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Ecological and Social Aspects of Transhumant Herding in Bhutan

Little is understood about the role of transhumance in subsistence economy and the interactions between cattle, forest, and pastureland in the Himalaya. We examined herding practices and the effects of grazing on forest ecology and grassland, using rapid rural appraisal techniques with transhumant herders in Haa and Merak in western and eastern Bhutan. Cattle are the main source of livelihood, contributing 71% and 84% of the herders' gross annual household income in Haa and Merak, respectively. Transhumance is a direct response to cold temperatures, shortage of forage, and the search for livelihood opportunities. Grazing rights over rangeland are individual and community-owned. Grazing regulations are based on mutual understanding and equity among high-elevation pastoralists and low-elevation sedentary cattle owners. The sustained use of rangeland requires accommodation of traditional rights and more clarity about ownership and rangeland management. Temperate forests and grasslands along the established migratory livestock routes exhibit signs of overgrazing that vary with forest types. Rotational grazing is recommended, particularly on severely depleted ranges.

Keywords: *Migratory herding practices; grazing; forest ecology; subsistence farming; livelihoods; Bhutan.*

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Introduction

High-elevation pastoralists in Bhutan have been practicing transhumance from temperate to subtropical grazing lands for more than 1300 years (MoA 2001). Mongar and Gyeltshen (2001) noted that the highlands ranging from 3500 to 5000 m are an important resource for alleviating rural poverty through livestock production. However, little is understood with regard to the role of transhumance in the household subsistence economy.

The Land Act of 1979 and the Forest and Nature Conservation Act of 1995 devolve grazing rights on grassland to individuals and communities, but these acts lack provisions to clarify ownership and management to promote more sustainable use (Norbu and Dorji 2001; Ura 2002). The complexity of dual and multiple ownership of rangeland based on temporal separation (herders in winter and someone else in summer) and inadequate accommodation of social and geographical factors have impeded nation-wide implementation of the "draft pasture policy" (MoA 2001). The causes of transhumance and traditional mechanisms that regulate grazing between high-elevation pastoralists and low-elevation individuals and communities are inadequately understood.

Mongar and Gyeltshen (2001) define migratory herding as a mutual relationship forged and fostered between individuals, communities, and institutions who do not have grassland but livestock, and vice-versa. In Laya, north-central Bhutan, Wangchuk (2003) found that monasteries own grazing rights over grassland and local communities compensate in kind with livestock products for the right to graze the pastures. He argues that such tenure neither encourages investment in the development of pastures nor facilitates equitable and sustainable use.

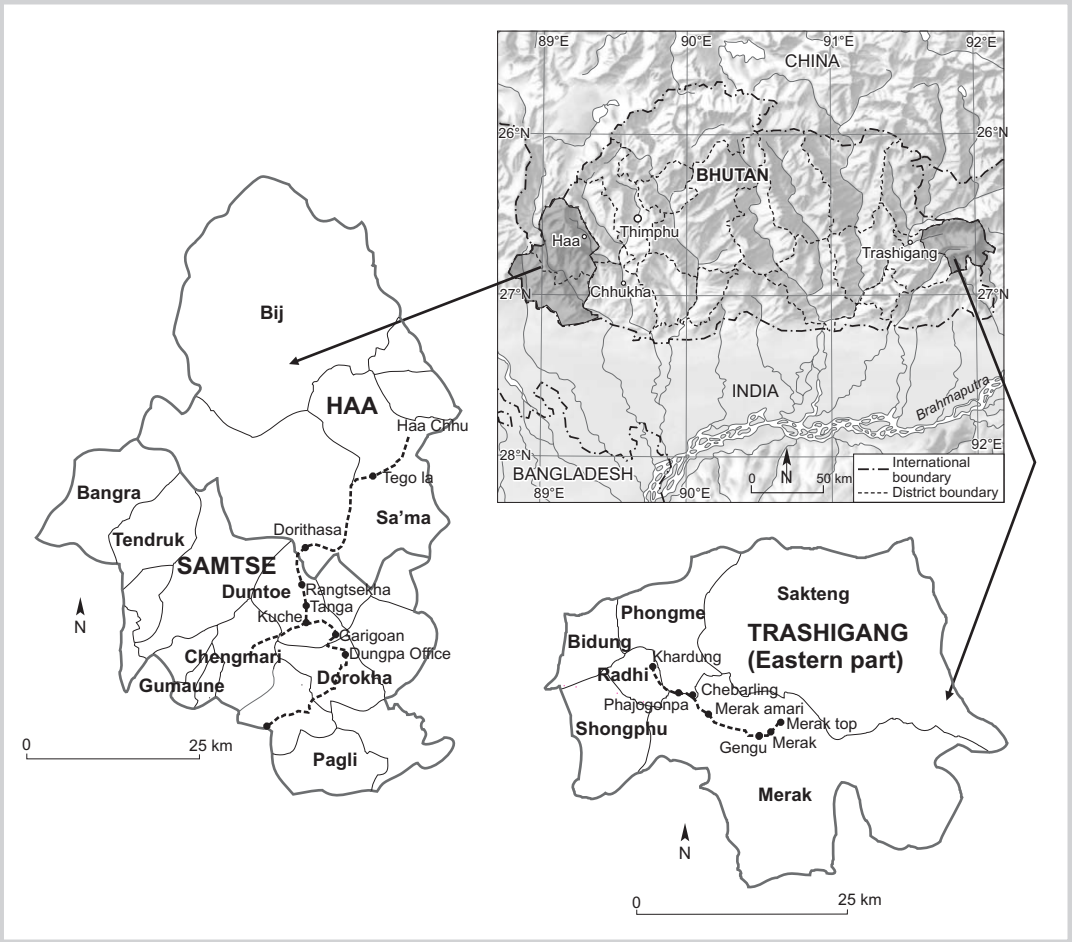
While many foresters perceive unregulated migratory and sedentary cattle grazing as a cause of forest degeneration (MoA 2001), others dispute this view as speculative and driven by conflicting interests (Roder et al 2002). Wangchuk (2003) concluded that when large numbers of livestock graze over a long period of time, or when the grazing interval is reduced, trees are overtaken by undesirable shrubs; hence he suggests regulating grazing, especially in forests that support dense cattle populations. In the local context, there is virtually no information available to qualify or disqualify this statement.

