



Demographic changes in small ruminant population in India: Some inferences from different livestock regions

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ABSTRACT

There is significant growth in population of small ruminants in India during the last three decades. Various economic and non – economic factors like prevalence of mass poverty, high population pressure on land, increasing landlessness, changing food habits, high income elasticity for meat and meat products could account for this growth in small ruminant population. The demand for small ruminants is basically a derived demand necessitated by the demand for mutton, milk, wool, hides, skins etc. In the present article, an attempt was made to explore the importance of small ruminant rearing in different livestock regions. The imbalances in large (cattle and buffalo) and small ruminant (sheep and goat) concentration is mainly due to demand for livestock products and availability of feed and fodder resources. This is largely on account of the vanishing common pasture and grazing lands. Hence, there is a need to have strong efforts to protect common property resources from increasing uses for non agriculture purposes and suitable technology should be developed for their improvement.

Key words: Common property resources, Demography, Small ruminant

Animal husbandry in India acts as safety valve during the subsistence crisis in different production systems (Kitalyi *et al.* 2005). There were about 108 million small ruminants in 1972 which increased to about 186 millions in 2003 with an increase of 73%. Growth of population of goat and sheep was 2.0 and 1.4% respectively during same period. Meat production from sheep and goat increased from 605 to 751 thousand tones during 1998–99 to 2007–08. Goats also contribute about 4% to the total milk production in India. The demand for small ruminants is basically a derived demand necessitated by the demand for mutton, milk, wool, hides, skins etc. Furthermore, the small ruminants farming is a low cost enterprise, high conversion efficiency of such roughages into protein, milk and meat with other advantages (twins, triplets and even quadruplets are common), short inter-lactation interval and wide range of adaptability (Dixit *et al.* 1995). Strategies for rural development need to be tailored according to the needs of different regions. No

serious attempts were made to assess agro-ecological region wise compositional change in livestock population with special reference to small ruminants population. Saxena *et al.* (2001) delineated different agro-climatic regions of the country, and these regions were further used by Kumar and Singh (2008) to study livestock production systems.

In the present study, an attempt was made to assess compositional changes in bovines vis-à-vis small ruminants (sheep and goats) in different livestock regions of the country during 1987 to 2003. The inferences drawn from present analysis on different composition of small ruminants — would help in planning to formulate livestock development programmes based on resource endowment of the specific regions and help in better identification of production constraints; will provide an insight view of region-specific population base and growth formulate targeting for region-specific intervention particularly in poor resource regions where small ruminants play an important role in rural economy; and will help environmentalist to study environmental concerns associated with small ruminants based production system.

MATERIALS AND METHODS

To study the distribution of small ruminants population across the country the paper makes use of livestock regions formed for a feed consumption survey undertaken as part of

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a larger project 'India's livestock feed balance and its environmental implications' funded by the Indian Council of Agricultural Research (ICAR) under the National Agricultural Technology Project (NATP), and carried out jointly by the National Centre for Agricultural Economics and Policy Research (NCAP) and the Society for Economic and Social Research (SESR), Delhi. The design of the feed consumption survey was developed at the SESR, which also carried out the survey. In the following paragraphs we discuss delineation of livestock regions and data used in this study.

Delineation of livestock regions: We took into consideration topography, climatic conditions and cropping pattern of 60 sub-zones, re-organized these into 11 broad regions which we call as 'livestock regions'. In doing so, it was ensured that a livestock region is contiguous. These regions are: Western Himalaya (WH), North-West Plain (NWP), Eastern Plain (EP), Central Highlands (CH), Eastern Plateau and Highlands (EP&H), Deccan Plateau and Hills (DP&H), Rajasthan-Gujarat Plains (RGP), Eastern Ghats (EG), Western Ghats (WG), Assam-Bengal Plain (ABP), and North-Eastern Highlands (NEH). Details on the territorial spread of each of these regions are provided in Table 1.

The data were compiled from diverse sources. District level data on livestock population were collected from Livestock Census of 1987, 1992, 1997 and 2003 and analysis is carried out at regional level by aggregating the district level data. Information on rural infrastructure was taken from Census of India, 2001. Land use pattern and status of irrigation compiled from DES, Government of India.

