of garbage in the area in 1998 alone. The annual amount of garbage left in the entire Khumbu area in 1997-1998 was estimated to be 209.5 tons (Table 5; SPCC 1998), which means that some 27.8% to 56.1% of the garbage

left in the area is likely to have come from the trekkers.

Table 4. *The amount of garbage by the 1999 spring trekking group to the Everest Base Camp*

Unit: gram

Date	Combustible garbage	Incombustible garbage	Can	Total
12May	610	540	270	1,420
13,14May	3,620	1,610	790	6,020
15May	2,100	1,360	720	4,180
16-22May	1,650	2,540	1,250	5,440
23May	460	1,050	620	2,130
24-25May	2,290	2,050	340	4,680
26May	2,240	680	430	3,350
27May	460	1,120	180	1,760
28May	1,080	650	240	1,970
29May	1,040	900	120	2,060
30May	770	810	130	1,710
Total	16,320	13,310	5,090	34,720

Table 5. *Annual amount of garbage in the entire Khumbu area, Namche Bazar, and Lukla*

Unit:kilogram

Settlement	Year	Combustible garbage	Incombustible garbage	Total
Entire area	1994-1995	75,610	50,763	126,373
	1995-1996	145,068	44,756	189,824
	1996-1997	174,948	68,143	243,091
	1997-1998	171,385	38,103	209,488
Namche Bazar	1994-1995	31,006	12,995	44,001
	Percentage	41	26	35
	1995-1996	74,209	17,915	92,124
	Percentage	51	40	49
Luklha	1994-1995	11,802	21,613	33,415
	Percentage	16	43	26
	1995-1996	33,828	13,757	47,585
	Percentage	23	31	25

Data source: SPCC (1998).

The number of trekkers visiting Sagarmatha (Mount Everest) National Park has been increasing year after year (Figure 1). Trekkers in commercial groups use guides and porters, who are also contributors to garbage production. Moreover, the increasing lodges and tea shops (Figure 1, Table 6) for trekkers also produce garbage, which has not yet been quantified. Although this study calculates the amount of garbage by trekkers on the basis of the total number of the trekkers in 1998, the types of trekking (group or individual) affect the amount of garbage to be left. This difference in the garbage amount is due to the

different mode of trekking, ie, length of stay, staying place (lodge or tent), and cooking style (at lodge or by themselves). It is, therefore, difficult to estimate the precise weight of garbage: the parts of the difference between the weight of garbage calculated by this study and the weight by SPCC (Table 5) should be attributed to the garbage generated at lodges mostly for individual trekkers. Nevertheless, the estimates yielded by this study can be an important base for future programmes and measures to reduce the garbage in the area.

Table 6. *The number of lodges and tea shops along the major trails in Sagarmatha National Park*

Settlement	Lodge		Tea shop	
	1979	1999	1979	1999
Jorsare	3	3	3	
Mamche Bazar	10	35	13	35
Khumjung	1	9		9
Thame og			3	
Pangboche		14	3	14
Tangboche	3	4		4
Deboche		3	1	3
Pheriche	4	8		5
Dingboche		14	1	14
Lobuche	2	4		1
Gorak Shep		2		2
Others	2		4	
Total	25	96	28	87

The 1979 data are from Sherpa (1979).

Human Wastes

Solid excrement

At the Everest Base Camp on the Khumbu Glacier (5,350 m), all human wastes had been left on the glacier prior to 1996. Since then, solid excrement has been carried down to Gorak Shep and buried there at a cost of NRs. 60 per kg (rate: as of spring 1999). SPCC (1998) reports that in the period from 1996 to 1997 1,594 kg of human wastes from 13 climbing parties was transported from the Base Camp and 2,469 kg from seven parties in 1998.

Urine

Although solid excrement is now removed to Gorak Shep, urine is still left in the high altitude areas. The amount of urine per person per day at high altitudes is estimated to be 1.5 times as much as that at the normal altitude, according to Prof. Masuyama of Chiba University (Masuyama 2000, Personal Communication): this comes to 2.16 liters per day.

Table 7 shows the estimated amount of urine left on/in the Khumbu Glacier at the Base Camp until 1999. The total number of the climbers until 1999 is 5,690, and the average stay at the camp is about 50 days, so the total climber-days is calculated to be 284,500. This gives 614,520 liters of urine left on the Khumbu Glacier up till 1999. In addition, Sherpas have left 921,780 liters of urine (Table 7), if they produce urine at the same rate.

Table 7. *The estimated amount of urine discharged from the Everest climbing parties*

	Total number of persons up to 1999	Average duration of stay (day)	Person-days	Total amount of urine (liter)
Climbers	5,690	50	284,500	614,520
Sherpas	8,535	50	426,750	921,780

(climbers and Sherpas only) until 1999

The number of sherpas = 1.5 x the number of climbers

The 1975 Japanese women team (15 climbers, 64 days) stayed 556 climber-days at the Base Camp, and 404 climber-days at C1 Camp. Based on this proportion, at the Everest Base Camp, 165,010 climber-days resulted in 356,422 liters of urine being left on the glacier. Similarly, at the higher sites than C1, the total of 119,490 climber-days has produced 258,098 liters of urine.

Although this study did not cover the amount of urine which had been discharged by trekkers, the amount must be enormous.

RECOMMENDATIONS

Recommendations for Government

From the foregoing results and discussion, I would like to propose the following recommendations to the HMG's Ministry of Tourism:

1) Special expeditions should carry down garbage left above the base camp;
2) The number of climbing parties should be restricted;
3) A "Control Tower Camp" should be established; station a permanent officer from the Ministry of Tourism or SPCC at the camp and abolish the current liaison officer system, which actually does not function well. The stationed officer should collaborate with climbing parties in order to develop and implement conserve measures; and,
4) Temporary toilets of the composting type should be installed Base Camp. Wastes should be removed and used as fertilizer at lower elevations. Toilet paper should be completely biodegradable.

More recommendations are available in Tabei (2000b).

Recommendations for Climbing Parties

In order to reduce the amount of garbage left by climbing parties, I suggest the following guidelines for all climbing teams:

1) Food should be essentially purchased as much as possible in the mountain area. The unnecessary packaging should be removed at the time of packing before starting expedition;
2) The number of fixed ropes, batteries, and other equipment should be carefully calculated according to the climbers' strength and objectives;
3) Boxes with chemical treatment should not be used for transportation. It is important to realize that the packing materials used for personal belongings to be carried back out and those to be consumed in the mountain area should be different;
4) Before the start of expedition, the climbing party should meet with the Ministry of Tourism and reach an understanding on the method of garbage disposal;

5) The accompanying Sherpas, cooks, kitchen boys, and porters, as well as climbing members, should all be encouraged to dispose of garbage appropriately;
6) Kerosene stoves should be provided to porters so as to minimise use of wood for fuel;
7) Kitchen and toilets should be set up at designated sites at the base camp. Used toilet paper should be kept out of the toilets, dried, and burned. It is important to use different toilets for urine and excrement to facilitate cleaning up at the end of the expedition;
8) Everything carried up to high altitudes should be carried down and taken out from the area; and,
9) Every climber should carry down his/her garbage and burn it at Base Camp.

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Mountain Environment and Tourism: The Nepal Experience

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ABSTRACT

The paper assesses the nexus of tourism, mountain environments and livelihood of mountain people with reference to Nepal. The rapid growth of mountain tourism has impacted mountain environment through the increased demand for fuelwood and timber, through the generation of garbage, changes in land use and growth of settlements. Tourism has also improved seasonal employment in portering and lodges. The impact of tourism on society and culture has not all been positive. Key concerns related to mountain tourism in Nepal include broader sharing of tourism benefits and revenues, local institution building, alternate energy, participatory planning, manpower development and diversification of tourism through supply side planning.

KEYWORDS: Mountain tourism; environment; tourism impact

THE CONTEXT

In 1999 mountain tourism accounted for about a quarter of the global tourist industry, involving $ 70-90 billion annually (Mountain Agenda 1999). Tourism has remained the fastest growing industry worldwide in terms of international tourism receipts, showing an average annual growth rate of close to 8 percent in the last decade. WTO predicts that the number of international tourists will grow by 4.3 percent per year, and earnings will grow by 6.7 percent per year in the next two decades (Frangialli 2000). This represents nearly three times as many international tourists as in 1999 (633 million) and nearly five times more economic activity than the $ 453 billion recorded in 1999 (Frangialli 2000). Domestic tourism is expected to increase by a factor of ten in terms of arrivals and by a factor of four in terms of receipts. It is expected that these trends will affect mountain tourism around the world.

Poverty and environmental degradation characterise mountain areas in general, and the degree of poverty and environmental degradation is more intense in the loftiest of all mountain regions, the Himalayas. For various reasons the inhabitants of these regions lack adequate access to means of sustainable livelihoods in terms of assets, capabilities and gainful remunerative activities. There is growing pressure on environmental resources for the fulfillment of basic necessities for survival. The traditional processes of adaptation are not only fast breaking down but are also being made irrelevant and redundant by the inexorable processes of globalization and liberalization. The challenges to sustainable quality of life in the fragile mountain environments of the Himalayas have never been so critical, nor so urgent. Tourism in the Himalayas must be considered in the context of these challenges.

Mountains have attracted people since antiquity. Part of their appeal has been the beauty and diversity of terrain, habitats and cultures. There has also been the sense of 'spirituality', 'sacredness', romance and adventure associated with the mountains. Only recently, however, has it been generally realized that the discovery that the affluent could be attracted by these attributes of the mountains, and that this attraction could provide a means of earning foreign exchange and of diversifying the economy by opening employment and income opportunities in both traditional and non-traditional economic sectors. Tourism and the hospitality industry in general are relatively labour intensive. Tourism happens to be one of the few industries where the traditional impediments to development - inaccessibility, remoteness, highly accidented terrain, and so on - add to the attraction and in fact offer a competitive advantage. Further,

tourism is one in situ export whose 'consumption' does not necessarily exhaust or impair the quantity or quality of the resource base.

In recent decades tourism under different names - ecotourism, green tourism, responsible tourism, etc. -is being promoted as a "win-win" situation, where biodiversity as well as the well-being of people can be simultaneously protected. Indeed, it is believed that the three objectives of sustainable tourism, ie, improvement of the quality of life of the host population, a high-quality experience for the visitor, and maintenance of the quality of the environment (on which both the visitor and the host population depend), can be achieved even with rising tourist numbers (WTO 1993). Mountain economies such as Nepal's have therefore begun to view tourism as a viable shortcut to rapid development. It is seen as one opportunity to partake in the fastest and the most dynamic global industry and learn to become partners in a "globalized" world. While international financial institutions are pursuing tourism as a serious export strategy, the implications of such a strategy for the poor economies of the third world under the dispensation of liberalization are also questioned (de Chavez 1999).

The present paper examines the nexus of tourism, mountain environments and livelihoods of mountain people particularly with respect to Nepal, the most tourism-dependent of the Himalayan nations. The following section presents some generalised implications of the mountain context for tourism development. The third section focuses on the specific experience of mountain tourism in Nepal in terms of the characteristics, trends, and impacts for mountain communities. The final section highlights some key areas of concern that emerge from Nepal's experience.

THE MOUNTAIN CONTEXT AND IMPLICATIONS FOR TOURISM

Chapter 13 of Agenda 21, the plan for action into the 21st century endorsed by the United Nations Conference on Environment and Development (UNCED) at Rio in 1992, drew the attention of the international community to "fragile" mountain ecosystems. The Agenda underscores the critical importance of mountain ecosystems to the global community and the need for sustainable development in these areas.

Indeed, mountain areas, as distinct from other geographical regions, have certain objective conditions or "specificities" (Jodha 1991). These conditions of inaccessibility, fragility, diversity, 'niche' or competitive advantage, and marginality add a particularly critical dimension to tourism in the mountains and call for particular modes of behavior (Table 1).

Difficulty of access has traditionally restricted the external linkages of mountain communities. The adaptive response to this condition by almost all mountain communities has been an emphasis on self-sufficiency. Because of the difficulties of transportation, trade and exchange tended to base on high value, low bulk products or unique craft-based production. Mountain tourism activities under commensurate circumstances can provide opportunities for new forms of adaptation to conditions of inaccessibility. Trekking, mountaineering and other forms of nature based adventure can thrive on relative inaccessibility and remoteness. These activities can also generate employment in transportation and provide economic support for the new infrastructure. However, the need to develop local capabilities and support systems becomes critical because tourism often leads to dependency on outside sources. Tourism itself is generally a seasonal activity. Inaccessibility in particular seasons and remoteness can exacerbate seasonality. For isolated remote areas with a limited resource base; however, tourism provides scope for improvements in livelihood that would not be possible otherwise. But at the same time tourism opens up otherwise closed and isolated communities to the outside world and exposes them to the vagaries of the marketplace and

sometimes the pernicious influences of cultural interaction.

Table 1. *Objective conditions in mountain environments and their implications for tourism*

Mountain Specificities	*Primary Attributes*	*Adaptation Characteristics*	*Implications for Mountain Tourism*
1. Inaccessibility	· Remoteness · Restricted external linkage · Isolation from markets · Insular economies, cultures	· Self sufficiency and self-provisioning · Small scale production of high value, low bulk goods	· Nature and culture based high value tourism; trekking, mountaineering and other forms of adventure tourism · Porterage/mule transportation · Induce activities that take advantage of relative inaccessibility · Need to develop local capability and support systems
2. Fragility	· Vulnerability of resources to rapid and often irreversible degradation with high intensity use	· Use of indigenous knowledge of resource conservation and recycling · Ethno-engineering;	· Wilderness as niche for tourism · Promotion of employment through environmentally regenerative activities · Conservation by non-use in bio-diversity hotspots · Determination of limits to acceptable change/carrying capacity · Emphasis on local resource centered production system technologies
3. Diversity	· Diverse resources and environmental situation · Large scale micro variations in physical/biological attributes · Interdependence of production bases	· Transhumance practices; diverse upland-lowland farming and production systems · Multiple, micro niche opportunities	· Use of micro-environment for harnessing specific comparative advantages · Linkage of tourism with agro-pastoral systems and resource management regimes · Focus on multi-dimensional institutions/ technology options (eg, micro hydro, solar, and other renewable technologies) · Employment and market potential of traditional activities (eg, carpet weaving, traditional handicraft etc.)
4. Niche	· Location/Area specific comparative advantages in resources/production activities · Small-scale specialisations · Attractions for explorations	· Traditional emphasis on activities that are mostly of an extractive nature such as mining, logging, hydroelectricity	· Harnessing of major and minor production niches linked to tourist demand (eg. Area-specific development of horticulture and vegetable production; environmentally friendly small scale extractive and processing activities, sustainable collection/processing of NTFPs) · Promotion of high value skill based or ethnicity and culture specific crafts for the tourism market · Development of hub tourism based on natural and cultural niches
5. Marginality	· Unequal terms of exchange · Minimal consideration of areas/people by mainstream decision makers · Limited own resources and production	· Exploitation of resource potentials by core areas/population; use of marginal areas; dependency	· Promotion of participatory decision making and community based tourism · Safeguard and regulate resource use with mandatory resource reinvestment (eg, ploughing a proportion tourist revenues in destination areas/regions) · Development of participatory institutions at the local level for regulating, monitoring tourism impacts and promoting tourism for local economic, environmental, social and cultural development · Training and human resources development to cater to tourist needs at the local level

Source: Adapted from Jodha (1991) and Sharma (1994)

Verticality, slope, altitude, geology, soil and vegetation conditions contribute to the dynamic or "fragile" character of mountain environments. Fragility denotes low carrying capacity and vulnerability of intensely used resources to rapid, and often irreversible, degradation. Increased rates of erosion, landslides, loss of endemic flora and fauna and biodiversity are examples of such degradation. Fragility as a characteristic

may also apply to human communities that depend on such environments and are susceptible to unpredictable processes of change due to forces external to their communities (Price 1997). Traditionally, the adaptive response to conditions of fragility involved resource-centered production processes with emphasis on conservation and recycling of resources. Field terraces on mountain slopes represent a sophisticated and widespread response to environmental fragility. Fragile environments tend also to be scale-sensitive. The type and scale of tourism, like other economic activities in mountain environments, needs to be sensitive to the physical, biological, and cultural characteristics and processes of the area. In many instances the fragility of mountain environments is itself a tourism asset and requires protection. In promoting mountain tourism, we must identify the most critical environmental factors impinging on the carrying capacity of the area and the limits to acceptable change; conservation and environmental rehabilitation must be part of the plan.

Mountain areas are characterized by a phenomenal diversity of terrain and micro-environmental conditions. Traditionally, mountain communities adapted to these conditions through the development of interdependent but varied production bases. Development of diverse farming and production systems at different altitudinal zones and aspects exemplify this process. With proper orientation mountain tourism can be used to enhance the linkages with these production systems and resource management regimes. Diversity also provides opportunities for the harnessing of diverse competitive advantages that specific mountain environments offer in terms of tourism activities such as river rafting, culture-based tourism in dense settlements, and trekking and mountaineering at higher altitudes. Diversity, however, needs to be handled with care. It calls for institutional arrangements and innovative technological options to fit diverse mountain conditions. Tourism-induced demand can be a catalyst in the development of such options.

A particular manifestation of diversity is the relative or absolute competitive advantage or niche afforded by particular locations and areas for small-scale specialization. Traditionally such niches of mountain environments have been exploited for a limited range of extractive activities such as mining, logging and hydro-electricity generation. Mountains today provide specific niches for a variety of tourism activities. Harnessing of production niches linked to mountain tourism such as horticulture and related processing, sustainable harvesting of non-timber forest products, and promotion of skill-based handicrafts for the tourism markets are some niche opportunities that flow from mountain tourism. However, the niche can be sustainably exploited only within the limits of the carrying capacity.

Historically, mountains have been neglected in terms of development priorities and have always been considered "marginal" entities economically and politically relative to the main stream. Mountain resources, be they forest, water or mineral, have traditionally been exploited by outsiders. Increased dependency, unequal terms of exchange and gradual loss of autonomy over resource use or decision-making are manifestations of marginality. Tourism can very easily fall in this trap. While tourism activities take place in the mountains, and impact mountain environments, the bulk of the proceeds from tourism often go to plains or urban-based tour and travel operators. If mountain tourism is to facilitate the reversal of marginalizing trends, it needs to be based on a process of decentralized decision-making, resource reinvestment and creation of conditions whereby the mountain areas and people become net beneficiaries of tourism development. This calls for the strengthening of participatory local institutions to promote the kind of tourism that contributes to local environmental, economic and social development. Local level formal and informal institutions can act as defenders of community interests, as mechanisms for local resource mobilization, and as sources for the promotion of the interests of the poor and disadvantaged groups who are often by-passed by the development process. The implication of marginality is

fundamental to the promotion of mountain tourism since it entails a complementary restructuring of the relationship between the mountains and other areas. The sensitivity with which tourism is practiced in mountain environments, and the extent to which it is responsive to mountain conditions largely determine its effectiveness in promoting sustainable livelihoods in the mountains.

It is also important to note that the impact of tourism on mountain environment, economy and society depends to a large extent on the nature and type of tourism. Table 2, which is based on a number of studies undertaken under the auspices of ICIMOD in the Himalayan region (Al Zalaly and Nazeer 1995; Banskota and Sharma 1995; Sreedhar 1995; Sharma 1996, 1998), presents a generalised picture of the implications of different types of tourism on the environment, economy and society of mountain areas. It reveals that the most serious impact may be on the environment. The potential for environmental degradation is high in trekking/mountaineering, resort tourism, and religious pilgrimage. Trekking and mountaineering have the potential of greater economic impact on rural areas than other forms of tourism. But the direct economic impact of tourism on rural households in terms of enhancing incomes and employment opportunities seems to be quite limited, although there are exceptions. The impact of tourism on society and culture begin to appear as the economic dependency on tourism grows and the demonstration effects and commercialisation of culture become more evident. It must of course be mentioned that not all the impacts are negative. Increased awareness of environmental issues, economic diversification and sense of pride in ones own heritage may be some of the positive impacts. Tourism impacts are not absolute and are influenced by policies and programmes in place.

MOUNTAIN ENVIRONMENT AND TOURISM: THE EXPERIENCE OF NEPAL

Within the Himalayan region Nepal is one of the countries that receives the largest number of international mountain tourists, and also one where tourism has shown relatively rapid growth. The case of Nepal is illustrative of the implications of tourism for mountain environments and livelihoods and also of the variety of policy and programme responses that tourism has induced.

Between 1962 and 1999 the number of tourists visiting Nepal grew from a little over 6,000 to nearly half a million, representing an average annual growth rate of 12.6 percent (Table 3). Some fluctuations notwithstanding, the proportion of tourists visiting Nepal with the purpose of trekking and mountaineering has risen steadily from 0.1 percent in 1966 to 11.8 percent in 1980, 15.7 percent in 1990 and 24.3 percent in 1998 (Table 4). In 1998 gross foreign exchange earnings from tourism amounted to $152.5 million, or 15.2 percent of the total foreign exchange earning during that fiscal year (MOT 1998). The contribution of the tourism sector to the GDP was 3.5 percent. In 1998 the average amount spent per visitor per day was $ 44.20 and the average length of stay per visitor was about 10.8 days. The average length of stay per visitor has not improved over the years although there has been significant increase in numbers. Seasonality in tourist arrivals is quite pronounced. September through November is the major peak period accounting for almost a third of all tourist arrivals, and about 51 percent of all those that come for the purpose of trekking and mountaineering in 1998. The other peak period is February through April, which in 1998 accounted for 26 percent of all tourist arrivals and 22.7 percent of trekkers and mountaineers. Seasonality is more pronounced for trekkers and mountaineers than for tourists with other objectives. Most trekkers and mountaineers come from Western Europe, 48.5 percent in 1998. Four countries, the UK, Germany, France and Netherlands, accounted for 38 percent of all such arrivals. About 62.4 percent of the trekkers came in groups and were handled by tour agencies, while 37.6 percent were free individual trekkers in 1998. Fifty nine percent of tourists fall into the age group 16-45.

Table 2. *Types of tourism and implications for environment, economy and society in rural mountain areas*

Trekking/ Mountaineering	Resort tourism	Culture tourism	Pilgrimage tourism
Environmental • Forest degradation due to increased demand for fuel-wood along trails • Trail degradation along heavily used trails • Pollution in and around campsites, wanton disposal of degradable and non-degradable waste • Contamination of creeks, rivers and water sources, pollution of soils and glaciers at high altitudes *Economic* • Direct income to rural households operating lodges, or using mules/ yaks for transporting tourist provisions, or those engaged in portering during the tourist season • Some impact on production regime due to tourist demand • Inflation and dependency • Growth of central settlements *Social/cultural* • Demonstration effect • Cultural awareness	*Environmental* • Land use problems brought about by sprawling growth of resorts • Deforestation/forest degradation due to demand for fuel-wood and timber • Soil instability and slope failures due to heavy construction along slopes • Discharge of untreated sewage and solid waste along slopes and rivers • Traffic congestion, noise and Vehicular pollution along popular resorts *Economic* • Some income to rural households due to demand for local Agricultural and livestock Produce • Some local employment during the tourist season • Increased dependency *Social/cultural* • Demonstration effect • Social aberrations/ problems Resulting from unscrupulous tourists and resort operators	*Environmental* • Most cultural tourists confined to, or based in major settlements or urban areas with historic, cultural monuments and relics so little direct impact on the environment except for tourist litter generated in these sites *Economic* • Some income to rural households from the sale of local handicrafts and other souvenirs • Employment and income due to the revival of traditional crafts caused by the demand from tourists • Increased dependency *Social/cultural* • Commercialization of art, culture and religious symbols • Theft of cultural, religious artifacts and black marketing • Breakdown of cultural inhibitions and erosion of cultural base • Awareness of social and cultural heritage • Openness to new ideas	*Environmental* • Heavy concentration of pilgrims during particular periods creating problems of waste disposal, pollution and congestion; high demand for fuel-wood during these periods • Many pilgrim sites in biologically sensitive fragile environments • Infrastructure overload during peak pilgrimage season *Economic* • Traditional pilgrimage based on frugal living that exerted little pressure on local economies • Easy access to many pilgrimage sites resulting in unscrupulous "mass" tourism and high dependence on imports • Some income to local households from the sale of local handicrafts *Social/cultural* • Commerciali-zation of religious rituals and symbolism • Continuity and maintenance of religious traditions

Trekking and mountaineering in Nepal is mostly confined to three major areas: Everest, Helambu-Langtang, and Annapurna. Eight-eight percent of all trekkers to Nepal visited these three areas in 1998. Incidentally, these three trekking regions are all associated with a National Park or Conservation Area. Annapurna is by far the most popular trekking destination. About 58 percent of trekkers visited Annapurna in 1998 followed by about 20 percent in the Everest region and about 10 percent in Helambu-Langtang

(Table 5). This pattern has remained more or less stable for over a decade now. Trekking to relatively high value trekking areas is quite limited in terms of numbers and accounted for 1.9 percent of all trekking permits issued in 1998.

Mountain tourism is a multi-faceted phenomenon with environmental, economic, political, social, cultural, historic and psychological dimensions (Godde et al 1999). The growth of mountain tourism in Nepal has had varying impacts on the natural and socio-economic environment of mountain communities (Bjønness 1980; Fürer-Haimendorf 1984; Fisher 1990; Gurung 1991; Sharma 1992; Byers and Banskota 1993; Stevens 1993; Banskota and Sharma 1995; Nepal 1997, 1999; Rogers 1997). There has, however, been little systematic knowledge gathered on these multi-faceted impacts of tourism in Nepal. The perception of impacts differs according to the area and time of the study. Available studies show that the most notable environmental impacts result from the demand for fuel-wood and timber and the generation of pollution and garbage; commonly reported changes involve land use, employment and income, and local customs and culture.

Table 3. *Growth of tourism in Nepal (1966-1999)*

Year	Number of tourists	Average Annual Growth Rate
1966	12,567	-
1970	45,970	38.3
1975	92,440	15.0
1980	162,897	12.0
1985	180,989	2.1
1990	254,885	7.1
1995	363,395	7.3
1997	421,857	7.7
1998	463,684	9.9
1999	491,504	6.0

Source: Ministry of Tourism/HMG, Nepal Tourism Statistics, different dates

Table 4. *Proportion of tourists by purpose of visit (1966-1998)*

Year	Pleasure and Holiday	Trekking and Mountaineering	Business	Official	Other
1966	87.2	0.1	2.6	7.2	2.9
1970	91.1	1.2	2.0	3.3	2.4
1975	75.9	13.6	5.3	4.6	0.6
1980	80.2	11.8	3.4	2.9	1.7
1985	70.8	15.9	5.8	5.1	2.4
1990	63.5	15.7	4.6	10.4	5.8
1995	50.4	23.3	6.0	5.5	14.8
1996	53.2	22.6	6.4	5.1	12.7
1997	59.1	21.7	6.5	5.7	7.0
1998	56.4	24.3	5.4	4.8	9.1

Source: Ministry of Tourism/HMG, Nepal Tourism Statistics, 1998.

Fuelwood Demand

Among the environmental impacts of tourism, degradation of forests due to the demand for fuel wood generated by tourism has attracted the most attention. Bjønness (1980) estimated firewood consumption at

4.5 kg per person per day for group trekkers in the Everest region in 1980 and noted significant forest clearance along trekking routes. In 1989 ERL estimated average per capita fuelwood consumption at 18.6 kg agency trekkers and 5.5 kg for independents. The proportion of fuelwood used for trekker tourism as opposed to local needs was 85.2 percent in the Sagarmatha (Mt. Everest) National Park area, 18 percent in the Langtang region and 4.7 percent in the Annapurna region; the proportion differed from location to location (ERL 1989).

Recent studies have found that the number of trekkers alone does not consistently correlate with the intensity of impact. Trekking style - group or individual - and ratio of staff to clients have implications for the consumption of fuelwood. Surveys conducted in the Sagarmatha and Langtang regions by Watanabe (1997) reveal that the ratios of porters and of guides to group trekkers were 1:1.85 and 1:3.14 respectively while the same ratio for individual trekkers was 1:0.23 and 1:0.32 respectively. Applying these ratios to a total of 91,525 trekkers in 1997 (44 percent of which were individual trekkers), the total number of visitors (ie, trekkers as well as porters and guides) to trekking destinations regions came to 200,000 (Table 6). Assuming a fuelwood consumption of 2 kg per visitor per day (which is quite on the low side), and an average trek duration of 10 days, the total consumption of fuelwood by trekkers and porter/guides in 1997 would have been to about 4,000 tons annually.

Table 5. *Number of trekking permits issued 1980-1998 by route*

Year	Everest Trek	Helambu, Langtang	Annapurna, Manang, Jomsom	Other	Controlled Area*	Total
1980	5,836	4,113	14,332	3,179	---	27,460
1985	8,347	4,610	18,960	813	---	32,730
1990	11,314	7,826	36,361	6,591	---	62,092
1991	11,862	9,603	39,107	5,198	---	65,770
1992	12,325	9,457	42,553	7,104	---	71,439
1993	12,475	9,187	39,764	6,547	1,646	69,619
1994	13,461	8,167	44,733	8,879	1,625	76,865
1995	14,997	8,427	50,012	9,458	1,893	84,787
1996	16,921	7,687	52,399	9,849	2,089	88,945
1997	18,179	8,201	54,078	9,220	1,847	91,525
1998	22,826	10,952	65,587	11,106	2,173	112,644
	(20.3)	(9.7)	(58.2)	(9.9)	(1.9)	(100.0)

*Source: MOT(1998), * Controlled Area includes Mustang, Dolpa, Humla and Manashu treks.*

A lodge survey in the Everest region conducted by Mattle in 1997 indicated that a total of 9.2 metric tons of fuelwood were consumed daily by the lodges in the region with an average of 43 kg per lodge per day (Nepal 1999). Consumption of fuelwood by lodges was found to comprise 24 percent of all fuelwood consumption in the Sagarmatha National Park area. In a recent note Nepal goes so far as to suggest that "almost 1,000 tons of firewood are burned daily during peak tourist seasons in 225 lodges" in the Everest region (Nepal 2000), although this large figure may need confirmation. Clearly, there is an enormous variation in the estimates for fuelwood consumption due to tourism. Systematic monitoring of the impact of tourism on fuelwood consumption along heavily trekked areas is long overdue. The broad picture that emerges seems to indicate that in spite of the requirement of using alternate fuel by group trekkers, the consumption of fuelwood is still quite considerable in all trekking areas. The evidence on the actual extent of deforestation, however, has remained controversial. Repeat photography in some areas in the Everest

region shows that forest cover along some trail locations has improved (Byers 1987).

Biodiversity

Nepal comprises 0.1 percent of the world's land area, but is reportedly home to 8.5 percent of the world's bird species, 4.2 percent of mammals and butterflies, 2.2 percent of freshwater fishes, and 2.2 percent of the world's flowering plants (Shrestha 1999). 246 species of flowering plants, 29 species and subspecies of butterflies, 8 species of freshwater fishes, 9 species of amphibians and 2 species of birds are reported to be endemic to Nepal. The impact of trekking tourism on this wealth of biodiversity particularly along heavily used trails is not known. Elsewhere in the developing world concerns have been raised with respect to biopiracy in tourist areas (de Chavez 1999).

Lodge Construction

Tourism has invariably meant new construction and increased demand for timber. Although this is certainly the case along all of Nepal's major trekking routes, the magnitude of this phenomenon is hard to quantify. In Namche Bazar in the Everest region, for example, the first 'hotel' was opened in 1971. By 1978 there were 17 hotels. In 1991 there were 83 hotels in operation and another 8 under construction (Stevens 1993). Nepal (1999) reports that in ten selected settlements in the Everest region there were 220 lodges with a total bed capacity of 3908 in 1997. Another study reports that there were a total of 248 lodges in Solu, Pharak and Khumbu in 1993 which went up to 293 in 1996, an increase of 45 lodges in 3 years (Rogers and Aitchison 1998). In the Langtang area the first hotel opened before 1975; by 1980 5 more were added and by 1994 the total number of hotels was around 38 (Watanabe 1997). Records from ACAP at Jomsom indicate that in Lower Mustang between Ghasa and Muktinath there were 92 hotels in early 1997. In the Annapurna area as a whole Nepal (1999) reports that there were 476 lodges with a bed capacity of 6800 around 1998. For the same period the lodge density per km of trail has been estimated at 2.0 for the Everest region and 1.6 for the Annapurna area. New lodge construction in many areas has encroached upon public open space or forest land.

Generation of Garbage

Although most of the data is anecdotal, garbage generated by tourists certainly has implications for the rural environment. The Sagarmatha Pollution Control Committee (SPCC), which has been operating in the region since 1993 provides some reliable data on the problem of garbage in the Everest region. In 1997 SPCC reported the collection of 243 tons of trekking-related garbage in the Everest region, of which 28 percent was non-biodegradable. Certain trail sections, for example around Namche, have a high concentration of garbage. In the Everest region as a whole Nepal (1999) reports 1.9 tons of garbage per trail km. According to SPCC the 840 mountain expedition teams that visited the Everest region between 1979 and 1988 were responsible for 422 tons of disposable garbage, 141 tons of non-biodegradable garbage and 207 tons of oxygen gas cylinders. Data from SPCC suggests that the volume of garbage generated has not been declining, and that the proportion of non-biodegradable garbage has been increasing. Garbage is a particularly serious environmental problem at higher altitudes. The mess seems to be less severe in the Annapurna region, but even there the problem of litter seems to be getting more critical with each passing year. Inadequate management of garbage along trails and in camping sites contributes to the pollution of local water sources. Furthermore, many lodge owners dispose of human waste directly into rivers and streams. Monitoring of the type and intensity of tourist-generated garbage has

been lacking even in heavily trekked areas in Nepal.

Table 6. *Styles of trekking and total number of visitors to the trekking regions in 1997*

Trekking regions	(1) Individual Trekkers	(2) Group Trekkers	(3) Total No. of Trekkers	(4) Porters/Guides Accompanying Individual trekkers*	(5) Porter/Guides Accompanying Group Trekkers**	(6) Total No. of Porter/Guides Accompanying Trekkers (4)+(5)	(7) Total Number of Visitors (3)+(6)
Everest	7,189	10,990	18,179	1,653	20,331	21,984	40,163
	(39.6)	(60.4)	(100.0)				
Langtang-Helambu	5,401	2,800	8,201	1,728	8,792	10,520	18,721
	(65.9)	(34.1)	(100.0)				
Annapurna	25,646	28,432	54,078	5,898	52,432	58,330	112,408
	(47.4)	(52.6)	(100.0)				
Other	1,752	9	11,067	402	17,232	17,634	28,701
	(15.8)	(84.2)	(100.0)				
Total:	39,988	51,537	91,525	9,681	98,787	108,468	199,993
	(43.7)	(56.3)	(100.0)				

Source: Individual and Group Trekker data from Nepal Tourism Statistics 1997.

**Porter, guide per individual trekker is 0.23 for Everest and 0.32 for Langtang according to Watanabe (1997). The ratio for the Annapurna and other areas has been assumed to be similar to that of the Everest region*

*** Following Watanabe, the ratio is 1.85 for the Everest region and 3.14 for the Langtang region. The ratio for the Annapurna and other regions has been assumed to be similar to that of the Everest region.*

LAND USE CHANGES

Land use changes due to the economic opportunities opened up as a result of tourism have been reported along major trails. This impact entails primarily changes patterns of cropping and settlement, and encroachment on forests and public land. Anecdotal evidence points to increases in the cultivation of fruits, potato, and vegetable crops along major trails. In some cases there has been a decline in traditional agricultural practices and relative neglect of livestock and pasture management activities (Baumgartner et al 1978; Banskota and Sharma 1995). Encroachment on forestland for lodge building has been observed in areas such as Ghorepani in the Annapurna region. Trail degradation and consequent soil erosion, vegetation loss and slope instability have been noted along heavily used trails. Almost 12 percent of the trails in Sagarmatha National Park has been reported to be seriously degraded due to high visitor density (Nepal 1997). Trails that are shared by mule caravans show more severe erosion.

Growth of Settlements

Tourism has led to the development of settlements and market towns that provide services and facilities not only to tourists but also for the regional population. On the Everest trail alone 20 settlements have been identified as having either emerged or grown directly as a result of tourism. These include settlements that emerged solely due to tourism, temporary settlements that became permanent due to tourism-related activities, and settlements that are experiencing recent lodge development region (Nepal 1999). Forty-three such settlements have been identified in the Annapurna. Rogers (1997) reports that at least 11 of the 38 settlements in the Everest trail from Junbesi to Namche showed significant impacts of tourism while 12 other settlements were moderately affected. The intensity of lodge development has been high along major trails.

Rustic natural trails linking villages along the main trails have been transformed into strings of lodges. In many cases vernacular architecture and aesthetics associated with traditional villages are gradually being overwhelmed by modern cement and concrete structures.

One of the positive impacts of increasing tourist traffic is the development of hospitality-related infrastructure. Access is facilitated. Information, communication, finance and health facilities become more widely available. All important tourist destinations and convergence points have evidenced this growth along major trekking routes in Nepal.

Employment and Income

In Nepal, the direct contribution of mountain tourism to trekking support staff employment for 1986 was estimated to be between 465,000 to 931,000 man-days per year (Banskota and Sharma 1995). Similar estimates for 1997 put the direct contribution of tourism to porter employment at between 1.2 to 2.5 million man-days (Table 7). Assuming an average wage of NRs. 150 per day, income from portering alone amounts to between 180 and 375 million rupees per year (ie, $ 3.2 to 6.7 million in 1967). This does not include employment in travel trade, hotels, lodges, restaurants, transport or the employment multiplier in other sectors of the economy.

Table 7. *Estimates of direct man-days of employment generated by mountain tourism in Nepal**

Year	Group Trekkers			Individual Trekkers			Total Employment Generated (Man Days)	
	Total Number	Employment Generated (Man Days)		Total Number	Employment Generated (Man Days)			
		High	Low		High	Low	High	Low
1986	19,829	793,160	396,580	13,780	137,800	68,900	930,960	465,480
1997	51,537	2,061,480	1,030,740	0	399,880	199,940	2,461,360	1,230,680
				39,988	0			

** The modal split is assumed to be 51:49 (group:individual) for 1986 and 56:44 for 1997. For group trekker the trekker: porter ratio is assumed to be 1:4 for high and 1:2 for low and for individual trekker similar ratio are 1:1 and 1:0.5 respectively.*

Banskota and Sharma (1997) have estimated the total earnings from tourism in the Annapurna region on the basis of sample data from Ghandruk and Ghorepani and ACAP revenues from trekking permits. They estimate a total of NRs. 246 million or $ 3.8 million accrued from tourism in the region of which about 26 percent was lodge related earning. Earning from lodges is a major component of tourism earnings. In the Khumbu area a popular lodge can gross as much as $ 10,000 a year. Over 90 percent of Khumbu lodges are operated by local residents (Stevens 1993; Rogers 1997). Women play a key role in the operation of lodges, and many lodges employ between 1 to 4 non-family helpers. There is also considerable earning from lodge-related portering as most goods have to be brought from outside. Many lodge owners in the Annapurna and Everest areas are locals. Nepal (1999) estimates the direct employment from tourism is around 16,000 in the Everest region and about 50,000 in the Annapurna region. Since tourism is a highly seasonal activity, these figures do not carry much meaning unless expressed in man-days or -years or in terms of the degree of reliance on tourism income and employment. Studies indicate that there is considerable income leakage from tourism - as much as 68 percent in the Ghandruk area (Banskota and Sharma 1997). Paudel (1996) estimates that only 23 percent of the tourist income is spent in local products and services.

Mountain tourism also generates direct revenue for the government in the form of trekking permit fees, park entrance fees and visas Chitwan National Park in the Terai realizes the largest proportion of revenue from park entrance fees. In 1995 these fees yielded over $ 3 million in Nepal's mountain areas (Table 8). The Annapurna area generates around 50 percent of this revenue. Trekking permit fees

accounted for the largest revenue share from mountain tourism in Nepal. The trek permit for the Annapurna area (not including Upper Mustang) goes to fund Annapurna Conservation Area activities in the region.

Table 8. *Tourism revenue by area, 1995*

Area/Region	Mountaineering Royalty[1]		Trekking Peak Fee[2]		Trek Permit Fee[3]		Park Entrance Fee[3]		Total	
	US$	%	US$	%	US$	%	US$	%	US$	%
1. Annapurna	29,500	5.2	20,100	13.4	1,088,120	78.1	618,583	34.0	1,756,303	44.6
2. Khumbu	383,000	67.0	96,450	64.3	149,970	10.8	239,700	13.2	869,120	22.1
3. Langtang	5,500	1.0	6,750	4.5	42,135	3.0	97,515	5.4	151,900	3.9
4. Others	153,500	26.8	26,700	17.8	113,510	8.1	863,294*	47.4	1,157,004	29.4
Total	571,500	100.0	150,000	100.0	1,393,735	100.0	1,819,092	100.0	3,934,327	100.0
	(14.5)		(3.8)		(35.4)		(46.2)		(100.0)	

Source: Table adapted from Gurung. Paper presented to the Japan Himalayan Club. 30th Anniversary, January, 1998.

1. Nepal Tourism Statistics, 1995. Area break-down by mountain ranges

2. NMA Parbat, ICM '97 Special Issue. Based on trekking permits issued in 1995. Revenue break-down is tentative based on US$ 5.00 per week for Langtang and US$10.00 (two weeks) for other areas. A total of 588,000 US dollars was realised from trekking permit to Upper Mustang in 1995. Excludes the high fee and low volume areas of Manaslu and Dolpo for lack of data.

3. DNPWL, Annual Progress Report 2052/53, Tables 3 & 4; and ACAP source

** The Chitwan National Park in the Terai realises a very large proportion of this amount.*

Society and Culture

Tourism has far-reaching implications for the society and culture of mountain areas. Remoteness and inaccessibility have shielded mountain communities for centuries. Consequently, the process of adaptation and change has historically been a slow process. Tourism has shown the potentials for accelerating this change. It is, however, just one of the many factors making inroads on the secluded lifestyles and cultures of mountain communities. The norms of behaviour and patterns of consumption of tourists can have a seductive impact on society, particularly among the young. These impacts may manifest themselves in the decline in local cultural practices and institutions, commercialization of art, loss of symbolism of cultural events, theft of cultural and religious objects and artifacts and a thriving black market. Positive effects of tourism on culture as evidenced in Nepal include openness to new ideas and opportunities, realization of the "worth" of native cultural and religious heritage, and motivation to maintain traditions (Sharma 1995). Tourism has contributed to the renewal and revival of ancient traditions of stone, wood and bronze work in the Kathmandu valley. Revival of festivals such the Mani Rimdu in Tangboche indicates that, whatever the motivation, communities have more interest in their own culture. The Sherpas of the Khumbu illustrate not only the economically invigorating effects of tourism and the revitalization of culture but also the difficulty of cultural "restructuring", of trying to search for an identity that find an equilibrium between local traditions and the demands and needs of the modern world (Ortner 1999).

The impact of tourism on women in Nepal is a subject that has not been the focus of much research. Some of the advantages of tourism for mountain women may include greater economic independence (Gurung 1995; Lama 1999). But tourism appears also to increase work burden on women as undertake responsibilities related to tourism in addition to household chores and agricultural duties.

om tourism has induced young boys and girls to migrate to Japan, Hong Kong, Western Europe and the Gulf countries in search of job opportunities.

This brief review of the implications of tourism on aspects of the environment, economy and society reveals that economic, and social benefits of tourism is limited to strategically located settlements and population groups that already have some resources to take advantage of tourism opportunities. The role that tourism has played in changing the face of areas such as the Khumbu and Annapurna has by all

accounts been spectacular. But the generally observed processes are environmental degradation, high leakages of tourism income, limited spread of benefits, and inadequate linkage of tourism with the productive sectors of the economy. The tourism-environment-development nexus does not always seem to be spontaneously positive. Policy and programme interventions are called for in linking tourism with sustainable development of the mountain areas of Nepal.

KEY CONCERNS IN MANAGING MOUNTAIN TOURISM IN NEPAL

In the light of the above discussion certain high-priority concerns in managing mountain tourism in Nepal can be highlighted here. Some of these concerns are already being addressed in various ways through efforts such as the Annapurna Conservation Area Project (Stevens 1997). It is necessary to learn from experience and to adjust policies and programmes accordingly. Indeed, a long-term policy perspective on mountain tourism with clear guidelines for planning, promoting, regulating, monitoring and managing mountain tourism is already overdue in Nepal.

In the mountain areas of Nepal tourism appears to be an attractive option for enhancing the quality of rural life. But the benefits of tourism may not flow spontaneously where they are most needed. Interventions are therefore called for to make tourism relevant to the three interrelated concerns of mountain development, namely, alleviation of poverty, environmental conservation, and empowerment of local communities. For rural mountain communities tourism has to be seen essentially as a development intervention.

Broader Sharing of Tourism Benefits

Poverty remains an endemic feature of mountain areas. Poverty can be reduced only by creating conditions for the provision of secure livelihoods. Sustainable tourism therefore has to place emphasis on host population's environment, economy, society and culture. Strengthening the tourism-development nexus by inducing a process of a broader sharing of tourism benefits appears to be the only way to address the question of poverty. Experience shows that the most broadly shared benefits of tourism stem from three processes: build-up of infrastructure (both physical and environmental such as better trails, drinking water, health and education facilities, communication, afforestation and better environmental care), forward and backward linkages with the production regime, and human resources development at the local level. This can occur only in areas where there is reinvestment of tourism-generated resources. To the extent that these processes are strengthened, there is a potential for the benefits of tourism to be broadly shared.

Institutionalization and Implementation of An Impact Monitoring Framework

There is at present a plethora of anecdotal evidence but no systematic understanding of mountain tourism in Nepal. Without the conceptual framework, there can be no operational framework to monitor the impact of mountain tourism, which in turn is indispensable for improved planning and mitigation of negative impacts.

Carrying capacity, or the limit to acceptable change, of major trekking routes and destinations has not been a major concern of tourism policy in Nepal. Indeed, recent government policies give the impression of a laissez faire attitude with respect to all three major routes. In order to frame effective policies and programmes, we must expand research on visitation patterns, visitor impacts and the scale at which negative effects begin to surface, as well as on the perceptions of visitors themselves.

Revenue sharing for Environmental Conservation and Community Development

Environment is not only the fundamental resource on which tourism depends but also the one most threatened by tourism. Sustainable tourism entails periodic reinvestment in conservation. This requires the mechanisms to ensure the sharing of revenues from mountain tourism with the communities of the tourism destination. This is where the Annapurna experience has been innovative. The total amount realized from the entry fee to Annapurna Conservation Area goes to the ACAP endowment and through it to the CDCs according to programmes developed at local levels and envisaged local contributions. While ACAP has had a relatively salutary effect, high value tourism in Upper Mustang has been far less effective, due mainly to the government's reluctance to share the proceeds from tourism with UMCDP and local communities. In 1998 only 4.1 percent of the entry fee of about $ 750,000 realized from trekkers to Upper Mustang had actually gone to fund UMCDP activities (Sharma 2000a). The process of resource reinvestment in tourist areas makes a larger community the beneficiaries of tourism through better sanitation, health, education, and environmental awareness. Environmental conservation also calls for the introduction of alternate energy technologies. Such technologies and systems can be affordable to households only when tourism enhances income levels. The issue of linkage therefore becomes important for environmental conservation.

Alternate Energy

Efficient energy sources that may alleviate the pressure on forests are clearly a high priority, and one with enormous implications for mountain environments, particularly where tourism is a factor. Improved stoves and backboilers, and renewable energy technologies such as micro-hydro and solar are significant potential in this regard (ICIMOD/CRT 1997). A study at Ghandruk in the Annapurna shows that lodges with efficient and alternative energy technologies reported much less firewood consumption than lodges without such devices (Banskota and Sharma 1997). Conservation education, adoption of energy efficient technologies, and introduction of renewable energy technologies can play important roles in easing the problem of fuelwood demand.

Environmental degradation in the hills and mountains of Nepal is mainly attributable to the lack of options for sustainable livelihoods in the face of an increasing population. Of the three contributors to deforestation in the Nepali highlands - conversion of forests to arable land, overgrazing, and extraction of fuelwood - the last has remained preeminent. Tourism has contributed by exacerbating the demand in certain areas; it is not, however, the sole contributor. Large-scale implementation of the new technologies is possible only if poorer households can afford; at present, this is not the case. Indeed a broader linkage of tourism with local economy seems to be called for to facilitate broader benefit sharing and increased household incomes of the poor. Several factors including awareness, affordability, availability, design, supportive grass roots institutions seem to be important in inducing households to climb up the energy ladder.

Institution Building and Participatory Planning of Tourism

Experiences such as that in the Annapurna Conservation Area Project in Nepal indicate the critical importance of participatory institution building at the local level in the process of linking tourism with environmental conservation and economic, social and cultural development (Gurung and de Coursey 1994). Such institutions clearly need to be nurtured to monitor and deal with tourism impacts, to orient the benefits accruing from tourism to environmental regeneration and provision of basic services, and facilitate

the more equitable distribution of tourism benefits. Broad representation, local leadership and trust, transparency of decision making, cooperation with existing institutions, and a resource base are essential to the development of local institutions that may actually empower their communities.

Strengthening Linkages with the Local Production Base

The importance of strengthening linkages of tourism with the local production base cannot be overemphasized. If more of the tourist needs and demands are met through local and regional production a larger share of tourism revenue will accrue to the locality or the region. Tourism development has to be conceived not as the development of one particular sector but an integrated exercise in developing the critical sectors, environment being one of the most important, on which tourism depends. Broad sharing of tourism benefits is facilitated and promoted if the linkages with the local production base are enhanced. In Nepal's experience, such linkage has been weak.

Training and Manpower Development

Training and manpower development may be the most important contribution of tourism to local communities. Training also builds confidence in the local communities. However, such development requires accurate identification of needs and opportunities. Training in lodge management, cooking, housekeeping and local guiding skills related to culture and nature are found to link well with local employment opportunities.

Diversification of Tourism and Supply Side Planning

In Nepal, tourism in general and mountain tourism in particular have remained essentially demand-driven. Diversification of mountain tourism, both in terms of product and destination, has been lacking. Moreover, demand-driven initiatives related to tourism tend to be extractive. There have been very few attempts at supply-side management (destination planning) or targeted enhancement of demand (Sharma 2000b). Tourism markets change with changes in income, age and other characteristics of tourists. While the appeal of Nepal's mountains as a trekkers' paradise will endure, the need for innovative diversification of the tourism product is important if tourism is to provide a sustainable option for livelihood in the mountains.

Increasing the Capacity of Stakeholders by Recognizing Their Comparative Advantage

Globalization and privatization notwithstanding, the state has a strategic role to play in orienting tourism impacts to desirable directions. The government can play the most effective role in creating a policy environment conducive to the growth of desirable type of tourism in specific contexts, developing and enforcing regulations and standards in tune with the carrying capacity, infrastructure development, establishing a system of judicious sharing of tourism revenues, manpower development and tourism promotion in the international market. Non-governmental agencies can also be helpful in organizing and mobilizing communities, acting as catalytic agents, and facilitating participatory planning of tourism at the local level. Local community organizations are crucial players in the planning of tourism, in monitoring impacts, and in initiating mitigating actions. The private sector is most effective in providing services and in running service establishments. In view of this there is clearly a need to increase the capacity of these different stakeholders at local, regional and national levels.

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Ecotourism: Bridge between Biodiversity Conservation and Development in Nepal

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ABSTRACT

Tourism is the second important source of foreign exchange for Nepal. Tourism-related activities generate revenue and will remain central to the economic sustainability of the country. Tourists' arrival in 1962 was 6,179 and the highest number of tourists (491,504) arrival in one year by air was recorded in 1998-1999 by TDB (Tourism Development Board) of Nepal. A growing alliance has been developed between the tourism sector and protected areas. Approximately 39% tourists (191,617 out of total 491,504 tourists in the country in fiscal year 1998-1999) visited protected areas in Nepal. Tourist arrivals are expected to grow 8-10% annually in the near future.

Nepal's landscape is predominantly composed of hills and mountains with amazing rich biodiversity at habitat, ecosystem, species and genetic levels within a relatively small area. The unique biodiversity of Nepal play a key role in maintaining the Himalayan ecosystem and adjoining areas. However, negative environmental impacts such as destruction of forest and other natural resources, loss of biological and cultural diversity are accelerated due to increasing number of tourists visiting Nepal which is exclusively centred in only few protected areas (Royal Chitwan National Park, Annapurna Conservation Area, and Sagarmatha (Mount Everest) National Park). Tourists are mainly engaged in visiting most popular trekking routes, climbing mountain peaks or riding on elephants to observe wildlife. The ecotourism potential of other protected areas as well as other areas of natural beauty, rich biological and cultural diversity, local people's knowledge about the biodiversity and natural history and their traditional life style remain largely unexplored. Another prerequisite about ecotourism is to create schemes, which allow the local communities to obtain fair share and direct benefit from ecotourism, and bring incentives from biodiversity conservation.

Tourism related policy and strategy including the Ninth Five Year Plan (1997-2002) has given emphasis to promote religious tourism, cultural tourism, and ecotourism and village tourism by His Majesty's Government (HMG) of Nepal. If ecotourism is to contribute seriously to biodiversity conservation and development, certain basic guidelines that: (i) provide significant benefits for local residents including education and health facilities, (ii) contribute to the conservation and sustainable use of the natural resources by improving links between local communities and those who manage protected areas (PAs), (iii) determine the carrying capacity of PAs that can sustain ecotourism accompanied with newer sites of tourist hotspots, and (iv) develop and manage programs to minimise negative impacts on environment and indigenous culture are required to be fulfilled. This paper focuses on ecotourism and makes arguments that: Does increasing PAs entry will sustain ecotourism? Does local incomes will conserve ecological and social damage? and Does increased ecological damage will reduce tourism in Nepal? An integrated approach among all stakeholders in ecotourism that combines fulfillment of basic needs of the society and environment conservation will be essential for sustainable tourism.

KEYWORDS: Ecotourism; biodiversity conservation; protected areas; Nepal

INTRODUCTION

Nepal is a Himalayan mountainous country of natural beauty, spectacular landscape, rich biological diversity, extraordinary cultural heritage and mosaic of ethnic diversity. It lies in strategic crossroad of eastern and western Himalayan ecosystems, Palearctic and oriental realms and consists of two Worlds Natural Heritage sites combined with eight World Cultural Heritage sites. This uniqueness has provided enormous potentiality of tourism development in the country. Tourists visiting Nepal are nature lovers who prefer the hills, mountains and wilderness or pilgrims who remain in urban and semi-urban areas.

Nepal is a centre of rich biodiversity due to vast topographic contrast and climatic conditions that range from tropical to alpine. A total of 35 forest types and 75 vegetation types have been described. The country harbours high share of species diversity within a total area of 147,181 km^2 (only about 0.1 percent

of the total land area of the world) including birds 844 species (9.3% of total species in the world), bryophytes 853 species (5.1%), gymnosperms 27 species (5.1%), mammals 181 species (4.5%), pteridophytes 380 species (3.4%), angiosperms 5,806 species (2.6%), butterflies (635 species) and moths (2,253 species) 2,888 species (2.6%), and algae 687 species (2.6%). The high altitudes of the Himalayas are known worldwide for their richness in medicinal herbs (over 100 species), rhododendrons (30 species, four subspecies and 8 varieties), saxifraga (89 taxa), primula (77 taxa), orchidaceae (over 350 species), and so on (Chaudhary 1998). However, high population pressure and poverty in Nepal are causing pressure to the forest and wilderness areas ultimately leading to massive deforestation, habitat degradation, over-exploitation of biological resources and threat to extinction of many animals and plants in the country.

To uplift the country's socio-economic condition, tourism industry, which plays an important role in the economy of the country by providing opportunities for employment and the capacity for earning foreign exchange has been highly promoted in Nepal. Nepal Tourism Statistics (NTB 1998-1999) recorded a total of 491,504 tourists visiting Nepal during 1999 representing an increase of 6% over the previous year. The gross foreign exchange earning from tourism in 1998 stood at US $ 152.5 million and its contribution to GDP is 3.5%. Approximately 56% of the tourists visited Nepal for the purpose of holiday pleasure and 24% come for trekking and mountaineering. Sightseeing tourists are concentrated mostly in urban areas like Kathmandu and Pokhara, whereas trekkers spread in rural and mountain regions. Number of tourists visiting Nepal is seasonal, maximum during October-November and minimum during June-July of the year. Majority of tourists from different countries visiting Nepal include India (30.88%), Japan (8.06%), USA (7.74%), UK (7.65%), Germany (5.14%), France (4.74%), Netherlands (3.1%), Italy (2.77%), Australia (2.4%), Spain (1.9%), and Switzerland (1.43%) contributing to 75.8% of the total tourists.

Tourism development has put pressure on all local resources where the concentration of tourists is high. Tourists consume energy and water, produce sewage and solid waste, and pollute air. In addition, lodges and transport facilities developed for tourists often degrade landscape and damage nature. These occur mainly in remote areas, thus accelerating negative environmental impacts.

As the polluting effects of mass tourism became more evident, alternative forms of tourism are to be identified and promoted. Ecotourism is only one of many forms of tourism. Ecotourism (*sensu stricto*) differs from 'nature tourism', which is concerned with the enjoyment of nature and their supporting ecosystems such as forests, mountain terrain, grasslands, coral reefs; ecotourism additionally requires a contribution to conservation.

The word 'ecotourism' has been coined relatively recently. The tag 'Eco-' has been used as prefix with different activities such as ecotour, ecotravel, ecosafari, ecovacation and so on, however, ecotourism has been quickly able to exploit the marketing value of tourism industry. According to Goodwin (1996), ecotourism is 'low impact nature tourism which contributes to the maintenance of species and habitats either directly through a contribution to conservation and/or indirectly by providing revenue to the local community sufficient for local people to value, and therefore protect, their wildlife heritage area as a source of income'.

Ecotourism trend indicates that an increasing number of tourists now prefer to visit sites of attractive natural beauty comprising rich biological and cultural heritage, often off the beaten track. Nepal's protected areas located in wide range of ecological zones, different altitudes and having unique traditional culture provide amazing opportunity of wilderness. This trend can favour biodiversity conservation as well as enable local communities for economic benefits when tourist activities are well regulated.

Natural and cultural environment comprises the major resources for ecotourism. These resources need to be maintained over the long term to attract tourists. More number of tourists are becoming environmentally sensitive in selecting their destinations and demand a high level of environmental quality and local cultural interest wherever they travel (Inskeep 1992).

According to the Globe 1990 Conference on Environment and Industry, sustainable tourism requires management of tourism resources in such a way that fulfils economic, social and aesthetic needs while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems. This implies that maintaining environmental resources and cultural integrity is essential while still bringing equitably distributed socio-economic benefits of tourism to residents of the tourism area is the essence of sustainable tourism development.

No one would question that tourism benefit to individuals as well as to national economy. Nor would anyone in government and industry would question the need for the protection of the environmental systems, which support the tourism industry (Anonymous 1992). If the challenge of Governance can be met, and economic, social and environmental impacts of tourism can be directed through appropriate strategic, rather than occur indiscriminately, then tourism can serve as an engine for sustainable community development (Manning 1998). The role of significant community participation and continuing, open dialogue among stakeholders, including those who traditionally have not heard, has been vital in working towards balancing tourism development and environmental protection in Banff and Banff National Park, Canada (Draper 2000).

In Nepalese perspectives, the biggest question is to reconcile goals of sustainable tourism and environmental protection. Even more challenging is how to build up equitable partnership with local communities and develop fair collaboration between government organisations, tourism and local people within the tourism industry. In this background, Nepal possesses several challenges and opportunities in the front of environmentally and economically sustainable tourism. This paper provides an overall assessment and contribution of ecotourism in biodiversity conservation and nation's development as a whole.

METHODOLOGY

The paper argues the needs for the development of ecotourism in Nepal that can form a bridge between conservation and sustainable use of components of biodiversity and development through analysis of current state of knowledge about tourism, review of tourism related documents, strategies, development plans, programs, institutional arrangements, policies, and personal interviews with relevant officials.

RESULTS

Impact of Tourism

Although a significant amount of revenue is generated through tourism, little attention has been paid to arrest environmental degradation. In all the popular destinations of Nepal, local forests are under heavy pressure due to fuel, timber and fodder requirements. The other problems involve solid waste management, sanitation and water supply, overgrazing and erosion of paths and trails (Jefferies 1982; Singh 1992; Brown et al 1997). The choice of fuelwood species has changed from *Shorea robusta, Acacia catechu, Terminalia tomentosa* to *Adina cordifolia, Lagerstroemia parviflora, Holarrhena pubescens* in the low lands, and *Castanopsis* spp., and *Quercus* spp. to *Engelhardtia spicata* and *Symplocos theifolia* in the hills

of Nepal. These species are under pressure to fulfil the needs of the local inhabitants and tourists.

Protected Areas (PAs) and Tourism

Tourism is the second important source of foreign exchange for Nepal. Tourists' arrival in 1962 was 6,179 and the highest number of tourists (491,504) arrival by air was recorded in 1999 (NTB 1999-2000) (Figure 1). A growing alliance has developed between the tourism sector and protected areas. Approximately 39% tourists (191,617 out of total 491,504 tourists in the country) in the year 1998/99 visited protected areas in Nepal. A large number of ecotourists visits only a few protected areas (Royal Chitwan National Park (77,266 visitors), Annapurna Conservation Area (66,320 visitors), and Sagarmatha (Mount Everest) National Park (21,372 visitors), as shown in Table 1. The above three protected areas accommodate 86% (164,958 out of total 191,617) of the total tourists visiting protected areas with highest concentration in Royal Chitwan National Park. Tourist arrivals are expected to grow 8-10% annually in the near future. As tourism-related activities in and around the protected areas generate revenue and this will remain central to the economic sustainability of the protected area system.

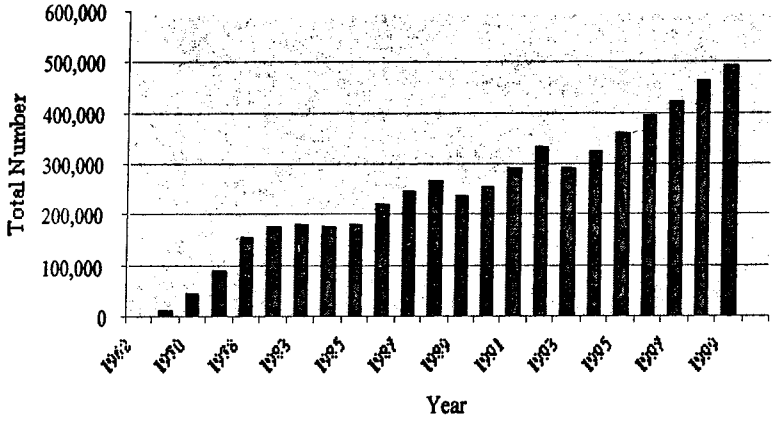

Figure 1. *Tourist Arrival(1962-1999) in Nepal(Source: Nepal Tourism Board)*

Tourism Related Strategy and Policy

The National Conservation Strategy for Nepal developed in 1988 (HMG/IUCN 1988) placed an importance to Nepal's economic growth by increasing annual earnings from tourism targeting to: (i) develop tourist areas in remote areas, and (ii) expand trekking routes by establishing the necessary ancillary physical facilities.

Nepal Environmental Policy and Action Plan in 1993 (HMGN 1993) identified the need to develop a new tourism policy by addressing a number of strategic issues, which include: (i) attracting limited number of high-budget travellers, (ii) opening new tourist areas, (iii) identifying appropriate mechanism for charging fees for trekking and mountaineering permits, and (iv) developing institutional capacity to monitor and regulate the environmental impacts of tourism.

Table 1. *Tourism in Nepal's most visited national parks*

Feature	Royal Chitwan National Park	Sagarmatha National Park	Annapurna Conservation Area
1. Characteristics			
Size (sq. km)	932	1,148	7,629
Year of declaration	1973	1976	1992 (initially in 1986)
IUCN Management Category (Year)	World Heritage Site (WHS) (1984)	WHS (1979)	-
Landscape location	Lowland	Hills & Mountains	Hills & Mountains
Resident population (estimated)	242,000 in buffer zone	3,000	120,000
PA management authority	DNPWC	DNPWC	ACAP
Regulation implementation authority/body	Royal Nepal Army	Royal Nepal Army	Local communities
Foreign visitors (1998/99)	77,266	21,372	66,320
Principal activity	Wildlife and culture viewing	Trekking & mountaineering	Trekking & mountaineering
2. Local Economic Benefit			
Local economic benefit attributed to tourism	Minor	Significant	Significant
Local peoples involvement	Stick dance, grass cutting	Guides	Community development projects
Beneficiary groups	Lodge/hotel owners	Lodge/hotel owners	Lodge/hotel owners
3. Revenue Capture (Entry fee)			
SAARC Nationals	NRs. 200 (per day)	NRs. 100 (per entry)	NRs. 100 (per entry till 31 Dec. 2000)
Other Foreigners (current)	NRs. 500 (per day) Approx. $ 7.00	NRs. 1,000 (per entry) Approx. $ 14.00	NRs. 1,000 (per entry till 31 Dec. 2000) Approx. $ 14.00
Other Foreigners (Dec. 1991-1999)	NRs. 650 (per entry) Approx. $ 16.00	NRs. 650 (per entry) Approx. $ 16.00	NRs. 650 (per entry) Approx. $ 16.00
Trekking permit fees	-	$50,000 (for 7 members team)	$ 1,500 to 10,000 (for 7 members team)
4.Biological characteristics & environmental threats			
No. of Angiosperms (expected species)	919	1,074	3,430
Fauna	Rhinoceros, tiger, sloth bear, crocodile	Red panda, snow leopard, musk deer	Snow leopard, panda, blue sheep, tahr, bharal
Environmental problems	·Excess of tourists ·Ineffective management ·High population	·Deforestation ·Over-grazing ·Waste disposal ·Ineffective management	·Deforestation ·Over-grazing ·Waste disposal

Nepal Environmental policy and Action Plan, Phase II (NEPAP-II) in continuation to the process initiated in 1993, two projects that integrate biodiversity with tourism namely *Biodiversity Conservation and Ecotourism and Forest Ecotourism Promotion and Development* have been proposed (HMGN 1998). These projects aim at promoting tourism in some potential new areas (Kaski, Baglung, Dhankuta, and

Jumla districts), and designing income-generating forest based programs with the help of local and private investors. The proposed program is also to undertake biological monitoring to evaluate the changes brought about by tourism.

The Ninth Five Year Plan (1997-2002) under its long-term objectives aims at developing (mass) tourism as an important part of overall economic development. Also, emphasis has been placed to promote ecotourism activities and expand the benefits of tourism to the village level. Local communities will be mobilised in the conservation and management of tourist resources. Natural, cultural and historical resources will be conserved and consolidated through the coordinated efforts of local government bodies, tourism entrepreneurs and bodies responsible for cultural promotion. Emphasis will be given to produce local goods and handicrafts for tourist consumption. An environment code of conduct will be formulated and local government bodies and private entrepreneurs will be mobilised to maintain environment quality conducive to tourism.

Tourism Policy 2052 (1995 AD) has been formed by Ministry of Tourism and Civil Aviation following the guidelines of the 9th Plan (HMGN/MTCA 1997) and developing marketing plan for the years 1999-2000 by Nepal Tourism Board (NTB 1999-2000). The main emphasis has been given to develop tourism industry as a main economic sector of the nation by establishing its inter-relation with other sectors of the country. Proposals have been made to develop 'Tourism Environment Guideline', and 'Code of Conduct concerning Environment'. 'Tourism Council', a high level body of representatives from Government and relevant tourism sectors give policy level guidelines to the subordinate executive agencies and review related plans.

Chapter 13 (the Mountain Agenda) of Agenda 21 identifies the need to generate and strengthen 'knowledge about the ecology and sustainable development of mountain ecosystems' and to promote 'alternative livelihood opportunities', including sustainable tourism, in mountain regions.

The policy, strategy and guideline are adequate to effectively manage the tourism sector in Nepal. The gap exists, however, in the implementation and targeted plans.

DISCUSSION

Tourism based largely on observation of wildlife within protected areas is a major and growing source of income for many developing countries. Although much initial tourism was based on the larger forms of wildlife that inhabit the tropical forests, increasing attention is now being given to ecotourism, which includes interest in the whole array of forest plants and animals. For example, there are tours to see butterflies and tours to coral reefs (Botkin and Keller 1995).

Despite various opportunities for tourism development in Nepal, important existing challenges that remain associated with ecotourism include identification and popularisation of newer tourism destinations, extension of services and facilities in newer ecotourist sites, determining carrying capacity of PAs for sustainable tourism, developing institutional mechanism for improvement of tourism and co-ordination among the relevant organisations.

Ecotourism is one of the most important ways in which money is generated to manage and protect the natural habitats, species and cultural integrity. The protected areas in Nepal generate money through park entry fee, filming permit fee, and helicopter landing. Park entry fee are collected at park entrances and sent to the Ministry of Finance. In addition, trekking permits to the specified areas such as Dolpa, Upper Mustang, Manang, Humla are issued by Department of Immigration, whereas Ministry of Culture,

Tourism and Civil Aviation charge royalty for mountaineering peaks.

Does Increasing PAs Entry Fee Will Sustain Ecotourism?

The entrance fees were raised from NRs. 60 (approx. $ 2.40) until 1988-1989 to NRs 250 (approx. $ 10) after November 1988, or June 1989 in case of Royal Chitwan National park, to NRs. 650 (Table 1; approx. $ 16 in 1991 which reduced to approx. $ 9.50 in 1999 due to devaluation of Nepalese Rupees). In this regard, Wells (1993) has rightly pointed out that increase in fees have not so far discouraged visitors, and there may be considerable scope for capturing higher revenues through further increases. To overcome this problem, there has been a change in entry fee for all national parks, reserves and conservation areas recently (2000 AD) within which a difference has been noticed in terms of amount entrance fee and duration or per entry to the protected areas. For foreigners, park entry fee to Royal Chitwan National Park is NRs. 500 (approx. $ 7) per day where most of tourists spend in average 2-3 days as package tour, whereas fee per entry to Sagarmatha National Park and Annapurna Conservation Area is NRs. 1000 (approx. $ 14). It is unfortunate that foreigners have to pay the entry fees in Nepalese currency and weakness in Nepalese currency has reduced the U.S. dollar value, thus making no additional cost to the foreigners. Moreover, visitors from top ten countries visiting Nepal (excluding India) have the highest per capita income (range from $ 15,960 for Spain to $ 29,240 for USA) in the world. The Galapagos National Park in Ecuador charges $ 40 and Parc National des Volcans in Rwanda charges $ 170 as entry fee for foreign visitors (Wells 1993).

Tourism could become one of the major components in biodiversity conservation, mainly of some protected areas that are visited by large numbers of tourists. Virtually no studies have so far been done on the carrying capacity of national parks or protected areas in Nepal. Impact of tourism in biodiversity has not been quantified either. NEPAP-II placed emphasis to study sustainability of tourism in protected areas (HMGN 1998). Nepal's tourism concentration exclusively centred in only few protected areas suggests to rethink on the carrying capacity of the PAs that can support the visitors' flow in such PAs, as well as to further raise the entry fee of selected PAs. There has been increase in Entry fee from NRs. 1,000 to NRs. 2,000 per person to Conservation Areas (Annapurna and Manaslu) effective from 1 January 2001 for foreigners with the long-term goal to reduce the impact of tourism in highly popular trekking routes.

Equally important mechanism proposed elsewhere could contribute to conservation and development and that is leasing rather than buying land from local residents in newly developed areas (Roque 1992). Ecotourism hotspot sites possessing combination of biological, environmental and cultural attributes such as an area rich in biological diversity, rare species, endemic species, and indigenous culture accompanied are needed to be identified, and the above mechanism could be tested in Nepal.

There has been little attention paid to develop policy on benefit sharing with indigenous people and conservation education in Nepal. A partnership should be established to initiate and expand rural entrepreneurs that develop tourism-related businesses.

Does Local Incomes Will Conserve Ecological and Social Damage?

Ecotourism is a kind of non-consumptive industry having direct and indirect impact on biological resources. Even if revenues generated by tourism were to increase local income directly, there is no guarantee that increased incomes would reduce the rate at which forests are converted to farmlands (Brandon and Margoluis 1996). Typically, ecotourism industry employs personnel from outside a region and fees charged to the visitors go to the government, not to the community, but local communities pay

ecotourism's price (Roque 1992). For example, the Tharus community in Royal Chitwan National Park has been serving as open zoo for the visitors at the cost of preserving nature since a long time. Also there has been so much practical negligence and contrast that the Tharus living as neighbour with highly standard hotels and lodges still use iodine devoid salt in their meals. The poaching of wild animals and illegal hunting of rare, threatened and endangered plants and animals still continue until now despite enforcement of legislations. However, a promising example of ecotourism has been developed in Annapurna Conservation Area by linking tourism, conservation and development.

Does Increased Ecological Damage Will Reduce Tourism?

An assumption is that ecotourists will avoid ecologically damaged natural areas (Yu et al 1997). Most of the tourists are in package tour. Tourists are provided limited information by the travel/trekking companies about environmental deterioration in Nepal and moreover tourists expenditure in Nepal is very low (ie, $ 45/day at present) than the neighbouring Himalayan countries, such as Bhutan (ie, $ 200/day).

CONCLUSIONS

Ecotourism benefit protected areas by: (i) contributing directly to conservation through park entree fees, accommodation, (ii) enabling local people to gain economically from protected areas, and (iii) raising awareness the importance of conservation and ecological literacy to both domestic and foreign tourists. If ecotourism is to contribute seriously to conservation and development, certain basic guidelines are necessary to be followed, which include to:

- provide significant benefits for local residents including education and health facilities,
- contribute to the conservation and sustainable use of the natural resources by improving links between local communities and those who manage protected areas,
- incorporate environmental education to tourists and local communities,
- determine the carrying capacity of PAs that can sustain ecotourism accompanied with newer sites of tourist hotspots, and
- develop and manage programs to minimise negative impacts on environment and indigenous culture.

To put them in practice, government and industry should involve local communities as equal partners in all phases of ecotourism planning and development. The Convention in Biological Diversity (article 10.e) encourages co-operation between its governmental authorities and its private sector in developing methods for sustainable uses of biological resources and ecotourism. Thus, all the co-operating parties share a common recognition that the sustainable use of biological resources is desirable for the country - socially, economically and environmentally, and ecotourism has to contribute significantly as bridge between biodiversity conservation and development.

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Tourism in Lijiang and the Jade Dragon Snow Mountains, Northwest Yunnan, China: Benign Development or a Pact with the Devil ?

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ABSTRACT

The paper gives an account of the development of tourism in Lijiang County (northwestern Yunnan) since 1985 when it was officially opened to foreign tourists after decades of complete isolation. This spectacularly mountainous county is (officially) the home of seven different ethnic minorities. The mountain landscape, with one of the world's deepest gorges and snow-capped peaks, indigenous cultures, outstanding architectural treasures, and rich flora and fauna has provided a strong attraction for rapid development of tourism. The problems of preserving indigenous culture and environmental stability are discussed in the face of an unprecedented influx of foreign capital and visitors, exacerbated by conflicts between the logging industry and a fledgling conservationist ethic. Enlightened local leadership has greatly reduced the dangers of inappropriate commercialization and degradation of the beautiful old Lijiang City (Dayan, ancient capital of the Naxi nation was designated a World Heritage Site in 1997). Nevertheless, the integrity of the wider mountain region and its impoverished minority peoples remain in the balance. Will the forces driving development learn nothing from the environmental and cultural mistakes of Kathmandu and so sign a pact with the devil, or will something of the ancient Naxi environmental ethic prevail? Some partial solutions are proposed.

KEYWORDS: Yulong Xue Shan, Jade Dragon Snow Mountains, Dayan, ecotourism, indigenous culture, deforestation, Joseph Rock

INTRODUCTION

In July 1985 the State Council and Military Commission of Yunnan Province declared Lijiang Naxi Autonomous County open to foreign tourism.

In December 1986 Lijiang City was designated a province-level historical and cultural attraction. In the following decade, international tourism increased rapidly, presenting substantial opportunities and risks. Lijiang County includes some of the poorest communities in China; presumably these places could benefit from the economic jump-start afforded by successful tourism development. At the same time the county has significant natural resources, including forests and potential sources of hydroelectricity, as well as unique topographical features and ecosystems. These resources are in danger of being over-exploited unless they are effectively protected. The development of appropriate forms of tourism could provide a strong stimulus for conservation.

While tourism presents opportunities, it also entails risks. The primary risks are degradation of the natural and cultural environment, particularly those features that are promoted as tourism amenities. There are other risks to the hosts, including economic disruption, as well as risks for investors, and even physical risks for travellers. One area of Lijiang County where the opportunities and risks are greatest is the Yulong Xue Shan, or Jade Dragon Snow Mountains.

Tourism is never a purely local phenomenon. In terms of attractions, there is both competition and synergy among clustered destinations. The appeal and accessibility of "gateway" locales contribute directly to the appeal and accessibility of the comparatively remote destination. The destination in question, in turn, may function as a gateway to even more remote sites. Depending on the interests and time constraints of visitors, a downstream destination may either enhance or diminish the appeal of an

intermediate locale. The popularity of Yunnan's provincial capital, Kunming, and of its many surrounding attractions, is critical, at least in the early stages, to the viability of tourism in the relatively remote counties of Dali and Lijiang. The development of tourism in Lijiang City, the county seat, would appear to have the strongest influence on development of the Jade Dragon Snow Mountains; the appeal of Lijiang City itself derives in part from the other sites throughout the county, as well as in the neighbouring county of Zhongdian to the northwest. The tourist industry in the very recently opened county of Deqen is currently dependent on spill-over from Lijiang, but further development of amenities in Deqen - and the eventual opening of the Yunnan-Tibet Highway - could presumably equalize or reverse this influence. Any plan for the development of tourism in the Jade Dragon Snow Mountains, therefore, must take into account an extended geographical context[1].

In addition to conditions in the host area, tourism development depends on factors relating to the visitors. These include: timing of visits; duration of stay; preferences in transportation (long-distance and local), accommodation, eating, and recreational activities; and patterns of expenditures. Analysis of current and future tourism impact must accommodate not just the intrinsic characteristics of the host area, but also the larger context of the international tourism industry.

In the 1960s it became fashionable to think of tourism as a solution to some of the world's most intractable problems: poverty and inter-cultural misunderstanding (IUOTO 1963; Hinch and Butler, 1996). Tourism was believed capable of creating economic opportunity in backward destinations with comparatively little investment since the stock-in-trade would be that very backwardness - primitive culture and pristine nature. According to this optimistic scenario, tourism would bring jobs and a market for handicrafts. Economic independence would lead to cultural pride and self-determination. The natural environment would be preserved due to the holistic proclivities of indigenous peoples. A sustainable symbiotic relationship between host and visitor would emerge as survival of cultural and natural assets was recognized as a shared priority.

More recent experience has not borne out the expectation that increased economic activity, through a "trickle down" effect, would result in a well-distributed increase in prosperity (Zurick 1995:15). Instead, it is realized that foreign capital transfers are subject to "leakage": costly goods and technology must be imported by the host country to support tourism. A disproportionate share of the wealth generated usually ends up in the hands of outside investors (who may own both local and international transportation facilities and other infrastructure) and tour operators, as well as a few local politicians and entrepreneurs. Within the host countries, foreign earnings tend to accrue primarily to the urban areas; tourism not only fails to alleviate the poverty in the rural areas, but actually aggravates the economic asymmetries.

Much of the foregoing discussion refers to what has become known as mass tourism. In response to its negative aspects, critics and tour operators have promoted alternative designations including *adventure tourism, ecotourism, nature tourism, cultural tourism*, and so on. A distinguishing feature of these varieties of *appropriate* or *alternative* tourism, supposedly, is their commitment to the natural environment and traditional lifestyles. Yet many problems remain. The thirst for "new" or "undiscovered" destinations implies that they have a short life: the hidden paradise evolves inevitably toward mass tourism attractions while the purists continue their search for the exotic elsewhere. Thus the very notion of "sustainable development" through tourism may be a non sequitur.

Furthermore, bridging many of the points of view introduced above, scholars in the field of gender

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[1] *Based on recent information, Zhongdian already has an airport and planning is well advanced for development of the Meili Xue Shan, on the border between Deqen and Tibet, as a major "ecotourism" region (Zackey 2001, pers. comm.).*

studies have taken increasing interest in the problems of tourist development. This includes differential social and economic impacts on male and female hosts (division of labour, control of revenues, and human rights), as well as the differential opportunities for male and female travellers. Particularly serious problems include prostitution (sex tourism), separate male and female economies, and reallocation of resources in ways that place a disproportionate burden on female hosts.

The following account outlines the physical and cultural attractions of Lijiang County, and especially the Jade Dragon Snow Mountains; recounts the development of tourism in the county between 1985 and 1996; and discusses the apparent conflicts that are occurring between mass tourism and the lower-impact tourism. It concludes with a proposal for a specific tourism model that already may have been eclipsed by the rapid development of infrastructure designed for mass tourism.

Lijiang County and the Jade Dragon Snow Mountains

Situated across latitude 27° North (Figures 1, 2), and with elevations ranging from 1,500 - 5,600 m asl, the landscape of Lijiang County is extremely varied. (See Photo 1) It includes rice paddies and lush meadows at the lower elevations, forested middle slopes steepening to the upper timberline at about 4,200 m, alpine meadows above, leading up to precipitous ice-fretted ridges and peaks that support Eurasia's southernmost glaciers. This majestic panorama is traversed by the spectacular course of the Jinsha Jiang (upper Yangtze) which climaxes in the "Tiger Leap Gorge". Here, for a distance of 25 km, the Jinsha has carved one of the world's deepest gorges along a major tectonic dislocation between the 5,500 m summits of the Haba Xue Shan and the Yulong Xue Shan (Jade Dragon Snow Mountains). In Tiger Leap Gorge (where, according to Naxi legend, a tiger jumped across the Jinsha to escape pursuit; see Photo 2), one finds within a horizontal distance of barely five kilometers a panoply of ecosystems ranging from subtropical monsoon rainforest (including the upper limits of banana plants) to alpine tundra and permanent snow and ice. Limestone terrain, with fretted pavements, sink holes, vanishing lakes, and underground caverns, along with sandstone pinnacles and travertine terraces, add to the attractions. The terrain, and its extremely diverse flora once supported a comparably varied fauna, including red panda, leopards, bears, tigers, wolves, foxes, and many birds, among which are several species of colourful and rare pheasants endemic to the Jade Dragon Snow Mountains, and a variety of raptors.

The monsoonal climate is tempered by the altitude, so that summers are cool and pleasant, relative to much of China and Southeast Asia. Spring and autumn, with low precipitation, are magnificent; even winters in the lower elevations are invigorating and appealing to active visitors: in the mountain villages above 3,000 m and in the absence of artificial light the night skies are major attractions in themselves.

The biological diversity of the region is matched by the cultural diversity. The highly accidented landscape and the enormous variety of agricultural and economic constraints provided habitats for many distinct ethnic minorities, including Naxi, Yi, Tibetan, Bai, Mousu, and Han. From the tourist's perspective, these cultures contribute to the "exotic" and "authentic" appeal of the region. In particular, the Naxi, who comprise the dominant minority, have a long and proud history; it is even argued that the pictograph literacy of their ancient (Dongba) culture predates the development of Han script. Regardless of the accuracy of this claim, the Naxi culture has produced an array of architectural gems that survived the Cultural Revolution or have been repaired and rebuilt since 1980. These are concentrated in and around the "Old Town" of Lijiang (Dayan), designated as a World Heritage site by UNESCO in 1997. There are also numerous outlying temples, well preserved traditional villages, manicured agricultural landscapes, extensive surviving minority customs and costumes which, together with the magnificent mountain setting,

collectively provide the incentive for a wide range of tourism styles. Given that mass tourism has received high-level governmental priority since 1990, the primary question is whether there are any niches remaining for less destructive forms of travel tourism.

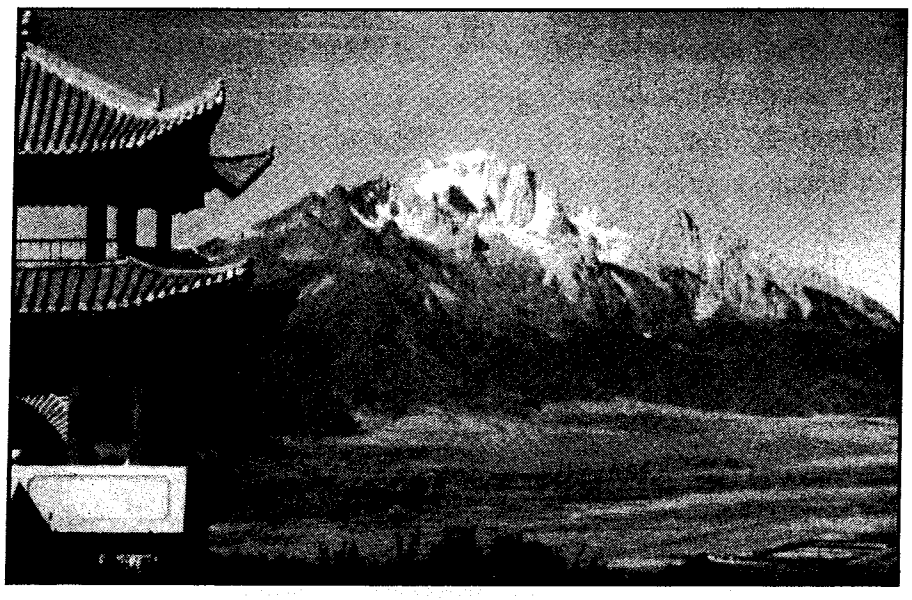
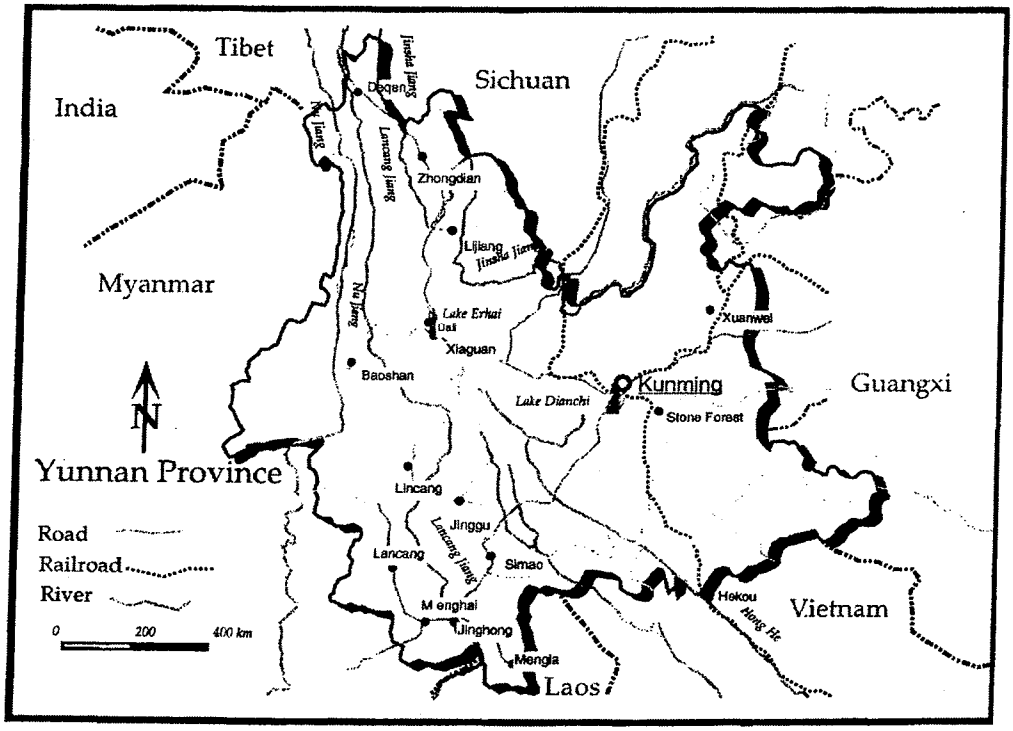


Photo 1. *View of Yulong Xue Shan rising above Yuhu on the Lijiang Plain, taken from Elephant Hill*

Figure 1. *Location of Yunnan*



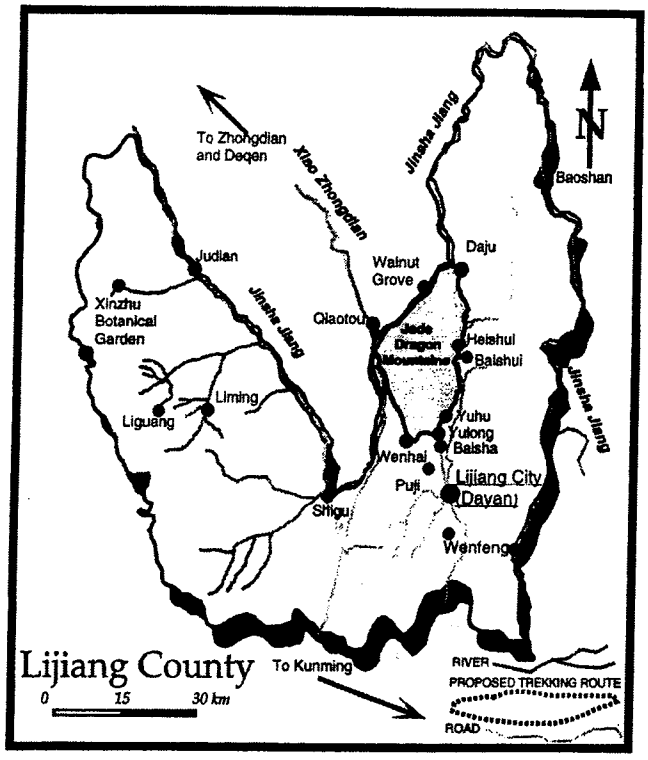


Figure 2. Lijiang in its provincial context (a:top) and Lijiang County (b: bottom)

The Evolution of Lijiang Tourism Since 1985

With the opening of the Lijiang region to foreign visitors in 1985, the tourism scene has developed from an extremely primitive level, at the end of a torturous two-day bus or jeep drive from Kunming, to one of rapidly extending paved roads, four-star hotels, attractive restaurants, air conditioned luxury tour

buses, and a modern airport giving 30-minute access from Kunming. Additionally, the condiions tied to granting World Heritage status have drastically reduced the pressure on the Old Town for gross development, although it is surrounded by unappealing modern architecture that is spreading out across the Lijiang plain like a gangrenous wound. Despite the catastrophic earthquake of February 1996, which destroyed a third of the buildings in the Old Town and damaged most of the others, the destruction itself was courageously and effectively used by the county and provincial governments, with extensive international financial assistance, to eliminate non-traditional structures that did survive and to reestablish much of the traditional beauty. Nevertheless, the 1998 visit of Jiang Zemin produced hyperbolic praise for the Lijiang Tourism Development Bureau and the county government as a successful model of (mass) tourism development.