Elsewhere, Abruzzi (1995) reported that overstocking of cattle and sheep and unregulated grazing lead to significant changes in the structure and composition of once rich forest and grassland, resulting in a predominance of unpalatable perennial grasses. Conversely, forest grazing is viewed as environment-friendly, as nutrients removed by browsing forest plants (Roder et al 2002) are replenished through dung and urine (DALSS 2002). The present article examines the herding practices and effects of grazing on forest and grassland ecology. It then discusses this information accompanied by data from research results in order to better understand issues, both real and perceived, and related interactions between cattle, forests, and pasture.

Methods

Walk and talk interviews with transhumant herders were conducted en-route along traditional migratory routes from Haa to Samtse districts in western Bhutan, and from Merak to Radhi and Phongme village in Trashigang in eastern Bhutan (Figure 1). Along these routes, we interviewed 30 herders from each study area in their make-shift camps, using semi-structured questionnaires on demography, income sources, migratory

FIGURE 1 Location of the 2 study areas, and maps of the established migratory routes (dotted lines) from Haa to Samtse in western Bhutan, and Merak to Radhi, Trashigang, in eastern Bhutan. (Map of Bhutan by Andreas Brodbeck; maps of migratory routes by Rinchen Dorji)



routes, constraints and opportunities, herding practices, and mechanisms that regulate grazing between high-elevation pastoralists and low-elevation cattle owners. These routes were mapped using a global positioning system and digital snapshots were taken to document evidence of sites. Temporary unfenced plots of 100 m^2 each (10×10 m) were laid out along the traditional routes (transects) to sample natural forest vegetation. In total, 7 plots (3 plots in Haa, with elevations ranging from 1000 to 3608 m, and 4 plots in Merak, with elevations ranging from 2486 to 3801 m) were sampled. These plots covered the major altitudinal range and different grazed forest types, from subtropical to temperate ecosystems. On each plot, all woody species including shrubs were enumerated by species. The graphs were drawn using the Statistical Package for Social Sciences (SPSS) version 13.0.

The study areas

Haa is located at longitude 89°17′ east and latitude 27°23′ north in western Bhutan (Rinchen and Pushparajah 1994), and Merak at longitude 91°52′ east and latitude 27°18′ north in eastern Bhutan (Figure 1). The topography is rugged and mountainous, with deeply incised valleys and elevations ranging from 1000 to 4031 m. Winters are extremely cold with mean annual minimum temperatures of –0.9°C, while summers are generally cool and occasionally warm, with a mean temperature of 20.3°C. The estimated total population is 8453, with 6.5 persons per household (Rinchen and Pushparajah 1994). Most herders are from Uesu and Sama sub-districts, constituting 71% of the district's population (Rinchen and Pushparajah 1994); 97% of the district is forested as a consequence of low population fortified by strong Buddhist conservation ethics. The economy depends mainly on livestock holding.