Simple tabular analysis, trends, ratio's compound annual growth rate (CAGR) was worked out between the census periods.

RESULTS AND DISCUSSION

Rural infrastructure and resource endowments: The infrastructural and resource availability were studied in different livestock regions of India in the year 2003. Distribution of inhabited villages, rural population, out of total inhabited villages, percent of villages connected with approach road and power supply and gross irrigated area as per cent of gross cropped area (irrigation intensity), distribution of permanent pasture and grazing lands and density of livestock and small ruminants per hectare of sown area and permanent pasture and grazing land are exhibited in Table 1.

The distribution of inhabited villages among livestock regions is mainly concentrated — more than 60% in EP&H, EP, NWP and RGP regions. Similarly, these regions constitute about 60% of human population. The rural infrastructure like power supply and roads facilitates in production and provide market outlet. About 84% of total inhabited villages had approach road in NWP region followed by WG region (81%), DP&H region (76%), EG region (66%). The share of villages having power supply varies as low as 57% in NEH region to 99% in DP&H region.

Higher the irrigation intensity reflects better availability of feed resources in terms of crop-residues and crop by-products in the region. Availability of feed resources is one of important factors that influence the adoption of productive dairy animals besides population, urbanization, road and veterinary infrastructure (Rao *et al.* 2004). EP region (Table 1) has the highest irrigated area (70%) followed by NWP region (62%) and WH region (36%) region. The lowest irrigated area was noticed in ABP region (14%) and WG

Table 1. Rural infrastructure, resource endowment in different livestock regions, 2003

Livestock regions	Inhabited village (%)	Rural pop. (%)	Village with approach road (%)	Village With power supply (%)	Irrigation Intensity (%)	Area under permanent pasture and grazing land (%)	Number of livestock Ha ⁻² of permanent pasture and grazing land area	
							Livestock*	Small ruminants
W. Himalaya	6.61	2.70	37	89	35.8	17.7	10.5	4.8
N-W plain	5.68	7.58	84	89	62.4	0.3	796.9	96.5
Eastern plain	16.78	19.68	55	66	69.7	0.6	884.6	263.5
C. highlands	7.50	5.27	34	92	31.1	10.0	29.3	7.1
East. Plateau & highlands	26.84	21.74	39	63	27.8	20.6	54.7	21.8
Deccan Plateau & Hills	4.35	5.75	76	99	27.9	7.3	45.4	25.5
Raj- Guj plains	9.41	9.60	61	86	31.2	24.0	26.9	13.1
Eastern ghats	5.46	7.12	66	76	31.6	1.8	186.5	89.5
Western ghats	8.42	12.51	81	98	19.8	15.8	29.7	10.8
Assam-Bengal plain	6.43	6.74	48	70	14.3	1.5	196.7	76.9
N-E highlands	2.54	1.31	41	57	21.5	0.2	358.2	74.4
All	100	100	53	76	35.9	100.0	45.8	17.6

*includes cattle, buffalo, sheep, goat, and pigs

Source: 1. Human Census 2001 2. Department of Economics and Statistics (DES), Govt. of India and 3. Livestock Census 2003

region (20%) region. This observation also supports that livestock regions having high irrigated area, the bovine to small ruminant ratio are relatively in favour of bovine than the regions with low irrigation intensity.

Permanent pasture and grazing lands (PP&GL) which is an important component of common property resources (CPRs) are shrinking across the country. The importance of this resource can be gauged from that it is source of fodder for livestock and help sustain a number of livestock which would not have been permitted by individuals' own land, especially for small farmers. One of the major livestock groups that depend predominantly on these grazing lands are small ruminants - sheep and goat - that are raised mainly by resource-poor farmers. According to Suresh *et al.* (2010), the decline in PP&GL resulted in cost escalation for sheep farming, particularly for the landless and small farmers in Rajasthan. Majority of farmers have perceived deterioration of the pastureland which has resulted in the reductions of wool yield per animal (18%), body weight of sheep (20%) and age of disposal of lambs (45%).

