

ECONOMY OF YAK HERDERS

*Pema Gyamtsho**

Introduction

It is widely accepted that an understanding of the environmental and socio-economic conditions of an area is a prerequisite for the identification and formulation of appropriate research and development strategies. It is important to know 'why people do what they do' especially in traditional societies which have remained relatively unchanged by the forces of modern technological advancement. The general belief that traditional pastoral practices need to be improved has largely shaped pasture development policy throughout the world (Sanford, 1983). According to Miller (1995), agricultural policies in the Himalayan countries have generally ignored the role of livestock in development, and failed to appreciate the efficacy of traditional pastoral systems. Ives and Messerli (1989) dwelt at great length on the need to develop policies and programmes that are sensitively attuned to, and supportive of the local people who are the prime actors at the interface of man-nature relationship. The need to conduct systematic research before introducing innovation in the name of progress is further stressed by Goldstein et al. (1990). Sustainable innovations for economic enhancement of the people or ecological improvement of the environment in which they live can only be introduced if there is a high degree of relevance to prevailing local cultural and production practices and traditions.

In the high altitude areas of Bhutan at elevations higher than 3000 m above sea level, yak production has been and continues to be the main source of livelihood for people inhabiting this rugged landscape who are known as *Brokpas*

**Pema Gyamtsho is the Head of Planning and Policy Division, Ministry of Agriculture, Royal Government of Bhutan.*

in central and eastern Bhutan, *Jops* in Western Bhutan, *Lakhaps* in West-Central region and *Dakpas* in the remote gewogs of Merak and Sakteng under Trashigang Dzongkhag. All these names, in one way or other means 'pastoralists' and underscores the dependence of the people on the pastures (known as *Tsadrok* and *Tsabrok* in Eastern and Central Bhutan or *Tsamjo* in western Bhutan) and the mountains (La). Yak rearing is practiced throughout the northern belt of the country extending from Haa in the west to Trashigang in the east and the production systems vary considerably from place to place. Nevertheless, there is no denying that yak is the lifeline of all these communities and is aptly referred to as the 'camel of the snows'. It is a multi-purpose animal providing milk, meat, draught and manure. It also adds to the aesthetic value of the Himalayas. Without it, one cannot imagine how humans could survive in this beautiful but hostile region.

This paper describes the yak rearing and production system prevailing in the remote areas of Laya, Lingshi and Lunana in north-western Bhutan. It is based on the field research carried out as part of the requirement for a doctoral study by the author. It narrates the importance and historical development of yak rearing in these areas, the management practices being followed, the production and processing methods of yak products and analyses the constraints and opportunities associated with yak rearing. This paper also looks at the long-term economic and environmental viability of yak production, and offers recommendations on necessary policy changes and technological adaptations if the future of yak production and that of the herders are to be protected. The conclusions, views and recommendations are entirely those of the author and do not in any way reflect those of the agency in which he is employed.

Sources of Information

Most of the descriptive information is drawn primarily from personal observations and impressions as well as from

lengthy tales narrated by knowledgeable residents of yak rearing areas of Laya over a period of three years (1992 to 1995). Information concerning common issues and problems faced by the inhabitants were collected during village meetings. Personal contact with members of the community was established and views were exchanged, and information provided voluntarily by these contact persons. Quantitative data on population, demographic features, land and livestock holdings were obtained directly from the respondents through structured interviews.

Specific information and data on yak production were collected during field visits to individual herds and recorded on pre-designed forms. Actual measurements of milk and hair yields and body dimensions of individual animals were carried out.

The information on the ownership and management of pastures were obtained from individual households during informal discussions and from formal meetings with the community members.

The study focussed primarily on the situation in Laya but included Lunana and Lingshi, when relevant data could be collected or obtained from assessments carried out by the World Wildlife Fund (WWF) during the same period.

Physical Features

Laya, Lunana and Lingshi together cover a total area of 432,003 ha. Snow and glacier cover account for 30%, 38% and 11 %, forests including scrub forest for 35%, 28% and 14% and natural pasture for 12%, 3% and 39% of the respective total areas of the three gewogs. Arable land area is insignificant.

The altitude of the study area varies between 3000 m at the lowest points to over 7000 m at the snow peaks. The topography is characterised by rugged mountain with snow-

clad peaks, steep slopes, narrow gorges and flat, narrow valley bottoms. The permanent snowline varies between 4700 m on the shady faces to over 5500 m on the sunny eastern and southern faces. Tree line lies at 3700 m on south facing slopes to nearly 4000 m on the shady northern slopes.

Table 1: Land cover of Laya, Lunana and Lingshi gewogs

Land cover	Area (ha)					
	Laya	%	Lunana	%	Lingshi	%
Agricultural land	50	0	61	0	22	0
Conifer forest	12215	12	40283	14	3634	9
Broadleaf forest	209	0	3691	1	274	1
Scrub forest	22177	23	39792	13	1459	4
Natural pasture	11557	12	8460	3	15122	39
Snow/glaciers	29209	30	113682	38	4077	11
Rock outcrops	18127	18	38639	13	9311	24
Land slips/eroded areas	3886	4	46322	16	4588	12
Water spreads	752	1	4239	2	95	0
Marshy areas	4	0	116	0	0	0
Total	98186	100	295285	100	38582	100

Source: Land Use Planning Project (LUPP, 1995)

Climate

Laya has a distinctly wet and rainy summer and a dry, cold winter with short spring and autumn seasons. Annual average precipitation excluding snowfall varies from 400 to 600 mm. Mean monthly temperatures vary between -8°C in January to 16°C in July.

Population and Demographic Features

The main villages and the number of households are shown in Table 2.

Table 2: Main villages and number of households in Laya and Lunana

Laya		Lunana	
Village	Households	Village	Households
Pashi	22	Thansa	29
Toko	16	Dotag	10
Lubja	12	Tencho	31
Naylo	15	Tshoshong	28
Chongra	12	Hedi	27
Lungo	20	Thega	18
		Wache	8
Total	97	Total	151

The population of Laya in 1994 was 723 with a male to female ratio of 1.1: 1

Table 3: Demographic features of Laya and Lunana

	Laya				Lunana			
Age group	M	F	Total	%	M	F	Total	%
< 10 Yrs.	119	95	214	30	68	75	143	22
10-25 Yrs.	120	112	232	32	63	93	156	24
26-50 Yrs.	96	84	180	25	94	107	201	31
> 50 Yrs.	50	47	97	13	70	82	152	23
Total	385	338	723	100	295	357	652	100
Percentage	53	47	100		45	55	100	
No. of Household	40	35	75		20	24	44	

On average, a household in Laya has 7.4 members with a range between 1 to 14 members. The population of Lunana was 652 with a male to female ratio of 0.8:1 and an average household size of 4.3 persons. This difference in demography between Laya and Lunana is a reflection of the social structure. In Laya, the polyandrous marriage system encourages larger families and lesser fragmentation of

households whereas in Lunana, polyandry is not practised, and therefore, households are continuously sub-dividing into new units of smaller sub-families. According to Johari (1994), the population of Lingshi in 1994 was 515 with a male to female ratio of 1:1, living in 86 households with an average size of 6.0 persons.

Population Distribution and Employment

In 1994, 91% of the population of Laya including almost all the women were engaged in farming.

