Dhokos and Dauri:
Tourism Related Firewood Use in the Makalu-Barun Area, Nepal

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Abstract

Despite regulation efforts, tourist related resource consumption continues to be a problem in many parts of Nepal. Using recall-based surveys of 78 porters and 26 lodge proprietors, the current status of firewood use by porters in the Makalu-Barun National Park and Conservation Area is examined. This study finds that porter consumption of firewood continues. More wood was used in the conservation area than in the national park. This difference in wood use patterns leads to greater porter wood use in the part of the protected area where local inhabitants already face wood shortages. An average of 0.7 baris (21 kilograms) of firewood is used daily by a group of five porters for cooking and warmth. Two thirds of surveyed porters are local kitchen users and a total of 92% of respondents buy firewood from lodges. The prevalence of firewood sales and porter use of local kitchens for food preparation causes community members to have an economic interest in porters' wood consumption. In the national park, firewood consumption decreased by 0.22 baris (7 kilograms) per night, and the number of porters using no fire at all increased by 55%. The direct enforcement of the firewood ban in the national park, and the local role in wood use in the conservation area, cause increased firewood use in the national park. While the role of porter shelters is inconclusive, blanket rentals are successful in reducing firewood use by one bari (30 kilograms) per group of five porters. The intended benefits of both programs, however, are directed more towards the national park than the conservation area. Community woodlots are suggested as an alternative that will help to alleviate pressure on forests while capitalizing on, instead of seeking to curtail, the connections between community and porter firewood use.

Introduction

In recent years, tourism has become the worlds largest and fastest growing industry (Gossling 1999). Scholars of tourism point to the predominantly unsustainable and unregulated nature of this growth (Boo 1993). Many conservation organizations, such as the World Conservation Union, have recognized tourism as the one of the major threats to protected areas worldwide (Goodwin 1996). In developing nations, resource demands generated by the growth of tourism are often at odds with sustainability and conservation efforts. Sharma (1998) found that mountain societies, such as Nepal, experience strong socio-economic pressures to increase tourism flow while neglecting environmental issues, especially in protected areas. Mountain environments, due to the limited availability of many resources, are ecologically sensitive to the increase in human presence associated with tourism (Inmann and Luger 1998). Nepal, a longstanding and popular tourist destination, is one of the most mountainous nations on earth.

Nepal attracts large numbers of foreign visitors every year, 34% of whom go trekking in the mountains. Mountain trekking brings $10 million a year directly to local inhabitants, making it the predominant source of monetary income in many rural communities (Nepal Ministry of Tourism and Civil Aviation, cited in Odell and Lama 1998). Trekking, defined as mountain tourism not involving technical climbing, typically brings tourists into contact with at least one of Nepal's 14 protected areas (Wells 1994). Trekking, especially in sensitive areas, is often coupled with an increase in local resource consumption. Banskota and Sharma (1998) identify waste generation, forest degradation, and changing land use patterns as three main categories of environmental degradation caused by tourism in Nepal. Studies have found that the majority of these impacts are focused on Nepal's protected areas (Zurick 1994). In particular, deforestation due to firewood needs has been a long-standing concern in Nepalese national parks (Odell 1998).

Tourism related use of firewood leads to a decrease in the amount of forest harvest available to locals during the off-season. This is compounded by a short growing period for trees and the fact that forest product harvest levels are already unsustainable in many areas. As one of his two major conclusions to his 1997 paper, Wantanabe recommends that, in order to reduce tourist impacts on Nepalese forests, a "reduction in wood consumption along trails by local porters" is necessary. Although studies have estimated fuel wood consumption

in specific parks, very little analysis exists regarding the effects of conservation efforts in reducing tourist related use of this vital forest product. Traditional conservation regimes have failed to curb tourism related use of firewood. In fact, most traditional protected area management strategies and have not placed sufficient emphasis on tourist resource use (Nepal 1999). Recently, however, support for ecodevelopment programs has been growing.

Ecodevelopment is aimed towards an ecological transition, in which the current unsustainable paradigms converge toward a less anthropocentric and more sustainable interaction with our surroundings (Gurung 1998). Tourism serves as a component, not the central focus, of development strategies. Ecodevelopment programs attempt to link the conservation of protected areas with the social and economic development of local communities near, or sometimes within, protected area boundaries. Ecodevelopment projects aim to achieve their conservation goals by promoting development and providing local people with alternative income sources that sustain, rather than threaten, the flora and fauna in natural habitats (Munasinghe 1994). The Annapurna and Makalu-Barun parks are examples of protected areas where ecodevelopment concepts are being applied in conservation and development regimes (Mehta and Kellert 1998).

The Makalu-Barun National Park and Conservation Area (MBNPCA), Nepal's newest national park, is among the nation's largest protected areas with a conservation regime based in ecodevelopment. The MBNPCA's management plan was designed to proactively counter the negative implications of mountain tourism observed in other trekking areas (Peniston 1999). In this study I will concentrate on firewood use by trekkers in the Makalu-Barun National Park and Conservation Area. An improvement in fuel wood supply for inhabitants, and reduction of ecosystem damages caused by excess wood gathering are integral and explicitly stated components of the project's mission statement (MBCP Task Force 1990). Because ecodevelopment projects, although much talked about, are few in number, programs in the MBNPCA merit evaluation. As ecodevelopment can often be a diffuse subject, specific concepts must be elaborated as a basis for evaluation.

Extensive literature exists establishing and justifying guidelines for managing tourism from an ecodevelopment perspective. Works from a variety of disciplines were studied in order to distill important concepts from a wide range of opinions. Chosen authors included: resource economists from Kathmandu (Banskota and Sharma 1998), the World Wildlife

Fund's ecotourism consultant (Boo 1993), a European policy analyst (Schrand 1998), ecodevelopment park managers (Inmann and Luger 1998), an Indian economist (Munasinghe 1994), and Mountain Institute ecotourism officers (Lama and Sherpa 1995). From these works, three common principles emerge that pertain directly to my topic. First, tourism related overuse and/or depletion of natural resources must be curtailed. Although MI has controlled direct tourist use of firewood, circumstantial evidence exists that porter and staff use are occurring (Peniston 1999). Second, in a context where a resource's use is only appropriate for indigenous populations, interdependence of tourist and community use should be avoided. If this is not done, decreasing tourist resource use can work against the immediate interests of locals. Third, effective alternatives to tourism related use should be provided using local technologies/mechanisms. These alternatives must retain economic benefit within local communities. The above three principles serve to align conservation efforts and the interests of local communities. Ecodevelopment treats conservation interests and community advancement as one and the same (Norberg-Hodge 1991). The guidelines above enable an ecodevelopmental consideration of firewood use in the context of community and habitat conservation.

This paper presents an analysis of the prohibition of tourist-related firewood use in the Makalu-Barun National Park and Conservation Area. Using recall-based surveys of 78 porters and 26 lodge proprietors, I examine the current status of firewood use by porters. My contention that firewood consumption continues among porters is investigated. Based on the above ecodevelopment criterion, local sector interaction and attempts to reduce non-local fuel wood use are considered in the contexts of the buffer zone and the national park. Hypothesis 1: Porter use of firewood continues in the Makalu-Barun National Park and Conservation Area. Hypothesis 2: The role of local lodges in porter use of firewood is important from an ecodevelopment perspective. Hypothesis 3: The use of porter shelters and blanket rentals as conservation mechanisms are resulting in lower levels of wood consumption by porters.