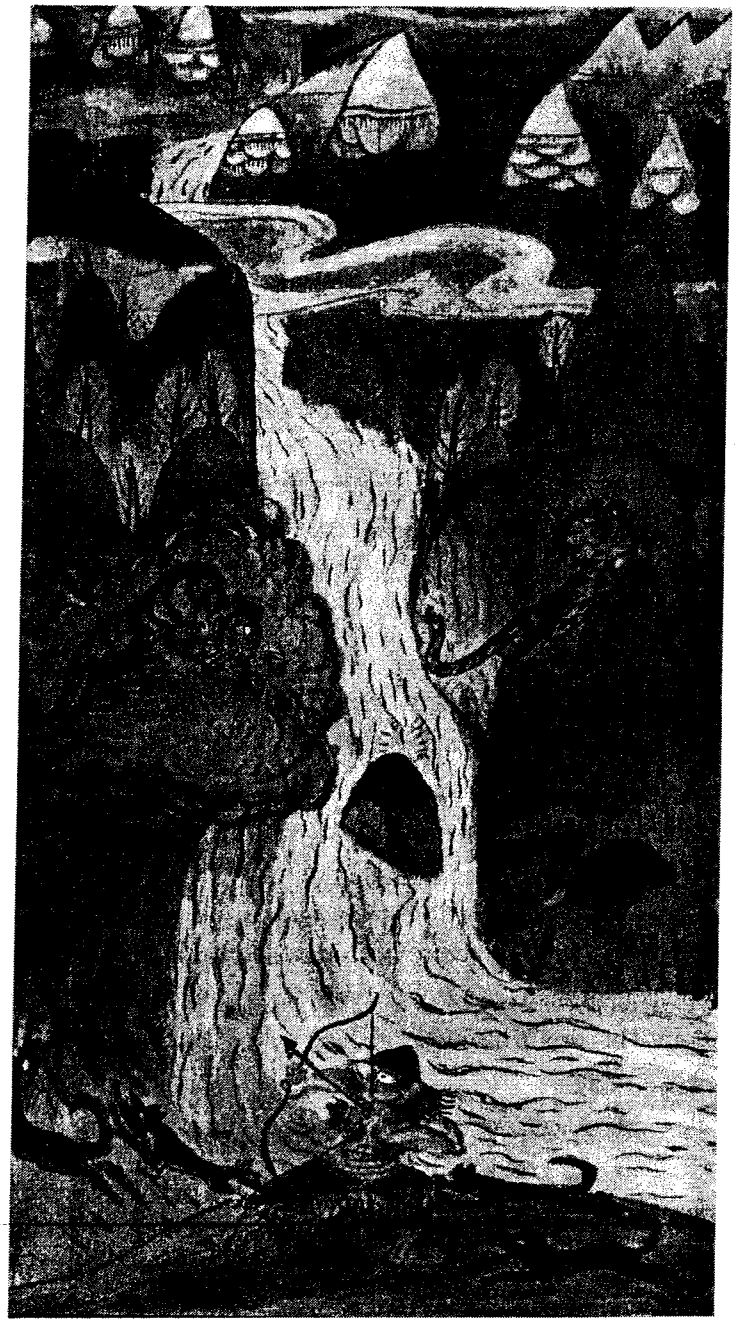


Photo 2. *Naive painting with elements of ancient Naxi style represents the myth of Tiger Leap Gorge: encouraged by his mate, a harried tiger pauses before leaping to safety.*

Concurrently with the development of Lijiang City and the Old Town, much of the Jade Dragon Snow Mountains is being protected as a nature preserve. Nevertheless, the small tectonic basins that run along the eastern foot of the mountains have become sites for elitist hotels, a golf course (currently under construction), and a pleasure park. The integrity of the mountain nature preserve itself has been compromised by the construction of a chair lift and a large gondola system. The former opened in 1994 and provided tourist access to one of the more attractive subalpine meadows steeped in Naxi tradition; the latter cuts a swath through the mountain forest belts to 5,000 m, well above timberline, and provides instant access to snow fields, glaciers, and delicate alpine meadows; a third lift has been constructed recently. The apparent motive here is to enable some of the more affluent millions of the city people of Southeast Asia and of China, lacking previous experience with snow, to indulge in the fantasy of summer snowball fights at hypoxic elevations. Finally, the integrity of the Tiger Leap Gorge, a potential World Heritage site in its own right, is being challenged by construction along its entire length of a wide road-bed adequate for large tour buses (The only benefit likely to come out of opening the gorge to mass tourism is that it may impede plans for a major hydroelectric project).

These infrastructural activities coincide with the dramatic increase in the number of tourists since 1985. Table 1 shows foreign arrivals in Lijiang annually from 1985 to 1996. The marked increase in arrivals represents an average annual growth rate of more than 70 percent, culminating in 1996 (our most recent year for data) in excess of 100,000 persons. This, however, is only a small proportion of total visits when the much larger, and equally rapidly growing, domestic element is taken into consideration.

Table 1. *Foreign tourism in Lijiang, 1985-1996*

YEAR	Foreign Tourists	Percent Increase
1985	688	
1986	1,992	190 %
1987	4,717	137 %
1988	7,563	60 %
1989	5,997	-21 %
1990	6,653	11 %
1991	9,275	39 %
1992	12,533	35 %
1993	15,850	26 %
1994	50,000	215 %
1995	65,000	30 %
1996	102,000	57 %

Source: CITS

Nevertheless, it is the foreign tourists who provide the vast majority that are inclined to indulge what we would consider "appropriate" tourism. Most of those taking the three-day trek through the Tiger Leap Gorge are of "western" origin. This group also is more likely to walk or bicycle to the more distant and/or off-road villages.

In aggregate the top eleven nationalities represented in our Lijiang tourist survey are as follows:

1. Netherlands (16.2%)
2. United Kingdom (14.9%)
3. United States (10.8%)
4. Denmark (9.5%)
5. France (8.3%)
6-7 Israel and Australia (6.6% each)
8 Canada (5.0%)

9-11. Belgium, Germany and Sweden (2.9% each)

Data were also collected on the male-to-female ratio among foreign visitors. One might anticipate that the earliest arrivals in a newly opened remote destination would be predominantly male and that as tour groups became more numerically significant the proportion of females would increase. The Lijiang Tourist Office and our own statistics confirm this trend: in 1985 the male:female ratio was 63:37; in 1993 it was 56:44; but the following year men were outnumbered by women, 43:57. Most respondents to our survey in 1993 and 1994 were in their twenties and thirties. In the 1993 sample the mean age of men was 30.0 years and of women 26.6 years. The 1994 figures were not significantly different.

We also collected data on the occupations of foreign tourists. As expected, a large proportion of respondents identified themselves as students (23% in 1993; 29% in 1994). Educators constituted the second largest category (11% in 1993; 15% in 1994). Other well-represented occupations included: engineers; social workers; architects; medical professionals, especially nurses. It is of interest that a very low percentage of foreign visitors arriving in Lijiang were businessmen compared with visitors to China as a whole (3.3% and 22.5%, respectively). It must be emphasized again, however, that the number of foreign visitors, despite the rapid increase between 1985 and 1996, is dwarfed by the number of domestic visitors. While increasing numbers of young Chinese (Han) are entering the mountains as trekkers, the target market for the development scheme outlined below is the foreign sector. This is because of the importance of attracting foreign currency and because the kind of low impact backpacker tourism we are advocating is an established style of travel among Western and "westernized" tourists and not among domestic travellers.

The Jade Dragon and the Tiger's Leap

The Jade Dragon Snow Mountains loom over the town of Lijiang. They are the sacred peaks of the old Naxi Dongba tradition, a recurring motif in Naxi lore. The combination of colourful folklore, beautiful and proximate mountain scenery, extensive remnants of ethnic minority cultures (Naxi, Yi, Bai, and Tibetan), temples and monasteries, and the Tiger Leap Gorge on the far side of the range, provides a rich resource base for tourism development. These elements are enhanced by the remarkable, almost legendary, figure of Dr. Joseph Rock who lived and worked at the foot of the Yulong Xue Shan from 1923 until 1949.

The sacred mountain of the Yulong has a commanding place in Naxi folklore, comparable to that of the Tibetan Shambala (fictionalized as Shangri La in James Hilton's Lost Horizon). It impinged more drastically on Naxi society after 1723 when the Qing Emperor Yongzheng tightened Han control over his minority subjects through the military governor in Lijiang. Confucianized political and social institutions were enforced on a previously open and matrilinial society. Hitherto, teenage relations had been essentially unrestricted and "love marriages" were more common than parentally-arranged contracts. After 1723, among many other changes, pre-marital chastity and Han-style prearranged marriages were required; out-of-wedlock childbirth was severely deprecated. This led directly to suicide pacts among love-stricken Naxi young people, often in groups of up to ten couples. According to Naxi beliefs, those who killed themselves following prescribed rituals in designated auspicious locales beneath the high peaks would attain blissful everlasting youth in a mystic valley beyond the mountains. For more than 200 years, and as recently as the 1950s, this tragic custom took a significant toll of the Naxi population. The most famous of the "jumping-off" points is the subalpine meadow called Yunshanping, now known to the burgeoning tourist trade as "Love-Suicide Meadow" (Swope et al 1997). It was largely to exploit this somewhat macabre resource that a chair lift was opened in 1994.

Joseph Rock had travelled the length of the Tiger Leap Gorge in the 1920s. In the post-Mao Zedong

era, however, few visitors had seen this world-class natural spectacle prior to its official opening as a park in 1992. The traverse involves a trek of about 30 km between Qiaotou, a small rough-hewn settlement in the south, and Daju, the northern trailhead. More than twice the depth of the Grand Canyon, but much narrower and with snow peaks on either side, Tiger Leap Gorge can be 'done' in two days, but it is much better to tarry. There are many possibilities for side excursions, and the family-owned guest houses at Walnut Grove are well-known attractions in their own right. The primary route varies as seasonal rains and earthquakes render the trail unstable but not actually perilous. It is conjectured that the new bus route may be more dangerous. There is also a high-level footpath that is far more stable. During dry weather, even in winter, dehydration and stroke are the most serious safety hazards.

The number of visitors increased from about 8,000 in 1992 to 25,000 or more in 1995. The drop to about 13,500 in 1996 was probably due to the after- effects of the February 1996 earthquake, the epicentre of which was directly beneath the gorge and resulted in increased slope instability. Efforts to blast a motor road through the entire route from Qiaotou to Daju resulted in a temporary closure after 1996.

Circumambulating the Jade Dragon: A Development Scheme

The Jade Dragon Snow Mountains and the Tiger Leap Gorge present obvious opportunities for trekking tourism. The picturesque but impoverished villages need only a modest amount of assistance to enable them to draw economic advantage from their cultural and topographic legacy. In circumambulating the mountain core in 1993, we found that there were only a few sections of the route where the trail would have to enhanced for trekkers, but that the greatest need was a convenient distribution of locally owned and managed lodges.

We propose a trek that begins and ends with the two villages, Yuhu and Wenhai, at the southern tip of the Jade Dragon range. The western branch of the walk, which could take from one to three weeks, would pass through Tiger Leap Gorge while the eastern branch winds through the low hills south of Daju and beneath the sheer eastern face of the Jade Dragon range. Yuhu, a Naxi village within an hour's jeep drive of Lijiang City, and also accessible by bicycle or foot, is the site of Joseph Rock's expeditionary headquarters of some seventy years ago. This is an opportunity for an important tourist attraction: the old farm that Rock used should be acquired and rehabilitated as a museum celebrating the ethnographic and natural wealth that were his magnificent obsessions (Rock 1924). An adjacent building should be equipped as a trekking lodge, to be operated by the village cooperative.

From Yuhu, a four-hour walk leads up to a wooded ridge and then descends gently to the exquisitely beautiful and impoverished lakeside village of Wenhai (3,200 m). With its splendid lake reflecting the Jade Dragon's glittering white teeth (actually a seasonal lake that disappears down a limestone sinkhole during the winter dry season), Wenhai is a potentially valuable tourist destination in its own right; moreover, the village is the logical base for the easiest route to the highest summits in the range (See Photo 3).

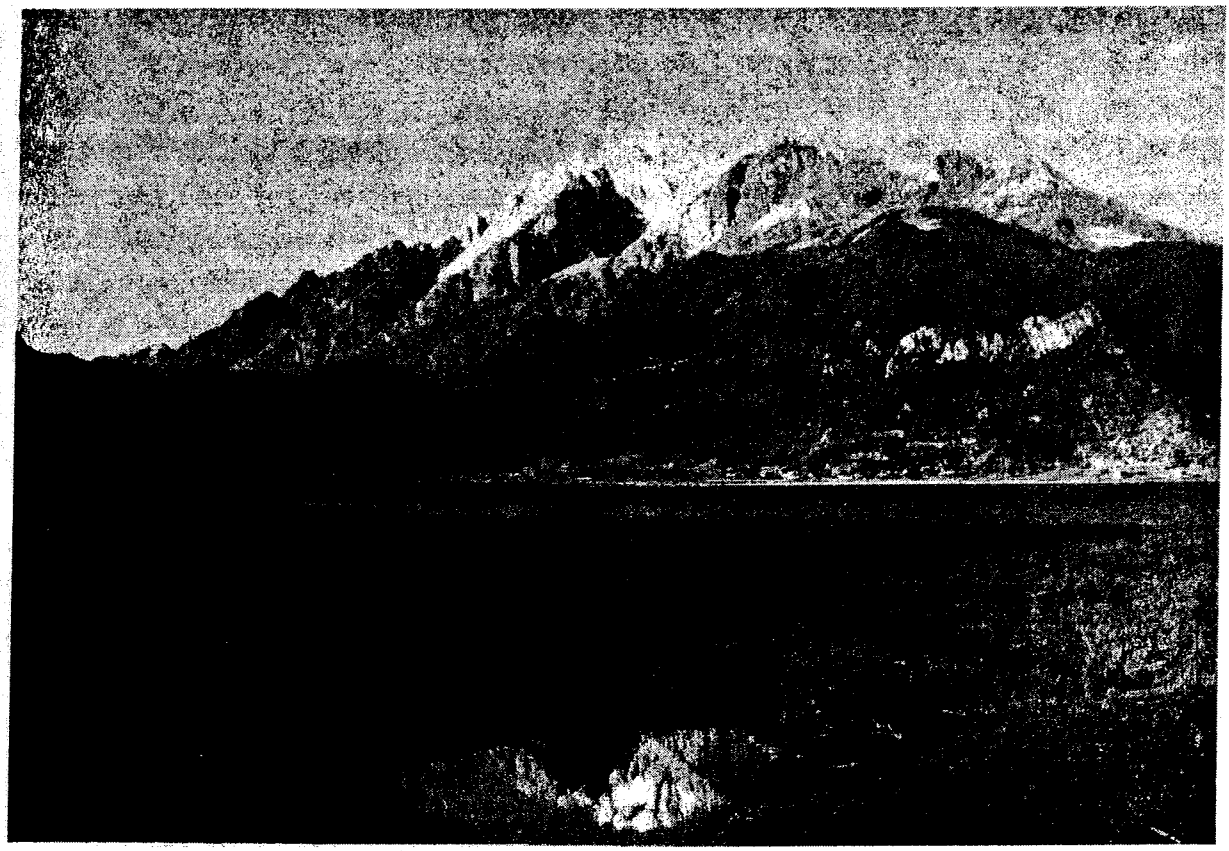


Photo 3. *Wenhai Lake and the peaks of Yulong Xue Shan. The Jade Dragon Mountains rise above Lijiang Plain.*

The trekking route would proceed northwestward from Wenhai through a series of small and isolated Yi villages. With an extension of a few kilometers around Longpan, the trail would drop nearly into the mouth of the Tiger Leap Gorge, avoiding the motor traffic on the dusty main road from Lijiang. Having traversed the gorge and reached Daju, the trekker would find that the eastern limb southward offers several variations via Yi and Tibetan villages. Side excursions are available, including a long but technically unproblematic ascent of the northern summits to approximately 5,400 m (accomplished by Rock in 1929), and a superb day trip into a side canyon replete with waterfall and hanging glacier, which was (as recently as 1995 at least) virtually unvisited by anyone other than local shepherds.

The establishment of village cooperatives in Yuhu and Wenhai was actually initiated in 1995 with assistance from our United Nations University/ Ford Foundation team. The Governor and Party Secretary of Lijiang offered enthusiastic moral support. A farmhouse in each village was acquired for development as tourist lodges. Links were established between the tentative village cooperatives and the Lijiang Cooperative Research and Training Centre, which was being assisted by a research group from Simon Fraser University, Canada, funded by the Canadian International Development Research Centre (IDRC). This was intended to facilitate the development of cooperative management skills among Yuhu and Wenhai personnel.

Putting the circumambulation scheme into effect requires a substantial but not daunting investment of effort and money. The actual trekking route needed to be delineated and mapped; additional lodges and cooperatives in other villages must be established in some areas; management procedures need to be worked out; and the entire destination needs well-targeted promotion. But there were a host of additional

options to match: accredited field courses for Western university students would provide a captive clientele for the trekking lodges as well as volunteer labor for survey exercises and trail; development of dining facilities at the lodge could be the first step in marketing local products, including yak butter, fish from the Yuhu hatchery and from Wenhai Lake (which would have to be managed to prevent its annual disappearance); a rhododendron nursery (already established) and captive breeding and release of rare pheasants would set the stage for specialized tours for rhododendron enthusiasts and nature photographers; and mild commercialization of the impressive costume dancing of both Yi and Naxi villagers. But already in 1993 we felt the growing impingement of the development of mass tourism. Would we be in time to help the mountain villagers help themselves?

A number of developments seemed to conspire against our scheme. In February 1996 a massive earthquake (7.2 on the Richter scale) devastated the entire area. Much of the Old Town of Lijiang was reduced to rubble. In Yuhu and Wenhai the two farms already obtained for conversion into trekking lodge collapsed. For a variety of reasons, our funding sources dried up. We had not been authorized in the first place to become tourism entrepreneurs; furthermore, a United Nations research institution cannot easily justify functioning as a development agency; and, paradoxically, development agencies find it inconvenient to fund development projects that cost mere hundreds of thousands of dollars rather than millions.

CONCLUSIONS

The question posed in the title of this paper will not yield an absolute answer. Certainly "benign development" is too optimistic. There is no doubt that the disparity between local wealth and poverty widening; this appears to occur wherever tourism expands rapidly in regions lacking sufficiently strong cultural and institutional structures. It is equally clear that the overall standard of living has improved dramatically since 1979; an accurate cost-benefit analysis will not be immediately forthcoming. Nevertheless, one does not have to probe very deeply to observe certain disconcerting developments.

One example is the "Love-Suicide Meadow". Here it was the extremely poor Yi villages nearby who seized the initial benefits from the tourist potential. They acquired horses and set their traditionally gaily costumed womenfolk to lead the gaudily caparisoned beasts bearing their well-heeled clients up the 600-metre ascent to the beautiful meadow. Within two years the three small Yi villages had assembled over a hundred horses as business boomed. The first negative result was an ugly competition between rival families. A second problem was litter, including plastic bags on which Yi livestock choked to death. (We must stress that the major litter problem comes from domestic and other Asian tourists, who take a much more casual approach to this problem than do Europeans and North Americans.) Next the chair lift was constructed with foreign investment, effectively undercutting the Yi business. A temporary shift to horse riding and racing in the meadow had to be terminated by the authorities because of the excessive environmental damage, and the villagers were left with dozens of horses they could not afford to feed and with neglected subsistence crops. The chair lift was amortized within two years; paved road, car park, restaurants, and guest houses sprang up overnight. Over the last several years tourist buses have even begun to cause traffic jams! As the local Yi witnessed the eclipse of their entrepreneurial initiative, two troupes of young Yi village dancers were "imported" from further afield. The girls were paid a pittance to satisfy the curious tourists; curiosity degenerated into prostitution. [A fuller account of development in the "Love-Suicide Meadow" is available in Swope et al (1997).]

At the other extreme is the success of the recovery of the Lijiang Old Town after the 1996 earthquake

and its designation as a World Heritage site in 1997.

Fortitude and good sense have combined to ensure turning the catastrophe into opportunity: non-traditional buildings have been eliminated; old buildings have been reestablished; the pre-earthquake encroachment of motorized traffic halted; the town is now a very comfortable, and culturally interesting destination. However, the rise in property values is forcing out original Naxi families to make room for boutiques and restaurants. The result is, at a minimum, loss of authenticity and diminishment of the exotic - Lijiang City's major stock-in-trade.

The situation in Tiger Leap Gorge is more serious. We contend that such needless desecration of a world-class attraction is indeed a "pact with the devil." The persistent economic distress of many poor villages such as Yuhu and Wenhai suggests that there remains a possibility for benign tourism development in a mode that will lift the living standards of the local minority peoples while promoting cultural diversity and protection of the environment; we may still find that opportunity in our proposal for a village-managed trekking route around the Jade Dragon. Yet the juggernaut of mass tourism has arrived. It will not stop in Lijiang but will move into the rest of northwestern Yunnan. As a rural development strategy tourism appears to be failing.

ACKNOWLEDGEMENTS

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Biodiversity and Tourism in the Sacred Valley

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ABSTRACT

Rolwaling Valley in north central Nepal presents an unusual combination of problems and opportunities linking biodiversity and tourism development. It is well-established that tea house trekking offers the most beneficial results both for the hosts and for most guests (Odell and Lama 1998). Relatively isolated and unimpacted, Rolwaling has been prevented from realizing its potential as an ecotourism destination by an unfair regulation requiring trekkers to acquire expensive trekking peak permits, which also entail traveling with fully-equipped caravans. The prominent models for tourism development are inappropriate in Rolwaling; with only modest external assistance, however, Rolwaling could easily transform itself into a popular trekking destination in its own right and a convenient route of access to or egress from Sagarmatha National Park.

KEYWORDS: Beding, EcoHimal, ecotourism, independent backpacker, Nepal, Oekohimal, Rolwaling, trek

INTRODUCTION

Since 1999, the authors have been running a study-abroad program that focuses on tourism development in the Khumbu District and Rolwaling. Rolwaling initially caught our attention because of the well-publicized danger of a Glacial Lake Outburst Flood (GLOF) from Tsho Rolpa, the largest moraine-dammed glacial lake in the Himalayas. This danger seems to have been mitigated through an ambitious engineering project initiated by the Netherlands-Nepal Friendship Association. It turns out, however, that Rolwaling has other problems. While the Sherpas of Khumbu have become the most prosperous minority in Nepal, the Sherpas of Rolwaling languish in a stultifying economic limbo due to the arbitrarily restrictive regulations on tourist access. As matters stand now, Rolwaling is a remarkable cultural and natural sanctuary, but one which is on the threshold of rapid change on a scale that could easily overshadow the most violent GLOF. Will planners be as successful in mitigating this threat as they have been at averting a catastrophic flood?

FACTORS CONTRIBUTING TO ISOLATION

Rolwaling's value as a biological refuge derives partly from its location and physical isolation (Figure 1). Running east-west for approximately 30 km, it is separated from Tibet by a stretch of the Himalayas that includes Gauri Shankar (7,134 m), which for some time was thought to be the highest peak in the world. The Rolwaling River flows into the Bhote Kosi (one of several in Nepal); this Bhote Kosi soon becomes the Tamba Kosi. Simigaon, at the confluence of the Rolwaling and the Bhote, is about 90 km east of Kathmandu as the crow flies. It can be reached by a 4 or 5 day trek from Barabise, which lies on the road to Tibet in the next valley to the west, or by a 2 or 3 day trek from Dolakha, the district administrative seat, located on a short branch off the Swiss road that connects Lamosangu with Jiri. The latter trail, the lower trails in Rolwaling itself, and particularly the steep ascent to Simigaon, are subject to frequent damage during the monsoon season, a problem that has recently been alleviated somewhat by improvements initiated by the Austrian agency Eco Himal and by the Tsho Rolpa GLOF hazard mitigation project being carried out by Nepal Hydro and General Construction in conjunction with Bhutwal Energy and HMG's

carried out by Nepal Hydro and General Construction in conjunction with Bhutwal Energy and HMG's Department of Hydrology and Meteorology (DHM) (Photo 1). To the east of Rolwaling is Khumbu district, which in 1976 was gazetted as Sagarmatha National Park. The wall of peaks between Rolwaling and Khumbu is breached by the formidable Tashi Laptsa pass: with good weather, one can make the crossing between the last settlement in Rolwaling and the most westerly settlement on the Khumbu in about four days. Altogether, access to Rolwaling is not quite impossible, but definitely more inconvenient than the most popular trekking routes, several of which can now be approached by air.

Fugure 1. *Location of Rolwaling Valley in north-central Nepal*

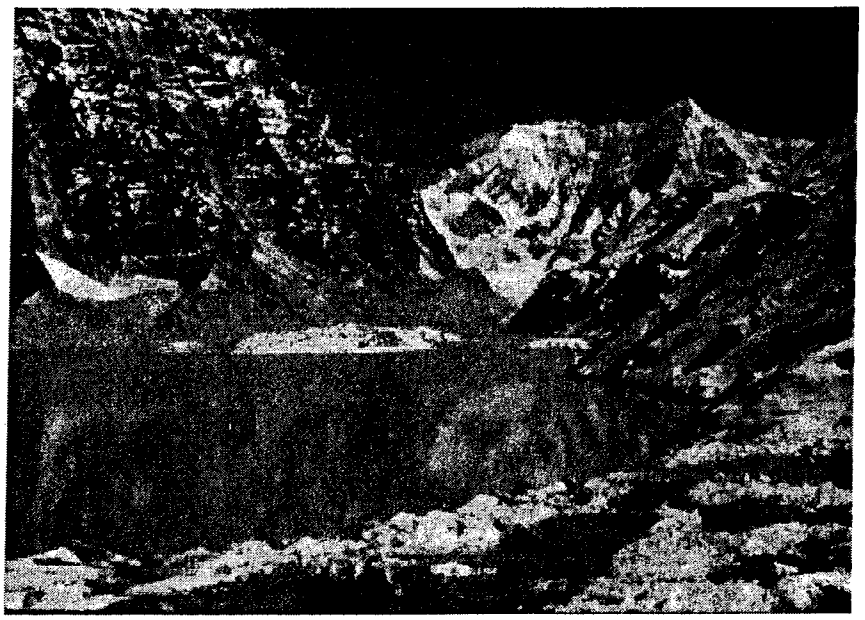

Photo 1. *Tsho Rolpa: flood hazard and tourist attraction*

Cultural factors have contributed to the conservation of species in Rolwaling. According to Tibetan Buddhism, about 1,250 years ago Padmasambhava [aka Guru Urgyen Rinpoche] plowed the valley out of the mountains in order to serve as one of eight "beyul," refuges that were to remain hidden until, in a time

of religious crisis, they would serve as sanctuaries, protecting dharma until the danger passed. The neighboring Khumbu was one such zone, and Rolwaling, in the shadow of the mountain abode of the goddess Tseringma (ie, Gauri Shankar), was another. Unlike Khumbu, Rolwaling remained unvisited and unimpacted until the nineteenth century, and then by a very few wanderers and outcasts. Due to the limited amount of arable land and the unsuitability of this east-west valley as a trade route between Tibet and India, Rolwaling's inhabitants remained poor and few, but devoutly mindful of their spiritual heritage. The Buddhist bans on hunting and slaughter, elsewhere observed less scrupulously, have protected the fauna; even plants are considered living creatures that ought not to be harmed if possible.

A third general factor that has contributed to the relatively unimpacted state of Rolwaling Valley has been the government's limitation of tourist access. Until recently, one needed both a trekking peak permit and a regular trekking permit. Last year, the requirement for regular trekking permits was eliminated in the most popular trekking districts, including Annapurna, Langtang, and Khumbu. Nothing was announced about trekking permits in Rolwaling, but most agencies have interpreted the new regulation to mean that they are not required. Officially, however, you still need a trekking peak permit to trek in Rolwaling. A trekking peak permit is not the same thing as a trekking permit. Trekking permits are dispensed by the Department of Immigration, and revenues go to His Majesty's Government (HMG). Trekking peak permits, on the other hand, are granted by the Nepal Mountaineering Association (NMA), and all funds collected belong to that organization. The trekking peaks are a set of about 20 smaller peaks ranging from about 5,500 to 6,500 m. Taller peaks require regular expedition permits, and these are also administered by the NMA.

The rules for trekking peak permits changed in 1999; previously there were two sets of trekking peaks, A being slightly higher than B and costing $300 for a ten-person permit instead of $250. Now all the permits are $350 for four people; $40 each is charged for the fifth, sixth, seventh and eighth members; $25 more for each additional member up to twelve. The trekking peak permit requirement, however, entails other costs: the permits can only be acquired through a registered trekking agency. This agency is theoretically supposed to grant them only to groups which are spending at least $20 per person; they are supposed to have an insured guide, which means that the group must be safely equipped, and effectively entails a full complement of tents, camping equipment, food, and porters. In other words, no teahouse treks. For years, Immigration personnel have openly informed would-be trekkers that they can indeed hike in Rolwaling if they are willing to pretend that they intend to climb a trekking peak. So, although Rolwaling has theoretically been restricted to climbers, in fact it is open to trekkers, provided they put a lot of money into the pockets of the NMA and a trek outfitter. Practically, however, few non-climbing trekkers have been going to Rolwaling, and the local people are making very little money from the self-sufficient group treks. Therefore there has been very little development of infrastructure, and not much impact on the environment.

In terms of biodiversity, Rolwaling is worthy of close attention. Janice Sacherer estimated that there are approximately 300 different plant species (Sacherer 1977, 1979). The atypical east-west orientation of the valley creates conditions unlike those in any other valley of the Himalayas. Partially shielded by its southern wall from the monsoon, Rolwaling has characteristics of the dry inner Himalaya; a good part of the flora derives from the Tibetan steppe and, in Nepal, is more typical of eastern valleys. As in other Himalayan valleys, Rolwaling's ecosystems vary dramatically from the broad glaciated valleys to the chiseled fluvial channel downstream; to a much greater extent than in other valleys, the sharp contrast between north- and south-exposed slopes affects the distribution of species. The east-west orientation of

the valley also makes it a convenient corridor for mobile fauna. Rolwaling is visited by quite a few of the charismatic mammals, including wolves, fox, several species of goat, bear, jackal, langur, and several members of the cat family, notably the snow leopard. Every resident that we interviewed on the subject is convinced that yeti frequent the valley. In short, Rolwaling's biological assets are clearly worth studying; their conservation should also be accorded high priority as the valley's protective isolation breaks down. Furthermore, one cannot consider development scenarios in the high Rolwaling Valley without assessing the implications for the rich subtropical ecosystems of the Tamba Valley into which it feeds.

If isolation has had a benign effect on the natural ecosystem, the human residents of Rolwaling have observed the tourism boom with envy. In next door valleys, every family could throw open its doors to backpackers and cash in on the amenity values of their homeland; in Rolwaling, the stakeholders stare wistfully as organized trekking caravans deploy their tents by the river, cook up their burrito and quiche feasts, and buy nothing from the local residents. In Khumbu, their relatives enjoy the benefits of prosperity: schools, upscale monasteries, telephone, electricity, numerous clinics, a hospital, post office – not to mention Internet, saunas, pool halls and chocolate croissants: none are available in Rolwaling. Many young men have found employment with trekking and climbing services. Such work entails extended absence from Rolwaling, and even emigration to Kathmandu or Khumbu. The result is a brain and manpower drain that leaves the villages of Rolwaling populated by women, children, and those no longer capable of strenuous labor. Agricultural fields have been abandoned, livestock ineffectively tended, trails poorly maintained. Alcohol, the only recreational option, is a serious health problem.

This disparity between the neighboring districts has created in Rolwaling (as in the access routes) an intense demand for free access to backpackers and economic opportunity. Last year, due to Maoist attacks on police primarily in western Nepal (not in Rolwaling or Tamba), the police checkpost in Simigaon was removed. There is no longer any effective restriction on independent trekkers. Inevitably the word will get out, and they will begin to arrive.

The question is: how can the impending tourism expansion be managed in a way that minimizes the environmental and cultural damage? There are several prominent models for sustainable tourism development in Nepal alone, and each has many positive aspects. However, in the next pages we will mention only the negative aspects, and indicate why the major models are poorly suited to Rolwaling.

HOW *NOT* TO DEVELOP ROLWALING

First, the national park next door in Khumbu. While the park is generally credited with reducing deforestation in Khumbu, it has accomplished little of what it set out to do. The money collected has all gone to HMG. A museum was built, but it is shamefully maintained. Many of the protective policies proved to be counter-productive, and some of them have been reversed and an attempt made to revive traditional conservation practices. Almost every progressive step in Khumbu has been initiated by local NGOs, especially the Sagarmatha Pollution Control Committee (SPCC), and by international donors such as the Himalayan Trust founded by Sir Edumund Hillary (which has built a hospital at Khunde as well as many schools) and Eco Himal (which installed the hydel plant below Thame). In any case, there is little likelihood of UNESCO's designating another World Heritage Site in Nepal: as it is, there has been repeated discussion of de-listing Nepal's WHSs because of mismanagement.

The Annapurna Conservation Area Project (ACAP) has received glowing praise from itself and other members of the development community. Unlike the Sagarmatha National Park, which can claim to be

understaffed and underfunded, ACAP has micromanaged its domain, right down to dictating the allowable colors for signs in the Annapurna Sanctuary (yellow and black). However, in a series of interviews with lodge owners in November 2000, we heard numerous complaints. Officials are overpaid and do little work ("For them, it's like winning the lottery"), and recently the top positions have been filled by political appointment; most of the money is spent in Pokhara and Gandruk, where ACAP has offices; nobody comes to inspect conditions or talk to people about problems in more remote villages. One owner of a new lodge in Ghorepani told how he got the wood to build his lodge: "ACAP wanted the towns to pay for transport of electrification equipment, but they couldn't afford it. The people of Ulleri complained, and ACAP allowed them to cut a grove of old-growth forest to pay for the cost. So I bought 11 trees." The most common complaints concerned the imposition of uniform prices for in the lodges. ACAP had required that each town set up a Hotel Management Committee to fix prices for food and accommodations. That means that the smaller and less attractive teashops are supposed to charge the same as the newer and fancier lodges. Since the committees are made up only of the wealthiest entrepreneurs in the village, who naturally stand to gain most by preventing the smaller facilities from undercutting their prices, it is no surprise that they have refused to allow discounts and they have also refused to limit new construction or the number of rooms in a lodge. While it may seem that everybody is at least making some money, economic opportunity for the less well-to-do is tainted by the burden of debt.

A third model, consistent in many ways with ACAP, is Eco Himal's Rolwaling Ecotourism Project (RTEP). Eco Himal ("the Society for Ecological Alps-Himalaya Cooperation") an INGO well-funded by the Austrian government, has been involved in several high profile projects including two hydroelectric installations to serve Khumbu, the first of which was placed directly in the path of the eminently foreseeable Dig Tsho Glacial Lake Outburst Flood (Ives 1986). In numerous publications (Inmann and Luger 1998; Luger et al 2000), the project leaders have described their exceedingly ambitious plans for Rolwaling. The cornerstone of this project is the realization that organized groups have contributed virtually nothing to the local economy, while inflicting the typical negative impact: resource depletion, waste accumulation, loss of cultural self-esteem. In view of the lack of infrastructure, the absence of local political structures, and the dearth of service skills, Eco Himal proposes the following measures as prerequisites for the initiation of Free Independent Trekker (FIT) tourism in Rolwaling:

- organization of community development committees (CDCs) to take responsibility for tourism development
- funding of loans for development
- improvement and maintenance of trails and bridges
- improvement of drinking water supply and sanitary facilities
- training programs in hygiene, food preparation, ecological management, lodge management, and guide and porter services
- construction of model lodges, and enforcement of standards in a "network of eco lodges"
- construction of community tourism service centers
- promotion of the new "Rolwaling/Eco Himal" destination

While Eco Himal has done some laudable work, the impact in Rolwaling itself has been negligible; furthermore, there are basic flaws in their vision that, in our view, vitiate the positive potential. First is Eco Himal's perception that the village of Beding, which is the core of the Gauri Shankar Ward of Dolakha

District (the ward that occupies most of Rolwaling Valley) is essentially a basket case[1]. When we met Maximilian Petrik, Eco Himal's field manager, as we were on our way to visit Rolwaling for the first time in March 1999, he told us that a) we would find "[virtually] nobody there: everybody with half a brain has left to find work in Khumbu or Kathmandu, and the really smart ones have gone to Europe or America", and b) "it is impossible to work there ... the CDC just fights all the time." In view of the impossibility of achieving a satisfactory level of "participatory development," Eco Himal has done virtually no work in Rolwaling Valley itself other than initiate some small-scale trail improvement work. [A model eco lodge, to be used for training purposes, has been built in Simigaon, at the mouth of the valley; or rather, it has been half-built and left unused for the past two years; meanwhile, since the planners chose to construct the lodge on a scenic knife-edge ridge, landslides are threatening to undermine it (Photos 2, 3).] Instead, Eco Himal has focused on the gateway regions, organizing CDCs in the villages along the trails from Barabise and Dolakha to Simigaon, installing water taps, establishing a mountaineering school for guides in Thame, and holding English training courses. The latter, ballyhooed in press releases as being held in Rolwaling, were actually held near Singate, a few hours from the Dolakha trailhead and at least two days' walk from Rolwaling Valley. Nobody from Rolwaling attended.

Apart from the legitimate frustrations entailed in trying to forge a community consensus and elicit cooperation from a populace that tends to disperse in search of employment, there are other impediments to the implementation of Eco Himal's vision. First, Beding gets rather uncomfortable by late fall. The valley is narrow, the fog rolls in by early afternoon, and after 3 o'clock, when the sun disappears behind the southern ridge, it gets downright cold. During the monsoon season, when most of the villagers are at home, the trails are messy if not impassible. Unlike Singate, where Eco Himal has its relatively posh headquarters, Beding has no electricity, or any other facilities for that matter. It is not a place where a senior INGO official is likely to want to spend a lot of time. Secondly, the high level of alcoholism makes it difficult to establish viable working relationships with the residents. Even the monks and the "big people" (prominent citizens) are prone to violent outbursts. Charges of embezzlement and domestic abuse have been leveled at those who work most closely with Eco Himal. Third, Eco Himal's "bottom up" trajectory appears to justify a go-slow approach. At least, there is no sense of urgency. On the trail below Simigaon in October 2000 we met one of the Nepali assistants who is based in Eco Himal's Singate headquarters; he told us that he had just been to Beding to see if he could organize a work group to install a water pipe, but found no one. When we arrived in Beding, we mentioned this to a lama with whom we were staying. "Yes," he said, "this man came in the early afternoon when everybody was working in the potato fields; then he went to look for a woman, which is really why he came. He was gone before 5 o'clock, when everybody comes home from the fields." Whether or not a woman was involved, one wonders why the assistant would not have expected people to be in the fields at that time, and why he could not stay longer. Whatever the truth of the matter, this level of miscommunication is surprising in a project that has theoretically been underway for four years.

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1 "Without external financial and logistical assistance, the development of the tourism infrastructure seems almost impossible. The local people in Bhote Kosi and Rolwaling Valleys are more or less waiting for outside support" (Inmann and Luger 1998). Ironically, Eco Himal is well-aware that is only the restricted access which has impeded Rolwaling's residents from developing tourism on their own: "...As agencies could more or less determine the prices themselves in places that were not officially declared trekking areas, they showed little interest in seeing the area opened up for individual tourism. They offered full service tours, which meant that everything was organized in and brought from Kathandu, including the crew. The local inhabitants hardly benefited at all from this form of tourism, except for selling extra food to the groups or occasionally providing a place to sleep. This is why no tourist infrastructure developed: so few tourists came to the area that it was not worth investing in infrastructure, and there was no prospect of earning any additional income" (Inmann 2000).

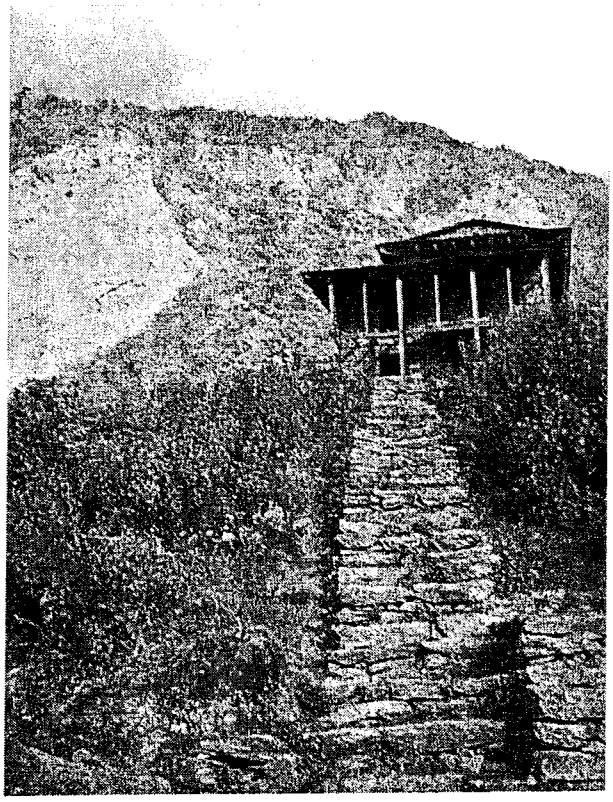

Photo 2.
Eco Himal's model lodge, perched on a ridge above Simigaon

Photo 3.
The slope immediately beneath Eco Himal's lodge is giving way

More seriously, Eco Himal has deliberately deceived the people of Beding. When we arrived for the first Bridges-PRTD program in October 1999, we discussed with our host whether it might not be appropriate to petition the Minister of Civil Aviation and Tourism to change the status of Rolwaling and make it accessible to independent teahouse trekkers. He informed us that such a petition had been solicited by Petrik two years before; everybody had signed it, but they never heard anything from the government. We immediately rushed down to Singate to find out the facts. Petrik readily admitted what we had heard. "What happened with the petition?" we asked.

"I filed it."

"You didn't give it to the Minister?"

"No. They're not ready for ecotourism. When they are, we'll force HMG to change the regulations."

"And you didn't tell the villagers that you were holding onto their petition?"

"No. It wasn't necessary."

The experience of Eco Himal underlines two lessons. First, it is not necessarily a good idea to freeze development pending extensive social engineering and infrastructure enhancement. It is true that many aspects of the ecotourism ideal are lacking; in particular, there are no police, rescue, medical or other services; there is no electricity; sanitatary and waste disposal systems are non-existent; the locals are unindoctrinated in Western hospitality values and skills, and there are only primitive educational and political institutions. All of these have come to other areas of Nepal *after* the arrival of tourists. It is

pointless to try to convince poor people to upgrade their villages in these respects in the absence of a tangible market. Right now the tourist traffic and the attendant negative ecological and cultural impacts simply are simply inconsequential. There is no need to impose international standards, with the usual restrictions on forest and other resources, not to mention the exclusion of goats and other economic sacrifices. Trees will have to be cut for lodges, as well as for new homes as the local standards improve and expatriated Rolwaling natives return from Kathmandu and elsewhere. The beauty of tea house trekking is that it can be jump-started; safeguards and corrective measures can be introduced once their value is appreciated.

Secondly, it is not necessarily a good idea to entrust administration, whether explicitly or by default, to an INGO that cannot be scrutinized and held accountable. Even supposedly independent academics are too dependent on the good graces of the administrative organizations for both data and extended access to be expected to render an unbiased assessment.

If none of the state-of-the-art mechanism for ecotourism development is appropriate, what do we suggest?

1- HMG should eliminate the unfair and unnecessary universal requirement for a trekking peak permit, and allow independent backpackers access to Rolwaling.

2- Beding's CDC has the right under law to charge a user's fee to all non-local traffic. It should immediately declare that Gauri Shankar Ward is a locally protected area, a Rolwaling People's Park. Even a modest fee such as 250-400 NRs per person would fund significant enhancements of tourism infrastructure and local living standards.

3- Contrary to Eco Himal's perception, Rolwaling is not a helpless basket case incapable of any development initiative without external assistance. We have spoken to several Rolwaling natives currently running trekking agencies in Nepal as well as Khumbu entrepreneurs who are eager to set up first-class lodges and other services in Rolwaling as soon as the shackles of limited access are removed.

4- Rolwaling's CDC should solicit the cooperation of NGOs such as the SPCC and the Tengboche Developent Project. We have spoken to administrators of both these organizations, and they are ready to help. Hari Karki, director of SPCC, told us that he could send an assistant to inspect the situation and make recommendations to the local people, even bringing a slide show to demonstrate the risks and opportunities of development as they have evolved in Khumbu; the cost for a two-week program would be approximately $200. Dr. Amchi Sherab and Michael W. Schmitz, manager of the Tengboche Development Project, who have set up a Tibetan clinic in Namche and introduced cultivation of native medicinal herbs in Tengboche are willing to take on a Rolwaling assistant as apprentice so that he or she could return to Beding and set up a similar program there. At a minimal cost, one could bring in staff from ACAP or the Kanchenjunga Area Conservation Project (KCAP) as well as foreign Nepali academics and others with applicable expertise; they could provide short-term assistance without saddling the villagers with a full-blown management apparatus. A few years down the road, once tourism has shown itself to provide lucrative opportunities, the local residents might be ready to cooperate with a more formal administration; or they might choose to go it alone.

5- Market the valley, not as "Rolwaling/Eco Himal" but as "Rolwaling, the Sacred Valley" [2].

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[2] *"Rolwaling/Oeko Himal is a new product with a particular image of adventure, which stands out against other products...." (Inmann and Luger 1998) Again, "To stress the ecological aspect of the product, the marketing strategy must focus on the core of the product... as well as the tourist infrastructure... and travel care and assistance, accommodation, catering, information and services, etc. Only in this way can a high-quality tourism product, 'Rolwaling/Oeko Himal' become a symbol for a*

ROLWALING, *THE* SACRED VALLEY

One of Rolwaling's assets as a tourism destination is its status as a sacred valley. Aside from the traveler's mundane interest in picturesque local sites, customs, and beliefs, there is a special interest in transcendent reality. Whether on pilgrimage or in search of "adventure," tourists are generally looking for something like a spiritual experience -- inner renewal, the scale and meaning of life, respite from routine. It is no accident that this sort of experience has traditionally been sought in remote and dramatic landscapes: secret valleys, lofty peaks, and mysterious lakes have inspired spiritual epiphanies, rapturous travelogues, slideshows and postcards home.

In a general sense, Rolwaling shares in the sacred charisma of Nepal (the birthplace of Buddha and host to several of the most important Buddhist and Hindu pilgrimage destinations) and particularly of the Himalayas. Myth aside, this youngest and greatest mountain range on Earth is fascinating for its dramatic tectonic history as well as its impact on every aspect of the regional and global environment. Not only do these peaks feed the sacred Indus, Ganges, and Bhramaputra rivers, they also directly cause the South Asian monsoon, the foundation of agriculture throughout the region. It is not surprising that the Himalayas are revered by hundreds of millions of Hindus and Buddhists as the home of gods. Himalaya means "Snow Place" but it is also the name of a god, the father of Shiva's wife Parvati, who lives with his queen Mena "in a palace ablaze with gold, attended by divine guardians, maidens, scent-eating creatures, and other magical beings" (Bernbaum 1990). Poets and prophets have described the Himalayas as an earthly paradise, a direct link to the heavenly version.

We have already mentioned Rolwaling's status as a real-world Shambala, and the cultural conservatism of its people. In assessing the value of spirituality as a tourist asset, it is important to keep in mind the context: Rolwaling would benefit in a synergistic way from the spiritual allure of the Himalayas, but it must also compete with the neighbors. In fact, there are well-known myths that connect many prominent topographical features of the Sherpa homeland with important figures in the Tibetan Buddhist and the Hindu pantheons. Mt. Everest, in particular, would seem a formidable competitor in the sacred stakes.

While Everest today looms in the Western imagination as the preeminent peak of the preeminent range, it might more properly be regarded as one of hundreds of sacred mountains in the Himalayas. According to Bernbaum (1990), the usual translation of the Tibetan name Jomolungma as "Goddess Mother of the World" is probably a mistranslation. He considers Jomo (goddess) to refer to the resident deity on that peak, which is possibly further qualified as *lung* – either "wind" or "place": "Lady of the Wind" or "Goddess of the Place." But he favors another interpretation: *Lungma* might have been shortened, in a linguistic strategy typical of the Tibetan handling of long names, from Miyo-Lungsangma, one of the Five Sisters of Long Life. Each of these beneficent goddesses, who inhabit mountain peaks above glacial lakes along the southern border of Tibet, controls a special boon, but together they are supposed to protect Buddhism. Miyo herself gives the blessing of food; her sister Tashi Tseringma's special gift is long life; Tekar Dosangma grants *whongdup*, or good luck; Chopen Dinsangma grants wealth; Thingri Shelsangma gives telepathic powers. It may be that this grander interpretation of Everest's name has recently become accepted in Khumbu, where the importance of Everest as a tourist draw is sufficient authority.

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standardized peformance of constantly high ecological quality and thus a unique selling proposition" (Inmann and Luger 1998).

Actually, Everest is not even the most sacred peak in Khumbu, the district in which it lies. That honor belongs to Khumbila (derived from Khumbui Yul Lha, or "Khumbu's Country God"), a peak on whose lower slopes are perched the major villages: Kunde, Khumjung, and Namche Bazaar. Khumbila is identified as one of the 21 demons (apparently Bön entities) that Guru Rinpoche subdued and recruited to the protection of Buddhist dharma. Like most other sacred peaks, Khumbila is of purely local significance, religiously speaking. However, it is much more important, in this respect, than Everest, which has acquired "sacred" value primarily as a result of the recent discovery that it is the highest mountain in the world, and thus a fitting symbol of our highest aspirations.

Compared to Khumbu, Rolwaling's peaks lie somewhat higher in the sacred pecking order. Everest's resident goddess Miyolungsangma is easily trumped by Tashi Tseringma (Luck Long-Life-Female), who has an abode atop Chomolhari, the most sacred mountain of western Bhutan, and on Gauri Shankar in Rolwaling, which is also venerated by Hindus as the abode of the great got Shiva in his ascetic form. In addition to Gauri Shankar, Rolwaling can boast of more than a dozen discrete sacred sites, including the local pilgrimage route to Lake Oma (Sacherer 1977).

SPECIFIC PROJECTS

In discussions with the chairman of the Beding CDC and the head lama of Beding Monastery, the two projects that emerged as significant to the future of Rolwaling Valley were the rehabilitation of the local primary school of the *gompas* in Beding and in Na. The enhancement of monastic infrastructure was seen as particularly important as a counterbalance to the cultural impact of tourism. In addition to the renovation of existing facilities, the goal is to establish a monastic institute to train monks not only from the local wards but from all of Nepal.

Immediately following the Hindu festival of Dasain, in which thousands of animals are sacrificed throughout Nepal, Rolwaling Sherpas observe a solemn holiday in which rituals are performed to assist the slaughtered animals in finding their way to a better position on the wheel of life. This festival has potential as a tourist attraction, especially for Western vegetarians and others concerned with animal welfare: a vegetarian Dasain would offer an alternative to remaining in Kathmandu Valley and witnessing the horrendous blood-letting. The notable popularity among tourists of the Mani Rimdu festival at Tengboche suggests that such a celebration would be a significant element in the promotion of tourism in Rolwaling.

Like many Himalayan valleys, Rolwaling has rich ethnobotanical resources. Sacherer (1977, 1979) has elucidated the vital connection between the flora and spirituality in the consciousness of Rolwaling Sherpas. These plants include those with application as medicinal herbs, poisons, foods, dyes, incense, forage, fertilizer, and handicrafts, and many could have economic value if they were collected (in a sustainable manner) or cultivated: locally, they could serve the needs of the residents, and they could also be sold to tourists. HMG has long been interested in promoting the identification and exploitation of such resources, and there are many INGOs and pharmaceutical enterprises that would likely be interested in assisting the project. Clearly, such development would both enhance cultural self-esteem and also reinforce the perception of Rolwaling as a sacred valley. Fortunately, an initiative with similar aims is being promoted by the Tengboche Development Project, and, as mentioned above, the project manager and the Tibetan herbalist at Namche are both eager to assist in the application of their methods in the valley next door.

Three years ago a flood severely damaged the stupa at Beding. Lamas and residents alike are determined to rebuild this stupa and another at Na. We suggested a third project: a collaborative effort involving local people and tourists. The proposal is to design an extravagantly large stupa that would be constructed on a ridge overlooking Tsho Rolpa, which for years has threatened the valley with a glacial lake outburst flood (GLOF). It would be announced that tourists are invited to participate in this effort, to be inaugurated in 2002 in conjunction with the UN-declared International Year of Mountains and International Year of Ecotourism. Trekkers would go to the monastery at Na, make a monetary contribution and inscribe their names in the donor log, and then be guided to the construction site, where they would place stones according to the architect's plan. Such an ambitious monument would evidently take years to complete, but would provide a continuing and fitting goal for trekkers. It would also provide an opportunity for the manufacture and sale of souvenir tee-shirts and miniature replicas, thus fulfilling MacCannell's "fourth level of tourism development: reproduction of the tourist attraction" (1976).

Rolwaling's assets are, of course, not limited to the sacred. A significant opportunity may be found in the geographical factors which have been seen as limiting constraints. It is true that Rolwaling lacks an Everest, but many trekkers would be interested in an alternative route of egress from Khumbu, one which would allow them to avoid retracing their steps and also to avoid the relatively expensive and overbooked flights from Lukla. (As noted above, Rolwaling is only a few days' walk from the road at Dolakha or Barabise, from which one can take the bus to Kathmandu for less than three dollars.) At the same time, this alternative would relieve some of the pressure on Khumbu facilities, which typically experience near gridlock in high season. The route up the Thame Valley and across Tashi Laptsa pass, however, has been perceived as too difficult for most independent trekkers. On the other hand, if more tourists could conveniently undertake this trek, it would not only assist in the development of the poorer communities on the Thame side but also meet the thirst for challenge and adventure that motivates increasing numbers of trekkers. In most cases, Khumbu trekkers have already visited Kala Pattar and/or Gokyo, and are therefore well acclimated. The problem has been that the route requires camping and climbing equipment, as well as a guide and porters; these are generally available only through outfitters located in Kathmandu. Very few independent Everest trekkers wish to hire a team for their entire Khumbu trek, much less for the Jiri walk-in, both of which are straightforward and require no special equipment or assistance. The solution is to establish an agency in Beding or Na, with a branch in Thame; this agency could offer a shuttle service, with teams leaving Rolwaling every Tuesday (for instance) and returning from Thame on Sunday. If all the equipment and the personnel were locally available, the cost would be reduced, and trekkers could conveniently make the decision to take this route even on the spur of the moment.

Another proposal, one which would tie in nicely with the Tashi Laptsa shuttle service, is to establish a climbing school for tourists. If the gear and the instruction were available *in situ*, trekkers could opt to prolong their stay and get some experience in technical climbing. They would then, of course, be even better equipped for Tashi Laptsa; and virtually all of the revenue would remain in Rolwaling.

CONCLUSION

Rolwaling may be poor and undeveloped, but it is not a basket case. If the arbitrary and currently

unenforceable requirement of a trekking peak permit were removed, independent trekkers could easily be attracted to this relatively pristine destination.

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Improving Livelihood of Farmers through Sustainable Use of Seabuckthorn (*Hippophae* Linn Spp.) in the Himalayan Region of Nepal: A Practical Approach

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ABSTRACT

Seabuckthorn (*Hippophae* linn spp. fm: Elaegnaceae) is an important native plant of the northwestern Himalayan region of Nepal. This plant has tremendous potential for income generation due to its multipurpose qualities (ecological, economical, medicinal, and cosmetic). Seabuckthorn has received little attention until recently. The Tree Improvement and Silviculture Component of Department of Forests of Nepal has initiated conservation and development activities in the Mustang and Manang districts of north-western Nepal with the goal of improving the livelihood of farmers through a participatory approach to 'conservation through judicious utilisation.' The activities include, inter alia: publicity, juice-making, gene conservation; plantation management; local institution building, product development, networking and marketing. There has been an encouraging increase in local income through sales of juice and information on propagation techniques for this underutilized resource. Future plans are identified.

KEYWORDS: Seabuckthorn; juice making; awareness; Himalaya

INTRODUCTION

Seabuckthorn is a useful plant found in the temperate zone of the central and mid-western high hills and mountainous regions of Nepal (1,500-5,000 m). This plant is a deciduous shrub or tree and in the wild is distributed mainly along river and stream banks in very small patches (a few hectares). All parts of the plants (fruit, leaves, root, stem) are useful (Fuhen et al 1999). Fruits are rich in nutrients and bioactive substances such as sugar, organic acid, and several vitamins. The vitamin C content is 5-100 times higher than any fruit or vegetable known (Rongsen 1990, 1992). Seabuckthorn plants have high medicinal properties and also possess important raw materials for cosmetics manufacturers. The plant has extensive and strong roots; it can contribute significantly to mitigation of soil erosion. The nodules present in the root are useful for fixing atmospheric nitrogen (Rongsen 1990; Fuhen et al 1999). The wood is also used as fuel with calorific value of 4,000 Kcal/kg (Rongsen 1990). This plant is therefore valuable not only for the protection and enhancement of the natural environment but also useful for production of value-added products from the berries and other plant parts. Evidently seabuckthorn can play an important role in the ecological economic development of remote mountainous regions of Nepal.

There are two species of seabuckthorn in Nepal: *H. salicifolia* and *H. tibetana*. In Asia, *H. salicifolia* is distributed in the southern Himalayas from Kashmir to Bhutan (Figure 1), at altitudes of between 1,500-3,800 m. *H. tibetana* normally occurs between 3,500-5,000 m within Nepal. It is also reported to occur in some part of southern China. Studies on the ecological distribution and quantification of this resource are currently underway in the northwestern part of Nepal.

Seabuckthorn occurs in the remotest part of Nepal where accessibility is the major constraining factor. Until recently, very little attention has been given to this species for its role in rural development efforts in the Himalayan region, and changes in the patterns of land use have had a negative impact on the occurrence of these species (Thomson et al 1993). The Department of Forests of Nepal has initiated a

program of conservation and judicious utilisation of these important resources, taking a participatory approach that has been implemented elsewhere (Dhar et al 1998, 1999). This paper focuses mainly on those activities conducted in the Mustang and Manang districts of the western development region of Nepal.

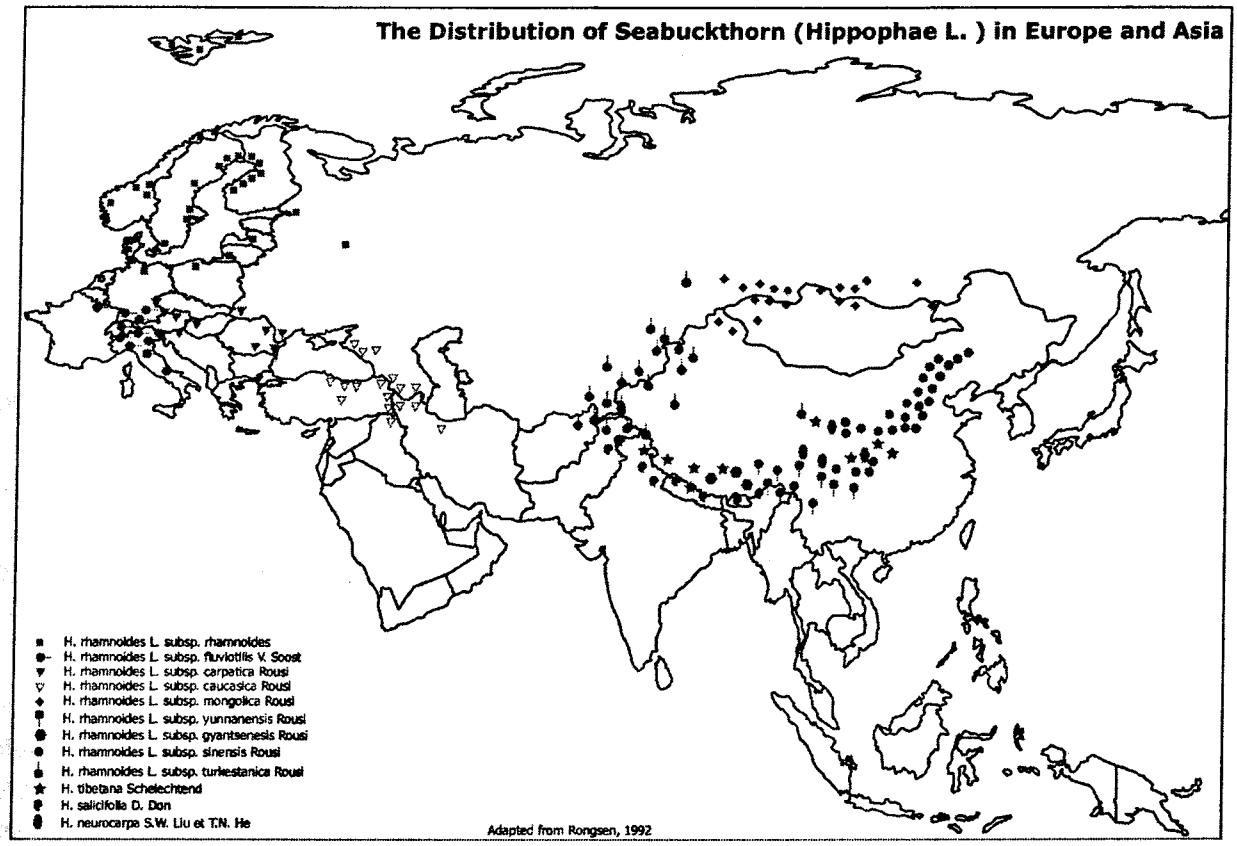

Figure 1. *Distribution of seabuckthorn in Eurasia.*

Seabuckthorn species have been well studied in Russia and China, with expanding research and development due to interest generated in other countries with temperate climates. While large-scale plantings have been established in China since the 1980s, research activities in Nepal are still limited. As of now the Tree Improvement and Silviculture Component (TISC) of the Department of Forest (DoF) is conducting propagation trials for indigenous and exotic varieties of this genus (*H. salicifolia* and *H. tibetana*; *H. turkistanica*). TISC has compiled pertinent information about these species from within and outside country for application in plantation forestry. With TISC support, seabuckthorn development projects have been implemented through local groups of farmer.

In Nepal the production and marketing of nutritional products from seabuckthorn fruits and seeds began in 1998. The products currently being tested and/or marketed are fruit juice, jam, pickles, and oils for a medicinal balm. The juice extracted by the local farmers and/or farmers' organisations is processed locally and is sold primarily to trekkers visiting the area. For farmers in these remote areas this is an opportunity for supplemental income where such opportunities are very few. The natural distribution of this genus also coincides with the area where vitamin A deficiency, especially among children, is a severe problem. Seabuckthorn is therefore expected to make contributions to the local economy and to the health of residents.

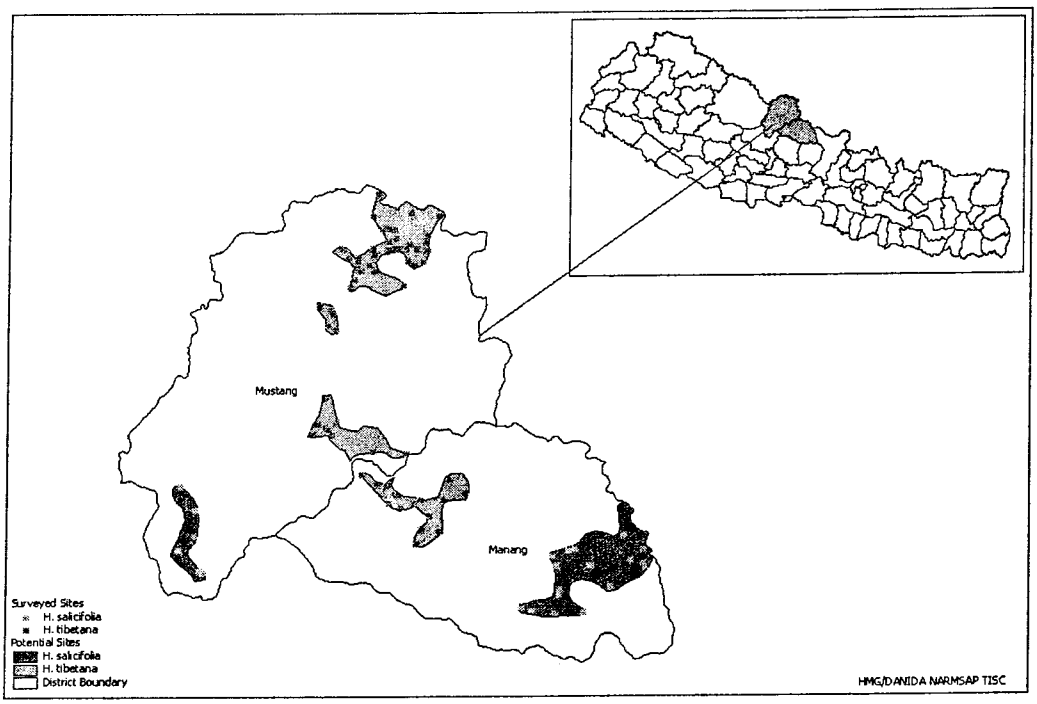

Figure 2. *Programme areas of Mustang and Manang districts-actual surveyed and potential sites of seabuckthorn (inset: Nepal).*

PRODUCTS OF SEABUCKTHORN AND ITS COMPOSITION

The food and drink products of seabuckthorn species are very high in vitamins and proteins. Some of the vitamins found in the juice are C, A, E, K, B1 and B2. The vitamin C content of seabuckthorn juice ranges from 70-1600 mg/100 g (Table 1). Similarly, the oil from the seed and fruit pulp of *Hippophae* spp. contains essential fatty acids (eg, Lenolic and Lenolinic acids) in addition to important vitamins which are useful in the preparation of cosmetics and medicines. Seabuckthorn extracts are utilised extensively by the local traditional healers/doctors for numerous health problems ranging from menstrual irregularities to asthma (Rongsen 1990). The plant also figures prominently in the Tibetan pharmacopoeia. In the Rasuwa, Mustang and Dolpa districts of Nepal, seabuckthorn concentrates are used for: an additive in pickles production; expectorant; relief of pain, asthma (in both humans and domestic animals), menstrual irregularity, and swelling; removal of tooth stains (the seabuckthorn is mixed with ash); and sour concentrates (Banjade 1999).

PROGRAMME APPROACH: "CONSERVATION THROUGH UTILISATION"

Since 1996 TISC/ Department of Forest (DoF) has been implementing a seabuckthorn conservation and utilisation programme. This programme has focused on conserving seabuckthorn resources through judicious utilisation. The long-term objective of TISC is to provide practical options to the farmers to augment their economy through effective utilisation of locally available seabuckthorn resource which until now have been underutilised or ignored altogether. The programme also believes that unless people are aware of the benefits of the plant they will not be motivated to conserve the resource. Therefore, TISC initiated an active awareness campaign to mobilise the farmers of Mustang and Manang. In the long term, the programme intends to restore the degraded environment, and promote social and economic development, and enhance the quality of life of inhabitants of these districts.

Table 1. *Constituents of fruit juice of Hippophae* spp. *in Mustang and Manang districts.*

District	Species	Total soluble solids %	Total acidity as citric acid %	Total acidity as tartaric acid %	Sulphur dioxide/ppm	Vitamin C mg/100 g
Mustang	*H. tibetana*	8	4.6	4.9	13.9	494.07
Manang	*H. salicifolia*	60	1.8	1.9	4.7	77.01

Source: Banjade (1999)

Programme Steps

The phases of the programme are summarized in Figure 3. The first step of the TISC action plan is to help farmers understanding the benefits of the plant. The second step focuses on identifying suitable cultivation techniques. The third step focuses on creating and assisting farmers' organisations. The programme also tries to support local initiatives in managing seabuckthorn resource by fostering an enabling environment in which local farmers/communities can take action for their own benefits. The fourth step focuses on product development and marketing.

Awareness Programme

Altogether, ten awareness training programmes have been undertaken since 1996, seven in Mustang and three in Manang. Awareness meetings to provide information on marketing possibilities of seabuckthorn resources have reached approximately 400 famers in these two districts.

The first step of the awareness plan involved holding workshops in which the agenda included dissemination of information about seabuckthorn biology, the potential ecological zone, beneficial properties of the plant; display of seabuckthorn products; screening of a video on seabuckthorn plantation and harvesting; demonstration of juice, jam and pickle making; and explanation of guidelines for hygiene and product safety.

In addition, TISC has established a seabuckthorn plantation demonstration site of in Jomsom (2,600 m). The intention is to increase awareness among farmers (especially women) of seabuckthorn and its benefits.

Propagation Trial

Propagation trials were initiated in 1998. The intention was to develop optimal nursery techniques for *H. salicifolia*, *H. tibetana*, and *H. turkistanica*. Two trials were established in Lupra (2,900 m) and In Jomsom (2,600 m), in Mustang. More trials are planned for the Manang and Mustang districts during Spring 2000.

For all the above-mentioned species several treatments were tested. These included: a) soaking (for from a few hours to several days) and boiling treatment of seed; b) running water beds for seed and cuttings; c) cuttings of stem and root (hardwood plant older than 3 years old ; both hard and soft wood for younger plants) with and without net/bare root in pebbles, plain bed; and d) direct seed sowing in polypots. Direct sowing for afforestation was not tested: Chinese research suggests that this is not a viable strategy (Hilbert 1997).

Preliminary trial results are encouraging. Dry zone varieties of seabuckthorn (*H. turkistanica*) from China are performing satisfactorily in the temperate zone of western Nepal. Vegetative propagation results are not encouraging (success rates are around 10%); significant problems were identified after evaluation (Poulstrup 1999).

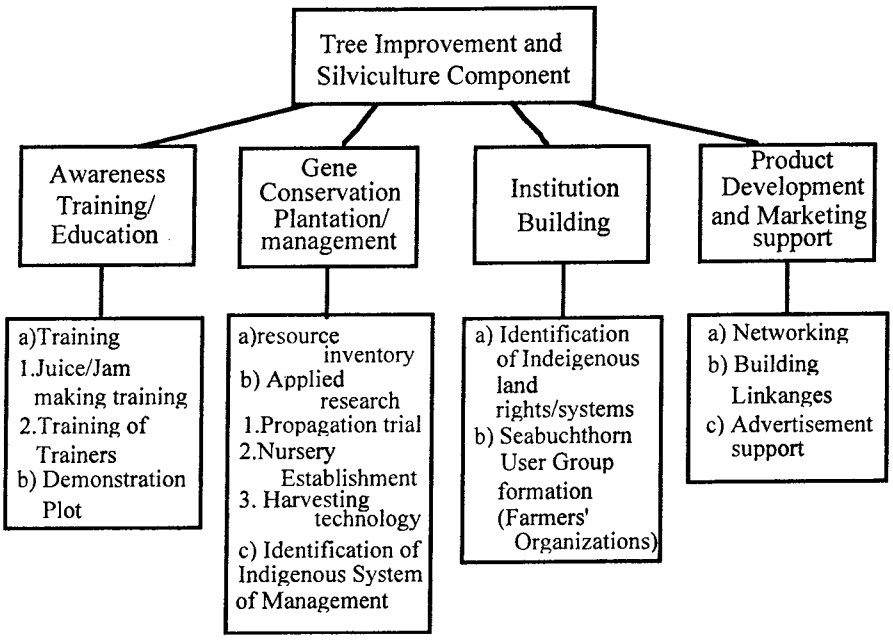

Figure 3. *Tree Improvement Component Seabuckthorn Programme Approach (Source: Dhakal 2000).*

TISC is planning to repeat the trials and expects better results with improved management of cutting. Propagation from seeds was successful (*H. salicifolia* 90%, *H. tibetana* 75%, and *H. turkistanica* 67%). The results are not conclusive: tests must be carried out in several sites under different management regimes. Vegetative propagation methods need to be checked especially for hardwood and softwood cuttings. Key points to be tested are timing for the collection of cuttings, choice of propagation media, pre-treatment of cuttings, and design of propagation facilities.

Institution Building

Several farmers' organisations, or Seabuckthorn User Groups (SUGs) were initiated in Mustang district in 1999, becoming operational in 2000. This activity is underway in the Manang district as well.

The right of traditional land use remains in Mustang. In lower Mustang amongst the *Thakalis*, a local ethnic group, *Mukhiyas* (traditional village heads) are responsible for assigning the land for proper use. With the concurrence of *Mukhiyas,* several SUGs were formed. In Jharkot there is another SUG. These are now instrumental in protecting the seabuckthorn within their area. In Jharkot the SUG has levied a penalty of NRs. 500 for cutting or removing a single plant: this has significantly helped in the conservation of the remaining *H. tibetana* population (Chalise 2000).

Product Development and Marketing Support

Product development

TISC has promoted the use of seabuckthorn through product diversification, focusing especially on products with clear market potential (Table 2). A training programme teaches people how to make seabuckthorn juice, jam, and pickle. These techniques are relatively easy for the farmers to adopt. Hygiene is emphasised.

Value addition to seabuckthorn products is high on the TISC agenda. TISC also facilitates networking and linkage between SUGs and lodge/restaurant owners, key partners in the sale of farmers' products.

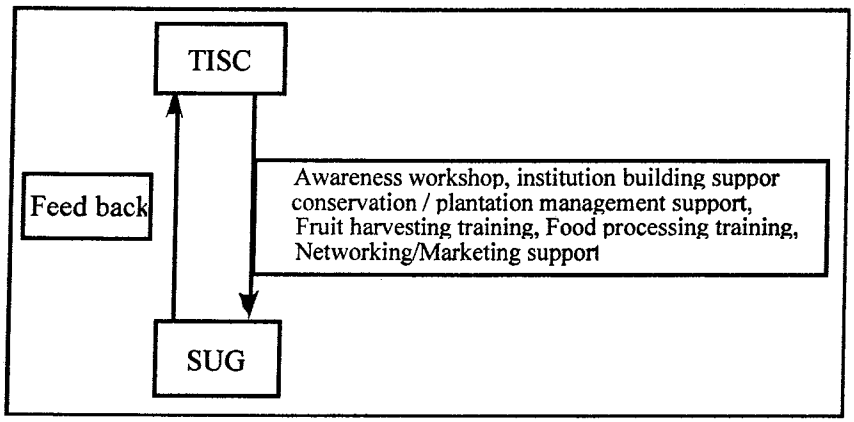

Figure 4. *General flow diagram of seabuckthorn programme implementation of TISC (Adopted from Dhakal, 2000).*

Table 2. *Product type and composition employed by TISC in Seabuckthorn programme*

Seabuckthorn Juice: Juice is diluted with water for consumption. For beverage preparation the following ingredients are used: 25% raw juice; 40-45% sugar; 1% fruit acid; no artificial colour is used. Composition often varies with species and berries harvested from different regions.

Seabuckthorn Jam: Made from fruit extract. For consistency and palatability, the best composition was found to be 0.75% pectin, 10% juice, 70% sugar and 1.14% acid.

Juice Powder: Mixing of 100 gm. juice in 1 kg. Sugar and 36 gm acid dried in oven at 40-500c and ground to powder. To serve, mix with water.

Pickle: Fenugreek: Roasted fenugreek 100 gm, roasted powdered radish seed 40 gm, mustard seed powder 10 gm, black pepper powder 20 gm, cumin powder 5 gm, ginger ground 15 gm, turmeric powder 10 gm, asafoetida powder 2 gm, salt 80 gm, and seabuckthorn juice 450 gm, water 500 gm should be mixed and boiled. Sodium benzoate 1.222 gm should be added later.

Source: Vaidya, 1999

Presently Mustang and Manang lodge and restaurant owners are selling seabuckthorn juices, mostly to the trekkers. The selling prices ranges from NRs. 230 to 350 per litre, depending on species and locations. The collection costs and profit margins are presented in Table 3. The collectors make very small profit from the sale of seabuckthorn compared to the restaurant owners, reflected in the buying price. In the aggregate, restaurant owners generate the largest profit despite the fact that they are the smallest group, their strength is that they have direct access to the trekkers.

Marketing costs are not included since TISC provides assistance for marketing by providing advertisement materials (brochure, labels for the bottle and posters).

Table 3. *Buying and selling prices and profit margins for seabuckthorn Juices*

Species/ Participant	Buying Price from Collector NRs/ litre	Production Cost*NRs/ litre	Selling Price NRs/ litre	Profit Margin NRs/ litre
H. salicifolia				
Restaurant Owner	100	25	230	105
H. tibetana				
Restaurant Owner	150	30	350	170

** Cost of sugar, fuelwood/kerosene, preservative, material and labour.*

Problems in marketing of products

The major limitation identified is the quality of the juice, which is not constant, presumably due to different harvesting time and techniques employed in different locations within both districts. The juice contains oils pressed from pulp and seeds; these separate out and float to the top after prolonged storage (shelf life is poor, only a few weeks). Inconsistency in product characteristics may also be due to varying quality and maturity of berries, and variations in processing methods.

Investigations to improve quality and prolonging shelf life of seabuckthorn juice are underway. Simple techniques are being tested in which floating oil are skimmed off after few days of storage. Alternatively, techniques of draining the juice through a tap fitted at the bottom of the container after few days of storage are being tested; results are encouraging results (Chalise 2000).

Future Directions

An ecological survey of seabuckthorn resources in the north-western Nepal is under completion. Results are expected to indicate the potential of genetic resources; this will provide a basis for seabuckthorn development planning. Different ecotypes and biodiversity of this species are reported in various publications (Rongsen 1990, 1992; Gupta et al 2000). The information as to seabuckthorn distribution could help in extending seabuckthorn development programmes to other Himalayan districts (Dolpa, Jumla, Humla and Mugu); these might have to be tailored to local specificities.

TISC has identified specific seabuckthorn traits of interest to the farmers of Mustang and Manang; these which include a) dwarf forms; b) absence of thorns; and c) prolific fruiting characteristics. Low-tech breeding programmes for both ecological and economic benefits could be considered. The growth performance of indigenous and exotic varieties need to be monitored and results should be utilised for the benefits of the users.

It is important to continue the exchange of genetic resources with the international community, particularly the International Centre for Research and Training in Seabuckthorn (ICRTS) in China, and to pursue the search for new genetic material – thornless, vitamin-rich, disease-resistant varieties. China has a wealth of information on breeding and plant development (Hilbert 1997). More biochemical research will improve our understanding of the species and helps to diversify its use.

Determination of optimum harvesting time for various regions within Nepal and development of appropriate harvesting and storing methods and tools should be another priority. Tools developed in other areas need to be studied for application within Nepal (eg, Shakers of Canada)

The participatory approach must be expanded, bringing in new local, national, and international collaborators; marketing research needs to be undertaken with the collaboration of all stakeholders including SUGs and other potential local organisations and groups. Active participation in international research and development organisations as ICRTS (Beijing), Lisavenko Institute of Horticulture (Russia), and Shelterbelt Centre (Indian Head, Saskacthewan, Canada), should be initiated in order to advance the world-wide exchange, testing and evaluation of seabuckthorn cultivars and germplasm, vegetative propagation methods and product marketing.

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An Ecological Assessment of Seabuckthorn (*Hippophae* Spp.) Resource in Manang and Mustang Districts of Nepal

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ABSTRACT

Seabuckthorn (*Hippophae* spp.) is an identified multipurpose natural plant resource of high Himalayan habitats. This species is proven good for its usefulness in soil conservation, soil reclamation, edible fruit resource, fuel and fodder. Seabuckthorn fruit juice, prepared at the local level is considered as an important commodity. There are two species of seabuckthorn, ie, *H. salicifolia* and *H. tibetana*, distributed in barren, least moist, least fertile open fields and landslide zones near the water resource of high altitudes in the various districts of northwest Nepal including Manang and Mustang. Sustainable utilization of this wild plant would, however, depend upon the size of available resource in terms of coverage and ecological distribution. As of now information is not understood completely for the potential of the species and their ecology. An ecological assessment of the available resource, therefore, was carried out to augment support for the benefits to the local people. Geographic positioning system (GPS) data were accumulated to help develop a resource map for both of these species. Results indicated *H. salicifolia* to occur close to the water bodies on alluvial gravel, landslides and river fords, mostly on south-facing slopes. In Mustang district it occurred between 2,000-2,800 m elevation with 28° 36'N to 28° 48'N and 83° 46'E to 83° 58'E. While for Manang district the corresponding data were 2,100-3,600m elevation with 28° 31'N to 28° 37'N and 84° 14'E to 84° 29'E. Variations in the distribution in Mustang and Manang districts were associated to differences in microclimatic conditions. Mustang is characterized by the windy weather with dry air. In Mustang *H. tibetana* occurred on relatively drier habitats with elevations between 2,780-3,940 m with 28° 48'N to 29° 15'N and 83° 46'E to 83° 58'E, while in Manang it occurred between 3,300-4,200 m elevation with 28° 37'N to 28° 44'N and 83° 58'E to 84° 07'E. The study identified a total of 50 and 60 ha of *H. salicifolia* stands with the average density of 675 and 763 individuals per hectare in Mustang and Manang districts, respectively. Hence, it indicates that Manang has more areas of *Hippophae* forests compared to Mustang, which may be due to the moist climate reflecting abundance of high altitude forests in Manang. In Mustang district *H. tibetana* comprised of 18,000 and 10,500 individuals per hectare in average. The study identified shrub lands around 100 and 60 hectares, respectively of *H. tibetana* in Mustang and Manang districts. A total land area of about 288 km^2 and 376 km^2 was calculated as iso-potential area for *H. salicifolia* and *H. tibetana*, respectively in Mustang and Manang. *H. salicifolia* started to grow from the upper distribution limit of the *Alnus nepalensis* and the major associate *Debregassia salicifolia* existed as an indicator species. Similarly, the major indicator associates of *H. tibetana* were *Caragana* sp., *Rosa* sp., and *Lonicera* sp.

KEYWORDS: Distribution; soil conservation; association; seabuckthorn; Nepal

INTRODUCTION

Hippophae, referred to as seabuckthorn in English; *Dalechuk* in Nepali; *Chichi* in Thakali; *Tora* in Gurung; *Tiji kyun* in Manange Gurung; or *Tserken* in upper Manang, is a diversified group of species distributed throughout Eurasia (Figure 1). This species is reported from mountainous areas of Nepal such as Darchula, Baglung, Jajarkot, Mugu, Dolpa, Humla, Mustang, Manang, Rasuwa, and Ramechhap at altitudes ranging from 2,000 m to 4,500 m. It is expected that the main area of distribution for seabuckthorn is northwest Nepal where the ecological and physiographic conditions are more favourable. National Herbarium, Nepal at Godavari, has specimens of three species of *Hippophae* namely *H. salicifolia*, *H. tibetana* and *H. rhamnoides*, but only former two species have been recorded from Manang and Mustang.

