Fuelwood, Timber and Deforestation in the Himalayas

Authors: Ali, Jawad, and Benjaminsen, Tor A.

Source: Mountain Research and Development, 24(4) : 312-318

Published By: International Mountain Society

URL: https://doi.org/10.1659/0276-4741(2004)024[0312:FTADIT]2.0.CO;2

Mountain Research and Development Vol 24 No 4 Nov 2004: 312–318

Jawad Ali and Tor A. Benjaminsen

Fuelwood, Timber and Deforestation in the Himalayas

The Case of Basho Valley, Baltistan Region, Pakistan

During the past century the "Theory of Himalayan Environmental Degradation" has dominated mainstream views concerning natural resource management in the Himalayan region. The main tenet of this theory is that increased human population has resulted in increased demands for natural resources, leading to severe resource depletion, especially deforestation. In this article, we use local data on fuelwood consumption and timber extraction from Basho Valley in northern Pakistan to investigate whether such general perceptions regarding forest depletion can be supported by an empirical case study. The results of this study indicate that local fuelwood collection is not the main cause of deforestation. Instead, the estimated deforestation of about 30% during the last 3 decades is primarily due to commercial harvesting and mismanagement by the government. A large amount of dead fallen wood and green trees was sold by the government or was taken out by a "timber mafia" that emerged during the main period of commercial harvesting in the 1970s and 80s. Thus, it is commercial and illegal harvesting that has left the forest in such a depleted state that it can no longer withstand the pressure from local use.

Keywords: *Deforestation; fuelwood; timber; "timber mafia"; Himalayas; Pakistan.*

Peer reviewed: *May 2004* ***Accepted:*** *July 2004*

Introduction

Fuelwood is an important component of household economies in Pakistan: it covers about 53% of total annual domestic energy needs (Government of Pakistan 1997). It has also been estimated that 70–79% of Pakistani households use fuelwood as a main source of energy (Hafeez 2000; Siddiqui 2000). This reliance on fuelwood is expected to remain high in Pakistan in the foreseeable future, mainly because the country's economic development is not strong enough for a shift from traditional to modern fuels (Siddiqui and Amjad 1993). The high demand for domestic fuelwood is believed to be the cause of Pakistan's rapid depletion of forests (Government of Pakistan 1992). The deforestation rate in the country is estimated to be the second highest in the world (IUCN 2002). The World Conservation Union (IUCN) has estimated that with the current population growth, wood consumption in Pakistan would increase by 3% per year. Hence, IUCN believes (2002), if the present rate of deforestation continues, Pakistan's forests may vanish within the next 10–15 years.

In Asia, the forests in the Himalayan region are considered to be among the most depleted (Tucker 1987; Duke 1994; Schickhoff 1995). Deforestation in the Himalayan region is also often attributed to increasing human population (Eckholm 1975, 1976; Sterling 1976; Lall and Moddie 1981; Myers 1986). Ives and Messerli (1989) called this explanation "overly simplistic" and have named it the "Theory of Himalayan Environmental Degradation." They argue that environmental degradation has been overdramatised, and often mere correlations between environmental degradation and other factors have been represented as a causal relationship. In this way, the conservationist literature has diverted the discussion from the main issues and the real causes of deforestation.

Despite the importance of fuelwood collection for the national economy, reliable data for Pakistan on fuelwood collection and its impact on natural forests are not available. This is especially true for the Western Himalayan region in the Northern Areas (NAs), where few—if any—empirical studies of fuelwood consumption have been conducted so far. The present study has been undertaken to respond to this lack of reliable data and to gain an understanding of how fuelwood collection by the local communities impacts on forests in the NAs of Pakistan. While other factors such as livestock grazing and conversion of forest to agricultural land may in some cases also be reported to contribute to deforestation, firewood consumption by local people is often mentioned in the literature as the main cause of deforestation in this region.

This study provides local data on fuelwood consumption from Basho Valley, and investigates whether general perceptions that forest depletion is caused by local fuelwood collection can be supported by this case study. In addition, the local extraction of timber was also estimated in order to be able to present a more complete picture of the causes of deforestation in the area. Indeed, overuse and mismanagement have been reported to have seriously impacted on natural forests in Basho Valley (Velle 1998).

