Constraints to Sheep Farming in Nepal: Development Challenge for Poverty Alleviation[a]

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ABSTRACT : The research was conducted to quantify farm and household characteristics of sheep farmers, evaluate farmer access to and the effectiveness of livestock services in sheep farming areas, and examine regional constraints to improving sheep productivity and profitability in Nepal. A rapid diagnostic socioeconomic survey of 200 sheep farmers was carried out in 1996 and all four ecological regions (Trans-Himalayan, Mountains, Hills and Terai), each with a distinct local sheep breed, were represented in the survey. Six major constraints were identified: (a) poor performance of local sheep breeds, (b) a serious seasonal deficit of pasture and other feed, (c) the lack of an organized market for wool and meat, (d) poor access to agricultural credit, (e) primitive shearing equipment, and (f) an inadequate supply of drinking water for sheep. Strategies to assist farmers develop their sheep management skills, improve access and quality of support services, improved technology adaptable to local conditions and effective linkages with local carpet and meat industry are likely to overcome the constraints and alleviate persistent poverty faced by sheep farmers in Nepal. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 8 : 1162-1172*)

Key Words : Sheep Farming, Production Constraints, Breeding, Household Characteristics, Nepal

INTRODUCTION

Sheep and wool production plays an important role in the Nepalese economy. Sheep are integral to the subsistence life of rural people; they provide a primary source of clothing and cash earnings, meat as a source of protein and manure for maintaining soil fertility. Official statistics indicate that Nepal has 0.6 to 0.9 million sheep, largely concentrated in the Mid-Western and Far-Western Development Regions (CBS, 1996). These sheep farming regions have relatively poor infrastructure (including roads) and are mostly isolated from major market centres. Sheep flocks range from 1 to 400 head and their management varies from migratory to sedentary. Most sheep are reported to be of one of the native breeds: Bhyanglung in the Trans-Himalayan, Baruwal in the Mountains, Kage in the Hills and Lampuchhre in the Terai region (Upreti and Shrestha, 1996). By international standards, productivity per sheep is very low, both in terms of body weight and wool production (Shrestha, 1996).

The Nepalese government and policy makers are seeking ways to revitalise sheep farming in order to support growth in the carpet industry which contributes more than 50% of total exports. Carpet manufacturers use very little domestic wool because it does not meet blend requirements. The supply of Tibetan wool, unlike that from New Zealand, the other major source of imports, has been erratic over the past five years and is dependent on a subsidised quota from the Chinese government. The Nepalese industry would encounter a major setback if this wool were not available on time. Nepalese farmers are therefore being encouraged to improve the management of local sheep so that they produce wool of suitable volume and quality for carpet manufacturing.

A pre-requisite to the preparation of a Government strategy to improve sheep and wool production is to obtain reliable data on current farm and household characteristics of sheep farmers, the effectiveness of livestock services in sheep farming areas, and regional constraints to sheep farm development. Other than anecdotal observations, this information is unavailable. This prompted the assessment of sheep farming in major sheep producing regions reported in this paper. The findings from this study will be important to all stakeholders in designing and developing an effective program for the sheep and wool sector in Nepal.

MATERIALS AND METHOD

Available statistics on sheep farming in Nepal were collected and reviewed (ADB, 1993; CBS, 1996). Brain-storming sessions were then held with scientists from the Nepal Agricultural Research Council (NARC) and the Department of Livestock Services (DLS) to identify major gaps in the data set. A personal

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Table 1. Household characteristics of sheep farmers in Nepal (1996)

Characteristic	District				Overall
	Mustang n=36	Jumla n=72	Kaski n=36	Banke n=56	n=200
Members per household (No.)					
Total male	2.9	4.9	3.7	5.3	4.4 (1.9)
Total female	2.9	4.9	3.1	4.8	4.2 (1.8)
Male (15-59 years age group)	1.2	2.6	1.9	3.2	2.4 (1.4)
Female (15-59 years age group)	1.2	2.7	1.4	2.9	2.2 (1.4)
Mean age of sheep farmers (years)	38	45	51	46	45.4 (12.4)[1]
Family members eating from the same kitchen (No.)					
Adult	3.8	5.5	3.1	6.1	4.9 (2.6)
Children	2.1	4.5	3.6	4.1	3.8 (2.0)
Household members engaged in sheep farming (No.)					
Full-time	1.2	1.4	1.0	1.2	1.2 (0.7)
Part-time	0.1	0.7	0.1	0.7	0.8 (0.5)
Children in school (No.)					
Male	0.6	0.8	1.1	1.5	1.0 (0.8)
Female	0.3	0.4	0.8	1.0	0.6 (0.7)

[1] Note: Figures in parentheses are standard deviations.

interview survey instrument, based on a participatory framework, was designed to collect these missing data from sheep farmers. This was pre-tested with five farmers and revised before farmer interviews were conducted. The field survey team consisted of three local experts: an animal scientist, a pasture scientist (NARC) and a district level livestock extension officer (DLO).