The highest area under permanent pasture and grazing lands (PP&GL) was found in RGP region (24%) followed by EP&H region (21%) and WG region (16%). These 3 regions together constitute about 60% of country's area under PP&GL in the year 2003. The reduction in sheep population between 1987 and 2003 strongly support this finding. Sheep suffer more from the decline of pasturelands as they are exclusively raised on these lands. Contrary to this, NWP region and EP region having buffalo based production system has almost no dependency on PP&GL and majority of the animals are stall fed. Information on density of livestock and small ruminant Ha^{-2} of PP&GL is given in Table 1. EP region has the highest livestock density i.e. 884 animals Ha^{-2} closely followed by NWP region (797 animals), NEH region (358 animals), ABP region (197 animals) and EG region (187 animals). This is because less availability of PP&GL in these regions. However, livestock density Ha^{-2} of PP&GL was

much lower in WH region (11 animals) followed by RGP region (27 animals), CH region (29 animals) and WG region (30 animals), this reflects the abundance of this natural resource. Similar trends were observed in small ruminant density Ha^{-2} of PP&GL. EP region has the highest density i.e. 264 animals and lowest in WH region (5 animals). It is an interesting observation that, the small ruminant density in RGP region was roughly half of the livestock density Ha^{-2} of PP&GL. The current scenario may further worsen if diversion of pastures and grazing for other uses will continue.

Trends in livestock demography in different livestock regions: As per 17th Livestock Census, India is a home to 185 million cattle, 98 million buffaloes, 124 million goats, 61 million of sheep and 14 million pigs. Livestock production in the country is bovine based. Dual-purpose breeds of cattle are a source of milk and provide draught power to perform agricultural operations and transport men and material from one place to another. Other important species are buffalo, sheep, goats, pigs and poultry have been traditionally maintained for food production (Birthal and Taneja 2006).

Distribution of major livestock species is exhibited in Table 2. Except few livestock regions, the share of major livestock species has not changed during the last one-and-half decade. In the year 2003, EP&H constituted highest share of cattle whereas, NWP region (includes entire Punjab, Haryana and western part of Ganga- Yamuna plains) possesses maximum number of buffalo. The dominance of bovine based production in these regions is understandable in view of the availability of crop residues and by-products, cultivated area and irrigation infrastructure. However, NEH region has the lowest share and contributes less than 1%. About 70% of sheep are reared in EP&H region, RGP region and DP&H regions. Pig was recognized as important species in EP&H region (28%) followed by NEH region (17%) and ABP region (15%). A declining trend has been noticed in the share of cattle population in majority of the regions. Contrary to this, EP&H region has shown increasing trends in the share of

Table 2. Share of major livestock species in different livestock regions

Livestock regions	Cattle		Buffalo		Sheep		Goat		Pigs	
	1987	2003	1987	2003	1987	2003	1987	2003	1987	2003
Western Himalaya (WH)	4.0	4.1	3.1	3.1	9.2	7.5	4.1	3.5	0.4	0.3
North-West Plain (NWP)	4.3	3.1	19.8	20.0	2.5	1.7	2.2	2.0	7.5	3.5
Eastern plain (EP)	10.8	10.9	16.1	18.0	3.2	1.9	9.7	12.7	21.6	15.6
Central highlands (CH)	11.0	8.9	7.5	6.7	1.5	0.8	6.8	5.6	3.6	3.0
Eastern Plateau and highlands (EP&H)	21.6	28.1	14.2	16.2	17.1	30.7	16.3	23.0	20.4	28.1
Deccan Plateau & Hills (DP&H)	7.8	5.4	8.6	5.0	21.2	18.9	9.4	6.4	8.4	2.9
Rajasthan-Gujarat plains (RGP)	9.3	9.4	14.6	17.4	26.7	19.7	19.0	16.8	3.1	4.8
Eastern ghats (EG)	8.0	7.4	5.6	4.1	9.7	10	8.7	8.6	5.6	3.9
Western ghats (WG)	13.6	12.2	8.8	8.3	7.8	7.9	13.5	10.6	6.9	5.8
Assam-Bengal plain (ABP)	8.0	8.7	1.4	1.2	0.9	0.8	9.5	9.7	10.3	15.4
North Eastern highlands (NEH)	1.7	1.6	0.3	0.2	0.1	0.1	0.9	1.1	12.3	16.8

Source: Livestock census, 1987 and 2003.

