GRAZING MANAGEMENT OF TEMPERATE GRASSLAND AND FALLOWS

*Walter Roder**

Introduction

The paper provides a general overview of fodder resources and their management in temperate Bhutan (altitude range of 1500-3000m). The terms are used as defined by RC-Jakar (RNR-RC-Jakar, 1996). As per these definitions, temperate pasture can include any kind of land used for grazing. When referring to registered grassland or *tsamdro,* only the term *tsamdrog* is used. Where possible, the term pasture is replaced with more specific or more appropriate terms.

Overview of Fodder Resources in Temperate Bhutan

The fodder resources used vary with climate, farming system and season. No reliable data is available on the relative contribution of individual fodder resources towards the total requirement at the national level. Different authors, however, do agree that natural grasslands and forest provide the highest proportion (Table 1). A recent survey carried out in selected gewog of Paro, Wangdue, Trongsa, Zhemgang and Bumthang supported these estimates [Figure 1; Roder, et al. 1998].

This survey also showed that:

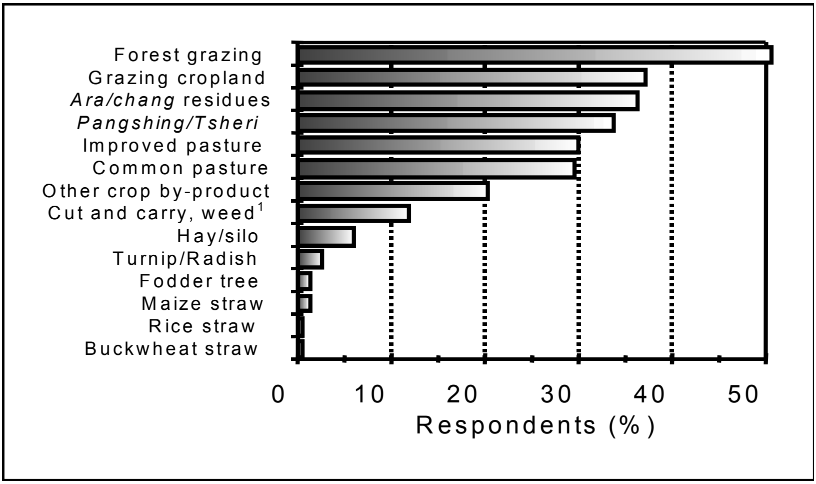
1. Depending on elevation and cropping systems, the most important winter feed are paddy straw, buckwheat straw, and turnips;
2. Grazing in crop fields (after crop harvest) received the highest overall ranking as a winter feed; and
3. Fodder trees are not as important as generally believed.

* Dr. Roder is a Co-manager at Renewable Natural Resources-Research Center, Jakar

Table 1: Contribution of fodder resources towards national fodder requirement

Fodder Source	Relative contribution (%)	
Forest grazing	22	23
Natural grassland	22	38
Improved pasture	1	9
Shifting cultivation and fallow land	15	-
Fodder trees	20	15
Crop residues	20	13
Source	Roder, 1990	RGOB, 1994

Figure 1: Main fodder resources during the summer period



([1]Fooder from cut and carry systems or weed collected in crop fields)

Fodder from improved pasture has received surprisingly high ranking, especially in Wangdue, Trongsa and Paro. Similarly, hay as a fodder resource for winter feeding received high rankings from cool regions of Paro, Wangdue and Bumthang.

Management of Grazing Resources in Temperate Bhutan

The main grazing resources currently used in temperate regions of Bhutan are:

1. *Tsamdrog* used in the traditional way;
2. Forest;
3. Unregistered grassland;
4. Crop land (*kamshing, chushing, pangshing, tseri*) grazed during fallow periods; and
5. Improved grassland.

Individual households may have one or more of the five categories.

Tsamdrog, forest land and unregistered grassland
Although these three categories have different legal status, they are similar in vegetation cover and potential fodder production. Most references discussing plant communities, production and production potential of grazing resources do not specify the legal status of the area observed. The country has over 400 thousand ha of *tsamdrog*. The natural grassland area estimated based on aerial photography is considerably lower compared to the area of registered *tsamdrog*. In the estimate based on the aerial photography, a large proportion of the registered *tsamdrog* is probably classified as forest due to substantial tree cover. While the most extensive natural grassland areas are found at altitudes above the tree line ranging from 4000-5000m, the *tsamdrog* does not follow the same trends [LUPP, 1995]. Although we lack specific information, we can assume that large areas of *tsamdrog* are situated in the temperate parts of Bhutan.