The eastern Bhutan study area, Merak, consists of Merak, Gengu, Khashiden, and Khiliphu hamlets with an estimated total population of 2005 in 260 households. Total land area is 8677 km^2, with 650 km^2 under the jurisdiction of Sakteng Wildlife Sanctuary in Trashigang District. Forests consist of fir, mixed conifer, and temperate broadleaf forest interspersed with a rich

TABLE 1 Contribution of migratory cattle to the household subsistence economy. Figures in parentheses are in local currency, with an exchange rate of US$ 1 = Nu 44.25 in 2004; n.a.: not applicable.

Source of income	Haa (n=30)	Merak (n=30)
Sale of butter	36% (43,272)	28.7% (8450)
Sale of cheese	30% (36,460)	31.7% (9338)
Sale of meat	0.4% (500)	1.7% (501)
Sale of live animals	5.0% (5500)	21.7% (6403)
Subtotal income from cattle	***71.4% (85,732)***	***83.8% (24,692)***
Hiring of horses	19.5% (23,325)	0.94% (278)
Sale of wool	n.a.	15.1% (4447)
Sale of cardamom	8.0% (9281)	n.a.
Sale of vegetables	1.0% (1200)	n.a.
Non-timber forest products	n.a.	n.a.
Total income per year	**100% (119,538)**	**100% (29,417)**

repository of rhododendrons (NCD 2004). Traditionally, the economy is livestock-based; growing of vegetables (potatoes) in home gardens is a recently introduced agricultural intervention (personal communication). Merak grassland soils are generally acidic (pH 4.8–6.3) with low phosphate and potassium; they are therefore unsuitable for exotic pastures without fertilization (Miller 1989; Wangdi 1992).

Findings

Herding practices

Cattle are the mainstay of the herders' subsistence economy, contributing 71% of gross annual household income in Haa and 84% in Merak (Table 1). Livestock products, mainly in the form of cheese and butter, are produced, sold, and used to buy and/or barter for basic necessities with communities and individuals at lower altitudes. Livestock and their products, therefore, guarantee household food security in the area during severe winters. Cattle migration from temperate to subtropical areas of Bhutan is in direct response to cold temperatures, acute shortage of forage, and livelihood opportunities.

Low-elevation migration from Haa commences in early October, as the annual minimum mean temperature drops to 4°C. Herds return to summer pastures during March of the following year when the temperature rises to 12.9°C. We found about 6 herds migrating from Sa'ma sub-district in Haa following these routes: Oladara, Chepji, Chochu, Pelekhar, Mochu, Langdo, Yuka, Gibzidara, Tinkharke, Samadakha, Samtepema, Penamthang Delorkhag, and Dhamdum. A few herds divert from Tinkharke to Deorali, Fokte and Talkharka, reaching the Chengmari mountains in Nainital as the furthest subtropical grazing destination in Samtse. About 50 herds follow the Chelela route: Jankaram, Pangosekha, Mobina, Dongo, Sakthu, Jalma, Denchuka, Sanguri, Gongmema, and finally Torsa under Chukka as their winter destination. These herds take about 2 months to migrate in one direction with transit halts ranging from a few days to weeks before reaching their furthest destinations. Some herds pause for 10–30 days in their transit ranges, while herders who do not own transit ranges travel without a break to reach their final destinations.

In Merak, migration to winter pastures commences in early November and the herds return to their original destination by the end of April in the following year. Merak cattle follow 3 main routes, namely: 1) Merak, Tshagsum, Jaylungnang, Chebarling; 2) Kangparzorthang, Yulompa, Sana, Gaybrong, Khaling-Kharungla, Kangpara; and 3) Chebling, Tshangdruk, Phamgang and Singkhar Lauri. Scarcity of forage during winter at high elevations is another constraint that triggers migration.

In Haa, migratory herds consist of: local cattle (crosses between *siri* and *mithun*) 64%; yaks 20%; horses

TABLE 2 Summary of constraints and opportunities related to transhumance in Haa and Merak.