Table 4: Occupation of people in Laya

Occupation	Male	Female	Total	% of total population
On farm	323	332	655	91
School	38	8	46	6
Monastery	15	0	15	2
Government	9	1	10	1
Service/business				
Total	385	338	723	100

The Economy

Agricultural grain products are used for their own purposes and do not make a significant part of the income. 84% of households benefit from farm sales. 65% percent of the households earn wages for agricultural and non-agricultural labourers within and outside Laya, 81% in porter services and 68% in business dealings with non-farm goods and 32% in tourism. These figures compare favourably with the results of surveys carried out by the World Wildlife Fund (Caron, 1994). As expected the income from livestock production is considerably higher than in other parts of the country. Guenat (1991) obtained income estimates of 5% and 10% respectively for Bumthang and Sephu, two other important livestock rearing areas in Bhutan. The contribution of

livestock production to national GDP was 10% in 1994 (Dorjee, 1995).

The main source of income is the sale of yaks and yak products as shown in Table 5.

Barter Trade

Bartering yak products, incense and medicinal plants for rice and other is an important form of trading still widely practised. Barter trade is carried out between the households, between the nomadic communities of Laya, Lunana and Lingshi and between the people of Punakha, Wangdi Phodrang and Thimphu. Standard forms of exchanges and their equivalent values in cash are shown in Table 6.

Yak Production System

Laya and Lunana *gewogs* have a combined yak population of 2924 heads. The data on the yak population of Lingshi could not be collected personally and was not included.

The yak production systems in Laya, Lunana and Lingshi do not differ considerably. While the descriptive details in the following sections cover Laya as well as Lunana, quantitative assessments of the productivity of yaks was done only in Laya. Table 8 shows the annual yak production schedule followed by the herders of Laya.

History and Development of Yak Rearing

The present domestic yak is descended from wild yak caught and tamed by ancient Quiang people in the Quaiantang and other areas of Northern Tibet in the late Stone Age about ten thousand years ago (Li and Wiener, 1995).

Table 5: Sources and estimates of annual income including cash value of bartered goods in Laya (1993-94)

Sources of Income	Mean income (Nu.)	% of total income	% households involved
Farm sales			
Yaks	9532	30	55
Horses	581	2	10
Bajos	258	0	13
Butter	2097	7	68
Cheese	1484	5	68
Meat	1316	4	45
Hair products	290	0	26
Grains	177	0	6
Chang	123	0	29
Sub-total	15858	49	84
Labour wages			
Agricultural labour in Laya	1384	4	48
Agricultural work outside	700	2	35
Non-agricultural work in Laya	1564	5	42
Non-agricultural work outside	1148	3	35
Sub-total for labour wages	4797	15	65
Porter Services			
Porters	77	0	19
Pack yaks	3110	10	58
Pack horses	1277	4	58
Sub-total for porter services	4464	14	81
Business (Non-far items)	5896	18	68
Tourism	1129	4	32
Grand Total	32177	100	100

Table 6: Barter and cash values of commonly traded goods in Laya

Goods	Butter (Sang)	Chugor (shey)	Rice (bje)	Barley (bje)	Mustd. (bje)	Chilli (kg)	Meat (kg)	D/ fish (kg)	Wages (days)	Kheyak (days)	Kheta (days)
Butter (Sang)		3.0	2.0	3.0	1.0	0.5	3.0	0.5	1.0	0.3	0.5
Chugor (shey)	0.3		0.5	1.0	0.3	0.2	1.0	0.2	0.3	0.1	0.2
Rice (bje)	0.5	2.0		2.0	0.5	0.25	2.0	0.25	0.5	0.2	0.3
Barley (bje)	0.3	1.0	0.5		0.3	0.2	1.0	0.2	0.3	0.15	0.2
Mustd (bje)	1.0	3.0	2.0	3.0		0.5	3.0	0.5	1.0	0.3	0.5
Chilli (kg)	2.0	5.0	2.5	5.0	2.0		6.0	1.0	2.0	0.5	1.0
Meat (kg)	0.3	1.0	0.5	1.0	0.3	0.2		0.2	0.3	0.1	0.2
Dry fish (kg)	2.0	5.0	2.5	5.0	2.0	1.0	6.0		2.0	0.75	1.0
Wages (days)	1.0	3.0	1.5	3.0	1.0	0.5	3.0	0.5		0.3	0.5
Kheyak (days)	3.0	10.0	5.0	10.0	3.0	2.0	10.0	2.0	2.0		0.75
Kheta (days)	2.0	6.0	3.0	6.0	2.0	1.0	6.0	1.0	1.0	0.075	
Cash Nu.	30	10	20	10	30	60	10	60	30	100	60

Table 7: Population of yaks in Laya and Lunana (1994/95)

Gewog	Yaks
Laya*	2158
Lunana**	766
Total	2924

* data collected in 1994

** data collected in 1995

Table 8: Annual yak production schedule in Laya

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Herds moved to summer pastures												
Calving												
Main milking period												
Shearing of hair												
Mating												
Hay making												
Selling/culling of animals												
Herds moved to winter pastures												
Supplementary feeding												
Marketing of products												

In the study area, yak rearing on the present scale has a relatively young history. In Laya, presently 75% of the households own yaks ranging from less than 10 to over 300 with an average ownership of 29.5 heads per households. According to village elders, around 30 years ago, there were less than 5 families who owned their own livestock and 3

families who tended the herds belonging to Kabji Dzong, Talo Gumpa and Central Monastic Body in Punakha (Gup Tshering and others, personal communications, October, 1993). Only two households kept horses while the majority owned a few heads of cattle.

Cropping was much more important than yak rearing in those days. Buckwheat (*Fagopyrum tabaricum* L.) was extensively cultivated on *tseris*, and much more barley (*Hordeum vulgare* L.) was cultivated then than it is today. This is evident from the abandoned fields around the villages. Engagement in trading and transporting goods on the then active trading route between Bhutan and Tibet were other sources of income.

Informal discussions with village elders consistently pointed out the following main reasons for the increase in yak population in Laya.

i) The Closure of the Tibetan Border Following the Chinese Invasion

The people of Laya were no more required to provide compulsory porter services for Bhutanese and Tibetan Government dignitaries, religious figures and other nobles. As a result, they had more time to engage in their own affairs. Fleeing Tibetans drove their yaks across the border and sold them at give-away prices, as they could not take the yaks with them below Gasa. Many new herds were established during this period.

i) The Abolition of Heavy In-Kind Taxes in the Form of Livestock Products and Porter Services

In the past, the inhabitants had no incentive to rear livestock as they were heavily taxed on the basis of livestock holding and often ended up remitting more products than they could actually produce. Those who owned a female yak or a cow were taxed in the range of 20 *sangs* (6-7 kg) of butter

regardless of its productivity status, and those with a pack yak or a horse were required by law to provide porter service to Gasa Dzong and other authorities as and when required without any compensation (Ap Kesang Tshering, Sangay Dorji & others, personal communications, July 1993). Once these taxes were abolished and herders could keep their products for themselves, they started keeping yaks and horses.

iii) Distribution of Female Yaks by the Government

During the Fifth Five-Year Plan (1982-87), households who did not own yaks were given two female yaks each as *soelra* or grants from the Government. Some of the recipients of this scheme were able to multiply their yaks and establish new herds. This scheme was repeated during the Seventh Plan (1992-97) and over 100 female yaks were distributed between 1993 and 1995.

iv) A General Improvement in the Economy

Economic development elsewhere in the country during the last two decades has enhanced the market for the products as well as brought in revenue through other sectors such as tourism and development projects. This, combined with the flourishing albeit illegal cross border trade in Chinese and Indian goods had greatly enhanced the purchasing power of the people.

