Annexes

Annex 1: **Human Densities on Cultivated Land and Livestock Stocking Densities in the Field Study Districts of Nepal**

Parameter	Nepal District Average	Kaski District	Parbat District
Human numbers per hectare of cultivated land	6.6	7.9	7.7
LSUs per hectare of agricultural, forest and grazing land (indicator of pressure on aggregate feed resource)	0.90	1.42	1.64
LSUs per hectare of forest and grazing land (indicator of pressure on CPR)	0.84	1.33	1.62
Number of buffaloes per hectare of cultivated land	1.19	1.64	2.67

LSUs = Livestock units

Annex 2: **Distribution of Human and Livestock Pressure across the Hill Districts of Nepal**

District	Human pressure per hectare of cultivated land	Human density per sq km	Livestock pressure on cultivated land *(average number of livestock per hectare of cultivated land)*		Livestock pressure on forest and shrubland (average number of livestock per hectare of *forest and shrubland)*	
			Buffalo	Cattle	Buffalo	Cattle
Parbat	7.7	291	2.67	2.11	2.49	1.96
Kaski	7.9	145	1.64	1.46	0.67	0.60
Dolakha	5.9	79	1.17	2.60	0.36	0.81
Solukhumbu	4.5	29	0.93	2.01	0.19	0.41
Rasuwa	5.8	24	2.52	3.67	0.31	0.44
Dadeldhura	5.4	68	0.98	3.56	0.16	0.59
Kalikot	5.6	51	1.12	3.54	0.17	0.53
Myagdi	5.2	44	1.82	3.07	0.42	0.70
Taplejung	4.4	33	1.16	2.68	0.23	0.53
Bajhang	5.1	41	1.15	3.52	0.28	0.84
Surkhet	6.2	92	0.94	3.41	0.19	0.69
Sankuwasabha	4.4	41	0.92	2.53	0.00	0.14
Udaypur	6.3	107	0.81	3.07	0.21	0.78
Panchthar	4.3	141	0.68	1.54	0.49	1.10
Darchula	6.3	44	2.06	4.81	0.42	0.97
Ilam	5.1	135	0.51	2.00	0.24	0.93
Salyan	5.3	124	0.70	4.08	0.30	1.76

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Annex 2: **Distribution of Human and Livestock Pressure across the Hill Districts of Nepal** (cont'd)

District	Human pressure per hectare of cultivated land	Human density per sq km	Livestock pressure on cultivated land *(average number of livestock per hectare of cultivated land)*		Livestock pressure on forest and shrubland (average number of livestock per hectare of *forest and shrubland)*	
			Buffalo	Cattle	Buffalo	Cattle
Dhankuta	4.4	164	0.65	2.37	0.60	2.15
Syangjha	7.8	252	2.89	3.01	3.44	3.59
Dhading	6.3	144	2.00	2.99	0.95	1.43
Baglung	7.2	130	2.44	2.41	0.84	0.83
Argakhanchi	7.5	152	2.81	2.40	0.93	0.80
Palpa	6.5	172	2.13	2.39	1.09	1.23
Dailekh	5.3	125	1.30	2.54	0.59	1.15
Gorkha	6.1	70	1.55	2.11	0.57	0.78
Baitadi	6.4	132	2.10	3.42	0.84	1.37
Kabhre	8.9	232	1.83	2.93	0.90	1.44
Khotang	4.6	136	1.32	2.11	0.78	1.25
Gulmi	8.5	232	2.63	2.52	1.98	1.91
Tanahun	6.7	173	1.44	2.70	0.68	1.28
Accham	5.0	118	1.45	2.41	0.65	1.08
Ramechap	4.7	122	1.39	2.12	0.84	1.28
Rukum	5.5	54	1.82	3.21	0.93	1.63
Pyuthan	6.2	134	1.81	3.07	0.70	1.19
Lamjhung	5.3	91	1.67	2.57	0.57	0.88

Annex 3: **Livestock Production and Management in a Subsistence Mixed Crop-Livestock Farming System**