A large proportion of the *tsamdrog* and other grazing resources are used by migrating herds taking advantage of the variation in climate and vegetation. Typically, alpine, temperate and subtropical areas are included. High altitude pastures are grazed during the summer, while lower elevations (usually in the south) are used for winter grazing. Therefore the system cannot be discussed by focusing on the temperate component only and there may be some duplication between this paper and the material discussed under the alpine and the subtropical systems.

Our understanding of the grassland communities and their production in temperate Bhutan is limited. List of species may exist but little is known of their relative importance or their value as grazing resources. Documented observations are influenced by seasonal trends in vegetation cover and personal bias. Dry sites ranging from 700 to 2100m are frequently dominated by *Cymbopogon* type grassland [Miller, 1989]. Major grass species at these sites include: *Cymbopogon khasianus, Cymbopogon* sp. *Cymbopogon gryllus, Apluda mutica, Arundinella nepalensis* and *Heteropogon contortus.* Above these elevations *Schyzachirium delavayi, Arundinella hockeri* and *Eragrostis* sp. become dominant [Roder et al. 1998]. Estimates of dry matter yields range from 0.7-3.0 t ha^{-1}.

In order to differentiate between forest grazing and *tsamdrog* a separate survey was carried out in three villages each of Bumthang, Trongsa and Zhemgang (Table 2). Fifteen or more households were visited in each village and information collected from households with and without *tsamdrog.*

Tsamdrog was considered as an important source for summer fodder in five villages. Much of the *tsamdrog* is communally owned and often not utilized by some of the owners. Others are far away from the village. Both these factors are major detriments for optimal utilization. Most *tsamdrog* owners are therefore not willing to invest in improvement or maintenance.

Table 2: Importance of tsamdrog in temperate farming systems

Location	Farming System	Tsamdrog Holding and Using (%) Households			Summer Fodder (Based On Ranking Importance)[1]
		Private	*Com.**	*Using*	
Shingkhar	Wheat, Barley, Semi-Nomadic	13	100	100	*Tsamdrog* - 0.93 Cropland - 0.35 Improved Pasture-0.26
Phamrong	Wheat, Barley, Buckwheat	27	-	7	Community Pasture - 0.44 Forest - 0.42 Cut and Carry-0.37
Gyetsha	Wheat, Barley, Buckwheat, Potato	7	100	53	Cut and Carry-0.50 Improved Pasture-0.47 *Tsamdrog* - 0.46
Tangsibi	Rice, Barely	40	20	40	Cut and Carry-0.46 Improved Pasture-0.42 Crop land- 0.33
Bemji	Rice, Maize	-	93	73	*Tsamdrog*-0.57 Crop Land-0.41 Cut and carry-0.33
K. Rabten	Rice, Maize	7	93	60	*Tsamdrog*-0.64 Maize Stalks/ Young Maize-0.39 Field Borders-0.35
Zurphy	Rice, Maize	-	Not Clear	33	Forest-0.64 Crop Field-0.29 Field Borders-0.13
Dunkhar	Rice, Maize	47	20	40	Improved Pasture-0.62 Forest - 0.32 By-products - 0.32
Berthi	Rice, Maize	40	80	80	Forest - 0.52 *Tsamdrog*- 0.46 Crop Land- 0.43

**Com.= community*

Tsamdrog was considered as an important source for summer fodder in five villages. Much of the *tsamdrog* is communally owned and often not utilized by some of the owners. Others are far away from the village. Both these factors are major detriments for optimal utilization. Most *tsamdrog* owners are therefore not willing to invest in improvement or maintenance work (Table 3). Only about 20 out of 120 respondents reported to carry out some maintenance or improvement work. This maintenance consists largely of slashing unwanted maintenance before it was prohibited.