The people of Lunana unfortunately did not benefit from the changes brought about by the events in Tibet, as there were no routes from Tibet into the area. Most of the yaks were bought from the neighbouring areas of Laya and Sephu in Wangduephodrang district. Yak distribution schemes have not fared so well and many families who were beneficiaries of the scheme in 1982-87 did not have yaks in 1995.

Herd Sizes and Composition

Table 9 shows the size and composition of 24 randomly selected herds in Laya. The analysis of yak herds by age and sex shows that 50% of the animals were above 8 years with a male to female ratio of 1:1.2. The low proportion of yaks below 4 years of age is an indication of heavy calf mortality. It is noteworthy that the proportion of male to female animals below 4 years is almost equal indicating that culling of males does not occur below this age. The high number of male yaks is kept as they are economically as important as the female ones providing transport and draught power. They are also a standing insurance against bad times as they could be easily sold in times of need and fetch good prices.

Table 9: Composition of yak herds by age and sex in Laya (n=24)

Age	Male No.	%	Female No.	%	Total No.	%
< 2 Yrs.	131	8	161	10	292	18
	<i>5.5</i>		<i>6.7</i>			
2-4 Yrs.	102	6	129	9	231	15
	<i>4.2</i>		<i>5.4</i>			
4-8 Yrs.	123	7	173	11	296	18
	<i>5.1</i>		<i>7.2</i>			
> 8 Yrs.	293	21	462	28	755	49
	<i>12.2</i>		<i>19.2</i>			
Total	649	42	925	58	1574	100

1) Figures in italics indicate the average number of animals per herd

2) Percentages of animal groups are calculated across herds and not of the total of the sample populations.

Further sub-division of the adult females into milking and dry animals shows that the ratio of dry to milking animals is almost equal (Table 10) indicating that herders have nearly constant milk production from year to year. The relatively high number of animals is due to the inclusion of four of the largest herds in the area with more than 150 animals each.

The proportion of adult female animals in this observation is much higher than those earlier reported by Harris (1987) in Soi Yaksa and Pelela in western Bhutan and is closer to the figures of Miller (1988) for herds in Merak Sakteng in eastern Bhutan.

Table 10: Production status of female yaks in 24 sample herds in Laya

Production status	Average number per herd	Average percentage per herd
Milking females	194	51
Dry females	191	49

Type and Breed of Yaks

Yaks in Bhutan are not yet categorized into breeds. There has not been an investigation to see whether the differences in appearance between yaks of different region within the country are due to genetic difference. From appearance, however, the Laya type most probably is descendant of the Henduan Alpine type found in the south-eastern part of Tibet as described by Li and Wiener (1995). Most of the yaks have black coats with few light brown ones. Other distinguishing marks are white faces, white legs and white tails. Exceptions from these are brown, or light brown in colours with or without tails and legs. The yaks in Lingshi are observed to be bigger than those in Laya, which in turn are bigger than those in Lunana. However, these differences are probably due to the difference in breeding and feeding management rather than any inherent genetic differences. Table 11 shows the linear body dimensions of different age groups of yaks measured randomly in different herds.

Table 11: Height at withers and body length of different age group of yaks

Age group	(n)	Ht. Withers (cm)	Body Length (cm)
-----------	-----	------------------------	---------------------

< 2 months (mixed)	11	62.5	74.1
12 months (mixed)	8	86.3	109.4
24 months (mixed)	5	103.0	133.2
> 4 years female	12	115.4	170.8
> 4 years male	11	138.7	189.4

The females are much smaller and also carry less hair than males. The horns of the males are long, round and curve out wide and evenly towards the tips. The females have shorter and thinner horns than males.

In comparison to the body dimensions of yaks in Tibet and China quoted by Li and Wiener (1995) from various studies, the size of yaks in Laya are similar or bigger. The height at withers of the Jinglong breed, which is the largest of the Chinese breeds, is 138 cm and the body length 178 cm. Since heart girth measurements were not taken, it is not possible to compare correlation with body weights as done in the Chinese studies (Li and Wiener, 1995).

Reproduction of Yak and Breeding System

The female yaks are mated for the first time at the age of 3 years or during the fourth warm season after birth. The survey results show that most of the females give birth in their fourth or fifth year (Table 12). The calving rate depends as much on feeding management as on genetic factors. Most of the females (81%) are reported to calve only in alternate years and only 18% annually. The females have a long reproductive life extending to over 15 years. Yaks are seasonal breeders and oestrus is affected by climatic factors, pasture growth and altitude. The yak females in Laya improve in body condition with the onset of spring in May and attain peak condition towards August when they come into heat. Hence most of the breeding takes place in July and August. Breeding is carried out naturally by the herd's own breeding yak or a more dominant and stronger bull from neighbouring herds. Breeding bulls are not restrained and roam freely among the different herds of females constantly challenging rivals. Hence herders generally are unsure of the male

pedigree of progenies apart from judgement of phenological features. Yak bulls are selected from the herder's own growing bull stock, purchased from neighbours or from Haa in western Bhutan. Performance of young bulls below 6 years is affected by the presence of stronger bulls around and they do not attain peak performance until they are around 7 to 8 years old and are able to fend off older challengers.

Conception rates are reported to be good with most females in heat, successfully conceiving after being served several times either by the same or different bulls. Under the circumstances, it is not unrealistic to estimate that the conception rate in a herd is around 80% or more although herders constantly reported achieving 100% conception of 0 females, which come in heat. The gestation period of yaks is shorter than those in cattle. Most of the calving occurs in May and June thus accounting for a gestation period between 8 to 9 months (approximately 240-270 days).

Due to the difficulty in monitoring the exact time of conception of a female yak, which generally occurs on the range and out of sight of herders, it is difficult to keep accurate records of individual animals. Robinson (1994) described similar reproductive characteristics in Nepalese yaks and by Li and Wiener (1995) in Chinese and Tibetan yaks demonstrating that there are no fundamental differences in the reproductive performances of yaks between these countries. In Mongolia, for example, conception rates of 94.4% had been observed (Magasch, 1990) and in China, 94.3% (Yu et al. 1993). No cross breeding with other bovine species are carried out in Laya, Lunana and Lingshi as in other parts of Bhutan. Although, herders are aware of the higher milk yields from crossbred animals, they prefer to maintain pure yaks, as the crossbreeds carry the stigma of producing inferior quality of milk and meat and infertility in male progenies.

When the time for parturition, which normally takes place during the day, approaches, the female yak isolates herself in

a sheltered spot such as a depression in the ground, under a tree or in secluded spots behind rocks. Delivery is done either while lying on her side or standing up. The dam licks the newborn calf until the calf attempts to stand up and suck. The placenta is ejected within half an hour to half a day after parturition. Bonding of dam and calf depends mainly on smelling and licking and a yak cow can differentiate her calf by smell from among large groups of calves. Abortion is reported to be rare and often related to disorders from disturbance by other animals or predators rather than due to reproductive disorders.

Table 13: Reproductive characteristics of female yaks in Laya

Age	Calving No.	Number of animals	Calving interval	Years
			1	2 or more
3	1	2	Not applicable	
4	1	8	Not applicable	
5	1	10.0	Not applicable	
6	2	10	3	7
7	2	4	1	3
7	3	6	2	4
8	2	4	0	4
8	3	13	3	10
9	3	9	1	8
10	3	1	0	1
10	4	2	0	2
11	3	1	0	1
11	4	4	1	3
12	3	1	0	1
12	4	3	0	3
13	4	2	0	2
13	5	3	1	2
14	5	1	0	1
		84	12 (18%)	52 (81%)

Source: Herders interviewed during milking time

The survival rate of the calves appears to be very low. Herders repeatedly reported losing more than 50% of the previous year's calf crop either to infection by gid disease, weakness over winter or from predation by wild animals. Calf survival is improved by not milking the dams for several days to weeks following parturition and allowing the calves to suckle. Once a day, they are milked as a strategy to improve the survival rate. In winter, they are fed with supplementary feed such as buckwheat dough, porridge and alcohol by-products.