Study area

Basho Valley is located in the Baltistan region in the NAs of Pakistan at 75°15′ E, 35°25′ N (Figure 1). The valley ascends from the southern side of the Indus river at an altitude of approximately 2150 m above sea level to the peak of Banak La (5520 m). Situated in the westernmost arm of the Himalayan range, Basho lies within a semi-arid and rugged mountain landscape. It is within

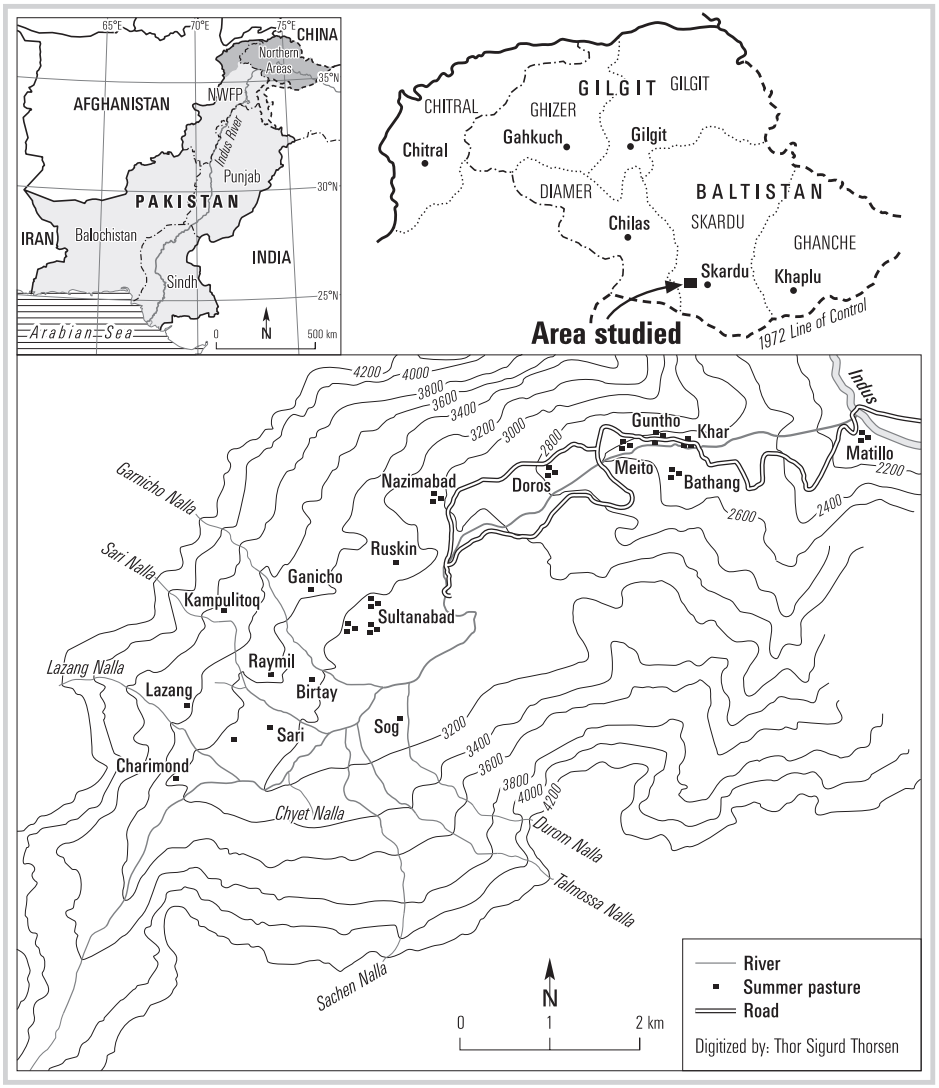


FIGURE 1 Map of Basho Valley and its location within Pakistan. Note: some borders on the location maps are not officially recognized. (Source of map: Velle 1998; redrawn by Andreas Brodbeck)

the rainshadow of the Himalayas. Average rainfall is estimated to be between 100 and 200 mm in the bottom of the valley but rises with elevation, thus creating a moister environment in the extensive, high-altitude rangelands. Because of the altitude, the area has a marked seasonal climate comparable to that of the temperate zone. The mean maximum temperature during summer revolves around 30–35°C, while the mercury may drop to –25°C in winter.

People in Basho live in 7 villages distributed in the zone of permanent habitation along the Khar Nalla stream: Sultanabad (highest village), Nazimabad, Meito, Guntho, Khar, Bathang, and Matillo (lowest village). The total number of households in Basho Valley was counted to be 286 during the fieldwork for this study and the total population was estimated to be 1950. Agriculture and livestock production are the major sources of livelihood. Crop cultivation is based on irrigation carried out by constructing irrigation channels that are fed by glacial snowmelt or springs.