Table 3: Improvement/maintenance work carried out for tsamdrog

Location	Dis-tance	Improvement, Maintenance Work Carried Out (HH No)				Why No Improvement?
		S	*P*	*IP*	*N*	
Shingkhar	1-200	1	-	-	14	Community Owned, Burning No More Allowed
Phamrong	50-140	3	-	-	1	Wild Boar, Long Distance
Gyetsha	1-200	-	-	1	14	Community Owned, Distance too Long, Tree Covered
Tangsibi	1-10	3	1	2	4	Community Owned, Distance too Long
Bemji	1-4	1	-	-	12	Community Owned, Burning Not Allowed, Not Utilized
K. Rabten	3-10	2	2	-	12	Community Owned, Not Utilized
Dunkhar	1-20	1	1	1	7	Community Owned, Long Distance
Berthi	1-33	6	-	-	5	Community Owned, Not Allowed by Park

S: slashing, P: planting, IP: improved pasture; N: none

There is a variation in gazing methods. Many of the community owned *tsamdrog* are continuously grazed with little control over the grazing livestock. In one village (Kunga Rabten) a *tsasungpa* is appointed to control grazing. High elevation and remote *tsamdrog* are usually used by migrating herds. The grazing methods for these *tsamdrog* are generally sound.

Recently introduced changes made it possible for households with non or insufficient *tsamdrog* to lease the same through the *dzongkhag*. Over 90% of the respondents in the survey said that they were not aware of these regulations. Most would have liked to have *tsamdrog* but it should be close to the village. Some of the households having *tsamdrog* had leased it out to other households against payment in kind.

Fallow land

In most production systems, cattle are allowed to graze freely after crop harvest. Depending on crop, weed flora and harvesting systems, the quantity and quality of fodder available after harvest can vary substantially (Table 4). The grazing period varies with crop and cropping system, but it is generally extensive during the dry winter season. Fallow systems, which provide substantial quantities of fodder, include the seasonal fallows (2-8 months) in maize systems and the long-term fallow (2-20 years) in the *pangshing* and *tseri* shifting cultivation systems.

Maize systems

Maize is the most important cereal both, in terms of area and production. Cultivated mostly on dry land, it can be found at elevations up to 3000m. The main maize growing areas are in eastern and southern Bhutan. Depending on the elevation, rainfall and soil fertility, maize cultivation is combined with a variety of other crops in intercropping and/or sequential cropping systems. The fallow period and the fodder available depend on the cropping system, elevation and moisture. Livestock is generally allowed to graze immediately after harvesting the cobs. The stems may be harvested and stored for winter feed. Because of the large acreage, substantial quantities of fodder are available from maize cropping systems.

Table 4: Fodder from fallow land and selected characteristics from the major crop/fallow systems

Type	Maize system	*Tseri*	*Pang-shing*
Area (ha)	55000	40,000	10,000
Altitude range (m)	300-2600	300-2500	2500-4000
Major fallow vegetation	Annual weeds	Shrubs, trees	Grasses, blue pine
Fallow period	4-8 months	2-8 years	6-20 years
Main feed	Annual weeds Crop residues	Annual weeds Shrubby species	Grasses
Dry matter (t/ha)	0.1-1.0	0.2-3.0	0.1-1.5

Slash and burn-Bush fallow (tseri) system

This system follows the widely used slash-and-burn system found in many subtropical and tropical regions of Asia [Roder et al. 1992]. The vegetation, consisting of trees, shrubs, other perennials and annuals, is cut during the dry season, allowed to dry and burned shortly before planting the seed. Seeds are either dibbled or broadcast without incorporation. Crops include maize, millet, rice and buckwheat.

Grass Fallow (*Pangshing*) System

The fallow vegetation evolving under grazing consists of short grasses, sedges and forbes, interspersed with blue pine (*Pinus wallichiana*). Prior to cultivation, the topsoil layer is cut with a hoe about 5-7 cm deep and is allowed to dry for several months. Dry topsoil is collected in conical mounds about 2-3 m apart (1200-2500 mounds ha^{-1}). Small quantities of fuel consisting of blue pine needles collected at the site or brought in from nearby forest and/or dry manure is added to each mound. After the fuel is ignited, the organic material in the dry soil mounds continues to burn slowly; temperatures eventually reach $500^{o}C$ or higher [Roder et al. 1993]. Burning lasts several hours resulting in high losses of organic matter and Nitrogen. Because almost all the vegetation is killed, the soil is fully exposed to the force of erosion. Buckwheat seeds broadcast in April may be covered using a traditional bullock drawn plough or manually with a rake. Labor inputs are high with about 150-400 days per ha. Most of the labor (65-85%) is required for land preparation. No weeding is necessary. The fodder production is small in the initial year after cultivation, but because of the long fallow period (up to 20 years) *pangshing* are important grazing resources at higher elevation in Haa, Wangdue and Bumthang.