Production Characteristics of Yaks

a) Observations on Growth

Herders estimate birth weight of yak calves in the range of 10-15 kg. This low birth weight is possibly a consequence of the relatively short gestation period and also of the poor nutrition during late pregnancy, having to survive mostly on frozen ground without much supplementary feeding. The growth rate of the calves is slow. At the age of 12 months, the height at wither and body length show only small differences from newborn calves of less than two months. Malnutrition appears to be the main cause of slow growth. According to the herders, growth rate is much faster between 2 and 4 years of age when the animals are strong enough to seek out better pastures. This is probably due to natural selection resulting in the survival of the strongest of the lot. Peak size in males is attained around 5 years of age and in females at around 4. All the animals attain peak weight and body condition annually towards the end of the warm season in September and October and are in their poorest conditions in March and April at the end of the dry harsh winters. Lack of adequate care and fodders during winter are reportedly as the main reasons for the poor growth rate and condition of animals. The estimated weight of a fully-grown bull is around 400-500 kg and of cows around 250-300 kg. From various sources, Li and Weiner (1995) reported live weight ranges between 235 kg

to 594 kg for males and 190 kg to 314 for females among different breeds of Chinese and Tibetan yaks.

b) Milk Production

The milk yield of cows shows an average of 1.2 kg a day per cow in the peak production period of July when the yak cows are milked twice a day and around 0.9 kg in October when they are milked only once (Table 14). The age of the cows as well as the lactation stage and the number of calvings influence the milk yield. Highest milk yields were obtained from those cows between 7-10 years of age in their third and fourth calving. Those calving annually give a higher daily milk yield than those calving in alternate season but the latter give higher lactation yields. From a wide range of data, the highest daily milk yield of 2.6 kg per animal was recorded from Bazhou yak in Xinjiang Autonomous Region of China and the lowest yield of 0.9 kg from Alpine yak in Tibet, recorded in summer months (Li and Weiner, 1995). However, this difference was believed to be due to the difference in supply of herbage, which was abundant in Xinjiang and scarce in Tibet.

Lactation yield per se has little meaning unless the period is defined since the number of days a cow is milked varies between herds. Annually, calving cows have an average milk production period of 120-180 days and therefore, average lactation yield of 130 to 150 kg of milk, while those calving in alternate years have a milk production period of 300 to 360 days and a yield of 220 to 250 kg based on the following calculations:

June to September = 120 days at 1.2 kg per day = 144 kg

October to November = 60 days at 0.9 kg per day = 54 kg

December to March/May = approx. 120 or 180 days at 0.25 per day 30-45 kg

The daily milk yield per animal and per herd varies little in autumn. In a herd of 13 milking cows, the average daily milk yield was 0.95 kg per animal and 11.1 kg for the whole herd and these yields varied little over 8 consecutive days.

Table 14: Average milk production of female yaks by number of calving and age of animals

No. of calving	Mean age	Average daily milk yield (kg)		
		Jul., 93	Oct., 93	Mean
1	4.4	1150	868	1009
2	6.8	1193	854	1024
3	8.4	1308	881	1095
4	11.3	1195.0	938	1067
	12.8	1125	1006	1066
Mean		1194	909	1052
Sample (n)		98	136	234

c) Hair Production

Hair production is not given as much importance in Laya as it is in Lunana and Lingshi. The average hair harvested (not potential yield) from male yaks is around 1 kg per year and in females around 0.3 kg from measurements made from hair shorn of 8 males and 22 females. The males are clipped of all the wool growing inside the outer layer of long hairs at the upper and lower flanks, whereas the females are stripped of all the hair. Hair is usually clipped in June/July and the staple length varies from 20 to 40 cm. Yak hair is much more valued in Tibet where other fibres are not as readily available as in Bhutan. Average hair yield is reported to range from 1.7 to 13.9 kg in male and 0.5 kg to 2.9 kg in female yaks (Li and Wiener, 1995).

d) Meat Production

October and November months are considered the best time for slaughtering animals for meat. The animals are considered to be in prime body condition and the temperature is cold enough for preserving fresh meat over longer period of time, which is essential for delivery to markets. The average dressed weight of fully-grown yak is around 200 kg. The

average weight of different portions of 6 carcasses weighed in October 1993 is shown in Table 15.

Table 15: Average weight of different portions of meat from yak carcass

Portion	Average weight (kg) (n=6)
Hind legs (2)	70
Front legs (2)	48
Ribs (2)	32
Chest	18
Intestine and stomach	12
Liver, kidney, heart, etc	10
Head	12
Total	206

The hide is usually stored for processing into leather and leather goods. It is also used as rug with the hair left intact and often as a substitute for meat after elaborate preparation.

e) Draught Performance

The male yaks mostly provide draught power. Young yaks are castrated when they reach around 4 years of age. A hole is pierced through their noses, which is used for fixing a wooden nose ring. This secured with a rope, enables herders to handle them easily. The young yaks are trained to carry loads and plough fields. While training them as pack yaks, they are secured by ropes to a dominant yak, and to plough, they are paired up with stronger and dominant yaks. On average, a yak carries 60 kg of load, loaded in equal halves on either flank of their back upon a saddle. A pair of yak ploughs as much as 3 times the area ploughed by a pair of bullocks in a day.

Management of Yak Herds

a) Seasonal Activities

Activities in early spring include supplementary feeding of weak and young stock, supervision of calving and subdividing of herds (refer Table 8). In summer, milk production and processing, supervision of mating, and hair production activities are carried out. Hay making is the main activity in September and supplementary feeding of weak animals in winter.

b) Grazing Management

The following factors determine the type of grazing management practised by herders:

- i) ownership of grazing areas
- ii) size and topography of grazing areas
- iii) vegetation and productivity of grazing areas
- iv) size and ownership of yak herds.

Generally, there are summer and winter pastures with small areas of autumn and spring grazing areas in the intermediate zone. Summer pastures are usually located at the top of the mountain ridges while winter pastures are closer to the permanent settlements, in more sheltered areas and on south facing slopes at lower elevation. Spring and autumn grazing areas are occupied for relatively short periods while on transit between summer and winter grazing areas. However, in Laya, there are no fixed criteria for differentiating summer and winter pastures. Animal movements from summer to winter pasture are often along a horizontal altitudinal plane rather than vertical as is the case in some other parts of Bhutan. They may be separated by several mountain ridges and valleys or lie within the same ridge or valley.

i) Ownership of Pastures

Table 16 shows the area of registered pastureland in Laya and Lunana. As per law, the herders only have grazing rights in areas registered in their names and referred to as *Tsadrok*. The land itself belongs to the state (The Land Acts, 1980). However, to all ends and purposes, herders with grazing rights over large areas consider the land as their own while those with less, insufficient or no grazing rights interpret differently.