The data generated by this investigation allows conclusions to be drawn as to the consequences of the regulation efforts in the region. The construction is valuable because it allows for a quantitatively based discussion about the ability of a conservation regime to curb tourist driven resource consumption. The number of variables involved in actually

determining if tourism is leading to deforestation or changes in indigenous use patterns is too great for the scope of this paper. However, identifying, and quantitatively estimating, continued uses of wood enables this study to evaluate successful and unsuccessful elements of the program. Ideally, the recommendations generated by this study will allow the overall conservation program to better serve the mountain communities for which it is designed.

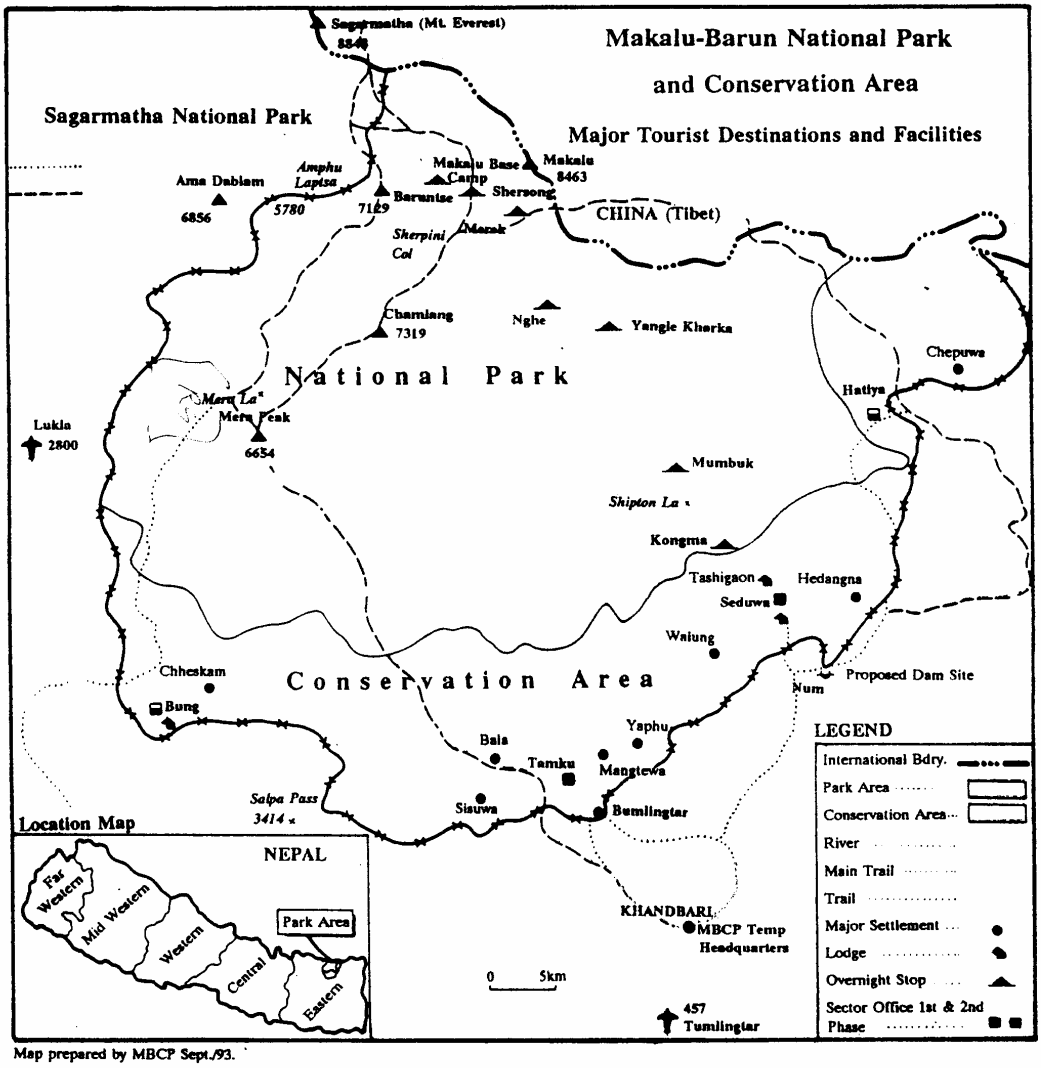
Site Description

The Makalu-Barun National Park and Conservation Area (MBNPCA) was inaugurated in 1992. Bordering Everest National Park to the West and Tibet to the North, it contains 2,330 square kilometers and is administered jointly by the Mountain Institute, USA, and the Department of National Parks and Wildlife Conservation, Nepal. The Mountain Institute (MI) is a West Virginia based non-governmental organization. The park receives between 1,000 and 1,500 trekkers annually and tourist numbers are projected to increase by 30-50% per year (Odell and Lama 1998). The MBNPCA consists of an almost uninhabited national park and an adjoining conservation area, which has about 32,000 inhabitants (Byers 1996). Mount Makalu, the fifth highest peak in the world at 8,463 m, is the primary tourist attraction and destination in Makalu-Barun National Park and Conservation Area. Compared to other mountain parks in Nepal, tourist flow along the base camp route is relatively low.

As there are neither lodges nor settlements above Tashigaon, the majority of visitors to Makalu-Barun National Park are group trekkers or mountaineering groups, attended by porters and support staff. "Porter" is a term referring to an individual who is paid to carry supplies for tourists. Unlike many areas in Nepal, tourists using porters in the Makalu area must hire the individuals locally (Sherpa 1998). The term staff, as used in this report, refers to any non-porter individual being directly employed by tourists while in the mountains and includes the group leader, cook, kitchen boy, and camp boy. Usually, staff members are not local, tend to have homes in Kathmandu, and are paid a good deal more than porters. The typical trekking route begins in Tumlingtar or Khandbari, ascends through several villages to Tashigaon, the highest settlement in the area, and which continues into the National Park up to base camp (Map 1).

Villagers rely heavily on utilization of resources found in the MBNPCA; regularly used resources include bamboo, wildlife, nettle fiber for cloth, shrub/tree bark, and medicinal

herbs (Carpenter and Zomer 1996). The growth period for wood in the mountains is extremely short and the people in major portions of the Park face food shortages four to six months per year (Mehta and Kellert 1998). The Makalu-Barun Conservation Project (MBCP) was established as the element of the MBNPCA in charge with implementing and maintaining the infrastructure of the park. The overall policy of the MBCP, which is staffed by MI, is to assist in community initiated development with tangible benefits intended to generate local support for long-term conservation goals (Lama 1999).



Map 1.

Methods

The data presented in this paper was generated primarily from recall based social surveys. Lodge proprietors and porters were chosen as focus groups for the study. Due to lack of a large population size, and the remoteness of the area, all possible members of each group were surveyed. Questionnaires were administered individually to porters and lodge proprietors by a hired administrator. The administrator was a Nepali individual with a background in forestry whom had previously worked with MI in a similar capacity. The surveyor followed the main trekking route from Khandbari to Tashigaon, administering a total of 78 porter surveys and 26 lodge proprietor surveys. Data collection occurred from March 21, 2000 to April 2, 2000, and took place in villages on the trail between Tashigaon and Khandbari.