Other cropping systems
Fallow land from other cropping systems, although locally important, contributes less to the overall fodder production due to limited area (wheat, barley) and/or shorter fallow periods. Fallow fields of wheat, barley and buckwheat systems are important at higher elevations, while rice fallow provide some grazing at an elevations of <2500 metres.

Cultivated fodder/improved pasture
Over the last two decades many farmers have sown legume-grass mixtures as recommended by the Ministry of Agriculture. These introduced fodder species were sown on *pangshing, tseri, kamshing*, orchards or *tsamdrog*. Although the area under introduced fodder species may be relatively low, the contribution to the overall fodder requirement is significant as demonstrated in the two recent surveys. In spite of land limitations farmers rarely used the *tsamdrog* for growing improved fodder species. Using *tsamdrog* was not possible because of communal ownership and/or uncertainties about rules and regulations.

Grazing effects on forest systems

In Bhutan, environmentalists and foresters routinely view cattle grazing as a serious threat to the environment and a main constraint for good forest management (Roder et al. 1998). The livestock producers may disagree but their voice is rarely heard. Although science is often evoked, arguments on the issue are routinely given without any quantitative proof for either side of the debate.

Observations made by White (1909), during a trek in Paro valley may be among the earliest references available. He noted: “On either side and at our back was a deep fringe of fine trees of every age, from the patriarch of the forest down to young seedlings. The Bhutanese seem to have acquired the secret of combining forests self-reproduction with unlimited grazing, far from the time we left Rinchengong (near Sikkim border, Haa) we passed through forests which, without exception, were self-reproducing”.

A ban on the use of fire for grassland improvement introduced in 1969 decreased the area and quality of the traditional grassland used by herders (Gyamtsho, 1996). The reduced fodder quantity available from traditionally used grasslands may have increased the pressure on the forest systems.

Following the results of a recent study in mixed coniferous forest in Bumthang (RNR-RC Jakar, 1997, Table 5) using six pairs of fenced and un-fenced plots, it was concluded that:

a. grazing increased the proportion of good quality blue pine plants;
b. browsing damage due to grazing animals is negligible for conifer species;
c. grazing reduced damage (debarking) by small rodents; and
d. grazing reduced the number and density of broadleaf species.

Table 5: Effect of fencing on regeneration and quality of seedlings (study with 6 pairs of fenced and unfenced plots)

Species	Good quality Plants (%)		Browsing damage (%)				Other damage (%)			
			Lateral branch		Terminal bud		Debarking		Biotic damage	
	F*	**G	F	G	F	G	F	G	F	G
Hemlock	82	68	0	0	0	1	7	1	11	30
Fir	91	85	0	0	0	0	0	0	9	15
Bluepine	77	91	0	0	0	0	8	0	15	9
Rhododendron	90	84	1	0	0	0	0	0	10	16
Betula	78	57	0	20	0	6	0	0	22	17
Other broadleaf	59	46	0	3	0	4	2	0	39	48

**F-fenced; **G-grazed*

The fact that grazing favours blue pine regeneration is painfully felt by many households which have lost large proportions of their cultivation land due to vigorous colonisation by this species in spite of heavy grazing pressure.

Yushania microphylla, a spreading bamboo species common at elevations of 2300-3700m, is often found to impede regeneration in coniferous forests disturbed by logging or other interruptions. The species is browsed by yak and cattle and the competition to regenerating coniferous species can be greatly reduced through the grazing animals. Gratzer et al. (1999) found that the density of fir seedlings increased threefold when the height of the bamboo (*Y. microphylla)* cover was reduced by grazing from a height of 150 cm to 100 cm.

Opponents of forest grazing often make an argument that grazing in the forest is backward. This is a serious misconception. Forest grazing and silvopastoral system are widely accepted as modern forest management tools. Clason and Sharrow (2000) estimated that one quarter of all forestland in the USA is grazed by livestock. Silvopastoral systems should be particularly interesting for hilly environments and they may offer the best economic and ecological options for many Bhutanese farmers who are finding it difficult to compete with lowland farmers in the production of agriculture crops.