Each district headquarter for the DLS was visited and, in consultation with the district Livestock Services Officer (LSO) and field staff, a list of Village Development Committees (VDCs) was prepared where sheep are a major agricultural activity. The VDCs were ranked according to their estimated number of sheep and those with the greatest populations were selected for further study. The survey covered one VDC each in the Mustang (Trans-Himalayan region) and Kaski (Western Hill region) districts, two VDCs in Jumla (Western Mountain region), and three VDCs in Banke (Far Western Terai region). In each district, a sample was selected randomly from a list of sheep farmers held by the LSOs. Unfavourable weather, along with time and resource constraints, limited the sample size to 200 sheep farmers. They were interviewed between mid-January and mid-March 1996.

Farmers were interviewed at their homestead, at a DLS district or area level office, or at local market at a time and location that was convenient for the interviewees. Most interviews were conducted during the lean period of the day (evenings or lunch hours). Since farmers did not keep official farm records, responses were based on their recollection of events. The farmers responses reflect a single cross-sectional view of their status at the time of interview.

The completed questionnaires were reviewed each evening by the interviewers and where possible, discrepancies were resolved and answers checked for accuracy. Edited questionnaires were brought to New Zealand for data analysis, based primarily on descriptive statistics, using the SAS® computer analysis package (SAS, 1993).

RESULTS

Farm household characteristics

The average sheep farm household had 8.6 members (table 1). The Mustang district had the smallest household size (5.8 members) while households in Banke were the largest (10.1 members). Overall, economically active household members (15-59 years old) accounted for 53% of the household members. Nearly 94% of the adult members in a household were economically active. The dependency ratio (defined as the total household members divided by the household members in the 15-59 year age range) was greatest in Mustang (65%) and least in Banke (40%).

An average farmer was 45 years old. The Mustang farmers were on average 13 years younger than the Kaski farmers and 7-8 years younger than the Banke and Jumla farmers were. The overall literacy rate for the survey respondents was 20%. More than 90% of the households had at least one member engaged in full-time and 43% had at least one further member engaged in part-time sheep farming (table 1). Part-time employment in sheep farming was most prevalent in Banke and Jumla, due to their proximity to commercial centres and the availability of transport to other employment centres and least prevalent in the more remote Mustang and Kaski districts.

Table 2. Land ownership, land use and farm size distribution of sheep farmers (1996)

Attributes	District				Overall
	Mustang n=36	Jumla n=72	Kaski n=36	Banke n=56	n=200
Area (ha)					
Total land owned	0.35	0.44	0.74	1.65	0.82 (0.76)[1]
Total land cultivated	0.32	0.40	0.71	1.61	0.78 (0.76)
Total irrigated area	0.11	0.06	0.21	0.18	0.11 (0.20)
Area under paddy	-	-	0.20	1.49	0.46 (0.79)
Upland area	0.16	0.28	0.45	1.13	0.53 (0.66)
Uncultivated shrubland	0.01	0.02	0.05	-	0.02 (0.05)
Farm size distribution (% Respondents)	n=31	n=65	n=30	n=52	n=178
Landless	3	0	0	2	1
Less than 0.5 ha	84	74	40	6	50
0.5-1.0 ha	13	23	37	17	22
More than 1.0 ha	0	3	23	75	27

[1] Figures in parentheses are standard deviations; [2] Paddy is also planted under rainfed conditions in many cases.

Table 3. Livestock ownership by sheep farmers (1996)

Livestock type	District				Overall
	Mustang	Jumla	Kaski	Banke	
A. Sheep					
Rams	19 (8.6)[1]	3 (1.8)	1 (1.0)	1 (1.2)	5 (16)
Ewes	7 (7.0)	22 (18.4)	11 (11.3)	22 (19.3)	17 (15)
Male lamb	2.3	6.2	3.6	7.1	5.2 (4.9)
Female lamb	2.3	6.9	3.2	7.1	5.5 (5.0)
Castrated rams	3.2	2.0	-	-	1.3 (3.5)
Pack sheep	0.1	2.5	-	-	0.9 (2.7)
Total sheep	31	38	19	38	33
B. Goat					
Male	36.6	2.0	0.3	0.3	7.4 (21.7)
Female	15.1	9.2	1.0	2.4	6.9 (12.4)
Male kid	3.5	3.6	0.7	1.1	2.4 (3.4)
Female kid	4.1	4.3	0.6	1.3	2.7 (4.1)
Castrated goat	8.7	0.6	0.6	0.2	1.8 (12.0)
C. Large ruminants					
Male	1.3	2.3	1.9	2.8	2.2 (1.1)
Female	0.4	4.3	1.4	3.8	2.9 (2.5)
Young male	-	1.4	0.8	1.2	1.0 (1.0)
Young female	0.9	1.4	0.6	1.2	1.0 (1.1)
D. Horse					
Adult male	0.8	0.6	-	-	0.3 (0.7)
Adult female	0.9	2.0	-	-	0.9 (1.8)
E. Poultry	-	10.2	0.1	8.6	6.1 (6.8)