Time, inclement weather, and lack of financial resources prevented an in depth assessment of firewood consumption by weight and source. A few such studies, discussed later, have been carried out but many authors, especially those seeking to determine broad trends as opposed to specific tendencies, have relied on surveys (Banskota and Sharma 1996, Fox 1993, Saksena et al. 1995). A recall-based questionnaire was designed using the extensive background knowledge of Dr. Peniston and myself (Appendix 1). Because most survey subjects were illiterate, asking them to keep a wood use journal was not feasible. Closed ended questions were chosen to reduce the amount of administration time necessary. Closed ended questions also promoted the emergence of broad trends over stochastic variance during data analysis. J. Fox (1984) notes that recall surveys tend to overestimate because of response ranges, imprecise conversion factors, and the nature of firewood use as an indicator of social status. Certain questions (#3, #4, #18, #20, #22,and #23), for which set answers were imprecise or illogical, were left open ended. The surveys were initially written and printed in English, and suitable terms of translation to spoken Nepalese were determined. They were then orally administered in Nepalese, with comments for each survey written in Nepalese to facilitate accuracy and speed of comment annotation. Data concerning lodge cooking methods, porter services, and family firewood use were generated by lodge owner surveys and an extensive review of existing literature. Data was transformed as necessary for discussion and analysis purposes (Appendix 2).

Limitations and biases In designing this project, my original intention was to produce a meta-analysis of existing firewood consumption studies. However, a meeting with MI staff in Kathmandu led to the conception of a collaborative project in which they provided data collection and I analyzed the data arose. This project is both an academic endeavor, and an evaluation of the effectiveness of MI's conservation efforts. The surveys were designed with the intention of providing the necessary data and additional information for MI. Therefore, questions about kerosene use were added to the survey just before it was administered without my knowledge. In addition to the hypotheses being tested in this paper, the lodge owner survey was meant to investigate wood use for hot showers. Because data in regards to tourist showers was of little significance and reliability, I abandoned this line of inquiry. Thus, although this type of planning may be criticized as biased, my foreknowledge of the process allowed me to correct for apparent inconsistencies.

While it is likely that both porters and staff are contributing to tourism-related use of fuel wood, porters were the focus of this survey for several reasons. Staff members, having had greater contact with Westerners and western concepts of conservation; are more likely to speak English, live in Kathmandu, and be aware of the conservationist agenda. Staff have greater awareness of park regulations, which prohibit staff and porter use of firewood, and will not admit to knowing violations of park policy. Staff responses are likely to be based on impressions of what the interviewer wants to hear instead of honest impressions as to actual firewood consumption (Sowerwine and Shrestha 1994). In order to have confidence in the data generated by the surveys, certain reasonable assumptions about porters were made. It was assumed that porter responses are honest, lacking in ulterior motive, and that respondents, as local residents and lifelong firewood users, have responded accurately. Due to a lack of western education, or prolonged exposure to a Western conservation agenda, porters are likely to be up front about their wood use habits (Sherpa 1999). These same assumptions were made about lodge proprietors.

In the course of my research, all attempts were made to minimize possible biases and maintain objectivity. Due to the nature of international research and social survey work, however, some arenas of my work may have been exposed to possible biases. Certain events definitely influenced my research, while others are described for the purposes of thorough documentation. A lack of funding and personnel dictated that surveys be administered

during only one part of the trekking season, so sampling procedures were temporally fixed. In order to have enough data, and due to low population density in the Makalu area, a random sampling of individuals could not be surveyed. Instead, the proprietors of all open lodges, and almost all porters encountered, were surveyed. The surveys were carried out before planting season, so as to include farmers who porter for additional income.

Bias in the sampling could have been generated due to the fact that porters traveling together in one large group completed 36 of the 78 porter surveys. Also, I was unable to perform a pretest on the surveys. It was planned that the administrator would complete five to ten surveys and then fax the results to Kathmandu. However, a Maoist attack on the MI office in Khandbari prevented this from happening, and the surveys were left in their initial format. Because I did not observe his methodology, it is possible that the survey administrator was ineffective, but he was previously employed by MI for the same purposes and had performed satisfactorily. On the other hand, the fact that the administrator was Nepali, and a native speaker, may have reduced possible culture and language biases. Question fatigue also seemed to be an issue, questions #19-#23 were left unanswered on many of the surveys.

Results

Cooking Unlike many of the other response categories, almost all porters answered questions regarding cooking methods and wood use. Of 70 porters responding, 27 reported using only fire to cook with, while another 10 only used stoves, with the rest using both methods (Chart 1). A majority of porters, 86%, use fires cook food for at least part of their voyage. When asked how much cooking wood their porter group used per day, the average porter response was 0.45 baris. Eight of the 68 respondents to this question reported using no firewood at all. The two non-respondents were individuals who used stoves as their sole method of food preparation. Overall, 57% of porters estimated the daily use of cooking wood at 0.25 baris per day, 31% reported using 0.75 baris per day.

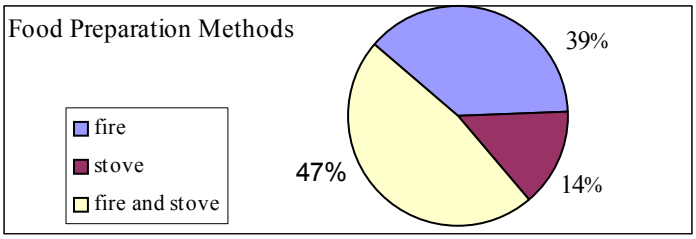


Chart 1.

Warmth In order to stay warm during the night, 54% of porters use only a blanket (Chart 2). While only two respondents report using only a fire, 46% overall make use of a fire at night. An average of 0.26 baris were used per night to stay warm. A majority of respondents, 30, reported no use of firewood, but another 39% reported using 0.25 baris per night. It should be noted that some porters who reported using only a blanket to stay warm also provided nightly warmth wood use estimates. All respondents using blankets to keep warm also rent the blankets in Tashigaon. Out of 67 porters renting blankets, 21 paid for the blankets themselves, 46 had the blankets paid for by their employers. About half of all porters' blankets rental fees were paid for directly by tourists.

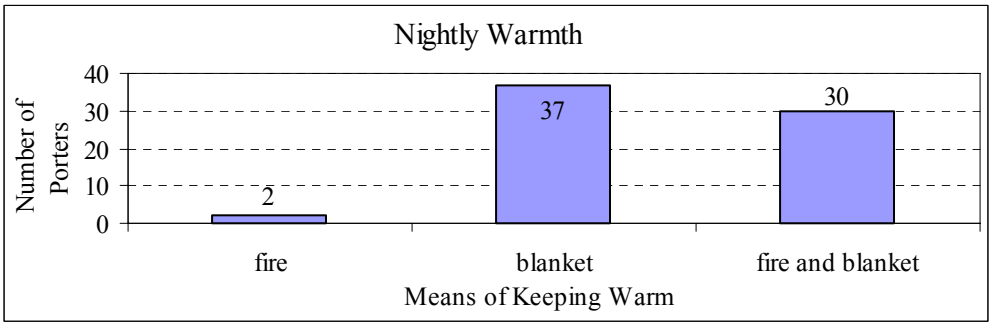


Chart 2.