Dukpa et al (1997) estimated that silvopastoral systems combining the fast growing blue pine with dairy production could generate cash returns of 1000-2000 US \$ ha^{-1} $year^{-1}$ from land presently used for shifting cultivation. Combining livestock with timber production will generate faster returns than systems limited to timber production only. Managing systems integrating timber and livestock production will be more demanding than systems focusing on a single output only. Farmers and herders, however have convincingly demonstrated that they can manage complicated systems provided they get the benefit from the outputs produced.

Nutrient Transfer and Alternative Nutrient Sources

Bhutanese farmers produce reasonably good crop yields with minimal inputs of chemical fertilizers. This is only possible due to the input of plant nutrients collected by the cattle. The animals grazing in the forest or on grasslands during the day are confined in houses or in crop fields during the night. This practice results in a continuous export of plant nutrients from the grazed areas. Soils in northern Bhutan are extremely poor in available phosphate. Burning the topsoil to increase availability of phosphate and burning manure to reduce the bulk and speed up the release of phosphate are indigenous practices devised by the Bhutanese farmers to optimise the use of the limited phosphate pools.

Growing on low phosphate soils, the plant material consumed has a relatively low phosphate content. In spite of this, the phosphate quantities transferred by the grazing animals is in the range of 3-6 kg per gazing animal (depending on the number of days, and hours per day grazed in). With about 250-400,000 animals depending on grazing in forest and on grasslands, the amount of phosphate transferred from these systems to agriculture systems is in the range of 300-900 t per year corresponding to 900-2000 t single super phosphate fertilizer.

Opportunities and Problems for Present and Future Management of *Tsamdrog* and Grassland

Tsamdrog and other permanent grassland or forests were the main resources for the traditional livestock production systems where few households had large herds of cattle. These systems evolved under a social and political setting favouring large herds owned by feudal lords and monasteries. In the last three decades the social structure of Bhutan has changed dramatically. This has also influenced the livestock production system. While large migrating cattle herds have declined in the temperate and subtropical regions, small and medium size farms have increased their livestock numbers. Rules and regulations governing the use of grazing resources need to be adapted to these changes. Changes attempted were based on a realistic assessment aiming at making resources available to a broader group of livestock producers. For various reasons, the average livestock producing households did not take advantage of the changes in the legislation and the overall development in the livestock sector is far below the general expectation. Although Bhutan's environment is favourable for livestock production, the country has become a net importer of livestock products. The trend continues despite a strong commitment and support by the government towards the development of the livestock sector.

What Has Gone Wrong?

The overall poor performance of the livestock sector is the result of complex interactions of many of factors. Some of these factors relating to the utilization of fodder resources and the resulting problems are listed in Table 6.

Table 6: Examples of factors influencing utilization of tsamdro and other fodder resources

Factors	Resulting problems
Confusing/ conflicting/ inadequate policies, rules and regulations	Herders/farmers could not take advantage of new regulations introduced. Herders/farmers are not motivated to optimize production of *tsamdrog.* *Tsamdro* which cannot be utilized due to logistic problems (distance) are not available for other herders/farmers. Communal resources are poorly managed and utilized leading to degradation of the resources. Herding practices make the introduction of changes in the fodder resource management impossible. Conflicts with forestry rules and regulations. *Tsamdrog* quality is deteriorating.
Strong influence of culture and traditions	The herders/farmers decisions are only partly based on economical and environmental concerns. Problems in culling. Community owned resources are not equally shared. Some of the traditional practices (migration, cross-breeding mithun) may have been detrimental to a sound development in the livestock sector. Improved fodder patches have to be protected from stray animals.
Marginal resources	Limited scope for increasing production. Low return on investments and labor. High expectations from the government side (production increase) and the herders/farmers side (increased income) cannot be satisfied.
Training and extension programs emphasizes animal health rather than fodder and nutrition	Herders/farmers do not get appropriate support. Extension system has lost credibility. Expensive health care system often treating secondary problems of nutritional deficiencies.
Free resource/common resource	Communal and private *tsamdrog* are not valued as they are there for everybody to use and abuse. Households without or with less livestock cannot profit from common resources.
Conservation related issues	Conflicting priorities. Limited options for management intervention.