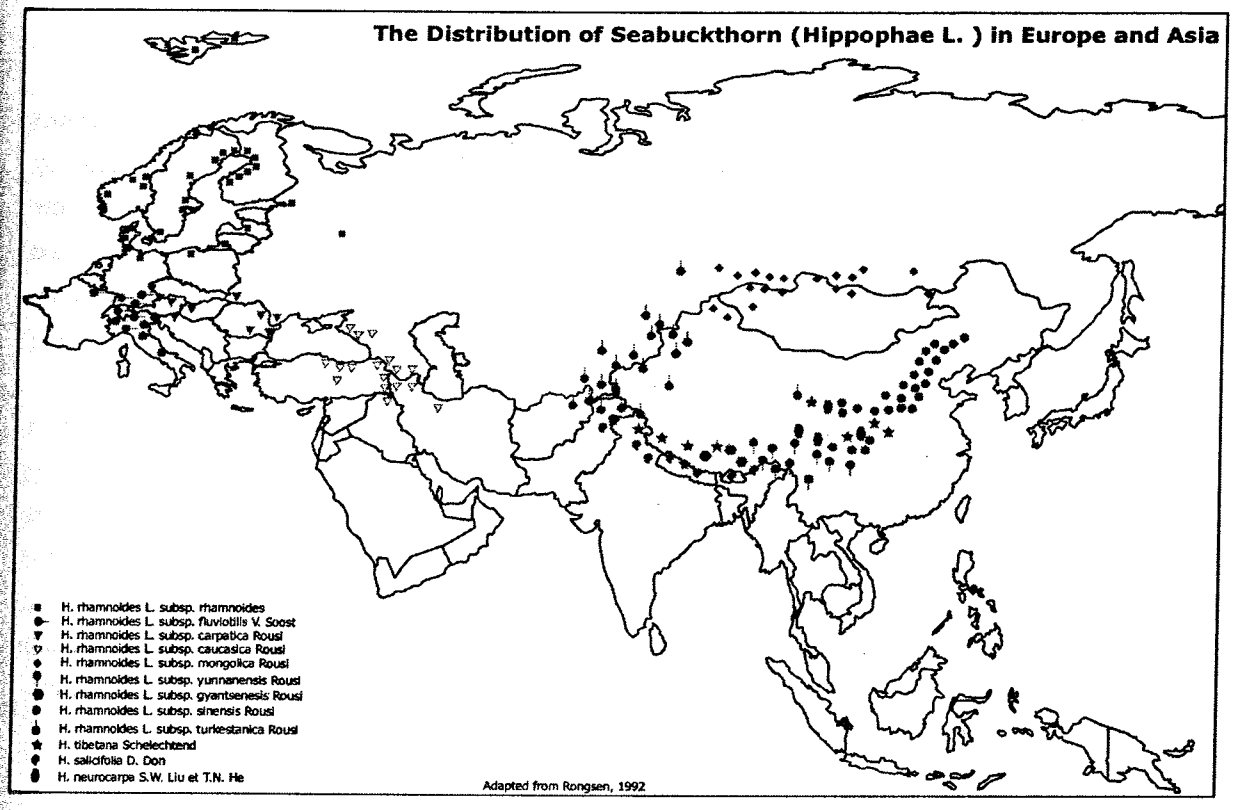

Figure 1. *Distribution of seabuckthorn in Eurasia*

Seabuckthorn belongs to the family *Elaegnaceae*, the morphological structure of plant shows many variations with species to species accounting microclimatic adaptations. It is a dioecious plant species with no distinct remarkable variation in the appearance of sexuality. It is multipurpose and an economically important plant with lesser degree of acknowledgement in Nepal.

Seabuckthorn bears tap root system with modified nitrogen fixing actinorrhizal and mycorrhizal associations so that it helps to reclaim the lost fertility of soil. Leaves are small, linear, lanceolate with silvery appearance on ventral surface, all favorable characters for arid and semi arid zones. Fruit of the plant have been used for long years as *Chuk* (traditional vinegar) after local processing from the extracted juice. Recently, raw juice (fruit extract) is being used for jam, jelly, and juice production. Juice is even manufactured for commercial purposes in some areas of the studied districts.

This plant species prefers low humid, less humus containing, infertile riverbanks or landslide zones (Rongsen 1992). It comes up as pioneer species of secondary succession of vegetation and colonizes a bare area in short time. On due course of succession they fail to compete with other plant species; hence, disappear or survive with smaller population. In Nepal this valuable plant species is depleted as the result of forest clearance. Mean time, well-vegetated areas are gradually converted into barren infertile ones due to extensive agricultural use, fuel wood collection and over grazing.

A detailed ecological survey and mapping will provide information on the current status and distribution of the species, which will be useful for identifying the areas to work for intensive domestication and conservation of this species.

The objectives of the study are to: a) prepare the distribution map of *Hippophae* in Mustang and Manang districts; b) make a quantitative assessment and identify the associates of *Hippophae salicifolia* and *H. tibetana*; and c) provide potential sites/areas of seabuckthorn.

METHODOLOGY

Mapping of the *Hippophae* species was done based on well-established methods (Braun and Blanquet 1927; Weaver and Clements 1938; Kershaw 1985). Requisite size of the quadrat was determined by species area curve method (Barbour et al 1980). Required size of the quadrats for the sparse and densely vegetated areas was determined. However, the remaining areas, not visited, were extrapolated utilizing the secondary data sources such as habitat and microclimatic factors (topography, soil condition, temperature, precipitation, humidity, etc.) and interviews. Potential *Hippophae* occurrence sites were screened out using visual observations, available data of the study sites and local information.

All trees and shrubs were identified in the field. Among them, stems, more than 5 cm in diameter at breast height (1.3 m above ground level) in each plot were measured for DBH. Generally the plant having DBH more than 10 cm is considered as mature tree but as the *H. salicifolia* is a medium sized tree and as in practice the plants with DBH about 5 cm were fully matured, 5 cm DBH was used as an indicator for a matured plant.

Canopy cover, height of the trees, aspects, gradient and altitude of each plot were recorded. Latitude and longitude were recorded using a GPS equipment. Phenology and identification of male and female plants were done by observation and local information.

Analytical Methods

On the basis of collected information, analysis and evaluation of vegetation dynamics at different sites were made by computing the collected information on density, frequency, and regeneration status of *Hippophae*.

Density(D) per hectare = Ni/(S x Np) x 10,000

Ni: Number of individuals of a species,

S: Plot size,

Np: Total number of plots sampled.

Frequency = Ns/Np x 100

Ns: Number of samples in which the species occurred.

FINDINGS

The size of quadrat determined for the study of *Hippophae salicifolia* was 400 m^2 (20 x 20 m^2) and *Hippophae tibetana* was 25 m^2. This was also recommended by the pilot survey conducted for Mustang (Gupta et al 2000).

Forest Cover Status of Seabuckthorn

A total land area of about 288 km^2 and 376 km^2 was calculated for *H. salicifolia* and *H. tibetana* respectively in Mustang and Manang as a presently available forest/shrubland cover as per survey.

From Table 1, it is obvious that the cover area for *H. salicifolia* is more in Manang while that for *H. tibetana* more in Mustang. These conditions may be explained in terms of climatological factors (MI and precipitation). In Mustang much of the area possesses the MI in negative digits indicating drier conditions which is favorable for *H. tibetana*. In contrast, Manang represents moister area as compared to Mustang.

Furthermore, the maximum negative value of MI (-33 in Manang, 3,300-4,200 m; and-51 in Mustang, 2,900-4,200 m) at the sites of *H.tibetana* and the maximum positive value (6 in Manang, 2,100-3,800 m; and 10 in Mustang, 2,000-2,800 m) at the sites of *H. salicifolia* were directly reflected in the present coverage of seabuckthorn.

Table 1. *Iso-potential area (km^2) by districts for seabuckthorn and moisture index*

Districts	Area of *H. salicifolia*	Area of *H.tibetana*	Moisture index(MI)
Mustang	57.091 Km^2	279.798 Km^2	10 to -51
Manang	230.495 Km^2	96.797 Km^2	6 to -33
Total	**288 Km^2**	**376 Km^2**	

Source of MI: Lillesso et al (2000)
NB: Total area was calculated using GIS map

Areas of *Hippophae* Occurrence

Stainton and Polunin (1997) writes:

> "*Hippophae salicifolia* appeared to be colonizing on alluvial gravels, wet landslips and riversides ranging from 2,000-3,500 m asl; Himanchal pradesh to S.E.Tibet. *H. tibetana* showed to be colonizing in the riversides, stony moraines; gregarious areas of the altitude between 3,300 and 4,500 m asl in the inner drier habitat. It is reported to occur between Himanchal pradesh to S.E Tibet, N.W. China."

H. salicifolia plants were found occuring naturally between 2,000-2,800 m in Mustang. Plants with luxuriant growth were also recorded in Lupra and Panda khola, at an altitude of 2,950 m (28° 48' 139" N and 83° 47' 551" E). Similarly, the latitudes between 28° 36' to 28° 48'N and longitudes between 83° 38' to 83° 47' E were the representative sites of *H. salicifolia* in Mustang.

H. tibetana showed preferences to grow in dry areas (less than 200 mm of precipitation per annum). However, luxuriant growth of these plants was recorded between 2,775 and 3,942 m. Thus, the latitudes between 28° 48' to 29° 15' N and longitudes between 83° 46' to 83° 58' E were estimated to be the representative boundaries of *H. tibetana* in Mustang.

In Manang *H. salicifolia* plants were observed at the altitudes between 2,100 m (Dharapani) and 3,668 m asl (Bhimtang) in Manang district in the geographical boundaries between 28° 31' to 28° 37'N and 84° 14' to 84° 29'E.

Similarly *H. tibetana* preferred to grow in dry areas (less than 200 mm of precipitation per annum). These plants were recorded at the altitude between 3,300 m asl (Pisang) and 4,200 m (Lattar) in Manang district within the geographical boundaries of 28° 37' to 28° 44'N and 83° 58' to 84° 07'E.

Iso-Potential Areas of Seabuckthorn Plantation Surveyed

The south-facing slopes were the best suitable to vouch for the potential area of *H. salicifolia*. Based upon the comprehensive field observations and consideration of ecological variability of the areas in question, potential distribution for *H. salicifolia* and *H. tibetana* was projected in Mustang and Manang districts (Figure 2).

Table 2. *Iso-potential sites, altitude, coordinates and site types for seabuckthorn.*

	Place	Tentative Area (ha)	Altitude (m)	Coordinates	Remarks
H. salicifolia	Sauro bagar	100	2505	28°40'809"/83°37'061"	P
/Mustang	Lete	100	2325	28°37'668"/83°37'051"	S
	Kunjo	50	2350	Na	P
	Kokhethanti	50	2400	28°39'5.37"/83°35'7.01"	P
	Tukuche	50	2550	Na	P
	Marpha	50	2550	Na	P
Manang	Bagarchhap	20	2180	28°31'51.9"/84°20'12.8"	S
	Dharapani	30	2100	28°32'16.4"/84°21'0.1"	S+P
	Chame	10	2690	28°33'2.0"/84°15'10"	S
	Thoche	20	2110	28°32'20"/84°21'0.9"	S
	Tilche	100	2150	28°32'37.3"/84°22'52.7"	S
H. tibetana	Jharkot	200	3647	28°48'39.8"/83°50'53.8"	S+P
/Mustang	Ghemi	100	3520	29°03'53"/83°52'24"	P
	Lo-manthang	300	3850	29°11'11"/83°57'43"	P
	Chhoser	100	3930	29°11'56"/83°37'37.5"	P
	Charang	200	3640	29°05'59.5"/83°55'37"	P
Manang	Yak kharka	20	3900	28°42'28"/83°58'41"	P
	Manang	50	3520	28°39'33.5"/84°02'02"	P
	Humdein	100	3390	28°38'2.8"/84°06'59.6"	P

P: plain land, S: slopes

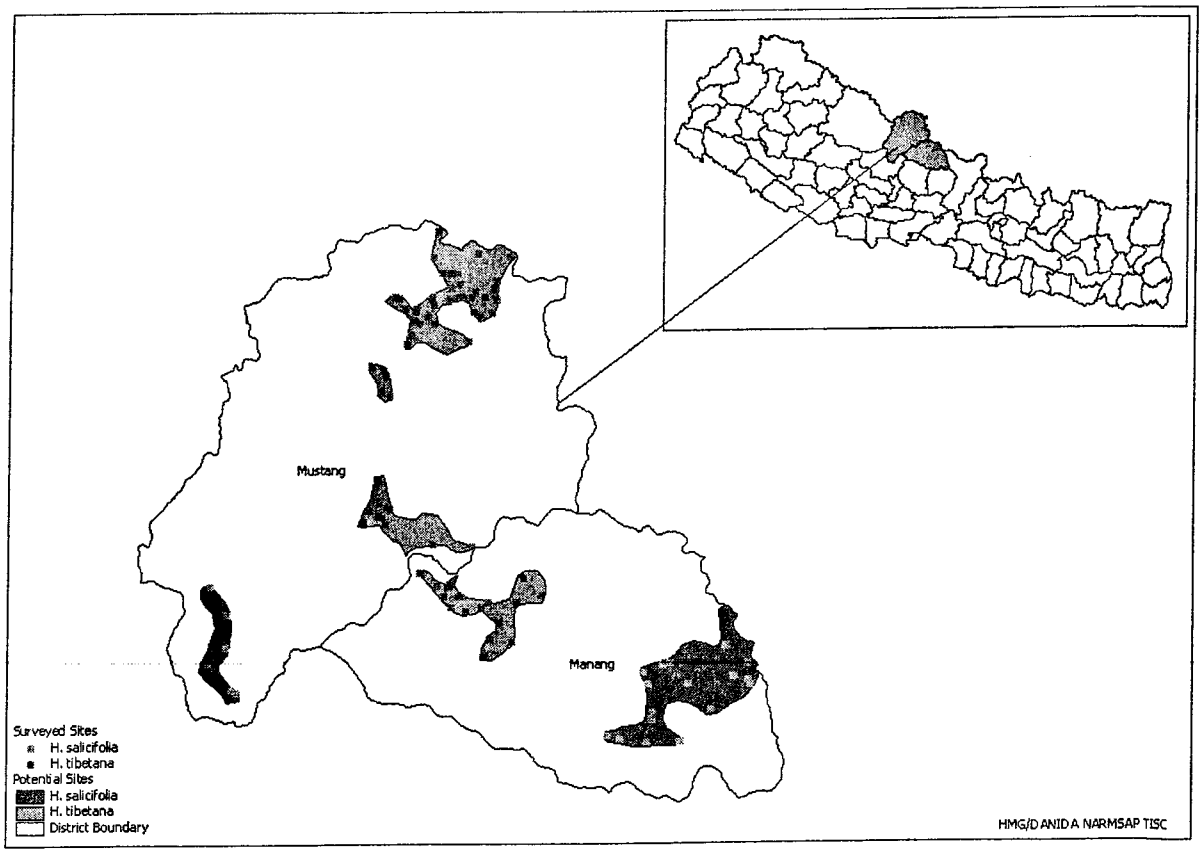

Figure 2. *Potential distribution areas of seabuckthorn in Manang and Mustang districts*

Distribution

Thirteen large spots of *H. salicifolia* and seventeen large patches of *H. tibetana* were recorded in Mustang as identified by field visit and local informants. Thirteen large spots of *H. salicifolia* were investigated by local informants and field visit. Likewise eight large spots of *H. tibetana* were recorded in Manang. It is noteworthy that a transition zone by altitude was noticed in Manang, 3,300-3,800 m, where the both species occurred (Figure 3).

Identified *Hippophae* sites

Regarding the noticeable forest of *H. salicifolia* in Mustang, few names of places were listed as follows: Ghansa, Ghumaune, Lete, Kunjo, Chhoyoford, Kokhethanti, Larjung, Yamkin khola. Likely for *H. tibetana,* Ghemi, Marang, Dhrakmar, Lo-manthang, Chhoser, Chhonup, Phuwa, Thengar, Jharkot were the remarkable places in Mustang.

Likewise, starting from Pisang up to Lattar including Humden, Manang Tilicho basecamp, Khangsar, Gunsang,Yak kharka represented the shrubland of *H. tibetana* in Manang. Similarly, Chame, Koto, Narkhola, Thanchowk, Latamarang, Bagarchhap, Dharapani, Thonche, Tilche, Surkikhola were few noteworthy places in terms of the forest of *H. salicifolia* in Manang.

According to local people there was huge forest of *H. salicifolia* in Tal (1,800 m), Manang, a few years ago. But there is not even a single individual at present. Actually this disappearance happened due to heavy flood. The increasing population pressure, over grazing and human consumption for the purpose of fuel wood and fodder might also have affected the loss of the seabuckhorn vegetation. A similar case was found in Chhuksang and Tirigaun (3,000 m), Mustang. Local people told that there were dense patches of *H. tibetana* 50 years ago, but now one can find hardly a few scattered individuals. Interesting fact was that these plants never yielded fruits.

Another very interesting thing about the distribution of seabuckthorn in Manang was the place name of "Tijilon," which meant the place of *H. salicifolia* in Gurung language (Tiji = *H. salicifolia*, Lon = Habitat).

Species Association

Various plant species were recorded from Mustang and Manang as the associated species of *Hippophae* (Figure 3). Among them few plant species with high frequency and ecological similarities were expected as the true friends of seabuckthorn.

Mustang

Excluding the high flood potential area (Larjung Bagar) and Kokhethanti, in other plots, similar types of herbs and shrubs were found in association with *H. salicifolia*. The main associates with *H. salicifolia* were: *Pinus wallichiana, Salix tibetana, Juniperus* sp., *Alnus nepalensis, Anacardia diversifolia, Arundinaria falcata, Berberis* sp., *Ephedra gerardinia, Sophora* sp., and *Inula kappa.*

Similarly, associated species of the *H. tibetana* were recorded as follows: *Berberis erythroclada, Caragana brevifolia, Lonicera spinosa, Ephedra gerardiana, Populus tibetana, Rosa* sp., *R. erythroclada, Cotoneaster microphyllus, Airtimes vulgaris, Sophora* sp., *Clematis* sp., and *Juniperus* sp.

Manang

The commonly available plant species in close association of *H. salicifolia* in Manang district were *Pinus wallichiana, Daphne bholua, Rosa* sp., *Tsuga dumosa, Salix* sp., *Arundinaria falcata, Berberis asiatica, B.*

aristata, Hedera nepalensis, Coriaria nepalensis, Picea smithiana, Populus sp., and *Pyracantha crenulata.*

The main associates of *H. tibetana* found in Manang district were as follows: *Lonicera angustifolia, L. spinosa, Juniperus indica, Rosa erythroclada, R. sericea, Aster himalaicus, Berberis angulosa, Caragana* sp., *Cotoneaster microphyllus, Airtimes vulgaris, Clematis* sp., *Ephedra gerardiana, Pinus wallichiana, Salix hylematica,* and *S. calyculata.*

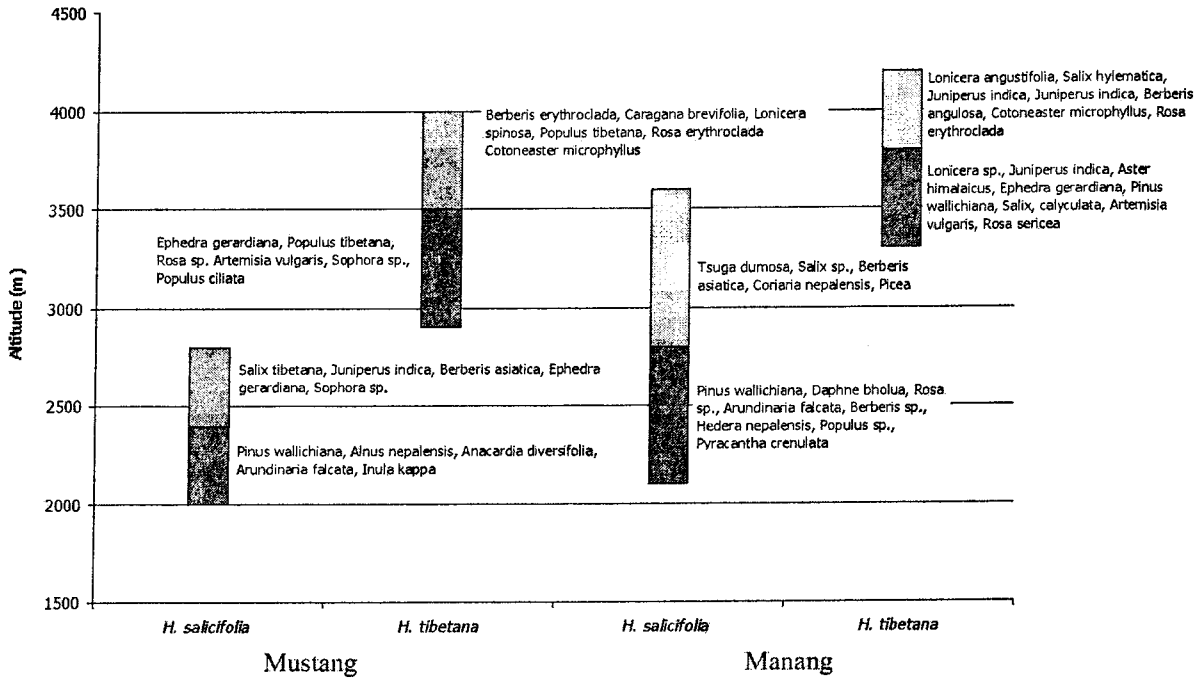

Figure 3. *Associated species of Seabuckthorn by altitude*

Common Associates from Mustang and Manang

Among the above given associated species few plants were commonly found for *H. salicifolia* from both districts, which are summarized in Table 3. Similarly common associated species for *H. tibetana* are summarized in Table 4.

The altitudewise variations in associated species were also noticed (Figure 3). The altitude reflected also in the diversity on species level. For example, Berberis asiatica/aristata was recorded in lower elevation while it was replaced by Berberis angulosa in higher elevation. Similarly *Salix hylematica* was replaced by *S. calyculata* while going upwards. *Pinus wallichiana, Ephedra gerardiana* and *Juniperus* sp. were found as associated species for both *Hippophae* species, though at a limited altitude.

Table 3. *Common associates of H. salicifolia from Manang and Mustang with frequency.*

Species	Frequency of associated species	
	Manang(%)	Mustang(%)
Pinus wallichiana	100	35.7
Salix tibetana	30.7	28.5
Berberis sp	38.4	21.4
Arundinaria falcata	38.4	21.4

Table 4. *Common associates of H.tibetana from Manang and Mustang with frequency.*

Species	Frequency of associated species	
	Manang(%)	Mustang(%)
Berberis erythroclada	75	81.25
Caaragana sp	50	75
Lonicera sp	100	68.75
Ephedra gerardiana	37.5	43.75
Rosa sp	87.5	56.25
Cotoneaster sp	50	37.5
Airtimes vulgaris	37.5	31.25
Clematis sp	37.5	25
Juniperus sp	87.5	25

Density of Seabuckthorn

Mustang

Average density of *H. salicifolia* in Mustang was recorded to be 675 individuals per hectare. Areas with high density were Lete khola, Larjung and Ghansa. Likewise the average density of *H. tibetana* was recorded to be 18,137 bushes per hector. The high-density area were Chhoser, Phuwa and Ghemi.

Manang

Average density of *H. salicifolia* in Manang was recorded 763 individuals per hecter. Tijilon, Bagarchhap and Surkikhola were the high density area. Likewise the highest density of *H.tibetana* was recorded 10,450 bushes per hecter. Lattar, Yak khark and Manang were the high-density areas.

Ecological Status

Hippophae salicifolia

The plant species occurred on the fragile lands with weak soil composition and unfertile river fords. Newly emerging plants were grown abundantly along the fords where the associates were lacking. The barren lands invade as the pioneer species of secondary succession. This species grows and flourishes within a short interval. This species occurred in temperate regions at elevations ranging from 2,000 to 3,500 m.

The plant is associated mainly with Alnus nepalensis, Pinus wallichiana, Arundinaria falcata and Berberis erythroclada at lower elevations whereas it mixed with Pinus wallichiana, Abies spectabilis, Taxus baccata, Tsuga dumosa and even with Betula utilis at higher elevations. Berberis sp., Sarcococca saligna, Sophora sp. were the bushes and shrubs that occur in association with the seabuckthorn. Forbs and grasses, on lower strata occurred in trace amount. This might be due to the their strong sensitiveness with the season. Visited season was almost dry and cold that might have caused to eliminate the associating forbs and grasses. Many of them were not identified because of their complete dryness. *Cannabis staves*, *Airtimes vulgaris*, *Ajuga* sp., *Gynura* sp., *Inula cappa* and *Eulaliopsis binata* were much common among them.

Some areas still remained where the matured trees of *Hippophae salicifolia* are present. Bamboos are associated with fairly large trees of *Hippophae*. That might be due to the forest firing, since bamboos are good successor species after the forest firing. Hence, the firing might have removed the invading new species in the areas.

Hippophae tibetana

This species frequently occurs in alpine tundra. The main associates of this species are, *Berberis*

erythroclada, *Caragana* sp., *Sophora* sp., *Lonicera* sp., *Cotoneaster* sp., and *Rosa* sp. ranging from altitudes of 3,300 to 4,200 m. Mostly these plants found on the southern slopes are more fruit bearing than those found on the northern slopes. Excluding few exceptions, all the plants were recorded within the periphery of 100 m apart on either side from the water sources. This indicates that seabuckthorn grows well if the soil moisture is good enough. Furthermore, as it has the capacity of nitrogen fixation, the soil around *Hippophae* growing area is noticed to be fertile. An evidence for that is the public interest to bring the soil from *Hippophae* growing area and add in the cultivated land, in Jharkot, Mustang.

Pressure on Seabuckthorn

As it grows and invades in fragile and virgin soil, it has high risk of the mass movement as well as flood wash. Mass movement in several places like Letekhola, Larjung, and Tijilon, noticed was a strong evidence of the case. Old forest of *Hippophae salicifolia* of Dhampu and Letekhola indicated the forest firing history, as it possessed bamboo as the associated species. Likely, the forest firing in Humden area adversely affected the distribution of seabuckthorn. Among the studied areas, Larjung ford (Sirkung and Sauro) was highly affected by human activities. The strong evidence was the highest number of cut stumps (65 per 400 m^2) in that area. Similarly, cut stumps of *H. salicifolia* were also recorded in Ghansa/Mustang and Bagarchhap/Manang. People cut the larger trees for making plough as it bears strong wood. The fuel wood is much smoky producing pungent smell. Thus it is the second priority for fuel wood in some areas of Mustang district. It has least value in construction purpose. *H. tibetana* is widely used for the fuel purpose in Mustang as there is no large trees and lacks other alternative energy sources. Moreover, *H. tibetana*, since it contains long thorns, is used for the fencing purpose in Mustang. This also adversely affects the species availability. Winter trek routes along the *Hippophae* covered areas of Larjung add adverse effect on the species especially to the new regeneration. Grazing has adverse effect on *Hippophae tibetana*. Horses, sheep, Chyangra (Mountain goats) and yaks in Muktinath area and in upper Mustang affect adversely to the species in the alpine pastures.

IN BRIEF

Results indicated that *H. salicifolia* possessed very good relationship with *Pinus wallichiana*, *Salix tibetana*, *Arundinaria falcata* and *Berberis* sp. Similarly *H. tibetana* showed very good relationship with *Berberis erythroclada*, *Caragana* sp. and *Lonicera* sp.

Furthermore, any area with the geographical boundaries of 28° 31' to 28° 48' N and 83° 30' to 84° 29' E at an altitudinal range of 2,000 to 3,668 m was suitable for *H. salicifolia*. Areas within 28° 37' to 29° 15' N and 83° 46' to 84° 07' E at an altitude between 2,800 to 4,200 m was found suitable for *H. tibetana*. But it needed water body around and alluvial weak soil composition in southern slopes especially landslips/landslides areas within 20° to 60° of gradient.

TOWARDS FUTURE

A detailed socio-economic survey is required, which can provide the real situation of the people's interest and feasibility of seabuckthorn promotion in Mustang and Manang districts. Utilization of *Hippophae* species on soil conservation and soil reclamation should be promoted in order to reduce the resource loss and ameliorate the soil conditions. Similarly, extensive awareness programs are required to popularize the plant among local people so as to establish it as an alternative income generating resource and nutritional resource as well. As it is one of the least known plant species among the local people, there is no any

conflict on resource use but conflicts may arise when it becomes popular and beneficial. Importantly, the local people interviewed with during the field visit indicated their desire for extensive plantation and conservation programs of seabuckthorn. Further plans can be designed on the basis of the outcomes of this study including iso-potential maps.

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Vegetation Analysis of a Corridor Linking Annapurna Conservation Area and Chitawan National Park of Nepal Himalaya

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ABSTRACT

This paper deals on floristic composition, distribution and "hotspot" analysis of terrestrial vegetation in a corridor zone lying between two protected areas: Annapurna Conservation Area and Royal Chitawan National Park belonging to the eastern Himalayan region of Nepal from an ecoregional perspective. The vegetation pattern indicated variation in species richness, Basal Area Ratio (BAR) and level of human disturbance along a distinct altitudinal gradient and river valley linkage of Madi, Marsysngdi, Seti and Narayani rivers. The habitat diversity, threat level and local conservation practices were found influencing factors in identification of floristic hotspot. Relevant measures for conservation of habitat and biodiversity through socio-economically viable approaches including ecotourism potentials have been discussed.

KEYWORDS: Vegetation analysis; floral diversity; corridor landscape; Nepal

INTRODUCTION

The Himalayan region is a critical area in the context of global biodiversity and fragile habitat. Degradation of natural resources and loss of biodiversity in the mountain ecosystem in terms of extensive deforestation, intensive cultivation in steep slopes, heavy population pressure and adverse impacts of large development projects has drawn major concern. In this relation, sustainable management of biological resources along with conservation of biodiversity have emerged as a major challenge (Shengji and Sharma 1998). The mountain specificities such as inaccessibility, fragility, marginality accompanied with natural and cultural diversity represent both constraints and opportunities. The latter parameter of mountain area represent a comparative advantage over the plains for specific development such as ecotourism, and an integrated, participatory approach is needed for solving the interrelated constraints and harnessing the opportunities (Bhatia et al 1998).

The Annapurna South Extension-Chitawan National Park complex area characterizing high land-low land and river valley linkages in the central midland hill of Nepal belonging to the eastern Himalayan broadleaf and conifer forest, come under one of the WWF registered "Global 2000" sites (Wikramanayake et al 1998). This under explored and not formally protected habitat area of relatively high biodiversity, important as a wildlife corridor extension between two Protected Area Systems (PAS), represents a gap in the regional protected area network of the Himalayas, and comes under a recommended area biodiversity conservation landscape (Dinerstein 1998).

Over exploitation of forestry resources outside the protected areas is still the main challenge of biodiversity conservation in Nepal, as dependence of local community on forest resources has not declined. The depletion of forest resources has resulted in the permanent loss of natural habitat for wildlife (Tiwari 1998). The chain of national parks and reserves as well community managed forests, have not only resulted an increase in wildlife species in particular and local biodiversity in general but also increased cases of wildlife depredations and a challenge of balancing conservation and development. This herald a conceptual shift from biodiversity conservation to biodiversity management along with an emphasis on improvement in quality of life of mountain communities through collaborative research and regional

cooperation (Bhatia et al 1998).

Despite several works in the adjacent PAS, there exists gap of information on the conservation and management status of local biodiversity and development potentials such as ecotourism in the present study area. In this line, the present work was carried out with an objective to assess biodiversity status, habitat condition and local conservation practices in the corridor zone linking Annapurna Conservation Area and Chitawan National Park of central Nepal, in relation to conserving biodiversity hotspots, restoring degraded habitats including wildlife migration corridor zone, and sustainably managing of biological resources from an ecoregional perspective.

STUDY AREA

The study area representing a transition and corridor zone lying between Annapurna Conservation Area Project (ACAP) and Royal Chitawan National Park (RCNP) in the northern and southern side respectively. It characterizes two distinct ecozones; Churia (Siwalik) range and Mahabharat hill range of central midland Nepal Himalayas. The area extends between geographical coordinates: 83° 50'-84° 45'E longitude and 27° 42'-28° 14'N latitude, altitudinal range of approx. 200-2,200 m asl and river valley linkage of four rivers namely Marsyangdi, Madi, Seti and Narayani river (Figure 1). The area comes under five districts; Tanahun, Lamjung, Kaski, Chitawan and Nawalparasi belonging under the Central and Western development regions of Nepal. The study area lying about 125 km west from Kathmandu, is bisected by Prithivi highway horizontally and by Dumre-Besisahar and Pokhara-Baglung road vertically. The road head area is accessible by motorable roads, Kathmandu-Pokhara/Bharatpur airplane service and distant area by treks on foot trails.

The study area feature a number of east-west extending hills or mid mountain ranges criss-crossed by a number of north-south flowing rivers resulting a number of river valleys and flood plains. Geologically the river valleys of the study area are formed out of the recent alluviums in general and constitute coarse fluvial deposits such as sandstone, shale and conglomerate in the Churia range and mainly clastic and carbonaceous rocks in the midland hilly area. The soil types include sandy and alluvial in inner Terai, gravely in Churia (Siwalik) to rocky in the hills and mountain area. The area is characterized by hot summer and dry winter monsoon climate with the range of temperature from 5°C to above 30°C and the average annual rainfall accounts 1,500 mm to above 3,500 mm (Shrestha 1988).

The major land use types include forest, shrub lands, grazing lands, agriculture lands, still to running water bodies/wetlands and urban to rural settlement area with population density ranging from below 100 to above 400 population per square kilometer (CBS 1991). The type of vegetation in terms of species composition, density and biomass vary with climatic and topographic variation from the inner Terai to the hills. The general natural vegetation type includes fairly dense to dense stands of tropical mixed hardwoods dominated by Sal (Shorea robusta) at inner Terai and Churia range whereas subtropical to temperate deciduous mixed broadleaved forest in the hilly mountain area.

METHODS

Field Survey

In the project area, three major potential habitat corridor corresponding to three major river valley of Marsyangdi, Madi and Seti river watersheds (Figure 1) were identified for movement of wildlife from Terai/Siwalik to Mahabharat midhill area during summer and vice versa in winter respectively. The field

study was orientated in detail survey of selected 18 representative sample sites (Figure 1) and general survey of adjacent forested hill ranges of the said river watersheds. Relevant available literatures and topographic/ vegetation maps were consulted prior to field visit. The field study was carried out for two weeks during June, 1999. Habitat diversity and threat level were assessed on the basis of field observation of land use types, human impacts and indicators of fragility (Dinerstein et al 1999). The floristic composition of every sample plots (10mx10m: 0.01 ha in area) was carried out using releve analysis approach (Dombois and Ellenberg 1974). The status of rare and endangered plant species were noted by specific search and by consulting relevant literatures (IUCN 1996; MOPE 1998). Floristic diversity in terms of species richness (number of total species /unit sample area) and 'hotspot' were identified by using indicator parameters (Dinerstein et al 1999). The Basal Area Ratio (BAR) of all tree species (>5cm circumference) was calculated by using a formula (Kanai and Shayka 1973).

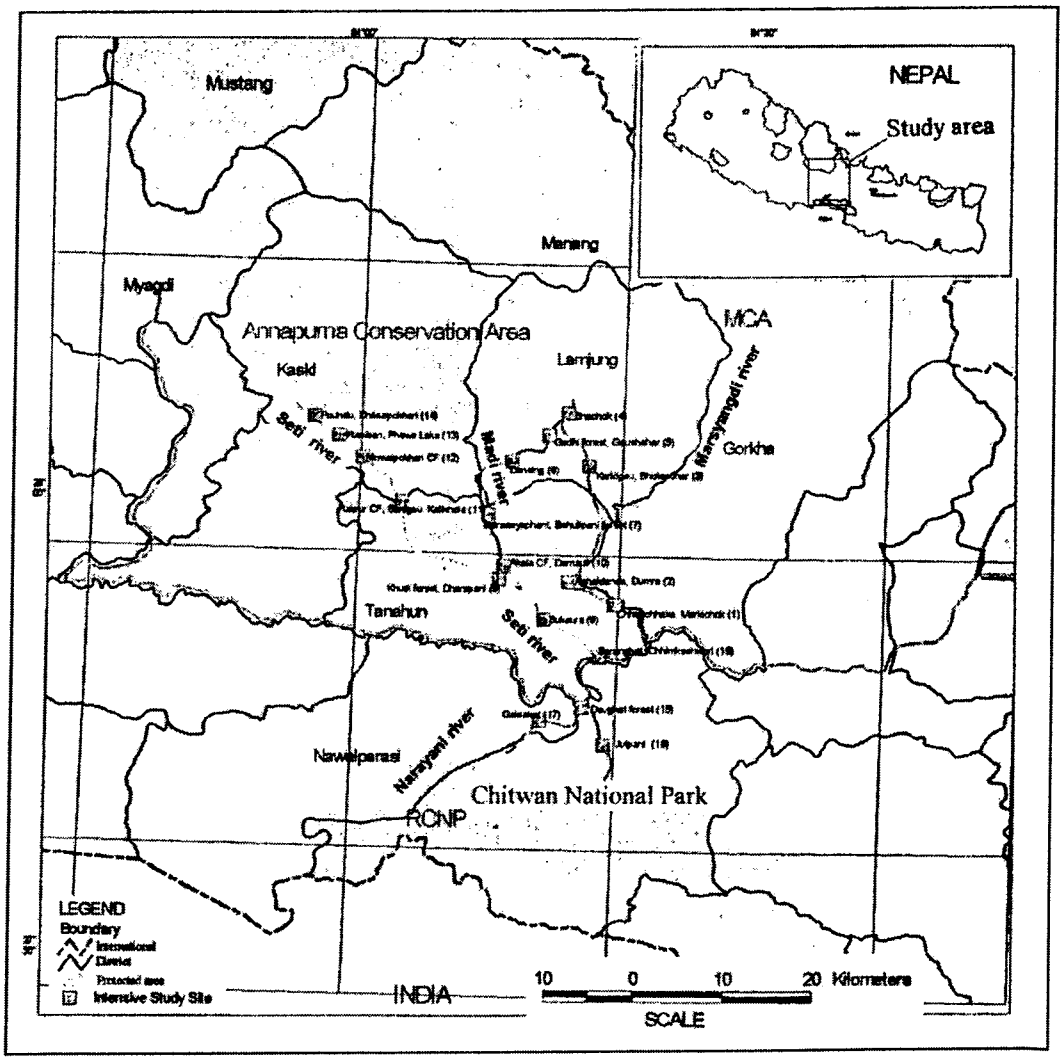

Figure 1. *Location map of quadrat sample sites for vegetation analysis by river valleys.*

Interview and Discussion

Information related to existing threats on local vegetation and relevant issues on conservation and management practices adopted by local community, was obtained by applying Rapid Rural Appraisal (RRA) method thereby administering a semi-structured questionnaire and holding interview/discussion

with key informants including farmers, school teachers, government officials, local leaders, NGO representatives, businessmen and women as natural resource manager.

Data Analysis and Evaluation

Data were analyzed qualitatively and quantitatively using matrices. The status of species level floral diversity was assessed using species richness, BAR and occurrence of rare/endangered species each divided into 3 level categories: Low (<25%), Moderate (>25-75%) and High (>75%). The High-level diversity area corresponded to areas having at least 2 high level and none of low level score, whereas for Moderate level at least 2 moderate level and 1 high or low level, and for Low level at least 2 low level score and with none high level score. The level of habitat/species threat was defined as Low, Moderate and High corresponding to proportionate increase or decrease in natural and anthropogenic disturbances. The evaluating parameters included; frequency of landslides, case of forest fires, overgrazing, slash/burn agriculture, number of cut stumps, regeneration of seedlings, canopy coverage, coverage of leaf litters, maturity of trees, habitat blocks, distance between forests and settlements and number of trails in the forest area.

The local conservation practices were evaluated under 3 categories: High, Moderate and Low. The parameters of evaluation included plantation, nursery establishment, construction of check dams, organic farming, herbals farming, activity of local NGOs/Community Based Organizations (CBOs), literacy programs, exposure on sustainable harvesting tips, application of environment friendly technologies (eg, biogas, smokeless stoves, solar energy, bioengineering for slope stabilization and activities related to promotion of ecotourism).

The level of management was derived from comparing threat on species level and habitat degradation against existing conservation and development activities. It was evaluated by using relevant computer program including GIS analysis (Wikramanayake et al 1998) and categorized into 3 categories: C=critical/poor management, I= Intermediate and M= relatively well managed. The evaluation parameters included presence/absence of Community Forest User Groups (CFUG), appointment of forest watchers, formulation of relevant regulations, enforcement of penalty for violators, contribution of local community in cash/kind as well as involvement of Government organizations (GOs)/ NGOs/ CBOs for local forest management and ground truth assessment on status of existing forest condition.

On the basis of overall evaluation, the study area was categorized into high and moderate level corresponding to 'critical area' and 'area of concern' for management interventions including urgency of restoration measures (Dinerstein et al 1999; KMTNC 1994).

RESULTS

Vegetation Analysis

Forest types: The study area in general is characterized by two major forest types: i) tropical and subtropical and ii) temperate and alpine broadleaved forest types (Stainton 1972; Kenting Earth Sciences 1986). Specifically, the former type constitute: Sal forest, Tropical deciduous riverain forest, Khair-Sissoo and Schima-Castanopsis forest. The latter type constitutes Oak-Rhodendron and lower Temperate mixed broadleaved forest.

Species composition: The survey area recorded 180 plant species belonging to 166 genera and 98 families. Out of these 145 and 35 species were reported from sample sites and adjacent area, respectively

(Basnet et al 1999). Out of total, 160 and 20 spp. constituted flowering and non flowering plant species respectively. By growth form the recorded species composed of trees, shrubs, herbs, climbers, epiphytes, lichens, ferns and mosses. The common broadleaved tree species include *Schima wallichii, Castanopsis indica, Shorea robusta, Lagertroemia parviflora, Engelhardtia spicata, Bombax ceiba* and *Dalbergia sissoo*. The conifers were represented by only *Pinus roxburghii*. Common shrub species included *Lantana camara, Clerodendron infortunatum, Murraya paniculata* and *Ipomoea carnea*. Common herb species included *Eupatorium adenophorum, Imperata cylindrica, Oplisemenus burmanii, Pilea racemosus* and *Colocasia esculentus*. Common climbers included *Acacia pennata, Dioscorea deltoidea, Porana grandiflora, Smilax aspera* and *Vitis* sp. Common ferns included *Cheilanthus albo-marginata, Drynaria cordata, Dryopteris cochleata, Lygodium* sp., and *Nephrolepis cordifolia*. Common epiphytic orchids included *Vanda roxburghii*, and *Coelogyne cristata* on mature trees of *S. wallichii* and *S. robusta*. The common moss species included *Polytrichum* sp. and *Selaginealla* sp. Relatively infrequent flowering plant species but having notable economical and ecological importances included, *Alstonia scholaris, Rauwolfia serpentina, Swertia chirayita, Acacia catechu, Aegle marmelos, Daphniphyllum himalayense* and *Panadanus nepalensis*. Among these first four species are categorized as rare, endangered, commercially threatened and vulnerable species under IUCN Red databook category. Relatively rare species e.g. *Michelia champaca*, A. catechu and common species e.g. *Shorea robusta* are categorized as protected plants under the list of Nepal by HMG/ Nepal (MOPE 1999).

Distribution Pattern

Distribution pattern of species in terms of speciation with respect to altitudinal and latitudinal variation indicated distinct variation in vertical zonation from river valley floor to crest of a hill slope. The range of forest types and transitional ones successively from tropical to temperate zone included *Acacia-Dalbergia, Shorea robusta* (Sal) forest, Shorea-Schima, Schima-Castanopsis, Schima-Rhododendron and Quercus-Rhododendron forest. The transitional zone between Khair-Sissoo and Sal forest were occupied by a variety of successional species such as *Bombax ceiba* and *Cedrella tooni* in lowland river banks. *Pandanus nepalensis* and *Daphniphyllum himalayense* were found sporadically distributed in moist ravines whereas *Alnus nepalesnsis* and *Macaranga pustulata* were found commonly in highland river banks and Eupatorium *adenophorum* and *Lantana camera* both alien weedy species, were occurred commonly in open degraded grazing lands.

Floral diversity Hotspots: Considering the species richness in sample plots of study area by average number of species and mean BAR of trees recorded highest in Madi river valley followed by Marsysnagdi and Seti river and lowest in Narayani river valleys (Figures 2, 3). By frequency of threatened plant species, the Narayani river valley recorded higher as compared to other river valleys (Figure 4). On the basis of evaluation parameters of level of species diversity, the Schima-Castanopsis forest of Mahabharat hill slopes of some localities eg, Gausahar, Bhachok (Site nos. 4, 5) recorded high species diversity as compared to Sal forest of inner Terai plain eg, Devghat and Saranghat (Site nos.15, 16). The annex of Telbrung, Taprang and Karpu danda lying along the Madi river watershed (Site nos. 5,6,7) characterized by a long corridor with extensive forest coverage from Sal to Oak-Rhodendron forest with relatively less human impact represents a high floral hot spot area (Figure 5). Along the Seti river valley Raipur community forest (Site no.12) recorded high floral diversity. Other sites lying along Marsysngdi and Narayani river valleys recorded low to moderate level floral diversity (Figure 5).

Threat Status

The natural disturbance exemplified by flood and landslides and human disturbances by forest fire, tree felling, overgrazing were recorded in watersheds of all the river valleys. The sites lying by tropical to sub tropical belt in the vicinity of settlement area (site nos. 1, 3, 15, 16, 18) recorded higher threat level as compared to those sites lying by Temperate belt and at a distance from settlement area (Site nos. 6, 11,12,13). The slash /burn practice with a 5-8 year rotation period is still prominent at sites along the Marsyangdi river (Site nos. 4,16) and loss of forest area by encroachment stands major threat at sites such as Jutpani, Devghat (Site no.18, 15) lying adjacent to urban area by the Narayani river (Table 1).

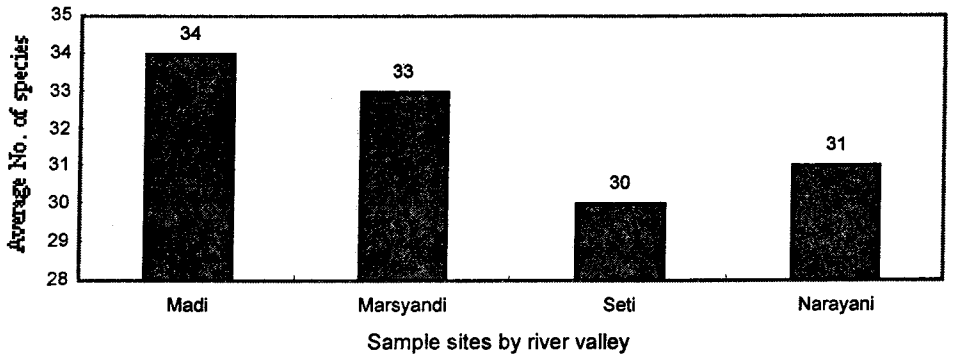

Figure 2. *Species richness of sample sites by river valley*

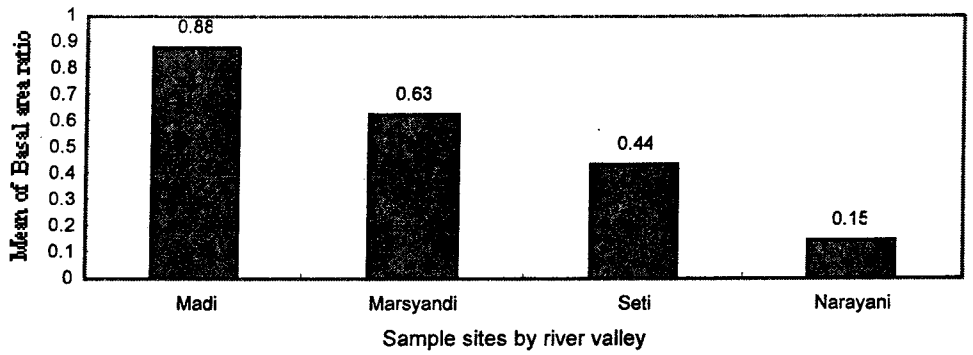

Figure 3. *Basal Area Ratio of Trees of sample sites by river valley*

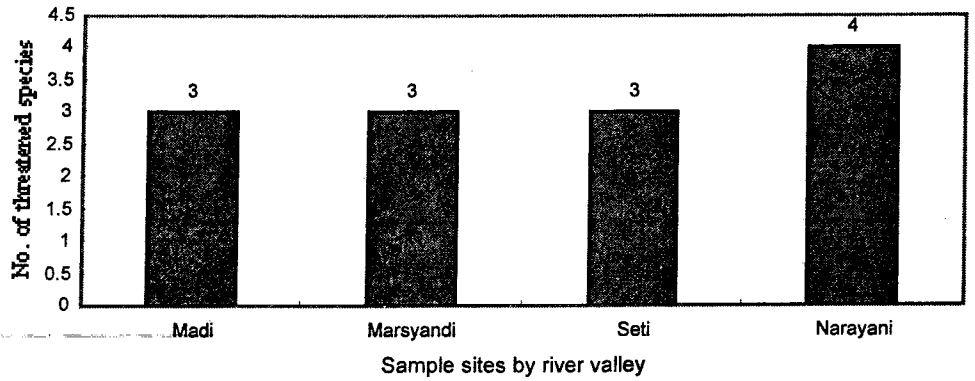

Figure 4. *Number of Threatened plant species of sample sites by river valley*

Local Conservation Practices

Evaluation of relevant parameters indicated variation in level of local conservation practices in different river valleys. Local people are trying for alternatives to reduce dependence on local forest resources in meeting their daily basic needs. Forests at many sites of the study area (Site nos.1-2,10-14,16-17) are under community management, a few(Site nos. 4,6,8,13) are under government management and still a few sites (Site nos. 9,15,18) are under conflict between the local community and forestry officials regarding the issue of ownership, boundary and resource/benefit sharing. Among the community managed ones, Nirmal pokhari community forest (Site no.12) was found relatively better. Local conservation effort accounted of good level in 4 sites whereas moderate level in 9 and fair level in 5 sites. In general, the status of local conservation efforts is of good, moderate and fair status in sites under community managed, government managed and under management conflict ones respectively (Table 2).

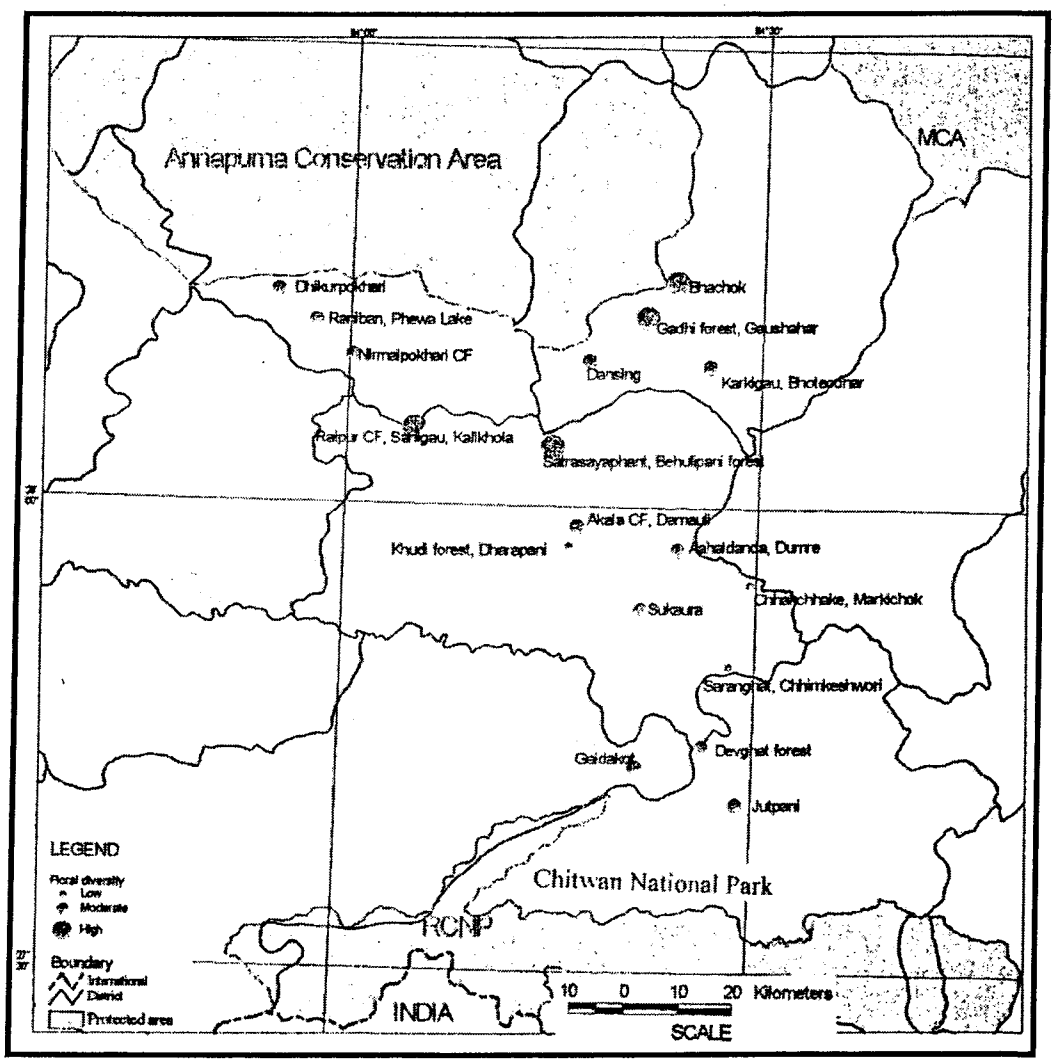

Figure 5. *Status of floral diversity in different sample sites, June 1999*

DISCUSSION

Vegetation Analysis

The higher floristic diversity of Schima-Castanopsis forest lying at Madi river valley belonging to midhill ecozone as compared to Sal forest of inner Terai-Churia range area lying by Narayani river valley (Figure

2) can be attributed to higher habitat diversity in terms of relatively high altitudinal gradient, less human impact and involvement of community in forest management and vice versa in the cases of low diversity area. The higher species diversity in Schima-Castanopsis forest of midhills as compared to Sal forest of lowlands (Figure 5) by per unit area of quadrat in the present case is substantiated by similar finding carried out in midhill forest of central and eastern Nepal respectively (Shrestha 1992). The higher mean Basal Area Ratio of trees at sampling plots of Madi, Marsyangdi and Seti river valleys lying by subtropical to temperate zone as compared to Narayani river (Figure 4) lying by tropical zone corresponds with similar trend in a cross sectional vegetation survey of Langtang area of central Nepal (Malla et al 1976). The low diversity in lowland forest having intense human pressure and disturbance such as encroachment corresponds with the similar finding in the Kanchenjunga mountain area of eastern Nepal (Yonzon 2000).

Table 1. *Threat status of sample sites by river valley.*

Site no./river	Threat to habitat	Threat to species	Site no./river	Threat to habitat	Threat to species	Site no./river	Threat to habitat	Threat to species
Marsyangdi			Seti			Narayani		
1	H	M	8	M	M	15	H	M
2	M	M	9	M	M	17	L	M
3	H	M	10	M	M	18	H	H
4	H	M	11	M	L			
5	M	M	12	L	L			
Madi			13	M	L			
6	L	M	14	H	M			
7	M	M	16	H	M			

Note: H=High, M=Medium and L=Low level

Table 2. *Status of local conservation practice at sites by river valleys.*

Site no.	Conservation practice	Site no.	Conservation practice	Site no.	Conservation practice
Marsyangdi		Seti		Narayani	
1	F	8	F	15	F
2	M	9	F	17	G
3	M	10	M	18	F
4	F	11	G		
5	G	12	G		
Madi		13	M		
6	M	14	M		
7	M	16	M		

Note: F= Fair, M=Moderate and G=Good.

Threat Status

An evaluation of threat on species level in terms of magnitude, by river valleys indicate proportionately high level at Narayani and Marsyangdi and river as compared to Madi and Seti river valleys (Table 1). This correlates with higher level of human pressure manifested by slash and burn cultivation and encroachment due to resettlement and development activities in the latter case. Indication of higher species diversity of threatened species in mid hill forests accounts their extra significance in biodiversity conservation. Disturbed mid hill habitats subjected to slash and burn leading to *Schima-Castanopsis* forest at climax condition, are tend to be characterized by more habitat diversity in terms of several habitat

patches, which in turn tend to attract diverse fauna (KMTNC 1994).

Local Conservation Practices

An evaluation of local conservation practices by sample sites indicates relatively more numbers of sites recorded moderate level (8 sites) followed by fair (6 sites) and good (4 sites) level (Table 2). Sites having good forest management status (eg, Site nos. 5, 12) correspond with forest area under community forest management. The forest cover and biodiversity status in the community managed ones as compared to government managed ones are better and those under conflict. This can be supported by the findings of apparent differences such as regeneration of fast depleting forest cover at the community managed ones and of deteriorating situation of bad to worse in government protected ones in Nepal (Mohpatra 2000).

Notable local conservation efforts included enforcement of forest protection regulations by CFUG, prohibition on open grazing by goats and sheep, no cutting of live trees without permission, establishment of forest guards, regeneration of degraded habitat through protection, reforestation, establishment of plant nursery and emphasis on plantation of native tree species. There has been also application of bioengineering practices in slope stabilization, Participatory District Development Program (PDDP) initiatives, infrastructure development for tourism promotion, community orientation towards promoting ecotourism in relatively good managed forest area and local environmental management through collaborative approach (Mohpatra 2000).

CONCLUSION

There exist several development potentials for the biodiversity conservation and ecotourism promotion in the study area. The former component includes conservation of critical habitats and floral hotspots through local efforts and international cooperation. From watershed /ecoregional approach, emphasis on sustainable use, fair benefit sharing mechanism and economic mapping of natural resources can be generated through entrepreneurship development through training of local community on sustainable management tips, provision of credit facilities and market intelligence. Incentive on conservation practices and penalization on violators, confidence build up of local community with good rapport, delegation of authority from the GOs and coordination among stakeholders on conflict resolution are important issues. In addition, there should be an emphasis on upgrading of local technology including production of value added products wider adoption of organic farming/agro-forestry practices and generation of alternative sources of energy e.g. biogas, briquettes, small/micro hydro- electric projects.

Relevant recommended measures for ecotourism promotion include: emphasis on ecotourism mapping /planning/training, investigation on carrying capacity, pockets of endangered plant species, possibility of village tourism, establishment of ethnic cultural museums/ souvenir shops, maintenance of basic infra-structure and river training works, farming of touristically important species, and international-level mass-scale publicity and provision of safety of tourists.

A proposed goal of conservation activity is to ensure a long-term survival of as many species as possible. Traditionally, most conservation activity has been focused on single flagship species. Such approach may protect a particular species and its habitat and a host of other associated species. This approach, however, does not necessarily conserve sites, which consist of most species (Groombridge 1992). It is recognized that unprotected lands having low economic values and even altered landscapes can support a variety of wildlife. As choices are limited it has to be tried out with an objective to maintain the

quality of the overall landscapes, harmonious human interaction and the biological diversity it contains (McNeely 1992). In the present context the accumulated knowledge and understanding of species and habitats/ecosystems should be put into conservation and management related actions along with public incentives and effective monitoring mechanism.

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Pteridophytes of Arun River Basin of Makalu-Barun National Park and Buffer Zone, Eastern Nepal

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ABSTRACT

A collection of Pteridophytes at different altitude that varies from 350-3,300 m in Arun River Basin of Sankhuwasawa and Bhojpur district of Koshi zone, Eastern Nepal was made. The identifications of recorded specimens were carried out in National Herbarium and Plant Laboratory, Godawari, with the help of morphological features by cross- checking with authentic herbaria and following relevant literatures. A total of one hundred twenty-eight species of Pteridophytes belonging to 27 families and 62 genera were recorded. Among families, Polypodiaceae (24 species) was the largest family followed by Parkeriaceae and Dryopteridaceae (each with 13 species). Among genera Selaginella (9 species) is the largest genus followed by Lycopodium and Thelypteris (each with 7 species). The altitudinal range between 1,500-2,000 m having 84 species was found very suitable for epiphytes as well as terrestrial species. On the basis of habitat 92 species were terrestrial, 16 species were epiphytes, 18 species were terrestrial as well as epiphytes and remaining 2 species were found aquatic. Out of 128 species, 29 species were found economically useful. Among them 5 were edible, 14 species were medicinal and 10 species were of miscellaneous uses.

INTRODUCTION

The Pteridophytes comprising the fern and fern-allies also constitute an important component of the Nepalese flora. Pteridophyte flora of the Himalayan region is considered to be the basic requirements for the advancement of knowledge in the field of Pteridology (Gurung 1994). The study of Pteridophytes of Nepal, a new light on different aspects of Asian Pteridology is much interesting (Fraser-Jenkins 1997). Reporting on Ferns and their-allies is far behind that on the flowering plants and there is no modern enumeration listing all the species known from Nepal (Iwatsuki 1988). Earlier works on Nepalese Pteridophytes were done together with other groups of plants, have been mostly in the nature of systematic, geographic and economic studies. These were done chiefly by the botanical survey of Nepal and a few on the topics of ethno-botanical study in master degree dissertation which shares a very few economically importance ferns.

Nepal lies in the central sectors of the great Himalayas in between latitudes 26° 22'-30° 27'N and longitudes 80° 04'- 88° 12' E. It occupies an area of 147,181 km^2. It has an average length of 885 km and width of 193 km. The altitude varies from 60 m to 8848m at Sagarmatha the highest peak of the world. The temperature varies from extreme hot in the tropical plains to arctic frost in the mountains region. Similarly, southern slope of Mahabharat range receives the maximum annual rainfall (5,550 mm at Lumle) and the minimum (295 mm) annually at Jomsom in the inner Himalayan valleys. These variation of climate, soil and altitude are responsible for the amazing range of Natural vegetation of the country (Chaudhary 1984). So it is endowed with the tropical to alpine vegetation.

The study of Pteridophytes in the world is extremely fascinating both from their morphological and phylogenetical aspects since the Linnaeous, 1753 publication 'Species Plantarum' consisting of 149 genera and 182 species (Mehra 1958). In the Nepalese context, David Don (1825) was probably the first to describe a few Nepalese ferns in 'Prodromus Florae Nepalensis' comprising 83 species. It was followed by Burkil 1910, Landon 1928; Parker 1932; Raizada and Vaid 1952; Tagawa 1955; Alston and Bonner 1956;

Pandey 1962; Roy et al 1971; Hara 1966-1971; Banerji 1975; Iwatsuki 1975, 1988; Department of Medicinal Plants Nepal 1974, 1976, 1988; Gurung 1979, 1982, 1984, 1985, 1986, 1988, 1989; MB Sinha and VL Gurung 1985; T Nakaike 1982, 1986 and 1987; T Nakaike and VL Gurung 1988 (Gurung 1991).

It is very unfortunate to say that a descriptive study and publication of Pteridophytes of Nepal is hitherto unknown. To get a complete work on Pteridophytes in the Himalayas, a complete work on Nepalese Pteridophytes is the most essential. There are 12000 species of Pteridophytes in the world (World Conservation Monitoring Centre 1992). Being a small country, covering only 0.003% area of the world Nepal shares 4.16% of Pteidophytes of the world.

METHODOLOGY

Study Area

This work was carried out in Arun Basin of Sankhuwasawa district, Eastern Nepal. The area visited for present study lies in between latitudes 27° 17' to 27° 35' N and longitudes 87° 13' to 87° 16' up to Uttisedanda in Seduwa sector. Hatiya sector lies in between latitudes 27° 17' to 27° 51' N and longitudes 87° 13' to 87° 24' up to Kimathanka. The study area lies between altitude (375 m-3,300 m).

Collection of Pteridophytes

The Pteridophytes in the field were collected during Dec.1998 and Sept.- Oct., 1999 by following the methods proposed by Fleming, 1984. A special attention was paid for the analytical studies on observation of their habitats as well as association with other flora in all bio-climatic zones. The localities, altitudes and their habit on the field were recorded at the time of collection.

Herbaria Preparation and Preservation

Herbaria were prepared after drying the collected specimens in a plant press with the help of blotters and newspaper as described by Lawerence (1951). A label with a complete details, date of collection, species number, scientific name, local name, family, locality, altitude, name of collector and information about ecological and economic aspects were given at the right bottom of herbarium sheets. The herbarium are placed in Central Department of Botany, TU, Kirtipur, Kathmandu, Nepal (TUCH). The specimens were preserved by using preservative periodically at the intervals of one or two months.

Identification

These collected specimens were identified in the National Herbarium and Plant Laboratory Godawary HMG Nepal. Plants were identified by studying morphological features and Ecological information collected during the field study and by following relevant references as those of Gleason et al (1922), Holttum (1954), Bower (1963), Verdoorn (1967), Bir (1983) and Iwatsuki (1971, 1988). These were also identified by cross checking of authentic sample deposited in the KATH.

RESULT AND DISCUSSION

Taxonomic Study

Present study of Pteridophytes in Arun River Basin comprises of 27 families 62 genera and 128 species. Out of which 122 species were identified up to species level. Six species were identified up to generic level. On the basis of number of species family Polypodiaceae is the largest one having 24 species followed by Parkeriaceae and Dryopteridaceae (each with 13 species), Athyriaceae (11 species), Selaginellaceae. (9 species), Lycopodiaceae and Thelypteridaceae (each with 7 species), Pteridaceae (6 species), Dennstaedtiaceae (5 species),Ophioglossaceae and Aspleniaceae (each with 4 species), Aspidiaceae (3

species), Blechnaceae, Davaliaceae, Glecheniaceae, Hymenophyllaceae, Lindsaceae, Oleandraceae, Schizaceae (each with 2 species) and remaining families Azollaceae, Cyatheaceae Equisetaceae, Lomariopsidaceae, Maratiaceae, Osmundaceae Plagiogyriaceae and Vittariaceae with single species.

The *Selaginella* is the largest genus having 9 species followed by *Lycopodium* and *Thelypteris* (each with 7 species), *Athyrium*, *Pteris* and *Pyrrosia* each with 6 species), *Dryopteris* (5 species), *Cheilanthes*, *Asplenium* and *Polystichum* each with 4 species), *Diplazium*, *Coniogramme*, *Botrychium* (each with 3 species), *Lgyodium*, *Dennstaedtia*, *Microlepia*, *Adiantum*. *Onychium*, *Tectaria*, *Arthromeris*, *Crypsinus Loxogramme*, *Microsorium* (each with 2 species) and remaining genera *Equisetum*, *Ophioglossum*, *Angiopteris*, *Osmunda*, *Plagiogyria*, *Dicranopteris*, *Gleichenia*, *Crepidomans*, *Hymenophyllum*, *Cyathea*, *Pteridium*, *Llindsaea*, *Sphenomeris*, *Gymmnogrammitis*, *Leucostegia*, *Nephrolepsis*, *Oleandra*, *Ceratopteris*, *Pityrogramma Vittaria*, *Blechnum*, *Woodwardia*, *Bolbitis*, *Arachniods*, *Cyrtomium*, *Dicalpe*, *Peranema*, *Ctenitis*, *Deparia*, *Diplaziopsis*, *Aglaomorpha*, *Belvisia*, *Colysis*, *Drynaria*, *Lemaphyllum*, *Neocheiropteris*, *Polypodium*, *Azolla* each with single species.

Distribution

The Pteridophytes found in this area are broadly categorized into three groups epiphytic, terrestrial, and aquatic on the basis of their habitat on which they occur in other plant, on land and in water or marshy places respectively.

Out of 128 species recorded, most of them were pure terrestrial (92 species), found only on clayey soil, gravely soil, rock and stone crevices in open and semi-shade shade areas. Sixteen species were epiphyte found only on trunk or branches of tree in open or shade areas. Two species were found aquatic on water lodged to marshy places. A total of 18 species were reported from tree trunks as well as from mossy cliff so these are categorized as epiphytic and terrestrial species.

Epiphytes

The composition of epiphytes changes greatly with altitude and the nature of forest. For luxurious growth of epiphytes a favorable substratum was provided by tree and generally it is possible in rainy season when the trunk and branches covered with thick layer of humus. The number of epiphytes found in dense and moist forests are comparatively higher than those found on open and dry areas. Even though the number of epiphytes varies greatly according to the altitude than the nature of forests. *Shorea robusta*, *Lagerstromia* sp. in lower Basin, *Schima wallichi*, *Castanopsis* sp., *Querqus* sp., *Eurea* sp., *Lyonia* sp. in middle elevation up to 2,000 m and *Betula* sp., *Rhododendron* sp., *Abies spectabilis* and *Berbaris* sp. in the elevation above 2,000 m in temperate and subalpine zones provided suitable substratum. The tree species like *Terminalia* sp., *Rhus* sp. in lower Arun Basin and *Pinus* sp. *Alnus* sp. in middle elevation have very few epiphytes. The main reason for poor growth of epiphytes in *Anacardium* sp. and *Terminalia* sp. might be due to the thin bark of these plant which can not accumulate humus due to low rainfall on this area.

Terrestrial

A majority of ferns (110 species) out of total 128 were terrestrial found on forest floor on clayey soil, forest borders on gravely soil and on rock and stones crevices on dry exposed and moist shade areas. Ninety-two species of ferns were true terrestrial found only on land and 18 species were common for land and also recorded from tree trunks.

Aquatic

Only two species were found on marshy land on the riverbank of Arun in lower Arun Bank near Chewabensi. *Azolla pinnata* found on wet muddy soil in water channels *Ceratopteris thallictroides* found on the semi-aquatic habitat on the edge of rice field near Chewabensi.

Availability of Species in the Field

All the species collected during field study were categorized mainly under three categories on the basis of their abundance. They were abundant (+++), frequent (++) and occasional (+). The species, which were recorded in higher proportion in different habitats and wide altitudinal range, were considered as abundant. The species found less commonly were categorized as frequent and those observed rarely and even in some cases found only in a particular habitat were designed as occasional. Among 128 species, 41 species were abundant, 61 species were frequent and 26 species were occasional.

Utility

Pteridophytes are also important on utility aspects. These were used in food, medicine, agricultural implements and as ornamental.

Edible

Total five species were found used as food. The tender shoots of *Diplazium esculentum*, *Tectaria coadunata*, *Dryopteris cochleata*, and *Cyathea chinensis* were used as vegetable during rainy season. *Nephrolepsis cordifolia* bear water balls on their long roots that consume to quench the thirst.

Medicinal

A total of 14 species were found as medicinal in various purposes. These were *Lycopodium clavatum*, *Equisetum diffusum*, *Cheilanthes furinosa*, *Cheilanthes doniana*, *Cheilanthes sp. Adiantum capilus-veneris*, *Adiantum phillippense*, *Vittaria flexuosa*, *Drynaria propinqua*, *Pteris biauriata*, *Lepisorus loriformis*, *Lygodium japonicum*, *Botrychium daucifolium* and *Lygodium flexuosum*. Among them the use of *Vittaria flexuosa*, *Pteris biauriata* and *Botrychium daucifolium*, was reported for the first time from this region.

Miscellaneous

A few species were commonly used for others various purpose such as ornamental agricultural implements and fodder. There were 10 species categorized under this heading which includes two species such as *Lycopodium phlegmaria* and *Selaginella monospora* were used for decorative material in religious ceremonies. Six species such as *Dicranopteris linearis*, *Dennstaedtia appendiculata*, *Pteridium revolutum* and *Pteris wallichiana*, *Osmunda claytoniuana* and *Gieichenia gigantea* were used as agricultural implements for making compost fertilizer and burned on land before cropping for fertility of land. These were also used to make bedding (carpets) for cattle. *Athyrium foliolosum* and *Polystichum lentum* were used as fodder. The edible ferns were also used as good fodder for cattle.

CONCLUSION

A total of 128 species belonging to 62 genera and 27 families were recorded. Family Polypodiaceae and genus Selaginella occupy the top position among families and genera respectively. On the basis of habitat 92 species were pure terrestrial 16 species were pure epiphytes, 18 species were terrestrial as well as epiphytes and 2 species were aquatic. Altitude and climate mainly influence the distribution of Pteridophytes. Moist and dense forest and River-bank were found suitable habitats for the growth of diversified fern. Altitudinal distribution pattern in Arun Basin comprises highest number of species between 1,500-2,000 m (84 species). It is followed by a range 1,000-1,500 m with (63 species), 500-1,000 m (50 species), 2,000-2,500 m (48 species), below 500 m (26 species), 2,500-3,000 m (16 species) and 3,000-3,300 m (6 species). The higher number of species in sub tropical zone is due to optimum temperature, plenty rainfall, high humidity with fertile soil. Out of total 128 species 29 species were found economically useful and used by local people in various purposes. Out of which 5 species were edible, 14

species were medicinal and 10 species were Miscellaneous.

Table 1. *A list of Pteridophytes of Arun River Basin*

Scientific nFamily/ Name of species	Loc.(Vern.) name	Locality&(Altitudem)	Habitat	Coll. no.
Aspidiaceae				
Ctenitis apiciflora		Chichila1900	Ter	154
Tectaria Coadunata	Kalo niuro(L)	Betbari, 1025	Ter	137
Tectaria Polymorpha		Numbridge, 760	Ter	184
Aspleniaceae				
Asplenium macrophyllum		NumBridge, 750-	Epi	174
Asplenium ensiforme		Kimathanka, 2400	Epi	222
Asplenium lacinatum	Spieen wort(E)	Chichila, 1900	Epi	142
Asplenium nidus	Bird nest fern(N)	Chamlakharka, 1050	Epi	115
Athyriaceae				
Athyrium atkinsoni		Hung-hung, 2600	Ter	232
Athyrium distans		Hung-hung, 2700	Ter	253
Athyrium foliolosum		Mudhe, 1990	Ter	139
Athyrium costdae		Hurhure, 1960	Ter	182
Athyrium pectinatum		Chichila, 1960	Ter	114
Athyrium setiferum		Chichila1900	Ter	197
Deparia boryana		Chichila, 1900	Ter	245
Diplaziopsis javanica		Chichila1940	Ter	190
Diplazium esculentum	Ghiu Niuro(L)	Bumlingtar, 500	Ter	175
Diplazium maximum		Chichila, 1900	Ter	249
Diplazium stolickzkae		Utise, 2300	Ter	192
Azollaceae				
Azolla pennata		Sattighat, 450	Aq	165
Blechnaceae				
Blechnum oriestale		Manebhanjyang, 100	Ter	125
Woodwardia unigemmata	Danthe uneu(L)	Chhumsur, 2300	Ter	225
Cyatheaceae				
Cyathea chinensis	Tree fern(E)	Chandanpur, 1025	Ter	166
Davaliaceae				
Gymnogrammitis dareiformis		Chepuwa, 2150	Ter	228
Leucostegia immersa	Chumsure Uneu(L)	Chichila, 1900	Epi	218
Dennstaedtiaceae				
Dennstaedtia apendiculata	Ground fern(E)	Tashigaon, 2150	Ter	112
Dennstaedtia scabra		Manebhayang, 1150	Ter	109
Microlepia firma		Sima, 1200	Ter	196
Microlepia speluncae		Deurali, 1925	Ter	191
Pteridium revolutum	Hade- Uneu(L)	Kimathanka, 2450	Ter	262
Dryopteridaceae				
Arachnoids spactabilis		Chichila, 1950	Ter	177
Cyrtomium hookerianum		Uttise, 2400	Ter	152
Dicalpe aspidioides		Chichila, 1900	Ter	259
Dryopteris chrysocoma		Thunkoppa, 2500	Ter	229
Dryopteris cochleata	Niuro(L)	Mure, 1975	Ter	144
Dryopteris fructuosa		Thungoppa, 2350	Ter	248
Dryopteris woodsisora.		Sima, 1400	Ter	270
Dryopteris wallichiana		Khiokma, 2250	Ter	227
Peranema cyatheoides		Chepuwa, 2150	Tetr	254
Polystihcum lentum		Seduwa, 1575	Ter	186
Polystichum nepalense		Hung-hung, 2900	Ter	217
Polystichum semifertile		Mure, 1900	Ter	231
Polystichum punctiferum				
Equisetaceae				
Equisetum diffusum	Horse tail(E)	Uttise, 2300	Ter	136
Gleicheniaceae				
Dicranopteris linearis		Hurhure, 1960	Ter	141
Gleichenia gigantea		Gogani, 1750	Ter	212

Table 1. Continued

Scientific nFamily/ Name of species	Loc.(Vern.) name	Locality&(Altitudem)	Habitat	Coll. no.
Hymenophyllaceae				
Crepidomanes radicans		Bungim, 1940	Ter	178
Hymenophyllum exertum		Bungim, 1925	Ter	149
Lindsaeaceae				
Lindsaea odorata		Chewabensi, 490	Ter	158
Sphenomeris chinensis		Manebha, 1000	Ter	157
Lomariopsidaceae				
Bolbitis appendiculata		Numbridge, 800	Ter	171
Lycopodiaceae				
Lycopodium cernum		Seduwa, 1700	Ter	127
Lycopodium clavatum	Nag beli(N)	Tashigaon, 2250	Ter	126
Lycopodium hamiltoni		Chichila, 1900	Ter	119
Lycopodium pulcherrimum		Chichila, 1950	Epi	132
Lycopodium serratum		Chichila, 1950	Ter	147
Lycopodium squarosum		Chmlakharka, 950	Epi	131
Lycopodium subulifolium		Chichila, 1900	Epi	118
Maratiaceae				
Angiopteris evecta		Numbridge, 775	Ter	103
Oleandraceae				
Nephrolepis codifolia	Pani amala(N)	Num, 1300	Ter	167
Oleandra wallichi		Tashigaon, 2150	Epi	130
Osmundaceae				
Osmunda claytoniana		Kimathanka, 2450	Ter	224
Ophioglossaceae				
Botrychium daucifolium		Bungim, 1900	Ter	102
Botrychium lanuginosum		Thungoppa, 2200	Ter	242
Botrychium multifidium	Grape fern(E)	Chichila, 1925	Ter	121
Ophioglossum sp.		Bumlingtar, 500	Ter	246
Parkeriaceae				
Adiantum capillus-veneris	Maidenhair fern(E)	Chandanpur, 750	Ter	101
Adiantum philippense		Sattighat, 475	Ter	105
Ceratopteris thalictroides		Chewabensi	Ter	203
Cheilanthes sp.	Rani –sinko(L)	Gogani, 1800	ter	153
Cheilanthes farinosa	Rani –sinko(L)	Bumlingtar, 600	Ter	205
Cheilanthes rufa	Rani –sinko(L)	Faxinda, 650	Ter	211
Cheilenthes doniana	Rani –sinko(L)	betini, 550	Ter	156
Coniogramme affinis		Chichila, 1900	Ter	162
Coniogramme fraxinea		Numbridge, 775	Ter	164
Coniogramme serulata		Chichila, 1940	Epi	163
Onychium japonicum	Claw fern(E)	Seduwa, 1700	Ter	135
Onychium siliculosum	Golden –fern(E)	Katlebhanjyang, 350	Ter	106
Pityrogramma calomelanos	Silver fern(E)	Begkhour, 850	Ter	116
Polypodiaceae				
Aglaomorpha coronans		Sitalpati, 925	Epi	133
Arthromeris wallichina	Chhepare-Uneu	Chichila, 1925	Epi	161
Arthromeris himalayansis		Chamlakharka, 950	Epi	134
Belvisia henry		Chichila, 1940	Epi	160
Colysis latiloba		Aquwa, 1500	Rock	257
Crypsinus quasidivaricatus		Hung-hung, 2300	Rock	215
Crysinus griffthianus		Chichila, 1900	Epi	176
Drynaria propinqua		Tashigawn, 2150	Epi	180
Lemaphyllum rostratum		Chichila, 1900	Epi	153
Lepisorus loriformis		Seduwa, 1750	Epi	188
Lepisorus nidus		Bungim, 1825	Ter	151
Lepisorus sublinearis		Seduwa, 1825	Epi	172
Loxogramme chinensis		Chichila, 1900	Epi	113
Loxogramme involuta		Chichila, 1875	Epi	155

Table 1. Continued.

Scientific nFamily/ Name of species	Loc.(Vern.) name	Locality&(Altitudem)	Habitat	Coll. no.
Microsorium cuspidatum		Chewabensi, 460	Ter	189
Microsorium membranaceum		Bhotebash, 1700	Epi	221
Neocheiropteris normalis		Chichila, 1900	Epi	170
Polypodium amoenum		Deurali, 1850	Epi	187
Pyrrosia lanceolata		Giddeghat, 450	Epi	111
Pyrrosia mannii		Seduwa, 1800	Epi	181
Pyrrosia nudum		Chichila.1900	Ter	169
Pyrrosia costata		Sitalpati, 1000	Epi	110
Pyrrosia floculosa		Gola, 1200	Epi	214
Pyrrosia heteractis		Aquwa, 1450	Rock	216
Pteridaceae				
Pteris aspericaulis		Manebhanjyan, 1100	Ter	273
Pteris cretica		Hedangna, 1050	Ter	230
Pteris pellucida		Kartikeghat, 450	Ter	117
Pteris vitta	Chinese brake	Betini, 460	Ter	143
Pteris biaurita	Brake fern(E)	Seduwa, 1600	Ter	185
Pteris wallichiana		Kimathanka, 2400	Ter	261
Plagiogyriaceae				
Plagiogyria communis		Tashigawn, 2100	Ter	150
Schizaceae				
Lygodium flexuosum		Chewabensi, 400	Ter	108
Lygodium japonicum	Climbing fern(E)	Tumlingtar, 430	Ter	140
Selaginellaceae				
Selaginella chrysocaules		Sitalpati, 900	Ter	209
Selaginella involvens		Seduwa, 1800	Ter	123
Selaginella monospora		Bungim, 1900	Ter	128
Selaginella pallida		Chichila, 1800	Ter	208
Selaginella pennata		Bumlingtar, 600	Ter	206
Selaginella sp.		Hatiya, 1500	Ter	239
Selaginella sp.		Bungim, 1900	Ter	122
Selaginella sp.		Hedangna, 1050	Ter	241
Selaginella subdiaphana		Sitalpati, 800	Ter	207
Thelypteridaceae				
Thelypteris nudata		Chamlakharka, 950	Ter	145
Thelypteris pyrrhorhachis		Kimathanka, 2450	Ter	264
Thelypteris erubecens		Chepuwa	Ter	271
Thelypteris auriata		Bhotebash	Ter	233
Thelypteris appendiculata		Chichila, 1800	Ter	195
Thelypteris Sp.		Chichila, 1925	Ter	148
Thelypteris torresiana		Deurali, 1800	Ter	124
Vittariaceae				
Vittaria flexuosa		Chichila1950	Epi	107

Habitat: (Ter: Terrestrial, Epi: Epiphytic, Aq: Aquatic)

Table 2. *A list of Pteridophytes on the basis of altitudinal range.*

Scientifc name	Up to 500 m	500-1000 m	1000-15000 m	1500-2000 m	2000-2500 m	2500-3000 m	3000-3300m	Status
Adiantum capillus-veneris	+	+	+					++
Adiantum philippense	+	+	+					+++
Aglaomorpha coronans		+						++
Angiopteris evecta		+		+				+
Arachnoids spactabilis				+				+
Arthromeris himalayensis		+	+	+				++
Arthromeris wallichina			+	+	+	+		++
Asplenium macrophyllum		+						+
Asplenium ensiforme				+	+	+		++
Asplenium lacinatum				+	+			+++
Asplenium nidus		+	+					++
Athyrium foliolosum		+	+	+				+++
Athyrium atkinsonii					+	+	+	++
Athyrium costde		+	+	+				+++
Athyrium distans						+		+
Athyrium pectinatum				+				++
Athyrium setiferum			+	+	+			++
Azolla pennata .	+							++
Belvisia henryi			+	+				++
Blechnum oriestale		+	+					+
Bolbitis appendiculata		+						+
Botrychium lanuginosum				+	+			++
Botrychium daucifolium				+	+			++
Botrychium multifidium				+		+		+
Ceratopteris thalictroides	+							+
Cheilanthes doniana	+	+						++
Cheilanthes farinosa	+	+						+++
Cheilanthes rufa		+						++
Cheilenthes sp.			+	+				++
Colysis latiloba			+					+
Coniogramme affinis			+	+				++
Coniogramme fraxinea		+	+					++
Coniogramme serulata			+	+				++
Crepidomanes radicans				+	+			+
Crypsinus griffthianus				+	+			+
Crypsinus quasidivaric					+			+
Ctenitis appiciflora				+	+			++
Cyathea chinensis		+	+	+				++
Cyrtomium hookerianum				+	+			+
Dennstaedtia apendiculata			+	+	+			+++
Dennstaedtia scabra	+	+	+					++
Deparia boryana				+	+			+++
Dicalpe aspidioides				+	+			++
Dicranopteris li7nearis			+	+				++
Diplazium esculentum	+	+	+	+				+++
Diplaziopsis javanica				+				+
Diplazium maximum				+				++
Diplazium stolickzkae				+	+			++

Table 2. *Continued*

Scientifc name	Up to 500 m	500-1000 m	1000-15000 m	1500-2000 m	2000-2500 m	2500-3000 m	3000-3300m	Status
Drynaria propinqua		+	+	+	+			+++
Dryopteris chrysocoma				+	+	+	+	++
Dryopteris cochleata	+	+	+	+				+++
Dryopteris fructuosa					+			++
Dryopteris wallichiana				+	+	+		+++
Dryopteris woodsisora			+	+				++
Equisetum diffusum		+			+			+++
Gleichenia gigantea				+				+++
Gymnogrammitis dareiformis					+	+		+
Hymenophyllum exertum				+				++
Lemaphyllum rostratum				+				++
Lepisorus Sublinearis				+	+			+++
Loxogramme chinensis				+	+			++
Lepisorus loriformis				+	+	+		+++
Lepisorus nudus			+	+	+			++
Leucostegia immersa				+				+
Lindsaea odorata	+	+	+	+				+++
Loxogramme involuta		+	+	+	+			+++
Lycopodium cernum			+					+
Lycopodium clavatum				+	+			++
Lycopodium hamiltoni			+	+				+
Lycopodium pulcherrimum				+				+
Lycopodium serratum				+				+
Lycopodium squarosum		+	+					+++
Lycopodium subulifolium		+	+	+				+++
Lygodium japonicum	+	+						+++
Lygodium flexuosum	+	+						+++
Microlepia firma			+					++
Microlepia speluncae		+	+					++
Microsorium cuspidatum	+	+	+	+				+++
Microsorium membranaceum			+	+				+
Neocheiropteris normalis				+				+
Nephrolepis cordifolia	+	+	+	+	+			+++
Oleandra wallichi			+	+	+			+++
Onychium japonicum		+	+	+				++
Onychium siliculosum	+	+	+					+++
Ophioglossum sp.		+						+
Osmunda claytoniana					+			+++
Peranema cyatheoides					+	+	+	+++
Pityrogramma calomelanos	+	+	+	+				+++
Plagiogyria communis					+	+	+	++
Polypodium amoenum			+	+	+			++
Polystichum nepalense						+	+	++
Polystichum punctiferum					+			++
Polystichum semifertile				+	+			++
Polysticum lentum		+	+	+	+			+++
Pronephrium nudatum	+	+	+	+				+++
Psedophagopteris pyrrhorhachis					+	+		+

Table 2. *Continued*

Scientifc name	Up to 500 m	500-1000 m	1000-15000 m	1500-2000 m	2000-2500 m	2500-3000 m	3000-3300m	Status
Pteridium revolutum			+	+	+			+++
Pteris aspericaulis			+	+				++
Pteris biaurita	+	+	+	+				+++
Pteris cretica			+	+	+			++
Pteris pellucida	+							++
Pteris vitta	+	+	+	+				+++
Pteris wallichina				+	+	+		++
Pyrrosia costata		+	+	+				++
Pyrrosia floculosa			+	+				++
Pyrrosia heteractis			+					+
Pyrrosia lanceolata	+	+						+++
Pyrrosia mannii		+	+	+	+	+	+	+++
Pyrrosia nudum	+	+	+					++
Selaginella chrysocaulos		+	+					++
Selaginella involvens				+	+			++
Selaginella monospora	+	+	+	+	+			+++
Selaginella pallida				+				++
Selaginella pennata	+	+	+					+++
Selaginella Sp.		+	+	+				+++
Selaginella Sp.		+	+					++
Selaginella sp.				+	+			++
Selaginella subdiaphana		+						+++
Sphenomeris chinensis	+	+	+	+				+++
Tectaria coadunata	+	+	+	+				+++
Tectaria Polymorpha		+						+
Thelypteris appendiculata			+	+				++
Thelypteris auriata			+	+				++
Thelypteris erubescens				+	+			++
Thelypteris Sp.			+	+	+			++
Thelypteris torresiana			+	+				++
Vittaria flexuosa				+				++
Woodwardia unigemmata				+	+	+		++

status: Occassional (+), Frequent(++), Abundant(+++)

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Vegetation Dynamics of Herbaceous Plants in Lower Arun River Basin of Makalu Barun Buffer Zone, East Nepal

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ABSTRACT

The present study has been carried out in the lower belt (tropical zone) of Makalu Barun Buffer Zone (MBBZ), East Nepal at an altitude of 375-700 m. Five different habitats were selected such as Flooded area (0-50 m from riverbank), Transition area (51-500 m), and Forest Area (Disturbed site I and site II and Relatively Undisturbed site). A total of 209 herbaceous plant species belonging to 66 families and 165 genera were accounted. Among the species, 17 species were pteridophytes, 39 were monocotyledones and 153 species were dicotyledones. Species richness was the highest in disturbed forest site-II, ie, 102 species; while the disturbed forest site-I had 82 species and relatively undisturbed forest site had only 84 species. Similarly, the transition area was comprised of 91 species and flooded area was comprised of 70 species only. The diversity index (H) value was the highest in disturbed forest site-II, ie, 5.64 and least in flooded area site, ie, 4.21. The index of similarity (IS) was highest in between disturbed forest site-I, and relatively undisturbed forest site where as the least between flooded area site and disturbed forest site-II. The highest species evenness value (J) was 0.84 for disturbed forest site-II and the least, ie, 0.68 for flooded area. The beta diversity was highest in disturbed forest site-II, ie, 2.44 while least in flooded area site, ie, 1.67. On the basis of IVI value, the dominant species in flooded area were *Imperata cylindrica, Saccharum spontaneum, Desmodium triflorum*; in transition area *Desmodium heterocarpon, Borreria alata, Eupatorium odoratum*; and in all forest sites *Shorea robusta saplings, Pogonatherum crinitum, Flemingia strobilifera.* The soil of the sites varied from loam to sandy loam in textures ie, loam in relatively undisturbed forest site and sandy loam in all remaining sites.