[1] Figures in the parentheses are standard deviations.

Farm characteristics

An average farm was smallest in the Trans-Himalayan region (0.35 ha in Mustang) and larger in the Terai (1.65 ha in the Banke district) (table 2). Nearly 95% of the farm area was cultivated, but only 13% of the farmers had access to irrigation. Paddy was the dominant crop in Banke (90% of the land area). Most (87% and 74%, respectively) farms in the Trans-Himalayan range (Mustang) and The Mountain region (Jumla) were 0.5 ha or smaller. A small percentage of respondents were landless in Mustang and Banke districts.

Livestock ownership was not limited to sheep: a variety of other animal species were farmed depending upon the agro-ecological environment (table 3). Rams were also used as pack animals in the Trans-Himalayan and Mountain regions (hence the larger ram to ewe ratio), but only for breeding purposes in the

Table 4. Breed structure and distribution of sheep per household in Nepal (1996)

Characteristic	District				Overall
	Mustang n=30	Jumla n=71	Kaski n=36	Banke n=56	n=193
Number of:					
a. Local ewes	7.9	19.9	1.0	22.1	15.2 (15.4)[1]
b. Improved ewes	-	1.9	10.2	-	2.6 (5.1)
c. Local rams	12.2	2.6	-	1.3	3.3 (7.0)
d. Improved rams	-	0.3	1.0	-	0.3 (0.6)
e. Local lambs	3.1	12.2	-	14.2	9.1 (10.2)
f. Improved lambs	-	0.9	6.5	-	1.5 (3.2)
Household with:					
a. Local breed	100	54	-	100	66
b. Improved breed	-	46	100	-	34
Age at first mating (months)	21.0	19.8	17.0	19.9	19.5 (3.9)
Lambing percentage (%):					
a. Local	84.2	77.6	87.9	76.3	80.2 (12.0)
b. Improved	-	73.6	88.3	-	84.8 (11.1)
Survival rate (%):					
a. After lambing					
- Local	95.2	94.2	96.8	96.0	95.4 (5.6)
- Improved	-	93.0	96.8	-	96.0 (2.6)
b. 1st four months					
- Local	86.7	75.6	70.3	84.4	78.3 (14.1)
- Improved	-	72.7	70.7	-	71.2 (15.8)

[1] Figures in the parentheses are standard deviations.

lower altitude areas (the Hills and Terai). The average flock size was larger in Mustang, Banke and Jumla (31, 37 and 48 sheep, respectively), than in Kaski (18). Goats were the other main type of other livestock owned in Mustang, but cattle and buffaloes, horses and poultry were common in Jumla.

Sheep attributes

Local breeds dominated the flocks in Mustang and Banke, but in Kaski exotic breeds had been used to establish crossbreeds. In Jumla 42% of the flocks had a Polwarth component and 4% of the flocks a Merino influence. A crossbred (Kage x (Border Leicester x Polwarth)) was used in all of the Kaski flocks. The age of ewes at first birth was nearly 20 months on average and there was relatively little variation across farms in flock performance parameters (CV=20%).

The live lamb to ewe ratio was between 60 and 65%, with a small non-significant variation in this performance parameter across districts. Most lambs were from single births. The lambing percentage was somewhat higher for the improved breeds in Jumla and Kaski, but the difference was not statistically significant (p=0.68). The 1996 situation reflected more or less a normal year for the farmers, except for a better lambing season.

The survival rate after lambing was claimed to be 93-96%: this was statistically similar for both local and improved breeds ($p<0.01$). However, in the first four months after lambing, the survival rate was somewhat greater in local than improved breeds (78% vs. 71%). The high mortality of lambs in the first four months was a major concern for most of the sheep farmers. The reasons for high post-natal mortality were multi-fold and included exposure to poisonous plants, lack of adequate feed and fodder, and inadequate attention to sheep health.