Constraints	Opportunities
Limited forage	Planting of native fodder trees and exotic grasses if government supplies free seeds; management of natural grassland
Limited pastureland	Acquiring of new pastureland; reduction in number of cattle; leasing of low-elevation grasslands to high-elevation herders
Unsustainable lopping of broadleaf fodder trees at middle and lower elevations	Appropriate lopping of tree fodder (cutting small branches and leaves only)
Increase in native ruminant population	Adoption of improved cattle breeds and/or reduction of herd size
Cattle predation by wild dogs	Guarding of cattle while grazing
Narrow and difficult routes	Widening of tracks with government assistance
Trespassing of transit ranges by cattle belonging to others	Conflict resolution based on mutual understanding
Cattle vulnerable to foot-and-mouth disease	Training for cattle health management

7%; pigs 5%; poultry 3%; and goats 1%. In Merak, local cattle accounted for 55%, yaks 35%, sheep 7%, and mules 3%. There is little improved pasture for livestock grazing in the highlands, especially during the winter. For example, in Merak, the area under exotic fodder cultivation from 1993 to 2003 amounted to only 110 ha, but there were 10,494 ruminants. Herders noted that shortage of forage and pastureland was the main constraint (Table 2). Thus the limited forage available often forces herders to migrate seasonally with their cattle to lower-elevation forest and grassland where abundant grasses and tree fodder can be found.

Surplus butter and cheese production in the highlands and livelihood opportunities at low elevations also drive migratory herding. For example, Merak produces about 15 tons of butter and and 29 tons of cheese, compared to 1.8 and 3.6 tons annually in Radhi. Thus excess production of 75% butter and 80% cheese is necessarily marketed and/or bartered after household consumption. Herders accordingly have no option but to exchange their surplus cheese and butter for food and non-food items with people at lower altitudes in order to reduce food vulnerability.

In western Bhutan, horses are also a significant source of cash for migratory herders during winter. Comprising 7% of the total livestock population in Haa, horses are very valuable for transporting oranges and cardamom to market for Dorokha's farmers, who are isolated from markets. These horses and mules transport about 4 to 7 *pons* (a *pon* is a measure of weight equal to 80 oranges) of mandarins at a time, depending on their size. The duration of transport is not accounted for and carriers are paid a carrying charge of Nu 85 to Nu 90 per *pon* delivered. On average, a herder from Haa who owns and engages about 6 horses can earn an actual gross income of about Nu 60,000 (US$ 1356) in a single harvest season lasting from December to February.

Apart from transporting cash crops to market, horses and mules are also engaged in transporting construction material for government infrastructure and food rations for schools. Most of the stocks of food, clothes and other consumer items are transported during the winter months, with migratory herders coming down from Haa doing most of this work.

In Haa and Merak, the transition from a migratory to a sedentary lifestyle is slow, as access to the outside world is limited owing to poor road and market infrastructure. Some agriculturists report that development activities introduced to improve agricultural production and livelihoods have been counterproductive. For example, Merak herders have switched to traditional, open-earth stoves—discarding efficient firewood stoves—due to the multiple benefits of the former (personal communication).

Grazing rights and traditional grassland management

Grazing rights on grassland are owned either individually or by the community. High-elevation pastoralists with dual land ownership (upland and lowland) have exclusive grazing rights on their private pastures (herders in winter and low-elevation partners in summer). Those who do not own grazing land have usufruct on lowland community grassland and forest traditionally set aside for grazing.

In such tenure situations, herders with large numbers of cattle compensate their partners with fewer cattle

in kind. Compensation takes place in equitable quantities of rice, butter and cheese, depending on the number of months and days grazed in a season. When herders migrate to high-elevation (summer) pastures, these low-elevation (winter) pastures are grazed by sedentary cattle belonging to partners, who reciprocate by protecting against trespassing and nurturing of naturally grown and planted fodder trees. For example, along Merak mid-elevation (2500 m) ranges, herders own large tracts of transit ranges, which are fenced using stones and fallen trees with branches, thus offering protection from grazing by livestock belonging to others and allowing grasses to regenerate during the short growing season. Occasionally, trespassing of these ranges causes conflicts among herders. Such conflicts are mediated by local elders and resolved amicably. In extreme cases, fines are imposed ranging from Nu 5000–6000 depending on the severity of the conflict.

Herders commonly practice rotational and seasonal grazing. Herders rotate cattle within and between grassland as a strategy for optimum use. For example, in Merak, migration starts in July to move to summer pastures, August for autumn pastures, and November for the move to winter pastures. These movement patterns are attuned to forage growth.