Basho Valley falls under 3 vegetation types (Schweinfurth 1957). The lower northeastern part from the Indus river to about 2500 m is described as sub-tropical semi-desert. The area further up is classified as Artemisia steppe, dominated by scrubs such as *Artemisia maritime* and *Eurotia ceratoides*. The vegetation in the uppermost part of Basho varies greatly from the drier southeastern facing slopes to the moist northwestern slopes. Natural blue pine forest covers the northeastern facing moraine slopes (Figure 2). The forested moraine slopes are characterized by gulches and glacifluvial gravel fans, with sparse vegetation consisting of blue pine, willow, and other shrubs. Grassy slopes and *Juniper macropoda* cover areas where the forest has been cut. Above the pine forest, patches of *Betula utilis* delineate the upper forest line at about 3800 m.

Methodology

Assessments of annual wood consumption were carried out during the summer and winter of 2001. The consumption of fuelwood and timber for local use and commercial wood was assessed to calculate total annual consumption. The 7 villages in Basho Valley are diverse as a result of altitude, annual precipitation, and length of growing season. With rising altitude, the winter becomes longer and more severe, while the growing season is shorter. The upper 3 villages need fuelwood for heating for longer periods compared to the lower 4 villages. Therefore, the upper 3 and lower 4 villages were grouped separately. For each group of villages, a 25% sample of households was taken randomly. Altogether 72 households were sampled out of the total of 286.

For the estimation of fuelwood consumption, a weight survey method was adopted (Benjaminsen 1993). Two surveys were conducted, one in August for summer consumption and one in December for winter consumption. During the surveys, woodstocks in each sampled household were weighed at noon and the people were asked to burn wood only from that bundle. At noon the next day, the remaining part of the stock was weighed again and one day's consumption was calculated.

No records were available for timber harvested, as most of the wood used is harvested illegally. The best possible alternative method to estimate the timber used locally was to assess the amount of timber used in the local buildings. All the houses and animal sheds built during the last 5 years were counted and the total number of rooms in all these houses was recorded. From these data, the average number of rooms built in 1 year was calculated. One house and an animal shed in each village were sampled randomly for the estimation of wood used in the construction. A carpenter was hired to measure the wood used in each room of a sampled house.

To assess commercial wood consumption, Government Forest Department (FD) officials, local village elders, local jeep owners (who transport both legal and illegal wood), village forest conservation volunteers, and the owner of the only sawmill in Basho were interviewed. Through these interviews, the annual commercial wood consumption was estimated. Descriptive statistics for the average, standard deviation, and coefficient of variation were calculated using the MINITAB procedures.

Forest cover change in the valley was estimated through interviews to analyze historical trends in the deforestation rate in Basho Valley. Fourteen elders, 2 from each village, were interviewed for this purpose. In addition, 11 foresters that had served in Basho Valley were interviewed to obtain general information on forest use.

FIGURE 2 The upper Basho forest: local elders estimate loss of forest cover. Blue pine and juniper forest patches are visible northeast of Basho Stream. The village of Sultanabad with cultivated fields (barley) is situated southeast of the stream. (Photo by Tor A. Benjaminsen)

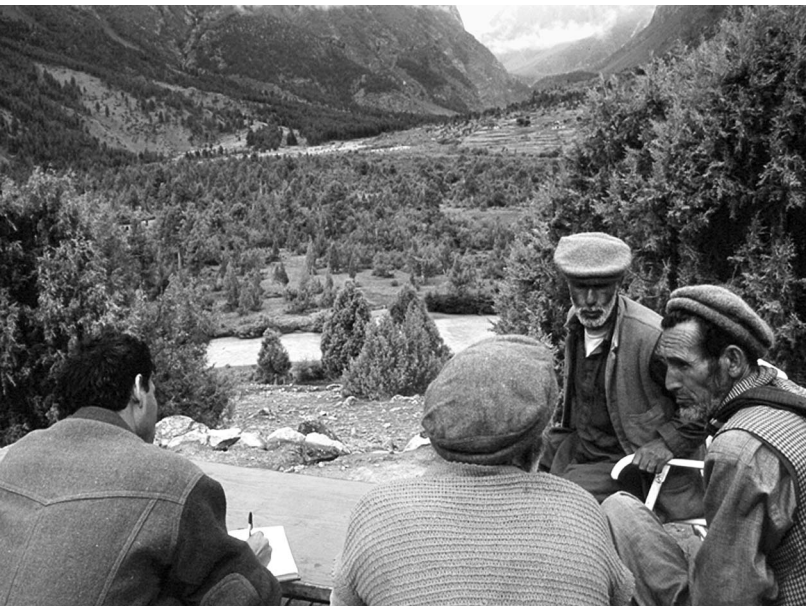


FIGURE 3 Daily fuelwood consumption in kg per capita in Basho Valley during the year 2001.