Table 16: Area of private and community registered pasture

Gewog	Private	Community	Total
Laya	10,682	3,503	14,185
Lunana	8,368	1,640	10,008
Total	19,050	5,143	24,193

Source: Land Record Data, Survey of Bhutan, from LUPP (1995)

Depending on the number, size and locations of pastures owned, herders can be divided into four categories as shown in Table 17. Grazing management varies between these groups. The first group, which consists of 23% of the herders in Laya, has fixed seasonal migration patterns from one pasture to another along routes followed annually. The duration of grazing on particular sites is as much dependent on the condition of the grass available as on historical tradition. The journey between summer and winter grazing grounds can vary between fractions of an hour to a week. However, those covering large distances between grazing grounds have stoppages at the villages following harvest of crops or autumn and spring grazing camps en route. The direction of movement and the route chosen is usually the same every year. The herders move with their tents and belongings until they reach the new campsite. Winter camps have permanent hutments of stone and mud walls with a thick layer of mud packing on the roof to protect from snowfall. Those with summer and winter pastures on the same ridge or valley are found in Tsherjathang and

Tashimakhang areas. The total number of sites owned determines the number of movements. The second group consisting of 29% of the herders in Laya and 21% in Lunana winter their herds in the community pastures around the villages after utilising their own summer pastures. The third group which accounts for 19% of Laya and 61 % of Lunana herders have group grazing rights in seasonal pastures and move from one pasture to the next on mutually agreed dates.

Table 17: Category of herders according to type of pasture ownership

Category of Herders	Laya		Lunana	
	No. of Herders	% of Herders	No. of Herders	% of Herders
Owning sufficient private pastures	17	23	0	0
Owning some of but not adequate pastures and dependents on community pastures for some season	29	29	22	21
Owning group pastures	14	19	63	61
Owning no pastures all year round	21	29	19	18
Total	73	100	104	100

This is typical of the arrangement found for pasture in Omtsa and Gangitey pastures. Disputes arise when a member of the group defaults on such agreements. The fourth group consists of those who took up yak herding only recently or of sub-units of families with no grazing rights. They use the community pastures around the villages all the year around or lease grazing lands from others for part of the year. The community pastures are shared by cattle and horses as well, and therefore, are the most heavily grazed of all the pastures. Following crop harvests, the animals have also access to grazing in the fields and the surrounding crop fallows.

Three herders in Laya still graze their herds on *tsadoks*, belonging to owners who live in Punakha, together with the animals belonging to these owners. The herding arrangement is on the basis of an old institution known as *keme shime* meaning 'no birth-no death' whereby the herder remits the product of a fixed number of animals every year and that any increase or decrease in herd numbers is the gain or loss of the herder. The other form of yak tenurial arrangement is called *puyig*, which is no more practised in Laya. In this system, the herder accounts dairy products to the owners according to the number of calves borne each year (verified by the owner or his/her representative annually). In both forms, the quantity is 30 sangs (10 kg) of butter for every milking cow.

ii) The Physiography and Area of Grazing Sites

The time and duration of grazing on a particular site is also influenced by the topography, slope exposure and gradient and the size of the grazeable area. The area registered in an individual herder's name has very little relevance or correlation to the area actually utilised for grazing by the herder. Registered grazing sites ranges in area from 0.04 ha (0.1 acre) to cover 202.4 ha (500 acres). Actual grazing area on a 0.04 ha site may be more than a kilometre's radius; similarly on a site registered as 200 acres, actual grazeable area may be less than half if the shrub cover and other unusable areas are deducted. Hence grazing time and duration is determined more by other physical factors than registered area. Sites on the valley bottom with riparian vegetation are grazed early in the summer to utilise the early growth. This period is determined by the fodder availability and by the time remaining before joining others at summer pastures. The topmost ridges are used for male animals during peak summer and the steep slopes are used more in dry season to avoid accidents from slipping. Likewise, most winter pastures are located in sheltered or sunny faces of the slope.

iii) Herders' Historical Knowledge of the Productivity and Quality of Pasture

Through their long history of using grazing sites, herders have developed some basic thumb rules to determine the time and duration of grazing on particular sites when they are not restricted by lack of alternative sites. They move to summer grazing sites when the *Primula sp* start blooming and move out of these areas to alternative sites when only unpalatable species of *Senecio* and *Therrnopsis* are visible, and milk yields drop significantly. Usually, the productivity and vegetation types do not differ significantly from year to year and herders move the animals after grazing for approximately the same number of days every year. Movement to winter grazing areas starts in September/October when barley harvesting is completed in the cropped areas.

In the case of herders owning enough independent grazing sites, the grazing system closely resembles rotational grazing management. The sites are in relatively healthy condition as compared to those grazed all the year round by the whole community.

iv) Herd Size

The larger herds are divided into two or more sub-herds. The pack yaks and growing male stock are separated from the main herd of females and young calves; the latter is further subdivided into milking and dry females in the case of two herds in Laya. The pack yaks are driven to the uppermost reaches of the ridge for the whole summer rounding up only when required. The dry female, young bulls and heifers occupy marginal pastures away from the main campsites and the milking females and calves are allotted the best and most accessible pastures. In Lunana, where the herd sizes are smaller, yaks are often combined from several herds and driven to a common summer pasture. In summer, between July and August, the calves are driven in a separate direction

from the dams so that they do not suckle the milk during the day.

c) Grazing Habits

Yaks are very versatile animals and consume nearly every type of herbage vegetation apart from few known toxic species of *Aconitum*, *Thernnopsis* and *Senecio*. However, these supposedly toxic species are also consumed when they are dry and herders do not consider them problematic. Yaks are able to feed on very short growth and are able to survive on herbage allowances less than 400 kg DM ha⁻¹ or herbage height of less than 3 cm as is commonly found in the community grazing areas for most part of the year. The preferred species according to the herders belong to the *Gramineae* and *Cyperaceae* families. Among the forbs, *Saussurea spp* are ranked highly and taken as an indication of good pastures and associated with high milk yields.

Yaks rarely browse on shrubs, which are readily eaten by other ruminants like cattle and goats. Only when hunger forces them during heavy snowfalls do they browse lightly on these plants. Yaks are also observed to dislike grazing in forests and tend to prefer the open meadows. Because of their surefootedness yaks are able to access fodder on very steep slopes. They can easily cross narrow footpaths and reach isolated grassy spots between rocks thus utilising fodder, which would otherwise be wasted.

d) Problems of Overgrazing

The problem of overgrazing is not recognised by most herders. Many herders, however, claimed that grazing resources have deteriorated for the following reasons:

- An increase in the number of new herders and encroachment in their grazing areas
- An increase in the area of shrub vegetation due to ban on fires

- An increase in the number of wild ungulates particularly blue sheep due to the decimation of wolves in the 1980s

The problem of overgrazing is particularly evident in the community grazing grounds where not only yaks but horses and cattle also graze all year round. These areas are also grazed by flocks of blue sheep particularly during mornings and evenings as they come down closer to human habitation to take refuge from predators like leopard and wild dogs. The private pastures on the other hand are not subject to the same intensity of grazing and are spelled for certain months of the year.

Erosion and grassland deterioration is particularly strong in areas where large herds of yaks are joined by flocks of blue sheep and large numbers of marmots. The marmots are found to be very destructive as they dig numerous burrows, which set off the process of erosion. The holes become larger under the hooves of yaks until they become large enough to be used as bull pits. In times of heavy rainfall, the soil from these open spots is washed down often causing landslips. The pastures around Laya, Lungo, Jarila and Lingshi are particularly affected by this phenomenon.

e) Supplementary Feeding

Supplementary feed consists of hay, barley straw, barley grain, mustard oil cake, buckwheat flour, and residues from alcoholic brewing. Hay is made from grass and other herbage growing around cropping fields and from forest undergrowth. The main species used for hay-making are *Elymus nutans*, *Poa spp* and *Vicia tibetica* in the plots around the fields. *Pleurospermum ambile*, *Selimum cortiodes* and *Heraculem nepalensis* from forest floors and winter camps as well as *Stipa* and *Festuca* grasses from grassy knolls on steep cliffs are also cut of making hay. The plants are cut with a bow sickle, collected and twisted into thick ropes and hung on the branches of trees around the fields and winter camp to dry.