KEYWORDS: Makaru Barun Baffer Zone; herbaceous plants; species richness; species evenness; diversity index

INTRODUCTION

Vegetation composition depends on local environmental variables. The total number of species within an area (species richness) is a simple and easily interpretable indicator of biological diversity (Hulbert 1971; Whittaker 1977). The classical view on richness and disturbance has been that undisturbed sites have the maximum species number (Odum 1971; Rao et al 1990); however, nowadays it has recognised that disturbance may increase species richness (Grime 1979; Sousa 1984; Vetaas 1997). Unless the presence of disturbances, community change proceeds towards climax where few species become dominant and species diversity becomes low due to elimination of poor competitors by dominant species (Reice 1994). The variation in total species richness is mostly influenced by the herbaceous species, which may have an uni-model response to disturbance (Vetaas 1997). The diversity does not remain constant for long period. It changes over the years and from season to season within the same year. Nowadays its loss is one of the most profound global crises (Wilson 1988). The gradual loss of diversity is attributed to lack of proper co-ordination between environmental protection and economic development, poverty, over population and inadequacy of environmental awareness.

The present study aims to quantitatively explore the herbaceous vegetation on variable habitat conditions. It reports on dynamic patterns of vegetation in tropical *Shorea robusta* forest on the riverbank of Arun and the transition area between the tropical *Shorea robusta* forest and Arun riverbank in Makalu-Barun Buffer zone (MBBZ), East Nepal. The forest is dominated by *Shorea robusta*, which is a common

forest type in tropical regions. Richness patterns of herbaceous vascular plants are less understood in this type of forests.

This study covers a detailed survey of understorey to identify the effects of environmental factors and exogenous disturbance on species composition. Analysis showed that environment and disturbance had additive and similar contributions to floristic variability (McIntyre and Lavorel 1994). The sites with physical evidence of soil disturbance and over grazing had significantly lowered the richness of native species and rare native species, while exotic species superseded.

Therefore, the primary aims were to: (i) study the herbaceous vegetation dynamics on heterogeneous habitat conditions, and (ii) to evaluate the results of understorey layer on different local environmental gradients.

AIMS AND METHODOLOGY

Study Area

The study was carried out in a pure *Shorea robusta* (Sal) dominant forest, flooded zone of Arun riverbank and the transition zone between forest area and flooded zone of lower Arun river basin, MBBZ, East Nepal. The area, located at the foot of Mt. Makalu (26° 25'-27° 55' N and 86° 45'-87° 34' E), in the southeast of Mount Everest, belong to a relatively wet region of the country. In the study area, precipitation occurred maximum during August and September (ie, 432.4 mm and 395.6 mm, respectively) and minimum during October and March (ie, 0-22 mm). The average monthly temperature ranges from 24.3°C, the highest in June to 1.8°C, the lowest in January.

Established in 1992, the Makalu Barun National Park and Conservation Area cover 2,330 km^2 comprising 1,500 km^2 as a national park area and 830 km^2 as a conservation area (at present designated as buffer zone). The targeted aims were to provide privileges to the local people for the sustainable use of natural resources and also for sharing of revenue generated from the protected area. The structure of the forest varies according to the disturbance levels. It is well known that areas that are climatically similar may be characterised by similar plant forms. Therefore, observations on dominant vegetations and their response to human interaction would provide useful clues to identify environmentally homogeneous or heterogeneous areas (Shrestha 1989). Dobremez (1976) provided the interpretation of the ecology of tropical zone along the *terai* and foothills from east to west with characteristics of uniform pattern of vegetation distribution all along Nepal.

The undisturbed forest type appeared to have a closed tree canopy where the herbs were thinly scattered. The main understorey layer of forest was *Shorea robusta* saplings, *Pogonatherum crinitum*, and *Flemingia strobilifera*. The transition area (wastelands or sunny exposed area) had large numbers of perennial exotic species such as *Desmodium heterocarpon*, *Borreria alata*, and *Eupatorium odoratum*, and flooded area (riverbank of Arun) comprised of flood resistant species such as *Imperata cylindrica*, *Saccharum spontaneum*, and *Desmodium triflorum*.

Field Sampling

The plots were located in forest areas with different disturbance levels: (1) Relatively Undisturbed forest (RUD) site = no sign of trampling, grazing, and more than 70% canopy cover, herb layer untouched and thinly scattered and extent of cutting and lopping were relatively absent; (2) disturbed forest site-I & II (D-I and D-II) = presence of all sorts of disturbances - felling, lopping, cutting, grazing, etc., higher than relatively undisturbed forest, canopy cover less than RUD and herb layer densely grown and scattered ; (3)

Flooded area (FA) = 0-50 m from Arun riverbank; and (4) Transition area (TA) = 51-500 m from riverbank. The reconnaissance survey of the study sites was undertaken in December 1998 and September - October 1999. The sampling was done at five different sites of four localities at the altitudes ranging form 375 -700 m (Table 1).

Table 1. *Study area*

Study Sites	Localities
Flooded area (FA)	Satighat, Kattikeghat, Bumlingtar
Transition Area (TA)	Satighat, Kattikeghat, Bumlingtar
Relatively undisturbed (RUD) forest	Satighat, Kattikeghat, Bumlingtar, Hookse
Disturbed I (D-I)	Satighat, Kattikeghat, Bumlingtar, Hookse
Disturbed II (D-II)	Satighat, Kattikeghat, Bumlingtar, Hookse

Quantitative vegetation study was undertaken by a quadrate plot method of systematic random sampling (Kershaw 1973), which is a square sample plot method. To analyse the ground vegetation, tree saplings, and seedling in the forest areas, two microplots each of 1x1m were laid at two corners within each plot. A total of 170 microplots [124 microplots were laid in the forest area (42 in relatively undisturbed forest site, 42 in disturbed forest site-I and 40 in disturbed forest site-II), 23 microplots in transition area and 23 microplots in flooded area] were analysed. All the herbs, seedlings and tree saplings found inside each plot were collected for correct identification. The nomenclature follows Hara et al (1978, 1979, 1982) for flowering plants, and Iwatsuki (1988) and Gurung (1991) for ferns. The canopy cover, aspect, slope and all kinds of disturbance were recorded for categorising at RUD, D-I and D-II sites of the forest areas.

Numerical Analysis

The numerical analysis of herbaceous vegetation was done by frequency, density, abundance, IVI, index of similarity and diversity index parameters (Zobel et al 1987). Diversity index is defined as a function of the number of species present in a given area and of the evenness, with which the individuals were distributed among the species. It is the combine effects of species richness and abundance. For the calculation of diversity index Simpson's (1949) index (D) and Shanon & Weiner's (1963) index (H) were accounted.

$$\text{Diversity index (D)} = 1-\sum pi^2$$

where, Pi = relative density.

$$(H) = 3.3219\left\{\frac{N\log N - \Sigma ni \log ni}{N}\right\}$$

where, N=total number of individuals of all species, and ni= total number of individuals of all species.

α diversity is taken as the measure of species packing within a habitat type so-called *within habitat diversity* (Mac Arther 1965) or α diversity (Whittaker 1960). It may be considered as number of species per unit area (Species richness). Evenness as stated by Magurran as another component of diversity is generally expressed as the ratio of observed diversity to maximum diversity.

$$\text{Sp. Evenness (J)} = \frac{H}{H\,max}$$

where, H = observed diversity, H max = maximum possible diversity, and Hmax = 3.3219 log $_{10}$K
where, K = number of species.

β diversity is a measure of species turnover across various habitat type so called between habitat diversity (Mac Arther 1965) or β diversity (Whittaker 1960). It is the difference in species diversity between areas or communities representing the species composition. It was calculated by following Whittaker (1972) formula:

$$\hat{a} = \frac{Sc}{S}$$

where, Sc = total number of species that occurred in a set of sample, and
S = average number of species occurring in an individual sample.

Index of similarity gives the degree of similarity between given stands that depend upon the quantitative phytosociological characters of species either. It was calculated by applying formula given by Sorenson's index modified by Gregsmith (1964):

$$IS = \frac{2C}{A+B}$$

where, A = total number of species in one sample, B = total number of species in another sample, and
C = total number of common species in both samples.

RESULTS

The floristic data comprised 209 taxa divided among 165 genera and 66 families. There were 39 species of monocotyledons, 153 species of dicotyledones and 17 species of pteridophytes. Among the five study sites, disturbed site-II (D-II forest) was found having the largest number of species (ie, 102 species) whereas disturbed site-I (D-I forest) had 82 species and relatively undisturbed (RUD) forest site had 84 species only (Figure 1). Similarly the total number of species found at the sites between river and forest area or the transition area (TA) had 91 species, while flooded area (FA) had 70 species only.

Index of similarity for herbs, seedlings and tree saplings of the study sites was found the highest between D-I forest and RUD forest sites while it was the least between FA and D-II (Table 2).

Table 2. *Index of Similarity*

IS between	FA	TA	RUD	D-I	D-II
FA	-	50.93	29.87	25.00	23.25
TA		-	42.28	36.99	38.34
RUD			-	63.85	60.21
D-I				-	51.08
D-II					-

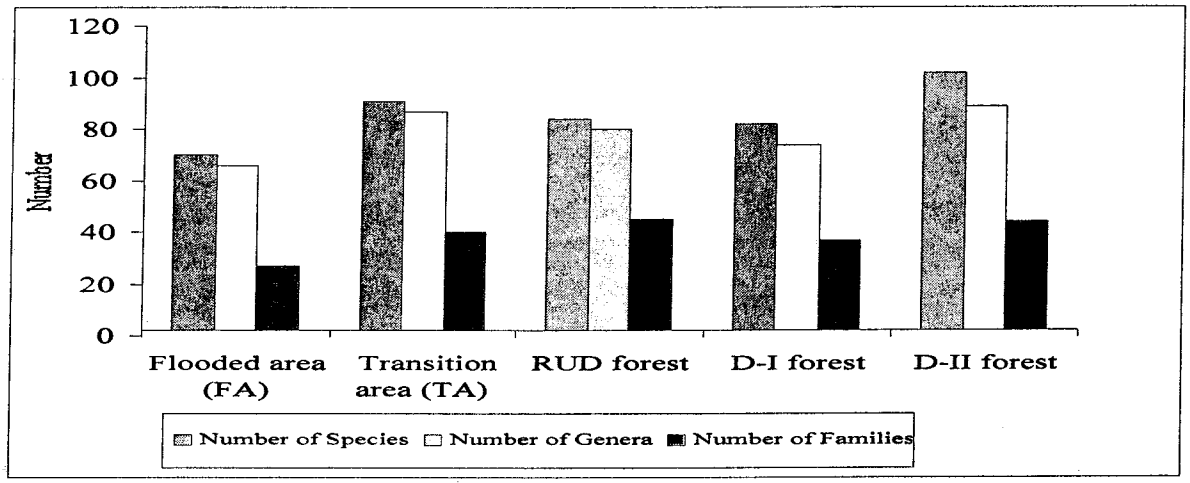

Figure 1. *The number of species, genera, and families at five study sites*

Both diversity indices were found to be the highest (D = 0.95 and H = 5.64) at D-II, while the least (D = 0.89 and H = 4.21) at FA (Table 3). The species richness (S) was the highest at D-II (102) and the least at FA (70). The evenness value (J) had the maximum at D-II, ie, 0.84, and the minimum at FA, ie, 0.68. For β diversity, the highest value 2.44 occurred at D-II while the least value 1.67 occurred at FA (Table 3).

Table 3. *Index of diversity, α and β diversity*

Site	S	D	H	H max	J	β div.
FA	70	0.89	4.21	6.12	0.68	1.67
TA	91	0.94	5.25	6.50	0.80	2.17
RUD	84	0.93	5.00	6.39	0.78	2.00
D-I	82	0.94	4.92	6.35	0.77	1.96
D-II	102	0.95	5.64	6.67	0.84	2.44

D = Simpson's diversity index, H max = Possible diversity
H = Shanon's diversity index, J = Evenness, S = Species richness

In a heterogeneous plant community, the overall picture of ecological importance of a species in relation to the community structure can be obtained by adding the relative values of density, frequency and abundance. On the basis of IVI value 5 dominating herbs, seedlings and tree sapling at each site are given in Table 4.

Table 4. *Dominating species on different habitats on the basis of IVI*

Study Site	Major dominant species
FA	*Imperata cylindrica, Saccharum spontaneum, Perotis hordeiformis, Desmodium trifloum, Borreria alata*
TA	*Desmodium heterocarpon, Justicia procumbens, Borreria alata, Digitaria adscendens, Eupatorium odoratum*
RUD	*Shorea robusta* (saplings), *Pogonatherum crinatum, Cheilanthes farinosa, Goldfussia capitata, Lygodium flexuosum*
D-I	*Shorea robusta* (saplings), *Pogonatherum crinatum, Flemingia strobilifera, Lygodium flexuosum, Cheilanthes farinosa*
D-II	*Shorea robusta* (saplings), *Cheilanthes farinosa, Dryopteris cochleata, Pogonatherum crinatum, Lygodium flexuosum*

DISCUSSION

From the results of species composition, flooded area's herbaceous vegetation composition of *Imperata cylindrica, Saccharum spontaneum, Borreria alata* have the highest importance value index due to sandy loam soil texture (high sand texture). The occurrence of *Imperata cylindrica* and *Saccharum spontaneum* has been reported earlier by Pokhrel (1993) in a flooded zone of Royal Bardia National Park. It may be noted that *Imperata cylindrica* and *Saccharum spontaneum* have stoloniferous propagating behaviour. Thus, the invasive effects and high abundance of these species became compounded because of the mode of the growth and the reproductive strategy (Saxena and Ramakrishna 1984). Thus, the disturbance-associated exposure of the habitat to sunlight allowed species such as *Desmodium heterocarpon, Justicia procumbens*, and *Eupatoriun odoratum* to occur in higher frequency. Disturbance gradients such as grazing, trampling and wastelands brought an increase in the number of plants especially synanthropic plants of limited cover. The saplings of *Shorea robusta* were the most frequent at all forest sites, which was a similar finding in Royal Chitwan National Park (Sejuwal 1994). The competitive interactions with the dense population of common species under the tree canopy are deleterious to *Shorea robusta* saplings (Singh & Singh 1989). The highest importance value index of *Shorea robusta* samplings was found at relatively undisturbed site and the lowest at disturbed forest site-I (D-I). The sum value of all species decreases by grazing (Jutila 1999).

Regarding the species richness, the value was the highest at D-II, which included 102 species of herbs, seedlings and tree saplings. This agrees with the study in Oak forest in central Nepal (Vetaas 1997). The variation in total species richness is influenced by the herbaceous species. High species richness of understorey individuals of tree species was positively correlated with that at a less fertile plot (Hutchinson et al 1999). Grazing brought about an increase in the number of plants especially synanthropic plants of limited cover (Jankowski 1997). Similarly, soil disturbance and grazing increase colonisation opportunities and decrease shoot-root competition. Soil disturbance open space for colonisation through seed establishment. Hence it would favour those species that are able to disperse effectively and exploit resources rapidly (Grime 1979). The high species richness at D-II was primarily due to greater number of herbaceous species, and result of more open canopies causing greater amount of light reaching the understorey. Increased species richness was caused by the presence of non-native (alien) or exotic species in disturbed forest stands but there were also more native grasses, ferns and nitrogen fixing species. We found the species richness in the habitat increased in response to thinning but decreased in response to higher organic matter, soil nitrogen and phosphorus content. At RUD site, grasses and perennial herbs were competitively excluded by trees as the life span of individual was affected by the competitive interaction between trees and trees as well as trees and grasses. The dominating species *Shorea robusta* saplings which require higher light condition to grow could not be regenerated well under the over shadowing large trees. Similarly, species growing under limited light condition may have lower growth rate due to high expenditure of carbon in maintenance of living (especially for non-productive) tissue and decreased mineral availability to support further growth. The lower resource allocation to sexual reproduction and more resource allocation to vegetative reproduction under forest cover may be attributed to competition and limitations to resource availability. It suggested that the reproductive efforts should decrease under shaded condition as more emphasis was given for vegetative growth of surviving plants there (Grime 1979). The lowest species richness value was reported for flooded area due to the environment that only favoured for tall grasses belonging to Poaceae. Flooding causes direct deleterious effect on non-tolerant and vernal forbs due to soil oxygen deprivation and indirect effects involving either

intensification or amelioration of grasses of competitive interactions (In Sausti et al 1999). *Shorea robusta* regeneration was not found in flooded area (FA) due to fresh sediments on riversides. The species richness value in transition area (TA) was little higher due to the presence of more exotic species on open wastelands. Index of diversity value (both Shanon's and Simpson's indices) was found highest for D-II. Diversity per plot was lower in the area protected from grazing. It is generally lower in community characterised by environmental extremeness than in mesic environment. Similarly, the higher value of index was found in transition area (TA) due to availability of more light and presence of large numbers of perennial exotic species. The diversity of species increased productivity while dominance increased community stability and reduced the production. The value was found lowest for flooded area (FA) among all study sites because habitat favoured only tall grasses belonging to Poaceae.

Index of similarity was calculated regarding the number of common species present at the study sites. This value was found highest between RUD forest site and D-I. Shrestha (1999) found similar results in *Castanopsis hystrix* forest of Makalu Barun Valley at the upper reaches of the Arun river basin. The apparent result could be the similarity of disturbance in habitat condition. Similarly, the soil charters of these sites had more affinities with each other. The lowest value was recorded between D-II and FA sites due to extreme habitat heterogeneity.

Flood tolerant species such as *Imperata cylindrical* and *Saccharum spontaneum* were found dominant in riverbank (flooded zone) of Arun, and exotic or non-native species such as *Eupatorium odoratum*, *Desmodium heterocarpon*, and *Borreria alata* were found dominant in transition area (wasteland). At disturbed forest site and open land, however, shrub species such as *Eupatorium odoratum* may have dominance in the field and species richness is low (Vetaas 1997). The dispersion of *Shorea robusta* saplings was uniform at all forest sites though the forest was categorised under three different sites.

In general, it is recommended that conservation accept small-scale human impact and disturbance gradient as in forest landscape. Large-scale human interference (canopy disturbance, lopping, grazing, etc.) would, thus reduce diversity and changed the species composition and it was replaced by exotic - weedy species at large.

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Patterns of Tree Species Richness in the Forests of Eastern Nepal

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ABSTRACT

Due to subtropical latitude and great height, altitudinal gradients in the Eastern Himalaya present tremendous ecological amplitude. Altitudinal changes in the floristic composition of forests in Eastern Nepal correspond to latitudinal change across the Eurasian continent. The phenology of dominant forest trees also mirrors this trend. Tree species richness declines with elevation, although human disturbance obscures this pattern at lower elevations. Understory plant species richness is also inversely correlated to elevation, although epiphyte species richness attains a maximum at upper temperate elevations (2,500-3,000 m).

KEYWORDS: Eastern Nepal; altitudinal change; biogeographyical affinity; species richness; phenology

INTRODUCTION

In recent years, the Eastern Himalaya has been recognized by conservation biologists as a place of exceptional ecological significance with high biological diversity and unique landscapes (Bibby et al 1992; Davis et al 1995; Olson and Dinerstein 1997; Mittermeier 2000). Preliminary estimations of species richness for flowering plants are about 5,800 to 6,500 species in Nepal (Chaudhary 1998), 4,000 species in Darjeeling District, West Bengal, India (Pradhan and Bhujel 2000), and at least 4,000 species in Sikkim (Khaling et al 2000).

While it is certainly invaluable to enumerate the botanical wealth of the Eastern Himalaya, a more rigorous, less scale-dependent quantification of plant species richness in different habitats, at different elevations, has been difficult to achieve. Studies by Japanese botanists such as Hara (1971, 1966), Numata (1983, 1966), and Ohsawa (1983) have provided important groundwork to describe the composition of forest communities, and the vegetation mapping efforts of Schweinfurth (1984) and Dobremez and Shakya (1975) provide an excellent conceptual framework for interpreting the Himalayan ecology. More recent publications by Singh and Singh (1987), Rana et al (1989), and Zobel and Singh (1997) contribute greatly to an understanding of the physiological ecology of Himalayan forest trees. Shreshtha (1989) and Carpenter and Zomer (1996) attempt qualitative descriptions at the community level and Zomer et al (1998) provides a more quantitative analysis for riparian corridor forests within the tropical zone.

These and other worthy studies contribute useful ecological insight, however basic questions remain unanswered about patterns of diversity for different groups of organisms in different kinds of Himalayan habitats. This deficiency is certainly evident with respect to plants, and there are several reasons why our understanding is so inadequate.

First, the organisms themselves resist enumeration: differences in abundance among different species span many orders of magnitude, relationships between distribution and habitat are species-specific and subtle, and some species are highly apparent while others are difficult to observe. A second obstacle that impedes ecological understanding of the Eastern Himalayan flora is lack of basic taxonomic information and a limited knowledge of the natural history of all but the most charismatic or economically important plant species. As elsewhere, morphological variability among populations of the same putative species from different parts of the Eastern Himalaya makes it difficult to assign species classifications merely upon

the basis of physical appearance, yet current understanding of diversity is based upon just such an approach. Even specialists are forced to speculate more often than they would like, and unfortunately, specialists are few and far between. Finally, the Himalaya is exceptionally steep and topographically complex. Many field locations are difficult to access. Thus the conceptual and logistical challenges to understanding patterns of biodiversity in the Himalaya are extremely daunting.

Recognizing these challenges, this paper will introduce very briefly a field study in progress. It is designed to provide a base of quantitative information that will allow interested researchers to seek patterns in the biological diversity of one group of organisms, forest trees, located in one part of the Eastern Himalaya, the Arun and Tamur River Basins of Eastern Nepal, 27 to 28° N. latitude, 87 to 88° E. longitude. Besides introducing the database, this paper will describe the preliminary results of investigations of tree species richness, phenology, and biogeographic affinity and how these patterns change with elevation.

Data evaluated here were collected by instructors, students and staff of the Wildlands Studies Program, San Francisco State University, College of Extended Learning during a series of field courses to Eastern Nepal, organized primarily for educational purposes. The data were obtained during thirteen 40-day visits to the study area during 1991 to 1997. Data collected during the six expeditions we have conducted since 1997 are being incorporated into the database at the present time. Data evaluated here was collected from a number of study sites distributed primarily throughout the Sankuwasaba and Taplejung Districts of Eastern Nepal (Figure 1). A tremendous debt of gratitude is owed to the international team of students, research and teaching assistants, support staff and colleagues who have helped to collect field data and assemble the database.

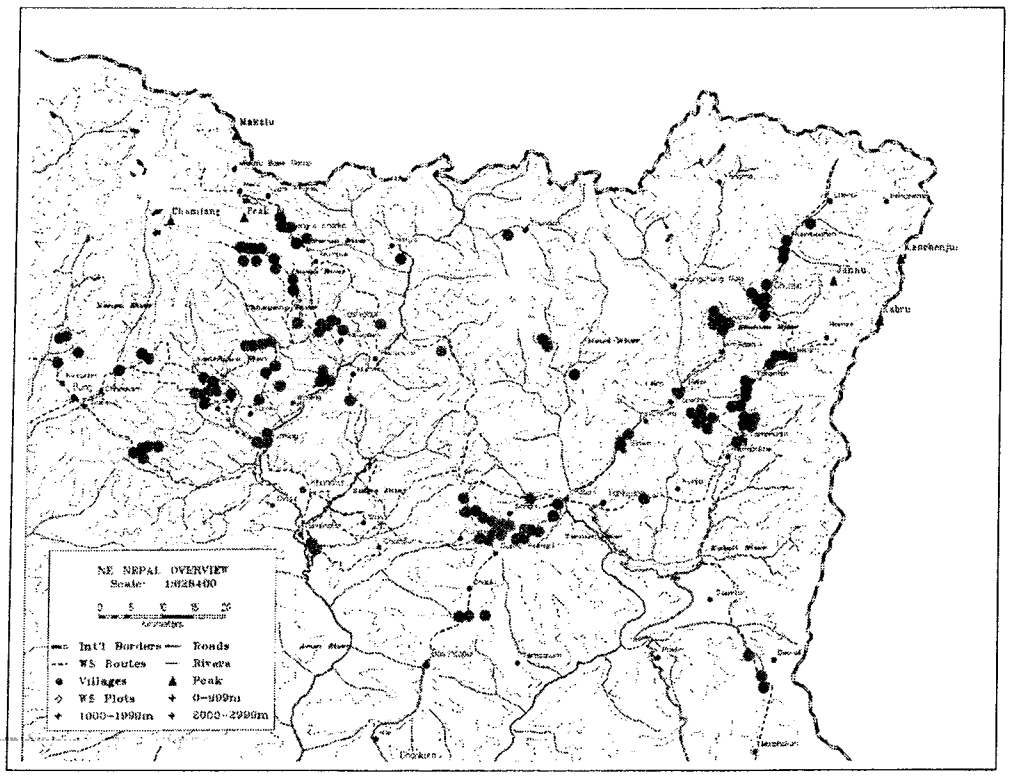


Figure 1. *Distribution of Forest Plots in Eastern Nepal*

METHODS

20 by 20 m quadrats were established in representative patches of undisturbed forest at various elevations throughout the study area. Plots were established haphazardly, not randomly, because team members

realized early-on that a strict randomization procedure for locating plots was not practical. First, the forest is patchy on a spatial scale similar to the size of a plot, so that random assignments often locate plots in places without forest. Since it is not our intention to attempt a comprehensive habitat classification, we decided to restrict our site selection to areas of existing forest. Second, a high proportion of the forest that survives today is located in places too steep for safe access. By restricting our study to forest stands located in places where the slope angle is less than 50°, we placed a further severe restriction on candidate sites (a surprisingly high proportion of the total Himalayan landscape in Eastern Nepal is comprised of slopes greater than 50°, that is, too steep to walk on). Because of these considerations, it should be understood that our plots are derived from a sample of the overall landscape that is biased: candidate sites are limited to those few places where the forest is accessible, yet intact. However, we believe that our plots provide a reasonably unbiased snapshot of this subset of the total landscape diversity.

Once the location is selected, plots are demarcated temporarily by flagging. Within each plot, physical and biological site characteristics are recorded. Physical characteristics include plot location (latitude, longitude, elevation, watershed), slope, aspect, and some brief notes about soils. Biological characteristics include the type and extent of human impact within each plot, an estimate of understory cover, and the species name, diameter at breast height, and status (live or dead) of all stems greater than 10 cm diameter at breast height. Trees that coppice below breast height may be recorded as two or more individual stems. Species richness of epiphytes and understory vegetation is also measured in selected plots.

Instruments include tapes for measuring plot boundaries and tree dbh, handheld GPS units to determine latitude, longitude and elevation, a Thommen analog altimeter for a second elevation estimate, clinometer for slope measurements and compass for aspect.

Trees were identified on site by means of references such as Grierson and Long (1983), Polunin and Stainton (1984) and Storrs and Storrs (1990). Those trees that could not be identified on site were assigned a provisional name and a small vegetation sample was transported to Kathmandu for subsequent identification at the National Herbarium.

RESULTS

During the 7 year duration of this study, 455 plots were investigated, containing 10,384 stems greater than 10 cm dbh. The total number of tree species identified in the wild is 73 together with a residuum of about 280 stem records that have remained unidentified for various reasons. Thus, species richness figures reported in this preliminary study are conservative under-estimations of the total species richness because they exclude all of those specimens that could not be identified with some certainty. For several reasons, it is likely that more tree species were missed at the lower elevations: first, fewer plots were established at low elevation; second, identification of trees at tropical and subtropical elevations is more difficult; third, more rare taxa occur at lower elevation (Figure 2). Furthermore, habitat heterogeneity may be greater at the lower elevations because differences in solar radiation according to aspect have powerful ecological effects below 1,000 m. Tree species identified in this study are listed in Table 1.

An unfortunate bias exists in the distribution of forest plots with elevation: as of fall 1997, 90% of the plots had been established at elevations above 2,000 m. This bias is due partly to institutional requirements to spend more time at the upper elevations, and due partly to the paucity of intact forest at the lower elevations. Although this bias makes it impossible to compare the absolute frequency of different forest types at different elevations, it is easy to determine the relative frequency of different forest types at each elevation. Our findings are derived mainly from comparisons in this mode.

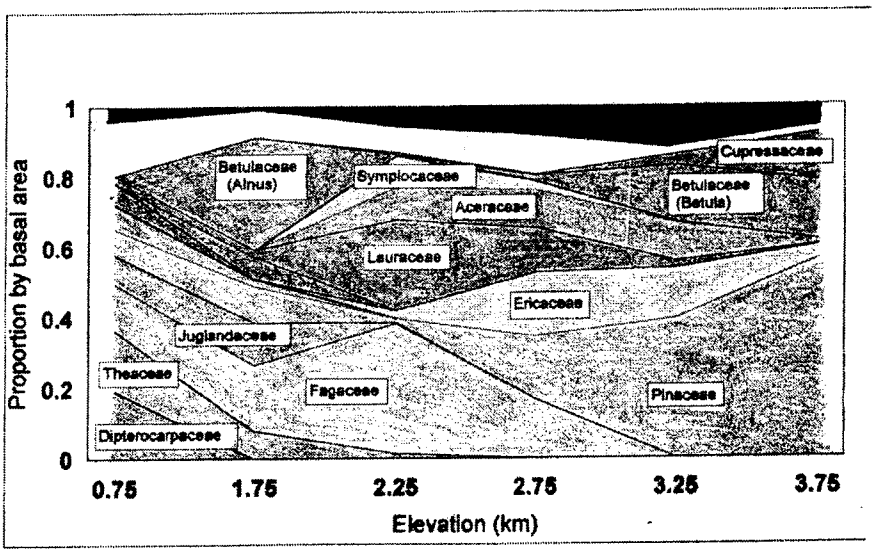


Figure 2. *Frequency of Tree Families by Elevation*

This chart shows the relative frequency of those families that comprise at least 5% of the total basal area at the elevation where they are most frequent. The white region near the top of the figure is the contribution of those families too rare to list, the black stripe at the top is the proportion of basal area attributed to dead stems.

Results have been entered into a relational database (Microsoft FoxPro) that consists of three linked tables (Figure 3). The first table contains information about each stem (species name, dbh, mortality status), the second contains information about each plot, the third contains general biological information about each tree species derived from published sources, including name (Latin, English, Nepali and/or local), family, phenology, general distribution, leaf size and shape. Information about each stem is linked to information about the plot in which it occurred and to general information about the species to which it belongs.

Once the database is compiled and basic housekeeping tasks are completed (these include identifying unknown stems or naming them provisionally, and reconciling conflicting species names), then questions can be asked about how various characteristics of the Eastern Nepal tree flora change according to elevation, geographical location or other environmental variables. Some results of these preliminary inquiries are presented below.

DISCUSSION

Many systems have been proposed to explain the altitudinal zonation of Himalayan forests. An excellent summary of these is provided by Ives and Messerli (1989). One bioclimatic zonation system, that of Dobremez and Shakya (1975), is especially useful because it is robust and generally applicable to much of the Eastern Himalaya. This system, summarized in Table 2, distinguishes forest types by 1000 m intervals into *tropical* (up to 1,000 m), *sub-tropical* (1,000-2,000 m), *temperate* (2,000-3,000 m) and *subalpine* (3,000-4,000 m).

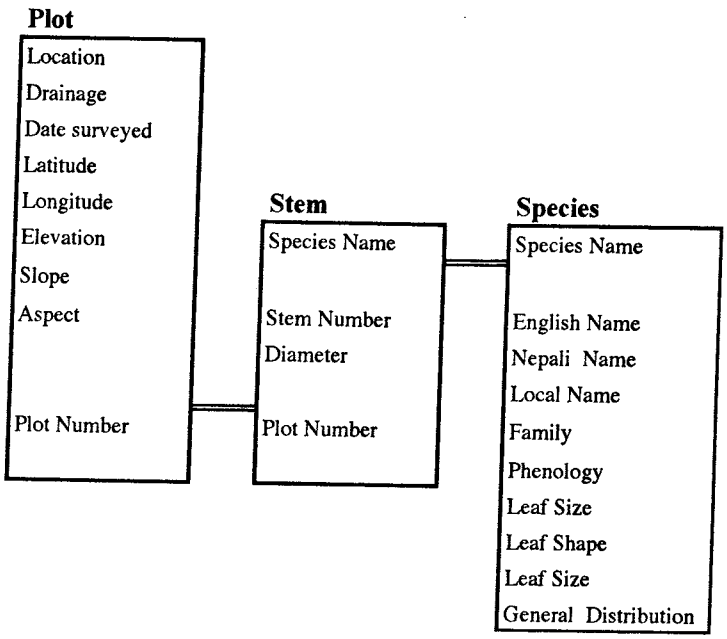


Figure 3. *Structure of the Forest Database*

Table 1. *Wild tree species recorded in the forests of Eastern Nepal*

1	*Rhododendron arboreum*	38	*Quercus glauca*
2	*Abies spectabilis*	39	*Syzygium cuminii*
3	*Acer campbellii*	40	*Duabanga grandiflora*
4	*Rhododendron hodgsonii*	41	*Dodecadenia grandiflora*
5	*Litsea salicifolia*	42	*Evodia fraxinifolia*
6	*Betula utilis*	43	*Castanopsis indica*
7	*LMussaenda frondosa*	44	*Acer sterculiaceum*
8	*Symplocos dryophila*	45	*Pinus roxburghii*
9	*Juniperus recurva*	46	*Rhododendron falconeri*
10	*Symplocos theifolia*	47	*Callicarpa arborea*
11	*Lyonia ovalifolia*	48	*Ilex dipyrena*
12	*Rhododendron barbatum*	49	*Myrsine capitulata*
13	*Quercus semecarpifolia*	50	*Ilex doniana*
14	*Viburnum nervosum*	51	*Merrilliopanax alpinus*
15	*Shorea robusta*	52	*Juglans regia*
16	*Quercus lineata*	53	*Rhus wallichii*
17	*Schima wallichii*	54	*Taxus baccata*
18	*Juniperus indica*	55	*Syzygium operculatum*
19	*Quercus lamellosa*	56	*Hydrangea anomala*
20	*Rhododendron campylocarpum*	57	*Bombax ceiba*
21	*Acer pectinatum*	58	*Populus ciliata*
22	*Larix griffithiana*	59	*Sapium insigne*
23	*Magnolia campbellii*	60	*Wendlandia exserta*
24	*Pieris formosa*	61	*Lithocarpus pachyphylla*
25	*Tsuga dumosa*	62	*Rhododendron fulgens*
26	*Castanopsis tribuloides*	63	*Rhododendron campanulatum*
27	*Alnus nepalensis*	64	*Terminalia tomentosa*
28	*Engelhardtia spicata*	65	*Tetracentron sinense*
29	*Lauraceae*	66	*Cipadessa baccifera*
30	*Sorbus cuspidata*	67	*Dillenia pentagyna*
31	*Betula alnoides*	68	*Elaeagnus parvifolia*
32	*Schefflera impressa*	69	*Ilex sikkimensis*
33	*Myrica esculenta*	70	*Prunus cornuta*
34	*Rhododendron cinnabarinum*	71	*Skimmia arborescens*
35	*Lindera pulcherrima*	72	*Ficus semicordata*
36	*Ardisia macrocarpa*	73	*Rhododendron griffithianum*
37	*Gamblea ciliata*		

Table 2. *The Bioclimatic Zonation System of Dobremez and Shakya (1975)*

Bioclimatic Zone	Approximate Elevation Range
"tropical"	below 1000 masl
sub-tropical	1000 to 2000 masl
temperate	2000 to 3000 masl
subalpine	3000 to 4000 masl
alpine	4000 to 5000 masl
nival	above 5000 masl

Ref: Dobremez and Shakya 1975

To properly understand this zonation system and to reconcile its generalizations with the observed distribution of trees in the wild, it is helpful to understand a few basic characteristics of the Eastern Himalayan ecosystem. First, because the Himalaya offer a protective barrier against Central Asian winter cold, low elevation forests in Eastern Nepal meet the thermal requirements for a tropical ecosystem (Shrestha 1989), even though they lie outside the tropical latitudes strictly defined. Second, within the temperate zone, two distinct forest formations are recognized, a lower temperate zone dominated by evergreen broad-leaved trees and an upper temperate zone in which most of the broad-leaved tree taxa are deciduous. Third, the bioclimatic zones as defined by Dobremez and Shakya are not distinct, rather, they tend to blend across broad, poorly defined ecotones. Finally, the upper limit of the subalpine zone is defined by the altitudinal treeline, about 4,000-4,200 m in the Eastern Himalaya, but above this elevation is an extensive region of moist alpine scrub dominated by large, woody shrubs of Juniperus and Rhododendron species that extends upward for another several hundred meters.

The forest diversity database described can provide empirical evidence to support or refute many generalizations about the composition of forests in the Eastern Himalaya. Three general patterns of ecological change with elevation are evaluated here: patterns of taxonomic richness, patterns of phenology, and patterns of bioeographic affinity.

Patterns of Taxonomic Richness

Data from the 455 forest plots were stratified within intervals of 500 m, and species accumulation functions z were defined by measuring the rate at which the cumulative number of species within each 500 m interval increases as the number of plots is increased. A species accumulation function is similar to a species area curve (MacArthur and Wilson 1967; Wilson 1992), except that here the independent variable represents sampling intensity rather than sample area. Thus z is the exponent of a decaying exponential curve with value $0 < z < 1$. It's slope is determined by log-transforming the data on both the independent and dependent axes, then calculating the slope of the line best-fit to the double-log transformed data using the method of least squares.

As an index of diversity, z is robust against variation in sampling intensity at different sites. Early in the sampling effort, new species are added rapidly. Later, new species are encountered less frequently. The rate of decline in new-species acquisition provides information about overall species richness for that group of organisms. In Eastern Nepal, z declines with elevation, indicating an overall decline in tree species richness with elevation (Figures 4, 5). In a separate analysis, patterns of tree species richness in the Arun and Tamur river valleys were compared for elevations above 2,000 m. Within each 500 m elevation interval above 2,000 m, 30 plots were randomly selected from the total sample of all plots in each of the two drainages, and the total number of tree species was counted. By repeating this process of random

selection and tallying six times for each elevation stratum in each drainage, a comparison of species richness patterns was obtained. Results from the two drainages were remarkably similar (Figure 6a, b). In each basin, above 2,000 m, the highest tree species richness occurred at elevations of 2500-3000 m, and richness declined at higher elevations.

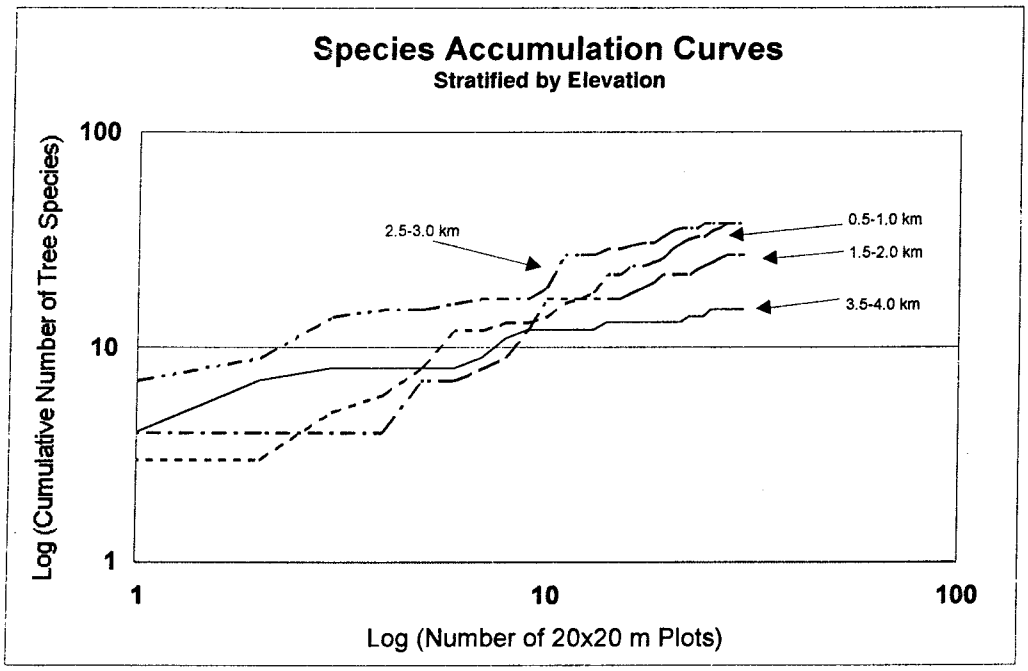


Figure 4. *The slopes of these species accumulation functions (double log-transformed) measure the rate at which new tree species are encountered with increased sampling intensity. Slopes decline with elevation (see Figure5).*

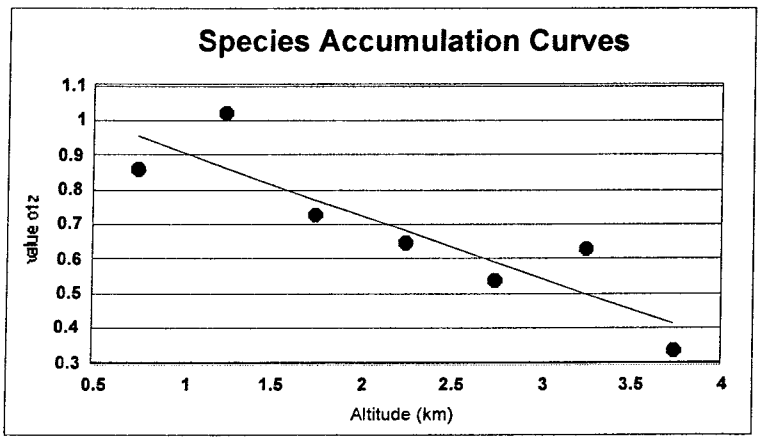
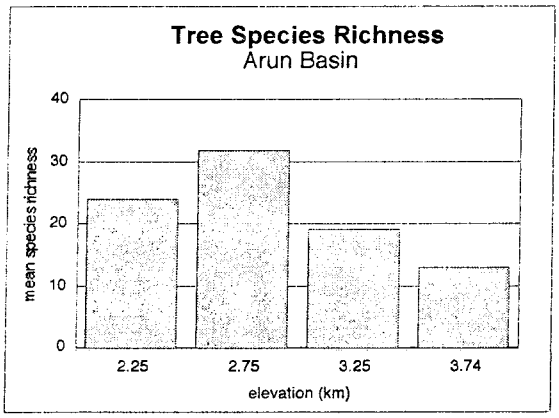


Figure 5. *Species accumulation functions plotted as a function of elevation. At higher elevations, new tree species are encountered less frequently as sampling intensity increases.*

Although forests at low elevation (<2,000 m) were under-sampled in our study, the scant evidence available (about 45 forest plots) produces species accumulation functions that suggest forests are most rich in tree species at the subtropical elevations of 1,000-2,000 m (Figure 5), with a general decline in tree species richness with elevation. This result is of considerable interest because subtropical elevations also comprise the zone where forests are most heavily degraded by human activity and where Nepal's protected area system is least well-established. Among the upper elevation forests, the upper temperate zone (*sensu* Dobremez and Shakya 1975), at 2,500-3,000 m, in both the Arun and Tamur river basins, contains the most tree species (Figure 6a, b).



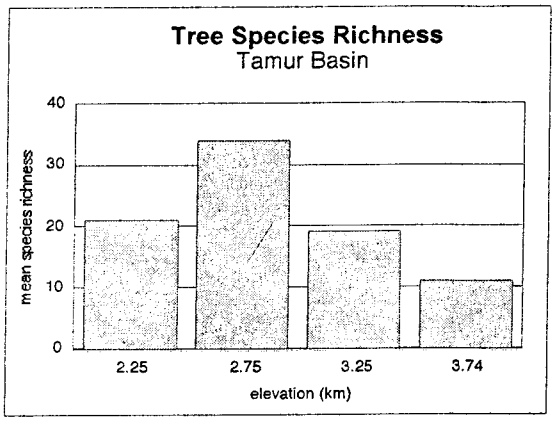


Figure 6a ***Figure 6b***

Estimated tree species richness patterns at different elevations are very similar within the Arun and Tamur River Drainages. See text for an explanation of how these figures were generated.

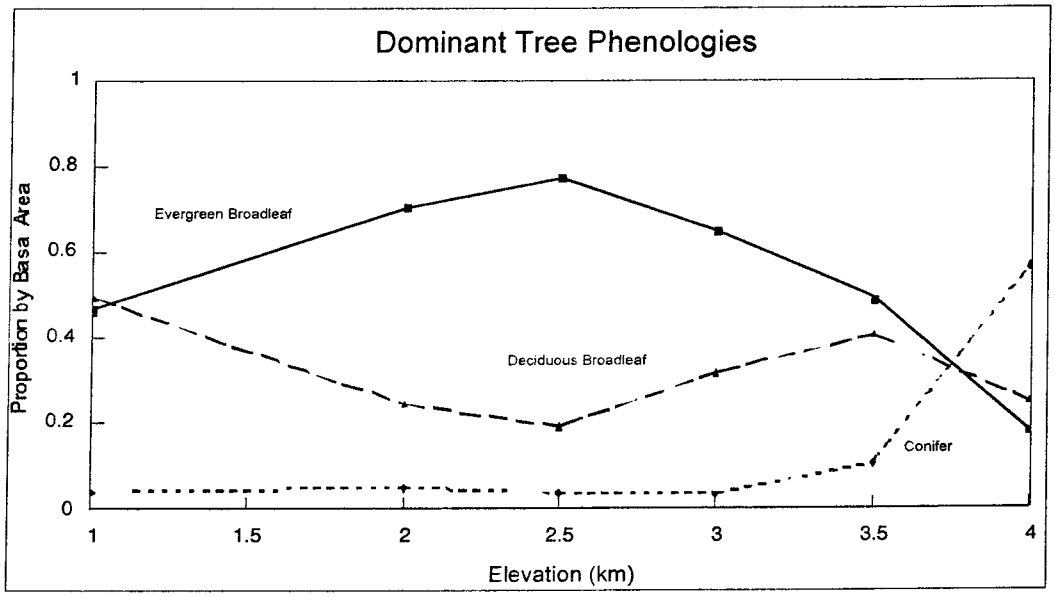


Figure 7. *The frequency of phenological types changes with elevation. Evergreen broadleaf trees are most frequent at the middle elevations (~2500 m) while drought deciduous trees are also frequent at low elevation. Conifers, evergreen broadleaved rhododendrons and winter deciduous taxa are all frequent in the upper elevation forests.*

During the past three years, the Wildlands Studies program has endeavored to collect more data from the lower elevations, and efforts are underway at this time to quantify patterns of species diversity more uniformly across the entire range of forested elevations from 350 to 4,000 m. Recent additions to the database also include cultivated landscapes that include fodder tree plantations as well as wild and semi-wild forest stands. An additional question that will be interesting to explore is the degree of similarity in tree species that occurs at equivalent elevations in different drainages throughout the study area.

Patterns of Phenology

By incorporating information about the leafing characteristics of the component tree species, it is possible to compare the frequency of different phenological types at different elevations. Figure 7, which charts as a function of elevation the frequency of each phenological type, reveals the following trends throughout the forests of Eastern Nepal. Forests at low elevation are dominated by broad-leaved trees in which deciduous taxa (*Shorea, Terminalia, Sapium*) co-occur with evergreens (*Schima, Castanopsis, Duabanga*). With

increasing elevation, evergreen broad-leaved taxa (*Quercus, Litsea, Symplocos*) predominate, then they decline above 2,500 m. At the higher elevations, deciduous broadleaved taxa (*Acer, Magnolia, Betula, Sorbus*) co-occur with evergreen conifers (*Tsuga, Abies, Juniperus*) and rhododendrons (*R. arboreum*, replaced in the subalpine by *R. hodgsonii, R. barbatum* and others).

The pattern illustrated in Figure 8 is consistent with generalizations made by Dobremez and Shakya (1975), and others. A likely hypothesis to explain these observations is that the subtropical and lower temperate elevations (1,500-2,500 m) are climatically most equable, neither too hot nor too cold, and are most favorable for those taxa, the broadleaved evergreens, that remain photosynthetically active year round. At lower elevations, pre-monsoon drought stress, especially on the south-facing slopes, creates an environment that selects tree species that drop their leaves in the spring. At higher elevations, winter cold selects tree species like conifers, deciduous broadleaved hardwoods, and evergreen broadleaved rhododendrons that tend toward winter dormancy.

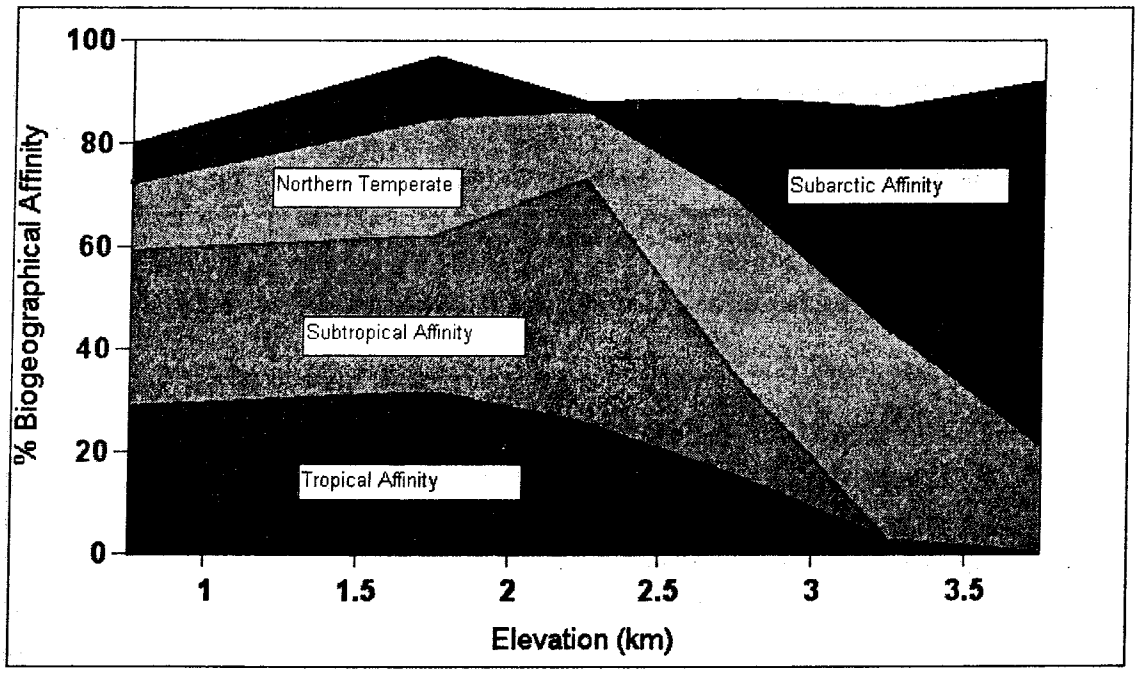


Figure 8. *Biogeograpical Affinities of Eastern Himalaya Forest Trees at the Family Level*
Tree species at low elevation belong mainly to tropical and subtropical families while those at high elevation belong to families with center of diversity at middle to high latitudes

Biogeographic Affinities

Figure 2 illustrates the relative frequency of different tree family groups at different elevations. Trends shown here also correspond to generalizations made by earlier researchers. For example, dipterocarps and members of the tea family (Theaceae) decline above 1,000 m, while the lower temperate zone (2,000-2,500 m) is dominated by oaks (Fagaceae) and laurels (Lauraceae). Higher elevations are dominated by members of the pine family (Pinaceae), with important contributions from the rhododendron (Ericaceae) and birch (Betulaceae) families as well. Thus, the overall transition with increasing elevation from drought deciduous monsoon forest to evergreen broadleaved forest to a subalpine complex of conifers, rhododendron and deciduous broadleaved taxa is illustrated clearly by an analysis of taxonomic frequency at the family level.

Several other interesting trends are discerned from Figure 2.

1. More families comprise the tree flora at the lower elevations compared to the higher elevations. At 500 m, the three most frequent families comprise about 50% of the total basal area; at 3,500 m, the three most frequent families comprise more than 85% of the total basal area. This pattern is consistent with the overall higher species richness measured for the lower elevation forests (Figure 4, 5). Furthermore, the overall proportion of rare families, not individually illustrated in Figure 2, but represented by the white area near the top, is greater at the lower elevations and declines with increasing elevation from about 20% to about 2% by basal area.

2. The relative proportion of standing dead stems by basal area (represented by the black stripe at the top), is greater at the higher elevations where nutrients are cycled more slowly. The proportion is lowest at the subtropical elevations where nutrients are cycled more rapidly. The elevation where the proportion of standing dead biomass is least corresponds to the elevation where human population density is greatest and forests are subject to the maximum human impact.

3. Despite their emblematic status in Eastern Nepal, rhododendrons appear here to be relatively minor associates in the upper elevation forests above 3000 m. Although highly apparent and numerically among the most abundant trees, the subalpine rhododendron (eg, *R. hodgsonii, R. campylocarpum, R. campanulatum, R wightii, R. thomsonii*) have low frequency in terms of basal area. For example, a single individual of *Abies spectabilis*, 1.5 m dbh, has the basal area of 100 stems of its frequent associate R. hodgsonii, 15 cm dbh. It is in the upper temperate zone (2,500-3,000 m) that Rhododendron is most important because here many stands are dominated by the large-statured trees, *R. arboreum.*

4. The birch family (Betulaceae) has an interesting bi-modal distribution pattern. It is important in the subtropical and lower temperate elevations because the alder *Alnus nepalensis* dominates steep, moist slopes at this elevation and it is important above 3,000 m because the birch Betula utilis is an important associate in the upper elevation *Abies spectabilis* forests.

Figure 7, a comparison of the frequency of different families according to their biogeographic affinity, provides graphical evidence of a pattern in the Himalaya that is also observed in other mountains ranges throughout the world. Trees that compose the forests at increasing elevations are derived from taxonomic groups that have their center of diversity at increasing latitudes. The pattern illustrated here is somewhat speculative because families important in the Himalaya, like Fagaceae and Pinaceae, are of widespread distribution. Nevertheless, the observed pattern is consistent with the hypothesis that an elevational transect of the Eastern Himalaya samples tree taxa whose biogeographic affinity maps to a latitudinal transect of East Asia from tropical Indochina to the Russian Far East.

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I would like to thank the students of the Wildlands Studies Nepal Program for their assistance collecting data in the field. The project would never have begun without their enthusiasm. The staff of Nilgiri Treks and Mountaineering, with whom we have cooperated for nearly ten years, has also been instrumental to the success of this project and we owe them all a powerful debt of gratitude. In addition, I would like to thank Robert Zomer who played a major role in developing the Wildlands Studies Nepal Program and with whom I collaborated in the field during spring 1991, fall 1992, spring 1994 and spring 1995.

Laxmi Dewan has handled logistics on 25 trips into the Himalayan backcountry, each time with

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Forest Diversity Conservation in Participatory Managed Forests in the Mid Hills of Nepal

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ABSTRACT

A study has been carried out in Mahadevsthan Village Development Committee (VDC) of the Kabrepalanchok district in the Mid hills of Central Nepal. Forest diversity was studied in eight forests of the VDC. The forests were selected because they were managed by forest users groups (FUGs) and managed with participatory approach of local villagers. The study was conducted from July to October 2000. The main focus of the study was to assess forest diversity conservation by the community (FUG). As it is known that there might be selectivity of usable forests by the community without maintaining the biodiversity. Protection of naturally regenerated seedlings is important for keeping the biodiversity. Age of tree sampling is assumed by the height of the trees. The age of the saplings was cross checked by the experienced member s of the FUG. The methods of study are quadrant samplings, direct observation along with key informant interview and small group discussion with the FUG. Forest biodiversity conservation is mainly affected by application of the rules and regulation of FUG. FUGs are responsible for the protection, management and utilization of the forest in their respective area. The naturally regenerated tree species are categorized on the basis of user value like timber tree, fodder tree, fuelwood tree, wild edible fruit and medicinal tree. The study has shown that the patch of forest area, number of members of FUG ratio has affected the survival potentials of new emerging seedings by natural regeneration. It is realised that few improvements are needed in the afforestation policy in community managed forests. Planning should be done according to the preference of use valure. Tree species which are easily germinated in natural conditions, plantation should be a priority.

KEYWORDS: Community forest; forest users' group; diversity; regeneration; participatory managed forest

INTRODUCTION

Nepal is a country of diversity from ecological point of view. A significant biodiversity is a peculiar characteristic of Nepal. The study district lies in the Mahabharat and Churia range of hills.

The study site lies in the Mahadevsthan Village Development Committee (VDC) of the Kavrepalanchok district in the central region of Nepal. It lies in the mid-hills from the topographical point of view. The Kavrepalanchok district occupies an area of 1,396 km^2. The elevation of the district ranges from 1,007 to 3,018 m asl. Some of the river basins are as long as 687 m asl 59.4% area of the Kavrepalanchok district is occupied by forests and shrubs (Pekkarainen and Poudel 1995), 28.2% is under agriculture land and the rest 12.4% is river basin, rocks and road . In the district, five different categories of forest are found, namely, the national forest, community forest, leasehold forest, private forest and religious forest.

OBJECTIVES OF THE STUDY

The objectives of the study were to find out the status of maintaining the bio-diversity in participatory managed forests.

Study Site

In the Mahadevstahn VDC there are twelve patches of forests managed in a participatory method. It means forest users group are formed to manage these forests. The forest users' group (FUG) is responsible for the conservation and management of the forest along with wise utilization of the forest products.

Kavrepalanchok district was selected for the study as the district is well known for the forest users' group from the very beginning. The concept of FUG was developed and piloted in this district some thirty years ago. Nepal Australia Community Resource Management Project (NACRMP) started working here since early eighties focusing on afforestration and conservation.

METHODOLOGY

Out of twelve participatory managed forests in the VDC, eight forests were considered for the present study. The name of the forests is as follows: 1. Bokse Forest, 2. Jukepani forest, 3. Salleni Baguwa forest, 4. Jamune pakha forest, 5. Ghyampe pani forest, 6. Ratomate Naubise forest, 7. Ghaitar Dundepakaha forest and 8. Pauwa forest. The total area of these eight forests is 266.5 hectare out of 322.55 hectare forest land in the Mahadevstahn VDC. All of these forests were handed over to the forest users group (FUG) over a period of past ten years (1991-1999). The newly handed over forests have less number of saplings than those which were handed over some five or more years ago (not shown in the table).

For the study of biodiversity conservation, indicators were taken as number of tree species of the natural regeneration in the selected forests. As in naturally occurring forests, tree species of Shorea robusta with other dominant tree species are counted in quadrates.

Regeneration of forest trees occurs by coppice in case of Shorea robusta. However seed germination is necessary for other species like Pinus, Castanopsis, Schima, Lyonia species.

To quantify the degree of natural regeneration of forest tree species, the following methods were used:

1. Direct observation of the forests. This was done by transect walk inside the selected forests. Effort was made to cover the whole area of the forest in the foot trail.
2. Quadrate sampling: This was done on tree saplings in each block of the forest area. The quadrate sampling area was 22.5 by 22.5 square meters. This area is equivalent to locally used measurement of land (called *ropani*), roughly equivalent to twentieth part of a hectare. Five quadrates were taken from each sampled forest and the number of species counted.
3. Focus group discussion (FGD): Focus group discussion was conducted with the FUG committee members of all the eight forests. This method was especially helpful in finding out the differences occurring some twenty years ago and now.
4. Cross checking: It was done by getting relevant information from the key informants including farmer leaders, teachers, range post in-charges. The key informants confirmed the findings from their observation/experiences over the years and verbal reports from the elderly.

FINDINGS

Direct Observation revealed the present condition of the forests. It shows the density of tree saplings over the area. Similarly, it gave idea about the quadrate sample. It was done with painting by enamel on the trees.

Quadrate sampling of the study area revealed the dominant tree species in the sample quadrate. The number of naturally regenerating dominant tree species is counted both by vegetative (coppice) and seed

germination.

The findings are summarized in Table 1. This table shows that three types of forests are being managed by the FUG: natural, planted and mixed.

Table 1. *Area and type of the Forests and number of tree species in it*

SN	Name of forest land	Area of forest (in hectare)	Forest type	Total number of tree species /hectare
1	Bokse FUG	111.3	Natural	3247
2	Jukepani	10.25	Natural + Plantation	1432
3	Salleni Baguwa	72.25	Natural	2182
4	Jamune Pakha	7.55	Natural + Plantation	1121
5	Ghyampe Pani	8.00	Plantation	1758
6	Ratamate naubise	18.75	Plantation	1867
7	Ghai tar Dude Pakha	25.85	Natural + Plantation	1923
8	Pauwa	12.25	Natural + Plantation	1543

Table 2 shows the average number naturally regenerated tree species in the eight forests. As shown in Table 2 Sal (Sorea robusta) is the dominant tree species in the naturally regenerated forests. This is followed by Salla (Pinus), Katus (Castanopsis), Chilauney (Schima) and Angeri (Lyonia).

Table 2. *Average number of tree species in naturally managed forests*

SN	Tree species	Number of trees	Local name
1	(Shorea robusta)	98 / hectare	Sal
2	(Pinus roxburghii)	68/ hectare	Salla
3	(Castonopsis hystrix)	51/ hectare	Katus
4	(Schima wallichii)	45/hectare	Chilauney
5	(Lyonia ovalifolia)	31/ hectare	Angeri

Note: Only the trees with more than two meters height were taken into consideration for the study purpose.

Table 3. *Average number of tree species in artificially planted forests*

SN	Tree species	Number of trees	Local name
1	(Morus alba)	38 / hectare	Kimbu
2	(Grevelia robusta)	32/ hectare	Kaiyo
3	(Leucinia leucophala)	25/ hectare	Epil epil
4	(Spondias axillaris)	8/hectare	Lapsi

Table 3 shows the average number of artificially planted tree species in the eight forests. From the focus group discussion and key informant interview it was found that the number of trees in the forest has been greatly increased. Though there is no quantitative baseline data with the FUG, the members of the FUG mentioned that the number of trees has increased by double and in some forests it was entirely newly-planted forest on a bush land. New saplings mainly of Pinus were introduced in these planted forests.

It was also observed that in the newly planted forests, only selective plants were introduced. The participants of FGD mentioned that in selecting the plants, their economic value was considered along

with their adaptability in the area and availability of saplings. Regarding the purpose of conservation of the tree species, the FGD participants mentioned that the trees were selected for their specific values as follows:

1. Firewood value
2. Timber value
3. Fodder value
4. Non-timber forest product value

In the focus group discussion, it was also mentioned that artificially planted tree species are gradually increasing in number in the forests. This view was also supported by the key informants.

Table 4 shows comparative number of tree species in the two types of forests.

Table 4. *Comparative table showing the number of tree species in naturally regenerated and artificially planted forests*

SN	Tree species	Number of trees in the Naturally regenerated forest	Number of trees in the planted forest	Local name
1	(Shorea robusta)		98 / hectare	Sal
2	(Pinus roxburghii)		68/ hectare	Salla
3	(Castonopsis hystrix)		51/ hectare	Katus
4	(Schima wallichii)		45/hectare	Chilauney
5	(Lyonia ovalifolia)		31/ hectare	Angeri
6	(Morus alba)		38 / hectare	Kimbu
7	(Grevelia robusta)		32/ hectare	Kaiyo
8	(Leucinia leucophala)		25/ hectare	Epil epil
9	(Spondias axillaris)		8/hectare	Lapsi

DISCUSSION

In the whole Kavrepalanchok district there are a total of 325 forests managed by forest user's group (Sharma and Gautam 1999). FUG manages and utilizes the forests under them. These FUGs are benefiting 28,315 households in the district.

His Majesty's Government of Nepal promotes the maintenance of forests in the kingdom. For this various activities have been carried out though with various modifications and modalities (Soussan et al 1998; Chapagain et al 1999).

The forests users' groups initially try to have natural regeneration in the forest. Promotion of natural regeneration is a priority. However, if it does not occur, FUG go for plantation. Natural regeneration is increasingly coming up in the forest areas where there is less human interference. The FUG are concerned with the adaptability of the species and so would like to wait for regeneration.

Plantation has been done additionally in forests where natural regeneration is poor or not possible. For plantation preferred species are planted by the FUG. They are selective in choosing tree-species depending upon the availability of the saplings.

The study revealed that the FUGs are aware of the economic potential of the trees. They know about the importance of broad leaf and indigenous tree species. Besides, they also know the ecological adaptiveness of the tree species.

Other studies also reveal that the forests have socio-economic importance to the community (Suvedi

1995; Thapa et al 1998). The community will chose the forests that will have economic importance to the FUG.

The forests, where pine plantation was done some 20-25 years ago, it is replacing the broad leaf and multi-purpose tree species.

CONCLUSION

Forest conservation has been promoted through plantation of new tree species with some value. This is being done by the forest users group of respective forests. The dominant tree is Sorea robusta followed by Pinus and Castonopsis. However, in planted forests, Morus, Grevelia, and Spondias were the frequently chosen species.

Forest biodiversity has not been maintained in the participatory managed forests. This raises the question whether the biodiversity will be considered in a broader aspect.

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Biodiversity Conservation through Community Participation: A Lesson from Park-People Programme of Nepal

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ABSTRACT

Nepal is a small Himalayan Country, located between two large countries in the northern and southern side ie, China and India. The country has 147,181 km^2 of area ,which accounts only 0.03 percent of the land area of the earth and 2.2 percent or even more coverage of total biodiversity of the world. National park and wildlife conservation areas contain both rare and valuable flora and fauna representing different places of the Himalayas and the South-East terrain of Asia. Some herb species like Paach Aunle, Yearcha Gumba, Nagveli, etc. may disappear, wild animals as like one horn Rhino, Bengal Tiger, Snow Leopard, Habre, Clouded Leopard, Swamp Deer and others are threatened, and some birds, flowing plants and aquatic animals are also endangered. Therefore, both approaches of preservation and conservation are very essential for the protection of magnificent bio-diversity resources of Nepal.

By realizing the fact of biodiversity conservation in Nepal, a joint effort of UNDP and Department of National Parks and Wildlife Conservation of HMG/Nepal had introduced a people-oriented and consumer-based conservation programme in 1994 and named as Park-People Programme (PPP) focused on sustainable development, and community mobilization approach focusing on bufferzone management system. This bufferzone management was based on community participation, resource management, bio-conservation, revenue generation and community development as well. This programme was implemented in seven protected areas in Terai and two in the mountains.

The major focused activities were park management inerventions inside the parks/reserves, conservation initiative in bufferzone, and forestry initiative outside the bufferzone. By the end of 1999, the annual report had shown indeed that it had yielded fruitful results in its efforts. Suggestions are drawn towards the continuation, consolidation and expansion of community mobilization approach for biodiversity conservation. The report also reflects the successful impact on the socio-economic realities of the bufferzone community people of Nepal and this is the unique programme and one of the most successful programmes even in the SAARC region.

KEYWORDS: Biodiversity; partnership approach; community mobilization; bufferzone; Park-People Programme; Nepal

Background and Geo-Structure of Nepal

Nepal is a small Himalayan country, located between two large countries in the northern side, China, and in the southern side, India. It has a rectangular shape roughly with north-west to south-east expansion. The country has 147,181 km^2 of area, which accounts as 0.03 percent of land area of the earth and 2.2 percent or even more coverage in local biodiversity. The absolute location of Nepal lies between 80° 04' to 88° 12' E in Longitude and 26° 22' to 30° 07' N in Latitude. The country has nearly 800 km in the E-W direction and 160 km in the N-S direction.

The physical features of Nepal are full of amazing variations from the lowland plain to perpetual snowy ranges above 8,000 m. For the convenience, the country Nepal can be divided in the following geographic landscape division: the Terai, the Chure Range, the Bhitrimadesh, the Mahabharat Region as the Midland Hill region, the main Himalayas as the Himalayan Region, the Inner Himalaya valleys and the Trans-Himalayan ranges. The climate variations also do occur from tropical to alpine and from high humidity to high dryness.

This kind of unique features has enable to support various types of forest which may vary from tropical hardwood to alpine conifer trees in one side and the other side immense habitat possibilities for both terrestrial and aquatic beings. It is because of these facts that Nepal is considered rich in flora and

fauna. However, forest resources of Nepal has witnessed a declining trend, nonetheless the mass awareness and community participation of these resources has led to the promotion and preservation of forests in the country particularly since and during last few years.

Protected Area and Bio-diversity Variations in Nepal

National parks, wildlife reserves and conservation areas contain both rare and representative valuable flora and fauna of different places of the Himalayas and the South-East terrain of Asia. There are some of the richest and unique pockets of special type of plants and animals, which had been lost due to spreading human habitation elsewhere. Some herb species like paach aunle (Orchis latifolia), yearcha gumba (cordceps sinenosis) antenior end of the worms or caterpillar, Nagveli (Lycopodium calratum) may disappear if they could not be preserved in time. In the same way, the one horn rhino, Bengal tiger, snow leopard, habre, clouded leopard, swamp deer, and others are threatened because of pouching and illegal hunting. So the conservation scheme is necessary to protect the nature, even though it requires further extension as well.

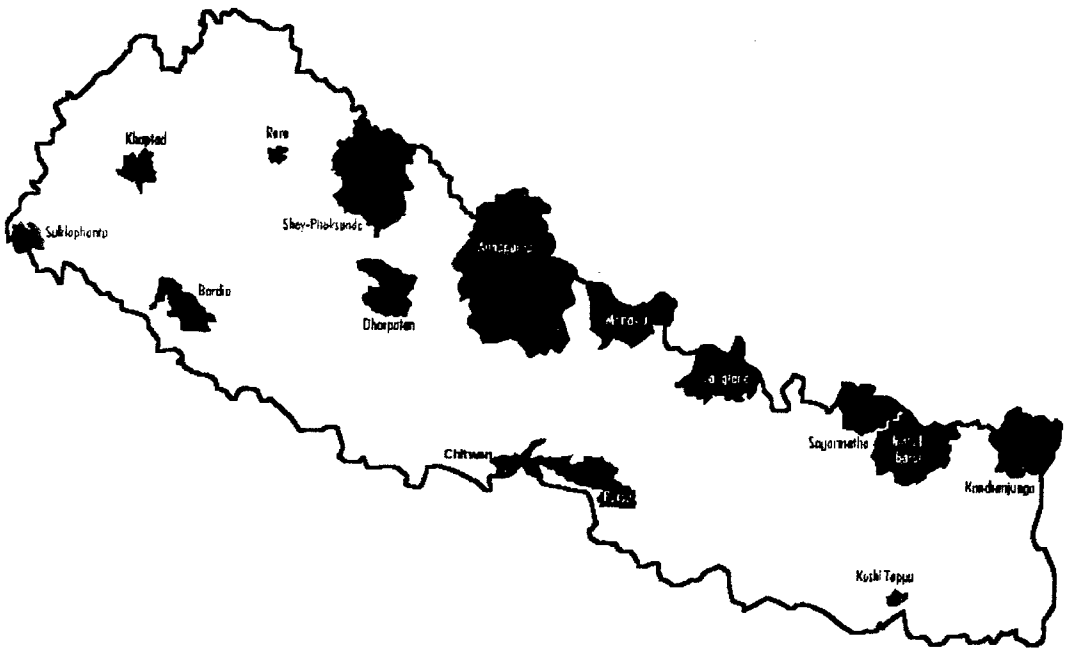

Figure 1. *Parks and Conservation Sites of Nepal*

Institutional effort is underway in order to cope with the conservation issues of bio-resources, the notable natural heritage of Nepal. In 1972, the office of the National parks and wildlife conservation was setup, and in 1979 it was upgraded to the departmental status. The department of medicinal plants is trying to develop herbal farms and cultivate important plants in gardens, including the establishment of Germ Plasma Bank. The establishment of King Mahendra Trust for the Nature Conservation in 1984, was also one of the important steps.

Preservation of nature from the view point of protecting flora and fauna species for sustainability was lately realised, even though some hunting reserves were developed in foothills of the Himalaya or in dense Terai forest during the Rana regime. At present there are eight National Parks covering 10,144 km^2, five wildlife reserves in 2,298 km^2 and two conservation areas in 8,430 km^2 (Figure 1). So the total protected area is 20,872 km^2, which covers 14.2 percent of the total area of the country. These parks, reserves and

conservation areas are distributed in different ecological belts as well as development regions of the country and coverage area also may change time to time due to extension programmes. Conservation of nature is attached and concerned with some religious and cultural values in Nepal. For example some forest pockets like Pashupati, Surya Binayak, Bajra Barahi in Kathmandu Valley are considered to be secret and are protected all the time. There are many other such areas outside the valley as well. Similarly some trees or plants species like Pipal (Ficus raligiors), Parijat (Byetanthes arbortricties) and Tulsi (Ocimum sentum) are considered as very holy and secret and are worshiped as Gods and Goddess.

Biodiversity Conservation through Community Participation (Park-People Programme)

Nepal is a small land-locked country possessing rich in biodiversity (Tables 1-3) and impressive protected areas' networks (Figure 1). The protection of biodiversity has come into direct conflict with the traditional linkages and practices in one side and the need of the communities to use these resources for survival on the other side during the past days.

The on-going activities of protection and conservation in these protected areas resulted negative effect on the communities concerned due to increase of wildlife population and livestock and depreciation in crop harvesting and corps production, thereby creating in Park-People conflicts. This conflict situation has demanded an appropriate strategy that can ensure the balance between the immediate and immense need of the local people and the long-term objectives of the protected areas.

Table 1. *Types of Species – Vegetation*

Group (Plants)	Number of Species	Group (Animals and Birds	Number of Species
Gymnosperm	28	Mammal	181
Angiosperm	5160	Avus	844
Mosses	380	Reptile	100
Fern and its allies	463	Amphibian	43
Lichen	435	Butterfly	635
Algae	687	Spider	144

Then through community mobilization people oriented or consumer-based conservation approach was introduced by the joint effort of UNDP and the Department of National Parks and Wildlife Conservation of HMG of Nepal as per the National Parks and Wildlife conservation Act 1993 (4th amendment). This Park-People Programme (PPP) is based on sustainable development and community mobilization approach focusing on bufferzone Management System. This bufferzone Management was based on community participation, resource management, bio-conservation, revenue generation and community development as well. This programme was implemented in 1994 covering seven protected areas, ie, all five in Terai and two (Khaptad and Rara National parks) in the mountains, which was extended further in 1998 in its coverage. The programme advocates the community-based approach for the conservation of parks resources by forging partnership arrangement between the village-based users group, users committee and specialized functional organizations of the communities of the bufferzone areas.

Table 2. Nepal's Share in Plant Species (Number)

Group of Species	Species of the World	Species of Nepal	Max. Percentage of Nepal's Share
Algae	40,000 above	687	1.72
Fungi	70,000 above	1670	2.38
Lichen	17,000 above	465	2.77
Bryophytes	14,000 above	853	6.09
Pteridophytes	12,000 above	383	3.19
Flowering Plants (Angiosperms and gymnosperms)	250,000 above	5175	2.07

Table 3. Nepal's Share in Animals/Living beings Diversity (Number)

Animals/Living Beings	Species of the World	Species of Nepal	Percent ageof Nepal
Insects	750,000	5,000	0.01
Butterfly	15,000	635	4.2
Fish	8,500 above	185	2.2
Amphibian	4,500 above	43	1.1
Reptiles	6,500 above	100	1.5
Birds	9,881 above	847	8.6
Mammals	4,327	181	4.2

Source : Profile of Biodiversity Project, 1995 A. D.

This Park-People Progamme is adopting an ecosystem approach of biodiversity conservation by implementing simultaneously three components. They are:

i) Park management interventions inside the parks/reserves
ii) Conservation initiative in bufferzone, and
iii) Forestry initiative outside bufferzone.

Along with these three components it has initiated its programme on the basis of six main principles. The main activity-based principals are biodiversity conservation and co-existence skill enhancement, women empowerment, community capital generation, application of appropriate technology and organization of users' group formation.

This programme has extended now seven protected areas of Terai covering 3,240 km^2. Bufferzone of seven protected areas lies 20 districts covering 73 VDCs and 315 wards. About 6.8 million population of 28,882 households of different walks of life live inside these bufferzone areas under coverage. The man activities included in the programme are formation of users groups, community capital generation and mobilization, human resource development, institutional capacity development, functional organization, production investment, conservation education and awareness, forestry and soil conservation, community plantation, private plantation and agro-forestry, park management initiatives and forest initiative outside bufferzones.

CONCLUSION

The 1998 annual report indeed yeilded fruitful results in its efforts and suggestions are drawn towards the continuation, consolidation and expansion of community mobilisation principles for bio-diversity conservation. This is one of the unique programme and one of the most successful ones even in the SAARC region. The report also reflects the successful impact of the programme on the socio-economic realities of bufferzone communties and overall biodiversity conservation of the protected areas of Nepal. This is also a type of approach based on the partnership in biodiversity conservation by the community people and programme implementation agencies.

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Fading Echoes in the Himalayan Woods: An Exploration of the Wealth of Biodiversity in Himalayan Folklore with Illustrations from Uttaranchal

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ABSTRACT

The exceptionally rich biogenetic resources in the Himalayas – till recently of interest only to the specialist, mountaineer or the hobbyist – have begun to attract popular attention due to shocking exposés of poaching and smuggling. Reckless commercial exploitation continues to ravage and degrade the environment. Echoing birdcalls no longer reverberate in the woods. We must realize that human welfare is entwined with the health of the environment. Many of the problems in the Himalayan region arise due to poverty and ignorance. It is difficult to imagine that the abjectly poor will be able to resist the temptation to participate in contraband trade in wildlife products.

With the death and migration of older people, traditional knowledge regarding local plants and animals has suffered great loss. Ironically it may be only the poacher and the smuggler who now know which species are available and what they are worth commercially.

Villagers in the Himalayan region need to be reeducated and motivated via their own folklore to revive the tradition of community management of natural resources and to build up an effective network to counter poaching and smuggling. Let us begin at the beginning. What is folklore and what does it do for the folk? It can be argued that folklore is the proper concern only of cultural anthropologists and that the whole concept is antiquated and has outlived its utility. After the cataloguing and documentation has been accomplished, the specialists can continue classification, comparison and analyses and we can draw on this encapsulated wisdom whenever required. Even more fundamental objections can be raised. The definition of "folk" itself is not agreed upon and more appropriate terms such as "community" or "people" have been suggested. Lore, as commonly understood, is oral traditional knowledge, and is not necessarily factual; in times when written texts or electronic recordings can capture and preserve information more accurately, it does seem a little quaint to argue in favor of folklore.

KEYWORDS: Folklore; Uttaranchal; biodiversity

INTRODUCTION

Folklore, above all, is sharing and caring: shared experiences, shared memories, shared dreams, shared problems and shared solutions. Without getting into distracting semantics it can be shown that folklore has served a useful purpose in the past and hzas retained its potential to do so at present and in the future. The beliefs of the people, their legends, and their songs are the source of all literature; and their institutions and customs are the origin of those of modern times. And today to the new science of folklore (which, as Andrew Lang points out must be taken to include psychical research or psychical science), archeology, anthropology, and comparative anthology and religion are indispensable. Thus folklore offers the scientific means of studying man in the sense meant by the poet who declared that the proper study of mankind is man." (Evans Wintz, quoted in Oakley and Gairola 1935).

Folklore is not simply storytelling in the local dialect brought to life with song and dance. Essentially these stories are 'owned' by a community that can be identified with reference to the depicted characters. The narratives, individually and collectively, represent a shared body of knowledge blending useful information and shared values that govern social conduct in an entertaining package. In our immediate context, information regarding flora and fauna in the Himalayan region is largely based on colonial surveys and fieldwork undertaken by government officials scholars and scientist in the post-independence

period.

It cannot be denied that the pioneering work done by European explorers and British administrators was extremely valuable; such work is, however, severely limited by its own nature. The colonial masters -- soldiers of fortune, missionaries and adventurers -- were not primarily motivated by scientific curiosity, nor were they all equally interested in assisting the community. Their primary motivation was to expand colonial control and to appropriate all natural resources for the enrichment of the empire. The decades after the war coincided with the rising tide of freedom struggle. With the advent of Gandhi not even the remote hill districts of UP remained untouched by anti-colonial fervor. Maintaining control of a restive population was a matter of survival for the British. They could hardly afford the luxury of scientific exploration or leisurely scholarship. These years of upheaval severely disrupted the task of gazetteer making. In fact, what we have is a compilation that is at least hundred years out of date. What was extant then has in many cases become extinct. And what was not noticed and recorded then may perish forever without a trace.

Thus far we have been focusing on the first function of folklore: information. As was pointed out above, folklore is not compartmentalized as scientific disciplines are. The relationship between man, animals and plants is conceived as an integrated -- interdependent -- organic whole. Thus information is not value-free nor are values attributed arbitrarily or justified with reference to man-made hierarchies. The myths and legends that provide the substance or text of traditional lore also provide the metaphors that facilitate our understanding in a basic sense of natural phenomenon. Furthermore, they provide valuable insights into the equitable sharing of natural resources in their sustainable joint management by the beneficiaries -- folk or community. Folklore is essentially the science and art of living. The values imparted via folklore describe and prescribe social norms and, over a period of time, reinforce custom. Experience has shown that law cannot replace custom especially in remote rural communities. Breaches of law continue to occur and shall continue to do so because punishment does not necessarily follow. On the other hand deviation from custom often results in social ostracism and opprobrium. It is only when breach of custom is sanctioned by law that a trespass becomes possible. This is demonstrated glaringly by the antiquated and exploitative forest legislation that continues to be in force. Poaching and smuggling of flora and fauna is rampant because the folk have been alienated from life-sustaining lore, and the letter of law remains lifeless without this vibrant force.

Folklore provides an alternate history -- a democratized version of the history that has a different tale to offer. This tale may in many cases be more significant than theoretical ("scientific") versions. J.G. Frazer perceptively observed

> a superstructure of theory is always transitory, being constantly superceded by fresh theories which make nearer and nearer approaches to the truth without ever reaching it. On the shore of the great ocean of reality men are perpetually building theoretical castles of sand, which are perpetually being washed away by the rising tide of knowledge (Frazer 1935).

The third element of artistic performance and entertainment also serves a very useful function in folklore. Sharing a ritual, jointly witnessing a spectacle, participating as an audience in a performance binds a community, enhances the sense of solidarity and explicitly asserts a common personality. In a broad sense folklore is the most effective public education program. But it would be wrong to suggest that folklore can provide a magical solution to all our problems. There is a real danger that folklore will lose its magic if a strenuous effort is made to tame and harness it to momentary mundane tasks. The timeless message can

easily become debased if it is forcibly introduced in governmental publicity programs.

Early References to the Himalayan Region

The Himalayas are associated with pristine, unspoiled, sacred and spectacular nature. For ages these mountains have attracted pilgrims, *sadhus* in search of *moksh* (salvation), explorers, adventurers, colonizers, traders and merchants. The earliest references to the Himalayan region are found in the Hindu epics: the *Ramayana*, the *Mahabharata*, and the *Puranik* literature. The references in the *Ramayana* are few, but the most valuable is to the Himalayan medicinal herb *Sanjeevani* that was used to revive the mortally wounded Laxman, brother of Lord Rama . The *Mahabharata* on the other hand is replete with Himalayan lore. From the encounter of the hero Arjuna with Lord Shiva in the manifestation of a *Kirat* tribal to the episode of the *Swargarohan* (ascent to heaven of the Pandavas), we are repeatedly transported to the Himalayas. There is a well-known verse in Kalidasa's classic *Kumarsambhavam* that describes the Himalaya as the *bhasvanti ratanani mahodhasheensch*, the repository of priceless gems and potent medicines. This provides fertile ground for speculation. Have such classical references crystallized from the embryonic inspiration provided by the folklore or has local folklore been enriched with additional information imported by immigrants with better or more systematic scientific knowledge? The *Skanda Purana* and the *Kurma Purana* have much more specialized information pertaining to the Himalayas. However, besides glorifying the mountain range and attributing it with spiritual virtues, not much hard data can be gleaned from these works.

It was this information, scattered and fragmentary, most of it focusing on the exotic, rare and miraculous, that was embellished and incorporated in subsequent references. The region was relatively inaccessible, penetrated only by occasional mendicants and adventurers; all others relied on word of mouth. It is worth pointing out that at times the folkloric narrative is deliberately obfuscated: mystification, exclusion of outsiders from access to information, is a hieratic imperative. Of course those members of the community who traditionally exercised control as custodians of natural resources would not be interpreting the stories literally and would be in a position to easily decode the ingeniously encrypted message.

It is possible to glean valuable information in an almost unbroken chain from the end of the eighteenth century to the advent of the British and after, pertaining to Uttaranchal comprising Kumaon and Gharwal in the Central Himalayan region from the folklore. This information valuably supplements the material surveys, revenue settlements, gazetteers and travelogues.

Mention of Flora in Modern Folklore

The earliest British account of Himalayan flora in folklore dates to the series of articles contributed in the 1830s to the Journal of the Royal Asiatic Society by Trail, first Commissioner of Kumaon. There are also some references to folklore in his Revenue Settlement Report for Gharwal. Atkinson relied heavily on this source while compiling his gazetteer. Another source from this period is the work of Rai Bahadur Pandit Ganga Dutt Upretti who served as Assistant Commissioner of Gharwal and undertook extensive research in folklore. However it is possible to go back to the vernacular literature and explore the realm of folklore in the works of Lok Nath Pant better known as 'Gumani' who was born to the family of a *Vaidya* (traditional physician) in 1791 and lived in Uttaranchal under the tyranny of Gorkha occupiers. He lived long enough to see the 'liberation' of Kumaon and Gharwal by the British. His work reflects a premonition that the liberator would soon turn into a predator himself:

> *Bishnu ka debal ukhara, upar bangla bana kharab, maharaja ka mahal dhawaya, berikhana tahain dhara, malle mahar urai nanda bangaloi se bhi tahain bhara angrezo ne almore ka naksha aure aur kara* [The temple of Vishnu was razed to dust and a bungalow erected in its place, the Maharaja's palace made way for the jail and beloved Nanda was shifted to create more space (Pande 1994; translated from the original by author).]