Use estimates The above two sections focused on specific uses of firewood, now general estimations for daily firewood use will be reviewed. Just above the hamlet of Tashigaon, the main trail leaves the conservation area and enters the national park. There are no villages on the seven day trek from Tashigaon to Makalu base camp, and neither firewood nor kerosene can be purchased (MBCP Task Force, 1990). Two types of estimates were calculated for wood use from Tashigaon to base camp and back, consumption estimates for a group of five

porters and ranges and averages based on midvalues of all responses. Of 58 who answered, 19 porters used no firewood at all while in the national park (Chart 3). The average wood consumption per porter group, based on all responses, was 2.4 baris. Roundtrip use estimates per standardized porter group have been produced only where group size was specified for consumption estimates. Eighteen porters included group size in their roundtrip estimate. When normalized for a group of five porters, the average consumption was 3.4 baris. The range of roundtrip use estimates spanned from 1.36 to 5.26 baris.

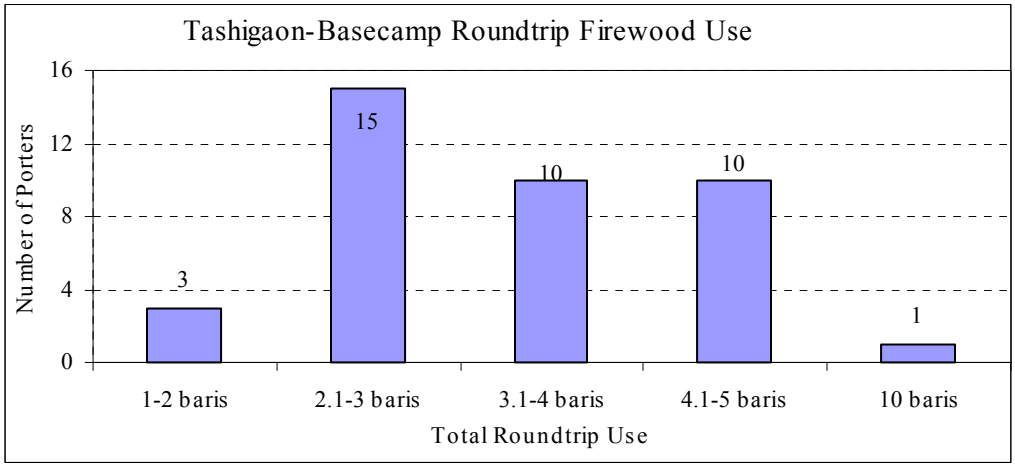


Chart 3.

Porters were asked to identify, and estimate consumption at, campsites where the most and least firewood was used. These questions were intended both to evaluate shelter use, discussed later, and to determine ranges for high and low consumption values per night. The high per capita nightly wood use estimates ranged from 0.2 to 0.56 baris, with an average of 0.37 baris across 17 responses. The low estimates, based on seven responses, ranged from 0.08 to 0.28, and averaged out to 0.14 baris per porter. Three porters mentioned that they did not use wood above Tashigaon because of a National Park Station, and it's recent enforcement of the ban on burning wood.

Using data from the high and low nightly estimates, the Tashigaon-basecamp total usage, and daily cooking and warmth responses Table 1 shows various estimates for a group of five porters. The last figure on the chart corresponds to the daily wood usage for a local family of five, as derived from lodge proprietors' family use estimates.

Source of Estimate	Firewood Used
Low Nightly Total	0.71 baris
High Nightly Total	1.87 baris
Daily Tashigaoni-basecamp	0.49 baris
Daily Cooking+Warmth	0.71 baris
Daily Use, Local Family of 5	1.07 baris

Table 1. Firewood use estimates.

Local cooking facilities Data examination now shifts from solely considering porter use to considering the interaction of porter firewood consumption and the household and trail energy sectors. Cooking wood data mentioned above did not differentiate among the three ways in which firewood is used; namely lodge cooking and use of house kitchens (collectively referred to as local kitchens), and direct use of firewood. Ninety-five percent of porters that consumed some form of firewood made use of local kitchens. Two thirds of all respondents reported using local kitchens, while 21 porters reported using only stoves or outdoor fires. Because there are no settlements above Tashigaon, and all porters must rely on stoves and/or outdoor fires for a portion of the trek, the figures presented for local kitchen users include porters who used both local and self reliant cooking means. The frequency of response for self reliant cookers, however, includes only those porters who used strictly self reliant methods (that is, they did not make use of local kitchens).

Table 2, detailing specific cooking methods and associated bari use, shows that over two thirds of the porters make use of local kitchen facilities. Porters use houses more often than lodges, although a majority of local kitchen users cook in both locations. Self reliant porters used an average of 0.12 baris, or 4.2 kilograms, less per diem than local kitchen patrons. In addition, 24 of 26 lodge proprietors provided food for porters. Only 11 porters reported using no wood above Tashigaon, and of these only two reported using stoves for the entire time.

Means of Food Preparation	Frequency of Response	Average Number of Baris Used Per Day for Cooking
Local Kitchen	**69%**	**0.43**
House	24%	0.44
Lodge	15%	0.45
Both	30%	0.40
Self Reliant	**31%**	**0.31**
Stove	13%	0.11
Fire	6%	0.38
Both	12%	0.50

Table 2. Application of wood use in communities.

Lodge-Porter firewood interactions Porters face two main choices in obtaining firewood, collecting it from the surrounding environs or purchasing it from local sources. 79% of respondents procured firewood in both ways. Only five of 62 porters gathered wood and did not buy from local sources. None of the porters reported that their trekking company was supplying wood for them. Lodges were determined to be a developed source of porter firewood. Half of the 26 proprietors interviewed stated that they sold wood to porters. However, 25 of 26 lodge proprietors provided an estimate as to the amount of wood they sold to porters and staff per overnight stay.

The lodge proprietor's role as a firewood salesman is of interest. Charts 4 and 5 show the distribution of responses for lodge proprietors when asked about their personal use and level of sales top porters. The most frequent response for both questions was 0.75 baris per night. The category ">2baris" was assigned a numerical value of 2.25 baris when calculating daily use per family. Treated in this way, the estimate produced is a lower value estimation for firewood consumption. Individual responses for both categories were compared, and 58% of proprietors consumed the same amount of wood sold. Six lodges sold more wood than they consumed, while another six consumed more than they sold. Across all respondents, an average of 1.12 baris per day were used in the home, while an average of 1.19 baris were sold to porters and staff. The difference, 0.07 baris, is equivalent to 2.10 kilograms of wood daily. Porter group size was not included in daily use estimates provided by lodge proprietors. The average daily use of firewood, adjusted for a family of five individuals, was 1.07 baris (Table 1). The family size of five was chosen to allow for comparison between household use and groups of five porters, as calculated above.

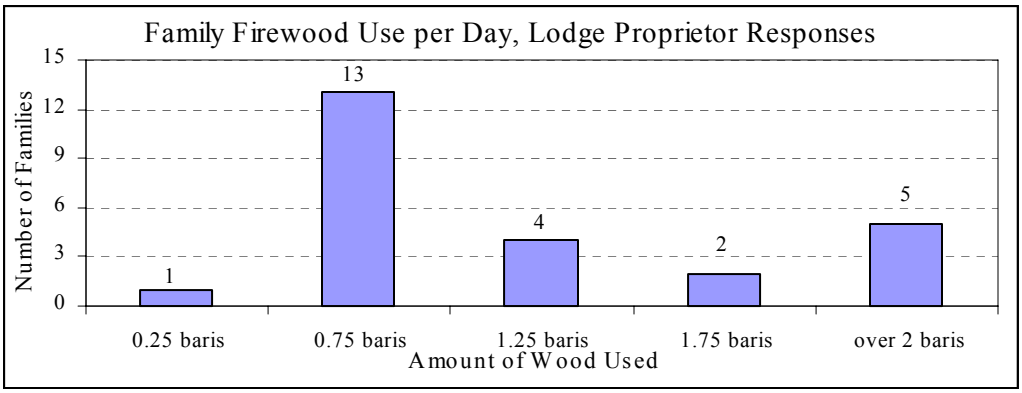


Chart 4.