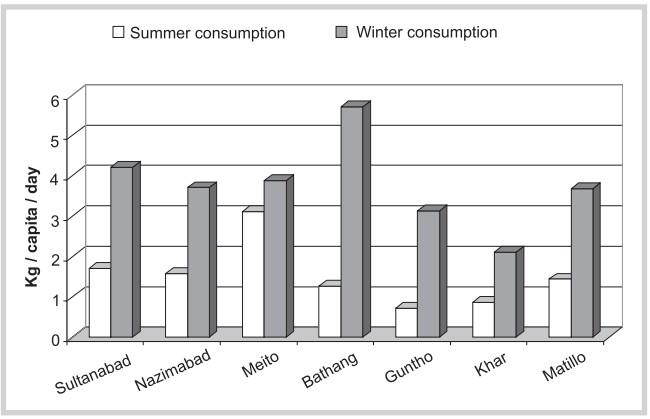
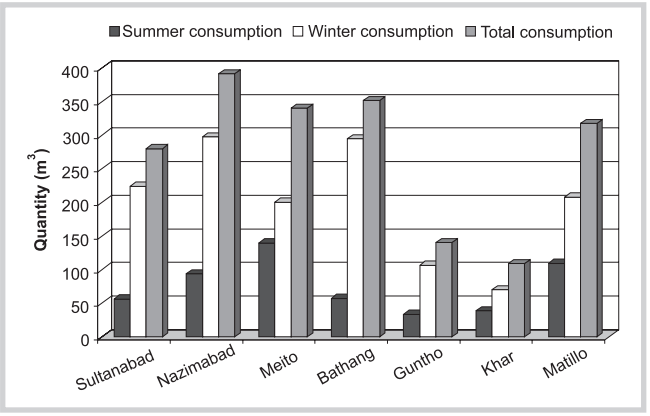


FIGURE 4 Yearly fuelwood consumption in m^3 in Basho Valley in 2001.



For the Basho forests, no studies were available before Velle (1998), as no inventory or forest management plan has been prepared in the past. Therefore, an estimation of forest change was not possible through field measurements in the absence of records for comparison.

Results and discussion

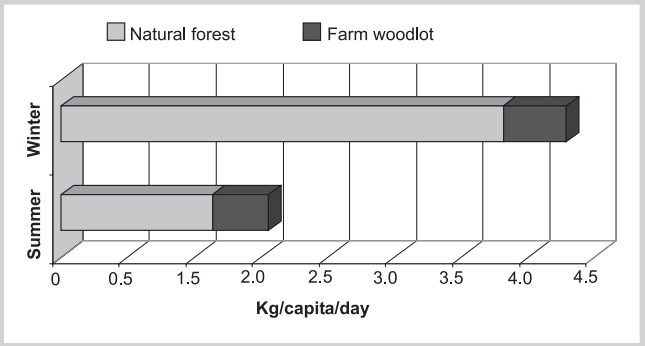
Fuelwood for local use

The survey recorded the source of fuelwood from both private and natural forests. The total wood measured in tons was converted into m^3. The measurements showed that a total of approximately 3044 m^3 of wood was harvested from the natural forest, while 635 m^3 came from farm woodlots in 2001.

The data for daily and yearly fuelwood consumption (Figures 3 and 4) show that wood consumption for the upper 3 villages—Sultanabad, Nazimabad and Maito—is higher compared to the lower 4 villages, except Bathang where winter consumption is higher than in all other villages. This village lies just below the Gorikh forest, which means that the villagers from Bathang do not have to carry wood over long distances. Bathang is also situated in the eastern part of the valley and remains under shade for most of the daytime especially during winter. Easy access to the forest and its location in the shade appear to increase wood consumption in Bathang. Fuelwood consumption in Basho Valley is associated with both village altitude and its distance to the natural forest. People in villages situated in higher elevations consume more wood because of longer winters than villagers at lower elevations. Also, the people in villages situated near the forest consume more wood compared to the villagers situated at a further distance. Inhabitants of the upper 3 villages harvest wood mainly from the upper Basho forest, which is accessible by jeep road. The villagers situated in the middle villages, Guntho and Khar, collect wood both from upper Basho and other forest areas (Gorikh and Farah), which have no jeep road. Both Guntho and Khar do not have easy access to any of the forests in Basho and hence have the lowest wood consumption rate. Matillo, which is situated at the entrance to the valley, has a longer summer and milder winter compared to the rest of the villages. Despite this, wood consumption in Matillo is higher than what is the case in Khar and Guntho. This is most likely due to easy accessibility of wood from farm woodlots in Matillo.