The ruthless British could not care less for Almora and changed its place) and,

> *Bane bane kaphal, kilmore chu bara muni darim kakro chi, gothan mein goru lain bakhoro cha, thatin mein uttam upraro cho. Kela, nimbu , akhor , darim, rikhu, naring ado, dahi, kaso bhat jamoli ko , kalkalo bhuna gaderi gawa Hisalu ki baan bari risal, jain jain pajache udheri khanche.* [Kaphal and Kilmora, Berberis asiatica, are found in plenty in all the forests, the kitchen garden provide pomegranate, and cucumbers. The cow in the shed yields thick rich milk and of all villages Uprara- the poet's village- is the best (Pande 1994; translated from the original by Indrajit).]

This song provides an elaborate list of fruits which were available for the local folk at that time; the point is that that was no dearth of natural resources to be used in daily life.

***Kaphal* [wild berry] - Epitome of Longing**

It is remarkable that the poems of Gumani devote as much attention to the common as to the exotic. The author describes the happy realm of the musk deer and the *Kaphal* [wild berry]. To some it may appear odd to mention this endangered and valuable deer and the lowly *Kaphal* berry in the same breath. But this precisely is the point. Two hundred years ago when Gumani was a young lad the hills of Uttaranchal were a world of their own, cut off from the plains; the people were grateful for nature's gifts. The kaphal tree was widespread and highly valued. "*Kaphal in*deed is a fruit worthy of the gods; some turned red in anger when the gods expelled them from heaven, others turned blue-black in shame, unable to countenance this disgrace."

Kaphal is a constant refrain from the days of Gumani to the fading echoes of the diminishing birds calling out - *kaphal pako meel ni chakho* (The *kaphal* berry has ripened but I haven't tasted it). The first Kumaoni song to be recorded by the legendary singer Mohan Upreti also begins with *Kaphal - Beru pako bara masa, narain kaphal pako chaita, Runa bhuna dina aiye gyana, mein pujya de maita.* The fig was common as it was available round the year; people had to wait for kaphal, which ripened only in the month of *Chait* (mid March to mid April); the married daughter is full of sorrow and longing for her mother's home. It is not just coincidence that the word chaita in this folk song is rhymed with *maita* (maternal home). Tradition in the hills enjoins the family to recall the married daughter and to send gifts to her to reassure her that she may be far away but is not forgotten.

The whole genre of *riturain* songs poignantly evokes the loneliness of a young bride longing to escape her drudgery at the in-laws' and to return home. *Yo ayo chaito ko mahina, iju meri sunali roli* (my mother surely shall break in tears when it dawns on her that the month of *Chait* has arrived). Folk poetry like any other poetry contains the distilled essence of emotions and is charged with energy. These simple words sparingly used outweigh in significance hundreds of pages of lifeless data about the poverty in hills, scarcity of water, the lot of the girl child married very young, for whom the ruggedness of terrain rendered

frequent family reunions extremely difficult. Memories mingled with desire in the plebian *kaphal*, the small scarlet berry, and indeed made April a cruel month to many who never heard of T.S.Eliot. Another point worth mentioning is the depletion of *Kaphal* trees. *Kaphal* is no longer a fruit that can be plucked by idle adolescents or lovers enjoying a tryst in the woods. It is sold in thimbles like strawberries- with prices to match, and bought primarily by tourists. Kids in the villages are no longer told stories by their grandparents to scare them away from the woods likely to be visited by the bear in search of *kaphal*. It has been observed that the presence or absence of a bird is a fairly accurate indicator of the state of the health of the eco-system. Pheasants, for instance, testify to the existence of a lush mixed evergreen forest; when these are cut down to make way for monoculture of commercially valuable timber and shrubs abound thrushes proliferate. When the poor bird wails, "*Kaphal pako meel ni chakho*" she is lamenting not only the loss of the kaphal trees but an entire way of life.

Towards the end of the nineteenth century we find another Kumaoni poet echoing this sentiment. He is Gauri Dutta Pandey (born in 1872), better known by his *nom* de *plume* 'Gaurda,' who penned verses in the Kumaoni dialect evoking the sights and smells of changing seasons in the hills. These poems are today considered valuable parts of folklore. Many of Gaurda's poems are nothing more than rhymed catalogues of fruits and flowers and birds and animals- *kaisa kaisa phal tum khancha suinta, gueya va kaphal laal, oshadha kale kame onoo harada, behada aula, kveral* (pineseeds, berries and cherries you taste , gray, yellow and crimson). And, another list of gifts of nature in "Humro Kumaon":

> *pathar chuna lua tama khari luchia, man dhou ke gari panghat gochar sub chia apana laine picharidaar, pirool, patail, lakro lochia chilukan phari, akhor, darim, nimua, naaring phali runchi bara agyari, goru bhase, bakra ghar ghar situke , palchia gwala ghasyari* (At will we could extract minerals from mines-copper and iron and stone and lime . Our rights over springs and pastures none ever disputed. The jungles provided us with timbre, fuel and resinous splinters, fallen leaves and pine needles formed soft beds in cowsheds. Walnuts, pomegranates, lemons and oranges hung from trees within an arms length. Goats, buffaloes and oxen did herdsmen and grass cutters rear in every home. In the form of yellow belleric and emblic, myrobalan and bauhinia we are served as ingredients for medicines; Pande 1997)

These may not be great poems but we must be grateful for the useful documentation. Entwined with a song like "*Vrikshan ko Vilap*" ("*Wailing of the Trees*") are the shared memories of popular protest against colonial forest policies and the agitation laid by Pandit GB Pant in 1916.
In the more recent agitation for the separate state of Uttarakhand/Uttaranchala, poet-folk singer Girish Tiwari 'Girda' was inspired to recast this song and adapt it as a marching tune: "*Nee karo nee karo hamari neelami, nee karo nee karo hamaro halal!*" ("Auction us not! Slaughter us not!") This is also an excellent example of continuity of content and form in what interests and involves the folk in the hills across almost three quarters of a century.

Another tree which is mentioned repeatedly in the folksongs of the region is the Rhododendron, locally called Buransh. It is distributed on slopes as high as 3,000 meters and blossoms crimson, violet, pink or white. Rhododendron groves, once common, seem to set the hills ablaze. In one song a lovelorn youth is almost deceived by the blazing Buransh, as it reminds him of his beloved clad in a scarlet skirt. "*Para bhida buransh phulo, main je kunu meri Paro ghara aige*" ("The flash of Buransh on yonder hill tricked me with the hope of my love's return").

In the hills the oak (*banj*) grove has always been cherished . Oak provides excellent fuel and is believed to retain more ground water than any other species. A popular folk song in the hills exhorts the villagers not to fell the curly oak thicket as it is the source of life sustaining cool and refreshing water: "*Ni kato ni kato jhumrali banja, bajari dhuro thando paani.*" Another equally evocative folk song associates the cool climate of the hills with the oak. A poor man destined to emigrate sighs whenever he thinks of his homeland:

> *Bhar poori bajari dhuro banje ki hawa cho, aja ka jaya bati kaba ki awae cho so ro ru, yo bato kain jancho bata su roru.* [The cool breeze is married to the oak trees. I bid farewell to them both, knowing not when I shall return. Nor do I know where this road shall lead me. My beloved sister, I know, shall preserve happy memories of our childhood like the surma in her eyes, taking care that it is not washed away when tears swell up when she misses me. The cool breeze is married to the oak trees and I know not when I will return (Translated from Kumaoni by author).]

The oak tree provided timber, fuel, fodder, and tinder for lighting fires before the days of safety matches; it preserved the water and the moss that clung to the tree trunks. Today, ironically, one is warned to be extra careful while using 'safety matches' lest they ignite a devastating forest-fire. To make matters worse the common people - the folk - have been alienated from the forests- those who dwell near forest are suspect. They have no interest in risking their lives to save the forests dousing the flames. The fires that ravaged the jungles of Uttaranchal a couple of years ago may blaze forth even more ravenously if the warning is not heeded.

Fauna in Folklore

If the harmonious relationship between man and other animals and plants is disturbed, the consequences may be disastrous. Himalayan folklore cautions and warns us about these hazards. This is what lends a mythic flavor to village folk tales. Mankind today can disregard the warning at its own peril. One such story from Champawat tells of Goril, famous for his physical prowess and generosity. After the death of his father, Jhalu Rai, Goril succeeded him. Goril's love for the animals and plants of his kingdom was immense. The story tells us of a dove who nested on a Ruini tree, whose nestlings were killed by cruel Dotial princes. The grief-stricken mother dove went weeping to Goril's court; her tears fell on his lap. Goril was moved and vowed not to rest until he had made the Dotials shed tears of blood. He mounted an expedition and killed all of them. This is an illustration of a just ruler who did not distinguish between human beings and animals (Oakley and Gairola 1935).

Then there is the story that tells of the warrior Bagh Dev. Koku Rawat the ruler of Kokukot had seven wives but no male heir. When his eighth wife promised to bear him a son she became his favorite. She expressed the desire to eat the meat of the deer, and her aging old husband promised to fulfill her wish. He went to the forest and chased a deer, in the process reaching Gangolihat. But by that time the deer had found refuge with an old warrior who refused to surrender it. In the end, the protector risked his own life in a duel with the king, and vanquished him. This account illustrates that not even a king could violate the immunity of an animal that was protected by the common people. This also shows that the protection of animals was not confined to rare and exotic animals (Oakley and Gairola 1935).

The legend of Sonu and Birnu reinforces this message. Sonu was married to Kunjawati. Sonu's villainous brother Birnu persuaded him to kill Kunjawati. Sonu who could not bear to do so; instead, he

threw his wife out and told his brother that he had killed her. Birnu soon dispossessed Sonu. Sonu began his life afresh by reclaiming some wasteland in a deserted village called Banjakot, and recalled his wife. Being a simple man he bore his brother no grudge; once when he had killed four deer, Sonu even sent one to him. The scheming brother dispatched the carcass to the king of Champawat as a proof of his brother's disloyalty to the king. The killing of wild animals, we are told, was against the king's orders. A strong contingent was sent to punish Sonu. Learning of his approaching doom, Sonu committed suicide. Kunjawati, afraid for the lives of her children, retreated into the forest. The boys grew up to be strong and brave and one day brought home a tiger bound in ropes. Their mother persuaded them to set the tiger free. The story continues with many other heroic deeds. However what is of interest to us is that the tiger was not a man-eating one, and both human beings and the tiger could co-exist peacefully. Another interesting feature of this story is that a single woman with small children preferred to go to the forest rather than stay in the village; she did not fear wild animals, as she knew that they would not harm her family (Oakley and Gairola 1935).

Versatile Mustard

A popular spell to drive away evil spirits in the Himalayan hills derives its power from mustard seeds:

> Salutations to Spiritual Guide, to Earth, King of Justice, Wind, Water, Soon and Sun! Oh Mustard! Oh Mustard! Thou art my sister and I am your brother. Thou goest wherever I sent thee. I shall sow thee in the plains and reap thee in the hills. Red Mustard, Black Mustard, Yellow Mustard, who produced thee or made thee spring up? Mahadev created thee and Parvati sowed thee. What shall I do with this Mustard? Its seeds are small but fruits great like the Bael fruit. By these seeds I shall kill great demons, daityas, mar, masan, bhoot, pret, chal, chidra,dith, mantra, trap, hunkar, evil eye of a black brahman and a fair shudras, khasias. Evil eyes, I will drive away of a ragged ascetic, of flowing water, of mewing cat or barking dog and evil eye of blowing wind. I am under the protection of the heroic Hanuman who will curse anyone who dares to disobey me. Be on your healing way mustard by the command of God" (Oakley and Gairola 1935).

This text is much more than a magical spell. It unveils for us the intricate web of the interrelationships that sustained life in a harsh environment. Mustard is a most useful seed, producing oil for food and light, and seasoning for an otherwise bland diet. The taste is pungent and astringent and recognized for its vermicidal properties. The incantation lists all the varieties grown in the hills. It is not surprising that something as useful and versatile as mustard should be considered a natural ally against all enemies, physical and spiritual. This verse also indicates the causes of distress. It is easy to dismiss the evil eye as superstition of illiterate hill folk. The blowing wind and running cold water were obviously elements to be guarded against. Dark *Brahmin* (conventionally, upper class) and fair *Shudras* (conventionally, the lowest class) were uncommon, and the barking of the dog announces the presence of a stranger who may bring with him infection or violence. Similarly the meowing cat signals something out of the ordinary. Even today, the household remedy for some common ailments is to fumigate the patient and his living quarters mustard smoke.

Why People Need to Reclaim Their Folklore

The people of the Himalayas must realize that the threat of bio-piracy and bio-prospecting is very real and

that in the post-WTO years the emerging regime of patents can jeopardize the interests of the indigenous people: issues of intellectual property rights and patent protection have become extremely controversial. The economic value of rare specimens used in pharmaceutical and aromatic industries is immense. Indians had to fight a 'great war' to retrieve the patent rights for *neem* (margosa), *haldi* (turmeric) and *basmati* (a variety of rice); this should remind us what can happen to other traditional resources. There is a very real risk that outsiders will plunder our traditional knowledge systems and exploiting our community resources, claiming these as 'Global Commons.' People should be aware of the biogenetic resources they possess and protect their legacy. Most of the residents of the Himalayan region live on or below the poverty line and have little formal education; they need to be reeducated and motivated through their folklore to revive the tradition of community management of natural resources. This would not be the first time that popular movements have drawn inspiration and legitimacy from folklore. Once there is greater awareness about what has belonged to the people for generations and what little remains today, they will be more cautious and more able to defend their interests

A Questionable Future

We conclude, not with convenient solutions, but with disturbing questions. Can folklore retain its impact if it is bereft of its mystique, its association with ritual and superstition? Will folklore not become debased if yoked to the propaganda of the government? Is there not the risk of debasing folklore by commercializing it and packaging it for the tourists? How can we draw upon this life-giving stream without exhausting or polluting it? The challenge is complex and difficult, but is there an alternative?

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Wildlife Management and Development of Ecotourism: A Case Study of Gaur Bison in Parsa Wildlife Reserve, Nepal

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ABSTRACT

Biodiversity conservation and management must contribute to socio-economy for sustainable development. Ecotourism is an ideal way to link these aspects. The objective of this paper is to show this linkage specifically focussing on status of gaur bison (*Bos gaurus gaurus*), its distribution pattern, interactions with livestock, and major tourist areas in Parsa Wildlife Reserve (PWR). Data were collected by literature review, field surveys and observations and participatory rural appraisal (PRA). A total of 33 individuals consisting of 8 herds were found in PWR. The ratio of male to female was 1: 1.3 and that of female to calf was 4:1(χ^2, $p<0.05$,d.f.=2). Herd size varied from 1-10 individuals. They were found mainly in the Churia foothills, and their distribution ranged from eastern part of Pakhribhas to Western part of Sitalpur Khola of the PWR. Large herds were seen mainly in the northern part of the Bedaha Khola up to Western part of Mahadev Khola. These areas had greater habitat variability with bamboo forest patches; lowland riverine habitats associated with mixed deciduous hardwood forest, sal forest, and natural salt licks. Major habitats of gaur bison included mixed hardwood forest (52.8%), mixed deciduous riverine forest (27.8%) and sal forest (19.4%) (χ^2, $p<0.05$,d.f.=2). Meadows were used mainly in the early morning or in the evening. Sighting frequency was higher during March and April in and around Kaminidaha, Bedaha Khola, Pakhribhas, Inner Khola and Mahadev Khola. Areas from Sitalpur Khola up to Jamunia Khola (about 39.1 km^2), particularly Ghodemashan, Laukidaha and Jalkhani areas were under grazing pressure. Interactions (facilitation or competition) between livestock and gaur bison were apparent during April, May and June in the mixed deciduous riverine forest due to the availability of water and abundant new grass shoots. More than 744 cattle and 38 buffaloes were recorded regularly grazing in gaur bison habitats. The PWR has very good habitats for gaur bison ranging for Tarai plains to Churia foothills. Given adequate legislation and proper management, the PWR could be an important destination for tourist with biodiversity, particularly gaur bison as a major attraction. This could provide economic incentive to the local communities and stimulate their interest in Churia ecosystem and wildlife conservation in general and gaur bison protection in particular.

KEYWORDS: Gaur bison; population; distribution; interaction with livestock; facilitation; competition; disturbance.

INTRODUCTION

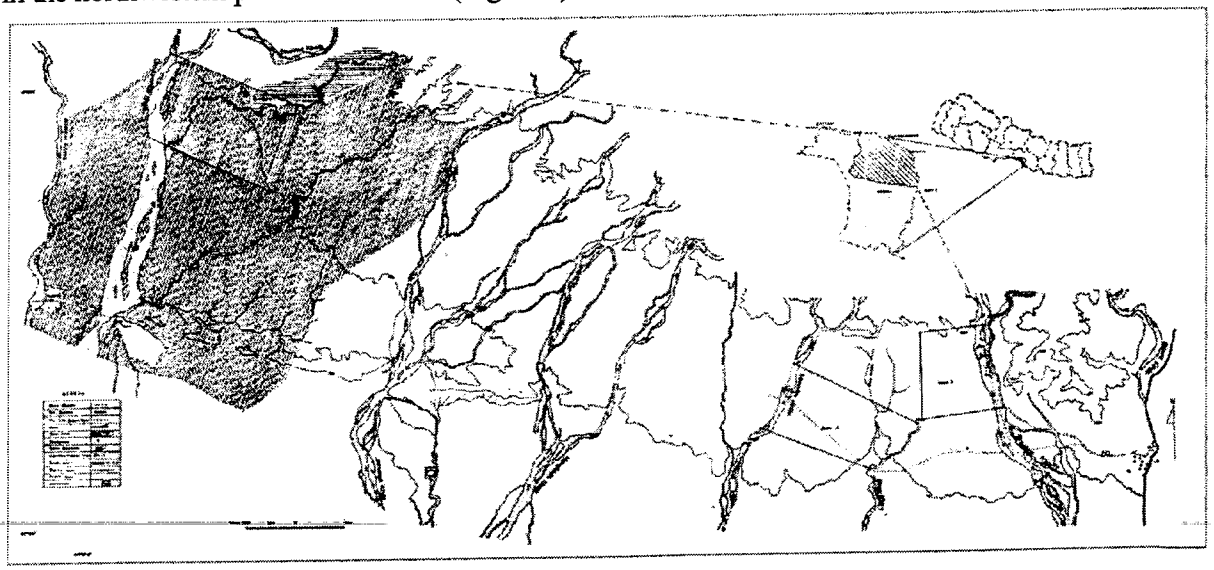
Biodiversity conservation and management must contribute to local socio-economy for sustainable development. Ecotourism is an ideal way to link these aspects. Though tourism has been accepted as the major component in biodiversity conservation and wildlife management in Nepal, not enough efforts are made to develop this sector. Parsa Wildlife Reserve (PWR) is not a destination for many, although it is located in the heart of Tarai's protected areas and close to Royal Chitwan National Park (RCNP). Few tourists, biologists and conservationists know about PWR. These areas which encompass both Tarai, Inner Tarai (Bhabhar), and the Churia hills harbor diverse and unique panoply of species, habitats, and ecosystems, including some of the most threatened and magnificent species like gaur bison (*Bos gaurus gaurus*). Due to poverty, lack of awareness, excessive livestock grazing, poaching, and intentionally setting of fire during the wrong time of the year, degradation of PWR ecosystems is getting severe. The initial impetus of this research was the concern for protecting gaur bison in PWR. We hypothesize that improvement of ecomomic conditions of the adjoining areas will ensure the protection of gaur bison and its habitats by reducing enchroachment. We, therefore, adopted ecotourism perspective for our investigation considering gaur bison as the indicator species.

The gaur bison (known as *gauri gai* in Nepali) may be the most handsome and impressive form of wild cattle in the world. It is listed as endangered by the National Red Data Book (NRDB) threat category (BPP 1995) and protected by His Majesty's Government of Nepal (HMG/N) under schedule 1 (Section 10) of the National Parks and Wildlife Conservation Act, 2029 (HMG/NPWC 1973). Gaur bisons are essentially hill animals but they travel to lowlands during certain seasons in search of pasture (Schaller 1967; Prater 1971; Ranjitsinh 1991). They were distributed in less-distributed forested areas of the eastern Tarai and Churia hills. Habitat degradation and epidemic diseases like rinderpest and murrain through infected cattle grazing in the forest are the major threats for survival of gaur bison in the wild (Brander 1923; Schaller 1967; Prater 1971; Tamang 1982; Gurung 1983; Tikadar 1983; Ramachandran 1985; Ranjitsinh 1991).

This paper describes the population, distribution, livestock/gaur bison interactions and major potential sighting areas in PWR. This work is an extension of gaur bison food ecology and habitat research conducted during January 1988 to April 1999 (Chetri 1999) and part of the broader research on gaur bison thereafter.

STUDY AREA

The study was conducted in Parsa Wildlife Reserve (84° 41'-84° 58'E, 27° 15'-27° 33'N) in Central lowland Nepal. PWR was established in 1984 with an area of 499 km^2 by the Department of National Parks and Wildlife Conservation, HMG/Nepal and has been designated for the protection of biodiversity. It lies at an altitude of 100 m-950 m asl and is surrounded by four districts: Chitwan, Makwanpur, Parsa and Bara (Figure 1). PWR adjoins RCNP to the west, and forms a corridor for wildlife movement. The research study area covers both the Tarai and the Churia foothills (approx. 13.1 km^2) at an altitude of 250 m-450 m asl. The study area was stratified into three sectors: Sector-A (3 km^2), Sector-B (4.6 km^2) and Sector-C (5.6 km^2). Both Sectors - A and B are located in the northeastern part whereas Sector-C is located in the northwestern part of the reserve (Figure 1).



Firure 1. *Location of the study site in PWR*

The climate is sub-tropical. Mean annual rainfall recorded during 1986-1996 at the nearest weather station

(Simara Airport) was 1,721 mm. Precipitation is highly variable, more than 83% of the precipitation occurs during June to October. Average maximum temperature reaches 35.2°C during May and gradually drops to 7.7°C during January. Winter is relatively cold with heavy mist in the morning.

Vegetation in the study area exhibits sub-tropical ranging from early successional stages on the dry riverbeds and floodplains with colonizing *Saccharum spontaneum*, *Imperata cylindrica* to a mature climax type of Sal (*Shorea robusta*) forest on the upper drylands. As altitude increases in the north along the Churia hills, the Sal forest is gradually replaced by pine forest (*Pinus roxburghii*).

In PWR, gaur bison shares habitat with domestic livestock (cows and buffaloes), Asiatic elephants (*Elephas maximus*), Bengal tigers (*Panthera tigris*), Leopard (*Panthera pardus*), Wild dog (*Cuon alpinus*), Striped hyaena (*Hyaena hyaena*), Sloth bear (*Melursus ursinus*), Four-horned antelope (*Tetraceros quadricornis*), Barking deer (*Muntiacus muntjak*), Spotted deer (*Axis axis*), Sambar deer (*Cervus unicolor*), Wild boar (*Sus scrofa*) and a rich variety of reptiles and forest birds. Rambhori and Bhata are two important settlements of subsistence farmers in the western part of the reserve, where as in the northern part, illegal settlers (*Ghotalas*) use to herd large number of livestock from the adjoining villages. The gaur bison inhabiting these areas are threatened by habitat degradation from overgrazing, human disturbances, and direct poaching (Chetri 1999).

METHODS

Population and Distribution

Previous study plots established during 1998-1999 (Chetri 1999) were monitored to estimate the number of gaur bison and their distribution in PWR. Because of the low number of animals' sightings in the previous study, a direct count method was used from three domestic elephant back with six observers in sectors-A and B. In sector-C, due to inaccessibility from elephant camp (Hattishar, Amlekhgunj), fresh tracks were followed with the help of two local villagers to locate the animals. Counts were made during 5:30-10:30 hrs. in the morning and 15:30-18:30 hrs. in the evening. Being larger in size, track was identified easily but it was difficult to follow the herd. Besides a dense tangled vegetation hindered the visibility. Therefore, some unclear observations were not included in population estimation. Following gaur bison from anti-wind direction on elephant back was found effective. The anti-parallel wind sweeps away the smell of the riding elephant and gaur bison cannot detect the presence of the observer. Sometimes one can reach as close as 100 to 200 m to the feeding herd of gaur bison if the elephants are successful in pretending that they are grazing instead of intentional chasing them away.

Although searches were conducted continuously in each sector, areas encompassing natural salt lick, streams and availability of preferred food plants received greater emphasis. In each sighting, herd size, sex, and habitat types were recorded. Diagnostic characteristics, peculiar to individual animals (eg, color, horn shape and size, body structure and shape, visible scarring and deformities) were noted. Photographs were taken with a 35 mm SLR camera equipped with a 300 mm telephoto lens for later comparison of the animals. These methods were used to minimize the chances of multiple counts of a herd and a single animal that belongs to a different herd. Global positioning system (GPS) was used to estimate geographic coordinates of the major potential sighting areas (Figures 2a, 2b). Frequency distribution of individuals counted in different habitats rather than sighting was used in statistical analysis (Borkowski et al 1998). This measurement is useful when there is a wide range in group size as in the present study (Barrette 1991).

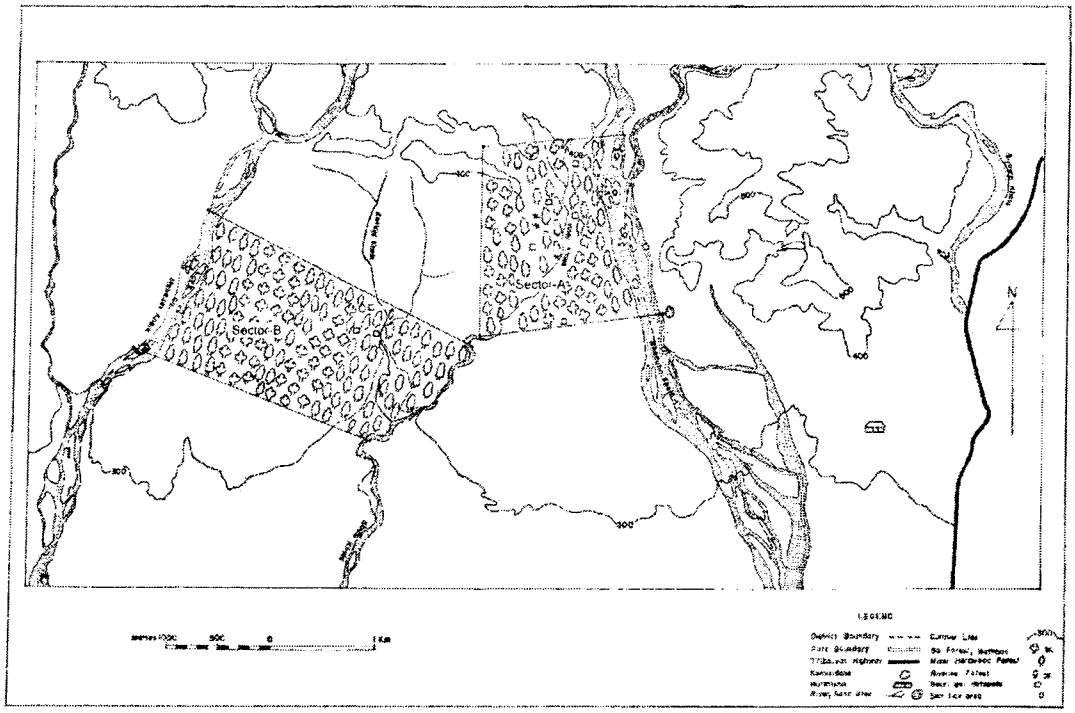


Figure 2a. *Habitats and hotspots of Gaur Bison*

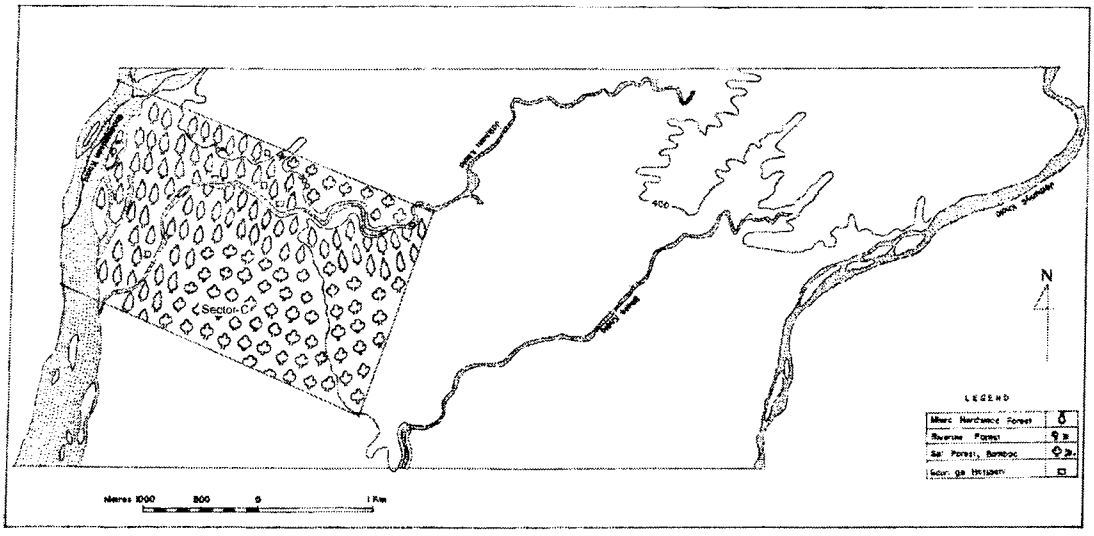


Figure 2b. *Habitas and hotspots of Gaur Bison*

Population Trend

Two sets of questionnaires were employed to explore views of local people and PWR staff about the existing population trend of gaur bison. In Rambhori and Bhata, each and every household was visited informing them about the purpose of the study basically to reduce bias during interview and discussion sessions. A second set of questionnaire was designed for the reserve staff, namely warden, game scouts, elephant drivers, Parks People Program staff and army personnel.

Livestock-Gaur Bison Interaction

Both direct gaur bison sighting areas and indirect signs (eg, fresh tracks, grazing areas, resting ground, fecal sample and urination ground) were recorded in order to assess their interactions with livestock. Grazing areas used by livestock were also recorded using Global Positioning System (GPS).

RESULTS AND DISCUSSION

Population and Distribution

Altogether a total of 33 individuals were recorded in a 13.1 km^2 area (Table 1). This number was very low in PWR in comparison to RCNP which had 189 (DNPWC 1997). A significant difference was observed when the individuals of the three sectors were compared (χ^2, $p<0.05, d.f.=2$). As shown in Photo 1, sector-A had a greater number of gaur bison of the largest herd size (Table 1) probably due to: i) sector-A provided a good quality forage and shelter to gaur bison, ii) the Churia foothills in sector-A are comparatively undisturbed, and iii) availability of natural salt-licks in the Bedaha Khola and Khairini Khola also attracted animals in sector-A (Chetri 1999).

Photo 1. *Largest herd of gaur bison in Bedha Khola*

Table 1. *Population structure and composition of gaur bison in the study area of PWR (Numbers in parenthesis in Sector-B indicate repeated sighting already recorded in Sector-A; AM = Adult male, BR = Brown bull, BL = Black bull, AF= Adult female, SA = Sub-adult, C = Calves).*

Area	AM		AF	SA	C	Total	Comparison of individuals in sectors
	BR	BL					
Sector-A	3	2	8	7	1	21	Sector-A vs. Sector-B: χ^2=20.00, p<0.05, d.f.=2
Sector-B	1(2)	-2	-5	-3	-	1(12)	Sector-A vs. Sector-C: χ^2=12.00, p<0.05, d.f.=2
Sector-C	2	1	4	2	2	11	Sector-B vs. Sector-C: χ^2=10.67, p<0.05, d.f.=2
Total	6	3	12	9	3	33	

The herd size varied from 1-10 individuals. The ratio of male to female was 1:1.3, female to calf was 4:1 and brown bull(Photo 2) to black bull was 2:1 respectively (Table 2). The herd size was small when

compared to Periyar and Mudumalai Sanctuary (Krishnan 1972). This is due to low population size and disturbance from human activities. A significant difference was observed in the occurrence of male, female, and calf (χ^2, $p<0.05, d.f.=2$, Table 2). The male to female ratio was similar to that of Kanha National Park (Schaller 1967) but female to calf ratio (4:1) was different. This difference was probably due to different birth seasons in Kanha National Park and PWR. Krishnan (1972) reported that the breeding season of gaur bison extended from February to July and from December to January. Most of the sub-adults encountered in PWR during the study period were 1 to 3 months old indicating that they were born during February-April.

Photo 2. *Adult brown bull in Ghodemashan Khola*

Table 2. *Herd size and sex-ratio recorded in the study area (Numbers in parenthesis in Sector-B indicate repeated sighting already recorded in Sector-A.*

Area	Herd Size	Sex-ratio			Comparison of sex
		Male to female	Female to calf	Brown bull to black bull	
Sector-A	2-10	1:1.6	8:1	1.5:1	Male vs. Female: $\chi^2=10.67, p<0.05$, d.f.=2
Sector-B	1(2)-(10)	-	-	-	Female vs. Calf: $\chi^2=10.00, p<0.05$, d.f.=2
Sector-C	1,4-6	1:1.3	2:1	2:1	Brown bull vs.Black bull: $\chi^2=3.5, p>0.05$, d.f.=2
Overall	1,2-10	1:1.3	4:1	2:1	

Except sal forest in Sector-C all the three major habitats (mixed deciduous hardwood forest, mixed deciduous riverine forest and the sal forest) had gaur bison (Table 3). Mean sighting frequency was higher in the mixed deciduous hardwood forest, followed by mixed deciduous riverine forest and the sal forest. Animals were frequently sighted during March and April in and around Kaminidaha, Bedaha Khola, Pakhribhas, Inner Khola, and Mahadev Khola (Chetri 1999).

Table 3. *Distribution of gaur bison in three different habitats based on frequency of sighting.*

Area	Habitat		
	Sal forest	Mixed deciduous hardwood forest	Mixed deciduous riverine forest
Sector - A	25%	25%	50%
Sector - B	33.30%	66.70%	0%
Sector - C	0%	66.70%	33.30%
Mean (χ)	19.40%	52.80%	27.80%

The distribution of individuals observed in the sal forest was significantly different from that in the mixed deciduous hardwood forest (χ^2, $p<0.05$, $d.f.=2$, Table 4). Compared to sal forest, mixed deciduous hardwood forest was characterized by a higher number of gaur bisons mainly due to the availability of diverse preferred food plants, undisturbed moist dense cover, and availability of water (Chetri 1999). The survey of literature showed that the areas within 500 m of major river, hilly terrain, undisturbed moist forest tracts with abundant water, coarse grasses, shrubs and trees were heavily utilized by gaur bison (Schaller 1967; Seidensticker 1976; Conry 1989). A similar trend was recorded when individuals from sal forest and mixed deciduous riverine forest were compared (χ^2, $p<0.05$, $d.f.=2$). Availability of nutritious new grass shoots and natural salt licks attracted the animals to these habitats. Besides, the animals used these comparatively open dry river belt forests to avoid flies and pests (eg, Prater 1971). A comparison between the mixed hardwood forest and the mixed deciduous riverine forest showed that a higher number of gaur bisons aggregated in the former habitat (χ^2, $p<0.05$, $d.f.=2$). The sal forest remains dry all year round with less availability of preferred food plants and water (Chetri 1999).

Table 4. *Distribution of gaur bison in three different habitats based on individual number of sighting (SF=Sal forest, MDHF=Mixed deciduous hardwood forest, MDRF=Mixed deciduous riverine forest)*

Area	Habitat			Comparison of Habitat
	SF	MDHF	MDRF	
Sector - A	4	2	15	SF vs. MDHF: $\chi^2=14.00$, $p<0.05$, d.f.=2
Sector - B	0	1	0	SF vs. MDRF: $\chi^2=27.29$, $p<0.05$, d.f.=2
Sector - C	0	5	6	MDHF vs. MDRF: $\chi^2=19.29$, $p<0.05$, d.f.=2

Population Trend

The population of gaur bison showed a decreasing trend during last 5-10 years (PRA 1999, Table 5). The cause of decline is supposed to be alteration to the habitat caused by man, and increased human disturbance. Both local people (N = 58) and PWR staff (N = 28) have more or less the same opinion. About 62% of the respondents confirmed that the population of gaur bison was decreasing while 7% reported that it was the same as before (Table 5). Surprisingly a large portion (20%) of the respondents did not know about gaur bison. Both local people and PWR staff identified habitat loss as the major cause of decline of gaur bison population in PWR (Table 6). A significantly large number of respondents (47%) suggested that the decline was due to habitat degradation and loss. Approximately 20% of the respondents attributed poaching as the major cause while 12% suggested that the decline in population was due to predation by tigers (*Panthera tigris*). It is interesting to note that nobody mentioned about the diseases.

Table 5. *Population trend of gaur bison in the study area of PWR based on PRA information (Numbers in parenthesis indicate percentage)*

Opinion	Local people	PWR Staff	Total
Increasing	6 (10.4)	4 (14.3)	10 (11.6)
Decreasing	37(63.8)	16(57.1)	53(61.6)
No change	1(1.7)	5(17.9)	6(7.0)
Not sure	14(24.1)	3(10.7)	17(19.8)
Total	58(100)	28(100)	86(100)

Table 6. *Major causes of declining of gaur bison number in PWR(Number in parenthesis indicate percentage)*

Causes	Local people	PWR Staff	Total
Habitat loss	25(43.1)	15(53.6)	40(46.5)
Poaching	11(19.0)	6(21.4)	17(19.8)
Predation	6(10.3)	4(14.3)	10(11.6)
Disease	0(0)	0(0)	0(0)
Not sure	16(27.6)	3(10.7)	19(22.1)
Total	58(100)	28(100)	86(100)

Their herd size and sighting frequencies have been declining for last 5-10 years (Table5) mainly because of increasing disturbances. Local villagers of Bhata and Rambhori suggested that large herds of 20-30 animals used to visit Bhata area during dry seasons when all the seasonal streams dried up, but nowadays only one bull was seen frequently during March and May. During the dry seasons local people and poachers intentionally set fire and almost all the areas are burnt completely (Photo 3). Sometimes the dead sal trees burn continuously until the onset of first monsoon rain. Field observations and PRA revealed that the habitats of gaur bison were highly disturbed. For example, in sector-C they adopted more or less nocturnal habitat, which supports Krishnan's (1972) assertion that the behavior of gaur bison changes in disturbed habitats.

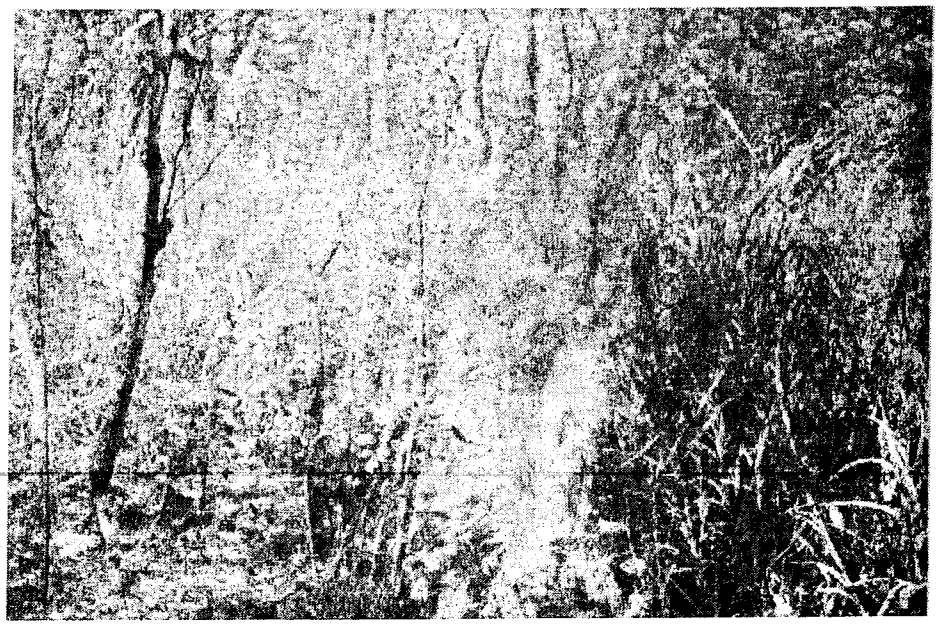


Photo 3. *Forest fires during the dry seasons cause large-scale destruction of forest every year and gaur bison habitats*

Poaching and hunting of gaur bison was not recorded during this study but it cannot be ruled out because it is common in other animals such as sambar deer and wild boars (Chetri 1999). Predation by tigers could be another reason of the declining trend of the population. Krishna (1972) suggested that most of the calves and sub-adults were preyed by tigers but adult males and females were seldom preyed. During the investigation period only one black bull was recorded with severe injuries due to a tiger attack. The population of black bull is low in comparison to cows and brown bulls, probably because they are the attraction of poachers due to some strong reasons including: a) bulky size and magnificent horns, and b) it is easier to shot big bulls as they can be approachable to closer range than adult females and sub-adults. We found that the females and sub-adults are more timid by nature than the bulls.

Livestock-Gaur Bison Interactions

Field observation revealed that gaur bison utilized the same habitat used by livestock in Sector-C of the study area showing a strong interaction. This area is much disturbed due to excessive livestock grazing by the villagers and illegal cattle herders. Both gaur bison and livestock grazed together in such severely disturbed areas as shown by fresh fecal samples, urination ground, resting area, feeding area, and fresh tracks in the Ghodemashan, Jamunia and Jalkhani areas (Figures 2a, 2b).

Majority of the respondents (about 52%) from the Bhata and Rambhori villages and the illegal cattle herders suggested that gaur bison and livestock utilize the same habitats during April and June (Table 7). Rest of the respondents (including some who did not know about gaur bison), were not sure about it. A total of 744 cattle and 38 buffaloes were regularly grazing in their habitats. More than 15 cattle sheds were located in the northern part of the reserve (Chetri 1999). Intensive livestock grazing occurs during the months of April, May and June in the mixed deciduous riverine forest due to the availability of water and abundant new grass shoots. Gaur bison utilized this habitat to feed on the luxuriant growth of new grass shoots either before human and livestock activities commence in the morning or after the activities cease in the evening, Herders of the Rambhori and Bhata villages often encountered gaur bison while grazing their livestock in the Ghodemashan, Laukhidaha and Jalkhani areas especially during April, May and June (particularly in May), during which most of the seasonal streams dried up and gaur bison and livestock used the same water holes in the Ghodemashan, Bhata and Jalkhani areas. Most of the illegal settlers (*Ghothalas*) center their extensive stocks rotationally in the areas where there is plenty of water and abundant food. It has been reported that disturbed habitats such as areas adjacent to settlements were not avoided by gaur bison (Conry 1989). These observations imply that the presence of goths, livestock, and livestock herders generates positive impacts if livestock grazing pressure is not high and hunting and poaching are not practiced by local herders. However, there is a high grazing pressure in PWR particularly in approximately 39.1 km^2 area from Jamunia up to Sitalpur Khola (Figure 1). While facilitation or competition between gaur bison and livestock needs further investigation, a risk of transmitting cattle-borne epidemic diseases like rinderpest and murrian which may directly affect their survival and distribution is always there.

Table 7. *Livestock and gaur bison interaction in the study area of PWR(Numbers in parenthesis indicate percentage)*

Opinion	Local people (Resident)	Herders (Non-resident)	Total
Same habitat utilization by gaur bison and livestock	32(55.2)	3(33.3)	35(52.2)
Not sure	26(44.8)	6(66.7)	32(47.8)
Total	58(100)	9(100)	67(100)

Source: Field surveys (RRA 1998)

CONCLUSION

PWR is good home for gaur bison, which are distributed in large herds mainly in the northern part of Bedaha Khola upto western part of Mahadev Khola (Figures 2a, 2b). Numerous small Churia foothills and existing streams, lowland riverine habitats, and plains with mosaic of vegetation (eg, bamboo forest patches, mixed deciduous hardwood, and sal forests) meet the food and shelter requirements of these ungulates in this area. A total of 13 hotspots (see Figures 2a, 2b) were identified as the major potential sighting areas of gaur bison in the reserve. Livestock and gaur bison interactions in PWR are obvious but the question of facilitation or competition needs further research as in other wildlife - livestock cases elsewhere (Basnet 1998). Various human disturbances and habitat degradation such as excessive livestock grazing, forest fires, and poaching are the major issues of conservation and management and the challenges of gaur bison for their survival in PWR.

Poverty and illiteracy are the major problems in local communities, which depend on forest resources for their daily needs. For example, annual burning of forests by villagers to grow new nutritious shoots for their unproductive livestock is common (Photo 4) and it directly affects the biodiversity. Therefore, a new management policy, particularly focusing on ecotourism development for the improvement of sustainable economy of the local people is essential. We emphasize that part of the areas should be tested with the involvement of local people as symbiotic relationship with the wildlife-based ecotourism practices. Research should be conducted regarding the monetary returns from tourists and benefits to the local people and wildlife (eg, gaur bison) conservation. The revenue generated through tourism could also be used to mitigate environmental degradation, community awareness, and development (Basnet 1992). Successful ecotourism development will successfully strengthen local interest to protect gaur bison in particular and overall biodiversity.

Photo 4. *Unproductive livestock herd in Bhata and Rambhori area*

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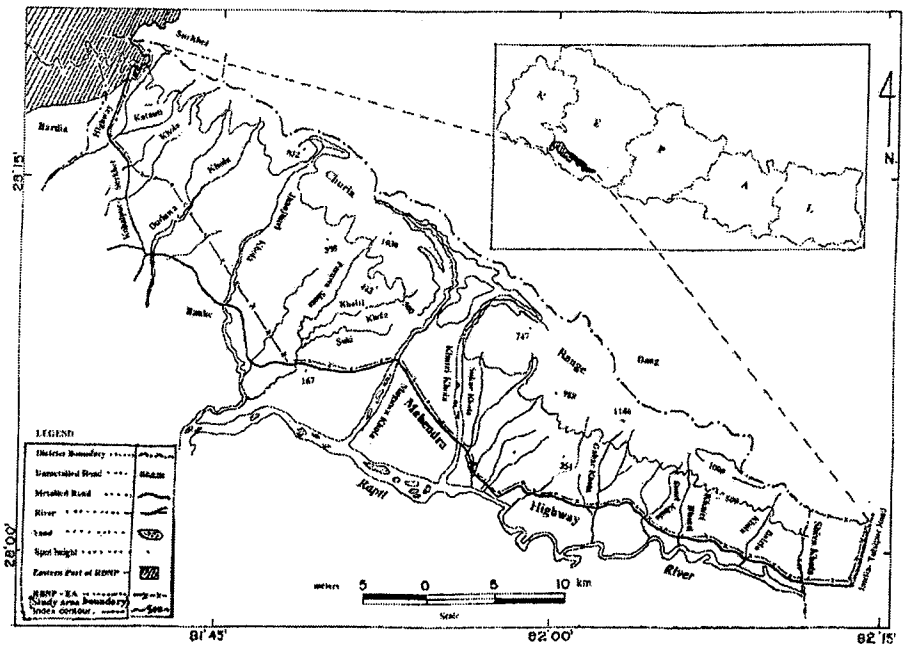

Figure 1. *Royal Bardia National Park Extension Area showing the present study area*

Most of the alluvial flat areas like Kohalpur, Dhakeri, Balapur, Oberi, Sikta and Kusum areas were encroached by settlers. Tharus were the ethnic group of this area. The other tribes like Bharamin, Chetri, Kumal, Rokka and Magar also inhabit in this area. Their main profession is agriculture.

MATERIALS AND METHODS

Status and Distribution

Field survey was conducted during October 1999 and September 2000 with extended fieldwork in January, April, and September 2000. It was followed by a preliminary assessment of the area by an extensive discussion with RBNP and King Mahendra Trust for Nature Conservation (KMTNC) staff, Banke district and Ilaka forest staff, previous researchers, local people, herders, and volunteers.

The study area was surveyed on dusty roads, dry streambeds, and sandy banks. When fresh track was found, a pugmark of the left rear track was traced by placing a glass plate (25cm x 20cm x 3cm) over the pugmark and sketched on the slide (Figure 2). A piece of tracing paper was overlaid on the glass plate and copied. If the pugmark was not distinct for tracing, the total pugmark length (PML) and pugmark breadth (PMB) were measured systematically by recording date, time, location and nature of ground. Different sets of tracks were examined on the basis of tracing and an individual tiger was identified according to distinct differences in their tracks such as the relative distance between fingers, pads, and shape and size of pugmarks (Panwar 1979; Sagar and Singh 1991; McDougal 1999).

Home Range and Tiger Routes

To determine the home range of a tiger, pugmarks and other signs like kills, scrapes, and tree markings were recorded and marked on a scaled field map. These marks on the map were later joined by dotted lines, which resulted polygons inscribing an area or just wavy lines showing a home range area or the main route of the tiger. With the help of the field records and other evidences these polygons or lines were refined and completed.

RESULTS AND DISCUSSION

Status and Distribution

During the survey, one male tiger was found as resident and one female with 2 cubs was considered as transient in RBNP-EA. According to an unpublished report, only one adult male tiger was recorded in the 1999 study (Personal communication, Goverdan Oli and Indra Prasad Jaishee 1999). During his 1995-1996 survey, McDougal (1997) recorded one adult male and three adult female tigers in Bardia Extension Area (Table 1). During the PRA discussions, several people (N=6) mentioned that one male tiger was killed by poachers in Samserganj forest and one female was killed by local farmers using poison in its kill (cow) in Imelia forest during the 1980s and 1990s respectively. Unreported and scattered information shows that illegal hunting and poaching and retaliatory attacks of local farmers are the major causes of decline in the number of tigers in the area. Similar cases have also been reported from other parts of Nepal such as Royal Chitwan National Park (Tamang 1982; Martin 1992; Smith 1993) and also from Bhutan (Dorji et al 1989).

Pugmarks and their measurement were excellent source of information to identify sex, their routes and distribution, and predators of kills. An average PML was 13.2 cm and an average PMB was 12.0 cm, showing a difference of 1.2 cm with a positive correlation (r=0.997). Sagar and Singh (1991) also found similar results in their study in Simplipal Tiger Reserve (Table 2). The male tiger had a large gap between one toe with another in left rear track, which was the distinctive track characteristic of the tiger (Figure 2). Pugmarks were found in nine different places and 11 evidences of male tiger kills (3 buffaloes, 6 cows and 2 oxen) were recorded (Table 3). In RBNP-EA, male tiger covered an area from Khairi Khola (Samsergunj forest) to Khairi Bhatti Khola (Imelia forest) but tiger pugmarks and kills were more frequent in Khairi Khola and Rajabash Khola (Figure 3). One big set of tracks and two sets of small tracks were recorded in Jhanjhari Khola on October 1999, thus showing an evidence of a female with 2 cubs (Personal Communication, Goverdan Oli 1999). A female tiger killed one buffalo each on 18 September 1999 in Katauti Khola area and on 25 September 1999 in Jhanjhari Khola. Two oxen were killed on 15 October 1999 in Katauti Khola. The distributional range of the female included the area from Katauti Khola to Jhanjhari Khola (Figures 1, 3).

Table 1. *Population of tigers in RBNP-EA 1999-2000*

Year	Male	Female	Cubs	Total tigers	Sources
1995-96	1	3	-	4	McDougal 1997
1999	1	-	-	1	Per. Comm. Indra P.Jaishee
2000	**1**	**1**	**2**	**2 (2)**	**Present study**

Table 2. *Relationship between Pugmark Length (PML) and Pugmark Breadth (PMB)*

	Sagar and Singh (1991)	Present study
Sex	Male	Male
No. of Observations	42	6
Mean PML (cm)	12.4	13.2
S. D +	1.2	0.8
Mean PMB (cm)	11.6	12.0
S. D +	1.1	0.1
Coefficient of correlation (r)	0.981	0.997
Significance of *t* above	99.90%	99%

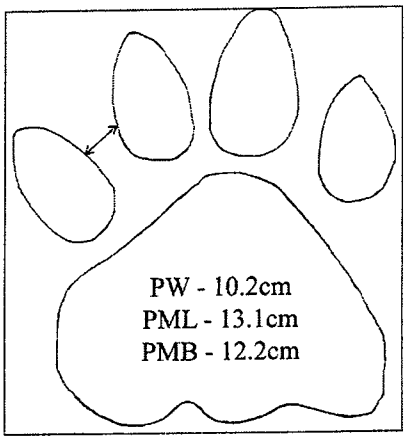

Figure 2. *Left rear track Khairi Bhatti Khola, 17/1/2000. Characteristic track of identified tiger, The⇔shows the relative distance used to identify the individual. PW=Pad Width; PML= Total length; PMB= Total Width*

Table 3. *Distribution of tigers in RBNP-EA*

Sector	Sex	Area	Records in	Evidence	
				Pugmark	Kills
A	Female	Katauti Khola, Jhanjhari Khola	Sept-Oct. 1999	Present	2 buffaloes 2 oxen
B	Male	Khari Khola, Suki Khola	Dec. 1999, July and Aug. 2000 May 2000 to Sep. 2000	Present	3 buffaloes, 1 cow and 1 ox
C	Male	Khaire Bhattti Khola, Rajabash Khola and Sauri Khola	Jan, Sept. 2000 July and Aug. 2000	Present	1 ox, 5 cows

Home Range and Its Routes

In RBNP-EA, it was found that the estimated home range (only inside the study area) of tiger was about 82-102 km^2, which was close to previous results (Sunquist 1981; Yonzon 1982). However, the present range was larger than that of Tamang (1982) and smaller than that of Raghunundan et al (1996, 1997) (Table 4). Such variations in tiger home ranges are common and depend upon the study season, availability of preys, suitable habitat/shelter, human disturbance, and dispersal distance. The dispersal distance of male was 24-30 km inside the study area. Smith (1993) found a large dispersal distance of about 33-65 km in RCNP. Kills and pugmarks of the male tiger were recorded in Khaire Khola on 31 December 1999 and pugmarks in Khaire Bhatti Khola on 2 January 2000. In April of 2000, tracks of the same tiger were recorded in Hadbash Khola area which is outside the present study area. The home range size in RBNP-EA is different from other studies in RCNP and Parsa Wildlife Reserve (PWR) forest (Table 4). This is probably due to the difference in habitat quality in different sites. Besides, lack of water during summer, disturbance by livestock and people affect their home range. Their home range also depends on dispersion of females with whom they could mate (McDougal 1977). Due to the lack of complete information about female tiger, we did not estimate the home range. The tiger used Gabar Khola to Sauri Khola area to cross the Rapti river as shown by its kills near Sauri Khola and pugmarks near Gaber Khola by the highway (Figures 1, 3).

Table 4. *Home range of tigers in RBNP-EA*

Sex	Size	Estimated by
Male	Above 60 km^2	Sunquist 1981
Female	16-17 km^2	
Male	45-100 km^2	Yonzon 1982
Female	10-35 km^2	
Male	48-62 km^2	Tamang 1982
Female	5-23 km^2	
Male	110 km^2- winter 200 km^2- summer	Raghunundan et al
Female	27 km^2	1996/1997
Male	82-102km^2	**Present study**
Female	Not Available	

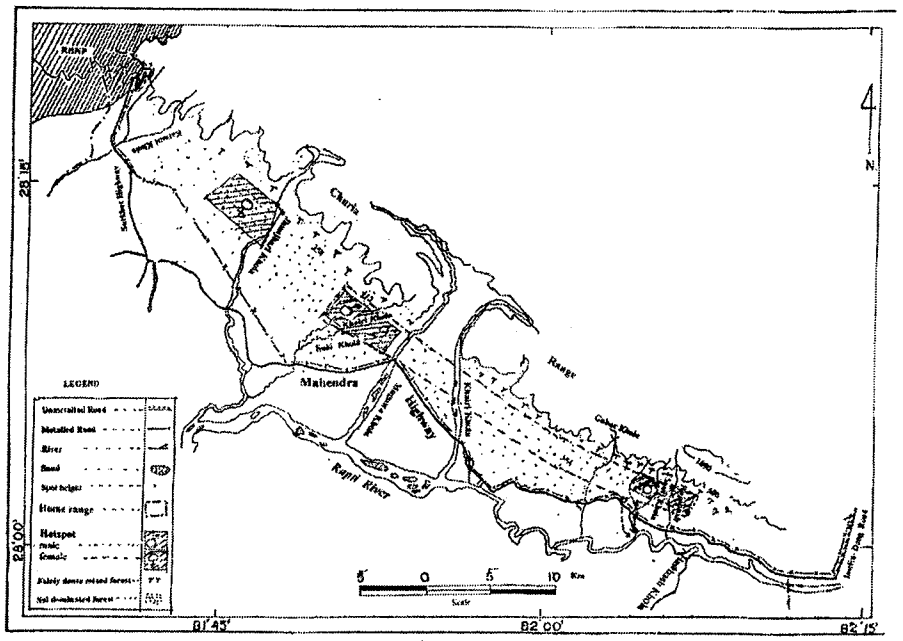

Figure3. *Hotspots and home range of tigers*

RBNP-EA is highly disturbed area (Basnet et al 1998). During the study period, there were 49 illegal established Goths and 3 machans in different places (Lutepani, lower Suki, Thuria) of the Churia foothill near the source of water. People collected grasses such as khar (*Erianthus revennae*), babio (*Eulaliopsis binata*), and many other species (*Imperata cylindrica, Phragmatis karka, Saccharum spontaneum, S. bengalensis* etc) for various purposes including roof thatch, fodder for livestock, raw material for industries (eg, paper factory).

CONCLUSIONS

RBNP-EA and its buffer zone area provide good habitats for tigers, its preys, and other endangered wildlife species. There were at least two tigers during the study period in 1999 and 2000. Jhanjhari Khola, Khairi Khola, and Khairi Bhatti Khola areas were considered as the major areas (hotspots) for tigers in RBNP-EA. Published and unpublished data show that the number of tigers in the area has been declining (Table 1) for some obvious reasons such as habitat degradation, hunting and poaching/killing. With the

implementation of the management plan with well-designed strategy, policies and programs (WWF 1998b), RBNP-EA can be an excellent home and corridor for tigers and other wildlife species linking the western and eastern parts of Savanna Grassland Ecoregion (Wikramanayake et al 1998).

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Kangchenjunga Conservation Area Project: Biodiversity Conservation for Sustainable Development

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ABSTRACT

The Kangchenjunga mountain ecosystem in northeast Nepal is recognized as one of WWF's Global 200 Ecoregions, encompassing distinct environmental and socio-cultural characteristics. Based on the results of feasibility studies conducted between 1992-1996, the area was declared a *Gift to the Earth* on April 29, 1997, in support of WWF's Living Planet Campaign. Soon thereafter, on July 21, 1997, the four Village Development Committees (VDCs) of Lelep, Tapethok, Walangchung Gola, and Yamphudin, were declared the Kangchenjunga Conservation Area (KCA) encompassing 1,650 sq. km.

Major environmental issues in the KCA are deforestation, poaching of wildlife and rare plant species, over-grazing, and land encroachment resulting mainly from poverty and lack of alternative income opportunities. Tourism-related pollution, primarily solid wastes, is also of concern. The Kangchenjunga area was opened to foreign visitors only since 1988 and currently receives less than 1,000 tourists annually.

The Kangchenjunga Conservation Area Project (KCAP) was launched on March 22, 1998, to address environmental and socio-economic issues in the KCA. The Project is a joint undertaking of His Majesty's Government of Nepal (HMG/Nepal) Department of National Parks and Wildlife Conservation (DNPWC) and WWF Nepal Program. The primary goal of the project, which implements community-based conservation and development programs, is to conserve the biodiversity of the KCA by integrating natural resource conservation with sustainable development. This is achieved by strengthening the capacity of local communities, community-based organizations, and government personnel to manage natural resources, and by enabling the local populace to improve their socio-economic conditions. Since its inception, the Project has focused on program activities such as nature and culture conservation, ecotourism, community services, and capacity-building of local women and men. Among these activities, ecotourism is considered a significant tool for achieving poverty reduction in the KCA.

The Project's notable achievements to date include establishing a Project headquarter office at Lelep and sector offices at Ghunsa, Walangchung Gola, and Yamphudin with wireless and Motorola communication systems, extension of the Conservation Area boundary on September 14, 1998, and gazetting of the Conservation Area Regulations 2057 by HMG/Nepal. In terms of local user groups and institutions, the Project has formed and institutionalized four Conservation Area Management Committees, twenty-six Mother Groups, and four school Eco Clubs. The Project has taken 71 KCA residents on exposure tours to other protected areas in Nepal, provided kitchen garden and other skill development training to 354 residents, distributed stipends to 18 girl students, and provided basic literacy to 185 residents.

The KCA is one of the most suitable platforms for promoting trans-boundary initiatives in the Eastern Himalaya Ecoregion. The KCA borders Sikkim-India to the east, the Tibet Autonomous Region of China to the north, and Sankhuwa-Sabha district of Nepal to the west. Due to its strategic location, trans-boundary conservation initiatives are of great importance. As a result, the KCA has been proposed for inclusion in the "*Tri-Nation Peace Park*" with Sikkim's Khangchendzonga National Park, as well as the extension of Tibet-China's Qomolungma Nature Reserve.

KEYWORDS: WWF (World Wildlife Fund); Kangchenjunga; Kangchenjunga Conservation Area Project; KCAP; community-based conservation; sustainable development

INTRODUCTION

The Kangchenjunga mountain ecosystem in the northeast region of Nepal represents an extraordinary landscape with unique floral and faunal diversity, breath-taking scenery, and rich cultural heritage. In recognition of the rich natural and cultural resources of the Kangchenjunga area and in support of WWF's Living Planet Campaign, His Majesty's Government/Nepal (HMG/N) declared the area "A Gift to the Earth" on April 29, 1997. Soon thereafter, on July 21, 1997, the four Village Development Committees (VDCs) of Lelep, Tapethok, Walangchung Gola, and Yamphudin, encompassing an area of 1,650 sq. km, were collectively declared the Kangchenjunga Conservation Area (KCA).

The Kangchenjunga Conservation Area borders Sikkim-India in the east, and the Tibet Autonomous Region (TAR) of China in the north (Figure 1), placing it in a strategic position to promote trans-boundary conservation initiatives. The KCA, which falls within WWF's Global 200 Ecoregions, is included in the Eastern Himalaya Ecoregion of WWF's emerging and innovative landscape-level Ecoregion Conservation (ERC) program (WWF Nepal Program 2000a). Based on the ERC, the major ecosystems found in the KCA are the Eastern Himalayan Alpine Shrubs and Meadows and the Eastern Himalayan Conifer and Broadleaf Forests. The Eastern Himalayan Ecoregion encompasses parts of Myanmar, India, Bhutan, Nepal and China.

Situated in the northern part of Taplejung district in eastern Nepal, the four VDCs of the KCA comprised 884 households with a total population of 4874 that includes 48% females (Table 1) (Dhakal 1996). The average literacy rate among KCA residents is 38%; female literacy (23%) is less than half the male literacy rate (48%). Farming is the major occupation of KCA residents (81%), followed by business (15%) and service (4%). In terms of sufficiency of farm production, more than half the population in the KCA is poor – ie, farm production is adequate for less than 6 months in the year.

Table 1. *Socio-economic conditions in the four Village Development Committees of the KCA (adapted from Dhakal 1996).*

VDC	*Lelep*	*Tapethok*	*Walangchung Gola*	*Yamphudin*	**Total**
Population:					
Female	1101	610	211	417	2339
Male	1115	720	209	491	2535
Total	*2216*	*1330*	*420*	*908*	*4874*
Households	412	254	79	139	884
Poverty*	77%	75%	63%	25%	60%
Occupation*:					
Farming	93%	87%	52%	91%	81%
Business	2%	3%	46%	9%	15%
Service	5%	10%	2%	0	4%

** Percentage of total households*

Natural and cultural resources are abundant in the KCA. While the physiography of the area is dominated by rocks and ice (65%), forests, shrubs, and grasses constitute 14%, 10%, and 9% of the area, respectively (Amatya et al 1995). Altitude in the KCA varies from a low of 1,200 m to 8,586 m – the height of Mt. Kangchenjunga, the third highest peak in the world. In addition to Mt. Kangchenjunga, there are ten peaks above 7,000 m in the area. Mt. Kangchenjunga also gives rise to four glaciers: the Kangchenjunga, Yalung, Talung and Zemu glaciers, with the latter considered one of the world's longest non-polar glaciers. The area hosts the only extensive pure stands of Himalayan larch (*Larix griffithiana*) in

Nepal, and harbors fifteen of the country's twenty-eight endemic flowering plants as well as twenty-four of Nepal's thirty known rhododendron species (Shrestha 1994). Among the numerous faunal species, the area is home to the endangered snow leopard (*Uncia uncia*), red panda (*Ailrus fulgens*), and musk deer (*Moschus chrysogaster*) (Amatya et al 1995). Numerous ethnic groups, including the Limbu, Bhotia/Sherpa/Lama, Gurung, Rai, and occupational castes such as Kami, Damai and Sarki, along with their traditions and ways of life, add to the cultural wealth of the KCA (Uprety 1994).

Conservation Issues in the KCA

The natural diversity of the KCA faces numerous threats from the local populace arising from various causes (Amatya et al 1995). Land encroachment for farming, grazing, and construction of homes and tea-houses threatens faunal and floral habitat. Moreover, residents are highly dependent on forests for fuelwood, timber, fodder and forest litter. Poaching of animals and plants, as well as unsustainable harvesting of non-timber forest products, particularly of lokta (*Daphne papyracea* and *D. bholua*) and chiraito (*Swertia chiraita*), also threatens the KCA's natural resources.

Some key causes of biodiversity threats in the KCA are poverty, lack of conservation awareness, limited infrastructure, and difficulty in enforcing regulations. With more than half the population considered poor, and the relative lack of alternative sources of income and energy sources, there is added pressure on the area's natural resources. Furthermore, the remoteness of the KCA has resulted in nominal infrastructure development. Collectively, these factors threaten the viability of the very resource base that resulted in its recognition as a "Gift to the Earth." In the past, the lack of regulations applicable to conservation areas other than the Annapurna Conservation Area Project (ACAP) has also been a major obstacle for effective natural resource management in the KCA.

Kangchenjunga Conservation Area Project

To address the environmental and socio-economic issues in the KCA, the Kangchenjunga Conservation Area Project (KCAP) was launched on March 22, 1998. The Project is a joint undertaking of HMG/Nepal Department of National Parks and Wildlife Conservation (DNPWC) and WWF Nepal Program. Utilizing the Integrated Conservation and Development Program (ICDP), the Project is generally modeled on the successful Annapurna Conservation Area Project of western Nepal. The primary goal of the Project is to conserve the biodiversity of the KCA by integrating natural resource management with sustainable development. This is achieved by strengthening the capacity of local communities and government personnel to manage natural resources, and by enabling the local populace to improve their socio-economic conditions. The vision of the Project is to establish a system whereby the KCA is managed by local institutions with support from the HMG/Nepal as stipulated in the Conservation Area Regulations 2057.

The main program components of the Project include 1) conserving ecological samples of forests, 2) conserving species of special concern, 3) promoting sustainable resource use, 4) reducing wasteful consumption and pollution, and 5) promoting environmental education and building local conservation capacity, while conservation education/awareness and gender mainstreaming are regarded as cross-cutting issues among all program components.

The major highlights of the Project's achievements (as of June 30, 2000) include:

- establishment of the Protected Area and management system.

- extension of the KCA boundaries, expanding the Conservation Area from 1,650 sq. km to 2,035 sq. km on September 14, 1998.
- gazetting of the Conservation Area Regulations 2057 by HMG/Nepal.
- preparation of the draft Kangchenjunga Conservation Area Tourism Plan.
- completion of detailed feasibility surveys for five micro-hydro schemes in the Project area.
- publication of the Kanchenjunga Mountain Complex Biodiversity Assessment.
- preparation of the Kangchenjunga Conservation Complex Project Brief.

Community participation in Project activities has been crucial for achieving results. These achievements up to June 30, 2000, are listed in Table 2.

Table 2. *Project achievements in terms of community participation in the KCA (adapted from WWF Nepal Program 1999 and 2000a).*

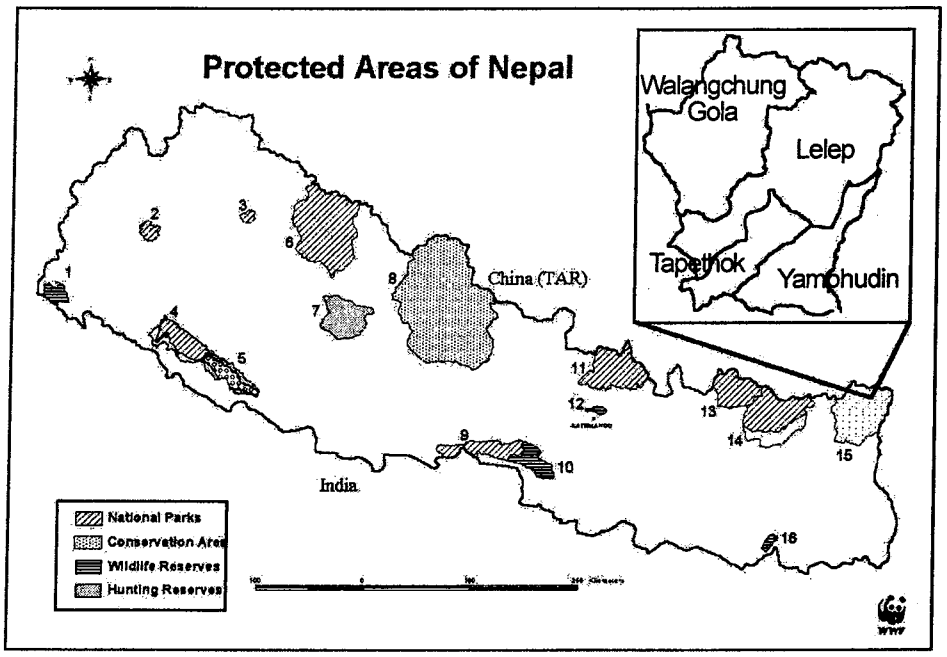
S.N.	Activity	Achievement
1	Natural Resource Management	· 3 multi-purpose nurseries established with on-going seedling production · Basic forest management training provided to 18 residents of Lelep and Tapethok VDC
2	Gender and Development	· 24 Mother Groups formed and institutionalized · 20 non-formal education classes provided with 185 women and 13 men obtaining basic literacy skills · 18 girl students receiving stipends · 2 exposure tours for Mother Group members to other protected areas in Nepal
3	Conservation Awareness	· Extension programs and audio-visual shows participated by over 60% of KCA population · 2 school Eco Clubs formed for raising student participation in conservation programs
4	Income Generation	· Basic kitchen garden training conducted in 18 KCA villages · Group management and saving-credit training provided to 11 members from 5 Mother Groups · 1 carpet-cutting training for 6 women and 3 men
5	Alternative Energy	· 25 back-boiler water heating systems installed · 1 kerosene depot established in Lelep-9
6	Health and Hygiene	· 1 Child Care Center established at Tapethok-8 · 12 toilets constructed in Walangchung Gola
7	Social Services	· 2 drinking water schemes established in Lelep-8 and Lelep-9 · 7 bridges repaired and maintained
8	Culture Conservation	· Support to 4 gumbas for roofing, painting, wall construction and courtyard paving · Wall construction around Pathibhara temple

Future Directions for KCAP

The Project recognizes that poverty reduction and trans-boundary initiatives are crucial to achieving the goal of biodiversity conservation. In Nepal poverty is one of the major reasons for high human dependency on natural resources. Hence, poverty reduction is one of the mechanisms for reducing resource dependency and achieving biodiversity conservation in the KCA (Figure 1). Furthermore, the Ninth Plan (1997-2002) of HMG/Nepal identifies poverty reduction and economic development activities based in natural resource management as one of the most important national objectives. These issues are also reflected in the National Biodiversity Action Plan that is currently in its final stage of completion.

Poverty reduction is proposed through three major activities - production and harvesting of non-timber forest products, agro-forestry promotion, and integrated ecotourism development (Figure 2). Besides timber, products extracted from forests are fuelwood, fodder, edible and medicinal plants, and other products such as *Arundinaria maling* (malingo) for construction and weaving baskets and *Girardinia diversifolia* (allo) for weaving cloth (Brown 1994). Non-timber forest products, particularly medicinal plants such as *Swertia chiraita* (locally known as chiraito) and *Cordyceps sinensis* (yar-tsa-gumba), and other plants such as lokta - whose bark is used to produce pulp in making traditional Nepali paper - have a

high economic capacity. Currently, the KCA villagers get a market price of 10,000 Nepali Rupees (NRs.) per mun (equivalent to 40 kg) for chiraito and NRs. 25 per sheet of lokta paper (200 cm x 100 cm). Agro-forestry is another major potential for income generation in the KCA. Currently, the predominant form of agro-forestry is the production of cardamom (*Amomum subulatum*). The current market price for cardamom sales in Taplejung ranges between NRs. 12,000 to NRs. 16,000 NR per mun.



1) CA Royal Shuklaphant Wildlife Reserve (WR); 2) Khaptad National Park (NP); 3) Rara NP; 4) Royal Bardia NP; 5) Royal Bardia NP Extension; 6) Shey Phoksumdo NP; 7) Dhorpatan Hunting Reserve; 8) Annapurna Conservation Area (CA); 9) Royal Chitwan NP; 10) Parsa WR; 11) Langtang NP; 12) Shivapuri WR; 13) Sagarmatha NP; 14) Makalu Barun NP and; 15) Kangchenjunga CA; 16) Koshi Tappu WR

Figure 1. *Location of the Kangchenjunga conservation Area in eastern Nepal*

Ecotourism development is yet another promising income-generating scheme in the KCA. The area hosts less than a thousand trekking tourists per year, yet a considerable number of pilgrims (approximately 20,000) from both Nepal and India visit the Pathibhara temple, especially during the months of April and October (Schellhorn and Simmons 2000). Tourism management in the KCA is currently minimal, and economic benefits from trekking tourism only reach the local community as a trickle-down phenomenon: most groups are handled by Kathmandu-based trek outfitters. Furthermore, access limitations and the harsh terrain place the KCA at a disadvantage relative to other popular trekking destinations in Nepal, such as the Annapurna, Sagarmatha and Langtang regions. The recently drafted Tourism Plan for the KCA (Schellhorn and Simmons 2000) recommends "staged" tourism development in the KCA to maximize "low volume, high yield" ecotourism ideals. This is to be achieved through conservation and tourism programs that include access improvement, development of a unique product mix, supply quality products and services, impact management, regional liaison and cooperation development, and enhanced management capacity of community-based organizations. This tourism development approach is intended to address the communities' needs for improved quality of life, while concurrently achieving the Project's goal conserving the natural resources on which tourism is based.

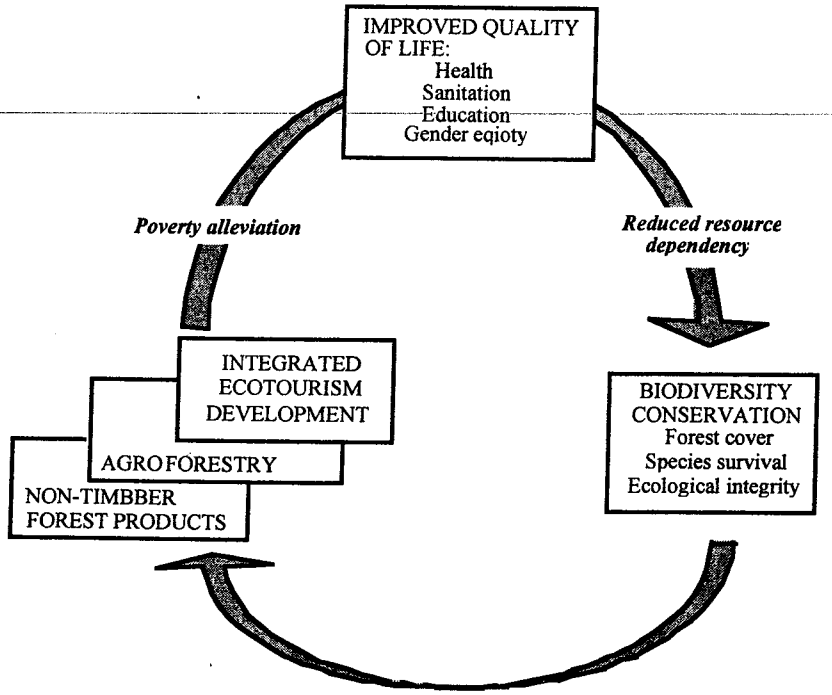


Figure 2. *Reducing resource dependency through poverty alleviation. (Adapted from Schellhorn and Simmons 2000.)*

In addition to national-level biodiversity conservation in the KCA, regional trans-boundary initiatives with Sikkim-India and the Tibet Autonomous Region of China are crucial for maintaining continuous biodiversity habitat landscapes. According to a biodiversity assessment and gap analysis of the Himalayas conducted in 1998 by the Conservation Science Program, WWF-US, the Khangchendzonga complex deserves priority for the protection of Himalayan broadleaf forests and populations of *Ovis ammon* (argali), *Equus kiang* (kiang), and *Procapra picticaudata* (Tibetan gazelle) (Wikramanayake et al 1998). Participatory biodiversity conservation among the three countries is proposed, based on a phase-wise implementation of Integrated Tourism Development (WWF Nepal Program 2000b). The first phase will include the application of the Integrated Tourism Development model to the south and south-western regions of the KCA. Three distinct proposed sites have been identified: 1) the Basantapur-Dobhan corridor, 2) Gopetar-Kabeli Valley and the Central Singalila Range, and 3) Pashupatinagar-Mai Pokhari and the South Singalila Range. The first phase will also involve liaison and exchange programs with WWF Nepal's counterparts in Darjeeling and Sikkim, India. By the fourth and final phase of the Khangchendzonga Complex Project, the Integrated Tourism Development model will be implemented in Nepal, India, and China. This phase is crucial for materializing the concept of the "Tri-nation Peace Park" in the Kangchenjunga Complex.

CONCLUSIONS

Since its initiation a little over two years ago, the Kangchenjunga Conservation Area Project has made significant progress in terms of Protected Area establishment and community capacity building. The future direction of the Project is to continue with building community capacity, while uplifting the socio-economic conditions of the resident population so that the overall objective of natural resources conservation can be achieved through sustainable community development. Only then can the long-term

vision of community management of the Conservation Area be achieved, by building partnerships between the local residents and the government. Regional trans-boundary initiatives in conservation are another major focus for the Project as conservation issues transcend political boundaries.

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Some Expected Roles of the Kanchenjunga Conservation Area Project

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ABSTRACT

The Kanchanjunga (Kanchenjunga) area was designated as a conservation area in 1997. Department of National Parks and Wildlife Conservation (DPNWC) with the support from WWF Nepal has started several activities for the development and conservation of this area (KCAP: Kanchenjunga Conservation Area Project). This paper aims to assess the work by KCAP, which had been carried out within the last three years, and propose some possible measures to create more income.

Although the achievement by KCAP within such a short period of time is highly appreciable, some problems are evident. KCAP can play active roles in many fields for development and conservation of the area. The promotion of cardamom cultivation, which improves the local economy, should be considered. Plantation of trees within cardamom field can help to reduce the pressure in forests and preserve biodiversity. On the other hand, the resultant increase in the livestock farming may cause adverse effects on the environments. These land use dynamics have to be carefully studied. Another prospect in this area is the development of tourism activities. However, there are many problems associated it. Introduction of community-based campsites is necessary, by which more local people are encouraged in promoting sustainable use and conservation of the environments. Local porter system with union should be introduced, so that local porters rather than Kathmandu-based porters can be hired. To promote such possible KCAP activities in-depth research is always necessary.

KEYWORDS: KCAP; income generation; cardamom cultivation; community-based campsite; local porter union; Kanchanjunga Conservation Area

INTRODUCTION

The history of tourism in Nepal started only after 1951 when the country was opened to the outside of the world. After the first conquest of Mount Everest in 1953, Nepal became a popular destination for climbers, trekkers, and tourists (Kansakar and Shrestha 1998). The governmental record shows that the number of tourists was only 1,140 in 1955 and that it increased to 463,684 in 1998 (Ministry of Tourism and Civil Aviation 1995). In this period His Majesty's Government of Nepal had made several policies and programmes and declared several areas as a national park and a conservation area, promoting the development of tourism.

The Kanchanjunja (Kanchenjunga) area (27° 15' to 27° 56' N and 87° 32' to 88° 65' E) in the Taplejung district of northeast Nepal was designated as a conservation area in April 1997. The Department of National Parks and Wildlife Conversation (DPNWC) with support from World Wildlife Fund Nepal (WWF Nepal) has started several activities for the development and conservation of this area (Gurung and Gurung 2001). The work carried out by the project (KCAP: Kanchenjunga Conservation Area Project) within the last three years is highly appreciable. But the local people's attitude to KCAP may not be necessarily so positive. This may be mostly because many of the local people have not been benefited by the KCAP activities.

Many of the future activities by KCAP are expected to provide economic benefit to most local people. It is important to develop activities/programmes, which cover not only the Kanchanjunga Conservation Area (KCA) but also the lower area around the KCA. Because of the lack of such programmes, this paper focuses on the programmes to be developed both in and around the KCA, emphasizing possibilities in creating direct economic benefit to local people and in conserving environments. This paper first outlines the major work carried out by KCAP until May 2000, by which

some problems in KCAP will be shown. Then, as possibilities in generating more income, the introduction of the cultivation of cardamom (*Anomum subulatum*) and *chiraito* (*chirayto*, *Swertia* sp.), community-based campsite system, and local porter system will be discussed.

EFFORTS MADE BY KCAP AND SOME PROBLEMS CREATED

KCAP started on 22 March 1998 (*chait 12, 2054 BS* in Nepali calendar) by establishing the main office in Lelep, two side offices in Ghunsa and Yamphudin (Figure 1), and another side office in Walangchung Gola, restricted area to tourists.

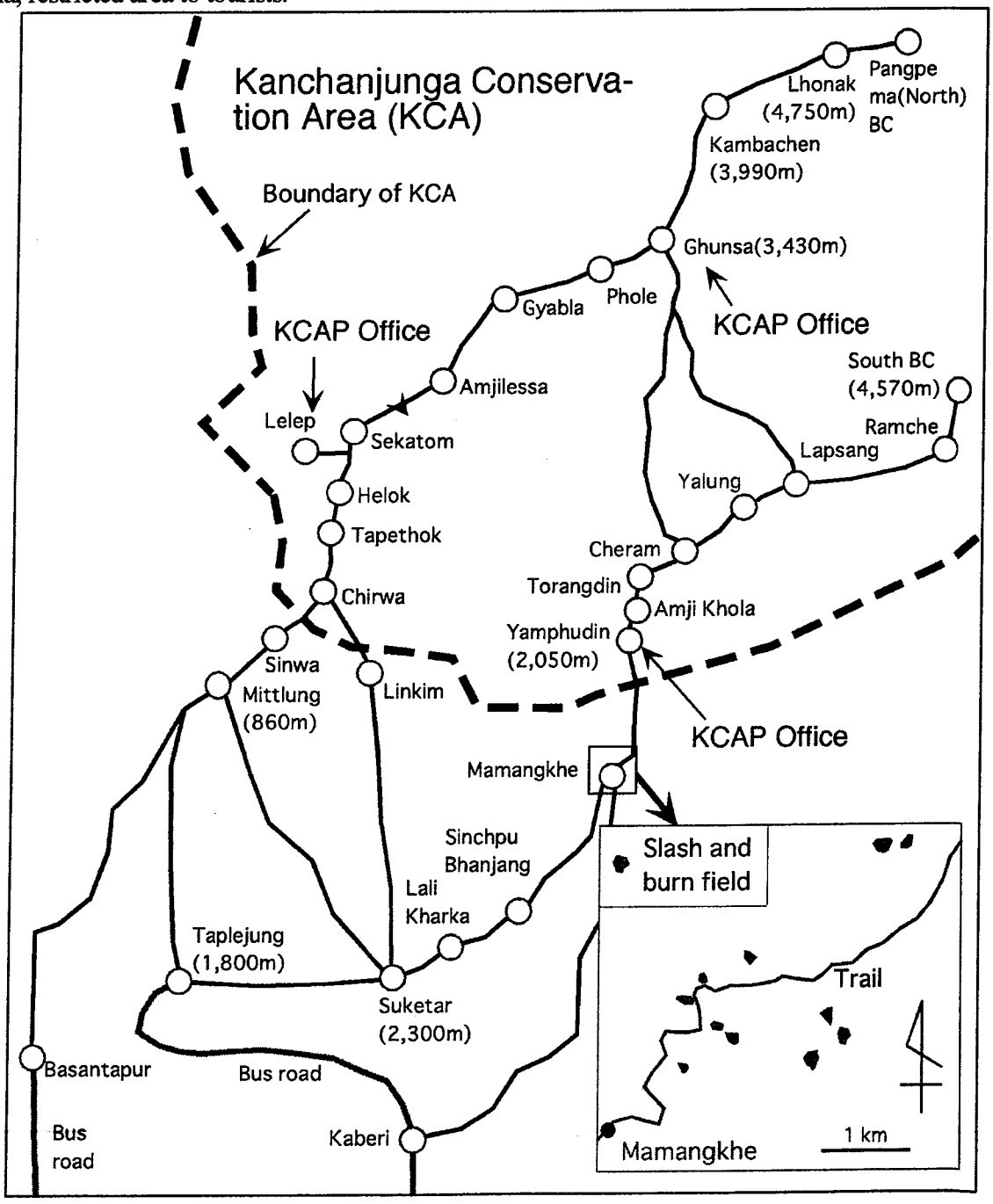

Figure 1. *Locations of the major settlements in and around the Kanchanjunga Conservation Area (KCA) and an example showing the distribution of the major slash and burn field along the trail near Mamangkhe. Slash and burn farming is common in the area.*

The primary goal of the project, which implements community-based conservation and development programe, is to conserve the biodiversity of the KCA by integrating natural resource conservation with sustainable development (Müller-Böker and Kollmair 2000; Gurung and Gurung 2001). To fulfill the project goal, KCAP has made several commitments to the local people at the initial stage. The major activities carried out by May 2000 include: construction of toilets in Ghunsa and Yamphudin; construction of rubbish pits in Yamphudin, Amji Khola, Ghunsa and Gyabla; formation of Mother Groups and Eco Youth Clubs; adult literacy programme in Ghunsa; stone paving on foot trails in Ghunsa and on the way from Amji Khola to Torangdin; some support to maintain *gomba*; distribution of modern musical instrument; water supply through pipe in Yamphudin, Ghunsa, and Gyabla; and exposure tour to some members of Mother Groups to other tourist areas of Nepal.

Many local people reported that the project has not carried all the work as per the commitments made at the initial stage. Furthermore, local people reported that they have voluntarily contributed the labour for all above-mentioned construction work, except only NRs.17 per person per day was given for paving stone on the trail and NRs. 7 for digging a rubbish pit. Local people also reported that the KCAP activities are far from employment generation and that the tourism activities are not also well managed because they provide benefit only to those who have lodges along the trekking routes, or more importantly only to the Kathmandu-based trekking agencies and their staff members who stay with group trekkers in this area, and to porters hired in the lower area near Taplejung and Suketar.