Sheep selection criteria used by farmers

The sheep selection criteria adopted by farmers varied widely across the four survey districts (table 5). These were largely determined by tradition and local market demand, and were subjective. Farmers in Mustang (Bhyanglung breed sheep) preferred heavier wool production (92%), a large body size (47%), strong legs/feet (31%) and a white fleece colour (19%) in their rams. These traits were consistent with the premium paid for the Bhyanglung wool produced in Mustang, which is identical to the Tibetan wool used in carpet manufacturing in Nepal. The Mustang farmers used four traits for ewe selection: good milker (36%), white wool colour (22%), strong body (6%) and good production (3%).

The Jumla farmers (Baruwal breed sheep), on the other hand, preferred rams with a large body size (85%), black colour (65%) and big horns (42%). The

Table 5. Criteria farmers utilise for ram (R) and ewe (E) selection in Nepal (percent respondents reporting)

Criteria/characteristics	District								Overall P values for chi-square statistics@	
	Mustang		Jumla		Kaski		Banke			
	R	E	R	E	R	E	R	E	R	E
Wool production	92	3	0	49	0	0	100	25	***	***
Big body size	47	0	85	0	0	0	68	45	***	***
Strong legs/feet/body structure	48	6	7	8	0	0	23	6	**	ns
Big horns/head/nose	6	0	51	1	100	0	33	2	***	***
Wool colour	19	22	0	12	100	100	25	13	***	*
Maternal behaviour/milking ability	3	36	0	36	0	97	0	8	ns	-
Good health	14	0	10	0	0	0	36	16	***	**

[1] ns means statistically not significant across the four districts.
***, ** and * represent p<0.01, p<0.05 and p<0.1, respectively.

Table 6. Months of severe feed shortage and pasture/supplement availability for sheep

Characteristics	District				Overall
	Mustang	Jumla	Kaski	Banke	
Trends in access to grazing between 1991 and 1996	n=30	n=70	n=36	n=56	n=192
Improved	-	-	-	-	-
Unchanged	3	67	67	64	56
Deteriorated	97	33	33	36	44
Reasons for deterioration in pasture access (% respondents)	n=15	n=20	n=13	n=35	n=83
Overstocking	58	17	33	14	27
Cultivation pressure	3	19	3	57	24
Dry monsoon	47	-	-	-	9
Bush removal for fuel wood	6	-	-	-	1
Feed shortage month (% respondents)	n=30	n=76	n=36	n=56	n=192
January	-	3	-	95	25
February	3	11	-	96	32
March	92	96	97	80	91
April	92	96	97	-	69
May	83	42	-	-	30
June	3	-	3	-	1
July	-	-	3	-	1
August	-	-	3	-	
September	-	-	-	-	1
October	-	-	-	4	1
November	-	-	-	16	5
December	-	-			
Use of supplements (% respondents)	n=27	n=68	n=36	-	
Yes (%)	33	96	100	-	
Months of feed supplement use (%)	n=36	n=72	n=36	n=56	
January	-	89	-	-	32
February	-	92	-	-	33
March	-	92	-	-	33
April	3	61	-	-	23
May	3	-	-	-	
November	-	3	-	-	1
December	-	8	-	-	3
Source of hay (% respondents)	n=31	n=70	-	-	
Communal land	23	81	-	-	32
Bond/terrace riser	55	3	-	-	10
Private land/own, cultivated land/own pasture	39	10	-	-	11

[1] a · denotes a value of less than 0.5.

preference of these farmers was guided by the utilisation of Baruwal wool in local rugs (radi, pakhi) and other woollen items (hats, caps, mittens, gloves, bags etc.). Wool production (49% of the respondents) and milking ability (36% of the respondents) were sought in the ewes. All of the Kaski farmers (Kage breed sheep) used big horns, white colour and a clean face as traits for selecting rams and wool color and milking ability were used to select ewes. Sheep farmers in the Banke district indicated that their ram selection decisions were guided by wool production and body size.

Sources of breeding rams and ewes

Three major sources of breeding ewes and rams were identified: own, government farms and neighbours or friends. Most farmers in Mustang (96%) and Jumla (99%), and all of the farmers in Banke bred their own flock replacements. In contrast, all but one farmer in Kaski sourced crossbred ewes from the Government farm. Only 3-4% of the farmers in Mustang and Jumla sourced rams from their neighbours and friends, preferring instead to use their own sires. However, one-third of the Jumla farmers and only one Kaski farmer purchased rams occasionally from the Government farms.