Hay and barley straws are fed to draught yaks and pack horses whenever they are employed for ploughing or transporting. Milking female yaks and calves are given supplementary hay in winter in the mornings and evenings in smaller herds. Other concentrates are given only to calves going through their first winter or very weak females in early spring. The level of supplementary feeding is very low and inadequate to meet the nutrient requirements of animals in winter. On the other hand, herders spend considerable time collecting grass for hay in the range of 60-100 working days per year.

f) Equipment, Enclosures and Pens

Yak herders need very few equipment. Their milk churner, milking pans and butter containers are made of canes and brought from lower areas. Large pans for cheese making and cooking utensils are other important equipment besides their camping gear consisting of yak hair tents and floor mats. Ropes for tethering and handling animals for different purposes are other essential gears. In winter, young calves are sheltered in simple mud wall pens and in summer, tethered around the camp on a long rope. No enclosures are used for adult animals although a stone wall is usually found around the herder's winter home where hay and other supplements are fed to weak and young animals.

g) Controlling the Herd on the Range

Yaks are more difficult to control than cattle. They scare easily and when disturbed unexpectedly react by running over long distances. Daily, they cover large areas of grazing grounds but they rarely stray too far away from each other in a group. The bulls are aggressive and can be wild tempered. The females are very protective of their young ones and can be temperamental at these times.

All animals are known by names to the herder and his family. The names are usually linked to their coat, colour or some

other particular characteristic. Common names for male yaks are Chung-due, Jukar, Zekar, Nado, Khampa, Dawa, etc. The females are called Yangchen, Jugchen, Dongtham, Zangjen, Nalem, etc. When rounding up, yaks who stray out are called by name, accompanied by throwing of small stones either by hand or by a yak hair sling. Stones can be accurately thrown over long distances with this sling. Yaks respond to its loud cracking noise although they may not always be hit by stone.

Male yaks and growing stock are allowed to graze freely day and night and rounded up only when administering salt or for other purposes. Regular observations are made to ensure that wild animals do not predate upon them. The milking females are rounded up every evening in summer for milking and then allowed to graze during the night until dawn when they are again rounded up for milking. Young calves and yearlings are penned or tethered to a long rope at night so that they do not suckle their dams or get predated upon. After milking in the morning, they are usually driven in a different part of the pasture so that the milk is saved for the evening. After peak lactation, the calves are allowed to graze with their mothers during the day.

h) Daily Schedules

The daily schedules generally followed in Laya are shown in Table 18. Daily activities differ depending on the number of times the cows are milked in a day.

Management of Individual Animal

a) Calf Rearing

Special attention is given to young calves. Upon parturition, they are encouraged to suckle and feed on the colostrum few minutes before milking to encourage milk letdown and after milking, to finish off what is left. It is also fed with a ball of buckwheat or wheat flour dough, usually weigh about 250 g at each milking. Fostering is attempted when a young calf has

lost its dam by smearing the calf with the milk of the intended foster mother, usually a cow which has lost its calf. The calves are penned at night or tethered to long ropes near the herders' tent or hut to protect them from predators. Weaning takes place between the age of 6 month and 12 months or more depending on the reproductive status of the dams. A nose ring, which is designed to obstruct suckling, is used when weaning calves, which persists in trying to suckle.

Table 18: Daily schedule in yak herding in Laya

Time	Twice daily milking (July-Sept)	Once daily milking (other seasons)
0500-0700	Yak cows rounded up from night grazing to the camp sites	Yak cows rounded up from night grazing to the camp sites
0700-0800	Milking; calves are released from overnight tethering or shelter one by one	Same as above
0830-1730	Yak cows and calves driven to separate grazing sites and allowed to graze freely	Yak cows and calves released and allowed to graze together freely
1730-1900	Yak cows and calves recalled from grazing for evening milking	Yak calves rounded up for penning and tethering
1900-2000	Milking; afterwards cows let loose to graze and calves are penned or tethered	Supplementary feeding of weak calves
2000-0500	Yak cows allowed to graze freely near campsite	Yak cows left to graze freely over night

b) Milking

The udder and teats are usually but not in all cases, washed before milking. Milking is done in a fixed order according to the tethering arrangement of the calves. When the calf is

released, it runs to its mother and suckles. After about half to one minute, it is held back and tethered or held by children. The hind legs of some cows need to be tied by a short rope. The teats between the fingers are squeezed since the teats of yaks are smaller than cows. A little quantity of barley powder mixed with salt is given to each cow before milking to win its cooperation.

c) Breeding Bull Selection and Management

Breeding bulls are selected from within the herds' growing male stock or purchased from other herds on the following selection criteria.

Body size -	the breeding bull should be bigger than other bulls of the same age
Body conformation -	it should have a proportionate body and not possess any deformity
Colour -	black with white tail and spot on the face is the most preferred colour
Horns -	the horns should be large and symmetric as they are highly correlated with the fighting ability of the bull
Temperament -	the bull should be dominating and aggressive to be able to fend off challengers

The breeding bull is given feed concentrates such as mustard oil and oil cakes at the end of the mating season. It is allowed to wander about at will and graze freely on its own. It is not shorn of hair or combed of its wool, which help to enhance its size when compared to the shorn bulls. Usually, the productive life of a breeding bull is up to 12 years of age after

which it becomes incapable of defending its status and is castrated or culled.

d) Castration of Males

All the young males other than the breeding bull are castrated. This is done when the bulls are about 3-4 years of age. The animal is tied up and grounded on its side. The lower part of the scrotum is then sliced open and the testicles pushed out. The cords are crushed and the wound, sterilised with boiling mustard or iodine solution. Most of the herders conduct castration.

e) Harvesting Down and Coarse Hair

Yak hair is shorn in early summer. The animal is secured by the horn with a short rope to a post. The front legs are tied together. In the case of male yaks, the upper section of the breast is clear cut while only the inside portion on the lower flank is cut. The tail is trimmed. Down is pulled out by hand which comes off easily at that time. Female yaks are clean shorn except for the hairs on legs.

f) Feeding Salt

Yaks do not take salt voluntarily and it has to be fed forcefully. The head is secured to the post by a short rope. The front and hind legs are tied together and the yaks brought to the ground on their sides. While one person holds the head and turns the mouth upwards, another person pours the salt down the animal's throat and follows it up with a mouthful of water to wash it down. Salt is fed thus to every animal monthly at the rate of 300-350 g per adult and 150-200 g for yearlings.

Mortality and its Causes in Yak Herds

Mortality rates are very high in yak herds particularly in the young stock. Average loss per herd in Laya was 6 animals

(20%) from an average herd size of 30 animals and in Lunana 4 animals (50%) of an average herd size of 8 animals (Table 19). This high mortality reported on Lunana was due to lack of winter fodder after the occurrence of the flood in October 1994, which swept across most of the winter pastures. Mortality in young stock accounts for 68% and 48% respectively in the two gewogs. Mortality in Laya is reported to be caused mainly by an infection of gid disease (47%), while in Lunana other sickness mostly related to weakness from poor nutrition (48%) is the main cause. Other causes are from predation by wild animals and accidental falls.