POSSIBLE MEASURES TO GENERATE MORE INCOME

KCAP may be advised to introduce measures to generate more income for the local people in order to promote sustainable development and nature conservation. In the following pages, we propose three possible measures, which KCAP may consider.

Cardamom and *Chiraito* Cultivation

Deforestation is the major environmental issues in the KCA (Gurung and Gurung 2001). Consumption of wood in the KCA seems to be still very large. Field survey indicates that the total consumption of wood by 62 lodges (excluding 2 lodges of Ramche) is approximately 3.9×10^5 kg with an average of 6,300 kg per lodge in a year. In addition, shifting cultivation (slash and burn farming) is also very common which can be seen especially on the way between Lali Kharka and Torangdin and in the areas surrounding Gyabla, Amjilessa, Sekatom, and Tapethok (Figure 1). If the economic situations of the local people are not improved, this environmental degradation would not be mitigated in the future.

The promotion of cardamom cultivation sounds economically and environmentally important in this area. Cardamom is the main cash crop in the lower part and the surrounding area of the KCA (Carpenter et al 1994). Some interviewees reported that they started cardamom cultivation nearly 15 years ago, which roughly coincides with the description by Shrestha (1994). Local people state that cardamom cultivation has made them economically stronger and provided more free time: cardamom needs less care than other food crops. Therefore, by promoting cardamom cultivation in this area KCAP can provide more economic opportunities to local people, such as practicing livestock farming (Chaury, Yak). Some elderly people have begun livestock farming, which was observed near Yamphudin and Amji Khola.

It was also found that the cardamom cultivation has led to high rates of plantation because

cardamom needs tree shade protection. Alder (*Alnus nepalensis*) is planted as cardamom's shade trees (Shrestha 1994), and Alder and cardamom groves are observed everywhere except in Hellok (Carpenter et al 1994). This can help to reduce the pressure in forests, and might lead to preserving biodiversity and reducing soil erosion and sedimentation problems as well. On the other hand, as a result of livestock farming, some forests were cleared near Yamphudin and Amji Khola, where deer as well as birds inhabit. The dynamics of the land use changes have to be examined in detail.

Cultivation of another cash crop, *chiraito*, a bitter tasting medicinal plant for cough, cold, fever, and malaria, has been recently introduced in the area at the altitudes between 2,000 and 2,800 m. *Chiraito* attracts local people, because its demand and price are increasing year after year in the market. *Chiraito* cultivation, therefore, can be a great potential for generating income, although detailed studies about possibilities in adverse environmental impacts, which might be caused by *chiraito* cultivation, should be urgently conducted.

Community-Based Campsite System

Facilities available for trekkers are very poor along the trekking routes in the Kanchanjunga area (Regmi 2001): only 15 lodges (23.4%) provide all facilities of kitchen, campsite, and toilet. There are 53 campsites in total. As described in Regmi (2001), the income from the trekking tourism varies from place to place. Competition among campsite owners may improve the quality of campsites. On the other hand, all people involved in the camping business should be a contributor to environmental conservation. Establishing community-based campsites may be an idea to incorporate all people a strong body to develop ecotourism.

Introduction of the community-based campsite system can help to reduce large income variation from settlement to settlement; to finish monopoly of large lodges; to keep social harmony in the future; to involve more people to conserve environment, and to construct and maintain bridges, routes, and water supply. Sustainability is achieved when ecology economy and society are simultaneously improved (Godde 2000), which is possible through community approach in the KCA. Therefore, it is important to conserve socio-culture, tradition and historical values and norms. Free competition can help only in the development of some basic infrastructure but it cannot help in the protection of religious faith, cultural values and norms. It is frequently reported that the sherpa culture has been changed, sherpas have become over westernized, and their religious faith has diminished (ICIMOD 1995).

Only a few campsite owners are able to make good income from tourism (Regmi 2001). KCAP is hoped to take some steps to open community-based campsites and help community to manage campsites. Community-based campsites can be opened and run either by forming a new committee or by existing Mother Groups. Parts of the income can be used in social welfare work, or can be used to give loan at low interest to the local people.

Local Porter System

So far, all trekkers to the KCA have to obtain trekking permit from the government. This is processed through an authorized trekking agency in Kathmandu, and the trekking agency automatically sends guides and porters from Kathmandu. In most cases, they do not hire local porters at high altitudes in the KCA, although some local porters may be hired in Taplejung, Suketar, and Basantapur, out side of the KCA. As a result, most money goes back to Kathmandu or goes to people living in the lower area.

People living in the KCA cannot earn money from poterage businesss, except for a few cases when trekking groups need further help by yak.

KCAP should encourage in hiring local porters rather than Kathmandu-based porters. KCAP can also take some steps to manage and control the porter problems in this area. The main union office should be established in Taplejung or Suketar, where trekkers can obtain local porters and guides. Trekkers can obtain information about the area from the local guides who are familiar with the area. More employment can be created for the local people, which can help to uplift local economic conditions.

Yaks, used to transport fuelwood in the KCA, can be used to transport trekkers' load. However, they can move only above Gyabla. In terms of income generation for the local people living in the KCA, a new porter union system, by which people living both in and around the KCA can be involved in, has to be developed. Construction of a branch union office of the local porters in Gyabla should be considered, so that lower people can transport load between Taplejung, Suketar, Basantapur and Gyabla, and high altitude people (using yaks) can transport the load between Gyabla and Base Camp. In this regard, it is important to establish an effective connecting system between the lower area (around the KCA) and the higher area (in the KCA).

CONCLUSIONS

Experience of local people about tourism and the KCAP activities are not necessarily regarded as positive so far. This is mainly because the local people cannot get the direct benefit from the tourism activities and the KCAP programmes. A comprehensive action plan is needed as soon as possible for the development of the KCA, which should consider in strengthening local income generation in order to conserve natural and social environments.

The existing infrastructure and service facilities for trekkers in the area are extremely poor (Gautam 1997; Regmi 2001). The introduction of a community-based campsite system can create stronger motivation for more local people and can provide some portion of the income available for conservation.

In the time when mountain tourism becomes more popular, the Kanchanjunga Conservation Area (KCA) has high prospects of becoming favourable tourist destination. Tourism-related activities have to be appropriately developed and managed from the initial stage. Tourism activities should create employment opportunities and provide more benefit not to Kathmandu-based trekking agencies but to local people: local porters should be always hired.

It is important to identify both effects of positive and negative before the suggestions made in this study are introduced. We already stated that a detailed study is needed to find possible impacts on the environments by *chiraito* cultivation. Also, before the cardamom cultivation is promoted, we need to know the dynamics of land use changes. Careful, in-depth research is always necessary for KCAP activities.

ACKNOWLEDGEMENT

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An Assessment of Available Infrastructure in and around the Kanchanjunga Conservation Area

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ABSTRACT

The Kanchanjunga area has been recently opened for trekking and mountaineering tourism. The number of tourist visits to this area has increased from 87 in 1988 to 801 in 1999. Although the number of tourist visits to this area has not been so high as compared to the other major tourist areas such as Khumbu, Langtang, and Annapurna, it is possible to increase greatly when developed. It is in this context that this paper focuses on the growth of lodges and available infrastructure along the trekking routes and the contribution of tourism to the income generation for the local people. The progressive increase in lodges led to the degradation of forests and the low quality of tourism infrastructure. The available infrastructure is not also equally distributed. No special attention was paid towards the fooding and lodging for porters. The contribution of the trekking tourism to the income generation for the local people is very small. A comprehensive action plan is needed for the tourism development and the proper utilization of the available resources.

KEYWORDS: Kanchanjunga Conservation Area; infrastructure; income level; trekking tourism; lodge; campsite

INTRODUCTION

The Kanchanjunga area was opened for a climbing expedition in 1978, and the area was opened for group trekkers in 1988. HMG/Nepal gazetted the Kanchanjunga Conservation Area (KCA) in April, 1997 and HMG/DWPWC (Department of National Parks and Wildlife Conservation) signed a five year agreement with WWF (World Wildlife Fund) Nepal on 12 September 1997 for the protection of wildlife, conservation and management of natural resources in the area.

The number of visitors to this area has not been so high until today: in 1988 it was only 87, while it reached 801 in 1999 (Department of Tourism 1999). However, it is important to access information about the present situations of tourism activities in the area, so that the change over time can be studied for better conservation and management in future.

The followings are the general objectives of this study: (1) to explore the existing infrastructure and service facilities available to trekkers along the Kanchanjunga Trekking Route, ie, from Suketar and Taplejung to Pangpema Base Camp, and (2) to assess the contribution of tourism industry to income generation. This study was carried out in the KCA (27° 15' to 27° 56' N and 87° 32' to 88° 65' E), which lies in the Taplejung district, northeast corner of Nepal (Figure 1).

METHODOLOGY

To fulfill the above-mentioned objectives, observations and group discussion were made during the field survey. The area was visited in the two different seasons: first, from October to December 1999, and second, from April to May 2000. Structured questions about available facilities and income from tourism were prepared for local residents.

LOCATION AND DISTRIBUTION OF LODGES AND CAMPSITES

There is no difference between a hotel and a lodge in this area, so this paper hereafter uses the term, lodge, which means a simple house providing some sort of service to trekkers. The total number of the lodges in this area is only 64, which are distributed disproportionally in 22 settlements. The average number of lodges in a single settlement is 2.8. The maximum concentration of eight lodges is found in Ghunsa and Kambachen (Table 1).

Campsites are not equally distributed as well. For an average of a 23- to 28-day long trek 21 settlements offer campsites along the trekking routes except the one in Torangdin made by KCAP (Table1; Figure 1). Three settlements of Ghunsa, Kambachen, and Lhonak, are generally used twice on the way to and from the Kanchanjunga North Base Camp (Pangpema) because there is no alternative place to stay. In the same way the Cheram campsite is used twice by trekkers who visit Ramche and the South Base Camp. Sinwa has three lodges but no campsites.

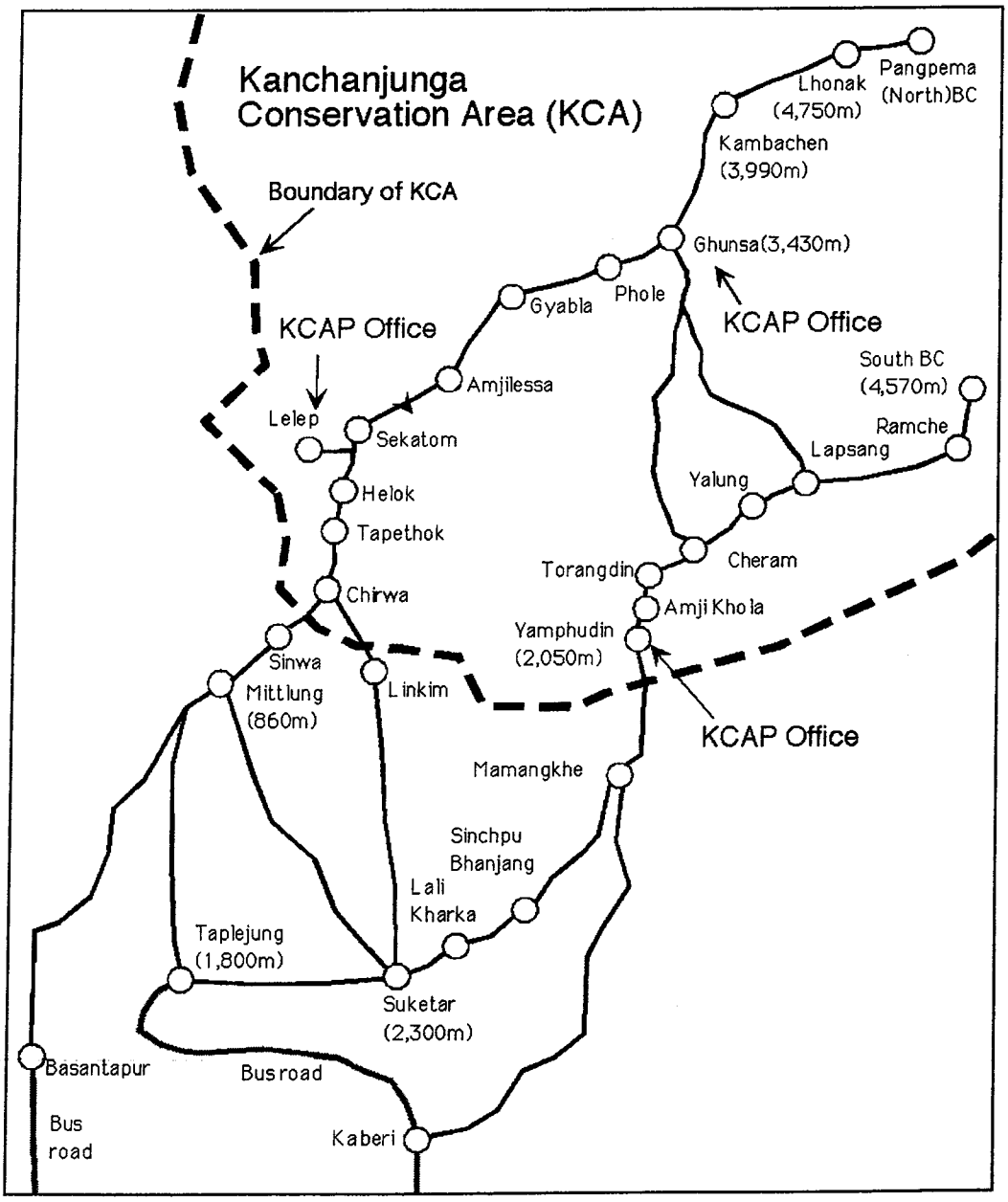

Figure 1. *Study Area*

Table 1. *Facilities provided to the Trekkers in the Kanchanjunga area in 2001*

Place	No of lodge	Kitchen	Camping site	Toilet
Lalikharka	3	1	3	2
Sinchepu Bhanjyang	4	1	1	1
Mamankhe	2	1	1	0
Yamphudin	3	1	2	0
Amjikhola	1	1	1	1
Torangdin	0	0	1 (KCAP)	0
Andhaphedi	1	1	1	0
Cherum	2	2	2	0
Ramche	2	2	2	0
Selelle Pass	1	1	1	0
Mitlung	2	1	1	0
Sinwa	3	0	0	3
Chiruwa	2	1	1	2
Tapethok	2	1	1	1
sekathum	2	2	2	1
Omjilosa	4	4	4	0
Thangyam	1	1	1	0
Gyablae	4	4	4	1
Pholea	4	4	4	1
Ghunsa	8	8	8	5
Kambachen	8	7	8	2
Lonak	4	4	4	0
Pangpema	1	1	1	0
Total	64	49	53	20
Percentage		76.6%	82.8%	31.3%

Source: field survey from October to December 1999 and from April to May 2000.

GROWTH OF LODGES

Before 1990 there were only six lodges (Table 2), which was only 9% of the presently existing lodges (May 2000). Between 1990 and 1995, 14 more lodges had been opened. The majority of the lodges (44) were constructed within the last five years after 1995. The number of lodges has been progressively increasing (Table 2), although most of these lodges were not primarily opened for tourism purposes. Especially in the higher altitude areas, the summer animal sheds were converted into lodges without considering facilities.

The rapid increase in the number of lodges (Table 2) strongly suggests the accelerated rate of deforestation, especially in the upper areas in Phole and Ghunsa. According to the respondents nearly 50 small trees and 10 large trees are required to construct one lodge in the Ghunsa area. Moreover 20 to 30 *tikka* wood (1 *tikka* = 80 m^3) is used in the higher altitude areas of Gyabla, Phole, Ghunsa, Cheram, and Andhaphedi. The consumption of wood to construct a lodge is small (3 to 8 *tikka*) in the lower areas of Sinwa, Mitlung, Tapethok, Lali Kharka, Sekatom and Sinchepu Bhanjyang. The average wood consumption to construct one lodge is estimated to be about 12 *tikka* in the entire area.

FACILITIES AVAILABLE FOR TREKKERS

Available facilities in this area are very poor. Kitchens, campsites, and toilets are the major facilities provided by lodge owners to trekkers (Table 1). Out of total 64 lodges 49 (76.6%) provide kitchen facilities, 53 (82.8%) provide campsite, and 20 (31.3%) provide toilet facilities (Table 1). The total number of lodges providing all three facilities of kitchen, campsite and toilet is only 15 (23.0%). Guest rooms for trekkers are

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Mamankhe	2	1	1	0
Yamphudin	3	1	2	0
Amjikhola	1	1	1	1
Torangdin	0	0	1 (KCAP)	0
Andhaphedi	1	1	1	0
Cherum	2	2	2	0
Ramche	2	2	2	0
Selelle Pass	1	1	1	0
Mitlung	2	1	1	0
Sinwa	3	0	0	3
Chiruwa	2	1	1	2
Tapethok	2	1	1	1
sekathum	2	2	2	1
Omjilosa	4	4	4	0
Thangyam	1	1	1	0
Gyablae	4	4	4	1
Pholea	4	4	4	1
Ghunsa	8	8	8	5
Kambachen	8	7	8	2
Lonak	4	4	4	0
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provided only by 28 lodges (43.8%).

No settlements have special arrangement for porters except the one in Gyabla and one in Ghunsa. These two lodges now start to provide service to the porters as no tourists stay in their lodges and campsites. Generally, porters pay NRs. 5 to NRs. 10 to the lodge owner for wood and they share kitchen and bed. Sometimes porters make fire near forests and prepare food on the way because there is no special arrangement of place to prepare lunch. It is very dangerous during windy seasons, as large forest fire took place around Amjilessa and Gyabla in 1972, as well as not good in terms of forest conservation.

Table 2. *Growth of the no of hotels and lodges in the Kanchenjunga area in 2001*

PLACE	Year of establishment			
	Before 1990	between 1990 and 1995	From 1996 to May,2000	Total no in 2000
Lalikharka	0	1	2	3
Sinchepu Bhanjyang	0	0	4	4
Mamankhe	2	0	0	2
Yamphudin	0	1	2	3
Amjikhola	0	1	0	1
Torangdin	0	0	0	0
Andhaphedi	0	0	1	1
Cherum	0	0	2	2
Ramche	0	0	2	2
Selelle Pass	0	1	0	1
Mitlung	1	0	1	2
Sinwa	0	1	2	3
Chiruwa	0	1	1	2
Tâpethok	0	0	2	2
sekathum	1	0	1	2
Omjilosa	1	2	1	4
Thangyam	0	1	0	1
Gyablae	1	0	3	4
Pholea	0	1	3	4
Ghunsa	0	2	6	8
Kambachen	0	1	7	8
Lonak	0	1	3	4
Pangpema	0	0	1	1
Total	6	14	44	64

Source: field survey from October to December 1999 and from April to May 2000.

INCOME FROM TREKKING INDUSTRY

The annual income of local people from tourism is very low (Table 3). Tourism has helped a little to increase local income through selling locally produced handicrafts, and providing market for vegetable, milk, meat, and locally produced wine (*Raxi*, *Chhyang* and *Tumba*). According to the field survey the total income from trekking industry of the 62 lodges (except two lodges of Ramche) was about NRs. 1,133,000 (equivalent to $15,736) with the average income of NRs. 18,274 ($254) as shown in Table 3. There is a great difference in the average income from place (settlement) to place. The annual average income of the Gyabla lodges was NRs. 34,500 ($479) whereas that of Sinchepu Bhanjyang and Phole lodges was only NRs. 7,000 ($ 97).

Self-dependent group trekking is the main reason for the low income. Group trekking creates direct employment for support staff: such as porters, cooks, kitchen boys and guides. However, it does not benefit

the local people as most of the opportunity is exploit by the people leaving outside. Individual trekkers, if allowed to visit this area, could create local employment. Since they are fully dependent on local lodges (food and bed), they generate direct benefit to the local people as seen elsewhere in the Nepal Himalaya (Maclellan et al 2000).

Table 3. *Annual income from tourism*

place	No. of hotel	Annual income	Average income	Less than Rs.10,000	Rs.10,000 to 20,000	Rs.20,000 to 30,000	Above Rs30,000
Lalikharka	3	52	17.3	0	2	1	0
Sinchepu Bhag.	4	28	7	3	1	0	0
Mamankhe	2	20	10	0	2	0	0
Yamphudin	3	50	16.7	0	1	2	0
Amjikhola	1	20	20	0	1	0	0
Andhaphedi	1	15	15	0	1	0	0
Cherum	2	70	35	0	1	0	1
Ramche	2	na	na	0	na	na	na
Selelle Pass	1	20	20	0	1	0	0
Mitlung	2	63	31.5	1	0	0	1
Sinwa	3	35	11.6	0	3	0	0
Chiruwa	2	20	10	1	1	0	0
Tapethok	2	45	22.5	0	1	1	0
Sekathum	2	70	35	0	1	0	1
Omjilosa	4	80	20	2	1	0	1
Thangyam	1	8	8	1	0	0	0
Gyablae	4	138	34.5	2	0	0	2
Pholea	4	28	7	4	0	0	0
Ghunsa	8	116	14.5	4	3	0	0
Kambachen	8	150	18.7	4	0	1	3
Lonak	4	85	21.2	1	2	1	1
Pangpema	1	20	20	0	1	0	0
total	64	1133		23	23	6	10
percent	62(100%)			37%	37%	10%	16%

Source: field survey from October to December 1999 and from April to May 2000.

DISCUSSION

The Kanchanjunga area has been open for trekking tourism only since 1988. There are currently only 500-800 tourist visits per year, and a substantial increase is not expected in the near future (Gurung 1996). In 1996, the three major tourist destinations of Everest, Langtang-Helambu, and Annapurna regions in Nepal accounted for around 87 percent of all trekkers (Sharma 1998). Among these the Annapurna trek accounted for about 59 percent, the Everest trek 19 percent, and the Langtang trek 9 percent of all trekkers. In the same year the Kanchanjunga trek received only 608 trekkers, which was about 0.7 percent of the total number of trekkers to Nepal. The reasons behind the low tourist flow in the KCA are difficult access due to remote location, and poor facilities for tourists (Gurung 1996).

With such small number of trekkers, local people cannot expect income generation.

i) Need of relocation of lodges

The lodges are located only in the settlement lies on the trekking route. In the higher altitude areas the settlements with campsites are located at the walking distance of 5-8 hours. There is no settlement or even a tea shop between such a long distance. In the early period, the ACA (Annapurna Conservation Area) also had the same experience, but since all lodges were build on public land, decision was made to relocate lodges in every 2-3 hour walking distance (Gurung 1998). Although the ownership of the land may be obstacles in the case of the KCA, relocation of some lodges is strongly recommended if lodges will not be

built between the major settlements.

ii) Need of control the haphazard growth of the lodges

The construction of lodges is increasing progressively without considering the distance and facilities. Between the year 1990-1995 the change in percentage of the number of the lodges is 133 percent, while in the period of 1996 and 2000 it is 214 percent. It is clear that the sudden growth of lodges during last 10 years has increased the demand of construction timber and fuelwood having caused deforestation in the higher area.

iii) Need of facility improvement

The facilities provided by the lodges are poor in comparison to other major tourist areas, ie, ACA, Sagarmatha National Park, and Langtang National Park. In total only 20 lodges, situated at 11 different settlement has a toilet facilities. No attention was given towards the porters fooding and lodging. The temporary campsites of Selelle Pass, Ramche, Cheram, Lonak and Pangpema, which have been recently opened are very poorly facilitated.

In the Annapurna area, in 1997 there were 26 lodges at seven locations. Each location has 2 to 5 lodges. A lodge can have a maximum of 15 beds to ensure that the scale of lodges remains manageable and no single lodge monopolized all business. Each lodge is allotted approximately 24.4 m x 13.7 m of land area and is required to have a pit or septic tank toilet, bath room, and a rubbish pit for biodegradable and non-biodegradable wastes. A lodge is operated by at least two households on a seasonal or yearly rotational basis (Sharma 1998).

iv) Need of income generation measures

As self-supported group trekkers visit the area, the local people are less benefited in comparison to the trekking agencies. The small amount of money come from the selling of locally produced goods and sometimes providing pottering service using yak in higher altitude area. Another source of income is the entry fee but it is collected by the KCAP and it does not directly benefit the local people.

The large proportion of campsite (82.8%) and kitchen facilities (76.6%) means most trekkers stay at campsite not in lodges. Therefore, even the number of lodges is increasing the lodge owners cannot earn money, except from fees of campsites and kitchen. In the absence of proper management and the individual trekkers in KCA, the income from tourism is very low with high difference from place to place and from lodge to lodge.

A study carried out in Sagarmatha National Park shows that the 30% of visitors were individual trekkers, out of which 73% ate in lodges and tea houses (ICIMOD 1995). A study conducted at Ghandruk, Jhinu Dada and Chhomrong in the Annapurna region indicated that an individual trekkers (FIT) on average spend NRs. 315 per night at the lodge and more than 61 percent of his/her expenditure goes for food (Paudel 1998). Therefore, at present situation KCA needs some programs for the proper management of hapazard growth and for the improvement of the lodges, available facilities, and to increase the income of the people.

CONCLUSIONS

The number of tourist visits to the Kanchanjunga area is very small in comparison to the other major tourism areas. The location and the concentration of lodges are unsystematic and very improper, as are located only in the settlement that lies at different distance. Haphazard growth of lodge is another problem as the lodges did not pay any attention to improve the facilities. Moreover, increase in the number of poorly facilitated lodges leads to high rate of deforestation, which is environmentally not acceptable. On

the name of facilities only camping and kitchen is available other facilities like, toilet and guest room are available only in few settlement. No consideration was made about porters lodging and fooding. In the absence of individual trekkers the income from the tourism is very low with high difference from lodge to lodge and place to place. Therefore, the individual trekkers should be allowed after developing proper lodge construction and management as well as developing cooking training program. In such a situation, to develop ecotourism, to give more facilities to tourists and more economic benefit to local people, a master plan should include program on locating and distributing lodges at appropriate distance, Program to develop the facilities, and furthermore some program to reduce consumption of wood, and to increase the level of income of the local people as soon as possible.

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What Can Visitors Expect to See in the Kanchanjunga Area? -Development of an Ecotourism Resource Map and a Phenology Calendar-

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ABSTRACT

This paper tries to identify ecotourism resources in the Kanchanjunga area of Nepal and to show how to make good use of them by the development of an ecotourism resource map and a phenology (seasonal) calendar. The identification of ecotourism resources is important to practice ecotour. Most visitors today participate in an ordinary trekking in the area. The information shown in the ecotourism resource map and the phenology calendar, however, enables to develop more various tourism programs than the existing ones.

KEYWORD : Kanchanjunga area; ecotourism resource map; phenology calendar; trekking

INTRODUCTION

The Kanchanjunga area situated in the eastern Nepal Himalaya opened the door to foreign trekking groups in 1988, and there are new hotels and lodges being constructed (Yoda 1998). The Kanchanjunga area was designated as a conservation area in 1997, and the environmentally conscious tourism (ecotourism) is expected. Ecotourism has three characteristics: tourism standing on the regional resources, tourism which is sustainable and contributing to the conservation of nature and culture of the area, and tourism contributing to the regional economy (Japan Ecotourism Society 1999). At the first stage of the appropriate development of ecotourism, adequate information of resources is required. This study, therefore, aims: 1) to identify the ecotourism resources in the Kanchanjunga area, and 2) to show how to make good use of resources by the development of an ecotourism map and a phenology (seasonal) calendar. The ecotourism resource map shows what visitors can see in the area. The phenology calendar indicates seasonal difference in the resources. Information by these materials will be helpful for both visitors and the local residents promoting environmental conservation in the area.

STUDY AREA

The Kanchanjunga area is located in the most northeastern portion of Nepal. The area has well known peaks such as Kanchanjunga, Yalung Kang, Jannu, and Twins. Trekking route starts from Taplejung and it ascends with Tamor Nadi (river) until Sekathum, and with Ghunsa Khola (river), then with Kanchanjunga Glacier in the upper area (Figure 1). The altitude of the route is between 830 m and 5,100 m, which creates the climate variations from warm sub-tropical monsoon to alpine tundra by the altitude (Thapa et al 1999).

The area contains a diverse wildlife (Carpenter et al 1994). The dominant vegetation differs with altitude as the climate changes. Tall tree forests can be found up until about 4,000 m, below Khambachen. Many kinds of wild animals live in the area, such as snow leopard, musk deer, blue sheep, goral, monkeys, red panda, bear and others, as well as many kinds of insects.

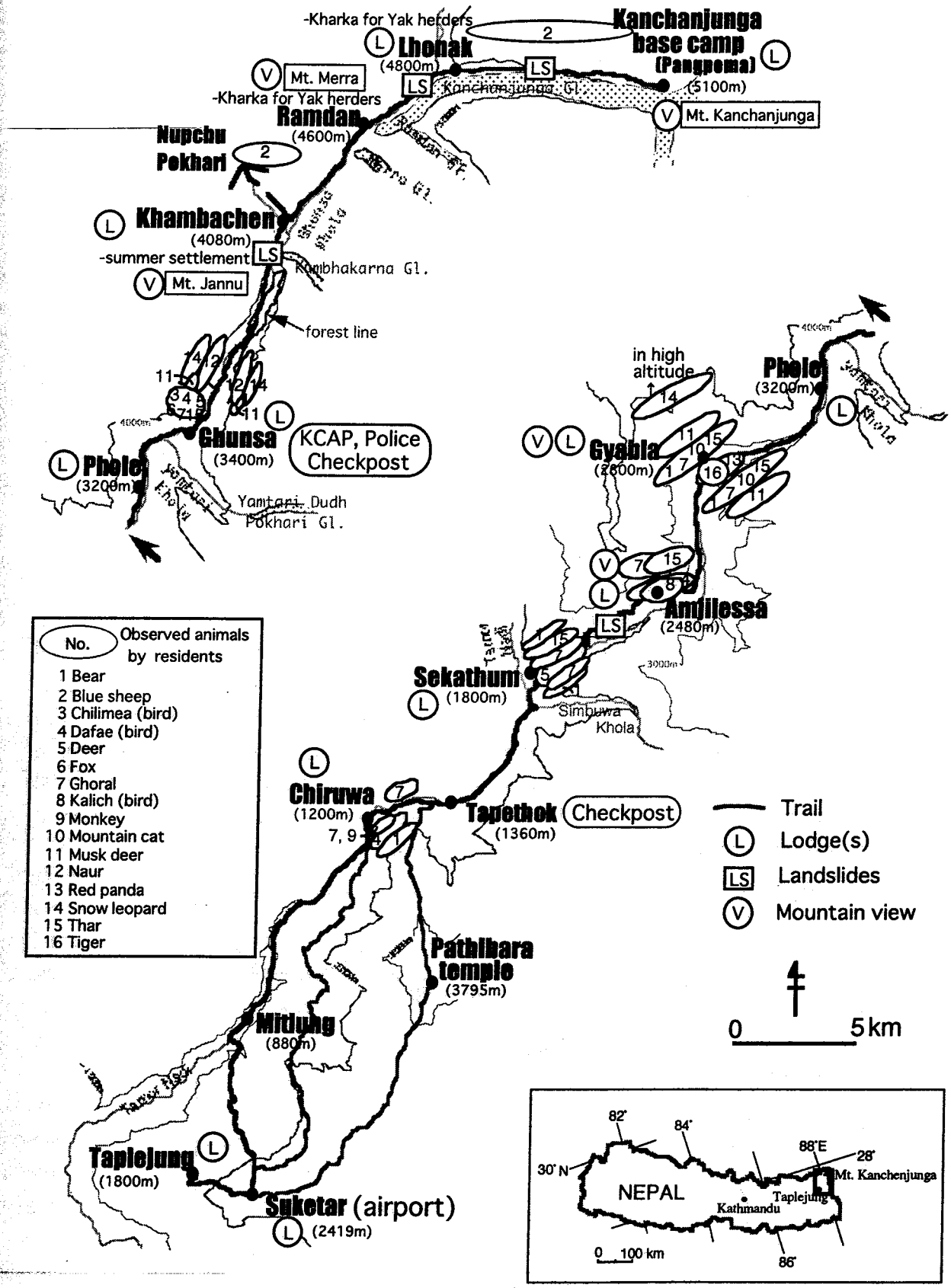

Figure 1. *Preliminary ecotourism resource map of the Kanchanjunga area*

Local people make their living mainly by agriculture and livestock herding. Some residents also weave carpets, and there are people who recently started managing lodging.

WWF Nepal Program has produced a series of reports on biodiversity and cultural conditions of the area to provide the basic information for making the area as a designated conservation area and for developing ecotourism (WWF Nepal Program Report Series). Hokkaido University has also been doing geographical research in the area for the conservation and development of ecotourism (Watanabe 1998, 1999).

STUDY METHOD

We collected the data by the method that Japan Wildlife Research Center had developed: by the interview with the local residents and by the field survey (Japan Wildlife Research Center 1999). Questions covered from the general information about the settlement to the nature and wildlife distribution which could be recognized as an ecotourism resource. Then, we drafted the ecotourism resource map and the phenology calendar. Main interview was conducted in 2000 with the cooperation of residents.

RESULTS

Present Trekking Condition of the Area

Most visitors today participate in an ordinary trekking in the area. At present, trekkers have to obtain trekking permits, and only group trekking with guides from authorized agencies is allowed to visit the area. The round trip to Kanchanjunga Base Camp usually takes more than 20 days (Nakamura and Uchida 1995) with the actual average of 26-30 days. The area receives around 800 trekkers each year, and the number has been slowly growing since 1988 when the area was first opened for trekking (Figure 2). As shown in Figure 3, 72% of the trekkers visited the area in a post monsoon season of September, October and November in 1998 (Department of Tourism 1998). Only 19% of the trekkeres visited the area in a pre-monsoon season of March and April, and hardly any trekkers visited in rainy June and July.

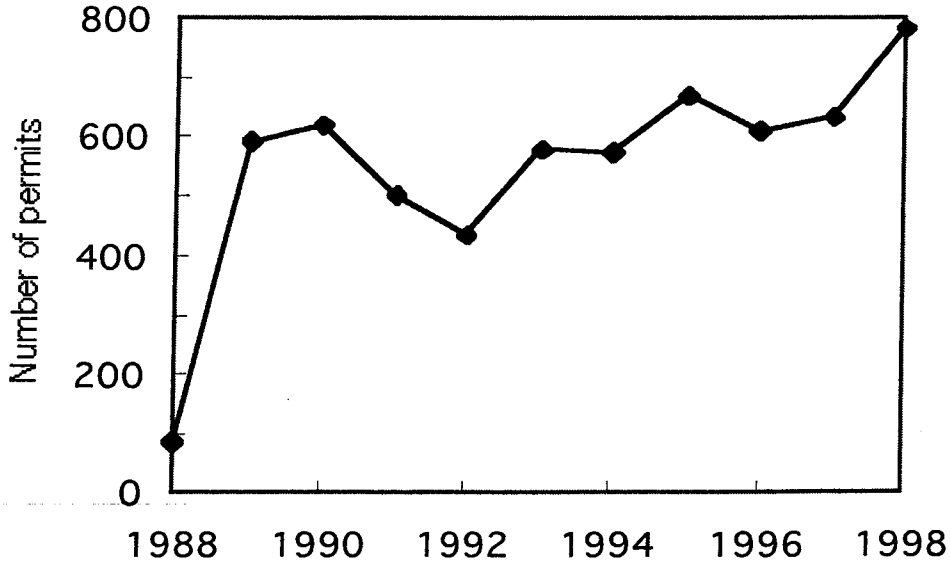

Figure 2. *Trekking permits issued for Kanchanjunga trek (Dept. of Toursim 1998)*

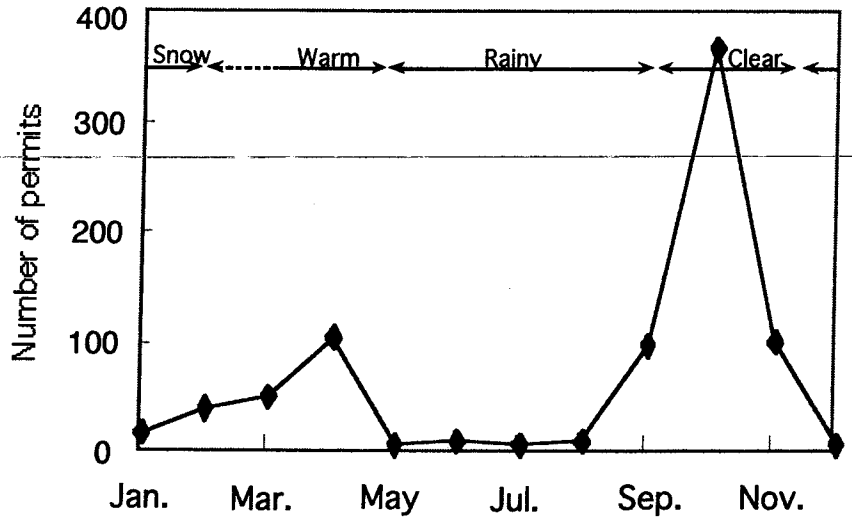

Figure 3. *Trekking permits issued by month in Kanchanjunga area in 1998 and weather condition in Ghunsa (Information on trekking permits is after Nepal Tourism Statistics 1998)*

Construction of new lodges has been recently significant in upper area (Yoda et al 1999), even though local residents do not stay throughout the year above Khambachen. For example, there was no lodge in Kanchanjunga Base Camp in 1997, but now there is one. KCAP (Kanchenjunga Conservation Area Project) was established in 1997 by the cooperation of the Department of National Parks and Wildlife Conservation and WWF Nepal Program. KCAP now works for the environmental conservation and development of sustainable tourism in the area. One of its offices is situated in Ghunsa. It is difficult for trekkers to get information about route conditions or nature of the area from the office at the moment, since information providing service is not available.

Ecotourism Resource Map and Phenology Calendar

Ecotourism resource map and phenology calendar can supply variety of information and can be used as a guide for visitors. A wide variety of things can be nominated as the ecotourism resources, when local residents find a recognition and consensus about the nomination. Wild animals, flowers, and mountains, for example, can be easily recognized as ecotourism resources, but also buildings, festivals, and even food can be identified as resources. We asked the local residents in five settlements especially about the distribution of wildlife, as wild animals are easily recognized (Figure 1).

The map shows the animals' distribution around the settlements observed by the residents. Although we cannot expect to see all the animals in a short period, this map indicates that there is a possibility to encounter with large animals, such as bear, red panda, or snow leopard. The map also contains critical information about land slides around the trails for safety standpoint. New scenic points to see the high mountain peaks near Amjilessa and Gyabla are also suggested in the lower area.

The phenology calendar shows seasonal cycle of the area. It has information about natural conditions and also human activities (Tables 1-5). Different animals and flowers can be seen in the different seasons and places. Local residents pointed out that many insects are observed in and just after the rainy season. If we see the local residents' activities, some festivals are common among settlements, but the others are the native festivals of the individual settlements.

Table 1. *Phenology calendar at Chirwa (ca. 1,240 m asl)* *All large letter words are Nepalese words*

Months		January	February	March	April	May	June	July	August	September	October	November	December
Nepalese Calendar		Push	Magh	Phalgun	Chait	Baishakh	Jesth	Ashar	Sharawan	Bhadawa	Ashwin	Kartik	Mangsir	Push
Seasons&Weather		Winter------			hot----------				rainy				Winter----------
Villagers (Annual Activities)	Festivals	LOSAR		CHAITI DAISAI				SAWARIAI SAKRATI		DASHAIN	TIHAR		CHAITY DAISAI
	Planting	Potato	Maize				Rice, Millet				Wheat		Potato
Wildlife	Trees, Flowers	(around village) UTISH (*Alnus*), CHILAUNI, SIRIS, KHANUE, KOIRALO, KAULO											
	Birds	(year around) KALJUDO, KALICH											
	Animals					Monkies, Ghoral DUMSI (Poccupine), Deer			Bear				
	Insects					Butterflies, BHAWARA, ARAUGIL							
						Bee							

(according to the interview in May 2000 and Kanchanjunga 1997 and 1998 reports)

Table 2. *Phenology calendar at Sekathum (ca. 1,800 m asl)* *All large letter words are Nepalese words*

Months		January	February	March	April	May	June	July	August	September	October	November	December
Nepalese Calendar		Push	Magh	Phalgun	Chait	Baishakh	Jesth	Ashar	Sharawan	Bhadawa	Ashwin	Kartik	Mangsir	Push
Seasons&Weather		Winter------			hot----------				rainy				Winter----------
Villagers (Annual Activities)	Festivals	small LOSAR	big LOSAR		DEVIPUJA			SHERKIM					
	Planting		Maize	Rice, Buckwheat	Soyabean					Wheat, Oats			Potato
Wildlife	Trees, Flowers			CHAP				AARU			LAPSI		
		CHILAUNI, PHALET											
	Birds	(year around) CHIBA, NEALULI, JURILI											
	Animals	(year around) Thar(in high altitude), Ghoral, Deer								Bear			
	Insects					Butterflies							

- *Bear used to damage maize.*
- *There is a hot spring by the bridge, but it is now covered with deposits from the landslide. If it is reconstructed, the trekkers may enjoy it.*

(according to the interview in May 2000 and Kanchanjunga 1997 and 1998 reports)

Table 3. *Phenology calendar at Amjilessa (ca. 2,480 m asl)* *All large letter words are Nepalese words*

Months		January	February	March	April	May	June	July	August	September	October	November	December
Nepalese Calendar		Push	Magh	Phalgun	Chait	Baishakh	Jesth	Ashar	Sharawan	Bhadawa	Ashwin	Kartik	Mangsir	Push
Seasons&Weather		Winter------			hot----------				rainy				Winter----------
Villagers (Annual Activities)	Festivals	small LOSAR	big LOSAR										
	Planting	Potato			Maize		Vegetables						
Wildlife	Trees, Flowers		*Rdodendran*		AARU								
			CHAP										
	Birds	(year around) KALICH(in group in August)											
	Animals	(year around) Thar(in high altitude), Ghoral, Deer											
	Insects						Butterflies and other insects						

- *The number of deer has been decreased.*
- *Mts. Kanchanjunga and Jannu can be seen from Big Bari in the north.*
- *Big landslides on the route from Sekathum.*

(according to the interview in May 2000 and Kanchanjunga 1997 and 1998 reports)

Table 4. *Phenology calendar at Gyabla (ca. 2,800 m asl)* *All large letter words are Nepalese words*

Months		January	February	March	April	May	June	July	August	September	October	November	December
Nepalese Calendar		Push	Magh	Phalgun	Chait	Baishakh	Jesth	Ashar	Sharawan	Bhadawa	Ashwin	Kartik	Mangsir	Push
Seasons&Weather		snow------	warm---- - - -	rainy----------	- - - - - -	clear--- snow-----							
Villagers (Annual Activities)	Festivals	LOSAR (new year)	LOSAR (Dode,Emde)	CHORTAEKORA	NESO		NEUNA, GYASO	LIPTZI					
	crops	Potato---------- - - - - -											
		Buckwheat----------											
		Barley----------											
	transhumance	Take Yak, CHAURI, JUM to higher altitude---- come back---											
Wildlife	Flowers Trees	*Rododendron*, CHIMAL					SUNPATI (in bloom)						
	Birds	DAFFEA			BHAKURIA								CHILIMEA
	Animals	Fox, Snow leopard					Bear						Fox, Snow leopard
							Monkey (rare)				blue sheep		
		(year around) Ghoral,Naur,Thar											
	Insects		BHAWARA				Butterflies						

- *Mts. Kanchanjunga, Jannu and other mountains can be seen from Riga Shanba (1 hour from Gyabla in South West).*
- *People used to make carring baskets with RAT NIGALA*

(according to the interview in May 2000 and Kanchanjunga 1997 and 1998 reports)

Table 5. *Phenology calendar at Ghunsa (ca. 3,400 m asl)* *All large letter words are Nepalese words*

Months		January	February	March	April	May	June	July	August	September	October	November	December
Nepalese Calendar		Push	Magh	Phalgun	Chait	Baishakh	Jesth	Ashar	Sharawan	Bhadawa	Ashwin	Kartik	Mangsir	Push
Seasons&Weather		snow------	warm---- - - -	rainy----------	- - - - - -	clear--- snow-----							
Villagers (Annual Activities)	Festivals	LOSAR (new year)	LOSAR (Dode,Emde)	CHORTAEKORA	NESO		NEUNA, GYASO	LIPTZI					
	crops	Potato---------- - - - - -											
		Buckwheat----------											
		Barley----------											
	transhumance	Take Yak, CHAURI, JUM to higher altitude---- come back---											
Wildlife	Flowers Trees	*Rododendron*, CHIMAL					SUNPATI (in bloom)						
	Birds	DAFFEA			BHAKURIA								CHILIMEA
	Animals	Fox, Snow leopard					Bear						Fox, Snow leopard
							Monkey (rare)				blue sheep		
		(year around) Ghoral,Naur,Thar											
	Insects		BHAWARA				Butterflies						

- *Most people stay in Phole in winter (Mangsir 25-Phagun 25)*
- *Leaves of SUNPATI can be used as a leech repellent.*

(according to the interview in May 2000 and Kanchanjunga 1997 and 1998 reports)

DISCUSSION

With the information from the ecotourism resource map and the phenology calendar, visitors can find what they expect to see in the area, and they can even choose the time to visit. At the same time, the information may be useful to develop more various tourism programs. Visitors can expect to see the different scenery

and wildlife depending on the season. More people may be attracted to visit the area, with the suggestion of a shorter and easier route with the view of the major mountains, while approximate duration of the usual trekking is 26 - 30 days. We found out those places where one could see Mt. Kanchanjunga and Mt. Jannu from not far from Amjilessa and Gyabla. In the festival season, visitors may get to know the local culture, through participating the festival themselves and trying some traditional dishes. Not many visitors come to the area in the rainy season, but it is possible to suggest new ecotour to watch various kinds of insects in the lower area. Introduction of cultural usage of herbs or plants may be another possibility in developing programs.

The information included in the ecotourism resource map and the phenology calendar has to be checked and be revised in the near future. Some of the topics that have to be covered are women's activities and food, which are essential elements of the culture. Along with the revision of the ecotourism resource map and the phenology calendar, new ideas of program may come out.

The cooperation among related groups is necessary to develop ecotourism. Ecotourism is developed based on the local resources, and the agreement on the resources both by the local residents and by the outside groups such as guides and researchers is needed to cooperate in practicing conservation. If some resources may need a frequent care, the local people's roles become important. Also ecotourism must contribute to the local economy, and the system with fair distribution of the profit is required.

To provide information effectively is as important as to collect. The idea of making a handbook compiling the information from ecotourism resource map and the phenology calendar may be useful for both trekkers and local residents. The information has to cover facilities, road condition, police and medical information, nature (wildlife or plants), and also the cultural information such as historical buildings, festivals, food or local rules. The case of Abaca, Fiji (Japan National Committee for Pacific Economic Cooperation 1999) seems to be working well, where there is a system that the sales of the book also contribute to the local economy. KCAP in Ghunsa can be expected to play an important role in compiling and providing information, though its primary object of conservation does not seem to be identical with local residents' expectations at present as Müller-Böker and Kollmair (2000) points out.

With the reliable information, good interpreters with rich in knowledge along with the environmentally conscious practices are indispensable for practicing the ecotour. Residents in the area may also be candidates who are not just translators of the local language. Such candidates are expected to know the area well, be able to explain the background of the phenomena, and have capability to guide the visitors to follow an environmentally sound tour. The ecotourism map and the phenology calendar could also help developing training programs providing the information to practice ecotourism.

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Biodiversity Conservastion : A Case Study of Blue Sheep in Kanchanjunga Conservation Area

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ABSTRACT

Kanchanjunga Conservation Area (KCA) of Nepal bordering China and India is rich in biodiversity. A study was conducted during October 1999 to October 2000 with two field traits (October-November of 1999 and October of 2000) to find out status, distribution and interaction of blue sheep with livestock and people by field observation and Participatory Rural Assessment (PRA) methods. During the study period of 1999, 57 herds (herd size, 2-65) with 673 blue sheep were observed. The average herd size was twelve. During the survey period of 2000, 29 herds (herd size, 2-54) with 558 blue sheep were observed. The average herd size was 19. During these field study periods, blue sheep were distributed within an altitudinal range of 4,040 m to 5,280 m. This altitudinal range also includes meadows for domestic yak and sheep. Trekking trails run along these alpine meadows in KCA, which is attracting tourists. Thus there are direct and indirect interactions between blue sheep, livestock and people. Biodiversity (flora and fauna) particularly endangered snow leopard (*Panthera uncia*) and its main prey blue sheep are the attractions for tourists. Studies on promotion of wildlife-based ecotourism are essential in KCA.

KEYWORDS: Biodiversity conservation; blue sheep; Kanchanjunga Conservation Area

INTRODUCTION

Blue sheep (*Pseudois nayaur*) belongs to the class Mammal, family Bovidae and subclass Caprinae. Brian Hodgson is the first scientist who described it in 1833, when he was appointed as an assistant to the resident diplomat of Britain in Nepal (Schaller 1980). It is native to the mountainous range of Nepal, India, Bhutan, Pakistan, China and Mongolia. The distribution and relative abundance of blue sheep is studied in western parts of Nepal, such as in Shey Phoksumdo National Park by Basnet (1996, 1998), in Dolpa and Dhorpatan by Schaller (1973, 1977), in Dhorpatan by Wegge (1976, 1979), in Manang by Wegge and Oli (1988), and in Dhorpatan by Wilson (1976, 1977). Studies on blue sheep in the eastern parts of Nepal are rare and recent data are not available (see Wegge 1991; Sherpa 1994; Yonzon 1994). Therefore, the main objectives of this study are to fill this gap of information. Specific objectives are to: a) explore the status and distribution of blue sheep in different sites of Kanchanjunga Conservation Area, and b) assess interactions between blue sheep, livestock and people.

STUDY AREA

Kanchanjunga Conservation Area (KCA) lies in the Taplejung district, northeastern part of Nepal. The area is bordered by Sikkim (India) in the east and Tibet (China) in the north (Figure 1). KCA was formally recognized as a protected area in July 1997. The area encompasses 2,035 km^2 and covers Lelep, Tapethok, Walangchungola and Yamphudin Village Development Comettees (VDCs) with an altitudinal range of 1,200 m to above 8,000 m. The topography is characterized by narrow V-shaped valleys with steep side slopes. It is drained by the Kabili, Simbuwa, Ghunsa and Yangma rivers which are tributaries of the Tamor river. These rivers deeply cut into the mountains creating deep gorges. The dominant ethinic groups of KCA include Limbu, Bhotia and Sherpa.

The study was conducted in northeast part of KCA. The study site was divided into three blocks- south block, middle block, and north block (Figure 1, Photos 1, 2, 3, 4). The south block ranges from

Simbuwa Khola upto Oktang view point along Yalung glacier (south part of Mt. Kanchanjunga, 8,586 m). Yamatari Khola along the Yamatari glacier (southwest of Mt. Kumbakarna, 7,710 m), Nupchu Khola upto Nupchu pokhari and Lambuk belongs to the middle block. Ramdan and above upto Pangpema (5,200 m) base camp along Kanchanjunga glacier (northwest of Mt. Kanchanjunga) is considered as the north block. The intensive study areas in the blocks measure more than 84 km^2.

Climate of the area has prolonged wet season caused by the early arrival and late departure of monsoon (Stainton 1972). From November 1998 to October 1999, an average yearly air temperature was 5.4 degree in Ghunsa (3,047 m), -2.2 degree in Lhonak (4,835 m), and -6.9 degree in 6,012 m (Watanabe 2000). These temperature data broadly represent the whole survey sites in KCA.

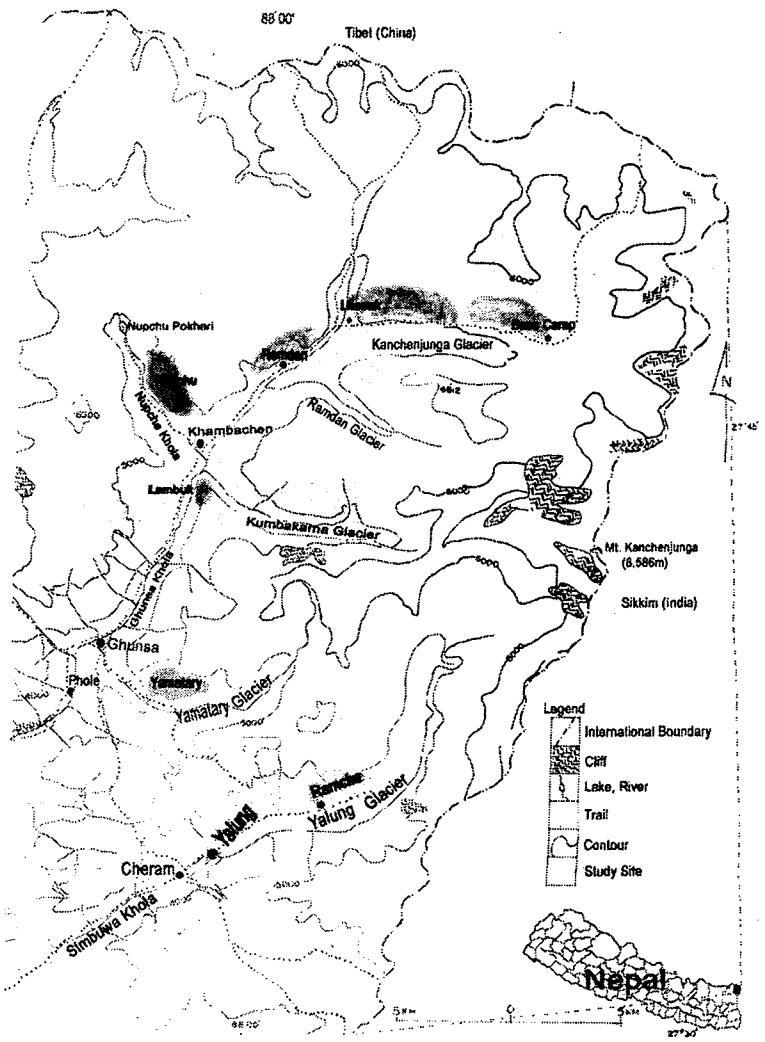

Figure 1

METHODS

Blue sheep were observed with 8 x 20 and 7 x 50 binoculars. In every observation, time, altitude, slope aspect, habitat type and activities of blue sheep were noted (Wegge and Oli 1988; Basnet 1996). The locations of blue sheep and livestock herds were marked on the topographic map (1:50,000) prepared by the Survey Department of His Majesty's Government of Nepal in co-operation with the Government of

Finland in 1997. All animals seen in the observation sites were recorded using the wildlife inventory format and Participatory Rural Assessment (PRA) method developed and used by Basnet (1996). Local people along the trail were interviewed to ascertain distribution and abundance, food habit, diseases and general attitude of locals towards blue sheep.

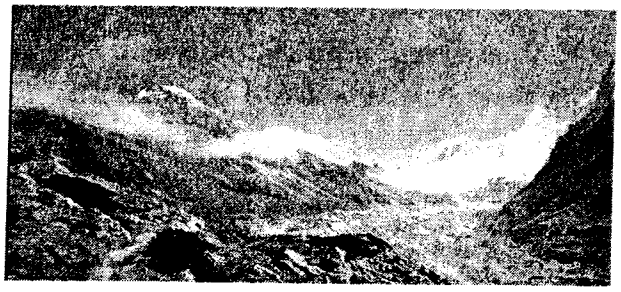

Photo 1.

Photo 2.

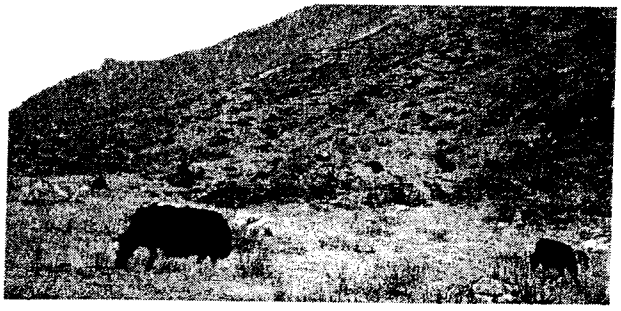

Photo 3.

Photo 4.

Photo 1. Lhonak and Base camp area along Kanchejunga Glacier (North block).

Photo 2. Base Camp area with Mount Kanchejunga (8,586m) at the background.

Photo 3. Grazing field of blue sheep and yaks overlapped in Nupchu (Middle block).

Photo 4. A blue sheep herd at Ramche on the lateral moraine of Yalung Glacier (South block).

RESULTS AND DISCUSSION

Status and Distribution of Blue Sheep

Density

During the field survey of 1999, the density of blue sheep was 8 individuals/km^2 and in 2000, 7 individuals/km^2. This difference may be due to the snow coverage on the high blue sheep grazing lands of north block from where more blue sheep came down for grazing. Sightings at Lhonak and base camp during 1999 survey were 190 and 67, respectively but in 2000 survey, they were 101 and 30, respectively (Table 1). In Manang, Wegge and Oli (1988) found 10 individuals/km^2 in the 60 km^2 area. In Dhorpatan, Wilson (1981) found 3 individuals/km^2. The density of Manang (10 individuals/km^2) compared favorable with the present study in KCA.

Herd size

The mean herd size was 12 individuals/herd in 1999 and 19 individuals/herd in 2000 (Table 1). This difference may be due to the heavy snowfall before survey period of 1999. The herds might have divided

into small groups for grazing. Yonzon (1996) found 10 individuals/herd by the survey of middle and south blocks in KCA of the same area. Basnet (1996) found an average of 17 individuals/herd while Schaller (1973, 1977) recorded 8-10 individuals/herd at Shey and Lapche, and Oli and Roggers (1996) noted a mean herd size of 16 animals/herd in Manang area of Nepal. Most of these data are comparable with that of present study. The most frequent herd size was found to be 1-5 individuals/herd in the survey of 1999 and 6-10 individuals/herd in the survey of 2000 (Figure 2). This variation was also due to the heavy snowfall in 1999. Schaller (1977) found 6-10 individuals/herd as a frequent herd size in the Tibetan plateau. Wegge and Oli (1988) found the most frequent herd size of 6-10 individuals/herd in Manang. These data were similar to the data of the present study in KCA.

In both surveys of 1999 and 2000, blue sheep were sighted at all eight study sites (Figure 3). Seventy-two percent of all herds were sighted on the south-, southeast- and southwest-facing slopes. Most of the south-facing slopes are warm. Lambuk is the only west facing site where blue sheep were sighted but during afternoon time. During the short cold days of November and December, blue sheep prefered warm south- and southeast-facing slopes (Wilson 1981). Wegge (1976) and Wilson (1981) reported a total of 67.5% and 65.2% of blue sheep during autumn on southern slopes of Dhorpatan Hunting Reserve. These results are similar with the sightings of blue sheep in KCA.

During the survey period, blue sheep were distributed within an altitudinal range of 4,040 m to 5280 m. The high densities were recorded at altitudinal range of 4,400m to 4,600 m (Figure 4). Oli (1990) observed most blue sheep in altitudinal range of 4,200 m to 4,400 m in Annapurna Conservation Area and Wilson (1981) observed most blue sheep in altitudes ranging 3,960 m to 4,570 m in Dhorpatan Hunting Reserve.

Table 1. *Population distribution of blue sheep at different areas of KCA in 1999 and 2000*

Area of observation	Region	No. of Herds -1999	No. of individuals -1999	individuals/ herd -1999	No. of Herds -2000	No. of individuals -2000	individuals/ herd -2000
Yalung	South block	8	61	8	4	60	15
Ramche	South block	8	122	15	10	180	18
Yamatary	Middle block	1	49	49	2	94	47
Lambuk	Middle block	3	26	9	1	17	17
Nupchu	Middle block	8	65	8	3	59	20
Ramdan	North block	10	93	9	2	17	8
Lhonak	North block	8	190	24	4	101	25
Base camp	North block	11	67	6	3	30	10
KCA	Whole	57	673	12	29	558	19

Blue sheep-Livestock-People interaction

Blue sheep feed on herbs which are also eaten by domestic livestock in summer (Watanabe and Ikeda 1999). Most of the blue sheep herds (74%) were observed within the distance of 100 m to 400 m from yak herds (Figure 5). Thus, grazing fields of livestock and blue sheep were overlapped in most of the study sites except for difficult rock cliffs. Wilson (1981) observed similar problem in Dhorpatan Hunting Reserve. The number of trekkers in the area is about 1,000 per annum (Gurung 2000) and it is expected to increase significantly. The trekking trail passes through the major grazing areas of blue sheep in the study sites. During the survey, most of the blue sheep herds (83%) were sighted within the distance of 100 m to 500 m (Figure 5) from the trekking trail. Hence, direct and indirect interactions between blue sheep and

people were obvious. Expanding tourist number can have long lasting effect on fragile alpine ecosystem.

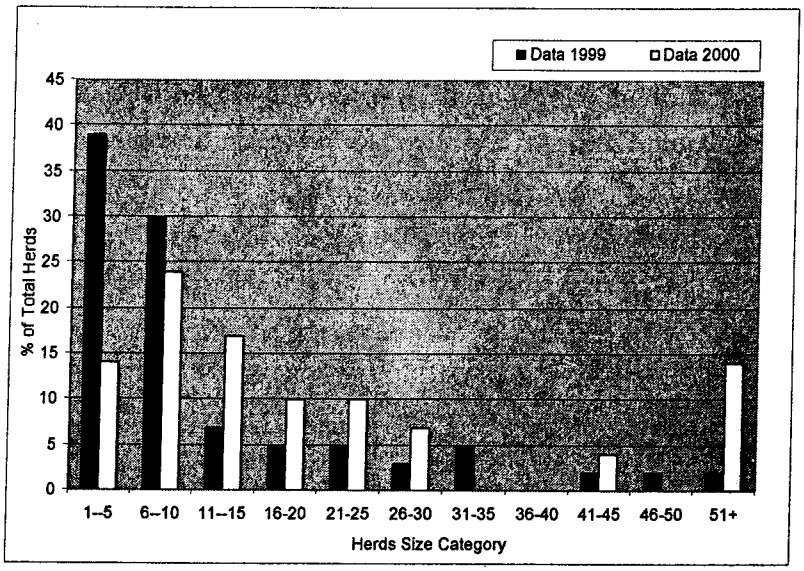

Figure 2. *Size and frequency distribution of blue sheep herds in KCA in 1999 and 2000*

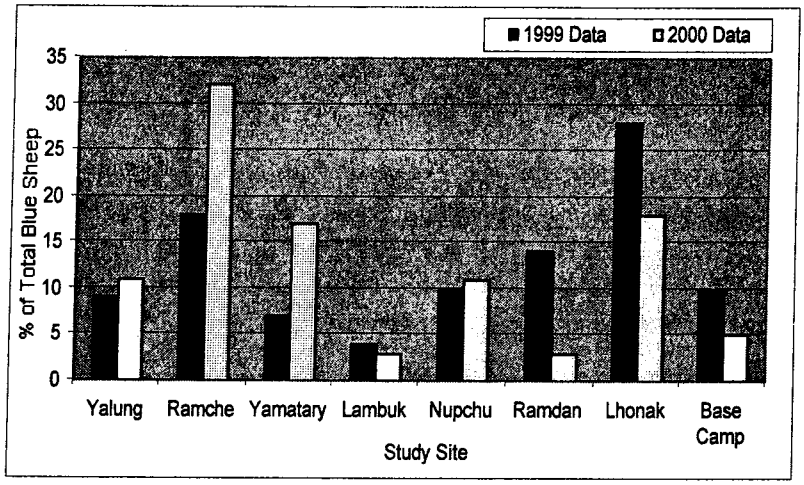

Figure 3. *Population distribution in different sites of KCA in 1999and 2000*

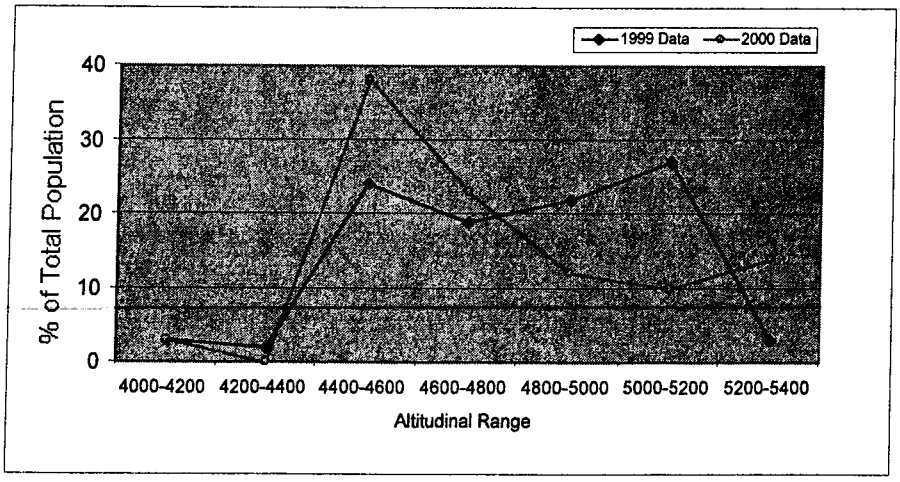

Figure 4. *Distribution of blue sheep in different altitudinal range of KCA in 1999 and 2000*

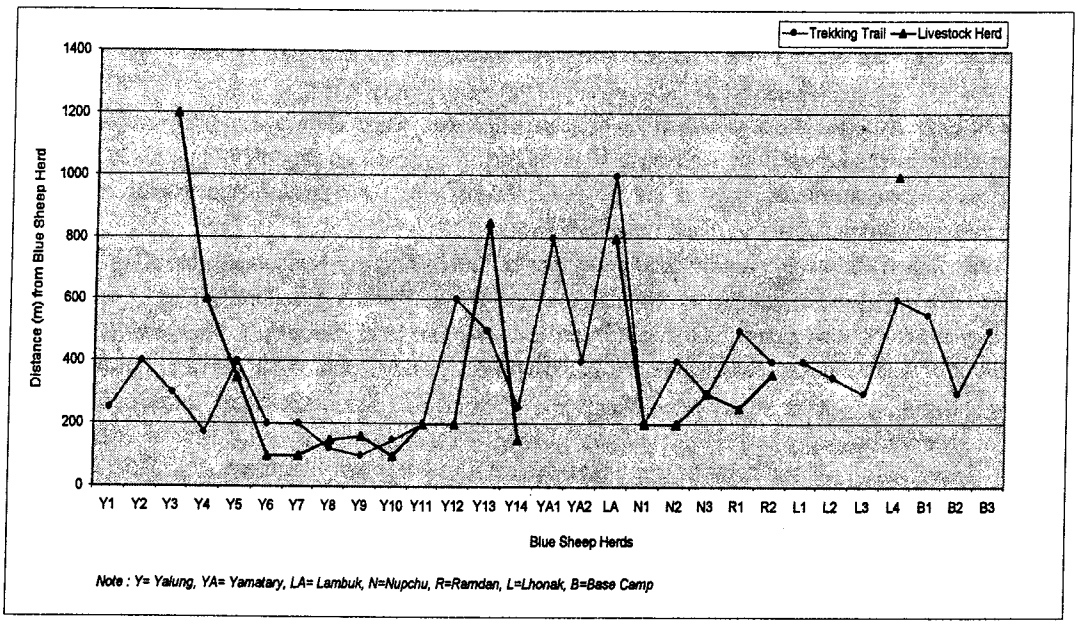

Figure 5. *Distance between blue sheep herds, trails and livestock*

Observations of eye and skin diseases in blue sheep were common. Local people also confirmed it during PRA discussion. They stated that, around 100 blue sheep died due to eye disease during 1995/96. These diseases, which affected the blue sheep during the months of June and July, were also common in the domestic livestock such as yaks.

CONCLUSIONS

The data of the present study (distribution and density of the blue sheep) showed a good standing of the animals in KCA. The grazing fields of livestock and blue sheep are overlapped in many places and the trails also pass through the grazing areas (Figure 5).

Further studies on eye and skin diseases on blue sheep as well as livestock, and on their transfer are essential. The distribution of blue sheep and other wildlife (eg, snow leopard) in different parts of KCA shows a high potentiality for wildlife-based ecotourism. However, further studies are essential to explore management issues, and strategies.

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Internal Structure of the Ice-Cored Rock Glacier in Kanchanjunga Himal, Eastern Nepal

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ABSTRACT

The internal structures of the morainic rock glacier, the Nupchu Rock Glacier in the Kanchanjunga Himal, were investigated by some geophysical methods. Shallow seismic soundings and annual ground temperature monitoring indicate the presence of perennially frozen layer. DC resistivity imaging revealed that this frozen layer is originated from the glacier ice body and distributes continuously within the rock glacier. These results suggest that this rock glacier's core is probably derived from dead ice, which was formed in response to the retreat of the glacier. This glacier-generated ice core has been preserved by the surface debris layers, which attenuate the ablation of the ice bodies subsurface. Glacier ice deformation model estimated that the flow velocity of this rock glacier is 1.67 m a^{-1}. This estimation suggests that the Nupchu Rock Glacier had initiated during Little Ice Age.

KEYWORDS: Dead ice; DC resistivity imaging; ice-cored rock glacier; shallow seismic sounding; Kanchanjunga Himal

INTRODUCTION

Rock glaciers are characterized morphologically by tongue-like or lobate shapes, having usually lobate transverse ridges and furrows on its surface and a steep terminus at or near the angle of repose for boulders. Rock glaciers have been studied extensively in mountain areas around the world, yet their origin and internal structure remain controversial. A number of studies indicated that some rock glaciers are composed of glacier ice mantled with a continuous and relatively thin debris layer (*ice-cored rock glacier*). One of the significances of the ice-cored rock glacier is that studies on the origin of rock glacier contribute to reconstruct on the past glacier fluctuation in an area.

Topographically, the ice-cored rock glaciers attribute to their morainic features, which are surrounded by the moraine ridges. Although no massive ice-bodies were found, the internal structure of them has been inferred mainly from the existence of snow accumulation zones at the root of the rock glacier and the sporadic exposures of ice on the surfaces (Clark et al 1994; Humlum 1996; Elcolin and LaChapelle 1997; Poter et al 1998). However, such continuous ice-bodies have been found neither directly nor indirectly.

In order to delineate the internal structure within the ice-cored rock glacier, we attempted 2-dimensional electrical resistivity imaging (ERI) to a morainic rock glacier in the Kanchanjunga Himal. This paper will report the internal structure of a morainic rock glacier revealed by ERI and other investigations. Then, the age of this rock glacier will be briefly discussed including the history of the glacier retreating in this area.

THE NUPCHU ROCK GLACIER

Mount Kanchanjunga, 8,586 m asl, is the third highest mountain in the world (Figure 1). The Ghunsa valley originating from the summit of Kanchanjunga was selected as a study area (Figure 1).
On the basis of air photograph analysis and field observations, a number of morainic rock glaciers were identified in this area (Figure 2). The Nupch Rock Glacier, which is representative morainic rock glaciers,

was studied intensively (Figures 2, 3). This rock glacier is situated along the Nupchu valley at the altitudes between 4,800 and 5,000 m on south facing slope, and develops within the lateral moraine ridges at the foot of the bedrock cliff below the clean-type glacier. The front slope is less vegetated and its relative height is approximately 50 m. The angles of inclination are 30 - 40°, which probably corresponds to the angle of repose for boulders. The length and width of surface are approximately 280 m and 140 m, respectively. No ice exposure is found on the surface of this rock glacier. Some longitudinal furrows and ridges are observed on the root of rock glacier, while there are some lobate-shaped on the frontal parts of the surface. These topographic features suggest that downward movements occur.

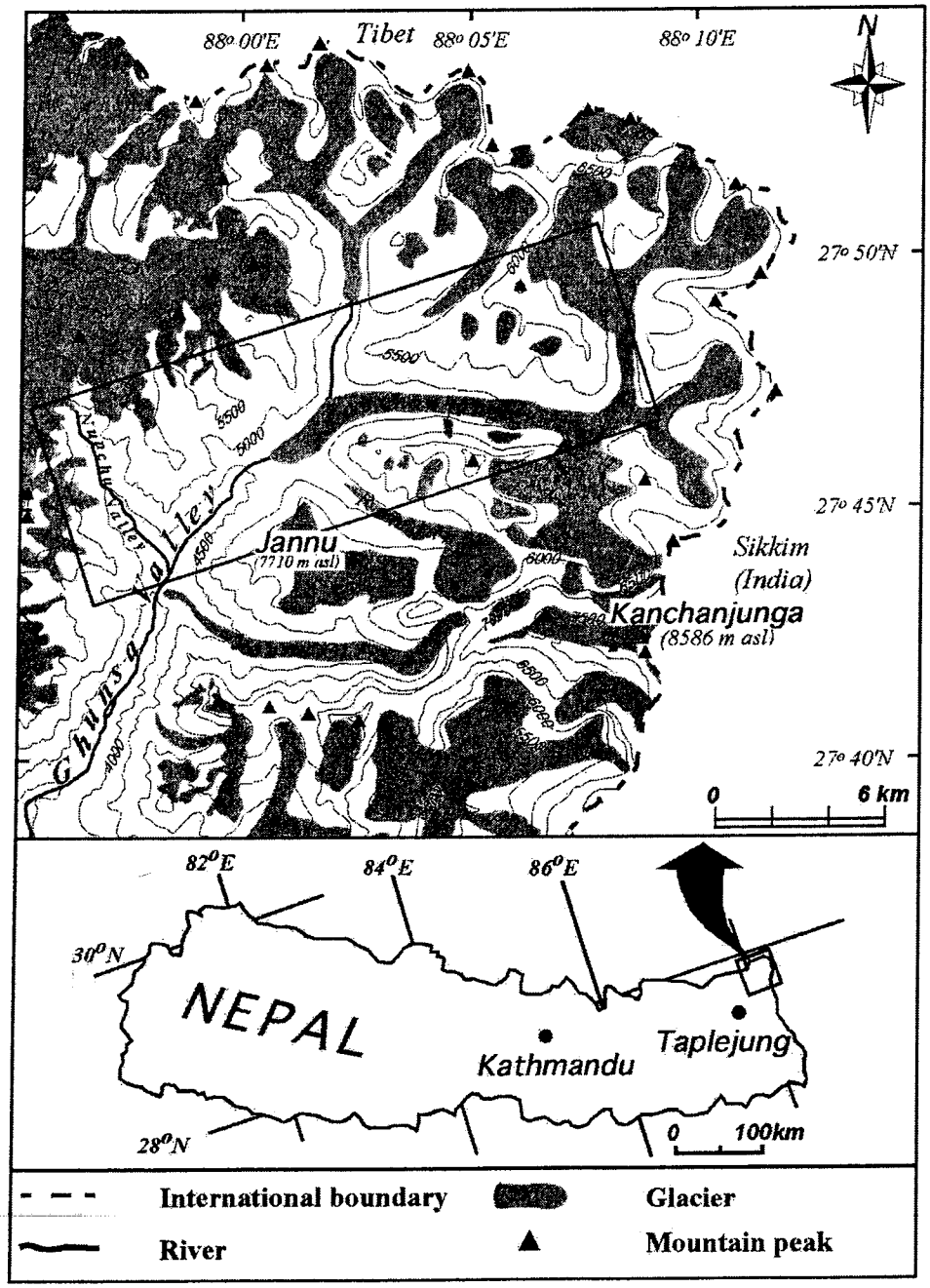


Figure 1. *Map of the study area (contour interval: 500m)*

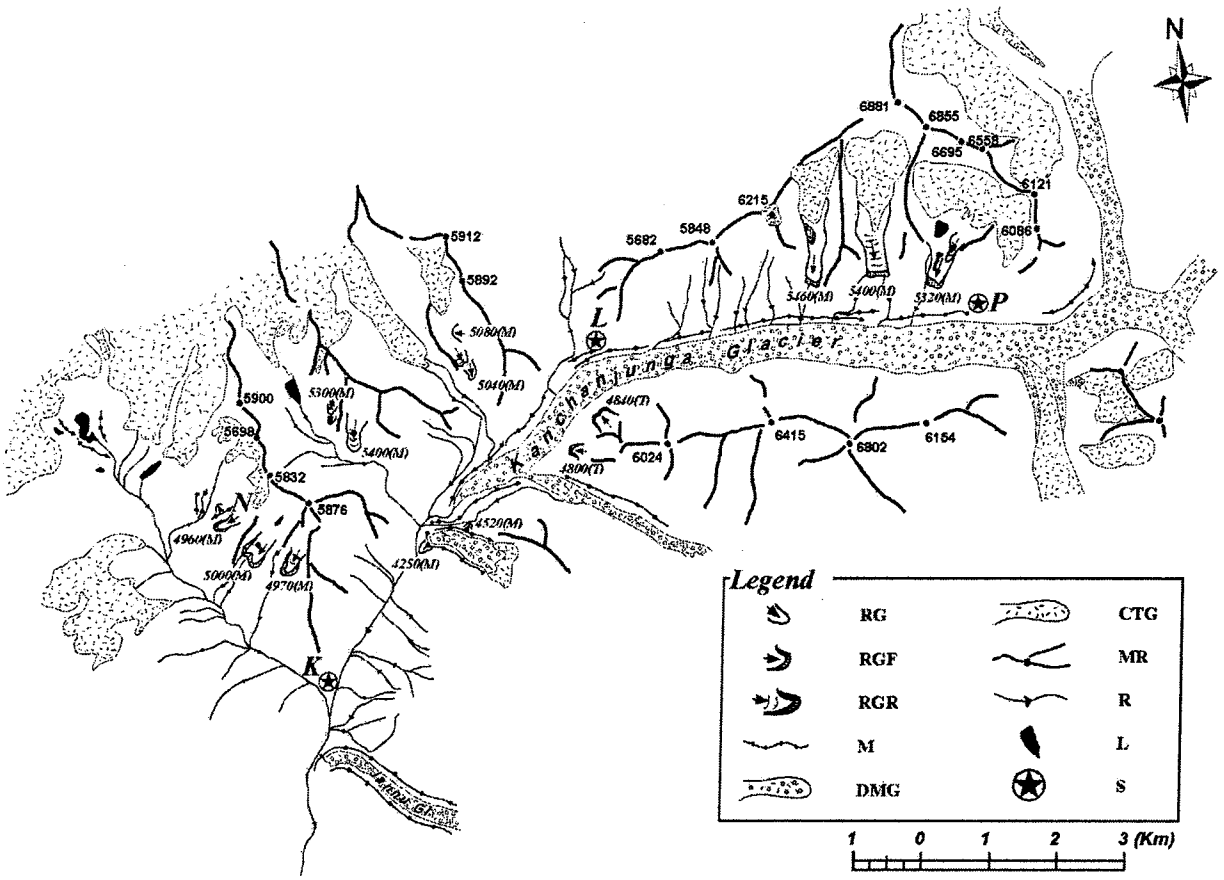


Figure 2. *Distribution of morainic rock glaciers in the Ghunsa valley and its tributary valleys. All rock glaciers imply a steep front slope with little vegetation. RG: Rock glacier, RGF: Rock glacier with high frontal slope, RGR: Rock glacier with high frontal slope, well developed furrows and ridges. M: Moraine, DMG: Debris-mantled glacier, CTG: Clean-type glacier, MR: Mountain ridge and peak, R: River, L: Lake, S: Settlement, Values in italics show the altitude of rock glacier termini. (T): Protalus rock glacier, (M): Morainic rock glacier. N: the Nupchu Rock Glacier, K: Kambachen (3,960 m asl), L: Lhonak (4,785 m asl), P: Pangpema, Kanchanjunga Base Camp (4,940 m asl).*

METHODS

The monitoring of ground temperature profiles whole a year allows an approximation of the depth of perennially frozen layer. Temperatures were monitored at a depth of 10, 30, 70, 110 and 170 cm below the surface of the Nupchu Rock Glacier (Figure 3). A temperature sensor mounted on a waterproof data logger (T&D TR52) was installed at each depth. This sensor-logger system reads temperatures from -20 to 80°C at a resolution of 0.1° C with an error less than $\pm$0.3°C.

In general, P-wave velocities are significantly different between open-work and matrix-filled boulders. Thus, existence and the depth of matrix-filled boulders layer are detectable by shallow seismic sounding. A handy seismograph (OYO Co., McSEIS-3) was used to estimate the velocity of P-wave through the subsurface on the surface and the outer fringe of the Nupchu Rock Glacier (Figure 3).

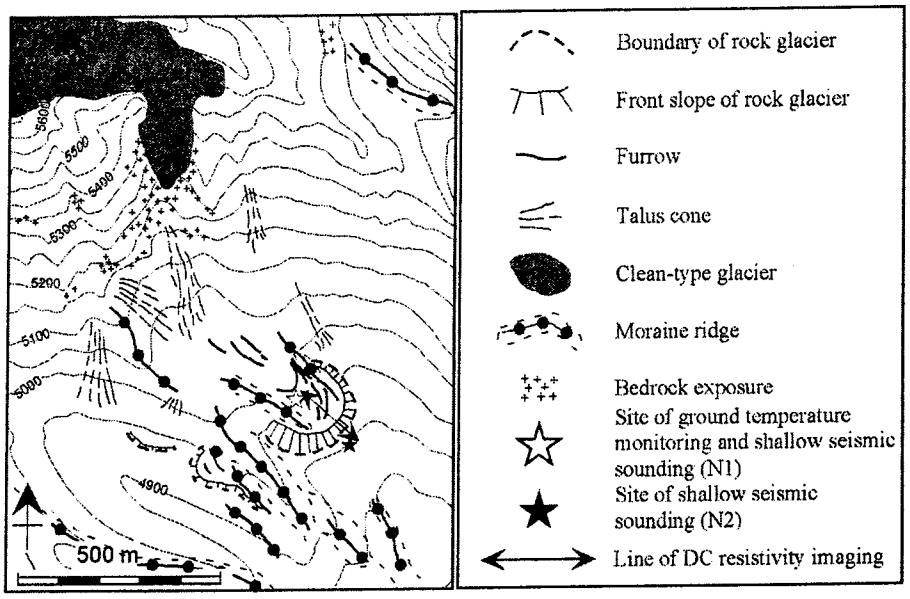


Figure 3. *Geomorphic maps of the Nupchu Rock Glaciers surveyed. Contour lines within the rock glacier are omitted.*

To determine whether the frozen layers are ice-cemented boulders or massive pure ice, we have measured DC resistivity values in the subsurface of the Nupchu Rock Glacier. We also have measured the DC resistivities in the subsurface of the debris-mantled part of the Kanchanjunga Glacier at Lhonak (4,750 m asl, see Figure 2 for location) for comparison. DC resistivity imaging technique is the combination of conventional vertical and horizontal resistivity soundings and gives detailed instruction in the subsurface including both horizontal and vertical structures. The electrode layout adopted in the present study is an Wenner-Schlumberger array, which is a hybrid of conventional Wenner and Schlumberger configurations. SYSCAL JUNIOR manufactured by IRIS Instruments was used for current injection and potential measurements. Multi-core cables and a remote control multiplexer were used for switching four active electrode configurations (Griffiths et al 1990). Data were stacked more than 10 times, together with the standard deviations of the obtained values of electric potentials. The obtained resistivity values calculated with high standard deviation (more than 50%) and abnormally high (or low) values were excluded prior to data analysis. The apparent resistivity data were contoured in the form of a pseudo-section, which gives an approximate picture of the subsurface resistivity. The inverted resistivity models, which approximately indicate the distribution of resistivity in the subsurface, were processed by software program, RES2DINV ver. 3.4 (Loke and Barker 1996). Several iterations were conducted until the RMS error converged and reached a minimum. The inverted resistivity tomograms show the model resistivity section. High gradients of resistivity values usually characterize a contact zone between different resistivity bodies.

RESULTS AND INTERPRETATIONS

Figure 4 shows the annual ground temperature profiles between November 1998 and November 1999 in the subsurface of the Nupchu Rock Glacier. The annual amplitudes of ground temperature decrease with increasing depth. Extrapolating the line of annual maximum temperature at each measured depth, ground temperature below the depth of 215 cm should be perennially below 0°C.

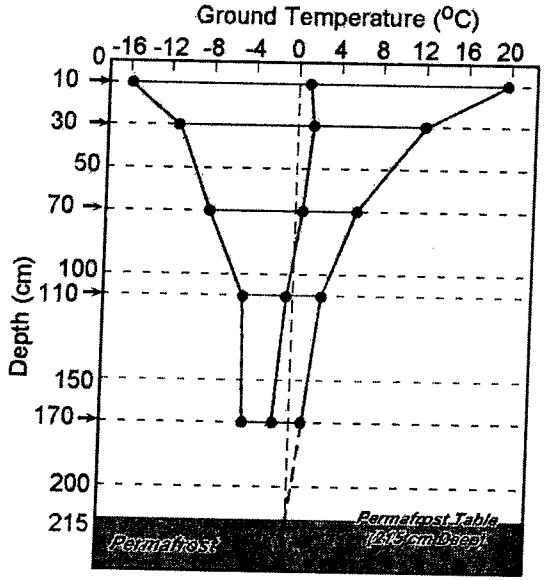


Figure 4. *Ground temperature profiles below the surface of the Nupchu Rock Glacier (See Figure 3 for location).*

Table 1 summarizes the results of shallow seismic sounding. At site N1, the P-wave velocities of the uppermost layer (V_1) were 275 and 314 m sec^{-1}, whereas those of the second layer (V_2) were 3,300 and 3,301 m sec^{-1}. The high velocity of the second layer indicates the existence of matrix-filled layer underneath the surface open-work boulders at site N1. At site N2, on the other hand, no significant differences in P-wave velocities were found between of the first and of the second layers. This means that no matrix-filled layer exists at this site.

Table 1. *Summarized results of shallow seismic sounding.*

Location	Run	V_1(m sec^{-1})	V_2(m sec^{-1})	Z(m)
N1	N1-1	275	3,300	2.2
	N1-2	314	3,301	1.5
N2	N2-1	314	917	2.1
	N2-2	324	786	1.9

Figure 5 shows the inverted resistivity tomogram of the debris-mantled parts of the Kanchanjunga Glacier. This tomogram demonstrates the existence of the extremely high resistivity zones below the surface. The calculated resistivity values (106 - more than 2×10^7 Ohm·m) are within those of the temperate glacier ice (Röthlisberger and Vögtli, 1967). These zones, therefore, can be regarded as glacier ice body, which is seen below the debris layer adjacent to this profile line.

Figure 6 shows the inverted resistivity tomogram of the Nupchu Rock Glacier. This tomogram shows the presence of a high resistivity zone below the rock glacier surface. Compared with the resistivity values obtained on the debris-mantled part of the Kanchanjunga Glacier (Figure 5), this zone probably corresponds to the pure ice body. The depth of the bottom of this ice body has not been found. On the contrary, a low resistivity zone was found below the front slope of the rock glacier, where frozen materials may not exist. A high resistivity zone was also found below the foot of the front slope. This high resistivity zone may correspond to boulders of the frontal apron of the rock glacier and does not include frozen materials.

AGRICULTURAL WATER SUPPLY

The largest hardship felt by the local residents of the Yarsha and Jhikhu Khola watersheds is adequate irrigation water supply. Water shortage for irrigation is an issue in the dry season months only, towards the end of the dry season in particular. Peak shortage is felt in the months *Falgun* to *Baisakh* (mid-February to mid-May) in the case of the Yarsha Khola watershed and from *Falgun* to *Jestha* (mid-February to mid-June) (Figure 3).