Impact on forest and grassland

In the course of migration to low-elevation grazing lands, the migratory herds graze and browse continually, and temperate conifer forest along the established routes exhibits symptoms of moderate browsing. Along these routes, opened up forest patches are found at frequent intervals. At higher elevations in Haa (3164 m) and Merak (3683 m) unpalatable trees such as *Daphne bholua, Rhododendron hodgsonii,* and *Juniperus recurva* were abundant along grazed routes in small diameter classes (Figure 2). *Abies densa* seedlings were found at a density of more than 3000 seedlings per ha in Haa (3608 m) and Merak (3801 m). *Rhododendron hodgsonii*, an important understorey species, tends to show inverse-J diameter frequency in the 1–9, 10–19, 20–29 and 30–39-cm diameter classes. As herds reach middle and lower elevations in Merak (2650 m, 2486 m) and Haa (1000 m), temperate mixed hardwood forest comes under considerable grazing pressure and unpalatable, commercially less desirable species such as *Daphne papyracea, Symplocos dryophila, Viburnum cylindricum*, *Dryopteris* spp., *Girardinia diversifolia*, *Yushania maling* dominate grazed sites in small diameter classes (Figure 2). These results indicate considerable damage to temperate mixed broadleaf forest from uncontrolled grazing by cattle.

These forests are also thinned from beneath by way of excessive lopping and cutting lower stems. As winter pastures for Merak cattle, yaks, horses, goats, and sheep, these middle and lower elevation ranges are intensively and extensively grazed, resulting in degradation, soil erosion, and landslides in overgrazed areas.

Discussion and conclusions

Herding practices

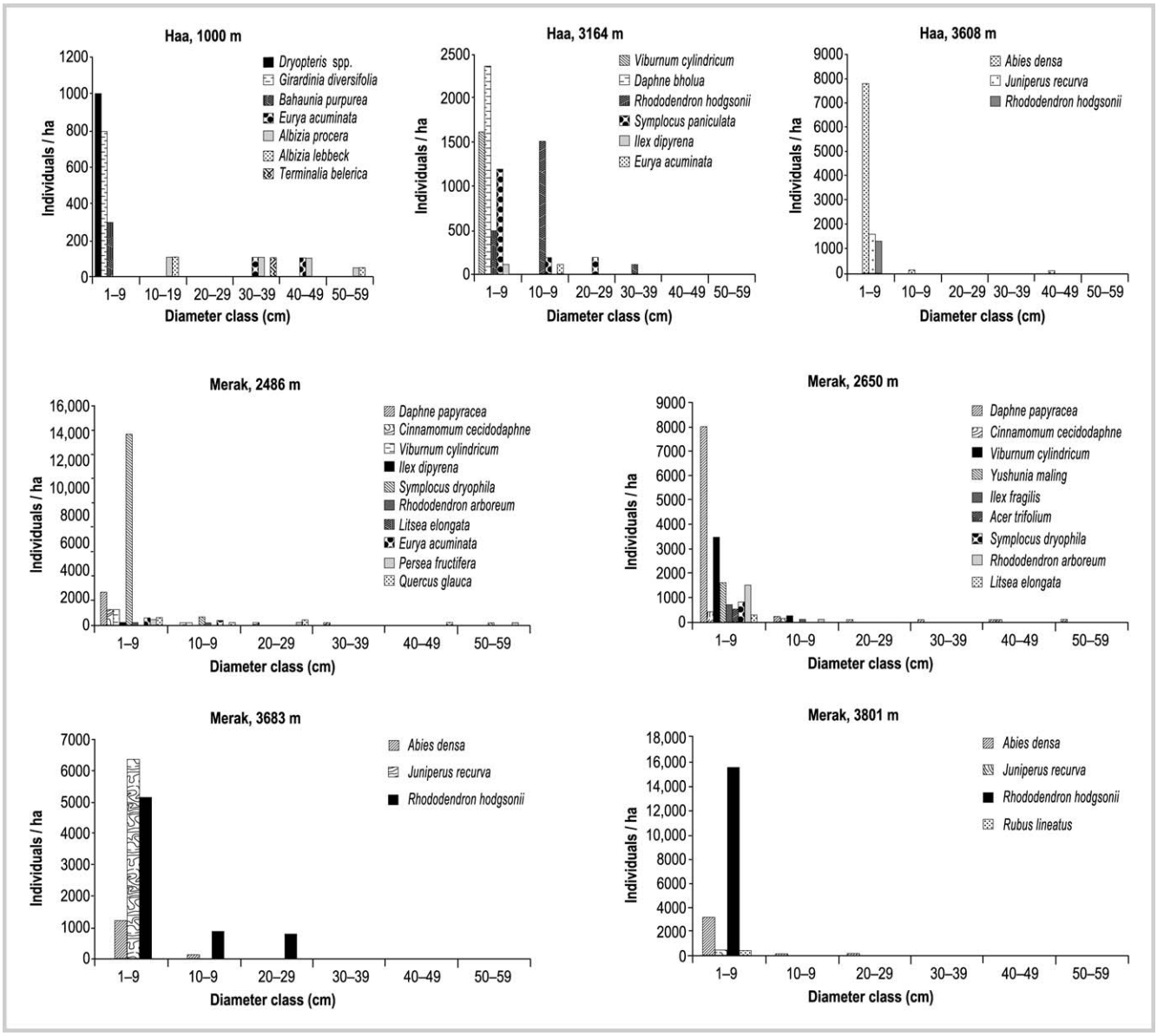
Findings indicate that cattle are the mainstay of the herders' economy. Livestock generate household cash income, provide food security, and contribute to poverty reduction. These livelihood strategies have evolved as an age-old tradition and indicate a symbiotic relationship forged and fostered between high-elevation pastoralists and low-elevation individuals and communities. Ura (2002) has noted that migration not only brings economic and social benefits to herders but also fosters multi-layered relationships between temperate and subtropical communities. We found that the migration strategy is in direct response to cold temperatures and shortage of forage at high elevations during winter, and to the availability of livelihood opportunities at low elevations. Many authors reported similar strategies from other areas in Bhutan (Ura 1992; Gyamtsho 1996; Dorji and Wangdi 2001; Wangdi 2005).