Livestock Class	Main Uses	General Management System	Specific Phase	Specific Feeding Strategy	Quality of Nutrition
Cattle	Traction, milk, manure	Rainy Season Stall fed with cut and carry green grass and field weeds	Dry Cattle	Crop residues and grasses: no feed grains	Sub-optimal
			Bullocks at work	Some kundo (cooked feed grain), crop residues and green grasses	Near-optimal
		Winter A few hours of grazing during the day, stall fed crop residues in the evening	Lactating cows	Crop residues and green grasses, kundo twice daily	Near-optimal
Buffalo	Milk, meat, manure, traction	Summer Short hours of grazing, stall-fed cut-carry green grasses and field weeds	Dry buffaloes	Crop residues and grasses: no feed grains	Sub-optimal
			Lactating buffaloes	Crop residues and green grasses, kundo twice daily	Near-optimal
		Winter A few hours of grazing during the day, stall fed crop residues in the evening			

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Annex 3: **Livestock Production and Management in a Subsistence Mixed Crop-Livestock Farming System**

Livestock Class	Main Uses	General Management System	Specific Phase	Specific Feeding Strategy	Quality of Nutrition
Goats	Meat, manure	Summer Short hours of grazing and stall feeding Winter Grazing on fallow lands, roadsides, and water canals	Adult goats	Tree fodder, green grass	Sub-Optimal
			Young goats	Tree fodder, green grass, and some grains	Near-optimal
Sheep	Meat, manure	Grazed all year round		Green grasses, crop residues (when not grazed)	Sub-optimal
Swine	Meat	Stall fed all year round		Kitchen waste, some grains	Near-optimal
Poultry	Meat, eggs	Scavenging all year round		Some grains	Sub-optimal

Source: Adapted from Tulachan (1989 and1994)

Annex 4: **Milk Hauling Distances for Milk Collected from Different Areas around Parbat to Kusma Chilling Centre**

Place:	Milk Chilling Centre; Kusma	Means of transport:	porters (35)
Person in charge:	Abadh Kumar Jha	Officals:	2
Established:	May 16 2052 BS	Cooperative associations:	5
Capacity:	3,000 litres		

Cooperatives	Distance	Amt.of milk	# farmers	% from cow	% from buffaloes
Jyadi	1 hr walking distance	240	150	100	
Patichaur	Bus 10km	132	100	100	
Laxmi	1½ hrs w.d., ½ hour bus	40	50	50	50
Laleswor	½ hour bus	81	55	40	60
Phalebas	3 hrs w.d.	106	85	75	25
Gahatepokhara	2 hrs w.d.	65	45	60	40
Devisthan	2½ hrs w.d.	38.5	20	100 (mixed)	100
Kurgha	4 hrs w.d.	42	31		100
Namuna	½ hr bus, 1½ hrs w.d.	29	35	50	50
Deurali	5 hrs w.d.	8	5		100 (local)
Shivalaya	2½ hrs w.d.	50	35		100

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Annex 4: **Milk Hauling Distances for Milk Collected from Different Areas around Parbat to Kusma Chilling Centre**

Cooperatives	Distance	Amt.of milk	# farmers	% from cow	% from buffaloes
Janahit	4½ hrs w.d.	16	12		100
Atmairbhar	3 hrs w.d.	41	40	60	40
Fedi	3 hrs	30	225	40	60
Janabikash	3½ hrs	9	5		100

w.d = walking distance

Annex 5: **Ecological Dimensions of Sustainability Related to Livestock, Himachal Pradesh**

I. Micro-Level Indicators from the Transformed Areas

	Indicators	Process of Change and Implications
1.	Decline in the livestock population	The decline in the livestock population per household, along with the complete switchover to stall feeding, has reduced the pressure on natural resources. The quality of livestock has also improved, leading to higher yields. These changes augur well for the ecology and environment of the area.
2.	Abandoned land	There is no abandoned land; in fact every inch of land is used. Marginal and steeply sloping lands have been brought under apple cultivation.
3.	Land under irrigation	Almost all the land is under irrigation. The irrigation scheme is functioning well and is managed by the Department of Irrigation and Public Health.
4.	Water from natural sources	There is no perceptible change in the amount of water available from natural water sources. In fact, the pressure on these sources has lessened because of the provision of piped water to all villages.
5.	Frequency of landslides and soil erosion	There is no visible increase in the frequency and intensity of landslides. Apple cultivation has helped to check landslides and soil erosion. The cropping intensity has declined. The orchards have thick grass cover which protects the soil.
6.	Support land	The amount of support land in terms of pasture and grassland available per hectare of agricultural land has declined to 0.11 hectares.