Sheep nutrition

In Mustang sheep grazed on rangeland and had some access to fallow crop fields (table 6). In Jumla, depending on the seasonal availability of pasture, rangeland, forests and crop fields provided the major sources of feed for sheep nutrition. Kaski and Banke farmers, on the other hand, relied exclusively on access to public forests/grazing land and fallow crop fields for sheep feed. Few farmers in Jumla also depended to some extent on a small area of forage crops that had been established on private farms for sheep feed. No recent tangible efforts to develop pasture and rangeland in the survey districts were reported.

Access to public grazing land has remained either unchanged or deteriorated since 1991. The deterioration in the availability of public grazing was most pronounced in Mustang where 97% of the farmers reported reduced access to rangeland. About one-third of farmers in the three other districts shared a similar view.

Farmers faced a serious feed shortage during March to May in Mustang; March to May in Jumla; April and May in Kaski; and January to March in Banke (table 6). Harsh winter weather and associated poor pasture growth, in conjunction with problems with rangeland and pasture management, were responsible for feed shortages in Mustang and Jumla, while unavailability of fallow land and restrictions on grazing in forests contributed to the feed shortages in the Kaski and Banke districts.

Almost all of the sheep farmers in Jumla and Kaski and one-third of the sheep farmers in Mustang used feed supplements for their flock (table 6). Feed supplements were primarily used to mitigate the winter feed deficit experienced in the respective regions. Farmers obtained hay from communal grazing land, bond/terrace rises and privately owned or cultivated land. Use of private land for this purpose was relatively more common in Mustang than in Jumla.

Diseases and parasites on sheep farms

The prevalence of sheep diseases and parasites varied with the geographical location of farms and the surrounding agro-ecological conditions (table 7). Nearly two-thirds of the farmers reported pneumonia and more than half of the farmers indicated the occurrence of diarrhoea in their sheep.

Liver fluke was the major parasite problem of sheep in all four districts: Jumla (99%), Banke (98%) and Mustang (78%). The presence of mange mites was cited by two-thirds of the farmers in all but the Kaski districts. Round worm, lice and tick were endemic in Mustang. The prevalence of lice and tick was associated with the once-yearly shearing policy adopted by farmers in Mustang. Other sheep parasites encountered by the respondents were tapeworm in Jumla and Banke, round worm in the other districts, and lice and ticks in Banke.

Most of the farmers in the more accessible regions (for example, Kaski and Banke) and only half of the farmers in the Mountain region (Jumla) had treated their sheep with veterinary medicines, but only one of the 36 farmers from the Trans-Himalayan region (Mustang) used veterinary medicine. Interestingly, 31% of the farmers in the Mountain region (Jumla) used *cannabis sativa* to treat sheep diseases. This practice is an ancient local tradition used by farmers, although the medicinal value of the plant in sheep is not scientifically established. Some farmers in Mustang and Jumla applied Neblon®, other local herbs or Himax® to treat various sheep ailments. Farmers were often unable to describe the specific treatment method they had adopted to treat parasites. Their responses included veterinary medicine (type of medicine unknown), Cyothin®, Tetzan®/Nilzam® and local herbs. Due to the remoteness from outlets for veterinary medicine, local herbs (names not known) were used by 31% of the farmers in the Trans-Himalayan region (Mustang). Cyothin® was used by half of the farmers in Jumla and Banke, while slightly more than two-thirds of the farmers in Banke also used Tetzan® or Nilzam®. Most of the treatments were adopted as a curative rather than a preventive measure.

Table 7. Major diseases and parasites prevalent of sheep farms and treatment methods adopted (Percent respondents reporting)

Disease/parasite	District				Overall
	Mustang	Jumla	Kaski	Banke	
Disease					
Pneumonia	56	58	97	59	65
Diarrhea	36	69	-	80	55
Foot rot/abscess	-	69	97	23	53
Sheep pox	-	35	-	13	13
Foot and mouth rot	22	13	-	7	5
Brisket rot	-	-	-	2	6
Wart/Eczema	-	-	-	-	3
Other	-	6	-	-	2
Parasites					
Liver fluke	78	99	10	98	95
Mange mites	67	67	-	70	51
Round or tape worm	14	10	3	9	9
Lice and ticks	28	-	-	44	6

Table 8. Availability of extension and veterinary services for livestock in sheep farming areas