Wood harvesting from farm woodlots remains almost the same throughout the year. However, harvesting from natural forests increases by a factor of 3 during winter (Figure 5). Four villages—Sultanabad, Nazimabad, Khar, and Bathang—depend only on natural forests during winter. In Sultanabad and Nazimabad very few trees are grown in the farms due to the short growing season. In the lower villages including Khar and Bathang, more trees are grown in farm woodlots. Farm forest products are sold on the market in Skardu, the nearest town, especially during winter when there is a high demand for fuelwood.

FIGURE 5 Comparison between summer and winter fuelwood consumption in kg per capita per day in 2001.

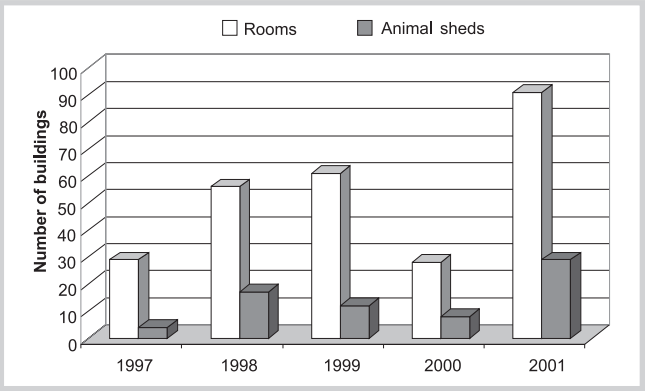


Timber for local construction

A total of 265 rooms and 70 animal sheds were built in the last 5 years. We noted an increasing construction trend of new buildings from 1997 to 2001, except for the year 2000 (Figure 6). This increase could, for example, be due to an increasing number of people engaged in off-farm employment. Those who engage in off-farm employment add a new room to their existing house or build a new house mainly to cater for guests. Though limited, off-farm employment opportunities have increased in Basho over the years.

On average about 360 m^3 of wood was used each year for construction of the houses and animal sheds. Wood for construction is generally harvested from the natural forests without formal permission. During the years 2000 and 2001 no permits for harvesting timber from the Basho forests were issued by the government. However, 59 poles damaged by natural hazards were distributed by the FD among the local people during this period. Considering the number of rooms built during

FIGURE 6 Construction trends in Basho Valley (1997–2001).



2000 and 2001, this seems an underestimation. Access to a permit to harvest timber is very difficult due to complicated procedures. Therefore people generally do not apply for permits.

Commercial wood and the "timber mafia"

The natural forests in Basho fall under the category "protected forest." Protected forests are a legal category; they are government property but local communities have all the use rights unless the government explicitly restricts them (Rao and Marwat 2003). Commercial harvesting in these forests is not permitted in principle. However, harvesting on a large scale was carried out in Basho forests in the past to cater to the government's construction needs. In this process, private people from outside Basho were also given permits. The government does not classify such harvesting as commercial. In this paper, "commercial harvesting" is used to describe harvesting that brings wood (timber and/or fuelwood) out of Basho Valley either for government use or for sale.

The official records at the Divisional Forest Office Baltistan (files concerning timber harvests from Basho) show that commercial harvesting started in 1974 and was banned in 1987. From 1974 to 2001, a total of 2002 trees (approximately 24,885 m^3, ie 1914 m^3 per year) were officially harvested. This does not include timber and dead fallen wood taken out without a permit. The local residents and some FD officials interviewed for this study believe that the FD records do not reflect the actual harvest. In Basho Valley most of the timber and fuelwood harvesting is carried out unofficially by what is locally known as the "timber mafia," which emerged during the period of commercial harvesting. This "mafia" (Yusufzai 1992) consists of an informal cooperation of contractors and some local people who earn cash from illegal wood sales supported by some government officials.

Before commercial harvesting started in the early 1970s, dead and fallen wood was abundant in Basho forest. The "mafia" collected dead and fallen wood either for free or by paying nominal charges, and sold it on the Skardu market where wood prices are the highest in the country. In 2001 for example, the tax to be paid to the government was Pakistani Rupees (PKR) 7.5 (US$ 0.12) per 100 kg firewood and PKR 304 (US$ 4.80) per m^3 timber. On the market in Skardu, the same amounts of fuelwood and timber cost PKR 350 (US$ 5.52) and PKR 2650 (US$ 41.80), respectively. In total, transportation, labor charges, and the government tax for 100 kg firewood would cost approximately PKR 77 (US$ 1.21). This obviously implies an attractive profit to be extracted in the wood business, and this profit was by and large appropriated by the "timber mafia."