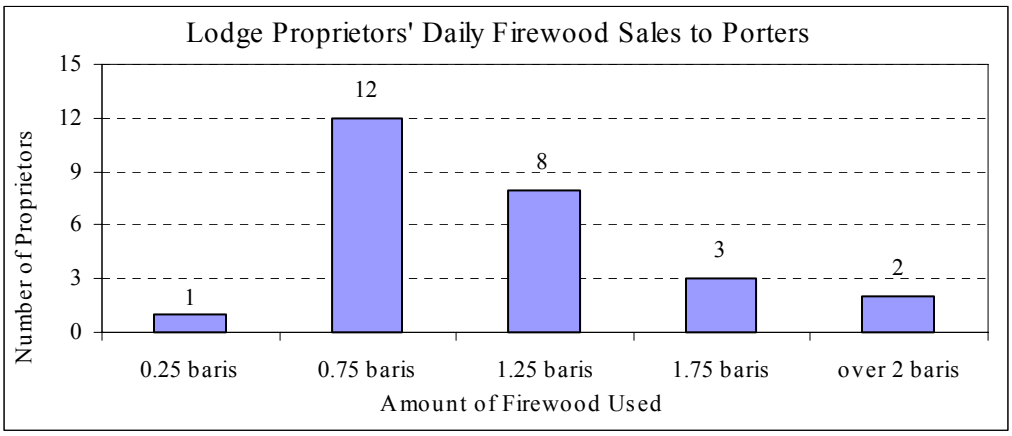


Chart 5.

Shelter Use Shelters were built on the trail from Tashigaon to basecamp in the following locations, listed in order of ascending altitude: Khongma, Shipton La, Mumbuk, Dobate, Yangle Kharka, Nghe, Merek, Sershong, and Makalu Basecamp (Map 1). The most frequently used shelter was at Khongma, with 20 porters reporting they had stayed there. Of the remaining eight shelters, only Dobate was used by over ten porters. Table 3 lists the remaining shelters. Factors that caused porters to use high levels of firewood included cold, a lack of snow, and sleeping at middle altitudes. Four porters cited a lack of decent shelter as a factor causing increased firewood use, while one porter cited good shelter as a factor causing greater use of firewood. On the other hand, four porters mentioned the presence of only fresh wood as a constraint on firewood use and two porters stated that the presence of porter

shelters caused them to use less wood. When asked if they used less wood because of the shelters, 53 of 56 porters responded negatively. Subjects were also asked whether they typically used less wood at a campsite with a shelter or without a shelter. Here, 81% reported using less wood at campsites with no shelter.

Shelter Location	Number of Porters
Khongma	20
Dobate	11
Mumbuk	6
Thulo Pokhari	5
Yangle	3
Nghe	2
Shipton La	2
Shershong	1
Merek	1

Table 3.

Blankets A total of 67 porters reported renting blankets in Tashigaon. 70% of porters had their blankets paid for by trekking or staff. Overall, tourists paid for three times as many blanket rentals as did staff (Table XX). Thirty-seven subjects reported that they only used blankets for warmth at night. Of these 37, seven porters provided estimates for nightly warmth wood use. On average, blanket-only porters consumed 0.18 baris per capita per night. Porters that utilized a fire for warmth used an average 0.33 baris per capita per night.

Paid for Blanket	Number of Porters
porter	21
trekking company	11
tourist	35

Table 4.

Discussion

General consumption Porter use of firewood was found to be occurring. In this respect, MI has been unable to prevent a significant portion of tourism related natural resource consumption. Overall, 86% of porters consume food prepared using firewood. Almost half

all subjects use firewood to keep warm. Considering daily, group, and roundtrip use, allows for a more inclusive understanding of the different temporal frames by which porters estimate wood use. Because this study is recall-based, comparing different estimations from the same subjects is useful. As will be discussed later, these various angles on the same issue show that different dynamics are acting at different points on the trail. Summary estimates are presented as group-use figures because porters rarely work alone and firewood is purchased and used as group commodity, both for cooking and warmth. The results presented above will now be evaluated in the context of the given hypotheses and the ecodevelopment framework mentioned earlier.

Cooking appears to be a larger firewood sink than keeping warm, with an average of 0.45 baris and 0.26 baris consumed per porter group per day, respectively. This finding is confirmed by Sinha et al. (1998) in their extensive survey of wood allotment in the Indian Himalaya. The average amount of wood used for both cooking and warmth, for an unspecified group size, was found to be 0.71 baris per day. Many porters provided specific group sizes when asked about consumption of wood at campsites. For a group of five porters, the average consumption was from 0.74 baris to 1.87 baris per night (at camps where the least and most firewood was used, respectively).

When considering consumption above Tashigaon, it is a positive indicator that 54% of porters did not use fires for warmth at night. One third reported using no firewood above Tashigaon at all. Interestingly, many of the porters who answered that they did not use fires in these situations provided use estimates when asked to do so in later questions. The average firewood consumption for a group of five porters on the Tashigaon-basecamp circuit was 3.4 baris, or 0.49 baris per night. Firewood consumption decreases above Tashigaon in respect to number of porters using fire, and average amount of wood used per night.

Almost all recent academic inquiries into porter use of firewood cite the work of Wanatanabe (1997) and Bjoness (1983). Wantanabe's research pays attention to use in lodges and briefly mentions local sector interactions, but neither provides estimates nor lists assumptions. His quantitative analysis is limited to a review of tourist numbers, and subsequent speculation as to consumption. Bjoness, although estimating tourist use, merely makes qualitative references to issues surrounding porter use of firewood. Unfortunately, then, very little data exists with which to compare my findings to. Nevertheless, my data can

be compared to household use and tourist use in other areas. As will be shown, porter consumption rates are high enough to merit an evaluation of the linkages between local community and porter kitchen use.

Local and tourist use Estimates exist for tourist use of firewood in the Makalu-Barun National Park before restrictions were in place. A 1989 study found that the average usage of firewood, in the national park, was 18.6 kilograms per person per day (Environmental Resources Limited cited in Sherpa and Lama 1995). This figure is thought to be an overestimation, perhaps overstating the situation by five to six kilograms (Peniston 1999). A 1995 study of the Everest region by Banskota and Sharma determined that an average of 8 kilograms of wood are consumed per tourist per day. In my research, porters consumed between 3 kilograms (above Tashigaon use) and 4 kilograms (general use) per day. So, compared to the studies presented, porters use about 38%-50% as much as tourists visiting Everest in 1995 and 16%-22% as much wood as tourists did in 1989 in Makalu. Although this may seem a small portion, there are usually between four and six porters for each tourist on a voyage in the Makalu region (Lama 1999). Thus a group of five porters consume approximately the same amount of firewood per night as a tourist would. This supports Wantanabe's statement that porter use of firewood is a meaningful portion of tourism related consumption.