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Annex 5: **Ecological Dimensions of Sustainability Related to Livestock, Himachal Pradesh**

II. Micro-Level Indicators from the Non-transformed Areas

	Indicators	Process of Change and Implications
1.	Decline in the livestock population	The livestock population has declined over time. Milk production has also declined for two reasons. First, because of the decline in grazing land and the availability of fodder; and second, because of the low quality of livestock.
2.	Abandoned land	There is no abandoned land.
3.	Land under irrigation	There is no irrigation.
4.	Water from natural sources	There has been no perceptible change in the amount of water available from natural sources.
5.	Landslides and soil erosion	There has been no noticeable increase in the intensity and frequency of landslides and soil erosion, thanks to the measures adopted by the farmers, e.g., terracing, bunding, and avoiding cultivation on steep slopes.
6	Support land	The amount of support land in terms of pasture and grassland has declined over time. One hectare of agricultural land has 0.45 hectares of support land, which is much less than desired. It is, however, much higher than in the transformed areas.

Source: Sharma (1996)

Annex 6: **Changing Links to CPRs in Areas of Transforming Animal Production Systems**

Change Parameters	Subsistence Production System	Transforming to Semi-commercial Systems and New implications for linkages to CPRs
Herd size	Stagnant (more or less)	Getting Smaller Less of animals per household and per unit area of natural resource base.
Feeding management	Combination of grazing and stall feeding	Increasing cases of exclusive stall feeding. Use of external inputs (concentrates) Linkages to CPR weakening, due to decrease in total reliance on forest/grazing land
Quality of animals	Low yielding local breed, with relatively more of them in the herd compared to semi-commercial systems	More improved breeds kept, e.g., improved buffaloes replacing local cattle or improved cows replacing local cows Improved milch buffaloes are not grazed for fear of losing milk output. Animals are stall-fed and need quality feed (concentrates); increasing external input thus decreases reliance on CPRs.
Diversification	No diversification. Farming systems composed of traditional food grain production with typical livestock component (local cattle, local buffaloes, goats/sheep).	Becoming more diversified. High-value crops, such as vegetables and fruit, generate more income than solely relying on traditional food crop/livestock production. Income from these options gives farmers an incentive to reduce the number of livestock. Such income also makes the purchase of external inputs (concentrates) affordable, needed to sustain high yielding animals. Livestock Pressure on CPR weakened

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Annex 6: **Changing Links to CPRs in Areas of Transforming Animal Production Systems**

Change Parameters	Subsistence Production System	Transforming to Semi-commercial Systems and New implications for linkages to CPRs
Draught animals	Numbers decreasing, practice of sharing/ hiring becoming common	Numbers decreasing. Horticulture is replacing field crops, tillage requirements are decreasing (HP) Fewer draught animals result in reduced pressure per unit resource base. Also, less tillage results in less erosion
Human labour	Decreasing. Out-migration/ seasonal migration for off-farm employment, increasing commitment to send children to school is having the overall effect of reducing human labour available for keeping livestock (feeding, grazing, fodder grass, and collecting leaf litter). Labour constraint limits expansion of herd size even if feed resources (for some) are unlimited. Weakening impact on natural resources due to less head of livestock	

Annex 7: **A Day in the Life of Phul Maya Thingsa, a 17-year old Tamang Girl**

AM

6:00	Woke up and left for the mill to grind corn
7:15	Returned from the mill
7:20	Morning wash, cleaned and prepared buffalo shed
7:45	Rested and watched the morning dairy crowd
8:20	Cut corn stalks for the buffalo
8:45	Rested beside fire and ate leftover rice
9:15	Left for private *pakho* (upland)
10:30	Began collecting fodder