By 1992, all the dead and fallen wood had been taken out of the forest and local people started cutting standing trees for fuel. Even though a ban has been put on commercial harvesting since 1987, the "mafia" is still active despite occasional resistance from the local population. In spite of the ban, the "mafia" members and other influential people still get a *chit* (hand written permit issued by FD officials) to export wood. A *chit* is different from a formal permit insofar as there are no records for *chits*. The 14 local elders, 4 jeep owners and 3 forest conservation volunteers interviewed estimated that on average 70 jeep loads of timber/firewood were transported out of Basho Valley each year illegally or using *chits*. Each load consists on average of 3 m^3 of wood. Therefore, around 210 m^3 wood would be taken out of Basho for commercial purposes annually. The standard deviation of the estimation made by the respondents for the number of jeep loads transported illegally was 5.8, with an 8.3% variation coefficient. From the statistical point of view this standard deviation is within the expected range (Montgomery 2001).

Further discussion

Estimating the impact of fuelwood collection on forests in Basho is a difficult task. Since the standing volume for the entire Basho forest is not available, it is not possible to compare this figure with the Mean Annual Increment (MAI) of the whole forest. However, inhabitants of the upper 3 villages in Basho collect fuelwood mainly from the upper Basho forest and since standing volume for this forest is known, the impact of fuelwood collection on the upper Basho forest can be estimated.

The figures for wood harvesting and consumption in the upper Basho forest paint a dismal picture for the future of the forest. Two decades of commercial harvesting have depleted the forest to a stage where local use is also starting to have an impact on the forest. The present study shows that a total of 4249 m^3 of wood is currently consumed each year in Basho. Out of the total, 635 m^3 wood is harvested from farm woodlots while 3614 m^3 comes from natural forests. Inhabitants of the upper 3 villages, who depend mainly on the natural forest, harvest 1746 m^3 fuelwood each year from the forest. The total standing volume in the upper Basho forest has been calculated at 18,176 m^3 and the MAI has been estimated to be 218 m^3 (Velle 1998). Therefore, even if only the inhabitants of the upper 3 villages continue to collect wood from the forest as they are doing at present and without taking into account wood harvested for construction and commercial wood, the remaining forest might disappear within 15–20 years at the current speed of extraction, unless alternative sources of energy or wood are made available.

The local population maintains that deforestation would not have occurred if commercial exploitation had not been carried out. The fact that certain age classes in the forest are missing corroborates the per-

ception that commercial harvesting has had an impact in addition to local use. Some areas have over-mature trees while other areas have been opened to the extent that new seedlings cannot survive due to direct sunlight and lack of moisture (Synnestvedt and Thompson 1999; Velle 1998). In 1998, normal regeneration was observed only in 5.5% of the forest area, some regeneration in 24% of the area, while no regeneration was observed in 70.5% of the area (Velle 1998).

According to a qualitative assessment by 14 elders, both Gorakh and upper Basho forests (Sultanabad) have been reduced by about 30% since extensive commercial harvesting started in 1974. The answers given by the elders do not deviate much except for 2 elders from Sultanabad, one of whom estimated the reduction to be 45% while the other estimated it to be 60% in the last 30 years. This could be explained by the fact that the upper Basho forests situated near Sultanabad are easily accessible and have been depleted more than the other forest areas in Basho. Interestingly, the estimation made by the elders match the findings of Gudbrandsson (2002), who reported a 31% forest loss in Basho from 1968–2001, based on stump analyses. However, these stump analyses were carried out only for the dense pine patches excluding open areas and most of the juniper forests. Inclusion of these areas could result in even a higher percentage of harvests for the period 1968–2001.

We conclude that during and after the period of extensive commercial harvesting a large amount of wood was sold by the government to outsiders or was taken illegally by the "timber mafia." At present, dead fallen wood no longer exists in the Basho forest. Therefore, the local population has no choice but to harvest green wood both for fuel and construction. The forest is classified as "protected forest" and has been too small in size for such large-scale commercial harvesting as was carried out in the past. Due to lack of any forest inventory, the forest authorities did not have sufficient information about how much wood was available for harvesting and how much was actually being harvested. A maximum number of trees were cut in easily accessible areas without considering the annual increment of the forest. Therefore, our conclusions confirm the local opinion that deforestation in Basho is primarily due to government mismanagement and extensive commercial harvesting endorsed by the FD.