Restriction of direct tourist use of firewood shifts a greater importance to porter use of firewood. In this context, it is important to consider how this remaining tourist related wood sink compares to local rates of household use. When averaged for a family of five, lodge proprietors reported using 32 kilograms per night for their family. Banskota et al. (1998) found that 20 kilograms of wood are consumed daily by a family of five in the Makalu-Barun conservation area. Many studies have been done on household use, but meta-analyses have repeatedly found a great degree of variance among them (Fox, 1984 and Sinha et al, 1998). The estimate for general daily use, 4 kilograms, indicates that a group of five porters uses 69% as much firewood as a local family of five along the Khandbari-Tashigaon trail. Due to the seasonality of tourism, porters are not a year round source of tourism related consumption, and the average survey respondent reported working 4.2 months out of the year.

Over three seasons a group of five porters can consume as much firewood as one family does in a year. Based on comparisons to household and tourist consumption levels, both local and non-local, porter consumption of firewood is occurring at significant levels. The finding that daily wood consumption levels for porters are two-thirds that of local families, especially in an area where firewood is scarce, indicates that tourism related consumption of this resource is ecologically and culturally inappropriate. Reducing tourist related consumption of a resource is very difficult if local residents have a vested interest in supplying that resource to tourists (Munasinghe 1998). Currently, lodge owners, through their sales of firewood to porters, and their provision of fire-cooked food, have an economic interest in porter consumption of firewood.

Firewood sales Porters often obtain wood by purchasing it in villages (Wantanabe 1998). Approximately 92% of porters reported purchasing wood from a lodge. Thus, only five porters relied solely on self-collection as a means to obtain wood. This finding is remarkably similar to Banskota et al.'s 1998 conclusion that 91% of assistants to group trekkers (i.e. porters or staff) bought firewood from local sources. The reliance on purchasing over harvesting, despite the availability of forest wood, may be a result of the presence of community forestry user groups. Community forestry user groups (CFUGs) are local organizations that blend traditional woodland management practices with participatory conservation area management (Valkerman 1997). Because they are integrative, and they promote incentive and community based conservation, CFUGs operate within the ecodevelopment paradigm.

Half of the 26 proprietors interviewed stated that they sold wood to porters. However, 25 of 26 lodge proprietors provided an estimate of the number of baris sold to porters and staff per overnight stay. The estimates provided in the latter question are more valuable because they require quantitative estimation instead of qualitative, and responses are likely to be more objective (Saksena 95). Thus, based on proprietor and porter surveys, lodges are a developed source of porter firewood. However, direct purchase of firewood is not the only way in which porters support local firewood use.

Indirect consumption Indirect consumption of firewood by porters occurs when local facilities, lodges or households, are used as eating facilities. Overall, local kitchen users consume an average of 3.5 kilograms more than outdoor cookers per day. The fact that local

kitchen users represent 70% of porters, and their higher wood consumption, makes them the porter sector on which to focus conservation education efforts. Norberg-Hodge (1991) has shown the positive potential of educating individuals as to the ramifications of tourism caused environmental change. In regards to household cooking, all houses in the area use only wood and other forest products as a fuel source. The use of local houses by porters is important, because this is the only linkage found to locals who are not in the tourism industry already. It is highly possible that additional firewood sales are occurring from private households to staff and porters, as has been found in other studies (Wantanabe 1998). Furthermore, 89% of the porters that did not use firewood above Tashigaon reported using local facilities below. It may be the case that use of household or lodge cooking facilities is determined by the proximity of a porter's home village to where he is staying.

Porter shelters The construction of porter shelters is a concrete effort on behalf of MI to provide warmer sleeping conditions and reduce porter use of firewood for warmth (Sherpa 1999). Simple rock shelters of this are of typical Himalayan style and are prevalent throughout the high country in Nepal (personal experience). As adaptations of local structures designed to ameliorate tourism induced pressures, the shelters are appropriate from an ecodevelopment point of view. They are also used by local goat and yak herders. Judging by porter response, almost all of the shelters are being used, although only two are used frequently. Objective responses indicate that shelters are not leading to firewood savings. However, four porters responded that lack of porter shelters led to increased firewood use. While quantitative data indicates that savings are not occurring, some porters responded qualitatively that they use more wood when they can't find shelter. Despite somewhat self-contradictory data, the porter shelter seems to be fulfilling one of its two missions. Porters are using the shelters to sleep in, but a majority of them indicate that less firewood is used at camps without porter shelters. Thus, I conclude that the porter shelters are not leading to a definitive savings of firewood.

Blanket rental The role of the blanket rental program in conserving firewood seems more positive than that of the shelters. Its wide use was indicated by the fact that all respondents to the question indicated that they rent blankets. 55% of porters used only blankets for warmth above Tashigaon. Overall, porters that used blankets and fire consumed 0.15 baris more per porter group per night than blanket-only users. This amount is equal to

an additional bari for the average roundtrip between Tashigaon and base camp. MI initiated the program through the provision of loans and supplies to local merchants. In this way, MI is subsidizing a beneficial market and promoting the conservation of local resources. At the same time, the program sustainably boosts the local economy, and providing a service for porters. The retention of capital within the local economy is often problematic in Himalayan communities (Banskota and Sharma 1998). It is important to remember that the blanket rentals are available in Tashigaon only, and the estimates for blanket rentals apply mainly in the National Park.

Differential consumption patterns When the various estimates of nightly consumption were considered in conjunction with the linkages between local and porter firewood use, an interesting trend emerged. Estimates of firewood use clearly indicated that higher porter consumption is occurring below Tashigaon. On average of a group of porters used 0.22 baris (about 7 kilograms) more per day when trekking below Tashigaon. Nineteen porters indicated that they did not use wood above Tashigaon. Seventeen of these 19 did make use of local kitchen facilities in the conservation area. In addition, only two porters indicated that they never made use of a fire.

Thus, there is a correlation between community linkages to firewood use and higher porter consumption of firewood. The fact that local residents, in the form of lodge proprietors, benefit from porter use of firewood makes separating difficult from an ecodevelopment point of view. In this case, the presence of tourism has created an economic incentive to overuse firewood. This correlation may be encouraged by the direct control mechanisms used in the national park (i.e. park officers) that forcibly limit use in that area. The failure of tourist shelters to reduce wood consumption may actually be a reflection of higher wood use below Tashigaon, where there are no shelters. In addition, incentive based conservation plans, such as blanket rental, keep economic benefit within conservation area, but fail to retain the benefits of firewood conserved. In this way, conservation benefits are being directed from the conservation area into the national park.

Ecodevelopment views indigenous needs as inseparable from conservation (Norberg-Hodge 1991), there is a need to focus more on the use of firewood within the buffer zone, or else firewood shortages may be experienced by locals. If the number of tourists visiting Makalu annually grows as expected, the number of porters will increase even more

dramatically. Because of this, tourism related firewood consumption can be expected to grow. On a lighter note, the fact that all porters are required to be from the surrounding areas has positive implications. Because the porters are local, belong to a porters association (Lama and Sherpa 1994), and they porter similar routes every year, they are more likely to recognize and be concerned about firewood scarcity. Locals also are receptive to alternatives to the current situation. Mehta and Kellert (1998) have identified highly positive attitudes among locals in regards to conservation issues involving ecotourism development.