In Haa and Merak, herders' transition from a migratory to a sedentary lifestyle is slow due to limited road and market infrastructure. Despite limited access, livestock products such as butter and cheese generate a significant household cash income with numerous markets at low elevations. As a result, these herders are reluctant to relinquish transhumant and nomadic lifestyles voluntarily. Similarly, Bimal (2003) concluded that sheep and goat herders are content with their present lifestyle as long as the herding is profitable in the Indian state of Himachal Pradesh. Findings from Soe Yaksa and Tobesa, Bhutan also revealed that few herders are settling down as a result of modernization (Norbu et al 2003; Anonymous 2004). In order to improve the living conditions of these herders, cattle (crosses between *siri* and *mithun*) and pasture development should be central to efforts for securing sustainable livelihoods.

Grazing rights and traditional grassland management

We found that grazing rights on grassland are individual and community-owned, and grazing regulations are based on mutual understanding. Compensation for use of winter pastures is on an in-kind and equity basis. Gyeltshen and Bhattari (2003) reported that herders own one or more private pastures individually or as part of a herding community with grazing rights over winter pastures, while low-elevation partners own summer grazing rights on the same pastures. We observed that the spatial and temporal pattern of grazing practiced by herdsmen provides a reasonable time interval for for-

FIGURE 2 Diameter frequency distribution of genera and species in grazed plots along the established migratory routes from Merak to Radhi in eastern Bhutan and Haa to Samtse, western Bhutan.



age regeneration. Similarly, Gyamtsho (1996) and Ura (1992) report rotational grazing as a strategy for optimizing forage productivity. Thus, good results may be expected by allowing every part of a pasture to grow to maturity at least once every few years by simply closing some part during its initial growing season.

Impact on forest and grassland

The temperate grasslands are continually grazed by herds of cattle, yaks, sheep, and horses. Intensive and extensive grazing results in soil erosion and landslides, indicating that temperate grasslands are overgrazed. According to Gyamtsho (1996), alpine ranges are overgrazed, with grazing pressure varying from high in Laya and Lingshi to moderate in Lunana, with a mean grazing pressure of 5.6 ha per AYE (Adult Yak Equivalent) resulting from intensive grazing by cattle, yaks, and horses, including blue sheep (*Pseudois nayaur*). Similarly, Sathyakumar and Adhikari (2005) concluded that degradation of overgrazed grasslands was due to a large livestock population, particularly cattle and yaks in Merak and Sakteng.

We have found that rotational grazing is essential in these severely depleted ranges. Regeneration results show higher numbers of *Abies densa* seedlings and inverse-J diameter frequency in *Rhododendron hodgsonii*.

Field observations also revealed that conifer seedlings were less palatable than broadleaf. These results indicate that the impact of livestock grazing on temperate conifer forest species was negligible. Studies conducted in central and western Bhutan revealed significantly higher numbers of conifer seedlings on unfenced than fenced plots (Darabant et al 2007), and that browsing of *Yushania microphylla* and other competing understorey shrubs fosters tree seedling growth (Gratzer et al 1999; Tshering 2005).