Conclusions and relevance of the results to other areas in the Himalayas

Demand for timber from Basho and other forested valleys in the Northern Areas (NAs) increased as a result of the political and administrative reforms during the late 1960s (Afridi 1988) and early 1970s (Dani 2001). For example, the NAs consisted of 2 Political Agencies in 1971 and were divided into 3 districts in 1972 and 4 districts in 1974. This led to a huge demand for timber to construct new buildings in the newly created districts. Timber for construction in Skardu in addition to many other buildings and bridges elsewhere in Baltistan was mainly harvested from Basho. Deforestation in Basho started during the early 1970s, after the construction of a jeep road that was specifically built to access the forest to meet increasing timber needs in Baltistan. Therefore deforestation in Basho is a relatively recent phenomenon. Although internal factors, for example grazing and the conversion of forest land to agriculture, have also most likely influenced the forest cover to some degree, these factors are of secondary importance by comparison with the impact of large-scale commercial harvesting. The forest has suffered enormous quantitative losses specifically due to commercial harvesting during the last 30 years. After timber extraction was banned in Basho in 1987, FD officials continued to informally endorse illegal harvesting of timber, as profit opportunities for the timber business were high.

The data collected for this study do not support the Theory of Himalayan Environmental Degradation, which claims that deforestation in the Himalayan region is caused by population growth. The population in the mountain regions of the NAs of Pakistan has increased very slowly due to harsh living conditions in the course of history (tribal wars, famine and diseases) (Afridi 1988; Jettmar 2002). For example, in Basho the average annual population growth from 1951 to 1961 was almost zero (Afridi 1988). According to the local respondents this was because of high mortality rates due to epidemics and the absence of medical facilities. From 1951 to 1981, average population growth in Baltistan was recorded to be 1.7% (GSD 1982), while the population increased at an average rate of 2.5% from 1951 to 1998 (GSD 1999), compared to an average national population growth rate of 3.5% for the same period (Government of Pakistan 2003). Most of the deforestation in Basho occurred from 1974 to 1987, when commercial harvesting was carried out, while population growth was relatively low during this period. These findings concur with those of Schickhoff (1995), who studied forest cover change in the Kaghan valley in the Western Himalaya. In Kaghan, Schickhoff found that deforestation was a long-term process caused by changes in the socioeconomic environment in the early years of British rule, rather than being caused by recent processes of population pressure.

Increased losses of forest cover in the Darel, Tangir and Chilas valleys in the NAs during the last 30 years have been studied by Gohar (2002). Here, increased access and sectarian disputes, followed by mismanagement by the FD are described as the main reasons for

deforestation. Since the FD took over the management of the private forests in Darel, Tangir, and Chilas in 1951, the contractors were given a free hand to exploit the forest. The construction of the Karakorum Highway (KKH), which links Pakistan with China, also played an important role in accelerating deforestation. The KKH facilitated easy and cheap transport of timber to other areas. Similarly, Knudsen (1996) found that harvesting by timber contractors was the main cause of deforestation in the North-West Frontier Province (NWFP) of Pakistan. The above results from other Pakistani mountain valleys also raise questions about the hypothesis that population growth is responsible for deforestation in the Himalayan region.

AUTHORS

Jawad Ali and Tor A. Benjaminsen
Noragric, Agricultural University of Norway, PO Box 5003, 1432 Ås, Norway.
jawad.ali@noragric.nlh.no (J.A.); t.a.benjaminsen@noragric.nlh.no (T.A.B.)

REFERENCES

Afridi BG. 1988. *Baltistan in History*. Peshawar, Pakistan: Emjay Books International.

Benjaminsen TA. 1993. Fuelwood and desertification: Sahel orthodoxies discussed on the basis of field data from the Gourma region in Mali. *Geoforum* 24(4):397–409.

Dani AH. 2001. *History of the Northern Areas of Pakistan*. Lahore, Pakistan: Sang-e-Meel Publications.

Duke G. 1994. A participatory approach to conservation safeguarding the Himalayan forests of the Palas valley, District Kohistan. *In:* Asian Study Group (Afghanistan Circle), editors. *The Destruction of the Forests and Wooden Architecture of Eastern Afghanistan and Northern Pakistan: Nuristan to Baltistan*. Islamabad, Pakistan: Asian Study Group, pp 40–48.

Eckholm E. 1975. The deterioration of mountain environments. *Science* 189:764–770.

Eckholm E. 1976. *Losing Ground. Environmental Stress and World Food Prospects*. New York: Norton.

Gohar A. 2002. *Competing Interests and Institutional Ambiguities: Problems of Sustainable Forest Management in the NAs of Pakistan* [PhD dissertation]. Bath, UK: University of Bath.