This pattern reflects the long-term rainfall with high likelihood of pre-monsoon rainfall events in the Yarsha Khola, where natural storage can be recharged. In the Jhikhu Khola on the other hand, pre-monsoon rainfall is not occurring on annual basis. Water shortage may be prolonged in comparison to the Yarsha Khola watershed.

The deficiency period coincides with the growing season of winter crops such as wheat and potato. Winter rain greatly facilitates the production of these crops; this situation, however, cannot be expected. Usually the farmers do not face any problems with the rice plantation as adequate water is available from the monsoon rain. Only during the early rice growing period, transplantating can be postponed due to late onset of the monsoon rain.

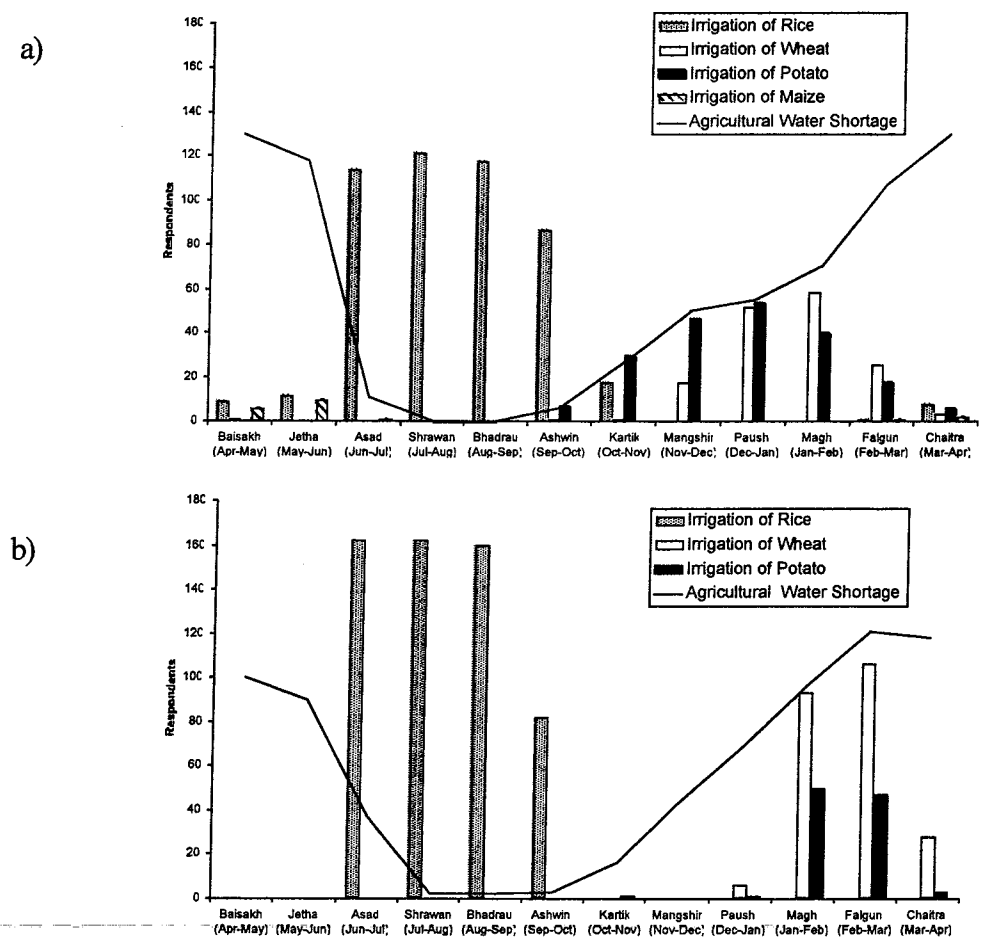


Figure 3. *Irrigation water shortage and irrigation time for different crops in a) the Jhikhu Khola and b) the Yarsha Khola*

Irrigation water is a constraint throughout the watershed. In the upper areas there is no surface water available. Therefore there is no possibility of having irrigated fields. In the lower areas, where most of the

production is on irrigated areas, water availability limits the production. Interventions with the goal of increasing water availability should therefore aim at the winter period.

DOMESTIC WATER SUPPLY

As mentioned above water supply for domestic use is a major constraint in both watersheds. With an average per person use of 22.4 l/day and 20.6 l/day in the Jhikhu Khola and the Yarsha Khola, respectively water use is below the design value for rural water supply schemes (HMG/FINNIDA, 1994).

The major constraint with the water sources of the respondents in both watersheds is sediment (Figure 4). Other problems related to water supply are bad taste, bad quality and animal waste. The sediment problem originates mostly from improper construction of intakes, misused and dirty intakes, broken supply pipes or collection of turbid sources like rivers. The major problem with sediment is the possibility of microbiological pollution associated with this sediment.

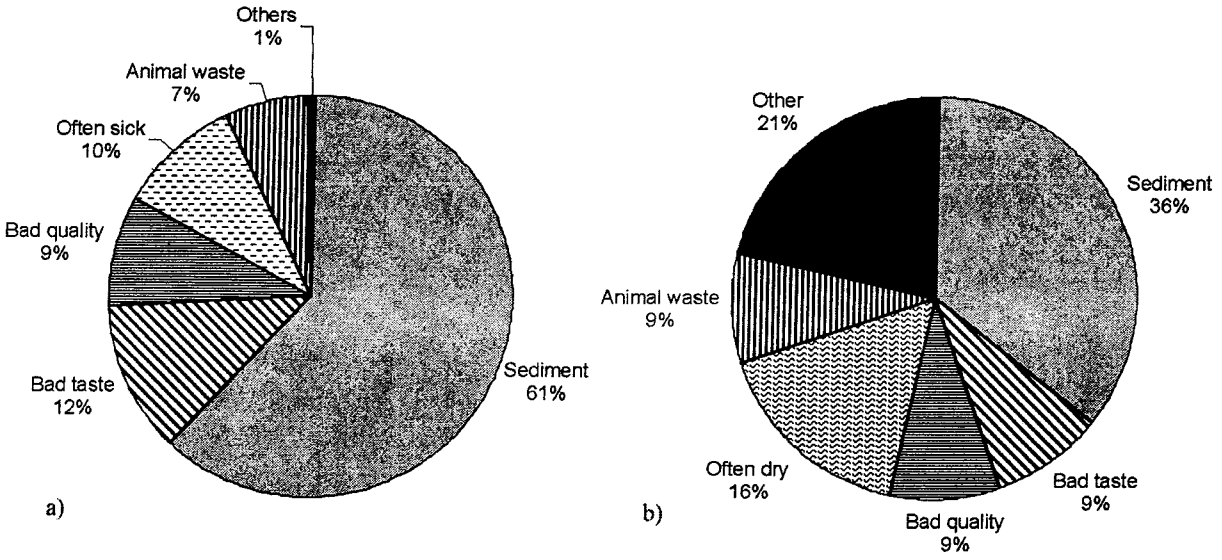


Figure 4. *Problems with drinking water supply in the a) Jhikhu and b) Yarsha Khola watersheds*

The perceived water quality problems reflect themselves in the results of the chemical and microbiological investigations. A total of 31 public water sources and 20 river sites in the Jhikhu Khola were monitored in the pre-monsoon 2000. During this campaign microbiological parameters like total and faecal coliform were in most cases magnitudes above the recommended values of WHO (WHO, 1993) (Figure 5).

It can be concluded that access to safe drinking water has become a major problem, though for local people it is apparently considered as a secondary issue after quantity. The relevant authorities should take this issue seriously.

WATER USE DYNAMICS

For the assessment of water resources dynamics as perceived by the respondents the questions on perceived changes in irrigation and domestic water supply over the last 25 and 5 years were asked. Domestic water supply questions were part of the questionnaire for female, as the irrigation supply questions were only on the male questionnaire. Figure 6 shows the perceived dynamics of the last 5 years

on the left and the last 25 years on the right side of the graph.

The changes in domestic water supply are not as dramatic. In the Yarsha Khola watershed in particular a majority of the female respondents experienced an increase in water supply over the last 5 and 25 years. This is mainly due to the construction of drinking water supply systems during this period. In the Jhikhu Khola this development is more balanced between increased and decreased with slight trend towards decreasing supply.

In terms of irrigation water Yarsha Khola respondents see mostly no change in water availability, both over the last 5 years as well as over the last 25 years. The change however shows decreasing trend. In the Jhikhu Khola watershed on the other hand respondents feel a major decrease in irrigation water supply. The reason for this decreasing trend, which was felt by the respondents cannot be explained by decreasing rainfall. There is no significant trend of either increasing or decreasing rainfall input visible in the long-term data of the meteorological stations in the Jhikhu Khola watershed (Figure 7): for Dolalghat -0.00002, for Panchkal -0.00002 and for Dhulikhel +0.0002.

The major reason for this is believed to be the intensification of the agricultural practices. Shrestha and Brown (1995) reported a slight increase in the area of the irrigated agricultural land between 1972 and 1990. However a change in cropping intensity was observed from 1.3 crops in 1980 to 2.3-2.6 crops per annum in 1994. In a survey mentioned by Shrestha and Brown (1995) 13% of the households in the Bela area grow four crops per annum. It is well known that this is not the most intensely cultivated area of the watershed.

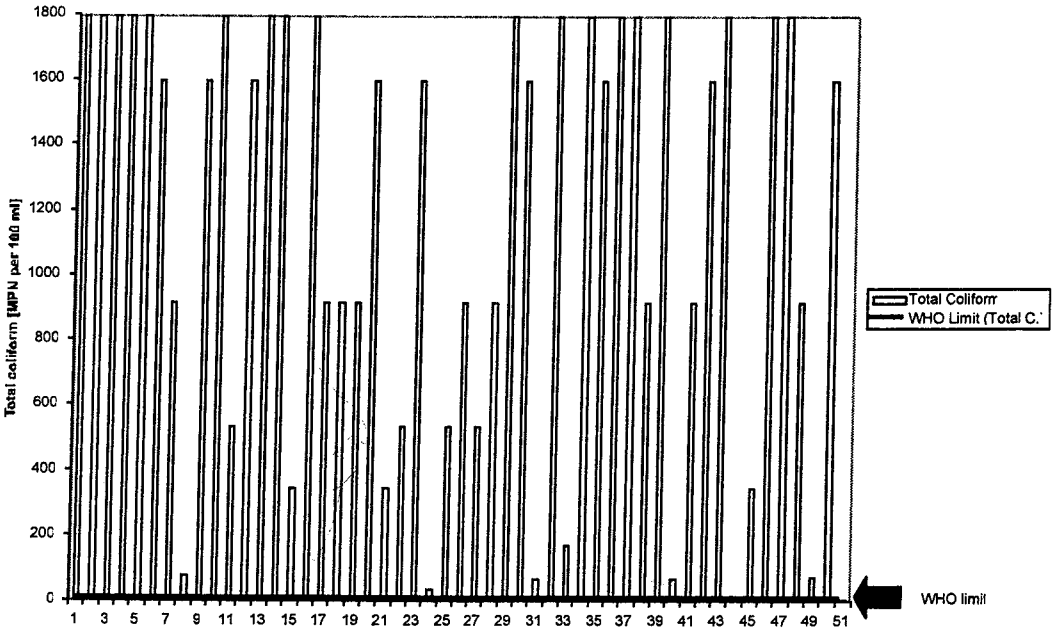
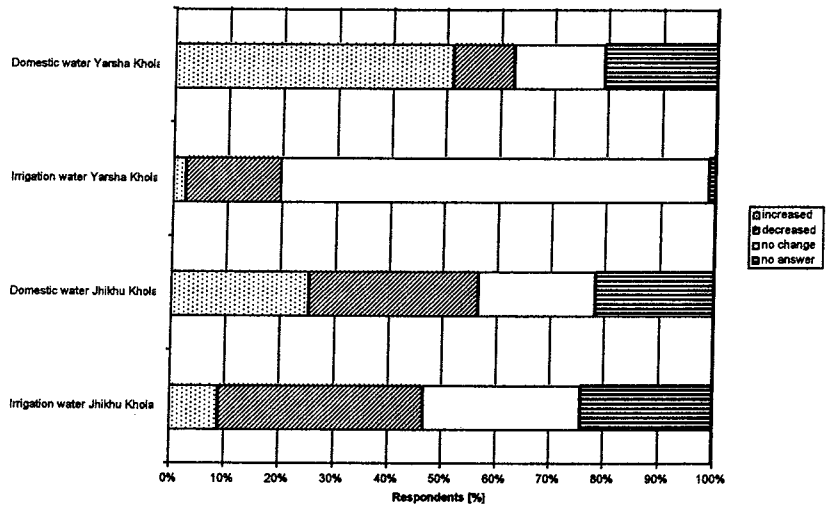


Figure5. *Results of the microbiological studies in the Jhikhu Khola watershed (from Bajracharya et al 2000).*
Attention: *The values of 1800 are to be read as more than 1800 MPN*

In the last 25 years high yielding varieties were introduced in the area. These varieties not only require high fertilizer doses, but also require higher amount of water.

Demand on water will further increase under the currently foreseeable development. In order to propose alternatives it is necessary to provide well studied technologies and methods. The following section will discuss the approach PARDYP has taken.

a)



b)

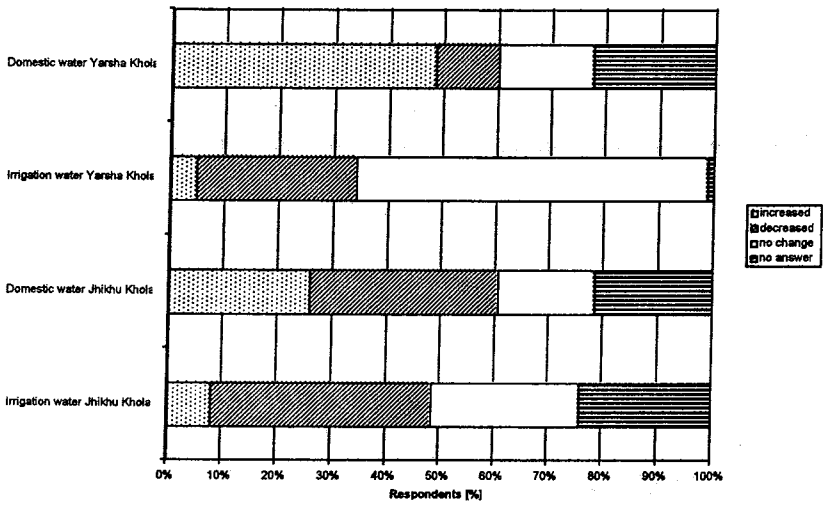


Figure 6. ***Perceived water supply changes over the last 5 (a) and 25 (b) years***

ACTION OF THE PARDYP PROJECT

In order to address the water related constraints the PARDYP project is following a sectoral approach. As shown above water problems in the Middle Mountain watersheds vary with physiographical location in a watershed more than with the elevation. A watershed is therefore divided into several zones according to landforms. The best water source (ie, rainfall, spring water, river water, ground water) is then assessed for each zone. According to the land use and the use of the water methods for water supply support can then be proposed. Figure 8 presents a schematic watershed with the different sectors. This scheme is studied in further detail and other important factors will be added.

Up to date the PARDYP project with its focus on marginalized and financially weak groups has so far focused on the upper areas of the watersheds without access to springs and without access to irrigation water. Harvesting of rainwater and surface flow seems to be the only alternative to the commonly used water sources. For the improvement of the situation of these groups the project has so far taken up two major foci for its water management activities:

1. to ensure sufficient and safe water for domestic use at convenient location and at reasonable cost, and,
2. to improve the water availability for cash crop production on land, which was lying fallow during the

dry season.

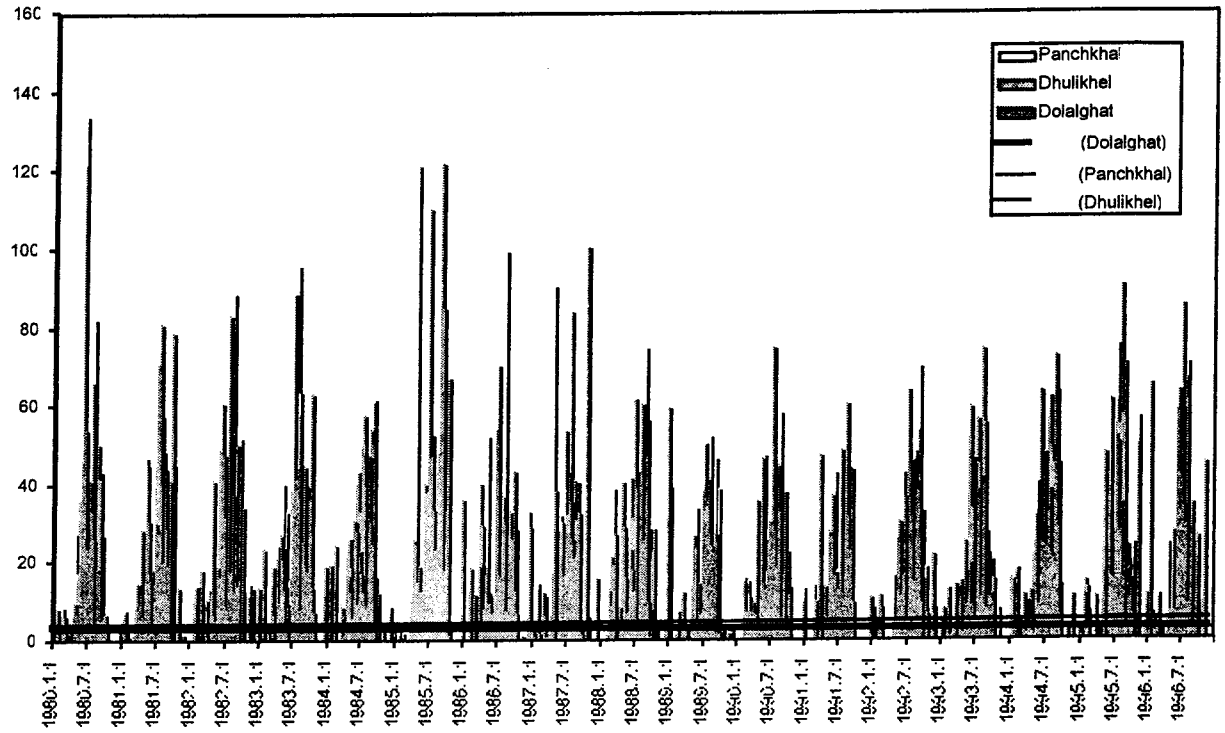


Figure 7. *Rainfall 1980-1996 at stations in or close to the Jhikhu Khola watershed (Data source: DHM,, 1999)*

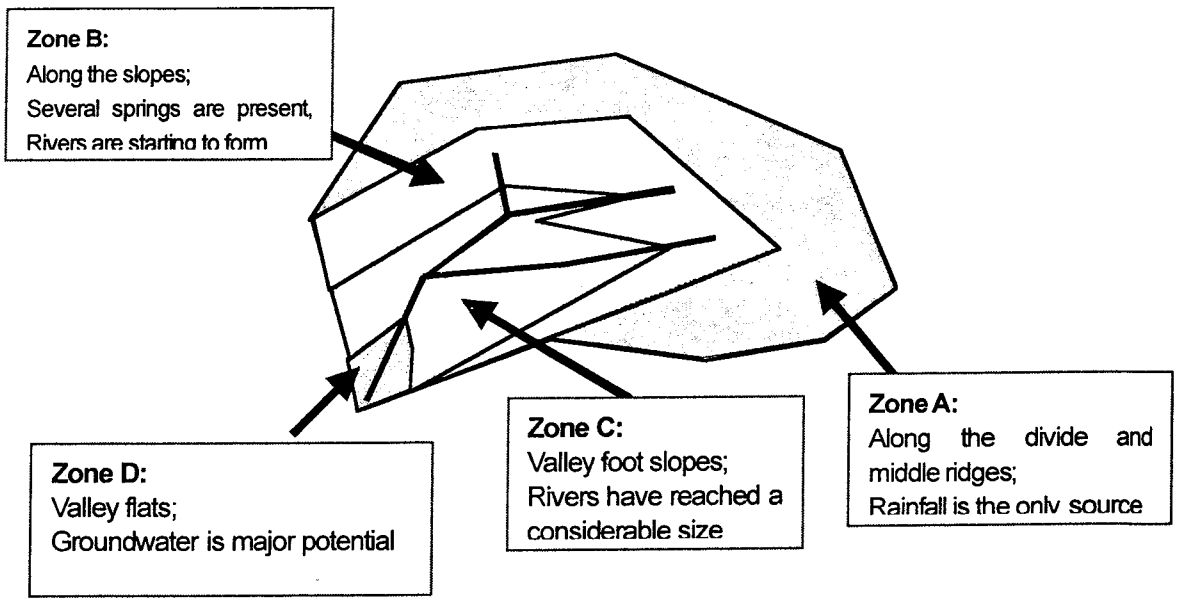


Figure 8. *Sectoral approach of PARDYP for water management and supply considerations*

As most rainfall occurs during the monsoon and only a few events are expected during the winter and the early pre-monsoon, the rain water has to be captured and saved for the dry season. In addition, much of the monsoon rain leaves the system as surface runoff. This water has to be kept back for use later in the season. The project therefore ventured into the field of water harvesting.

For the purpose of drinking water supply, trials were initiated on the jar technology as implemented by the Rural Water Supply and Sanitation Programme (RWSSSP) in the Lumbini Zone. In collaboration with the Water Harvesting Programme of ICIMOD and RWSSSP the project trained local masons in the

two PARDYP watersheds of Jhikhu and Yarsha Khola. Subsequently a total of 13 trial and demonstration units in the Jhikhu Khola and 9 units in the Yarsha Khola were constructed. The funds for the construction were collected from the beneficiaries, the local authorities and the rest was provided by the project. The constructed units are currently under observation, both from a technical as well as a socio-economic point of view. Further implementation of the jar technology now depends on the acceptance of the local residents. The project has clearly stated to the different stakeholders in the two watersheds that it is willing to support any further implementation activities with expertise. Funding has to be organized from elsewhere.

For the purpose of irrigation of cash crops grown in rainfed agricultural land the project has initiated trials with water harvesting tanks capturing overland flow from suitable surfaces (eg, road, degraded areas) in connection with alternative water application technology, ie, drip irrigation. More detailed information is presented in Nakarmi and Neupane (2000) and Nakarmi et al (2000).

In future PARDYP will further improve the sectoral approach up to the development of a decision support system. This will include applicable methodology for all sectors in a watershed of the Middle Mountains.

CONCLUSIONS

Water is a major constraint in the Middle Mountain watersheds of Nepal. People face hardships both for irrigation as well as domestic supply. People along the watershed divide are mainly in need of domestic water supply. Water quality is becoming an issue throughout the watersheds. For irrigation mainly the lower parts are facing problems. This is due to further intensification of agricultural production including cropping intensity and new varieties. To address these issues PARDYP is following a sectoral approach where a watershed is divided into different zones according to physiographic location, water source and water and land use. This approach is currently being modified and studied in further detail. In places conventional methods are not effective and too expensive for implementation. Here alternative technologies have to be promoted. At present PARDYP addresses the need of the uppermost areas in the watershed using different methods for water harvesting. In these areas only rainwater is available so rainwater harvesting from sealed surface and roof tops are proposed, tested and demonstrated. Further studies including other sectors must be conducted.

A similar approach could be proposed for overall watershed management in order to answer watershed management questions in a holistic manner.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the financial support of the Swiss Agency for Development and Cooperation (SDC), the International Development Research Centre (IDRC) and the International Centre for Integrated Mountain Development (ICIMOD) for the PARDYP project. Furthermore without the support of the PARDYP Nepal team, Pravakar B. Shah, Pradeep M. Dangol, Madhav P. Dhakal and Bhawani S. Dongol, Bhuban Shrestha and Smita K. Shrestha in particular this paper would not have been possible.

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Population and Land Use/Land Cover Change in the Himalayas: A Case Study of the Madi Watershed, Central Nepal

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ABSTRACT

This paper provides an introduction to the historical and contemporary changes in population and land use in the mountain areas of Nepal in general and the Madi watershed in particular. Emigration of individual family members at a regional scale and territorial mobility of farm household below regional scale have been major processes of population change in the mountain areas of Nepal since historical time. The magnitude and direction of mobility changed over time. Shifting of human settlements from ridge to valley and from rural to urban is a recent phenomenon after the 1950s. Fluidity in agricultural, fallow, shrub and even forest cover was the historical processes of land use change. Such fluidity has changed into directional at present with two distinct pathways in the place of destination and origin of the migrants. These pathways are not unique to the mountain areas of Nepal but common to the mountain areas elsewhere though the timing and magnitude are different.

KEYWORDS: Historical; mobility; settlement; agriculture; lose; abandonment

INTRODUCTION

The Nepal Himalayas is one of the most dynamic environments not only because of its high energy due to very rugged topography, highly concentrated monsoon precipitation and frequent occurrence of seismic activities but also increasing pressure on natural resources as the result of rapid growth in population. It is believed that over dependency of primary resources and increasing demand for food, wood and fodder due to rapid growth in human and livestock population and infrastructure and commercial activities without developing alternatives, have caused very high rate of deforestation and environmental degradation (Eckholm 1975; Bajracharya 1983; Fox 1983; Wallace 1981). Nepal is often cited as one of the examples of very high rate of deforestation and environmental degradation in the world. Ives and Messerli (1989) have described it as the Theory of Himalayan Environmental Degradation. It mentions that uncontrolled population growth, subsistence economy and poverty and malnutrition have been causing mass deforestation and environmental degradation in the form of increasing rate of runoff and erosion, siltation and flooding and drying up of springs and wells and destabilization of mountain slopes resulting vicious cycle of environmental degradation and poverty. Quite a few studies in the latter part of the 1980s showed that the Theory of Himalayan Environmental Degradation based on simple cause-effect relationship of population growth and depletion of forest is not enough to explain the process of land cover and land use change. It was reported that though the growth of population remained very high, the pressure of population was adjusted through migration (Goldestein et al 1983) on the one hand and the rate of deforestation was higher before the 1950s when the size of population was small than at present (Mahat 1985).

The interrelationships between population and resource use and the rate and direction of land use and land cover dynamics change with time and space. The findings about the direction of the past land use change ie from forest to agriculture and bare ground due to increase in population and consequent increase in the demand for food and fuelwood and fodder were relevant in the closed system where the flow of goods, services, information and technology from outside the system was not feasible due to physical and other socio-economic and political barrier. However, the situation has been changed with the improvement

in accessibility condition after the later part of the 1970s. The improvement in accessibility condition has made it easier to flow goods, services, information and technology from outside the system. As the result, the rate and direction of the change in land use and land cover have occurred. This paper attempts to discuss the historical and contemporary processes of population and land use/land cover change in the mountain areas in Nepal in general and in the Madi watershed in particular.

METHODS AND MATERIALS

The Madi watershed in the central part of the country with an area of 1,123.49 km^2 and the altitude ranging from 307 m to 7,937 m representing almost all the ecological regions of the mountain areas of the country has been selected for discussion (Figure 1). This area lies between comparatively drier western and wetter eastern parts of the country where the possibility of developing sedentary agriculture is relatively high. This region is transferring very fast as the result of various development activities. This region is ranked as best according to the overall composite index of development in the country (Banskota et al 1997). It was expected that this region could provide information on the historical and contemporary population and land use and land cover in context of changing spatial and economic condition of the country.

Oral history, land use and land cover related government's order, land grant certificates and other published and unpublished materials have been used to trace historical changes of population, human settlements and land use and land cover. Maps published by the government at different periods have been used to examine contemporary land cover changes in the watershed. Similarly, Population Census data taken in different period have also been used to analyse contemporary changes in the size of population. In addition to these, information on land use at household level collected through household survey have also been used. Presently, there are 47 Village Development Committes (VDCs) in the Madi watershed (Figure 2). A total of 556 households from 14 villages in the watershed were selected randomly for interview, which represented about 1.7 percent of the total household in these VDCs.

CHANGES IN POPULATION AND HUMAN SETTLEMENTS

Demographic process is one of the causes of land use and land cover change. Changes in population lead to the changes in agricultural land use in particular and land cover as a whole through four distinct processes. These include extensification, intensification, deintensification and abandonment. Extensification is the process of the expansion of the agricultural use by clearing new land whereas the intensification is the application of more input in order to raise output per unit of land. Similarly, deintensification is the reduction in inputs per unit of land whereas complete withdrawal of input results abandonment of the land. In areas where rapid growth in population due to rapid decline in mortality rate in subsistence agricultural economy and where the use of technology is limited, extensification is often considered as the major processes of land use/land cover change. If the change in population is due to migration, very different process of land use/land cover change occurs in the place of origin and destination. The process of change also differs with the type of migration whether it is temporary or permanent and individual or family. Deintensification and abandonment are the major processes at the place of origin whereas extensification and intensification are the major processes of the change in agricultural land. So, proper understanding of population process is essential to evaluate the pathways of land use and land cover change. The dynamics of population in the Madi watershed has been discussed below.

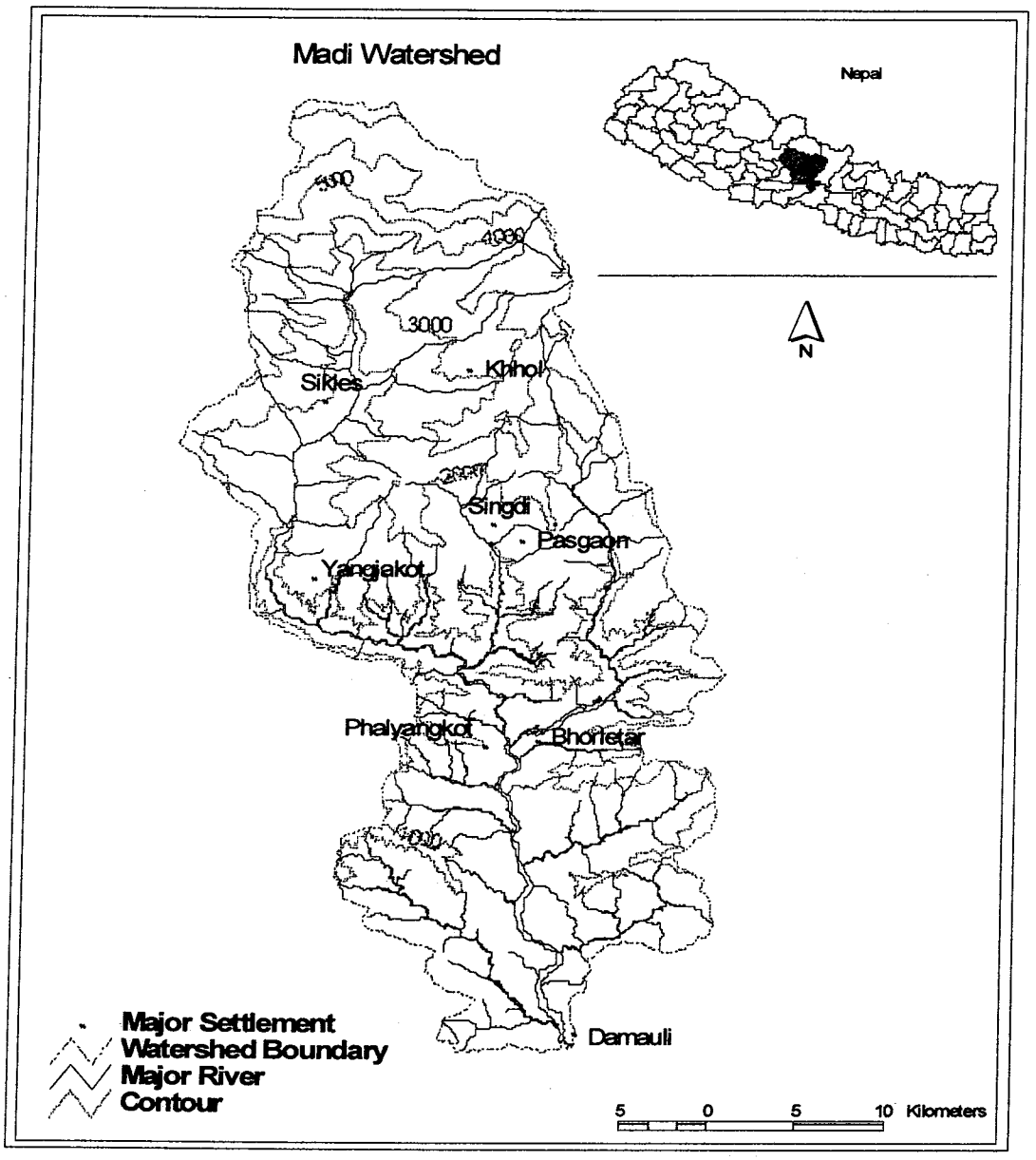

Figure 1. *Madi Watershed*

Historical Changes

The Madi watershed is inhabited by many ethnic groups. These include Gurung, Magar, Dura, Brahamin, Chhetry, Thakuri, Sanyasi, Newar, Tamang, Chureta, Damai, Kami, Sarki, Darai, Kumal, Bote and other ethnic groups of Tarai origin. According to population census of 1991, Gurung comprises about 24 percent of the total population in the VDCs in the Madi watershed followed by Brahamin (20.6 percent). Chhetri, Thakuri and Sanyasi in combination comprise about 16.4 percent of the total population. Occupational caste groups such as Damai, Kami and Sarki comprise 16.4 percent followed by Magar (7.9 percent) and Newar (5.4 percent). Bote, Darai and Kumal in combination accounts for 3 percent of the total population followed by Tamang (1.4 percent). Other ethnic groups comprise less than 5 percent of the total population. The dominant ethnic group is Gurung (45 percent) in the upper part of the watershed, Brahamin and

Chhetry (46 percent) in the middle and mixed group of Brahamin, Chhetry, Magar and Gurung in the lower.

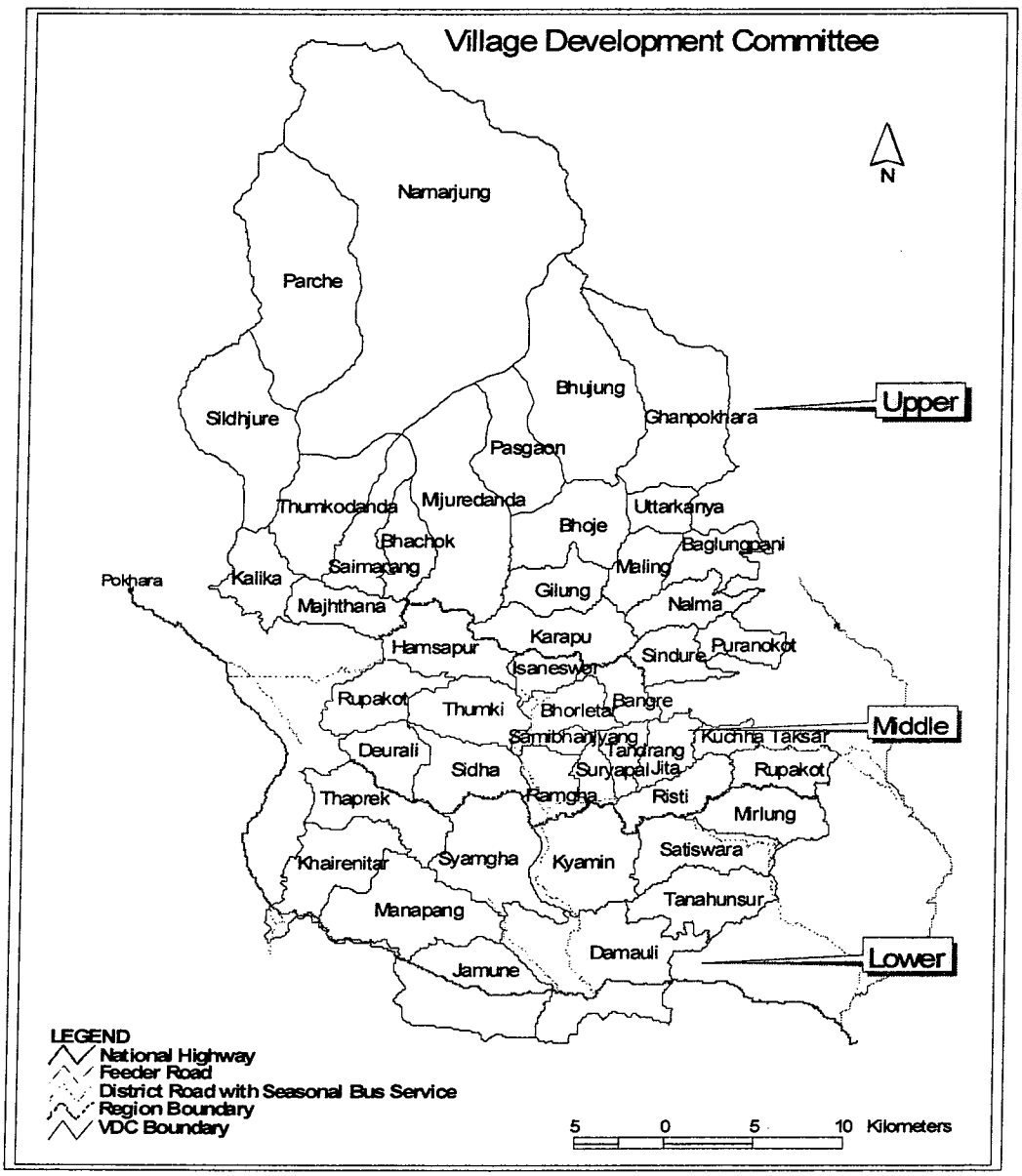

Figure 2. *Village Development Committee*

It is not possible to reconstruct the date of inmigration of different ethnic groups in this area. Studies in the past show that Gurungs in the north which was also known as Shesanta, and Magar in the south which was also known as Kachhad, inmigrated in this region before the 7th century and Indo-Aryan Groups such as Brahamin, Chhetry, and Thakuri in the 11th century (Poffenberger 1980). Duras who are presently residing in Sindhure and Puranokot area inmigrated from Dullu in the west in the 11th century (Madge 1986).

Bote, Darai, Kumal who were immunized to *awal* (malaria) inmigrated along river valleys in the lower and middle parts of the watershed before the 17th century (Subba 1989). Land grant certificate issued in 1720 AD shows that there were 32 settlements of Darai scattered in different parts along Madi

river in the lower part of the watershed before this time. Newar presently residing in the middle and lower part of the watershed inmigrated from the east before the 18th century. Bandipur one of the major market towns in nearby area developed by Newars in the past was established in 1769 AD (Mikesell 1988). Tamangs who are also known as Kagate (paper maker) in this area might have inmigrated from the east at the same time when the Newars inmigrated with main objective to develop cotton textile industries and trade in the region. Their presence in this area was recorded only in the *tirij* (records for the collection of land tax) of 1883 AD.

Churetas who account for about one percent of the total population in the lower part of the watershed immigrated from India in the late 15th century as traders of *chura* (bangles) and *pote* (a kind of necklace that is worn by women). Inmigration of other ethnic groups of Tarai origin in the middle and lower region is a recent phenomenon for trade and services.

Territorial mobility in different directions was common in the past. Khhol located in the northeastern part of the Madi watershed is referred to the first place where the Gurung settled permanently in the southern part of the Himalayas (Gurung 1978; Messerschmidt 1976). Many of the Gurung villages inside the Madi watershed and outside its adjoining areas were developed later by the people migrated from this area. Similarly, Indo-Aryan groups who inmigrated in this area from the western hills started to migrate in another place after some time. For example, Khanal's *Vamsavali* (genealogy) shows migration of families from Manahun located in Madi watershed to Chudi in th 16th century and from Phalyangkot (Thumki VDC) to Rangrung in the south western part outside the watershed (Khanal Vamsavali Nirman Samiti1998). Ruined settlements are found in many places of the watershed even within the forest area. The kingdom of Ghale Raja, ancestral Gurung king was in Khhol located at about 3,500 m and migrated to Ghanpokhara (2,000 m). He was eventually overthrown by the Nepali Raja around the 15th century (Messerschmidt 1976). There were many settlements of Gurungs above 3,000 m in the northeastern part of the watershed. It has been reported that there were 80-600 houses in Kabru Krongar (Karapu danda) (above 3,000 m) area before the 15th century (Gurung 1978; Rivan-Chaur Nathu-Pralad Pariwar Samittee1997). All those old settlements located above 3,000 m have been abandoned and people migrated to the south and settled in Ghanpokhara, Bhujung, Pasgaon, Singdi, Nagidhar, Puranogaon, Yanjakot, Tanting, Namarjun, Sikles below 2,100 m. Many reasons led to such shift of settlements from higher altitude during the 14th and the 15th centuries. These included political blockade imposed by the Nepali Raja in the south, change in climatic condition and prospects of agricultural development in the lower altitude.

Three events of heavy snow fall remaining several days in the 13th century and four events in the 14th century were recorded in Kathmandu (Vajracharya and Malla 1985). People in Yanjakot told that snow had driven their ancestor from higher altitude. The people from Mijure area also expressed similar views. Severe cold and lack of drinking water in the higher altitude drove many people south to Puranogaon, Pasgaon and Singdi (Shrestha et al nd). Ghai and Su villages near Ghanpokhara were abandoned after the plague and Ghaisu was developed by the people migrated from Ghai and Su before 1850 AD (Messerschmidt 1976). Migration from Pasgaon, Singdi and Puranokot in the later part to further south was also reported during the fieldwork in the lower part of the watershed though the exact time of migration was not known.

Large-scale emigration of people from Nepal to Kangra valley, Shillong, Assam and Burma after the peace treaty of 1816 has been reported (Kansakar 1974). But such a large-scale emigration to these areas was not reported from this watershed.

Ruined settlements such as Phoksing, Tunibhanjyang, Bhorle and Syaldanda even in the lower part of the watershed were observed. These settlements were abandoned about 80 years ago and these areas are presently covered with forest. The reason for the abandonment of these settlements was the occurrence of *khawate* (*khawate* was a disease which has been translated into English as tuberculosis but the symptoms reported by the local people are different. Local people reported it as epidemics).

Contemporary Changes

Recorded population data for different year at different levels - national, regional and district, *Thum* and VDC (Village Development Committee) are available since 1911. It was not possible to estimate population at watershed and sub-watershed level before 1954. Attempt has been made to estimate population at watershed and sub-watershed level since 1954 based on population data reported by Central Bureau of Statistics (CBS) by *Thums* in 1954 and 1961 and by Panchayat in 1971 and 1981 and by VDCs in 1991. It was not possible to estimate population of 1954 and 1961 at VDC level since *Thum* was divided into many Panchayats and VDCs in later. Frequent changes in the number of VDCs and its boundaries created problem to report population size by VDCs accurately even after 1971. However, attempt was made to adjust number of population based on the Population Census of Nepal and information so far available on the changes in boundary and population from the Ministry of Local Development and published documents by individual author.

Reported population at district, region and national level and adjusted population at watershed and sub-watershed level are presented in Table 1. Population in the country has increased from 5,638,749 in 1911 to 18,491,097 in 1991. It increased by more than 3 times within 80 years. The growth rate of population is given in Table 2. The recorded census of population up to 1930 shows negative growth in population. The growth rate remained higher after 1940. The reasons for such negative growth rate between 1911-1940 were wars, emigration of people, epidemics, and other natural hazards such as earthquakes, and under/over enumeration in some of the Censuses because of different causes (Kansakar 1974; Poffenburger 1980). Very high growth between 1952/54 was due to the return of large number of people of Nepalese origin from Burma and return of Gorkha troops after World War II. Very low growth rate was reported from Lamjung and high from Tanahun and Kaski district between 1954 and 1940. The growth rate in the population in Madi watershed as a whole remained far below the national average after 1954. The growth rate remained more or less the same in the lower, the middle and the upper parts of the watershed Frequent occurrence of landslides and floods between 1951 and 1957 in the watershed on the one hand and opening of Tarai and inner Tarai after the eradication of malaria in 1956, large-scale outmigration of people from this area took place. More than 237 landslides and debris flow scars were observed in the airphotographs taken in 1957 and 1958 and damages at large-scale of agricultural land both along the river course and open hillslopes was done between this period (Khanal 1999). As the consequences many families were migrated. For example, nearly 23 percent of the total male family members of Khanal from Gunadi in the lower part of the watershed migrated to Chitwan between 1956 and 1960. However, the land price in Tarai and inner Tarai increased rapidly within a few years as compared to the land price of tars (river terraces) located along the Madi river in the lower part of the catchment. As the result, people from the northwestern part outside the Madi watershed inmigrated in the lower part of the watershed. The growth rate remained higher in the middle and the lower parts than the national average and the average for Tarai between 1961-1971. At the same time there was negative growth in the upper part of the watershed (Table 2, Figure 3). It shows large-scale migration of people in

the middle and lower part of the watershed.

Table 1. *Census Population Recorded in Different Year*

	1750	1911	1921	1930	1940	1952/54	1961	1971	1981	1991
Upper						47,842	52,654	51,123	54,693	54,644
Middle						29,566	32,272	41,076	48,484	45,240
Lower						28,601	31,328	40,498	56,425	70,093
Total						106,009	116,254	132,697	159,602	169,977
Tanahun		na	82,160	na	72,878	121,274				
Kaski		na	na	na	94,358	133,627				
Lamjung		na	na	na	107,543	121,601				
Kaski+Lamjung		na	139,565	na	201,901	255,228				
WestNo.3		na	221,725	na	274,779	376,502				
Western Hills		1,971,400	1,935,757	na	2,549,342	3,509,609				
Mountain								1,138,610	1,302,896	1,443,130
Hills								6,071,407	7,163,115	8,419,889
Hills & Mountains						5,349,988	5,991,297	7,210,017	8,466,011	9,863,019
Tarai						2,906,637	3,421,699	4,345,966	6,556,828	8,628,078
Nepal	3,063,300	5,638,749	5,573,788	5,532,565	6,283,649	8,473,478	9,412,996	11,555,983	15,022,839	18,491,097

Source: CBS, Population Census Reports different volumes

Table 2. *Annual Growth Rate of Population in Different Period*

	1921-1911	1930-1921	1940-1930	1952/54-1940	1961-1952/54	1971-1961	1981-1971	1991-1981
Upper					1.38	-0.29	0.68	-0.01
Middle					1.26	2.44	1.67	-0.69
Lower					1.31	2.6	3.37	2.19
Total					1.33	1.33	1.86	0.63
Tanahun			-0.63	3.7	1.69	2.49		
Kaski				2.52	1.9	1.76		
Lamjung				0.88	0.63	0.69		
Kaski+Lamjung			1.96	1.69				
WestNo.3			1.14	2.28				
Western Hills	-0.18		1.46	2.31	1.54			
Mountain							1.36	1.02
Hills							1.67	1.62
Hills & Mountains					1.42	1.87	1.62	1.53
Tarai					2.06	2.42	4.2	2.75
Nepal	-0.13	-0.07	1.16	2.3	1.65	2.07	2.66	2.08

Table 3. *Number of family members and percent of absent population*

Region	VDCs	Total population	Absentee population	Percent of Absentee population
Upper	Parche	550	135	24.5
	Pasgaon	491	108	22
	Maling	528	143	27.1
	Total	1,569	386	24.6
Middle	Thumki	654	151	23.1
	Suryapal	493	111	22.5
	Total	1,147	262	22.8
Lower	Damauli	521	107	20.5
	Satiswara	493	99	20.1
	Total	1,014	206	20.3
Total		3,730	854	22.9

Source: Household Survey, 2000.

The growth rate between 1981 and 1971 declined drastically in the middle part of the watershed whereas the growth rate in the lower part of the watershed further increased from 2.6 percent to 3.37 percent. Between 1991-1981 population growth rate remained negative in both the upper and middle part

of the watershed whereas it remained higher than the national growth rate in the lower part of the watershed. During 37 years between 1991 and 1954, population increased by 1.14 times in the upper, 1.53 times in the middle and 2.45 times in the lower against 1.6 times in the Madi watershed and 2.18 in the country and 2.97 in the Tarai. Eradication of malaria along the river valleys after 1956; development of road network in the 1970s; development of service facilities such as health, and education; availability of culturable waste in *tars* (river terraces) along the Madi river; and opportunities for jobs in construction works in the newly developing market centres and settlements were some of the pull factor for such migration in the lower part of the watershed.

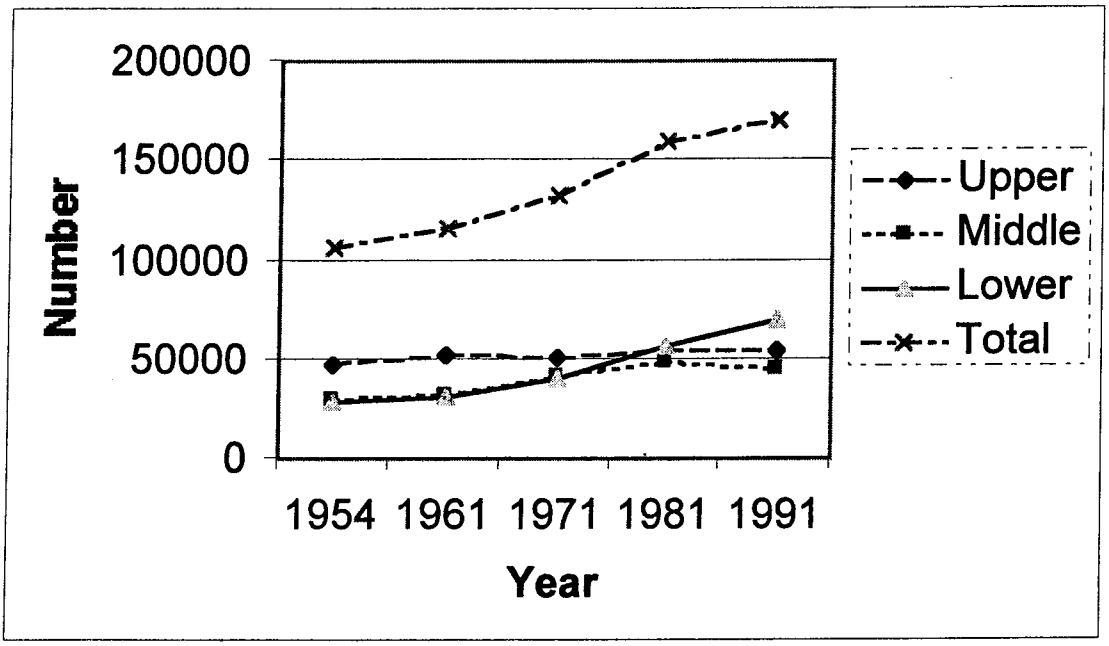

Figure 3. *Population in Madi Watershed*

Large-scale ridge to valley migration took place after the eradication of malaria even in the lower part of the watershed. Many old settlements located in the ridge such as Dabhung, Syamgha and Deurali in the lower and Phalyangkot and Jita in the middle part of the watershed have become virtual ghost villages. Similar processes of the shifting of human settlements from above 1,000 m altitude to below 1,000 m altitude have been reported in the upper part of the watershed. For example, Ghanpokhara which was developed after the migration of Ghale Raja during 14th or 15th century, has become a virtual ghost village and people dispersed permanently into the fertile river valleys (Messerschmidt 1976). Old settlements mostly located along the ridge top were clustered. Development of old settlements in such location had two purposes - defense and human health. The lower river valleys were prone to malaria and the north facing slopes were prone to other health problems such as asthma. So, these areas were avoided for human settlement by many ethnic groups except Bote, Darai and Kumal who were immune to malaria. Availability of water for drinking was another important factor in the establishment of the settlement. There was no plentiful water for drinking and other household use in almost all the settlements developed along the ridge top in the middle and lower parts of the watershed. The demand for water for family use increased significantly with the changing pattern of life style in recent years. This became one of the major push factors to ridge to valley migration. With the eradication of malaria and improved access to health services in the lower valleys, the fear from pest and diseases no longer existed. Improved access to market, water, health and education facilities and comparatively fertile soil in the valleys became major pull factors

in the valleys.

Emigration in search of job has been one of the strategies of the Nepalese hill farmers to minimize the risk of food shortages and rural indebtedness since the beginning of the 19th century. Large numbers of Nepali were recruited in British and Indian Army. The regiment was recruited mostly from among the Rais and Limbus in the eastern hills and Magar and Gurung from the western hills. During World War I, 200,000 Gurkhas turned up at recruiting camps of the British Indian Army and over 300,000 Nepali soldiers fought on the battlefield of World War II (Hagen 1998). It has been estimated that about 20 percent of the eligible male population served with the British during World War I (Kansakar 1974). The United Kingdom had begun cutting down on recruitment and also had begun phasing out the various regiments since 1970. However, new jobs were opened after the 1970s in other countries. At the same time job opportunities inside the country was also increased. In the past, employment opportunity in the British Army was confined to Limbu, Rai, Magar and Gurung ethnic groups. But the employment opportunities developed in other countries after the 1970s were open to all irrespective of ethnicity. As the result, the proportion of absentee population increased in almost all the villages in the watershed.

Survey of 556 household from 14 settlements located in different part of the Madi watershed in 2000, shows 23 percent absentee population. The percentage of absentee population in the watershed ranged from 20.3 percent in the lower part, 22.8 percent in the middle and 24.6 percent in the upper part (Table 3). The Census of 1954 reported only 6 percent of absentee population in Parche (Siklis and Khilang) whereas present survey shows 24.5 percent in this VDC. Similarly, the percentage of absentee population was only 6.65 percent in 1954 and 7.58 percent in 1961 in Pasgaon and it increased to 22 percent at present. The percentage of absentee population in Thumki was 7.91 percent in 1954 and it increased to 23.1 percent at present. Similarly, percentage of absentee population recorded was 6.06 in 1954 and 6.82 in 1961 in Dasthar including Maling, it increased to 27.1 percent at present. The percentage of absentee population increased from about 7 percent in 1954 to 20.5 percent in Damauli area and from 9.2 percent to 20.1 percent in Satiswara area in the lower part of the watershed. Present processes of such three to four times increase in the proportion of absentee population on the one hand and shifting of settlements from ridge top to valleys and from upper part to the lower on the other have significant implications in land use and land management practices in the watershed. The changes in land use and land cover in the watershed are discussed in below.

CHANGES IN LAND USE AND LAND COVER

One of the major characteristics of land use and land cover changes in Nepal throughout the history is the fluidity in agricultural, fallow, shrub and even forest cover as the results of frequent changes in the population size at local level and government policies on taxation by exploiting natural resources on the one hand and use of labour force on the other. Another important factor for such fluidity in land use and land cover is *lose* (shifting cultivation) culture of the people. *Lose* system was common until recent past among the Magar and Gurung communities who entered in this area before the 7th century. *Lose* was common in the lower part of the watershed 30 years ago and in upper part 10 years ago.

Land Use And Land Cover In The Past

The ruler in the past constantly encouraged farmers to reclaim the land for agricultural use by granting tax concession for some years in order to increase their revenue one the one hand and constructing irrigation canal and embankment using *jhara* labor (compulsory unpaid forced labor). Tax exemption normally for 3

years was granted as an incentive of reclamation of forest since the 16th century. Such provision further encouraged people to continue lose system with rotation more than 3 years. This system had three advantages to the local people. Firstly, the extra burden of state's land tax was avoided by cultivating with rotation of more than 3 years and secondly soil nutrient was maintained by burning vegetation and thirdly the fuelwood and fodder were obtained from these land in rotation with crops.

During the late 18th century, land reclamation task was given to individual contractor. Such reclaimed land was allotted to new person on payment of higher amounts. There are several places in the middle and upper parts of the watershed, which are named as Moharia, which means the use of coins. These areas might probably reclaimed during this time.

Frequent revision of land tax also caused fluidity between agriculture and wasteland. Arbitrary enhancement of land rent in the middle of the 18th century forced the farmers to abandon agricultural land. It is reported that even the rice land was left fallow in many areas of Kaski and Lamjung districts due to conflict between landlords and tenants in fixing land tax (Regmi 1978).

Farmers had to pay free labour to the state, landlords and other functionaries. There were three forms of compulsory unpaid labor - *jhara* (obligation to work for the government), *beth* (supply of field labor to landlords and local officials) and *begar* (supply of porterage service to government and its functionaries). The entire adult population had to render compulsory and unpaid labor services whenever required by the state. *Jhara* system was developed before the 15th century (Dhungel and Pradhananga 1999). People had to pay *jhara* obligation continuously upto three months in a year. One order issued in 1813 AD regarding *jhara* shows that people from Sikles, Khilang, Taprang and Thak located in the upper part of the watershed were asked to go to Lamachaur in Pokhara to construct irrigation canal continuously for three months. It has been reported that peasant who found the burden of *jhara* intolerable deserted their homesteads and village (Regmi 1978). Forced recruitment of Gurkhas by the British especially during and between the two world wars also resulted labor shortage in agricultural activities and agricultural production stagnated and even declined in the country (Thapa 1979).

Frequent shifting of houses and villages from one area to another also caused the fluidity in land use and land cover. Presence of well-terraced fields and ruined houses within the forest, shrub and grazing area at several places in the watershed is the evidence of such fluidity. Some of the previously abandoned fields have been recently cultivated and new settlements have been developed. Some of the areas such as Bangre, Mandre and Bhorle in the lower part in the watershed have been reclaimed again whereas in some areas well-terraced slope is left fallow since the early 20th century. Extensive area of such abandoned terraces is found in and around Phalyangkot and Jita in the middle part of the watershed.

It is not possible to quantify the extensification process of agricultural land in the past in the watershed. However, historical documents available within the watershed show that large part of the present day agricultural land had been existed before the 19th century. Though complete list of the permission to reclaim land for agriculture is not available, permissions to construct khet land (irrigated terraces) by developing irrigation facilities were granted to many people living in the upper part of the watershed between 1807 and 1823 AD. One document issued in 1813 shows that people living in the upper part of the watershed in Bhujung, Pasgaon, Yanjakot and Karapu had to pay 2,250 *muri* of paddy amounting NRs. 1,287 annually as land tax. This also shows that khet land was extensively constructed even in the upper part of the watershed.

The forest protection order issued in 1837 in the middle part of the watershed indicates severe pressure on the forest in that time. In 1837, the government issued an order to the people living in the

middle part of the watershed (Tandrang, Jita, Thansing, Karapu, Chisanku and Bangre area) not to cut trees in the government forest. Similarly another order was issued in 1860 for Kaski and Lamjung districts, which lie in the middle and upper part of the watershed to control the use of forest from the local people. It says that the ownership of forest has been transferred from government to the local people. Local people were asked to protect and manage the forest given to them. It was prohibited to cut green tree, to let forest fire, to clear for *khorea/lose* and to carry out hunting. It allowed collecting dried and felled trees and if the green trees are needed for the construction of house and public infrastructures such as inns and bridges the local community had to decide it. It also instructed to cut matured trees in thickly vegetated zone with strict control near the sources of water, temples and trails (Rivan-Chaur Nathu-Pralad Pariwar Samittee 1997). These evidences clearly show that problem of deforestation is not recent phenomena, it was felt in the beginning of the 19th century. Analysis of charcoal and humic materials in soil of Sirubari in Nuwakot and Junbesi and Phaplu in Solukhumbu shows accelerated deforestation in the 14-15th centuries in Nuwakot district and the 8-12th centuries in Solukhumbu district (Iwata et al 1996).

Before the 18th century the major crops grown were different varieties of dry rice (*ghaiya*), wet paddy, *kaguno*, *sama*, phapar (buckwheat), barley, *uwa*, wheat, cotton, mustard, pulses and lentiles. Maize and potato were introduced in Nepal in 18th century (Regmi, 1972). Maize became principal crop in the late the 18th century (Kirkpatrick, 1996; Hamilton 1990). The introduction of maize was widely accepted by the farmers. It made possible to grow two crops - maize and millet simultaneously in *pakho* land, which was not possible under *ghaiya* system. At the same time, the requirement of labor per unit of land was less than *ghaiya*. However, Ghaiya, Sama and cotton were grown well in *khorea* at the margin of prime agricultural fields or inside forest area and less prone to wildlife depredation. So, *ghaiya* was also widely grown in *khorea* in the hills and mountains until the 1960s. With the introduction of cheap ready made clothes from India, the production of cotton was also stopped after the 1960s.

Land Use And Land Cover Change After The 1950s

Land use and land cover statistics generated from the available maps at watershed and sub-watersheds scale is given in Tables 4-7. The accuracy of the statistics presented in these tables is yet to be evaluated because of the differences in the definition of land use and land cover categories on the one hand and the scale of mapping on the other. No objective definition was used for forest and shrub while preparing topographical maps. The scale of airphotographs was small (1:50,000). So, it is difficult to distinguish cultivated land left fallow for a short period and grazing. The minimum unit of mapping for the year 1979 was fixed to 25 ha and non-cultivated enclosures less than 25 ha were included within cultivated land. The map of 1957/58 was at the scale of 1: 63,360 whereas it was 1:50,000 in 1979; and 1:25,000 for the large part of the watershed and 1:50,000 for small part in the upper in 1996. *Khorea/lose* cultivation with rotation of 3 to 10 years was common 30 years ago in the lower and 10 years ago in the upper part of the watershed. So, comparison based on the photographs taken in one single year may not be accurate due to annual fluctuation in the size of cultivated land under khore/lose system.

Table 4. *Land Use and Land Cover in Madi Watershed (km^2)*

Landuse/landcover	1957/58		1979		1996	
	Area	Percent	Area	Percent	Area	Percent
Cultivated	218.1	19.4	312	27.8	283.1	25.2
Forest	638.5	56.8	557	49.6	619.6	55.1
Shrub	80.5	7.2	70.1	6.2	27.7	2.5
Grazing	na	0	48.5	4.3	64.8	5.8
Water and sands	17.6	1.6	11.3	1	22.9	2
Ice/snow	160.5	14.3	62.3	5.5	59.9	5.3
Landslide	8.3	0.7	2.5	0.2	11.3	1
Rock	na	0	59.8	5.3	34.2	3
Total	1123.5	100	1123.5	100	1123.5	100

Table 4 shows that cultivated area increased very rapidly in the watershed between 1957/58 and 1979 and declined in 1996. It increased from 437 ha per year between 1957/58 and 1979 and declined by 170 ha per year between 1979 and 1996. Similarly forest and shrub land in combination declined by 427 ha per year between 1957/58 and 1979 and increased by 119 ha per year between 1979 and 1996. Preliminary survey of the area shows that large part of the forest so far cleared between this period were regenerated forests after the abandonment of agriculture (*khrea/lose*) due to various reasons. Inflow of people from outside the watershed in the lower and middle part of the watershed in the 1960s was the main reason for such increase in cultivated land. Moreover, formulation of forest act to declare and demarcate forest area in 1961 and declaration of cadestral survey program to define and register ownership right of the land in 1971 also encouraged people to reclaim culturable waste land including forest in order to maintain the ownership right of the land. Cadestral survey was completed in 1975 in Tanahun (lower part of the watershed), in 1979 in Kaski (middle and upper part in the western section of the watershed) and in 1987 in Lamjung district (middle and upper part in the eastern section of the watershed) in 1987. Further encroachment in the forest for cultivation ceased after the completion of cadastral survey in the watershed. The magnitude and the pathways of land use and land cover change as shown by the maps differ within the watershed.

Constant increase in cultivated land and decline in forest and shrub land in higher magnitude is the major contemporary precesses in the lower part of the watershed whereas an decline in cultivated land and increase in forest area are the major processes after 1979 in the upper and the middle parts of the watershed (Tables 5-7 and Figures 4-7). Heavy outflow of farm households from the upper and middle parts to the lower part and urban centers such as Pokhara, Bensishahar and Kathmandu was responsible for such processes. Moreover, the implementation of Annapurna Conservation Program in the upper part of the watershed also became instrumental to control further extension of agricultural land into forest and other land use type. The Forest Act 1993 and Forest Regulation 1995 made the provision of seven categories of forests - national, government (managed by District Forest Office), protected, community, leasehold, religious and private. At present almost all the accessible forest nearby major settlements are under the community forestry scheme and local communities are given responsibility to manage these forests. Conversion of forest into other use has been strictly controlled. However, degradation of the government managed forest located far from the major settlements due to increasing demand for timber, fuelwood and fodder as the result of high rate of population growth was observed in the lower and middle parts of the watershed.

Land use and land cover type at household level is presented in Table 8. It shows very high

percentage (16.61 percent) of abandoned land at household level in the upper part of the watershed as compared to the middle (2.38 percent) and the lower parts (2.68 percent). The proportion of abandoned land even in the middle and the lower parts of the watershed are higher. Previously cultivated land located in the ridge and upper slope are left fallow due to increased distance from house to farm land after the outflow of people from the ridge and upper slopes to valleys. This proportion of abandoned land might be higher at village and landscape level since it was not possible to incorporate in the household survey to those families who had migrated to other areas by keeping ownership right of the land in the village. One study in Thumki VDC at different level ranging from household to village and in the middle part of the watershed using photographs taken during the field work and household survey shows an increase in the proportion of agricultural land left fallow from 3.6 percent at household level to 30.9 percent at village and landscape level (Thapa 2001). The reason for such a high proportion of abandoned land were the changes in the size of population due to outmigration of families; decreasing supply of agricultural labor at household level due to outmigration of able individual family members for employment and increasing involvement of children in schooling; decline in the availability of farmyard manure due to decline in livestock number; continued ownership right with absentee landlord; degradation of soil due to erosion, landslides and floods as the result of decreasing land maintenance activities; and increasing access to imported food items at cheaper price due to improvement in accessibility condition after the 1970s (Khanal 2000 and Thapa 2001).

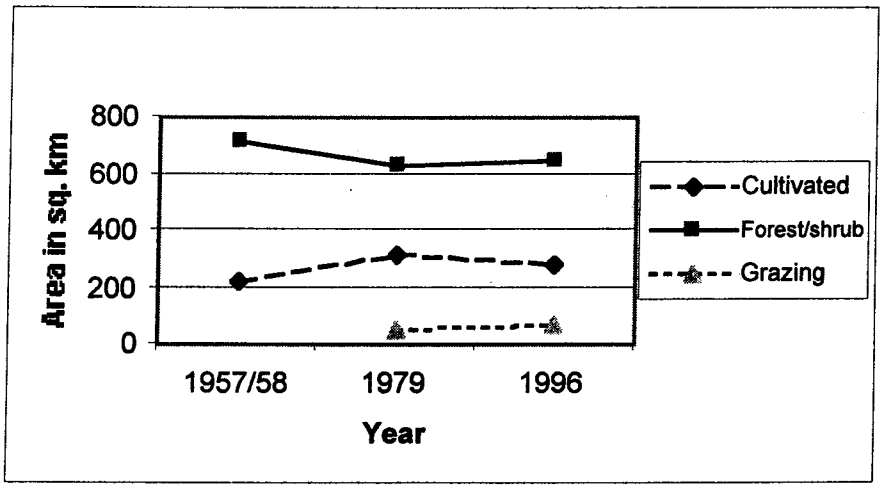

Figure 4. *Land Use in Madi Watershed*

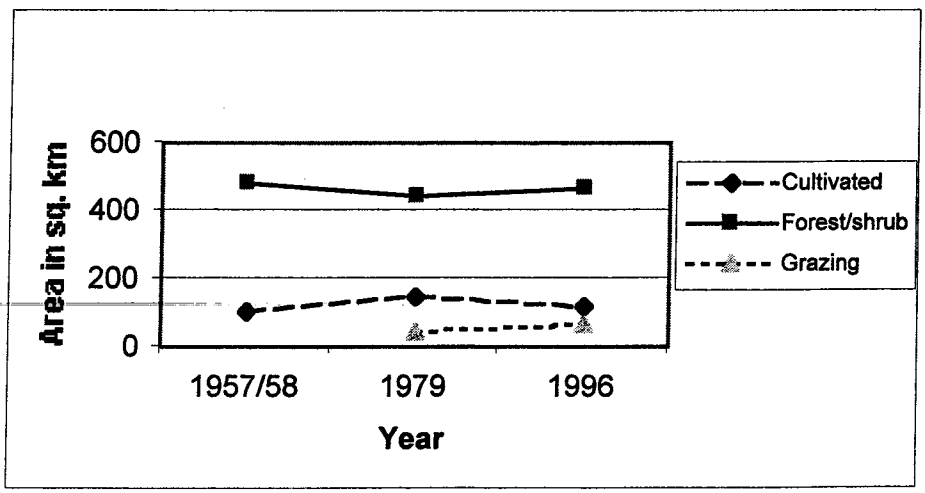

Figure 5. *Land Use in the Upper Part of Madi Watershed*

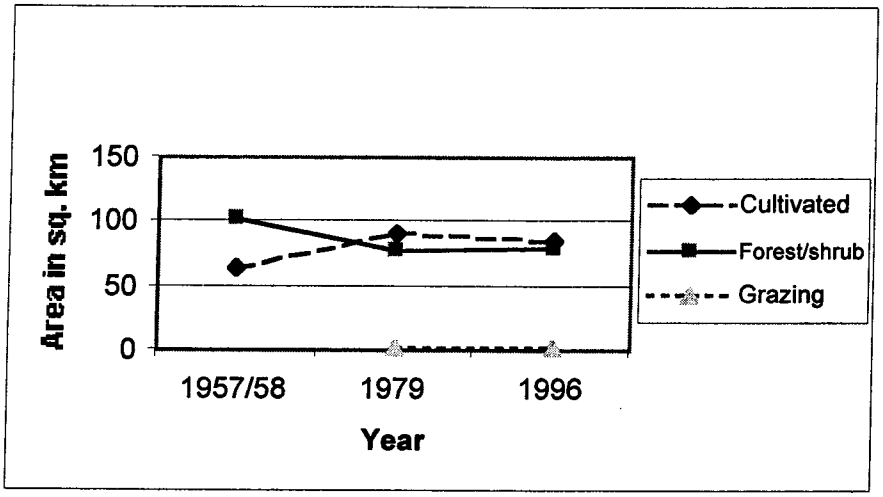

Figure 6. *Land Use in the Middle Part of Madi Watershed*

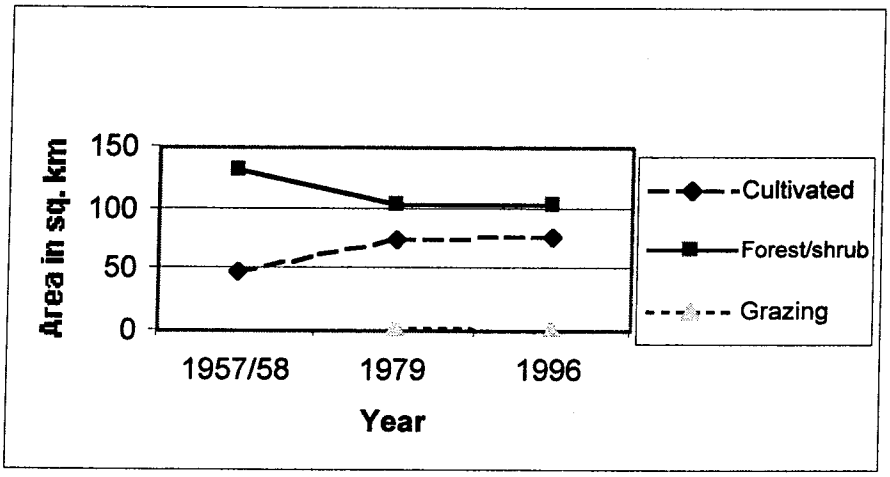

Figure 7. *Land Use in the Lower Part of Madi Watershed*

Table 5. *Land Use and Land Cover in the Upper*

Landuse/landcover	1957/58		1979		1996	
	Area	Percent	Area	Percent	Area	Percent
Cultivated	106.1	13.9	145.8	19.1	119.7	15.7
Forest	412	54	378	49.5	439.6	57.6
Shrub	72.9	9.5	67.8	8.9	24.7	3.2
Grazing		0	46	6	63.2	8.3
Water and sand	5.5	0.7	1.3	0.2	11	1.4
Ice/snow	160.5	21	62.3	8.2	59.9	7.8
Landslides	6.5	0.9	2.5	0.3	11.2	1.5
Rock	na	0	59.8	7.8	34.2	4.5
Total	763.5	100	763.5	100	763.5	100

Table 6. *Land Use and Land Cover in the Middle*

Landuse/landcover	1957/58		1979		1996	
	Area	Percent	Area	Percent	Area	Percent
Cultivated	63.8	36.8	91.8	53	86.3	49.8
Forest	98.9	57.1	76.8	44.3	80.2	46.3
Shrub	3.5	2	0.3	0.1	0.4	0.2
Grazing	na	0	1	0.6	1	0.6
Water and sand	6.1	3.5	3.4	2	5.3	3.1
Ice/snow		0		0		0
Landslides	1.1	0.6		0	0.1	0
Rock	na	0		0		0
Total	173.3	100	173.3	100	173.3	100

Table 7. *Land Use and Land Cover in the Lower*

Landuse/landcover	1957/58		1979		1996	
	Area	Percent	Area	Percent	Area	Percent
Cultivated	48.2	25.8	74.3	39.8	77.1	41.3
Forest	127.6	68.4	102.2	54.7	99.8	53.4
Shrub	4.1	2.2	2.1	1.1	2.6	1.4
Grazing	na	0	1.5	0.8	0.6	0.3
Water and sand	6	3.2	6.6	3.5	6.6	3.5
Ice/snow		0		0		0
Landslides	0.7	0.4		0	0	0
Rock	na	0		0		0
Total	186.7	100	186.7	100	186.7	100

Table 8. *Average size of holding by land use and land cover type (ha)*

Types of land	Upper		Middle		Lower		Total	
	Area	Percent	Area	Percent	Area	Percent	Area	Percent
1. Own Khet land	0.52	46.57	0.38	45.36	0.29	38.66	0.41	44.44
2. Own Bari land	0.31	27.71	0.37	44.05	0.38	50.6	0.35	37.22
3. Own Kharbari	0.06	5.42	0.06	7.26	0.05	6.17	0.06	6.04
4. Khorea land	0.01	0.54	0	0	0	0	0	0.32
5. Abandoned land	0.18	16.61	0.02	2.38	0.02	2.68	0.09	9.71
6. Own forest land	0.01	1.26	0	0.12	0.01	0.81	0.01	0.86
7. Waste land	0.02	1.9	0	0.36	0.01	0.81	0.01	1.29
8. Other land	0	0	0	0.48	0	0.27	0	0.22
Total land owned	1.11	100	0.84	100	0.75	100	0.93	100

CONCLUDING REMARKS

Abandonment of agricultural fields in the higher mountain slopes is not a new and peculiar phenomenon of the Madi watershed and Nepal. It is common in almost all parts of the mountain areas of the world. Such phenomena at higher rates, for examples were observed in the Pyrenees (Garcia-Ruiz and Lasanta-Martinez 1990, 1993) and the Swiss Alps (Walther 1986). It has become a very critical issue not only from economic point of view where more than 62 percent household in the watershed do not have enough production to meet their annual food requirement (Khanal 2000) but also from ecological perspective where soil erosion, landslides and floods are the major environmental problems. It is often considered that cultivated land after the abandonment reverts quickly to forest and environmental condition is improved. Study in other parts of the mountain area indicates that it is less likely to revert to forest in areas, which have been used intensively. Though some of the areas in the lower part of the watersheds like in Phoksing

and Tunibhnjyang are reverted into forest after the abandonment but in many areas in the middle part of the watershed left fallow at the same time or prior to this are in degraded condition. For example, the terraces near Phalyankot and near Jita were abandoned more than 50 years ago, but these are still in degraded condition without any trees. Piping, gullies, soil erosion and landslides in the absence of water and terrace maintenance are common geomorphic processes, which take place and are further intensified. One can see the damages of abandoned terraces in the form of landslip and landslides in the slope along the trail to Siklis.

Proper utilization of these lands could improve the economic condition of the people. Keeping in view, the scarcity of water in the ridge and the upper slope particularly in the middle and lower parts of the watershed, it is not possible to develop traditional crops which need higher amount of water by increasing only the labor input. Introduction of crops/trees which can grow easily even in drier condition of winter could help to develop these lands. For this, revision on the present ownership right of the land and efforts to transfer the technology and information are necessary.

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Lessons from the Nepal Mountaineering School

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ABSTRACT

Year after year, many tourists, trekkers and expeditions come to the Himalaya. They cannot start their journey without the assistance of local guides, sirdars and other service providers. It is not surprising, therefore, that the growth of mountain tourism implies radical changes in the economy of the most popular destinations. The impact of tourism, however, affects more than just the economy: while teaching in the Nepal Mountaineering School in Manang in 1989, 1991 and 1995, the author observed important changes in the environment and also in the behavior of the locals.

At the Mountaineering School, which was organised by the Nepal Mountaineering Association for mountain guides, our team discussed the natural and human ecology of Himalayan tourism destinations with the student guides. We found them keenly aware of the advantages of mountain tourism, increasingly cognizant of the disadvantages of the this traffic, and convinced of the importance of wildland ethics and environmental conservation.

It is very important to educate the local students about acceptable procedures for disposal of trash and human waste, proper choice of campsite, and non-destructive use of water and other resources. We found these lessons to be particularly important for local trekking and mountaineering organisations as well as the tourists themselves: plan ahead and prepare; concentrate impacts in the heavy use areas; disperse use and impact in the pristine areas; avoid places at the initial stage of impact; pack it in and pack it out; properly dispose of what you cannot pack out; leave what you find; and use fire responsibly. The students of Nepal Mountaineering School were imbued with the importance of the central principle of low-impact tourism: "Leave no trace!"

KEYWORDS: Ecotourism; education; environment; Himalaya; Manang; Mountaineering School; preservation; pollution; Sherpa

INTRODUCTION

"Everest is an aim, the school for mountain guides is a mission," said Kunaver, the leader of Yugoslav expeditions to the Himalaya. His great desire was that the inhabitants of the remote valleys under the world's highest mountains live a better life (Markic 1990). The high valleys do not have many inhabitants, yet they pay a high cost in lives for the foreign expedition members who long to enter the abode of the gods. Inexperienced and untrained, natives accompany foreigners high up to the dreaded peaks. After the death of a Sherpa on one of his expeditions, Kunaver said that the alpinists should teach Nepali climbing personnel how to minimize risk at high altitude (Savenc 1979).

Work toward the realization of Kunaver's dream got under way with the 1979 Annapurna expedition. Money to build a school for mountain guides in Nepal was contributed by the Executive Council of former Yugoslavia and the Solidarity Fund (Savenc 1979; Markic 1990). By now, the skills taught at the Manang Mountaineering School have already averted many dangerous falls from icy cliffs; many alumni have relied on techniques learned at Manang to find their way out of deadly glacier crevasses. The experience has also helped many graduates secure employment not just as porters and cooks but as guides and sirdars, and even invitations to participate as equals, on international mountaineering expeditions (Savenc 1979; Markic 1990).

More expedition members, trekkers, and tourists visit Nepal each year. These visitors bring not only money, but also many problems for the local people and the environment. It is important to stop the flood of litter and cultural pollution, to educate the locals how to protect their homeland and their culture.

I have served as an alpinist instructor in the Manang Mountaineering School in the Annapurna area on three occasions, from 1989 to 1995. During this period I have observed many positive changes. The students themselves generated a wealth of useful ideas as to how to conserve the natural resources and beauty. For the staff and students at the Manang Mountaineering School, reaching environmental awareness has been more important than reaching any physical summit.

MATERIALS AND METHODS

The Manang Mountaineering School is situated in the valley surrounded by Annapurnas III and IV, just half an hours' walk from the Hongde airport. Instructors taking part in the basic courses were from Slovenia, Croatia, Nepal, Germany, Switzerland, France, Poland and Canada. Most of the trainees were from Nepal (Markic 1986, 1987).

The curriculum at the Manang Mountaineering School comprises theoretical lectures, practical work, and technical training in ice, rock and snow climbing. Lectures cover geology and geography of mountains; flora and fauna of Nepal; meteorology; ecology and environment protection; history of mountaineering and alpinism; mountain hazards; mountaineering expressions and terminology; human physiology; nutrition in the mountains; hygiene; first aid; high-altitude illness; organisation of trekking and expedition; preparation for ascent; climbing gear; personal and technical equipment; clothes and boots; camping and bivouacking; mountain navigation (orientation); radio communication; mountain walking and climbing techniques; psychological characteristics of a mountain guide; description and evaluation of climb ascents; and guide-client relations. Practical work includes: self-rescue techniques; partner rescue; rescue techniques by conventional and improvised means; descending by rope; use of ice axe and crampons; first aid; rock climbing; ice and snow climbing; and orientation.

The theoretical lectures are followed by discussion. A more informal format was adopted as we trekked from Dumre to Manang: we were able to focus on concrete examples of fauna and flora, environment pollution, damaged and lopped trees, erosion, and landslides along the way. For teaching and learning we used climbing gear, navigation instruments, first aid kits, radio, and (when electricity was available) a slide projector.

Tourism and Human Ecology in the Himalaya

Human ecology is an interdisciplinary subject which encompasses the interaction of humans and their environment: nature, culture and technology are inseparable. Human ecology also includes the economics of sustainable development, or "economic ecology" (Pollak 1995). The interrelationship of Himalayan ecology and tourism can be perceived through analysis of the advantages and disadvantages of mountain tourism.

Nepal has been relying on tourism for its development because this sector is the largest source of foreign currency (Armington 1991). Tourism has provided food and employment to thousands of Nepalis. Tourism also offers a vital means of cultural exchange, useful to guests from the "developed world" as well as to the host society (Armington 1991; Pollak 1995).

Many of the disadvantages of tourism impinge on agriculture: fields along the tourist routes are vulnerable to degradation as a result of the diversion of labor from the tedious farmwork into the more lucrative and prestigious tourism services. Forests are cleared to serve needs of tourists accustomed to comforts that are luxurious by local standards.. Flowers, plants, insects and other wildlife are removed by

amateur collectors - activities that we feel should be legally restricted in mountain areas.

The advent of tourism has given impetus to the smuggling of cultural artifacts out of the country. Steps must be taken to counteract this trend, and to conserve the cultural heritage.

Mountain tourism has brought a widespread problem of solid waste disposal. Great quantities of trash can be seen in high mountain areas: human waste, plastic bags, cans, bottles, wrappers, tissue papers, napkins, and so on. The absence of facilities for solid waste management is the major cause of such contamination of the physical environment.

What Can Be Done?

The staff and students of the Nepal Mountaineering School urge the following steps:

1. Discourage consumption of luxury commodities in the mountains.
2. Encourage visitors to eat foods produced locally.
3. Discourage people from buying antiques and culturally-significant artifacts.
4. Do not collect or purchase fossils.
5. Discourage villagers from trafficking in wildlife products.

For more detailed recommendations, consult the publications of the Nepal Mountaineering Association and visit the Website of the Kathmandu Environmental Education Project (KEEP) at http://www.keepnepal.org/mission.htm.

We also recommend the conservation guidelines of the American National Outdoor Leadership School (NOLS). Its program and principles are appropriate for trekkers and expeditions, because they consistently represent wild-land ethics and low-impact backcountry adventure tourism and ecotourism.

Leaving No Trace: a question of attitude and awareness rather than rules and regulations

Low impact camping practices must be flexible and tempered by judgment and experiences. Consider the variables of each place: soil, vegetation, wildlife, moisture level, the amount and type of use, and overall effect of prior use; then, use these observations to determine which practices to apply (Golnar 1993; Jazbec 1999). Minimise your impact on the land and on other visitors, but make sure that you and your clients enjoy your/their visit (Pollak 1995).

Planning ahead and preparing means knowing what to expect, repackaging food supplies, having the proper equipment, and familiarizing yourself with the area prior to the visit (Azman et al 1998; Jazbec 1999). If you know that the destination is remote and has few visitors, you should be prepared to camp and practice stringent "leave no trace" techniques.

Respect Wildlife!

By travelling quietly you will be more aware of the environment and wildlife will be less disturbed in their territory. Give the wildlife plenty of space for their safety and yours (Pollak 1995).

Tourism impact on wildlife, soil and vegetation can be minimised by walking on marked trails. Walking outside the track, to avoid rocks or mud, break down the trail edge and widens the trail. Taking shortcuts instead of following switchbacks cause erosion.

Selecting an appropriate campsite is perhaps the most important aspect of low-impact back-country use. It requires the greatest application of judgment and information and often involves a tradeoff between conflicting objectives of minimising ecological and social impacts. A decision about where to camp should be based on information about the level and type of use in the area, the fragility of vegetation and soil, the

likelihood of wildlife disturbance, and an assessment of previous impacts.

At high-impact sites, tents, kitchen, and traffic routes should be concentrated on already impacted areas to avoid enlarging the area of disturbance. When leaving a campsite, make sure that it is clean and attractive to subsequent campers. Pick up and pack out all of your litter (Skerbinek 1983a, 1983b; Smreke 1989). On the way out, when your pack is light, try to pick up litter left by others.

Keeping food waste away from animals is important so that they do not become habituated to people as a food source and their normal activities are not disrupted.

Avoid Camping Close to Water!

We should not position tents, toilets, latrines, kitchen and other buildings close to open water. If we use an open water source, we should first take out water for drinking and cooking, then for watering animals, washing people, washing animals, and lastly for washing clothes (Smreke 1989; Pollak 1995). The primary consideration is to avoid contamination of water supplies. When washing yourself or your clothes, one should avoid allowing soap to enter lakes and streams, so it is best to minimise its use. Soap is unnecessary for most dish washing jobs.

Proper disposal of human waste is important to avoid pollution of water sources, to minimise the possibility of spreading diseases and to maximise the rate of decomposition. You need to choose an appropriate location far from water, campsites and other frequently used places. Toilet paper should be also packed out; otherwise, use natural undyed toilet paper.

Use Fire Responsibly!

Cooking should be done with kerosene or gas, not with wood.

RESULTS AND DISCUSSION

Biodiversity in Nepal is of such magnitude that the country itself can be considered one of the richest biopreserves in the world. The motivation to create National Wildlife Preservation Parks such as Chitwan, Sagarmatha, Langtang, Lake Rara and others, was the perception of an international demand that this treasure be maintained (Pollak 1995). Nowadays ecotourism has come into its own in Nepal.

Although visitors adore Nepal because of its natural beauty, they do not necessarily take enough care of it. If the visitors do not take care, the locals need to advise the visitors how to behave. As Golnar observes (1989) the most effective form of advice is to be a good example. You can be a good example only if you are well aware of potential negative consequences.

To show the people why we have to take care of the environment, we need to focus on all aspects of life: from health to culture and also to natural disasters such as erosion and landslide.

The knowledge disseminated by the school has already saved many lives and improved the quality of life for those who have been able to get good jobs in tourism services. But more important, it is making a significant contribution to the protection of the cultural and natural resources which constitute the basis of mountain tourism and the fabric of life itself for the host population.

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The Socioeconomic Dynamics of Farmers' Maintenance of Agrobiodiversity in the Lower Hills of Western Nepal

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ABSTRACT

Since farmers are the custodians of traditional crop diversity, understanding of farmers' socioeconomic circumstances is imperative for comprehending the underlying issues of erosion of diversity and thus initiating effective measures for curbing loss of valuable genetic resources. This study attempts to identify the socioeconomic factors associated with farmers' maintenance of crop diversity in the context of semi-subsistence economy in the western hills of Nepal. Research makes use of interdisciplinary approach comprising participatory rural appraisal (PRA), households' interviews and on-site observations. Multivariate regression measures were employed to examine the relationship between farmers' capacity of maintaining crop diversity and potential household resource variables, coupled with market as an exogenous factor. The study confirmed the hypothesis that crop diversity maintained on a farm is contingent upon a household's resource variables. Simultaneously, the study unraveled the dichotomy of diversity maintenance between market-proximate and market-distant domains leading to the inference that in the flawed policy environment, exogenous pressure exerted by the market have adverse effect on the maintenance of on-farm diversity. The findings have direct implications on the on-farm conservation progammes as to identifying potential grassroot stakeholders and locating the appropriate sites for on-farm conservations.