How can we improve the benefits from tsamdrog and utilization of other fodder resources?

The current rules and regulations and the traditional management methods are probably adequate for alpine grasslands and *tsamdrog* but they are inadequate for *tsamdrog* in the temperate and subtropical regions. When formulating rules and regulations in the temperate and subtropical regions we need to consider the following:

Specific rules for lower regions. Tsamdrog in temperate and subtropical areas requires specific rules.

Clear rules dissemination. Rules should not allow room for misinterpretation. There is a need to disseminate new rules more effectively eliminating room for introducing personal bias. In the event that *tsamdrog* resources are nationalized, this should be carried out clearly, uniformly and speedily.

Optimal resource use/conversion. The rules and regulations should favour optimal resource use. If production potential and environmental considerations are in favour of other utilization (state forest, private forest, social forest, improved pasture, horticulture, mixed farming), the conversion should be supported.

Land ceiling. Tsamdrog holdings per household could be limited by appropriate land ceiling regulations.

Communal properties. Special attention has to be given to communal properties. If these properties can be better utilized/preserved by private use there should be opportunities to do so.

Distance. Distance from the household is a major constraint for proper utilization of *tsamdrog*. Mechanisms (land ceiling, tax structure etc) should be created to encourage owners to surrender such fields.

Increase value/appreciation of tsamdrog. Mechanisms have to be created to increase the perceived value of the *tsamdro*. This could be achieved through taxes, land ceiling etc.

Other fodder resources/synergistic effects of fodder
There is a need to create a suitable legal/social environment to optimise benefits from growing improved fodder. This would also include benefits from synergetic effects of growing fodder in field crop, horticulture and forest systems. Mechanism could include: subsidies for phosphate fertilizer, taxes for nitrogen fertilizer, strong rule on stray animals etc.

Bibliography

1. Clason, T.R. and S.H. Sharrow (2000). "Silvopastoral practices", pp. 119-147, in Garrett. H.E., Rietveld, W.J., and Fisher, R.F. ed., *North American agroforestry: an integrated science and practice*, ASA: Madison
2. Dukpa, T, Wangchuk, et al (1997). "Recent changes and farmers innovations in the management of shifting cultivation land in Bhutan". Poster presented at the *International Workshop on Indigenous Strategies for Intensification of Shifting Cultivation in Southeast Asia*, June 23-27, Bogor, Indonesia
3. Gratzer, G. et al (1999). *The influence of the bamboo Yushania microphylla on regeneration of Abies densa in Central Bhutan*. Can. J. For. Res. 29: 1518 – 1527
4. Gyamtsho, P. (1996). *Assessment of the condition and potential for improvement of high altitude rangeland of Bhutan,* Diss. ETH No 11726, Zurich
5. LUPP (1995). *LUPP Dzongkhag data sheets for Bhutan*, Thimphu: Land Use Planning Project, MOA
6. Miller, D.J. (1989). *HLDP - End of assignment report*, Thimphu: AHD
7. RGOB (N.A.). *National Policy document on use and maintenance of domestic animal diversity*
8. RNR-RC, Jakar. (1996). "Suggested terminology for feed and fodder", Annex 4.13, pp. 57-59, in *Proceedings of 1st National Research Planning Workshop,* RC-Jakar
9. RNR-RC, Jakar. (1997). "Field visit of forestry research activities in Hurchi FMU, Chumey valley", Paper presented at the IUFRO Seminar, 25 October

10. Roder, W. (1990). "A review of literature and technical reports on grassland and fodder in Bhutan". *Himalayan Pasture and Fodder Research Network (RAS/79/121,* Thimphu
11. Roder, W. et al (1992). "Shifting cultivation systems practiced in Bhutan". *Agroforestry Systems* 19:149-158
12. Roder, W. (1998). "Feed and fodder research and development in Bhutan", *RNR-RC Jakar, Special Publication No 1*
13. White, J.C. (1909). *Sikkim and Bhutan,* Delhi: Cosmos Publications

---

[1] Average of 1/rank given for a particular fodder resource e.g. if all households would rank a particular fodder source as the most important the fodder would receive the ranking 1.0