Yak Products and Their Utilisation

a) Milk Products

Yak milk in larger herds is churned every day using a cylindrical cane bucket called **zum** and wooden churner. In smaller herds, milk from successive milkings is accumulated in the churner until sufficient quantity is reached for churning. Depending on the size of the churner and the corresponding quality of milk, it takes two to three hours before butter is formed. The butter is skimmed off using a flat wooden spoon and then drained of liquid by slapping it against a flat wooden box with the spoon. It is then shaped into circular or rectangular biscuits and wrapped in large leaves or pressed into a cane container called **sibang**. If done properly, butter preserved with these methods can keep for long periods without becoming rancid.

Table 19: Mortality in yak herds from different causes in Laya and Lunana

Gewog	Herds surveyed (No.)		Cause	Mortality			%
	Total	Avg. size		Young	Adult	Total	
Laya	73	30	Gid	2.7	0.1	2.8	47
			Other sickness (weakness)	1.4	1	2.4	40
			Accidents/predation	0	0.8	0.8	13
			Total	4.1	1.9	6	100
			%	68	32	100	
Lunana	104	8	Gid	1.2	0.2	1.4	35
			Other sickness (weakness)	0.5	1.4	1.9	48
			Accidents/predation	0.2	0.5	0.7	18
			Total	1.9	2.1	4	100
			%	48	53		

The buttermilk is then poured into a large pan (size depend on quality) and gently heated to boiling point. As it coagulated, a small quantity of whey from previous making is added and the solution gently stirred by a ladder in a circular motion. It takes between a half to an hour (depending on quality) before cheese formation takes place. The whey is then drained out from the pan using a ladle and a sieve. The cheese is then wrapped in the cloth and pressed between two large stones and left overnight to get rid of all liquid and becomes compact. The cheese is then either used fresh or processed further into hard cheese for marketing.

Two types of dried hard cheese are made, *chugo* and *hapi ruto* depending on the market for which they are intended. *Chugo* is made by slicing the circular cheese into small pieces of

approximately 2 cm by 3 cm cubes and hanging them in strings of twenty pieces on a yak hair string. After boiling it in milk, the strings are hanged on a pole in the tent and allowed to dry until they become rock hard. *Hapi ruto* is made in larger pieces of around 8 cm square by 1 cm thick and dried again in strings of 20 pieces. To obtain uniform drying, wooden sticks are used to separate the pieces. Such cheese can be kept for a very long time, and is easy to transport. They are light and resistant to damage from handling. *Chugo* is sold in local markets in Punakha and Thimphu and *hapi ruto* in Phuntsholing to Indian dealers.

In Lunana, a product called *phuelu* is made from milk. The process involves pouring of milk from every milking into a container in which a coiled piece of juniper or birch twig is placed. The accumulation of milk cream over a period of time results in formation of a thick layer of cheese-like material on the wooden coil. This is scraped off and stored in a *sibang* and has the same market value as butter. The average annual production of butter and cheese from a female yak is estimated to be 30 *sangs* (10 kg) of butter, 40 *sheys* of *chugo* and with an additional 2-3 kg of *phuelu* in Lunana.

b) Meat Products

Yak meat is considered a delicacy and eaten as dried venison or cooked into stews and curries. It is often consumed as '*masha*' (red meat) by preserving a piece of leg in winter wrapped in a cotton cloth and kept in a warm place. Almost every part of the yak carcass is consumed after processing in various ways. The legs below the knee are separated from the thighs together with the skin. Similarly, the head is severed at the neck without skinning. The hairs on these parts are burned over an open fire and scrapped off with a sharp knife until the skin becomes clean of any hair stubbles. The hooves and horns are then removed by heating, which makes the outer sheaths to come off. The head is then split along the center dividing it into two equal halves and dried on a rake above the fireplace if it is to be consumed later. It may also be

cut into smaller pieces and boiled overnight. When the pieces are thoroughly cooked, the meaty part comes off the bones and is then fried in oil and treated with chilli and black pepper and other spices to make *gushapa* (head meat dish). The legs are usually left for a long time and used for making *kangju* (bone marrow soup) on festive occasions or religious ceremonies. Spices and other condiments are added and then served together with the pieces.

The gut and the intestines are thoroughly washed to remove all excrements. The gut is sliced into thin strips and dried for later use. The intestines are used to make sausages by filling them with a mixture of blood from the slaughtered animal, fat, wheat flour, and chilli and black pepper powder. The filled intestines are then boiled until they are cooked and become solid. They are prepared together with oil and spices for meal or dried by hanging them on ropes secured to the ceiling for future use. The livers, heart and kidneys, if free of any lesions and flukes, are cut into fine pieces and fried together with spices and eaten as snacks with alcoholic drinks.

c) Yak Hide

The fresh skin is stretched on a smooth dry ground by holding the ends with wooden pegs stuck into the ground. After it is dried, it is stored in the attic until the owner finds time to process it into floor mats, leathers, glues or *kosha* (hide meat - a substitute when meat is not available). It is also used as mats. The flesh and fat inside the skin is scraped off, oiled with mustard and softened by rubbing it under the feet until it becomes flexible. To make leather, the skin is soaked in cold water for several days until the hair comes off easily when pulled by hand. All hair on the skin and flesh inside it are scraped off thoroughly often using coarse sands or rock grains. Then it is treated with mustard or vegetable oil, folded and rubbed by feet until the outer part turns into a golden brown tan. The leather is used for making bags for storing and transporting grains, flour, shoe soles and saddle straps. The rejected ends are used as fine strings for

sewing leather bags. Poor quality leather is stripped into very fine ropes and used for carrying loads of firewood, hay and straws. Strips of raw hides are also used for binding wooden fittings of houses to secure them in position.

d) Yak Hair Products

The hair from the yak is a valuable item essential for the daily life of the herder's household. The long hair is washed, dried and spun into thick yarns and used for weaving tents, bags, rugs, slings and ropes. The products are waterproof and very durable. Often, the yarn is dyed red particularly for making rugs and bags when it is combined with white and black yarns to make colourful striped pieces. The soft hair is used for making garments and blankets. Usually it is dyed red black or deep maroon for making dresses.

Yak Production Constraints and Issues as Perceived by the Herders

Shortage of winter fodder is ranked as the most serious problem in both gewogs (Table 20). Heavy mortality as a result of weakness from malnutrition is attributed to this factor. Gid disease continues to be a major health problem. Inability to obtain new bloodlines of breeding bulls is considered a major cause of decrease in yak sizes. Lack of sufficient pasture and increasing number of blue sheep and marmots are listed as other production problems. Marketing is not perceived as a problem.

Table 20: Yak production constraints and issues as perceived by the herders

Constraints/issues	Ranking		Causes/Reasons
	Laya	Lunana	
Lack of winter fodder	1	1	Insufficient land for hay making, poor grass growth
Insufficient pasture	2	2	Land tenureship, shrub invasion, flood damage (Lunana)
Unavailability of breeding bulls	3	3	Lack of sources; distance
Gid disease infection	4	5	Poor veterinary services
Increase in blue sheep	5	8	No population control
Increase in shrub/forest cover	6	6	Banning of forest fires and shifting cultivation
Predation by wildlife	7	7	More cover for stalking
Religious beliefs	8	4	Restricts culling (Laya); annual animal sacrifices limits nemrical increase in herd (Lunana)

Conclusions and Recommendations

Yak rearing will continue to be the main source of livelihood for the people living high altitudes in Bhutan. New and emerging issues confronting the country in general and the remote yak rearing, areas in particular leaves no doubt that yak rearing and with it the lifestyle of many nomadic and semi-nomadic communities, are under threat. Increasing human population, exposure to new culture and changing social norms, climatic changes, soil erosion and land degradation, genetic degradation of yaks and dwindling grazing resources etc. are all manifested in one form or other, much more seriously in these areas than in other parts of the country.