Indicator	District				Overall
	Mustang	Jumla	Kaski	Banke	
Availability of extension and vet. Services	n=34	n=72	n=36	n=56	n=200
Responding Yes (%)	24	56	100	77	64
Distance to vet. Service	n=26	n=34	n=35	n=53	n=150
Mean (km)	6.0	1.8	4.9	2.5	3.5
Std. dev.	(2.0)	(0.9)	(2.6)	(0.9)	(2.3)
Mean (hrs)	1.7	0.9	0.5	1.0	1.0
Std. dev.	(0.6)	(0.7)	(0.1)	(0.5)	(0.5)
Payment required for vet. Service	n=27	n=51	n=36	n=53	n=167
Responding Yes (%)	22	41	100	96	71
Amount required for payment	n=4	n=6	n=36	n=51	n=97
Mean (Rs)	25	25	81	50	59
Std. dev.	(-)	(-)	(3)	(8)	(19.4)
No. of visits in the past 12 months	n=27	n=51	n=36	n=54	n=168
Mean	0.11	1.18	0.97	0.73	0.80
Std. dev.	(0.32)	(0.71)	(0.17)	(0.69)	(0.7)
No. of paid visits in the past 12 months					
Mean	0.11	0.61	0.97	0.63	0.60
Std. dev.	(0.32)	(0.72)	(0.17)	(0.59)	(0.60)

Causes of sheep death in Nepal

Sheep feeding on poisonous plants (names unknown) was identified as the leading cause of sheep death in Jumla (64%), Kaski (97%) and Banke (45%). Farmers in Mustang (50%) and Jumla (47%), the high altitude regions, experienced ewe losses through malnutrition and this also contributed to low milk production by ewes. One in nine farmers in Mustang also experienced difficulties with predators (wild animals) and some farmers in Mustang (3%) and Jumla (8%) had encountered poaching problems.

Veterinary services for livestock

Nearly two-thirds of the farmers interviewed knew that a veterinary service for livestock was available in their area (table 8). However, the availability of such services varied widely across the four districts (24% of farmers in Mustang, 56% in Jumla, 100% in Kaski and 77% in Banke). This result was consistent with the inverse relationship between the availability of

Table 9. Wool harvesting in Nepal (1996)

Indicator	District				Overall
	Mustang	Jumla	Kaski	Banke	
Shearing frequency and wool staple length (cm)	n=33	n=70	n=35	n=55	n=193
1st shearing	13.0	10.8	8.0	10.2	10.5
(n=191)	(1.4)	(1.4)	(-)	(1.1)	(1.9)1
2nd shearing	-	10.5	9.0	8.3	9.5
(n=161)		(1.8)	(-)	(0.9)	(1.6)
3rd shearing	-	-	-	8.4	8.4
(n=56)				(1.0)	(1.0)
Tools used for shearing	n=29	n=65	n=35	n=56	
a. Sickle	14	10	-	5	
b. Scissors	-	56	-	23	
c. Khukuri	-	2	-	27	
d. Local knife	14	-	100	59	
Wool yield (kg/sheep)					n=194
1st shearing	1.4	0.4	0.1	0.4	0.5
(n=190)	(0.21)	(0.05)	(0.03)	(0.04)	(0.4)
2nd shearing	-	0.4	0.2	0.3	0.3
(n=154)		(0.15)	(-)	(0.05)	(0.1)
3rd shearing	-	-	-	0.3	0.3
(n=53)				(0.05)	(0.1)
Time of shearing (month)	n=33	n=71	n=36	n=100	
March	-	1	97	-	
April	3	97	3	-	
May	-	1	-	100	
June	36	-	-	100	
September	58	97	97	-	
October	3	3	3		
Total wool produced/farmer (kg)	n=33	n=63	n=35	n=55	n=186
	26.2	23.8	3.9	20.0	19.3
	(19.3)	(23.9)	(2.3)	(11.7)	(18.9)
Proportion of wool used at home (%)	51	65	-	15	31
	(45)	(35)	(-)	(21)	(38)

[1] Figures in parentheses are standard deviations.

services and the degree of remoteness of the farms. The sheep farmers indicated that on average the service centre was located about 3.5 km from their homestead, equivalent of about one hour travelling time. The distance to veterinary services should be interpreted with caution however, as it is a relative measure based on farmer perception rather than physical measurement. Almost all of the farmers had to walk to the veterinary centre. Veterinary staff generally charged directly for veterinary medicine or prescribed its purchase from private shops. The user fee for services varied across the four districts (Rs 25 in Mustang and Jumla, Rs 50 in Banke and Rs 81 in Kaski per sheep). Farmers incurred an additional cost for prescribed medicines.