KEYWORD: Agrobiodiversity; species; land-races; gross cropped area; double-log model

INTRODUCTION

The agrobiodiversity on-farm is the outcome of the on-going evolutionary process managed by farmers and shaped by the heterogeneity of environmental and social conditions with which they contend. One of the fundamental features of traditional agricultural systems is diversity of crops grown (Harwood and Price 1976; Altieri 1987). The traditional farmers maintain agrobiodiversity for diversity of diet and income source, stability of production, reduced insects and pest damage, intensification of production with limited resources, optimization of natural resource use, minimization of risk and indigenous beliefs and rituals (Thurston et al 1999). Swanson (1998) conceptualizes values of agrobiodiversity into four categories: (i) expected agricultural yields, (ii) portfolio value, (iii) quasi-option value, and (iv)exploration value. Individual farmers pursue the portfolio value when they have few other assets to rely upon. With the growing access to markets, crop insurance programmes and other subsidy measures, portfolio value of agrobiodiversity appears to be redundant for the individual farmers and there is little incentive for maintaining diverse crops and livestock.

The maintenance of agrobiodiversity on-farm is confronting with various obstacles under the changing social and economic circumstances (Giempatro 1997; Smale and Bellon 1999). The rigorous review of Thurston et al (1999) indicated that market forces are increasing threats to traditional agrobiodiversity, and the increasingly higher opportunity cost of labour also lead to jeopardize the management of on-farm diversity, which involves labour-intensive tasks. Government policy bias towards certain commodities and devaluation of native crops and varieties, also limit the choices available to the farmers and thereby skews the decisions among them (Oosterhoot 1996; Sateesh 1996).

Apart from various exogenous forces, farm household's endogenous variables also come into play on

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Apart from various exogenous forces, farm household's endogenous variables also come into play on

the maintenance of agrobiodiversity on-farm. Shaxson and Taurer (1992) analyzed the effect of different household characteristics on diversity of cropping patterns on smallholder farms in southern Malawi. The result suggest that cropping pattern diversity has quadratic type of relationship with per capita cultivated land holding, while increase in labour availability over the production period is associated with more diverse cropping pattern.

Similarly, as observed by Zimmerer (1995) in the tropical-montane Paucartambo region in Peru's southern sierra, contingent socioeconomic and cultural conditions in the lives of the peasant households shape either maintenance or loss of native crop cultivars. He found that changes in the capacity of peasant households to allocate land, labour, and capital impacted differently on cultivars loss in the four crops studied: potatoes, maize, ulluco and quinoa. The cultivar loss in precocious potatoes belonging to the species Solanum phureja and slow-maturing maize were found to be associated with seasonally acute labour shortages, due to farmers' growing involvement in non-subsistence economic activities, especially commercial crop production (Zimmerer 1995).

RESEARCH METHODOLOGY

The study made use of an interdisciplinary approach involving participatory rural appraisal, semi-structured interviews group discussions and on-site observation during March and May 1999. Selection of study area was judiciously carried out such that the study could unravel factors associated with the farmers' maintenance of crop diversity on-farm. A few studies on the aspect of agrobiodiversity were found to be carried out in the middle hill context (Joshi et al 1998; Lohar and Rana 1998), and there are virtually no studies accomplished so far in the lower hill agroecosystems. Moreover, the lower hill agroecosystems represent the recent frontiers of agricultural expansion following the malaria eradication and opening of roadway. Therefore, these agroecosystems are of immense interest for understanding as to how farmers are responding to the rapidly altered socioeconomic circumstances and what has been the concomitant fate of agrobiodiversity.

With these perspectives in mind, two typical villages namely Damar and Dobhan in the Palpa District in the Western Nepal[1] were deemed appropriate. Figure 1 shows the location of Palpa District in Nepal and topographical map of the District. These villages are situated in two small, adjacent watersheds in the foothills of Himalayas. The former represents the market-distant site requiring over three hours' walk to get to the nearest Mahendra highway and further one-hour's journey by bus to the Butwal town; while the later site is dissected by Siddhartha highway and requires less than half an hour to get to Butwal town for the people living in road vicinity. Therefore, selection of these two villages allowed to the investigation of the effect of market proximity on the farmers' maintenance of crop diversity on-farm.

Some group meetings with farmers and village elite preceded the village surveys in order to explain the aim of the study and to get preliminary idea about salient features of farming systems. During subsequent meetings with the key informants, an inventory of the village was prepared which was used as a basis for preparing checklists of crops and livestock, and selecting farm households for surveys. By using the stratified random sampling, 50 households in Dobhan and 36 households in Damar representing large, medium and small holders were selected. During household surveys, existing crops as well as other

[1] *Western Nepal refers here to the Western Development Region of the kingdom. For administrative purposes, Nepal is divided into five Development regions. Each region comprises two to three Zones, which, in turn, comprise four to eight Districts. Altogether, Nepal has 14 Zones and 75 Districts.*

domesticated plants maintained by the corresponding households were recorded.

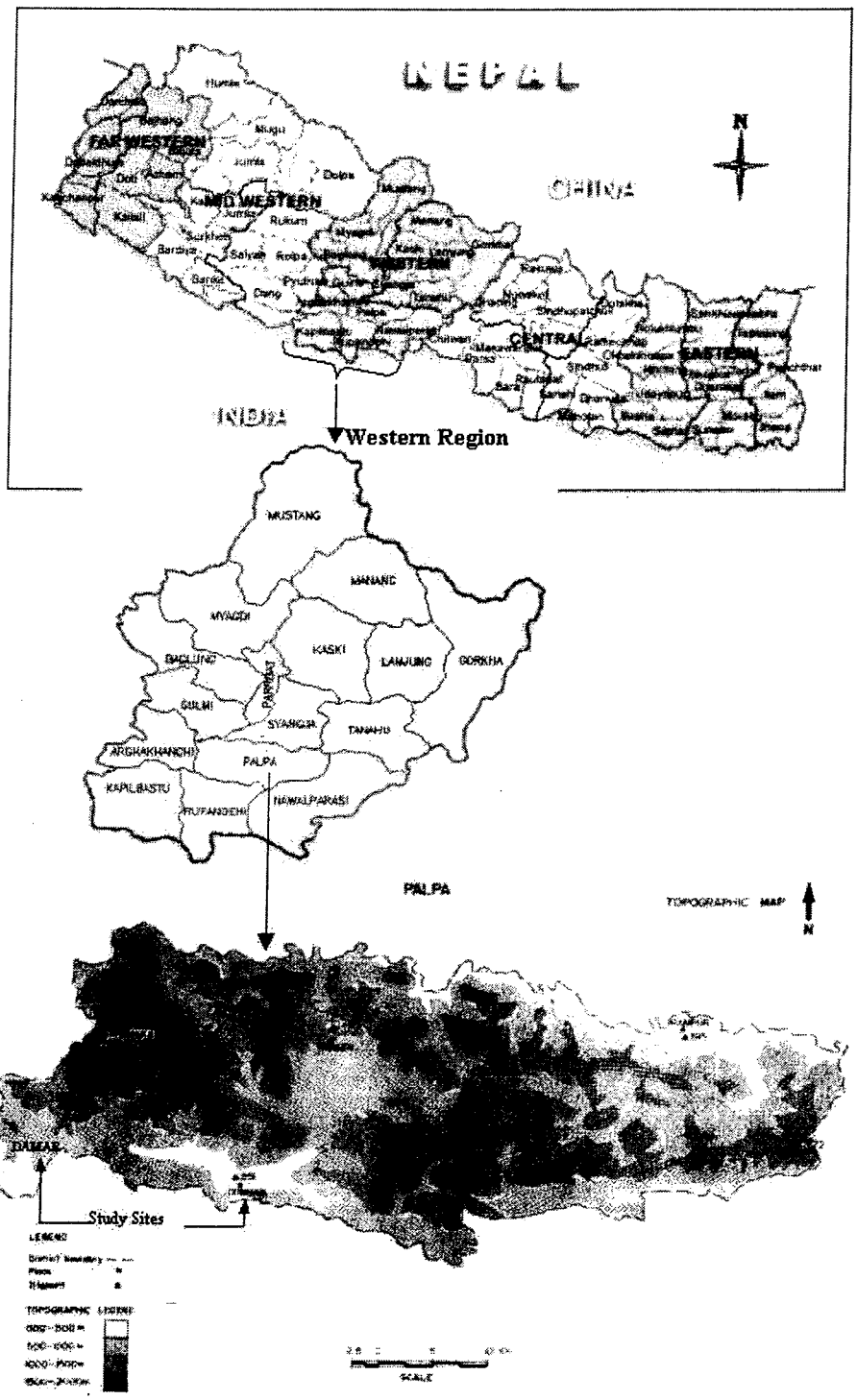

Figure 1. *Location of study sites in Palpa District in the Western Nepal.*

Two indices of diversity namely Species index and Variety index are used to express on-farm agrobiodiversity. Brief description of these indices are given below:

i. Species index (*S*):

The Species index is a simple count of the number of different crop and other economic plant species grown on each farm (Shaxson and Tauer 1992). Thus, this index expresses the on-farm crop diversity in

absolute terms.

ii. Variety index (V):

Analogous to the species index that takes into account species-level diversity, the variety index takes into account distinct cultivars or landraces that local people can discern. Accordingly, the total count of the crop cultivars maintained on each farm gives the variety index of that farm.

The framework of the study was conceptualized with the premises that maintenance of agrobiodiversity on farm is governed by various socio-economic and resources related factors, which the farm households confront with. Household's operational holding, labour force, ingenuity and economic well-being were considered as proxies of potential access to resources, which were deemed to be conducive to the diversity maintenance. Conversely, inadequacy of those resources was considered as resource pressure resulting in erosion of agrobiodiversity since the farmers with little access to resources may trade off their farm production with off-farm wages depending on their comparative advantage. It was assumed that the resource poor farmers generally opt to cultivate a few less risky staple crops, and purchase other minor crop products with their off-farm earning. Consequently, the agrobiodiversity in the resource-constrained farms is envisaged to be low. The number of distantly scattered parcels of land was also considered as another dimension of resource pressure for the farm households. Similarly, market proximity was taken as a proxy of socioeconomic pressure creating disincentive toward maintenance of minor crops and local land-races. These hypotheses led to conceptualize the following agrobiodiversity function:

$$Diversity = f(GCA, AGRLF, NPL, HHINJ, MKPT, ECON)$$

Where, ***Diversity*** denotes Species Index and Variety Index on each farm. The definition of the explanatory variables are in order, while their underlying hypotheses are discussed in the foregoing discussions:

i. GCA

GCA stands for gross cropped area, which is the sum of the individual areas of all plots planted to each crop. In other words, it is the product of total cultivated farm area and the cropping intensity of the farm.

ii. AGRLF

AGRLF stands for agricultural labour force of the household. Number of household members between 15 and 70 years of age, and mainly involved in agricultural activities is considered agricultural labour force of the household.

iii. NPL

NPL stands for the number of parcels of farmland owned by a household.

iv. HHINJ

HHINJ is the dummy variable denoting ingenuity of household head. The farmers regarded as the best in the eyes of their peers were taken as ingenious ones.

v. ECON

The dummy variable ECON stands for the economic well being of farm households. The farmers categorized as high-, medium- and low-income groups were expected to have differential capacity to maintain agrobiodiversity.

vi. MKPT

MKPT is the dummy variable, which stands for market proximity of the location.

After compilation of surveyed data, the model specification started with rigorous examination of the data

as to whether they meet the general assumptions underlying multivariate regression. Statistical software packages SPSS 9.0 and STATISTICA 5.0 were used for the analysis. The parsimony of the data was assessed through graphical as well as formal statistical techniques. The linearity in the data was examined through analyzing the residuals obtained after simple linear regression analysis and no apparent problem was detected. All dependent as well as explanatory metric variables failed to bear normality. This parsimony was successfully overcome by transforming the data into natural logarithms.

Assessment of variables was followed by the assessment of multivariate model. The log-linear model turned out to be reasonable one with very high degree of determination, while quadratic model failed to be borne out. Then the log-linear model was subjected to the test for multicollinearity and homoscedasticity. Based on the tolerance value, the variance inflation factor, pairwise correlation and other subjective measures, no multicollinearity problem was noticed in the model. Similarly, heteroscedasticity problem was also not evidenced through graphical as well as some statistical approaches described in Gujarati (1999), Studenmond and Cassidy (1992) and Hair et al (1995). The detailed result of tests of model parsimony is available in Khanal (2000). The variable NPL showed up as non-significant in all functional forms attempted including linear, quadratic and log-linear formulations, and hence dropped from the model.

Based on the hypothesis developed earlier, the on-farm diversity bears concave relationship with GCA and AGRLF. The hypothesis can be reiterated that as the household's access to land and labour increases, the diversity maintained per farm will increase initially in increasing rate until certain level and then will gradually level off. In line with this basic hypothesis, both quadratic as well as logarithmic functional forms were rigorously examined. The quadratic response was borne out only with respect to gross cropped area (GCA) in the quadratic functional form, and therefore, this form was compared with log-linear form. The degree of determination (R^2) in the quadratic form Species index and Variety index models were 0.82 and 0.77 respectively. Since dependent variables differed between quadratic and log-linear forms[2], the fitness of the models could not be compared based on the respective R^2 values. Therefore, comparable quasi-R^2 for the log-linear functional form were calculated by using following formula:

$$Quasi\ -R^2 = \frac{(\sum y_i \hat{y}_i)^2}{(\sum y_i^2)(\sum \hat{y}_i^2)}$$

where y_i and $\hat{y}_i$ are respectively the actual diversity and estimated diversity in the individual farm. The calculation procedure is found in Gujarati (1995, pp. 209-210) and Gujarati (1995, pp. 190 and 269). The quasi-R^2 values of Species index and Variety index models came out to be 0.97 and 0.95 respectively, which are exceedingly higher than the corresponding R^2 values of quadratic form. Having higher quasi- R^2 as well as the variables normalized, the log-linear functional form was deemed more tenable and hence its results are reported here. The model specification was:

$$\ln D = \alpha + \beta_1 \text{LnGCA} + \beta_2 \text{LnAGRLF} + \gamma_1 \text{ HHINJ} + \gamma_2 \text{HIGH} + \gamma_3 \text{ MED} + \gamma_4 \text{ MKPT}$$

where lnD denotes natural logarithm of species index and variety index, lnGCA and lnAGRLF are the natural log-transformed metric variables standing for gross cropped area and agricultural labour force of individual household respectively, and HHINJ, HIGH, MED and MKPT are the categorical variables that stand for household's ingenuity, high-income household, medium income household, and market

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[2] *Dependent variables in quadratic functional form are species index and Variety index, while those in log-linear form are natural log of Species index and Variety index.*

proximity respectively.

RESULTS AND DISCUSSION

The analysis results are presented in Table 1 and Table 2, which correspond to the prediction of Species and Variety indices respectively. The analysis of variance of the regression came out to be highly significant (p=0.000) with reasonably high degree of determination of the models (R^2 = 0.80 and 0.81). In other words, the models can explain over 80% of the variability in the diversity maintenance by the farmers, with nearly 100 percent certainty. As was hypothesized, the results bore out that potential household resources are the positive correlates, while market proximity is a negative correlate of on-farm diversity maintained by individual farm households.

Table 1. *Results of log-linear regressions of Species index (lnSpindex)*

	Unstandardized Coefficients	Std. Error	Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B		Beta			Tolerance	VIF
Constant	2.346	0.115		20.465	0.000		
lnGCA	0.219	0.037	0.390	5.978	0.000	0.595	1.680
lnAGRLF	0.159	0.047	0.185	3.402	0.001	0.862	1.160
HHINJ	0.421	0.051	0.429	8.276	0.000	0.944	1.060
HIGH	0.181	0.073	0.176	2.495	0.015	0.510	1.961
MED	0.244	0.050	0.310	4.894	0.000	0.630	1.587
MKPT	-0.235	0.041	-0.297	-5.718	0.000	0.942	1.062

R^2 = 0.800 SignifF = 0.000 Adjusted R2 = 0.784 Standard error = 0.1824

Table 2. *Results of log-linear regressions of Variety index (lnVarindex)*

	Unstandardized Coefficients	Std. Error	Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B		Beta			Tolerance	VIF
Constant	2.191	0.123		17.819	0.000		
lnGCA	0.287	0.039	0.456	7.318	0.000	0.595	1.680
lnAGRLF	0.200	0.050	0.206	3.985	0.000	0.862	1.160
HHINJ	0.515	0.055	0.467	9.435	0.000	0.944	1.060
HIGH	0.161	0.078	0.139	2.071	0.042	0.510	1.961
MED	0.214	0.053	0.243	4.011	0.000	0.630	1.587
MKPT	-0.185	0.044	-0.207	-4.189	0.000	0.942	1.062

R^2 = 0.818 SignifF = 0.000 Adjusted R^2 = 0.804 Standard error = 0.1957

Gross-Cropped Area and Its Effect on Diversity

Though the total acreage of land owned by the farm-household gives an indication of the household's access to land resource, land quality in terms of fertility and irrigation facility, is another dimension of land resource potential to be considered. The quality of land is obviously reflected by the intensity of cropping, which in turn is accounted for in the gross cropped area. Therefore, in the analysis, gross-cropped area that more closely reflects both quantity and quality of holding was taken into account as the resource variable. It was hypothesized that the households owning small gross cropped area would rely less on farm

production for their subsistence needs and that their farms would be less diverse than those of larger area holders would.

The results of regression clearly revealed significantly elastic relationship ($p<0.001$) between crop diversity maintained at farm level and the gross cropped area owned by the household. This implies that as gross cropped area per farm increases, so does the crop diversity on the farm in constantly elastic pattern rather than at constant rate. In the current case, to every 1- percent increase in the gross cropped area, number of crop species and varieties maintained per farm increases by about 0.22 and 0.29 per cent respectively, ceteris paribus. Such gross cropped area elasticity of on-farm diversity maintains a concave relationship between diversity and gross cropped area (Figure 2), as was hypothesized before. The graph clearly displays that, in response to increase in gross crops area while other variables held constant at their mean level, the variety level diversity increases more remarkably than the species level diversity. Conversely, as farmers' access to land resource shrinks, there is more threat to intra-species diversity than interspecies diversity of the crops.

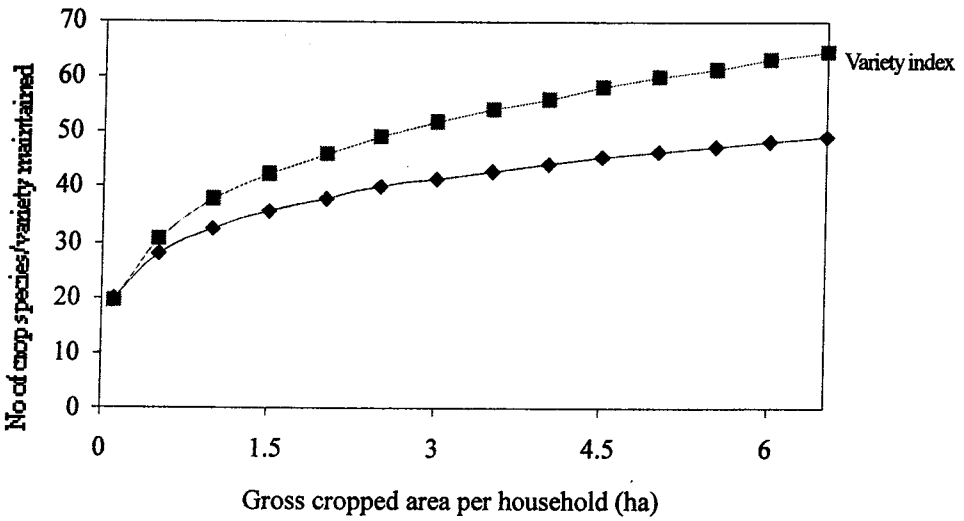

Figure 2. *Relationships between crop Species/Variety indices and gross cropped area per household.*

The small holding does constrain the choice of crops, and offers little incentive for managing farm because of limited capacity of livelihood support. Thus, it is quite apparent that threat to traditional agrobiodiversity will increase as the amount of cropland available per household is reduced. On the other hand, as operational holding increases, law of variable proportions (Samuelson and Nordhaus 1998) of the household resources comes to be operative resulting in leveling off of household's capacity to manage large portfolio of crop varieties. This finding has significant implications to the on-farm agrobiodiversity conservation measures. The farmers with reasonably large farm size can be the potential collaborators in the on-farm conservation programmes. Moreover, correction of land-related distortions, such as progressively increasing land fragmentation and highly skewed access to land resources, seemed to be precipitous for maintaining on-farm diversity alive in the long run.

Household's Labour Force and On-Farm Diversity

Management of diverse portfolio of crop species and varieties on-farm is a labour-intensive endeavour. Therefore, it was hypothesized that as agricultural labour force of the household increases, so does the crop diversity until the former reaches disproportionately high levels in relation to other complementary

resources. Additionally, it is generally observed that as labour force in the family rises, farmers tend to seek livelihood diversity by emphasizing livestock sector, local trade, and off-farm and non-farm earnings. As expected, the result of regression clearly bore out significantly positive ($p = 0.001$ for Species index and <0.001 for variety index) relationship between on-farm diversity and the number of economically active household members predominantly involved in farming. Like in the case of gross cropped area, both Species and Variety indices manifested concave response to the labour force of the household. The regression analysis shows that to every 1-percent rise in family members associated with farming, number of crop species will increase by 0.16 percent and variety number will increase by 0.20 percent, other things remaining constant. Figure 3 shows the relationship between the diversity indices and agricultural labour force of the household, while other predictor variables are held constant at their mean level.

This positive relationship between household's agricultural labour force and on-farm diversity implies that absorption of additional household members by the distant off-farm employment reduces the capacity of household to manage diversity. On the other hand, off-farm as well as subsidiary occupations are essential for household's prosperity. Development of allied rural sector such as small-scale food processing, appropriate rural cottage industries and generation of off-farm employment opportunities at local level can be a potential solution so as to rationalize this trade-off, since it allows the family members to contribute to their farm during off-hours. Moreover, the supplementary income derived from allied activities enables the households to invest on agriculture thereby bolstering the farm resources including agrobiodiversity.

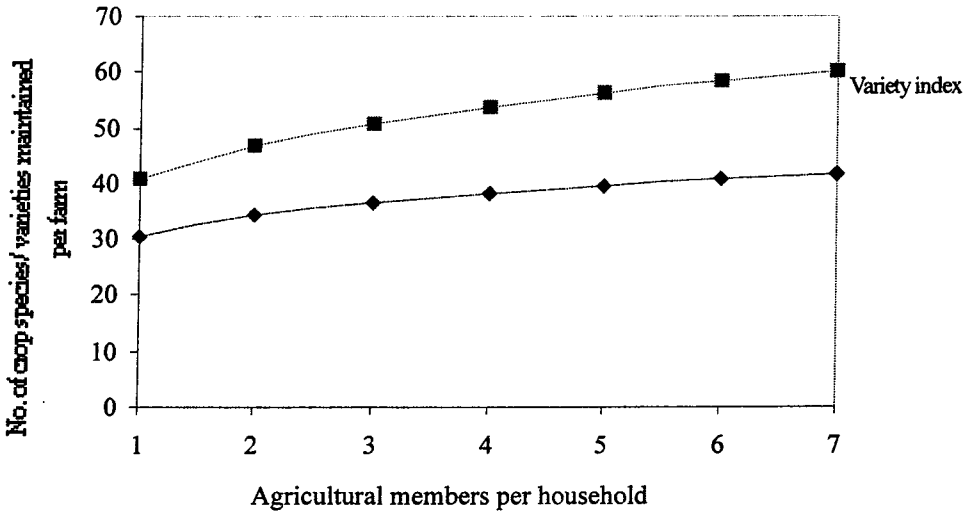

Figure 3. *Relationship between the diversity indices and agricultural labour force of the household*

Effect of Ingenuity of Household-Head on On-Farm Diversity

During the field surveys, some farmers were designated as the ingenious based on the perceptions of local key informants. The distinguishing characteristics of the ingenious farmers were their inherent interest in farming, diligence, and prudent resource management skills and comparative advantage of farming over other occupations in their access. Their motivations towards farming were reflected by their well-managed farms. In this research, it was hypothesized that farmer's ingenuity would be associated with his/her knowledge of minutiae of the farm system, of the microenvironment and the suitability of different crop species and varieties to different niches. Thus, diversity would be positively correlated with ingenuity of

household.

Taken as the categorical variable in the regression model, farmer's ingenuity appeared to be extremely paramount determinant of on-farm diversity. The statistical test is highly significant (0.001) both in the cases of Species index and Variety index. According to the model predictions, the ingenuous farmers will maintain about 42 percent more species and 52 percent more varieties than the ordinary farmers. Thus, such farmers hold great promise to be the key stakeholders in the in situ conservation of agrobiodiversity. Therefore, there is an urgent institutional imperative to support and encourage these farmers with appropriate recognition and incentive measures. In the agrarian environment beset with structural distortions such as skewed land distribution and bewildering tenancy policies, the most feasible in situ conservation approach becomes fostering of the local "centres of excellence" created and maintained by ingenious farmers.

Household's Economic Well-Being and On-Farm Crop Diversity

Although access to land resources is one of the indicators of economic well-being of farm-households, it is not the sole indicator. There are other vital indicators of farmers' economic characterization such as demographic status, and access to and types of non-farm sources of earning. Accordingly, the sample households were categorized into three economic classes: high-, medium- and low-income households, which are incorporated in the regression analysis as categorical variables. It was assumed that both high- and low-income classes would rely more heavily on non-farm or off-farm earnings, than medium class would. This tendency would be translated into agrobiodiversity management such that the medium income farmers would have more planned-diversity on their farms.

This hypothesis also was shown to be realistic in the regression analysis. It appeared that, ceteris paribus, the medium-income households could maintain about 25 percent more species and 22 percent more varietal diversity than the low-income group could. Similarly, high-income class could be capable of retaining species and varietal diversity level in the order of 18 per cent and 16 percent higher than the low-income households retain. Intuitively, it seemed that medium-income households' farms are more diverse than those of high-income ones, which is apparent with 7 percent more species and 6 percent more varieties on the formers' farms. This implies that the low-income group intensely confronted with economic and resource pressures could maintain scant diversity on the farm, while high income groups with better non-farm livelihoods also find less incentive in diversity management compared to the medium-income groups.

It is generally described that poor households are caught in a vicious circle that pushes them away from their farms in an effort to earn their living. The poor households can hardly carry out important farm activities in their farms in appropriate time, because they tend to seek off-farm wages and labouring opportunities in the rich household's farm in pursuit of much needed cash for daily food requirement. Consequently, their harvests are poor and in the following seasons they are bound to depend more on non-farm sources of income for their living. Thus, the poor household's farms are progressively neglected and the vicious circle continues. Obviously, the agrobiodiversity perils in such economically impoverished condition.

Market Proximity and On-Farm Diversity

Market proximity is assumed to reflect market signals in the choice of crop, and also assumed to have greater exposure to other external stimulus imparted by policy, access to information and off-farm

opportunities. In the absence of adequate publicity of traditional crops, the market favours the cultivation of few cash crops, thereby providing a disincentive toward the formers. Market proximity allowed more pervasive institutional interventions, which were unfortunately far removed from the local perspectives and mismatched with the local contexts and needs. Hence, it served as the proxy of exogenous socioeconomic pressure that leads to the lower diversity maintained per farm.

Having the research sites dichotomized as market-proximate and market-distant domains, the market proximity was incorporated in the model as categorical variable. A negative relationship between the market proximity and crop diversity maintained by individual household was clearly born out by the result of regression. With highly significant statistic ($p<0.001$), the result demonstrated that the crop species and varietal diversities maintained by individual household in market-proximate site were nearly 24 per cent and 19 per cent lower than in the market-distant domain. Experience shows that the minor crops which are devoid of policy and research support, are gradually cast aside as a result of the market-orientation of the production system. If this fate of minor crops is to be halted, there is a need of rigorous review of research strategies and intervention approaches; and traditional crops should be promoted in the marketplace through their nutritional publicity or other inherent qualities associated with them.

Number of Scattered Land-Parcels And On-Farm Diversity

It seems apparently logical that increased number of dispersed land parcels increases transaction cost and thereby reduces the resource use efficiency of the farmer. In the same token, it was hypothesized that number of parcels would hold negative relationship on the maintenance of diversity. However, the result having non-significant t-statistics, could not sufficiently support the hypothesis. There can be two reasons for this result. Firstly, farm-household can maintain desired portfolio of crop varieties in the parcels close to their homestead, which can mask the manifestation of negative effect of distant parcels. Experience shows that households having reasonably large parcel in the vicinity of homestead can manage wide array of field crops, fruits and vegetables. Secondly, the distance of scattered parcels from homestead can be another even more important dimension, which was not taken into account in this study. Therefore, the real effect of number of scattered parcels and their distances from the homestead on the management efficiency of the farmers deserves further research. The efficiency can be measured against factors' productivity, cropping intensity and agrobiodiversity maintained.

CONCLUSION

The on-farm agrobiodiversity is an important and measurable outcome of the farmers' behaviour. There is high degree of association between the crop diversity maintenance on the farm and household's access to resources. Both operational holding and agricultural labour force appeared to be the paramount on-farm resource variables determining the on-farm diversity. The low- and high-income households seemed to have lower diversity on the farm as compared to the medium-income households. Inter alia, ingenuity of household-head held special merit, thereby providing for local "centres of excellence" in terms of well-planned, high degree of crop diversity on the farm. In the absence of visionary policy support, the market constitutes an exogenous pressure, which counteracts with the farmer's strategies of crop diversity management, resulting in the extirpation of minor crops and traditional land-races.

The findings address some of the important questions pertaining to on-farm conservation of crop diversity. The first question the study addresses is what kind of farmers can be the key stakeholders for on-

farm conservation. Based on the findings, households with reasonably sized holdings, adequate family labour force, medium-level income status and demonstrated aptitude towards managing on-farm biodiversity, have the higher capacity and interest in the maintenance of crop diversity. The programmes and projects aiming at on-farm conservation should seek the farmers with such qualities and duly harness their potential for genetic resource conservation.

The second question addressed in the study pertains to location of on-farm conservation. The study found that market-proximity has negative effect on traditional agrobiodiversity and households with market access tend to retain substantially lower number crop species and varieties. So, on-farm conservation is likely to be more feasible in the market distant areas where farmers pursue their self-reliant livelihood through on-farm crop diversification.

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Chances of Protecting Middle Mountains Environments in Central Nepal from Pesticide Misuse Considering Socio-Economic Conditions

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ABSTRACT

To investigate the environmental risks of excessive pesticide use in market-near cash crop areas of Nepal, an interdisciplinary research project was started in 1999 at about 50 km east of Kathmandu. The project aims at developing an IPMS (Integrated Pesticide Management System). In order to meet the very complex environmental, agricultural and socio-economic problems a multilateral approach is pursued which combines several university and central research institutes of Germany, and governmental authorities and NGOs of Nepal. Research activities focus on assessing environmental conditions, farming practices considering rain-fed (bari) and irrigated (khet) land, cropping pattern, irrigation and pesticide application habits. Selected results are shown here. Since the intended recommendations for reduced pesticide application, which are planned to supplement the actually practised IPM (Integrated Pest Management) measures, need to consider the farmers' socio-economic situation. An inquiry of 200 farm households was carried out in order to provide the necessary information. Preliminary conclusions in respect to environmental risks and chances in a reduction of applied pesticide amounts are: (i) the environment seems to be less affected by pesticides than could be concluded from the high and frequent pesticide application quantities observed and (ii) household expenses on pesticides are negligible as compared to other expenses, hence an introduction of incentives for pesticide reduction would need thorough proof.

KEYWORDS: Mountainous agro-ecosystems; environmental conditions; pesticides; farming practices; socio-economic conditions; Himalayas; Hindu Kush-Himalayan (HKH) Region; Nepal

INTRODUCTION

Pesticide misuse is an increasing problem in the Hindu Kush-Himalayan (HKH) region. Excessive application of pesticides causes damages of environ-mental resources like water and soils, and health problems which affect both farmers and consumers. In order to mitigate direct impacts of pesticides and indirect impacts through food chain on man and environment, demands are being raised repeatedly for creating the political, scientific and educational fundaments and regulations, considering political, economic, agronomic and socio-economic aspects and practices for pesticide reduction.

Nepal is well aware of the diverse problems bound to pesticide misuse. This can be concluded from reports and publications by Klarman (1987), Baker and Gyawali (1994) and Dahal (1995) where the pesticide problem is comprehensively discussed. Additional governmental action to control the pesticide problem concerns the establishment of a National Pesticides Board through the Pesticide Rules established in 1994 that resulted from the legislative measure of the Pesticide Act of 1991.

On the other hand, the realisation of concrete pesticide reduction measures is above all a socio-economic and educational problem. Although the infrastructure to teach farmers in new technologies is quite well developed on the district basis in Nepal (as farmers' schools run by District Agricultural

Development Offices [DADO; cf. Figure 3]), still many obstacles have to be overcome with respect to proper pesticide use. The project which is presented here, is aiming at developing an adequate Integrated Pesticide Management System (IPMS) for Nepal and HKH region in order to mitigate pesticide impact on man and environment. Socio-economic conditions of the farmers community are considered, taking Panchkhal VDC in Jhikhu Khola catchment (JKC) basin as an example. This is located in the Middle Mountains near Dhulikhel at about 50 km east of Kathmandu. The study has started in 1999, and is performed in the framework of a three years Collaborative Research Project on Integrated Pesticide Management System (IPMS) in Nepal which is funded by the Volkswagen-Stiftung Foundation (Herrmann and Schumann 1999). The structure and organisation of the project will be shown, furthermore the decision pathways and legal/administrative boundary conditions for bottom-up regulation systems in the agricultural sector of Nepal.

RESEARCH PROJECT ON IPMS

Experimental Sites, Structure, Organisation and Environmental Conditions

An open and frequently neglected question in agro-ecosystem research in developing countries is to what extent the environment is affected by the misuse of pesticides. Therefore, to develop proper IPMS information here, the pesticide transport through the system under investigation is of main interest. Micro-scale experiments are performed on khet, ie, irrigated land on the governmental Horticulture Farm in Tamaghat and on adjacent farmers' land. Studies on small basin scale are carried out in two terraced khet and bari (rain-fed) catchment areas close to Tinpiple at 5 km from Tamaghat. Study sites are made up of loamy and sandy substrates, and are subject to cultivation of cash crops, ie, vegetables (irrigated and non-irrigated) due to market-near position, and to stable foods. The natural hydrological regime is controlled through the monsoon climate. Reliable basic hydrologic and climatic data are guaranteed by appropriate measuring network and recording system.

The simplified hydrological model in Figure 1 represents khet land, thus describing possible water bound pathways of pesticides through this system. A major hydrological problem consists of varying confined/semi-confined state of perched aquifers and of varying soil water saturation conditions according to season. Therefore, mathematical modelling of relevant water fluxes and water-bound pesticide transport which the project is finally aiming at will be difficult. Applications of the environmental (isotopes) and artificial tracer techniques (salts, heavy water, dyes) are used to support these intentions.

Figure 2 shows the thematic and organisational structure of the project which combines competent German and Nepali partners with PHYSHYD (Department of Hydrology and Landscape Ecology) of the Technical University of Braunschweig, Germany and DOA (HMG Department of Agriculture, Kathmandu, Nepal) as the focal counterparts in the participating countries. The influencing position of the project in Nepalese administrative structures is demonstrated in Figure 3. The project's two main goals are: (i) quantification of pesticide fate under specific environmental condition and development of future model scenarios for specific pesticide application patterns, and (ii) development and introduction of a knowledge-based decision support system for proper pesticide use in addition to the traditional Integrated Pest Management (IPM) measures.

The experimental data are assembled in a project data base with environmental (climatic, hydrological, pedological, geological etc.), land use and socio-economic data of which the latter are characterised in more detail below. The project's work programme is multi-layered. It starts with system analyses and the collection of basic data in the first phase, and becomes successively more integrative as

Table 4. *Seasonal area covered by different crops and crop yield (average per SHH).*

Crop	Tinpiple						Thamaghat					
	Summer		Winter		Spring		Summer		Winter		Spring	
	Area (ha)	Yield (t/ha)	Area (ha)	Yield (t/ha)	Area (ha)	Yield (t/ha)	Area (ha)	Yield (t/ha)	Area (ha)	Yield (t/ha)	Area (ha)	Yield (t/ha)
Rice	23.86	5.20			0.15	2.00	38.10	6.60			0.50	6.00
Wheat			6.06	1.91					1.50	2.20	0.25	2.40
Maize			0.55	1.70	9.97	1.96					15.25	2.80
Potato	0.05	19.20	14.65	17.48					26.70	21.70		
Tomato			0.36	16.55	3.86	6.30	0.15	16.70	0.45	20.00	7.00	14.00

The major external source for plant nutrients is farmyard manure, which is supplemented by chemical fertilisers such as urea (nitrogen 45%) and DAP (diammonium phosphate: nitrogen 18%, P2O5 46%). Supply shortage for fertiliser on national markets during the main growing season is a common problem. Amounts of plant nutrients applied to main crops are compiled in Table 5. Maximum rates found on main crops in Tamaghat (values for Tinpiple in brackets) are 387 kg/ha (221 kg/ha) for potato and 295 kg/ha (61.3 kg/ha only!) for tomato, whereas 112 kg/ha is very high for wheat in Tinpiple as compared to 7.2 kg/ha in Tamaghat. Excessive fertiliser doses are applied for several vegetables grown on limited area only, and which are not considered in Table 5. For example average rates are 887 kg/ha for chilli and 400 kg/ha for bittergourd in Tamaghat.

Table 5. *Doses of fertiliser and farmyard manure (FYM) used on main crops.*

Crops	Tinpiple		Tamaghat	
	Fertiliser (kg/ha)	FYM (t/ha)	Fertiliser (kg/ha)	FYM (t/ha)
Rice	25.0	14.0	74.4	30.6
Wheat	112.0	3.0	7.2	0.2
Maize	60.8	26.0	10.8	1.7
Potato	220.8	136.3	387.1	70.1
Tomato	61.3	6.7	295.0	24.7

Use of Pesticides

In general, Nepalese farmers have a preference for highly toxic insecticides with broad-spectrum activity which result in immediate knockdown of pests. A long list of pesticides have been approved by HMG Department of Agriculture. In Nepal, everybody is allowed to sell, buy and use toxic chemicals. There are many dealers of pesticides in the country, many of the sold products are imported from India and are, very often, of doubtful quality, or expiry dates are lapsed. In this respect, Baker and Gyawali (1994) inform comprehensively about these problems with pesticides in Nepal.

All sample farmers in Thamaghat and 97% of those in Tinpiple are found to use pesticides on standing crops in the fields. Nearly 20% in Tamaghat treat seeds with pesticides which need to be stored for several months. This is not practised in Tinpiple. Pesticides are applied to all crops found in Table 3, except to wheat and maize. Table 6 comprises the most frequently used insecticides (Dichlorvos, Fenvalerate, Dimethoate) and fungicides (Mancozeb, Hinosan), and informs about doses and frequencies. Presently, the by far most frequently used fungicide is Mancozeb which is applied by at least two third of the SHH to potato and tomato. Less than half the SHH at both study sites use insecticides on rice. At first site, the applied amounts are not really excessive as compared to European standards for example. But it is questionable to what extent farmers' answers to enumerators are reliable in this respect due to miss

knowledge of proper evaluation of amounts of masses or volumes, ie, how frequent over-dosage of specific pesticides is done. Furthermore it must be looked upon the question to what extent pesticides accumulate in the environment considering application frequencies and amounts. To investigate the environmental pesticide residues is a primary objective of this project.

Pesticide application criteria farmers use are the presence of pests or their damage symptoms (or both), with the damage symptoms being the most frequent criterion. This is above all explicable in case of potato late blight disease caused by a fungus which cannot be seen by naked eyes. Very often however pesticides are applied preventively which may be one explanation for frequent too short waiting period (grave in the case of tomatoes) between the last application of a pesticide on a crop and the date of its harvest. Average waiting periods of the farmers after the application of Mancozeb, Fenvalerate and Dimethoate are summarised in Table 7. They are too short in both research sites for tomatoes as compared to recommended waiting periods (by Plant Protection Directorate of DOA), ie, the harvested vegetables are on average not safe for human consumption.

Table 6. *Recommended rates for pesticide application (in g/Ropani, active substance) and actually applied rates according to survey (Figures in parenthesis indicate % of the total households). One Ropani (R) = 521 m^2 = 0.0521 ha.*

Crop	Mancozeb		Dichlorvos		Fenvalerate		Dimethoate		Hinosan	
	Amount (g/R)	Frq. (No.)	Amount (g/R)	Frq. (No.)	Amount (g/R)	Frq. (No.)	Amount (g/R)	Frq. (No.)	Amount (g/R)	Frq. (No.)
Amount/Frq. intervals (days) rec.*	72.9 – 100.0	every 7-10 days	15.6 - 52.1	every 5 days	13.0	every 10-12days	15.6 - 36.5	every 12-14days	1.6 - 2.6	every 15 days
Amount/ Frq (No)./ vegetation period rec.**	75.0	8	Only in gas form	1	1.6	2	12.5	1	Not known	Not known
				Tinpiple						
Rice			10.7 (16.6)	1.1	11.5 (5.8)	3.2			18.3 (2.5)	1.3
Potato	34.8 (64.1)	7.7	11.5 (3.3)	7.2	13.5 (10)	5.3	8 (0.8)	15		
Tomato	38.3 (65)	9.6	15 (6.6)	7.8	13.7 (25)	7.7	8.8 (12.5)			
				Tamaghat						
Rice			12.6 (16.2)	2.2	19.1 (7.5)	1.8	10.2 (21.2)	1.8	15.9 (20)	1.6
Potato	32.5 (98.7)	8.8	12.2 (6.2)	8.2	7.1 (8.7)	8	12 (6.2)	8.6		
Tomato	36.3 (60)	10.9	10.5 (38.7)	11.1	10.9 (13.7)	11.3	10.7 (8.7)	15		

**as recommended by Plant Protection Directorate, DOA, HMG, Nepal*

***BBA (2000): Verzeichnis zugelassener Pflanzenschutzmittel (Index of authorised pesticides). http://www.bba.de/ (Germany)*

Although Tamaghat male farmers have a comparatively good school education, know-how about proper crop-specific type and use of pesticide, methods of application and precaution measures for health hazards is little developed. This is worse among women and true for both sexes in Tinpiple. On average, knowledge about proper precaution measures and health risks is most largely spread among SHH in Tamaghat (45%) while this applies to only to 22% in Tinpiple. Protective devices are almost never taken. This may explain why almost 1/3 of the respondents from Tinpiple suffer from headache after pesticide use, and some of them from additional symptoms like nasal bleeding, cough or dizziness and others. On the other hand, only 7% of the Tamaghat respondents mentioned such symptoms. As to public awareness, 67% and 85% of the respondents in Tamaghat and Tinpiple, respectively, knew about the possible side

(Figure 5b). To cope with food deficiency, farmers adopt various strategies such as working as on-farm or off-farm labourers, temporary migration to other places in search of jobs, and doing miscellaneous activities.

DISCUSSION

Farmers' expenses on pesticides are negligible as compared to the almost 15 times higher expenditures on chemical fertilisers for instance. Therefore, from economic point of view, possible incentives offered to farmers for a pesticide application reduction have to be multiple of the pesticide cost itself. Presently pesticides are not subject to import tax. A similar finding is generated on economic macro-scale, ie, on national level using a data base which was established from different sources like World Bank, Asian Development Bank and Central Bureau of Statistics. Since the economic value of pesticides is minor, no political support can be expected for a pesticide reduction programme, more specially since an introduction of import taxes on pesticides and hence an accomplishment control are measures unlikely to be taken by HMG Nepal (Wiebelt 2000).

Cost of pesticide use as referred to micro- (farm) and macro- (nation-wide) levels include direct and indirect expense as shown in Figure 6. On national level, indirect costs caused through health damages and through environmental damages are of primary importance considered on long-term. Gomboso and Thomas (1998) recently demonstrated how complex environmental cost-benefit analysis is, having calculated the cost of agricultural groundwater pollution in Australia. It seems, however, that similar calculations for developing countries is still lacking.

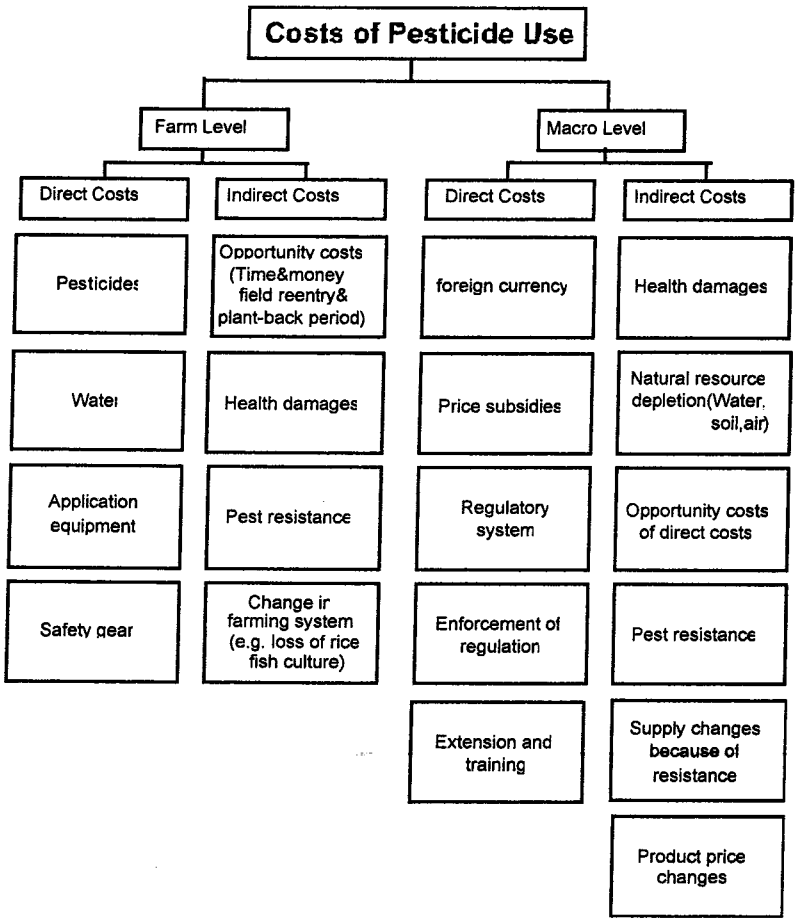

Figure 6. *Costs of pesticide use on micro-(farm) and macro-(national) levels (Source: M. Wiebelt, Institute of World Economics at Kiel University)*

Since Nepal has already established a functioning agricultural extension system on district scale (as demonstrated with Figure 3) the Nepali government should be encouraged to set up respective pesticide regulation system on the basis of its Pesticide Act of 1991, furthermore to enforce extension and training capacities and programmes in this field. This would contribute to mitigate or even prevent environmental damage caused by pesticides, since, at present state of investigations, they cannot be excluded.

CONCLUSIONS

Results from this study on environmental hazards caused through the use of pesticides do not really invite to stop applying uncontrolled quantities of xenobiotics to the sensitive mountainous environment under investigation. However, one should notice that the investigations still continue.

Hence, the following conclusions are still preliminary:

- First results show, that the environment seems to be less affected by pesticide use than could be concluded from the high and frequent pesticide application quantities observed.
- Feasibility of measures for environmental protection regarding pesticide use is difficult due to lack of money, resources and control instances and the relative economic unimportance of pesticides.
- Household pesticide expenses are negligible as compared to other household expenses, hence an introduction of incentives for pesticide reduction would need thorough proof.
- Human health risks caused through pesticide application without the use of adequate protection measures or precautions still remain, since investigation on this is not included in the project's work-scope. Lacking precautions also comprise too short waiting periods between pesticide application and crop consumption.
- The educational status of the population allows detailed information on pesticides use and Integrated Pesticide Management (IPM). Farmers' schools are an adequate mean but the present farmer exposure is too low. If farmers could be convinced to reduce the use of pesticide and to apply Integrated Pesticide Management (IPM) measures, this would benefit, the environment and man, since his food chain would be better protected.

Finally, it should be pointed out that the existing regional infrastructure of the Nepali government on the district scale is a good basis to better enlighten the farmer about hazards and risks of excessive use of pesticides, and to instruct them on proper choice and use of pesticides.

ACKNOWLEDGEMENT

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Understanding Territorial Mobility in the Himalayas: An Application of Genealogical and Life-History Approach

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ABSTRACT

Territorial mobility in the Himalayan kingdom of Nepal reflects ecological, economic and political processes. Using a genealogical and life history approach this paper demonstrates how genealogy of a clan combined with life history of its member of current generation can be used as a valuable source to describe the direction and socio-economic context of territorial mobility in the Himalayan environment in Nepal. Understanding the pattern of territorial mobility with the help of residential shifts of successive generations and its socio-economic and politico-cultural context is a complex process. Over time, mobility in the rural areas in the Himalayan kingdom reflects people's shifting concern from mere survival to more of a concern for the utilization of all possible external opportunities. The overall process reveals a consistency in terms of patterns, directions, and a concern for similar ecological conditions and/or better resource endowment areas. However, the national and local context within which the mobility process in the Himalayas has operated over generations has been different.

KEYWORDS: Territorial mobility; Genealogy; Bhattarai clan; life history; survival strategy; ecological process; political process

INTRODUCTION

Human territorial mobility is as old as human history. This process not only mirrors events in history of a country but also mirrors social, economic and political situation of the area concerned. Similarly, movers are not only individuals who are member of a household but also member of social, cultural and clan group. History suggests that each social or clan group ordinarily occupies specific locations at least for some generations. Numerical prominence of a particular ethnic and/or clan group at specific locations within specific district indicates continuity of this practice (see also Gurung 1998). However, over generations when the clan population grows in a particular area, it is natural that some members continue to stay there, ie, in the areas occupied by their forefathers while others adventure for new locations. Genealogy of a clan group is a valuable source which, when combined with identification of places adventured and lived, highlights the history of the clan on the one hand and addresses contemporaneous ecological, demographic and social process at work on the other. One of such process is territorial mobility for which genealogical information is very useful especially when longitudinal understanding of this process is considered.

The main purpose of this paper is to demonstrate how genealogy of a clan can be used as a valuable source to describe the direction and ecological plus socio-economic context of territorial mobility along the hills in Nepal. Understanding the pattern of territorial mobility with the help of residential shifts of successive generations and its socio-economic and politico-cultural context is a complex process. For this, while details on the current generation are necessary, particulars of previous generations and their concurrent context of movement are critical. While Nepali society is an ethnic cauldron comprised of more than 100 caste and ethnic groups (Dahal 1995) and that caste groups being more mobile than ethnic groups historically (Subedi 1993), genealogy of one of the caste clan is assumed to provide more detailed pattern of mobility compared with those of ethnic groups. While genealogy is the documentation of historical context, individual life histories are illustrative of more details of persons in their different roles as a

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member of the household (eg, Racule 1985). When information obtained from these two sources are combined, they not only reveal details of rural mobility: historical and contemporary, but also the social, political, and economic context in which mobility occurs.

In rural agricultural societies, the socio-cultural processes that have influenced mobility have endured. An examination of customary and contemporary life styles of individuals and households in these societies suggests that mobility has continued to be an essential component of life from historical times. Because socio-cultural processes are so integral to life in the village, mobility related to these processes is often overlooked and thus, taken for granted. As a result, this form of movement has become less visible. The impact of economic processes, on the contrary, is distinct and mobility related to economic concerns is clearly noticeable. Moreover, a focus on economic concerns leads to an impression of mobility as a recent occurrence. In other words, the idea that mobility is primarily concerned with economic motives i.e., need for cash, and that the need for cash and a search for a more comfortable life is a recent phenomenon dominates the literature.

APPROACH

Tracing genealogy of a clan back through time and space is one approach to uncover the pattern of mobility over time in the Himalayan environment and the various processes at work for such outcome. However, merely finding out the names and numbers of descendants and their marriage partners in respective generations provides no clue to the mobility of clan members and their family. What are needed are the details of the residential shifts of each generation at major stages of life. Although human territorial mobility in the Himalayas is part of tradition, this does not mean that the processes at work have remained the same throughout history. Societies transform through time; human mobility reflects this and societies in the Himalayan environment are no exceptions. Documentation of territorial shifts of clan members over time helps reconstruct history and unravel internal and external processes leading to socio-economic changes there.

Genealogy is a rich source to get longitudinal data on ecological and demographic processes such as territorial mobility. However, clan genealogies are rarely used to illuminate the patterns of mobility in history elsewhere in general and in Nepal in particular. In fact, an examination of the literature on genealogy suggests that its use is primarily limited to providing a way of fixing the position of the individual being studied in the kinship system, and explaining the origin of different types of kinship nomenclature and lineage system (see earlier study by Evans-Pritchard 1940). Likewise, genealogies have also been used as a tool to analyze social structure (Barnes 1947) and are crucial to decipher accurate accounts of biological relationships. The Tokelau study is a succinct example of this (Huntsman et al 1986). Genealogies are hardly used to analyze a wider range of demographic processes than the usual investigation of linguistic nature.

In recent years, attempts have been made to trace and record the *Vamsawali* (genealogy) of some clan groups in Nepal. The main concern in these attempts has been to find out the names of ancestors and generations passed between the current household and the farthest records available. The residential location of previous generations is not a necessary element of the inquiry. Similarly, all these details thus far come from oral tradition. The details neither provide pattern of mobility nor the context in which specific activities have taken place in the past.

Several settlement studies have used clan genealogy to explain the territorial evolution of functionally segmented settlements in North India (see Singh 1968, 1977). However, genealogy as a source to analyze

the process and pattern of mobility has had very limited attention. Lauro (1979) pioneered its use to analyze the demography of a Thai village more than two decade ago and Singhanetra-Renard (1982) used genealogical details to analyze the pattern of Northern Thai mobility. More importantly, a study of mobility in Fiji, found that genealogical details were very helpful to assess the impact of structural elements on mobility (Chung 1987).

Likewise, it is suggested that this movement set in its historical and concurrent political context reveals much about contemporary society. In its entirety, in the studies of migration and mobility in Nepal, the use of genealogical and life-history approach has been lacking. An attempt is made in this paper to describe the direction and ecological and socio-economic context of movement of clan members from western Nepal into Namsaling, a village located in Ilam district of Eastern Nepal. It is believed that by tracing the place of origin of the residents back through time, the general direction and the context of people's movement along the Himalayan environment in Nepal is captured.

THE METHOD: THE COLLECTION OF GENEALOGIES

This paper is based on material collected during 18 months fieldwork conducted in Namsaling, a remote village located in Ilam district of Eastern Nepal. It describes the direction and ecological and socio-economic context of movement of clan members from western Nepal to Namsaling. It is believed that by tracing the place of origin of the residents in Ghumaune and Yakhagaun, two village hamlets in Namsaling, back through time, the general direction of population movement along the Hills of Nepal is captured. A number of caste and ethnic groups have been living in this village for several generations. During the fieldwork, genealogy (patrilineal) was collected for four clans who had had been living there for several decades and who had sizeable population in the village hamlet. These clan included Adhikari, Bhattarai, Pokhrel and Subedi. However, for only one clan, ie, Bhattarai, reliable details of mobility for more than 10 generations was available. Apart from finding out the names of earlier generations which helped fixing the position of the individual being studied in the kinship system, and explaining the origin of different types of kinship nomenclature and lineage system, the focus was on finding out the place of residence of their previous generations for as many generations as possible, number of family members in each generations and place of birth for each of the siblings.

The area under study is part of South Asian society, which is rich in oral tradition. Written documents about clans, their cultural practices, linkages with others are not available. Whatever information exists is based on oral tradition, ie, whatever information is passed to new generations orally. Formal education and schooling is quite a recent phenomenon in this society. As a result, many heads of the household were not informed about where their forefathers had lived. No registers such as baptism registers (eg, Chung 1987) or parish registers (eg, Hagerstrand 1975) were kept in this area. Whatever was available about previous generations is solely based on the memory of informants.

As stated earlier, no written documents of genealogy of this clan was available at the time of survey, let alone shifts in residential location of past generations. Thus, information had to be based on memory of the elderly, knowledgeable persons and clan's socio-cultural interaction with others living elsewhere. As a result, some discrepancies due to memory lapse cannot be overruled. The main intention of this paper is *to demonstrate how genealogy can be successfully used to illustrate the pattern of territorial mobility in Nepal.* The present place of residence, ie, Ghumaune, Namsaling, has been taken as the point of reference from which residential shifts of past generations of Bhattarai clan have been traced based on the memory and other available documents that this clan possesses. In addition to information obtained from senior clan

members from Namsaling, visits were made to several other places such as Ilam municipality, Jhapa and Kathmandu and information from elderly there were also collected.

In a society where most members are not comfortable about articulating their parent and/or husband's name, collection of genealogies is a very challenging task. The most common way of identifying individuals is by their birth order in conjunction with locality. Too poor knowledge of informants about their clan genealogy is a limitation. While a few household heads and senior members were well informed about their clan histories, many had little or no idea about their ancestry.

Despite ample use of genealogical details (biological) in rituals and social functions of the households, the documentation of past generations is not common in these areas. They are widely used in rituals such as *shradda* (annual ritual in tribute of deceased parents, grandparents and/or immediate clan members) and in the arrangements of marriage partners. In arranged marriages every attempt is made to avoid the marriage between those who may have been genetically related. Likewise, the names of all the deceased up to six generations are essential to commemorate *shradda*. But for all these purposes the place-based details are not needed and it is only the name and relation to the current head that matters. The process of collecting genealogical details is tedious, time-consuming and at times, frustrating because discrepancies on information about previous generations do occur as investigations go deeper in history and when verification is very difficult.

Interview and informal discussions were used as method of data collection. In Namsaling because of rural setting with very informal (easygoing) inter-household relations plus author's long acquaintance to this area, most interviews were conducted in the evenings after meal. A few senior members also knew clan history of their relatives and neighbors and thus were invited to participate in such interviews and discussions. In reality, such knowledgeable elderly were the primary informants in the process. A group approach was an effective way to collect detail information related to residential shifts of particular generation. The advantage of having three or more senior people participating in the discussion is that, not only does the discussion become livelier, but also particulars related to one clan in turn arouse similar details of other clans.

The Bhattarai clan is selected to illustrate historical mobility of Nepali along the hills. It is a dominant clan group and is relatively advanced compared with other clans in the settlement hamlet in Ghumaune, one of the several settlement hamlets in Namsaling. In addition, details obtained for this clan are more reliable and cover longer span of time than many others. For this clan, details traced (including place of residence) were consistent up to fourteen generations, which covers more than two centuries and thus, is considered sufficient to unravel an understanding of the process of mobility and its intergenerational change, spatial as well as temporal along the hills of Nepal. Beyond this, details become less clear. Apart from Bhattarai clan, information from other clans such as Adhikari and Pokhrel are also used to illuminate the context of territorial mobility in Nepal at places in this paper.

TERRITORIAL MOBILITY AND HISTORY OF CLAN'S SHIFT IN RESIDENCE

Tracing territorial shifts of clan members over time helps to reconstruct historical mobility and unravel internal and external processes of social transformation. This is important because processes at work leading into mobility of people have not remained the same throughout history. Bhattarai clan, which is taken as illustrative of mobility pattern in this paper claim that historical evidences reasonably link this clan (and many others) to a place called Kanyakubjya, known as Kannauj today, in North India in the seventh century. Such a claim is supported by at least two common practices in the village. Firstly, all the Brahmins

in this area consider themselves as *Kanyakubjya Brahmin*, which means the ancestors of Brahmins were once settled in Kanyakubjya (see also Sharma 1982). There are stories passed on through oral tradition to this effect. Secondly, the use of place (origin) based recognition to identify the newcomer household is a convention in regular conversation in the rural areas in Nepal (see Subedi 1993). For example, a household that has come from Bhojpur is normally recognized as Bhojpure. Likewise, household with Assam as origin will be recognized as Assame and the like. These practices clearly suggest association of the clan under investigation with Kanyakubjya during historical times.

From Kanyakubjya to Far-western Nepal

Because Kanyakubjya (India) is the place to which ancestral residence of the Bhattarai clan is linked, a brief account of the incidents that resulted into movement of caste groups towards the north and northeast is relevant. Historical records suggest that Kanyakubjya was the center of political, economic, and social activities during the sixth and seventh century AD in North India. 3 Several dynasties ruled this area. However, Harsha Vardan of the Vardan dynasty became more famous than others because of his social reforms in the early seventh century. He did not have dynastic heir. Thus, after his death in 647 AD, Arjuna, one of his prudent ministers, ascended the throne. During that time a Chinese delegation led by Wang Huan Tse (Qing?) came there. For some reason, Arjuna strongly objected to the delegation. This incident enraged China. China, with the assistance of 'Nepal', declared war with Kannauj and defeated Kannauj. Arjuna was imprisoned and taken to China. For several years following this incident, Kannauj went through a period of chaos and instability. As a result, many inhabitants from *Kanyakubjya* moved into the northern hills. The process of leaving Kannauj continued for several years as the successive dynasties of Varman, Ayudh, Pratihar and others governed this area (for details, see Sharma 1982). The ancestors of Bhattarai clan were probably one of many clan groups to leave Kannauj during this period.

The fragmentary evidence in various historical accounts after the seventh century does not always correspond. It is likely that these Brahmins settled in the Northwestern hills of India for some generations before they entered Nepal. The entry of many caste groups from north India across the Mahakali river (western border of modern Nepal) to Nepal during the eleventh and twelfth century AD has been documented (see, Kansakar 1974). It coincides with Muslim invasion in North India and because of the invasion, caste groups attempted to escape. It is probable that these immigrants were descendants of the group who left Kannauj.

The Bhattarai clan consider themselves Brahmins whose ancestors came from Kanyakubjya. Their tradition that they are Kanyakubjya Brahmins and the historical evidence of instability in Kannauj followed by Muslim invasions indicates that they are likely to be one of many clans who entered Nepal around eleventh and twelfth century. In all the likelihood, they must have continued their move towards the eastern hills once they entered Nepal.

From the Far-west to the West (Gandaki Areas)

Territorial mobility of Namsaling's Bhattarai clan can be reliably traced back to fourteen generations, which links them to Lamjung. The precise interpretation of history and complexity of the movement process is difficult and it remains an unfinished story. Figure 1, however, illustrates the mobility of Bhattarai clan through space and time, which in turn reflects general dispersal of caste groups and the direction of population mobility along the hills of Nepal in recent history. The dispersal follows a sequence of time. In each time period there was a complex of processes within which the movement was a reflection

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of one or more processes. Within each period a combination of processes operated but one or two were rather dominant.

Figure 1 illustrates that several processes and contexts at work collectively through time and over space. While it narrates history, the portrayal of the direction of territorial mobility is integral to it. More importantly, the figures within each triangle are illustrative of the demography of genealogy, whereas the particulars on the margins elucidate the social, economic, and political context within which mobility occurred. This in turn, is a reflection of the whole process of territorial mobility as it relates to long-term shifts in residence along with the history of a clan.

While this figure clearly demonstrates the pattern of territorial mobility along Nepalese hills in the 18th and 19th century, it also reflects the processes at work facilitating territorial mobility in general in the Himalayan kingdom of Nepal. The figure should also be interpreted cautiously and the fact that the figure shows movement of successive generations towards east should not mean that the whole clan group or the whole settlement moved. At least one out of the total male descendants (figure within triangle) of that generation is reported to have moved to the following station. The rest are likely to have lived at the place for several generations. How long the "stayers" lived in the particular place is beyond the scope of this study. Nonetheless, the voter lists of national elections published from time to time by Election Commission shows that many of their off springs have been living in these locations even at present.

Viswa Nath's clan, ie, Bhattarai clan (Δ1, Figure 1), who has been living in Namsaling (Ghumaune) for some generations, has been traced back fourteen generations to Lamjung. Before coming to Namsaling this clan has lived in at eight distinct 'stepping stations' in coming from Lamjung. While up to four generations have been spent at some 'stations' (eg, Δ8-11 and Δ1-4, Figure 1), there are 'stations' where not even a single generation spent their full span of life (eg, Δ11, Figure 1). In a regional sense, this clan appears to have crossed three major areal clusters or regions. In other words, territorial mobility of this clan along the hills has proceeded in steps and has followed clear regional pattern with three regions. These three regions are Gandaki (Lamjung, Gorkha), Kathmandu (Nuwakot, Kathmandu, Sindhu) and Koshi (Okhaldhunga, Bhojpur). It is likely that they may have come to Lamjung somewhere from Karnali region if speculation is made based on the history of Nepal (Regmi 1979).

From West to the Center (the Capital areas) and to the East

Territorial mobility from one region to another roughly relate to the historical events and actions of then government. While the coming of Kathmandu revolves around unification campaign, the following movements were associated with state policies. For example, an informed elderly person from Jhapa had this account about his ancestor who lived around the seventeenth century:

> Rishiswor, the son of Shiveswor, was born in Nuwakot. During his early years, he came to Kathmandu for an adventure. There he got an opportunity to serve the royalty of which he later became an employee. He was awarded Sindhu (Sindhukot) as *birta* to acknowledge his distinguished service to the royalty. In his later years, he moved to his birta and settled there. All of his descendants are said to have lived there for at least three generations after which Nandikeshor, one of his offspring moved further east.

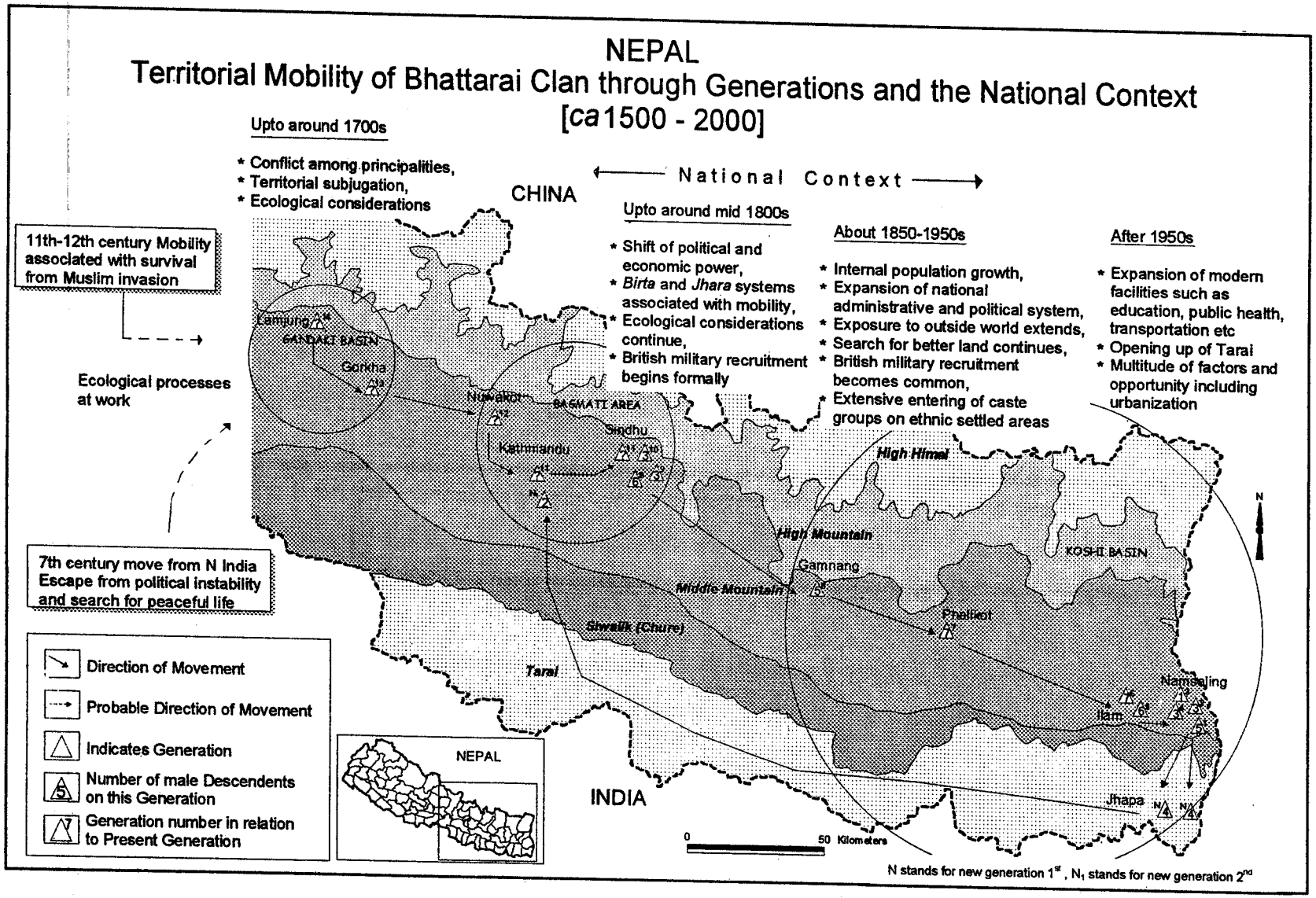

Figure 1. *Territorial mobility through generations in national context, Bhattarai Clan from ca. 1500 to 1990*

From Sindhukot members of this clan moved to Gamnang, Okhaldhunga. In particular, Nandikeshor, great grandson of Laxmi Das, son of Rishiswor (Δ8 Figure 1) moved to Okhaldhunga in 1757 AD. His movement was also closely tied to the practice of *birta* system. Nandikeshor received *birta* land in Gamnang (Okhaldhunga) from Hem Karna Sen. The *birta* system played an important role in shaping the pattern of mobility in the past. The essence of *birta* was clearly stated in the owners document as '*rasti rasai basti basai khanu*' which loosely translates as 'to open up (utilize) the area and to develop settlements.' It is a system of land grants initiated by the rulers and was common during the seventeenth and eighteenth centuries. *Birta* land was primarily new land. The parcels were often large and their produce sufficient for several families. Thus, it was common for the owner to encourage relatives and others to settle there and develop the area.

Persons awarded birta were the foundation of the state's social and politico-administrative structure. These land grants were usually awarded to priests and religious leaders (Brahmins), members of the nobility and chiefly class (Chhetri), soldiers and persons who served the royalty. *Birta* ownership was also symbolic to higher social and economic status on the part of recipient; while for the rulers, it was a means to extend political control of territory. Thus, it became instrumental in promoting mobility.

Up until lately territorial mobility of this clan has been in an eastward direction along the middle hills. This trend is typical of territorial mobility in the Himalayan environment. There are several reasons for this. First, areas south of the middle hills were densely forested and malarial, then a deadly disease. Second, areas north of middle hills were mountainous. The terrain was rough and rocky and was frequently covered with snow. Earning livelihood for these *pahadi* (hill) people who were so much part of rice culture, the mountainous north was like a 'region of refuge' to adventure for residential shift. Third, since the caste groups came from the west and had escaped from the Muslim invasion in the past and that east was ecologically better, wetter and suited for rice cultivation, going back towards areas of remorseful memory, ie, west, was unthinkable. Fourth, these caste groups had better agricultural skills than the locals and there was ample scope for agriculture towards east.

After being at Okhaldhunga for two generations, chronicle suggests movement of one clan member further east to Bhojpur where he comes into contact with *Kirants* (local ethnic group). *Kirants* were not hostile to the new comers. Thus, the adjustment was relatively easy and quick. Arable land was abundant and land colonization was not difficult. More importantly, since these in-migrants were part of 'rice culture,' farming was integral to them from generations. Thus, these in-migrants had better agricultural skills and were enterprising compared with the locals. From Okhaldhunga some members of this clan moved to Phalikot, Bhojpur then to Ilam bazaar (district headquarters) and finally three generation ago members of this clan came to Namsaling where there are more than 50 households at present.

The Himalayan Kingdom of Nepal was consolidated into a single nation, by the second half of the eighteenth century. The nation was politically stable and there was reasonable security of life. The population grew and the central government in Kathmandu expanded its administrative and political activities. The government had deliberate policy if sending administrative personnel to these newly consolidated areas to supervise law and order. Agents sent from the center were normally members of the Brahmin/Chhetri group. They move with their families and were joined by relatives, friends and clients in a form of chain migration. In a short span of time, *parbatiya* (Indo-Aryan) culture emerged dominant in the hills and the life ways of local ethnic groups begun to turn into low-key.

After 1500 AD up to the present, the pattern of territorial mobility has remained consistent. People shifted their place of residence at many times (Figure 1); clans colonized an area and lived there for some generations. Some clan members continued to stay there, but some adventurous member moved to look for a 'better' place elsewhere. This was a normal pattern of life in history and today's diversity of caste and ethnic composition throughout the hills of Nepal is illustrative of this. studies of the evolution of Rajput clan settlement elsewhere in North India suggest similar findings (see Singh 1977).

SOME INTERPRETATIONS OF DIRECTION AND CONTEXT OF CLAN MOBILITY

The Bhattarai clan has continued to spread over space and through time. The number of generations the clan remained at each location varied. Individual factors had much to do with their shifting of locations but more important was the concurrent local ecology and socio-political circumstances. As noted earlier mobility of clan members in history is the outcome of the interplay of various processes. Different generations responded to different sets of contextual factors. As circumstances changed over time, individuals responded to each new situation. While these processes are not mutually exclusive, at each point in time one factor emerges dominant. Overall, four main interpretations of historical mobility of the Bhattarai clan emerge important. They include: I) mobility as a survival strategy, II) ecological processes and mobility, III) mobility as an outcome of national political processes and, IV) mobility related to other processes and personal factors.

Mobility as a Survival Strategy

One interpretation of mobility is that it was a strategy to ensure the survival of the group, its lifestyle, and economic livelihood. An examination of the mobility history of clans suggests that these concerns usually developed in progressive order.

Mobility as a survival strategy has attracted much attention in the study of nomadic society (Stenning 1957) and aboriginals (eg, Young and Doohan 1989). Mobility in agricultural societies is also interpreted likewise (see Breman, 1985; Mukerji 1985). The movement of caste groups from Kannauj through the hills of Nepal reveals survival as a primary rationale. It was a survival strategy for clans and their lifestyles. History suggests that inter-group hostility and territorial encroachment was common in the past. Many people were forced to move and find a secure place in these circumstances. The collective concern of group survival and the security from external enemies was the prime concern and individual behavior was motivated by these factors. Consequently, it is likely that historical shifts in residence were closely tied to the survival and security of groups and clans.

Mobility that occurred before the rise of the house of Gorkha, ie, up to the 1700s can be interpreted as that of survival strategy. It is during this period that the ancestors of the Bhattarai clan left Kannauj, entered western Nepal and settled there. They felt unsecured when Kannauj was involved in war and subsequent turmoil. The Muslim invasion further aggravated their peaceful living there. Whereas the departure from Kannauj can be interpreted primarily concerned with survival, the main concern after entering western Nepal during the eleventh and twelfth century was with preserving their customary lifestyle. This period was characterized by the Muslim invasion in north India. Not only were the lives of Hindus (primarily Brahmins and Rajputs) threatened, but also their customary lifestyle and beliefs were in jeopardy. For those who did not conform to the norms of the invaders, the only option was to leave. A concern for personal survival and for the survival of customary lifestyle consequently led them to the western hills of Nepal.

In the western hills, these groups came into contact with the *Khas*. *Khas* language and culture were

similar to that of these immigrants, but the *Khas* did not follow caste rules strictly. According to the *Manu Smriti* (code of Hindu behavior) *Khas* rulers were to be treated as low caste because of their neglect of caste rules. The immigrants on the other hand, were orthodox Brahmins and could provide priestly services and elevate their caste status. The total population of the *Khas* kingdom was small, and only a fraction of the potential agricultural land was brought under cultivation by then. Thus, the trade off was easy. The immigrants provided priestly services and elevated the *Khas* to the status of Chhetri, second to Brahmin but powerful in state affairs. In exchange, the rulers provided land to settle and cultivate.

As external threats disappeared, the domestic survival and progress of the clans and households became principal concern. Economic pursuit emerged as an important consideration of life. Possession of large amount of land now translated into a secure future. Consequently, clearing more forestland and moving to colonize better land became important. However, the spatial extent of colonization was often limited compared with the long distance movements of the past.

Mobility as a 'survival strategy' among traditional societies explains why people left their place of origin. However, it does not explain the direction of flow and characteristics of a target area. Thus, an understanding of mobility is incomplete. For this reason, it is imperative to consider other processes at work.

Ecological Processes and Mobility

Ecological factors at both the origin and destination are important in determining the pattern and direction of mobility. Among agriculturists, the search for an environmentally similar territory has remained a prime concern in migration decision-making (see also, Gardner 1981). It was imperative for clans and groups to move to places where they could continue their long-standing agricultural and pastoral practices. The preferred locations were areas: i) suitable for farming, ii) close to the source of water and ii) with similar ecological conditions. The movement of caste groups (illustrated by the Bhattarai clan) towards the eastern hills confirms these considerations.

While economic models such as income differentials between two places or employment opportunities (eg, Todaro 1969) or even the social and kinship network (eg, Mitchell 1983) are commonly referred as explanatory variables of mobility, none of these are relevant in the context of mobility of this clan during the nineteenth and early twentieth century. At that time, earning a livelihood beyond agriculture was extremely limited and movement was aimed at localities suitable for growing staple crops and raising cattle. Thus, the movement of clans toward the eastern hills was natural given the similar ecological conditions. In addition, the fact that the eastern hills are wetter than the western hills further reinforced their agricultural suitability.

While a personal and lifestyle survival was relevant in interpreting clan mobility from Kannauj and from north India to the western hills, subsequent movements were clearly influenced by ecological considerations. Movement was considered necessary when the resources in the immediate environment were exhausted and the system of farming was unable to cope with the increasing demand of the family (Subedi 1991). Similarly, when population grew to a level that the available land was unable to support, movement to another place was imperative for clan members. Moreover, extensive forestlands were still available within the country and agricultural colonization and expansion of settlement to new areas was not difficult.

Mobility as an Outcome of National Political Processes

Caste groups were instrumental in the successful territorial expansion of Gorkha rulers during the

eighteenth and nineteenth century. They became integral to the consolidation of principalities within and beyond the Karnali and Gandaki regions. Before unification the status of several principalities collectively known as *Baisi* (Karnali Region) and *Choubisi* (Gandaki Region) were often in dispute and their integration into the Nepali kingdom often in doubt.

The movement of several caste groups was tied to the advances and retreats of the Nepali rulers in the western hills. If military invasion was a precursor, permanent occupancy was indispensable to continue subsequent control of the subjugated territory. Subsequent development of permanent settlement in the conquered territory was a vital strategy of nation building. Implementation of this strategy led to the movement of households into newly occupied territory. The attempt to control newly occupied areas was one factor in eastward movement during the nineteenth century. Likewise, many households, frustrated by the chronic conflict between principalities, also moved towards the eastern hills. History also suggests that as early as the seventeenth century, some rulers had encouraged their citizens to advance further east and expand their territory. The Sen dynasty (*Choubisi*) of Palpa, for example, extended its control as far as the eastern Tarai (Regmi 1979).

By the eighteenth century, Gorkha rulers had already begun their campaign of territorial expansion to Kathmandu valley and further east. Whereas this attempt to consolidate power and unify the principalities into a single state was, in fact, driven by personal political ambition, it was also needed to protect Nepali territory from British imperialism in India. Accordingly, by the 1770s, Prithvi Narayan Shah, an astute Gorkha ruler, extended his territorial control to Kathmandu valley. Kathmandu was made the capital of the kingdom of Nepal. This change of capital, and subsequent shift of political and economic power, resulted in a permanent movement of the ruling class and many caste groups to Kathmandu. The territorial expansion and consolidation of power continued and further movement towards Kathmandu and to the east became prominent. Likewise, many young adults were encouraged to join the royal army and were subsequently stationed at strategic locations in the east.

The extension of governmental control was further reinforced by the *birta* scheme, a system of land grants (discussed earlier). This system was a part of the central government's plan of broader territorial control in the subjugated territory. The granting of *birta* proved instrumental in encouraging mobility towards new areas to the east and southeast of Katmandu during the seventeenth and eighteenth century. The extension of the Bhattarai clan to Sindhu and Gamnang (Figure 1) through a scheme of land grants is a clear example of the whole process of mobility through land occupation and colonization.

While *birta* were instrumental for clan mobility during the eighteenth century, *Gorkha* recruitment surfaced as an important outlet for many other ethnic groups. Thousands of young men joined the British army and served all over the British Empire. Recruitment emerged prominently after British India and Nepal signed the treaty of Sugauli (1816). The treaty formally allowed British recruiting officers to recruit *Gurkhas* for the British Indian army. This type of movement for recruitment increased tremendously over the years. During both World Wars, young men were forced to join the British Indian army by Rana rulers. These are the Gurkhas who are world famous for their bravery. However, for some unclear reasons, recruitment for the British army was limited to ethnic groups such as Gurung, Magar and Kirants, whereas recruitment for the Indian army was essentially open to all. There was a considerable 'demonstration effect' of returning *lahure* among young boys. The clothes, the language, and modern items such as wristwatches, and transistor radios of returning *lahure* are very tempting to youths. Overall, the army recruitment involved an important section of young men.

In addition, during the nineteenth century, for the continuation of territorial expansion process towards

east, the government was in a desperate need of labor force and the cash. A sizable manpower base was essential to maintain the military strength. There was also an urgent need to expand the administrative machinery throughout the country. A considerable labor force was also essential to transport military equipment and administrative accessories to the assigned districts. Likewise, cash was necessary to buy military and other equipment from outside the country.

In understanding the territorial mobility along the hills of Nepal, it is important to summarize the territorial campaign and subsequent government interventions. Territorial campaign was costly. The government needed revenue to meet administrative costs. This endeavor to recruit manpower and raise revenue was further complicated by the small size of the population. Hence, the government introduced a head tax and the *jhara* system. The *jhara* system involved work in which households were required to provide unpaid labor for government initiated programs. It was mandatory and at times the labor input extended for several days at one time.

In the long run, the head tax and *jhara* systems distressed the unprivileged sections of society, making it difficult for them to comply with the state regulations. Ordinary households were forced to send people away for a certain part of the year to earn cash to pay the taxes. Moves such as *kulli bharti jane and ara katna jane*, discussed elsewhere are illustrative of this (see Subedi 1993). Many households were forced to mortgage their land to chiefs and feudal heads. Ultimately, frustrated with hardship and impoverishment, some households chose, rather unwillingly, to leave the community. Sayings such as '*aaj sangrati, bholi bhagrati; parsi dangdang rati*' meaning today is the first day of the month [therefore I do not run any financial dealings], tomorrow night [I] run away, day after tomorrow [you may come but this house is] already deserted (discussed in Subedi 1993), are indicative of these complexities. This saying conveys the meaning that there is a limit to which one can delay paying one's debts. When the limit is over one has to submit. One way to submit is to flee. History reflects this kind of induced mobility (see Regmi 1979).

Other processes leading to mobility

Politics, ecology, and personal and group survival strategies were not the only processes involved in the eastward mobility of clan groups. Many subsidiary mechanisms reinforced the process. Often natural disasters, or disease epidemics resulted in the sudden death of several household members. These incidences often forced households to leave their community. The mobility history of clans and life stories of many household heads in Namsaling suggest that natural disasters and disease epidemics were important. For example, the coming of the Pokhrel clan to Ghumaune, Namsaling was attributed to this factor. This type of cause is not uncommon in traditional societies. For example, in his study of Majangir mobility in Ethiopia, Stauder (1971) reported that the death of family members was important in their decision to move to other place. Similar examples are available in South Asia (see Breman 1985; Agarwal 1990).

Uncertainties surround exactly what stimulated the Bhattarai clan to move from Phalikot to Ilam Danda and then to Namsaling. However, given the common practice of awarding chieftainships, it is likely that one of the clan members was awarded a chieftainship and/or administrative position in Phalikot and later in Ilam. This is based on the clan's contemporary social status in the village as well as the political and administrative history of eastern Nepal. First, they are still regarded as *mukhiya* (loosely translated as local chief) today, a position designated by the rulers in the past. Second, up until recently, they appropriated land and collected revenue from several settlements and clients (locally known as *raiti*) in and around Namsaling. At least one elderly person had a vivid memory of a court case between his clan and a local

Magar Chief about the conflicting claim of control over some *raiti* (This case was settled out of court later). Third, after their arrival in Ilam, the clan especially those who continued to stay in Ilam Danda, has always maintained a close contact with administrative personnel sent from Kathmandu. This indicates that the clan's arrival and dominance in Ilam Danda was related to their link with the central administration in Kathmandu.

The coming of the Bhattarai clan to Namsaling was also linked to their association with regional rulers. According to Viswa Nath, his great grandfather came from Ilam Danda to settle in Ghumaune due to his personal ambition. He had *raiti* for which he looked after the land appropriation and revenue collection. He also owned land in and around Ghumaune.

In addition to the Bhattarai clan and the general explanation of mobility thus far, a few clans also related their arrival to personal ambitions and curiosity. Ram Hari (aged 47) who lives in Ghumaune had this to say about the coming of Adhikari, ie, his clan in Ghumaune:

> Seven generations ago, Balananda, a young person, came to Ghumaune, from (Gh) Hunga in Kaski Pokhara (?). It is said that he had come thus far as an adventure trip to see the world beyond (*desh khan hideka*). No one knew where he was headed. In Ghumaune, he stayed with the Bhattarai family as a *gothalo* (literally, one who looks after domestic cattle). Bhattarai was a dominant clan in Ghumaune then. Later, Balananda married a Bhattarai girl. He lived there for several years. After a while he decided to visit his family back home. Unfortunately he died there. After his untimely death his wife decided to live closer to her natal place. They had two sons named Brahma Lal and Ganga Dhar [The genealogy of Adhikari clan there clearly links them with these two names].

This indicates that mobility in the past was the result of combination of survival, ecological, political, as well as personal factors and circumstances beyond personal control. While the general circumstances may appear comparable over time and across clans, the specifics are different for different people. Moreover, the dominance of one factor over the other depends upon the time-period under consideration and concurrent spatio-ecological processes at work.

CONTEMPORARY MOBILITY TRACED THROUGH LIFE HISTORIES

Thus far, discussion in this paper has focused on the history of clan mobility set within a national context. This establishes the dynamics of mobility along Nepal hills in the past. However, understanding the complexity of mobility is incomplete without outlining the context within which contemporary mobility is anchored. For this, life histories of the contemporary generation become an essential and authentic instrument. Excerpts from the life histories of household heads and/or elders illustrate this.

The following excerpt from the life history of Viswa Nath, who was seventy-eight when he told important events in his life, illuminates several facets of contemporary mobility. The Bhattarai clan was selected to illustrate historical clan mobility. It is therefore, useful that the life story of someone from the same clan be selected to describe concurrent mobility. In addition, Viswa Nath has lived more than seven decades in this community and his family is representative of both local and national mobility contexts.

> Born in 1912 he spent his early childhood in a *kharka* (open pasture, usually located in the high hills). The *kharka* was located at about one day's walk from his home. At age 10 he got an opportunity to learn Sanskrit locally. His father died when he was fifteen. His study discontinued by this incident. After three years he was able to resume his study because his brothers were able to manage their land and household affairs. His study was primarily related to astrology for which he moved to several places between the ages of 18 and 21. First, he went to Lapsibote where he spent one and a half year in *Guru*'s home. Then he moved to Soyang with another *Guru* for the next few months. In between, he visited home frequently. Finally, he went to Sukia Pokhari (India) where he got a chance to study with

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