Rapid fragmentation of family herds and grazing land is just one example which not only leads to the establishment of economically unviable units of operation but also increases environmental degradation through breakdown of traditional institutions for sustainable utilisation of grazing resources. There are, however, no immediate solutions. What is required is a multi- disciplinary approach to tackle social, legal, economic and environmental issues.

Diversification of employment of the local people will be one of the key social strategies to reduce pressure on the scarce resources. To do so, access to education must be given top priority so that the future generations of *Jops* could become competitive in non-traditional jobs. Establishment of a 'Reserve Seat System' for children from these disadvantaged communities in national institutions like Sherubtse College, Natural Resources Training Institute, Royal Bhutan Polytechnic, Royal Institute of Management, Royal Health School and the National Institute of Traditional Medicine will go a long way towards furthering this cause. Population planning rather than family planning, whereby the population of the community within the given area is taken as the unit of planning, should be given equal priority to halt unsustainable levels of population growth.

On the legal agenda, laws pertaining to inheritance of family property, taxation on livestock and pastures, grazing rights etc. need to be revised. Yak rearing units, if not checked through appropriate inheritance legislation, will not be economically viable or environmentally sustainable. The present taxation system is not conducive to responsible management of livestock and grazing resources since very little value is given to them because of the extremely low taxes. An upward revision of the taxes would not only limit the increase of livestock and encourage off-take of excess animals through culling and thereby increase the economic viability of yak production but also encourage greater responsibility on the part of herders to manage grazing resources. Simultaneously, the existing policy of allocating

grazing rights to herders need to be replaced by a new policy of either leasing out pastures to herders on long- term lease or passing on full ownership to the herders. Without such a policy, it would be futile to attempt any technological innovation to improve rangelands. One of the key constraints to improve yak production is the deteriorating condition of rangelands and their declining productivity. This phenomenon is caused by several factors; the ban on fire (Forest Act, 1969) as a management tool to control invading shrubs like dwarf juniper and rhododendrons, the poor recycling of nutrients due to removal of dung for manuring crops and for fuel, and the continuous grazing by both yaks and wild ungulates like blue sheep. A policy change to allow controlled prescribed burning to reclaim some of the areas under shrubs will relieve pressure off the open meadows and reduce soil erosion. Better management of soil nutrients retaining and distributing the manure over the pasture will help replenish soil fertility and increase pasture production. Reorganisation of herders into User Groups to re-establish seasonal rotational grazing of pastures is recommended to control overgrazing. Of immediate benefit to the herders will be the establishment of intensively managed small plots of hay meadows using highly productive but non-aggressive exotic species of grasses and legumes, viz. Italian ryegrass, cocksfoot, tall fescue, red clover, crown vetch, milk vetch etc., together with the application of limited quantity of chemical phosphorus fertiliser and fencing to protect from uncontrolled grazing.

Genetic degradation of yaks is manifested in their decreasing size and productivity. This needs to be addressed through introduction of new bloodlines, if possible, imported from the Tibetan Autonomous Region of China, and through selective breeding. Breeding needs to be controlled by monitoring the movement of breeding bulls of different herds so that more accurate records of their progenies could be kept.

Gid and tick-borne diseases continue to be major causes of mortality in yaks especially in spring when they are in their

weakest condition. Adequate veterinary health coverage to control these diseases would go a long way in improving the health and productivity of the yaks. To this end, the services of a qualified and dedicated veterinarian would greatly strengthen herders' faith and confidence in government initiatives. Unfortunately, no veterinarians so far have ventured to take up this challenging and undoubtedly fulfilling assignment.

Yak products like meat, butter and cheese will continue to command premium prices in the local market for some time to come. However, to sustain the production in future, improved processing, preservation and marketing methods needs to be developed so that the market niche for yak products can extend beyond local consumers. Production of smoked meat, Swiss type of cheese and salted butter may already be carried out with minimal investment.

Finally, the future of yak rearing appears to be rather bleak if appropriate steps are not taken now. It would indeed be a pity if we allow yak rearing to cease as an occupation. Not only would our future generations be denied the sight of the magnificent and lovable yak gracing the dizzy heights of the Himalayan meadows, but a whole culture and tradition revolving around it will be lost.

Bibliography

Animal Husbandry Department (AHD), (1992). Review of Sixth Five Year Plan (1987-1992). Thimphu, Bhutan.

Caron, C.M. (1994). Society, Culture and Economy: The lifestyles and livelihoods of Jigme Dorji National Park's resident population. WWF, Thimphu, Bhutan.

Goldstein, M.C., Beal, C.M. and Cincotta, R.P. (1990). Indigenous nomadic pastoralism and ecological conservation

of Tibet's Northern Plateau. National Geographic Research 6:139- 156.

Gyamtsho, P. (1992). Review of Pasture Policy implementation under the High Altitude Area Development Project. AHD, Thimphu, Bhutan.

Harris, P.S. (1987). Grassland survey and integrated pasture development in the high mountain region of Bhutan. (TCP/BHU/4505(A) AHD/FAO, Thimphu, Bhutan.

Ives, J.D. and Messerli, B. (1989). The Himalayan Dilemma-Reconciling Development and Conservation. P 27 1. The United Nations University, Routledge London and New York.

Johari, R. (1993). Review of findings and recommendation of rapid socio-economic surveys conducted in and around Jigme Dorji Wildlife Sanctuary. WWF, Thimphu, Bhutan.

Li, C. and Wiener, G. (1995). The Yak. RAP/FAO 1995/25, Bangkok, Thailand.

LUPP (Land Use Planning Project (1995). LUPP Dzongkhag Data Sheets for Bhutan. Ministry of Agriculture, Thimphu, Bhutan

Magasch, A. (1990). Statische Masszahlen diagnostischer Zuchthygienemerkmale bei Yakkuhen in der Mongolei. Wiss. Zeitschrift der Humboldt-Universitat zu Berlin R. Agranviss 39:356- 366.

Miller, D.J. (1988). HLDP - End of Assignment Report. In: HLDP End of Assignment Report. AHD, Thimphu, Bhutan.

Miller, D.J. (1995). Herds on the Move: Winds of change among pastoralists in the Himalayas and on the Tibetan Plateau. ICIMOD, Kathmandu, Nepal.

MoA (Ministry of Agriculture), (1991). The Seventh Plan for the RNR Sector, Volume I and II. Thimphu, Bhutan.

MoA(1993). Draft Master Plan for Livestock Development, RGOB, Thimphu, Bhutan.

RGOB (Royal Government of Bhutan) (1980). The Land Act. Thimphu, Bhutan

RGOB (1969). Forest Act. Thimphu, Bhutan.

Robinson, P. (1994). Indigenous knowledge in yak/cattle cross breeding and management in high altitude Nepal. In: Indigenous management of natural Resources in Nepal (eds. Tamang, D.; Gill, G.J. and Thapa, G.B.)

pp. 140-148. HMG/Winrok International, Kathmandu, Nepal.

Sanford, S. (1983). Management of pastoral development in the Third World. John Wiley and Sons, London, UK.

Yu, S.J., Huang, Y.M. and Chen, B.X. (1993). Reproductive patterns of the yak. 1. Reproductive Phenomena of the female yak. British Veterinary Journal 149:579-583.