Government of Pakistan. 1992. *Forestry Sector Master Plan 1992.* Volume 1. Islamabad, Pakistan: Ministry of Food, Agriculture and Co-operatives, Government of Pakistan.

Government of Pakistan. 1997. *Pakistan Energy Yearbook 1996*. Islamabad, Pakistan: Ministry of Petroleum and Natural Resources, Government of Pakistan.

Government of Pakistan. 2003. *Pakistan Statistical Yearbook 2003*. Islamabad, Pakistan: Ministry of Finance, Economic Affairs, Statistics and Revenue, Government of Pakistan.

GSD [Government Statistic Division]. 1982. *District Census Report of Baltistan for 1981.* Islamabad, Pakistan: GSD.

GSD [Government Statistic Division]. 1999. *District Census Report of Baltistan for 1998.* Islamabad, Pakistan: GSD.

Gudbrandsson SF. 2002. *Assessment of Current Status of Basho Forest* [MSc thesis]. Ås, Norway: Agricultural University of Norway.

Hafeez SM. 2000. Bio-energy for meeting growing energy needs. *In:* RWEDP [Regional Wood Energy Development Programme], editor. *Wood Fuel Production and Marketing in Pakistan. National Workshop, Faisalabad, Pakistan, 28-30 October 1997*. RWEDP Report No 49. Bangkok, Thailand: FAO [Food and Agriculture Organization of the United Nations], pp 143–149.

IUCN [The World Conservation Union]. 2002. *Environmental Issues. Land. Fuelwood.* http://www.edu.sdnpk.org/edu/land.htm; accessed on 15 March 2003.

Ives JD, Messerli B. 1989. *The Himalayan Dilemma: Reconciling Development and Conservation*. London and New York: Routledge.

Jettmar K. 2002. *Beyond the Gorges of the Indus: Archaeology Before Excavation.* Karachi, Pakistan: Oxford University Press.

Knudsen AJ. 1996. Deforestation and entrepreneurship in the North-West Frontier Province, Pakistan. *In:* Madsen ST, editor. *State, Society and the Environment in South Asia.* Richmond, UK: Curzon Press, pp 200–235.

Lall JS, Moddie AD, editors. 1981. *The Himalaya: Aspect of Change*. New Delhi: Oxford University Press.

Montgomery DC. 2001. *Design and Analysis of Experiments*. New York: Wiley.

Myers N. 1986. Environmental repercussions of deforestation in the Himalayas. *Journal of World Forest Resources Management* 2:63–72.

Rao AL, Marwat AH. 2003. *Northern Areas Strategy for Sustainable Development. Background Paper for Forestry.* Gilgit, Pakistan: IUCN [The World Conservation Union].

Schickhoff U. 1995. Himalayan forest-cover change in historical perspective: A case study from the Kaghan Valley, Northern Pakistan. *Mountain Research and Development* 15(1):3–18.

Schweinfurth U. 1957. *Die horizontale und vertikale Verbreitung der Vegetation im Himalaya*. Bonner Geographische Abhandlungen 20. Bonn, Germany: Ferdinand Dümmlers.

Siddiqui KM. 2000. Wood fuel in the national energy balance. *In:* RWEDP [Regional Wood Energy Development Programme], editor. *Wood Fuel Production and Marketing in Pakistan. National Workshop, Faisalabad, Pakistan, 28-30 October 1997*. RWEDP Report No 49. Bangkok, Thailand: FAO [Food and Agriculture Organization of the United Nations], pp 25–30.

Siddiqui KM, Amjad M. 1993. *A Case Study on Marketing of Wood Fuel in Peshawar City, Pakistan.* Bangkok, Thailand: Food and Agriculture Organization of the United Nations.

Sterling C. 1976. Nepal. *Atlantic Monthly* 238(4):14–25.

Synnestvedt SJ, Thompson JS. 1999. *Factors Influencing Regeneration of* Pinus wallichiana *and* Juniperus excelsa*, Basho Valley, Baltistan, Pakistan* [MSc thesis]. Ås, Norway: Agricultural University of Norway.

Tucker RP. 1987. Dimensions of deforestation in the Himalayas: The historical settings. *Mountain Research and Development* 7(3):328–331.

Velle K. 1998. *Natural Forest Inventory.* High Altitude Integrated Natural Resources Management Project Report No 4. Ås, Norway: Centre for International Environment and Development Studies, Agricultural University of Norway.

Yusufzai R. 1992. The Timber Mafia. *Newsline* 1992(10):126–130.