PM

12:30	Brought fodder home
12:40	Went into hut and cut corn stalks for buffalo
1:15	Fed fodder to buffalo
2:00	Sat down to eat lunch of rice and curry
2:15	Washed plate and other dishes
2:20	Mixed pre-packaged buffalo feed in lukewarm water and fed buffalo, Put out fodder for goats
2:50	Left for Paribas (government) forest
3:50	Arrived and started looking for fuelwood
5:15	Arranged fuelwood sticks into a bundle and began walking home
6:00	Arrived home and milked buffalo
6:30	Prepared dinner

Annex 7: **A Day in the Life of Phul Maya Thingsa, a 17-year old Tamang Girl**

7:15	Ate dinner
7:30	Washed utensils
8:00	Started shelling corn
9:30	Finished shelling corn, left it to dry for next day. Began cutting corn stalks for next day's buffalo feed.
10:15	Rested, had cigarette
10:30	Went to sleep

Source: Bhatt *et al.* 1994

Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
1. Population Growth	↑	• More demand for milk, meat; high pressure on both private and common land • Greater pressure for resources needed for livestock management • Demand for livestock products may increase and also may increase as income generation activity. • Reduction in feed availability for livestock • If the purchasing power is not high, livestock development may go down. • Difficult to manage because of feed scarcity
2. Land Fragmentation	↑	• Decrease in number of draught animals required per farming family • Increased livestock pressure per unit of land • Challenge to meet fodder/ feed demand or must buy concentrate feed • Difficult to raise improved livestock
3. Farm Size	↓	• Pressure of livestock on farmland • Need to manage fodder/ feed demand from both economic and sustainability aspects • Difficulty in raising large ruminants • Feed scarcity due to decrease in support land and cultivated land
4. Livestock Holding	↓	• Declining soil fertility, draught power, reduced interdependent LS systems-transhumance benefitting lowland farmers • Emphasis on commercialisation • Promotion of productive animals • Better health care, feed availability • Because of land fragmentation (small land sizes), high pressure

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
5. Cropping Intensity	↑	• Possible increase in crop residues but reduced time for *in situ* manuring • More feed (by-products) for animal feeding • More cash crops should be grown • Promote crops with high fodder/forage value • Need more manure therefore better FYM management, check losses of nutrients in system
6. Land Use Pattern	◆	• Likelihood of increased conversion to agricultural land; double/ triple cropping, reduced winter pasture for migrant herds • Seek balance from the perspective of sustainable feed availability-livestock productivity • Changes in land use pattern due to stall-feeding practices
7. Crop Diversification	↑	• Attempt legume integration to increase livestock protein intake • Legumes contribute to sustainability • Less time for livestock management • Only near market areas • Less availability of traditional feed, more use of concentrate feed, less animals/HH

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
8. Draught Power Requirement	↓	• Will release resources for other livestock production • Surplus cattle may increase and have an effect on management strategies • Perhaps not in all areas • Cropping intensity increased • Requirement for draught power may increase or decrease depending upon type of farming system, need for draught power also decreases with mechanisation
9. Livestock Contribution to Farm Economy	↑↓	• Where? Horticultural areas decrease, dairy areas increase • Increase in commercialisation — a positive development • Complex — depends on type of livestock, prevailing market prices, market facilities, etc • This is increasing in actual terms • Promote complementary and supplementary activities • An increase in contribution would help better management as livestock would be seen as economically worthwhile

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
10. Use of CPRs Control of CPRs by Community	↓ ↑	• User groups to be encouraged/strengthened • Enabling policy environment is required for community forestry development • Balanced means of harvesting fodder/feed from CPRs without degrading them is a challenge • Environment improved • More intensive management of livestock and replacement of cattle by buffaloes
11. Soil Fertility	↑↓	• Triple cropping system can decrease fertility but fertility on *khet* has increased. • On average, soil fertility is decreasing. • Soil fertility is decreasing due to insufficient/ improper nutrient supplementation • Legumes to be incorporated into cropping systems • We may have to attempt FYM management and improvement • Stall feeding should be promoted so fertilizer is not lost when grazing • Soil fertility declining which results in less production of quality fodder and crop residue
12. Use of Private Land for Fodder Supply	↑	• Commercialisation and productivity will rise • Improvement if higher income generation (opportunity cost to land) • Research on appropriate fodder or forage grass development suitable for marginal lands • Assured supply of feed, more nutrition, etc • Raise productive animals only • Signs of improved livestock farming • More intensive care and management of quality animals