Wool harvesting

Shearing per sheep each year varied with the agro-ecological conditions (table 9). In the Trans-Himalayan range (Mustang), where there are harsh winter and dry monsoon seasons, sheep are shorn only once in a year. The majority of the farmers (58%) in this region shore in September, prior to the onset of winter, and slightly more than one-third of the farmers shore in June. In the Mountain and Hill regions, (Jumla and Kaski) farmers had adopted a twice-yearly shearing policy. Almost all shearing was undertaken in March (Kaski) April (Jumla) and September (both districts). The Terai (Banke) farmers, due to hot weather, shore their sheep three times each year (April, June and September). Four major reasons were given for a multiple shearing policy: to prevent shedding (Jumla), to harvest more wool (Jumla), to keep sheep comfortable(Jumla and Kaski) and to follow tradition (Banke).

Farmers used very traditional tools to remove wool from sheep: sickles (Mustang, Jumla and Banke), scissors (Jumla), and khukuri (Gorkha knife) (Jumla

Table 10. Problems faced and solutions suggested by sheep farmers in Nepal (1996)

	District				Overall Chi-square (P level)
	Mustang	Jumla	Kaski	Banke	
Problems faced					
Lack of market	25	61	97	40	57***[1]
Access to agricultural credit	17	65	100	25	52***
Undeveloped pasture land	11	22	-	21	16**
Poor performance of local breeds	72	15	97	77	58***
Over cultivation	-	14	-	7	7**
Shearing equipment	31	1	3	4	8***
Drinking water for sheep	14	-	-	-	3**
Solutions suggested					
Create an organized market for wool	3	46		39	28***
Provide credit from Agricultural Development Bank/Nepal	8	42		23	16**
Develop pasture land	44	14		77	35***
Improved breeding service	-	11		4	5**
Reduce over cultivation	-	3		2	2 ns
Provide reliable veterinary services	25	7		4	8**
Provide subsidized transport for wool	3	7		-	3**
Controlled grazing under sedentary system	-	1		13	4***
Provide access to drinking water for sheep	36	-		-	7***
Organize seasonal grazing permit for pasture in China	8	-		-	2***
	17	-		-	3***

[1] NS = Not significant, * p<0.1, ** p<0.05, *** p<0.01 across the four districts/ecological zones.

and Banke). The most popular tools were the local knife (Mustang, Kaski and Banke) and scissors (Jumla). Shearing often involved at least two people and took 2-4 hours per sheep.

An average sheep in Mustang provided the highest wool yield (1.4 kg/sheep) compared to 0.8 kg in Jumla, 0.3 kg in Kaski and 1.0 kg in Banke. The average wool yield per sheep for the four districts was 1.1 kg. Wool staple length was longest in Mustang (13.0 cm) and shortest in Kaski (8.0 cm). The longer staple length of wool from Mustang was associated with the local once-yearly shearing policy.

Constraints reported by sheep farmers

Almost all farmers in Kaski and nearly three-fourths of the farmers in Mustang and Banke expressed concern about the low productivity of the local sheep breed (table 10). Under-development of pastureland and cultivation of marginal lands were expressed as the primary concern of farmers in terms of sheep feeding. Farmers were concerned about the increased time involved, particularly for women, to collect fodder during the peak feed deficit periods. The pasture available for sheep was of both poor nutritional value and low dry matter productivity. Furthermore, farmers with large ruminants dominated community forestry programs and hence sheep farmers had problems in accessing grasses and other fodder from these forests.

As sheep and wool production is largely concentrated in remote areas, the lack of markets for both live sheep and wool was one the major problems mentioned by farmers. Prohibitive transport costs, lack of knowledge about buyers, poor or no market signals for price and demand, exploitation by middlemen and the small quantity of wool produced per farm collectively, all contributed to farmers experiencing problems in marketing their sheep products.

Farmers had insufficient capital to upgrade their sheep flock by purchasing superior ewes and rams. They also could not borrow from a commercial or the Agricultural Development Bank because they had been practicing a migratory sheep grazing system. Lack of collateral was one of the major issues in obtaining access to credit. In addition, farmers also were located too far (several hours walk) from the banks. One area for which credit was required was for the installation of a water supply for sheep: one in seven Mustang farmers faced an acute water problem in the area.

Nearly one-third of the farmers in Mustang reported that the lack of proper shearing equipment meant wool harvesting was very time consuming. In addition, they had to leave a fair amount of wool on sheep to protect them from serious skin cuts.

Solutions proposed by farmers

Farmers specified a number of ideas to alleviate most of the problems they faced in sheep farming

(table 10). Development of pasture land, controlled grazing under a sedentary flock environment, Government initiatives at a senior level to organize seasonal grazing permits for pasture in Tibet and the provision of reliable services to support sheep farming were actions proposed by the farmers in Mustang. Creating an organized market for wool, providing agricultural credit for sheep farming and developing pasture land were areas in which the Jumla and Banke farmers wanted to see improvements. Farmers in Kaski did not provide any suggestions on resolving problems.