The presence of unpalatable, commercially less desirable species on dominated grazed sites indicates considerable livestock grazing and browsing pressure on temperate broadleaf forests. These forests were also thinned from beneath and excessive lopping of fodder trees was practiced in some areas. Norbu (2000) and Rinchen (2004) report similar findings from their transhumance studies in temperate broadleaf forests in central and western Bhutan. Pooled data from grazing exclusion studies conducted from 1998 to 2000 in temperate mixed broadleaf forests in eastern Bhutan showed significant differences in overall net palatable seedling gains but insignificant differences between unpalatable gains and losses in fenced compared to unfenced plots, due to uncontrolled grazing by cattle (Davidson et al 1999).

Our study presents consolidated information on herding practices and effects of grazing on forests and grassland ecology, thus hopefully offering a better understanding of issues, both real and perceived. We propose additional studies to address the following unresolved issues:

- To overcome the shortage of winter forage, there is a need to assess current forage production practices and the economics of feed supplementation to better understand the seasonality of feed supply and diversify forage production.
- To reconcile stock numbers in equilibrium with pasture productivity and regulate rotational and seasonal grazing more effectively, it is necessary to consolidate the inventory of pastureland and conduct quality-trend studies in winter and summer pastures.
- To decide where and with what intensity grazing is acceptable, there is a need to determine the livestock carrying capacity of different forest types in relation to availability of forage and livestock numbers.

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REFERENCES

Abruzzi WS. 1995. The social and ecological consequences of early cattle ranching in the Little Colorado river basin, Arizona. *Cattle and Sheep Grazing*. http://www.cpluhna.nau.edu/Research/grazinglitcolr.htm; accessed on 21 June 2007.

Anonymous. 2004. The nomads. *Kuensel*. 10 January 2004, pp 4–5.

Bimal M. 2003. Migratory goat and sheep rearing in Himachal Pradesh, India. *In:* Suttie JM, Reynolds SG, editors. *Transhumant Grazing Systems in Temperate Asia.* Plant Production and Protection Series 31. Rome, Italy: Food and Agriculture Organization of the United Nations, pp 203–215.

DALSS [Department of Agriculture and Livestock Support Services]. 2002. *Livestock Sub-Sector 9th Five Year Plan Document (2002–2007).* Thimphu, Bhutan: Department of Agriculture and Livestock Support Services.

Darabant A, Rai PB, Tenzin K, Rosset J, Gratzer G. 2007. Forest grazing facilitates regeneration of logged gaps in mixed conifer forest with *Yushania microphylla* bamboo understory in Bhutan. Unpublished paper presented at a meeting on *National Sectoral Forestry Research and Extension Coordination.* Phuentsholing, Bhutan, 9–11 January 2007. Available from the authors of this article.

Davidson J, Moktan MR, Gyeltshen J. 1999. Observations on regeneration and harvesting of mixed broad-leaved forests of eastern Bhutan. *In:* Wolf R, Gurung DB, editors. *IUFRO [International Union of Forestry Research Organizations] International Seminar on Silviculture and Sustainable Management of Mixed Broadleaved Forests, Himalayas*. Bhutan German Sustainable Natural Resources Development Project Proceedings. Lobesa, Bhutan: Bhutan German Sustainable Natural Resources Development Project, pp 39–69.

Dorji P, Wangdi R. 2001. Migration. *In:* Ministry of Agriculture, editor. *National Grazing Policy.* Proceedings of a workshop held in Bumthang, Bhutan, 21–24 August 2001. Thimphu, Bhutan: Ministry of Agriculture and Forestry Institutional Development Initiative, pp 9–11.

Gratzer G, Rai PB, Glatzel G. 1999. The influence of bamboo *Yushania microphylla* on regeneration of *Abies densa* in Central Bhutan. *Canadian Journal of Forest Research* 29:1518–1527.

Gyamtsho P. 1996. *Assessment of the Condition and Potential for Improvement of High Altitude Rangelands of Bhutan* [PhD dissertation]. Zurich, Switzerland: Swiss Federal Institute of Technology.

Gyeltshen T, Bhattari BN. 2003. Bhutan case study 1: Transhumant cattle raising in western Bhutan. *In:* Suttie JM, Reynolds SG, editors. *Transhumant Grazing Systems in Temperate Asia.* Plant Production and Protection Series 31. Rome, Italy: Food and Agriculture Organization of the United Nations, pp 255–265.