While the blanket program is successful, other programs are needed to curtail porter use of firewood. One option would be to promote the use of yaks instead of porters, thereby reducing porter presence. This option has several drawbacks, including trail erosion and pasture degradation (Byers 1996). Portering is an important source of supplementary income for many porters, and using yaks would eliminate employment for these local individuals. Another alternative, and one that is currently available, is to make stoves widely available for porters. As the data shows, stove rental by porters is indeed occurring, but not at a level that prevents wood use for warmth or cooking. Therefore, stove rental below Tashigaon could potentially be encouraged in order to reduce firewood use in the conservation area. Increasing the use of stoves, however, requires that a larger amount of kerosene be available during the tourist season. Increasing kerosene use leads to an excessive dependence on externally supplied resources. In the event that prices of kerosene should rise, locals will have no alternative but to use the forest as a fuel source. In 19XX, when India imposed a kerosene embargo on Nepal, firewood use and related deforestation increased greatly (Peniston, 1999). Thus, although kerosene use will undoubtedly continue, mechanisms will have been developed to curb forest wood use in the absence of wood fuel alternatives.

It is suggested that community woodlots be developed as source of porter, and potentially tourist, firewood. Almost all wood used by tourists and their accompaniment comes from forests (Bjoness 1980). Already tilled land could be used for tree lots where quick growing species could be raised specifically for porter use. Because there are trained and locally residing foresters and rangers in the conservation area, the institutional capacity exists to develop these woodlots (Sherpa 1999). In line with ecodevelopment principles, woodlot programs necessitate neither large bureaucracies nor extensive external involvement. Community woodlots will allow the current interconnection of porter and community use to

remain in place and create new ways in which locals can benefit from tourist presence. This allows a reduction in the ecological consequences of tourism related wood use through incentive based mechanisms. In the event that a kerosene shortage should occur again, the woodlots could also function as reserves for community use.

Conclusion

Porter use of firewood for cooking and warmth continues in the Makalu-Barun National Park and Conservation Area. On average, a group of porters uses approximately 0.7 baris per day and, overall, 97% of porters utilize firewood in some way. Firewood sales patterns, local kitchen use, and the difference in wood use patterns above and below Tashigaon all indicate an interdependence of local and tourist related resource consumption. All but one lodge sold wood to porters, and 92% of porters purchased firewood form lodges or homes. Local households and lodges were used as food preparation facilities. Two thirds of all respondents were local kitchen users, and these users consumed wood at higher levels than independent cookers. The amount of wood consumed on average by a group of five porters was 69% as much firewood as a local family of five along the Khandbari-Tashigaon trail. Wood use above Tashigaon decreased by an average of 0.22 baris per day for a group of porters. Reasons given for this decrease included the absence of dry wood, the presence of a ranger station, and blanket rentals.

The above findings indicate that wood use is focused more heavily in the area below Tashigaon. The near equivalency of porter consumption to local levels of wood use places responsibility for abatement on present and future ecodevelopment mechanisms. The blanket rental program reduces the amount of firewood used by porters when in the national park, but porter shelters do not appear to conserve firewood. The direct enforcement of the firewood ban in the national park and the local role in wood use below Tashigaon make the latter of these two findings inconclusive. Overall then, the use of direct enforcement, while an option in curtailing outsider use of wood, cannot be used to curb local use of wood in the conservation area. Doing so would violate the ecodevelopment principle of community initiative based change. The firewood use mitigation mechanisms considered here, blanket rental and shelter construction, both focus benefits toward the national park. As shown above, firewood use in the conservation area allows multiple sectors of the community

benefit from porter wood consumption. The interconnection of local and porter usage is problematic because it encourages wood use in an area where current mechanisms are not in place. Thus, community based alternatives to porter use of forest firewood, such as commercial woodlots, are in need of development.

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References

Bajracharya, S.B. 1998. Tourism development and management in the Annapurna area. Pp. 237-242 *In* Sustainability in mountain tourism: perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Banskota, K. and B. Sharma. 1995. Mountain tourism in Nepal: an overview. International Center for Integrated Mountain Development, Kathmandu, Nepal. 233pp.

_____. 1997. Case studies from Ghandruk. International Center for Integrated Mountain Development, Kathmandu, Nepal. 53 pp.

_____. 1998. Understanding sustainability in mountain tourism. Pp. 111-147. *In* Sustainability in mountain tourism : perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Banskota, K., B. Sharma and M. Upadhyay. 1996. Socio-economic survey of the Makalu-Barun conservation area, Working paper No. 28. Makalu-Barun Conservation Project, Kathmandu, Nepal. 27pp.

Bjoness, I. 1980. External economic dependency and changing human adjustment to marginal environment in the Himalaya, Nepal. Mountain Research and Development 3: 263-272

Boo, E. 1993. Ecotourism planning for protected areas. Pp.15-31 *In* Ecotourism: a guide for planners and managers. Lindberg, K. and D.E. Hawkins, eds. Ecotourinsm Society, North Bennington, Vermont.

Brown, K., R. K. Turner, H. Hameed, and I. Bateman. 1997. Environmental carrying capacity and tourism development in the Maldives and Nepal. Environmental Conservation 24:316-325

Byers, A. C. 1996. Historical and contemporary human disturbance in the upper Barun valley, Makalu-Barun National Park and Conservation Area, East Nepal. Mountain Research and Development 16:235-247

Carpenter, C., and R. Zomer. 1996. Forest ecology of Makalu-Barun National Park and Conservation Area, Nepal. Mountain Research and Development 16: 135-148

Collins, A. 1999. Tourism development and natural capital. Annals of Tourism Research 26:98-109

Environmental Resources Limited (ERL). 1989. Natural resources management for sustainable development in Nepal with special emphasis on the hills. Draft Final Report. London, UK. *cited in* Lama, W. and A.R. Sherpa. 1995. Tourism management plan for the upper Barun Valley, Working paper No. 24. Makalu-Barun Conservation Project, Kathmandu, Nepal. 62pp.

Fox, J. 1984. Firewood consumption in a Nepali village. Environmental Management 8: 243-250

Fox, J. 1993. Forest resources in a Nepali village in 1980 and 1990: the positive influence of population growth. Mountain Research and Development 13: 89-98

Gilmour, D. 1991. Villagers, forests, and foresters: the philosophy, process, and practice of community forestry in Nepal. Sahayogi Press. Kathmandu, Nepal.

Goodwin, H. 1996. In pursuit of ecotourism. Biodiversity and Conservation 5:277-291

Gossling, S. 1999. Ecotourism: a means to safeguard biodiversity and ecosystem functions? Ecological Economics 29:303-320.

Gurung, H. 1998. Sustainability and development in mountain tourism. Pp. 29-46 *In* Sustainability in mountain tourism : perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Inmann, K., and K. Luger. 1998. Ecotourism and village development: the Oeko Himal strategy for sustainable tourism. Pp. 289-312 *In* Sustainability in mountain tourism: perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Lama, W. Ecotourism Consultant, Makalu-Barun Conservaiton Project/Mountain Institute, Kathmandu, Nepal. December 23, 1999, personal communication.

Lama, W. and A.R. Sherpa. 1995. Tourism management plan for the upper Barun Valley, Working paper No. 24. Makalu-Barun Conservation Project, Kathmandu, Nepal. 62pp.

Makalu Barun Conservation Project (MBCP) Task Force. 1990. Makalu-Barun National Park and Conservation Area Management Plan. Makalu-Barun Conservation Project, Kathmandu, Nepal. 85pp.

Mehta, J.N. and S.R. Kellert. 1998. Local attitudes towards community based conservaiton policy and programs in Nepal: a case study in the Makalu-Barun Conservation Area. Conservation Biology 25: 320-333.

Munasinghe, M. 1994. Economic and policy issues in natural habitats and protected areas. Pp. 15-50. *In* Protected area economics and policy: linking conservation and sustainable development. Munasinghe, M. and J. McNeely, eds. World Bank and World Conservation Union (IUCN), Washington, DC.