DISCUSSION

Major sheep and wool production regions in Nepal are poorer than other parts of the country in terms of physical, human and capital resource endowments (ICIMOD, 1997). The regions are characterised by the high illiteracy (80% sheep areas vs. 65% nationally), smaller landholding size (one-third smaller than the national average), larger household size (one-fifth larger than national average) and lack of tangible income generating opportunities (CBS, 1998; ICIMOD, 1997).

Farming in the region is primarily subsistence agriculture and households engaged in sheep and wool production tend to have little choice other than being somehow engaged in sheep farming. Sheep farming in Nepal has suffered in the past 30 years (sheep population declined by more than 50% (CBS, 1996)). Several factors contributed to this outcome and primarily can be summarised in terms of large variation in flock size, dominance of indigenous breeds across and within regions, poor infrastructure, restricted grazing land and/or fodder access, remote location and lack of effective support services for sheep farming. Some of the problems identified in this study are consistent with an earlier study (Shrestha, S., 1996).

Heavy in-breeding, low average lambing percentage, low live lambs birth to ewes ratio and mostly single births reflect poor productivity in Nepal compared to Western countries (Upreti, 1995). Poor veterinary services and lack of trained staff and technical know how in local farming community tend to limit farmers ability to objectively measure capabilities of breeding ewes and rams; thus limiting breeding material selection solely based on subjective visual attributes. Unavailability of externally sourced rams and ewes along with poor extension service have been limiting factors in increasing genetic potential of local breeds. This presumably reflects the very low level of crossbreeding, as well as a lack of knowledge on the part of farmers concerning sheep breeding policies and inadequate sheep nutrition.

The introduction of exotic breeds to Nepal, to date, has been very much on an *ad hoc* basis. Live sheep have been introduced from Australia, UK and New Zealand. The status of individual crossbred at the farm level and their genetic composition is unknown because of the high level of inbreeding, even in crossbred flocks.

Lack of pasture management skills and poor co-ordination of feed demand and supply are the primary reasons for sub-standard feed management on most of the sheep farms (Gavigan, 1995). In addition, access to public grazing land has deteriorated since 1991 due to restricted access to public forests, community forestry schemes and other land management programs. More specifically, over-stocking and dry monsoon seasons were cited as the main reasons for deterioration in access to public rangeland in Mustang, while cultivation pressure on marginal lands and over-stocking of cattle and small ruminants were primary problems associated with access to common grazing land in Jumla, Kaski and Banke. No tangible efforts are taking place in Nepal to develop local pasture and rangeland for sheep grazing. Farmers experienced periods of serious feed deficits for their sheep and were attempting to cope with these by feeding hay, and when available fodder tree leaves, twigs, and grazing in forests. In many cases, coping strategies were not sustainable and not necessarily provided better returns and even led to feeding on poisonous plants leading to sheep death.

Wide variation in the availability of such extension and veterinary services across the four districts with an inverse relationship between the availability of services and the degree of remoteness of the farming location. Sheep are apparently often given a low priority by livestock extension staff and veterinarians. Livestock treatments are often adopted as a curative rather than a preventive measure as and when farmers were able to afford to provide for.

In summary, six major constraints to sheep farming in Nepal were identified: (a) poor performance of local sheep breeds; (b) a serious seasonal deficit of pasture and other feed; (c) the lack of an organized market for wool and meat; (d) poor access to agricultural credit; (e) primitive shearing equipment; and (f) an inadequate supply of drinking water for sheep. These constraints are consistent with the anecdotal evidence available prior to the rapid diagnostic survey.

IMPLICATIONS

The study provides major implications for sheep and wool industry in Nepal. The quality and volume of sheep meat and wool production can be increased several folds from the current levels but future developmental activities in the areas studied calls for a collaborative approach from all stakeholders including

farmers, government policy institutions, Nepalese carpet industry and NARC. Immediate attentions required include efforts to develop management practices and technologies introduce them to mitigate or remove these constraints. This is a significant challenge to NARC and DLS to work together towards a common goal in assisting sheep farmers out of poverty trap. Second, non-formal education programs should be implemented to raise their awareness of the technologies and to help them develop and implement solutions, which will best meet their local needs and circumstances. Third, efforts are required in linking producers in remote areas and carpet industry (largely concentrated in the Kathmandu Valley). This can be facilitated by development of sheep producer cooperatives as a link server between small producers and the industry. Fourth, efforts are required to educate farmers in culling unproductive sheep, increasing breeding potential in local sheep by artificial insemination and minimizing in-breeding, improving sheep health and nutrition.

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