Miller DJ. 1989. *End of Assignment Report.* Thimphu, Bhutan: Department of Animal Husbandry, Highland Livestock Development Project.

MoA [Ministry of Agriculture], editor. 2001. *National Grazing Policy.* Proceedings of a workshop held in Bumthang, Bhutan, 21–24 August 2001. Thimphu, Bhutan: Ministry of Agriculture and Forestry Institutional Development Initiative.

Mongar TB, Gyeltshen T. 2001. High altitude *tsamdrog*. *In:* Ministry of Agriculture, editor. *National Grazing Policy.* Proceedings of a workshop held in Bumthang, Bhutan, 21–24 August 2001. Thimphu, Bhutan: Ministry of Agriculture and Forestry Institutional Development Initiative, pp 9–11.

NCD [Nature Conservation Division]. 2004. *Bhutan Biological Conservation Complex. A Landscape Conservation Plan: A Way Forward.* Thimphu, Bhutan: Nature Conservation Division.

Norbu L. 2000. *Cattle Grazing—An Integral Part of Broadleaf Forest Management Planning in Bhutan* [PhD dissertation]. Zurich, Switzerland: Swiss Federal Institute of Technology.

Norbu L, Dorji S. 2001. Sub-tropical *tsamdrog*. *In:* Ministry of Agriculture, editor. *National Grazing Policy.* Proceedings of a workshop held in Bumthang, Bhutan, 21–24 August 2001. Thimphu, Bhutan: Ministry of Agriculture and Forestry Institutional Development Initiative, pp 12–13.

Norbu L, Pradhan NK, Dukpa D. 2003. Rights and benefits for poor people in the traditional cattle grazing system in Tobesa Geog in western Bhutan. Unpublished paper presented at the *Regional Workshop on Policy Advocacy for Enhancing Equity and Rights in the Common Property Resources in the Hindu Kush–Himalayas.* Kathmandu, Nepal, 4–8 August 2003. Available from the authors of this article.

Rinchen D. 2004. *Study on Grazing, Cattle Migration and Shifting Cultivation/Dryland in Thrumshingla National Park—Phase I Report*. Thimphu, Bhutan: World Wildlife Fund Bhutan and Nature Conservation Division.

Rinchen D, Pushparajah. 1994. *Management Plan for Haa East Forest Management Unit.* Thimphu, Bhutan: Forest Resource Management and Institutional Development Project.

Roder W, Gratzer G, Wangdi K. 2002. Cattle grazing in the conifer forests of Bhutan. *Mountain Research and Development* 22(4):1–7.

Sathyakumar S, Adhikari BS. 2005. *Vegetation, Bird and Mammal Surveys in Sakteng Wildlife Sanctuary.* Report by Wildlife Institute of India, Dehradun. Thimphu, Bhutan: World Wildlife Fund Bhutan and Nature Conservation Division.

Tshering P. 2005. *The Interaction of Grazing and Competition in the Conifer Forest of Bhutan* [Master's thesis]. Vienna, Austria: University of Natural Resources and Applied Life Sciences.

Ura K. 1992. *The Nomads' Gamble.* Background paper for Bhutan's National Environmental Strategy. Thimphu, Bhutan: Centre for Bhutan Studies and National Environment Commission.

Ura K. 2002. The Herdsmen's Dilemma. *Journal of Bhutan Studies* 7:1–43.

Wangchuk S. 2003. *An Overview and Analysis of Conservation Threats, Issues and Opportunities.* Background paper presented at a workshop on Operational Planning for Bhutan Biological Conservation Complex, Thimphu, Bhutan, 13 October 2003. Thimphu, Bhutan: World Wildlife Fund Bhutan and Nature Conservation Division.

Wangdi K. 1992. *Those Five Years—Review of Pasture Development in the Eastern Districts.* Mongar, Bhutan: Highland Livestock Development Project and Department of Animal Husbandry.

Wangdi K. 2005. Agro-pastoralism—Towards an efficient exploitation of fodder resources? *Proceedings of the Fifth Meeting of the Temperate Asia Pasture and Fodder Network (TAPAFON). Held at Renewable Natural Resources Research Centre, Bajo, Wangdue, Bhutan, 29 April to 4 May 2002.* http://www.fao.org/ag/AGP/AGPC/doc/Proceedings/Tapafon02/tapafon2.htm; accessed on 24 July 2007.