Nepal, S. 1999. Tourism-induced environmental changes in the Nepalese Himalaya. PhD dissertation, Center for Development and Environment, University of Berne.

Norberg-Hodge, H. 1991. Ancient futures: learning from Ladakh. Sierra Club Books, San Francisco. 198pp.

Odell, M. J. 1998. The challenge of global conservation: protected area management, ecotourism, and local people. Pp.213-222 *In* Sustainability in mountain tourism : perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu

Odell, M. J., and W.B. Lama. 1998. Tea house trekking in Nepal: the case for environmentally friendly indigenous tourism. Pp.191-206 *In* Sustainability in mountain tourism : perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Saksena, S., R. Prasad, and V. Joshi. 1995. Time allocation and fuel usage in three villages of the Garwhal Himalaya, India. Mountain Research and Development 15: 57-67

Schrand, A. 1998. Social indicators of sustainable tourism. Pp. 207-212 *In* Sustainability in mountain tourism : perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Sharma, P. 1998. Sustainable tourism in the Hindu-Kush Himalayas. Pp. 47-70 *In* Sustainability in mountain tourism : perspectives for the Himalayan countries. 1998. East, P., K. Luger, K. Inmann, eds.. Studienverlag, Innsbruck, Austria, Distributed by Pilgrims Book House, Kathmandu.

Sherpa, A.R. 1999. Ecotourism Consultant, Makalu-Barun Conservaiton Project/Mountain Institute, Kathmandu, Nepal. November 24, 1999, personal communication.

Sherpa, A., T. Bhotia and C. Dahal. 1998. Porter association in Tashigaon. Incidental Paper. Makalu-Barun Conservaiton Project/Mountain Institute, Kathmandu, Nepal.

Sinha, C., S. Sinha and V. Joshi. 1998. Energy use in rural areas of india: setting up a rural energy database. Biomass and Bioenergy 14: 489-503.

Sowerwine, J. and A. Shrestha. 1994. Recommendations for waste management/ recycling plan for ACAP and ecotourism development project in the Ghalekharka Sikles region. K.M. Trust for Nature Conservancy, Kathmandu, Nepal. 62pp.

Wells, M. P. 1994. Parks and tourism in Nepal: reconciling the social and economic opportunities with the ecological and cultural threats. Pp. 319-331 In Protected Area Economics and Policy: Linking Conservation and Sustainable Development. Munasinghe, M. and J. McNeely, eds. World Bank and World Conservation Union, Washington, DC.

Western, D. 1993. Defining ecotourism. Pp. 7-11 In Ecotourism: a Guide for Planners and Managers. Lindberg, K. and D.E. Hawkins, eds. Ecotourinsm Society, North Bennington, Vermont.

Zurick, D.N. 1992. Adventure travel and sustainable tourism in the peripheral economy of Nepal. Annals of the Association of American Geographers 82: 608-628

Appendix 1

Porter Surveys

Name Age Sex Major Occupation

Resident of a) buffer zone b) conservation area

1. Traveling with: a) independent trekker b) group terkker
2. Number of months per year spent working as porter
3. How many porters are traveling in your group?
4. How many tourists are traveling in your group?
5. What food do you normally cook?
6. How do you cook your daily food?
7. How many litres of kerosene are used per day by porter?
8. How much wood does your group of porters use per day for cooking?
9. How do you get your kerosene?
10. How do you get your fuelwood?
11. How much food do you use during the trek form Tashigaon to basecamp and back?
12. How many litres of kerosene do you use during the trek form Tashigaon to basecamp and back?
13. What are the common use of firewood for porter and staff
14. How do you keep yourself warm at night?
15. If you use firewood to keep warm at night, what is the average amount used to keep warm for one night?
16. If you rent blankets from Tashigaon, who pays the rent on these items for you?
17. If you rent stoves from Tashigaon, who pays the rent on these items for you?
18. Have you used porter shelters on the way to Makalu base camp?
19. When comparing camps with and without porter shelters, did you less wood at:
21. Overall are you using less fuelwood because of these shelters?
22. At what campsite do you use the most firewood? How much do you use per night at this campsite?
23. At what campsite do you use the least firewood? How much do you use per night at this campsite?

Lodge Owner Survey

Location Name of Lodge Number of rooms

Name of Proprietor Primary Occupation Family Size

Do you have camping facilities?

During the tourist season, how much firewood do you and your family use in your household?

What is the most tents you can take at one time?

When is the peak season period?

What is the average number of visitors staying in your lodge in the peak season?

When is the off season?

What is the average number of visitors staying in your lodge in the off season?

How many tourists or trekkers stayed at your lodge last year??

What type of fuel do you use in your lodge?

How much fuelwood do you use in a season?

How much kerosene do you use in a season?

How many trekkers or tourists ask for a hot shower?

If you heat water for shower, what do you use to heat water?

If answer is fuelwood, how much wood do you use when heating water for one shower?

If answer to #14 is back boiler or fuel efficient device, how much wood do you think these devices have helped to save?

During the high season, what is the average number of showers you make for non-overnight tourists per month/week?

During the high season, what is the average number of showers you make for overnight tourists per month/week?

What kind of services do you provide for camping tourists?

What type of tourists mostly use hot water for showers?

What do you provide for trekking staff and porters?

If wood, how much wood do you sell to porters and trekking staff per overnight stay?

Do porters and staff use the same firewood to cook with?

Do porters and staff use the same firewood to stay warm at night with?

Appendix 2.

Of the 78 porter surveys, eight surveys were excluded from the data set. One of the surveys was unanswered after question #3, and the other seven survey recipients were actually staff members, not porters. Certain adjustments of the raw data were necessary. Where consumption ranges were provided, the middle value in the range was used for further calculation and discussion. This was necessary to overcome a flaw in the design of questions #8, #11, #12, and #15. Of the ranges provided for responses to these questions, the range for response a) begins with 0, making quantitative comparison difficult. If, elsewhere in the survey, the respondent indicated that kerosene and/or firewood use was occurring, the answers to questions #8, #11, #12, and #15 were assumed to be nonzero. Thus, the middle value of the provided range was used in discussion to avoid over- and under-estimation of firewood use.

Another issue in question design was the failure to ask for porter group size when answering questions #11, #15, #22, and #23. One-third of subjects provided group sizes when answering these questions. In these cases, per capita wood use per porter per night was found by dividing the mid-value of a specific consumption estimate by the mid-value of the correlated group size. However, as porters rarely travel alone, this per capita figure was multiplied by 5, the average porter group size, to have a more realistic estimates of use. Because the correlation was unknown, the possibility exists that the per capita figures do not represent group use. These per capita figures were generated from group estimates, and are used to allow for comparisons across porter groups of different sizes. Therefore, discussion in regards to porter wood use focuses on interpretation of the general estimates provided by all subjects, and the per capita estimates described above.

Several options were available when determining the units in which to measure firewood. In the Makalu area, wood is measured in terms of weight, collection baskets, and ready-to-burn bundles. Because the ready-to-burn bundles are the last organizational form that wood takes before it is used as firewood, this measurement is most appropriate for recall-based surveys (Banskota and Sharma 1997). Each of these bundles is known as “bari” and represents approximately 30 kilograms of dry wood. The provided ranges for closed-end questions were based on past studies and existing knowledge of consumption habits.