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
13. Use of Chemical Fertilizer	↑	• In areas close to markets where they can afford to buy-declining soil health due to decrease LS no • For crop production-more agricultural by-product (feed for animal) • More crop residues • This is not, however, going to change the need for organic matter. • Remove subsidy on chemical fertilizer • Potential for fodder cultivation, increased agriculture by –product and also for reduction in livestock number • Feed/fodder production and availability may be higher but should think from environmental perspective • Less dependence on animal products for manure, thus keeping less no. of animals
14. Use of Concentrate Feed	↑	• Only in market areas • Because farmers are keeping animals for commercial purposes • Only in commercial production and mainly for poultry • Training should be given to farmers on how to make better concentrate feed using locally available resources • Depends on purchasing power of household • Because less fodder is available and increased number of improved animals • For more productive animals • Less degradation of natural resources and highly dependent on external markets

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
15. Purchase of Improved Buffaloes (demand driven)	↑	• Mainly supplied from Indian/external market. Policies to supply them locally are needed • Support large livestock with good health facilities • Livestock raising is becoming a commercial activity. Buffaloes generate income so farmers are encouraged to buy them. • A minus point is that some good characteristics of our local breeds may be lost. • We need to provide more concentrate feed as per its production. • Purchase of the animals is increasing in and around agri-roads. • Better management and care of buffaloes to produce high milk yield needed
16. Preference for Improved Cows	↓	• Demand is decreasing near markets for milk –not that there was great demand before. • Depends on management skill levels because improved cows are harder to raise. • Decreased preference among smallholder farmers and in remote areas without proper veterinary services. Supply of improved breeds of cows should be limited to areas accessible by road and for semi-commercial production. • In Himachal, preference for these animals has increased, and this is also encouraging stall feeding. • We may lose some good aspects of improved breeds as demand dwindles. • Demand has not decreased in all areas and can be seen, for example, in Ilam there are no buffaloes to be seen, only cows • Increase in milk-shed area • The situation is the result of poor extension services from DLS/NGOs.

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
17 Gender Workload	❍	• Improved breeds increase women's work unless enough farm fodder is available. • So in marginal HH, increased workload may discourage the activity. • Need national level data representation of different agro-ecological zones, as well as an overall social and economic perspective. • Women shoulder a larger burden of the work of managing livestock compared to men. Their workload should be reduced and their contribution and knowledge recognised • Both sexes should have equal participation in livestock raising • As the commercialisation or crop intensity grows, women will be increasingly loaded down with work. Proper technology should be introduced to help lighten the workload. • Educate people about the amount of work put in by women compared to men.
18 Gender Decisions	↑	• Men tend to benefit from the sale of dairy produce, men often get the training rather than women.
• Gender Equity	↑	• There is more gender-balanced livestock management in terms of the role of men and women in all kinds of activities.
• Gender Knowledge/ Skills		• Increased participation by women will help to increase productivity. • This will be true only in a semi-commercial production system. • Effective management and job sharing — and better animal health

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Annex 8: **Ground Realities**

	Trend	Implications for Sustainable Livestock Management Strategies
19. Social Equity	↑↓	• Only in those areas where intensive external support is provided but in areas where no support is provided, still little equity. Requires social and integrated perspective and practical implementation strategy on how to go about it. • Knowledge base is under-utilised. Women should be provided with more opportunity in all programmes. • Increased cash income for dairy milk has increased women's access to cash; and better animal management follows. • There is little change in social equity. There should be clear guidelines to help the poor implement workable livestock management strategies. • Small landholders are more averse to taking risks and find it difficult to invest. • Benefits mostly restricted to large farmers. Small farmers and the disadvantaged section of society must also benefit. • Women, poor consumers/farmers are benefitted by increased milk availability, better nutrition at the household level.