Table 3. Sex-wise composition and small ruminant to bovine ratio

Livestock regions	Census year	Small ruminants (%)			Bovine : Small ruminants	
		Male	Female	Total	Bovines	Small ruminants
Western Himalaya	1987	3.7	3.8	3.8	73	27
	2003	2.7	3.1	3.0	71	29
North-West plain	1987	2.3	1.9	2.1	92	8
	2003	1.8	1.7	1.7	91	9
Eastern plain	1987	11.4	8.1	9.0	79	21
	2003	12.5	10.1	10.8	71	29
Central highlands	1987	6.0	6.4	6.3	81	19
	2003	4.3	4.9	4.8	77	23
Eastern Plateau and highlands	1987	22.3	19.6	20.3	72	28
	2003	31.4	29.6	30.1	61	39
Deccan Plateau & Hills	1987	10.1	10.2	10.2	68	32
	2003	7.3	8.3	8.0	56	44
Rajasthan-Gujarat plains	1987	9.9	20.2	17.5	63	37
	2003	8.2	16.8	14.4	62	38
Eastern ghats	1987	11.1	8.2	8.9	69	31
	2003	10.5	8.4	9.0	58	42
Western ghats	1987	10.1	13.3	12.4	73	27
	2003	8.5	9.3	9.1	70	30
Assam-Bengal plain	1987	12.1	7.6	8.8	65	35
	2003	11.4	7.0	8.2	59	41
North Eastern highlands	1987	1.0	0.7	0.8	82	18
	2003	1.3	0.8	0.9	72	28
All Regions	1987	100.0	100.0	100.0	73	27
	2003	100.0	100.0	100.0	66	34

Source: As given for Table 2

cattle population between 1987 and 2003. NWP region reared highest number of buffalo (20%) closely followed by EP region (18%), RGP region (17%) and EP&H region (16%).

The share of sheep population declined in most of the livestock regions except EP&H region where number of sheep increased from 17 to 31% during 1987 to 2003. Similar pattern was noticed for goat. It is worthwhile to mention here that sheep, goat and pigs generally reared for meat have shown increasing trend in EP&H region during 1987 to 2003. This may possibly due to higher demand for meat in this region. An important observation exhibited in Table 2 is that the share of sheep and goat declined in RGP region, which is native of many important breeds of small ruminants and need to be further investigated. NEH and ABP regions registered increasing share of pig. Other species in this region has shown declining trends except goat during 1987 to 2003. The share of pig in EP region has decelerated from 22 to 16% during the same period.

Demographic change in small ruminants population: The ratio of small ruminant population has significantly increased in EP&H region; it increased from 20 to 30% between 1987 and 2003 (Table 3). The rate of change was almost similar for male and female. It indicated that small ruminants are reared for meat as well as milk. EP, EG and NEH regions also showed positive changes. However, WG, RGP and

DP&H regions showed decreasing share of small ruminant population. One of the interesting features of this analysis is demographic shift in favour of small ruminant in all the livestock regions. In the country as whole, the share of bovine declined from 73% in 1987 to 66% in 2003.

On the other hand, share of small ruminants increased from 27 to 34% during the same period (Table 3). The decline in bovine share was more pronounced in DP&H region closely followed by EP&H region, EG region and NEH region. This may be due to constraints in the availability of feed and fodder resources and change in cropping pattern in favour of cash crops which are the poor source of biomass. It is likely that the deficiency in the feed resources is contributing towards a shift in rearing of sheep and goat. Equally important is the fact that cultivable land per farm is declining, capital investments in bovine is relatively higher than that of the small ruminants and associated risk. On the other hand, there is ease of maintenance under a low input system with virtually zero opportunity cost, higher returns in short run and higher demand in rural and urban areas.

Growth and density of small ruminants in different livestock regions: The growth rate in cattle population was 0.34% in the country as a whole (Table 4). However, a negative growth was noticed in DP&H, NWP, CH, WG and ED regions during the same period. Contrary to this, growth

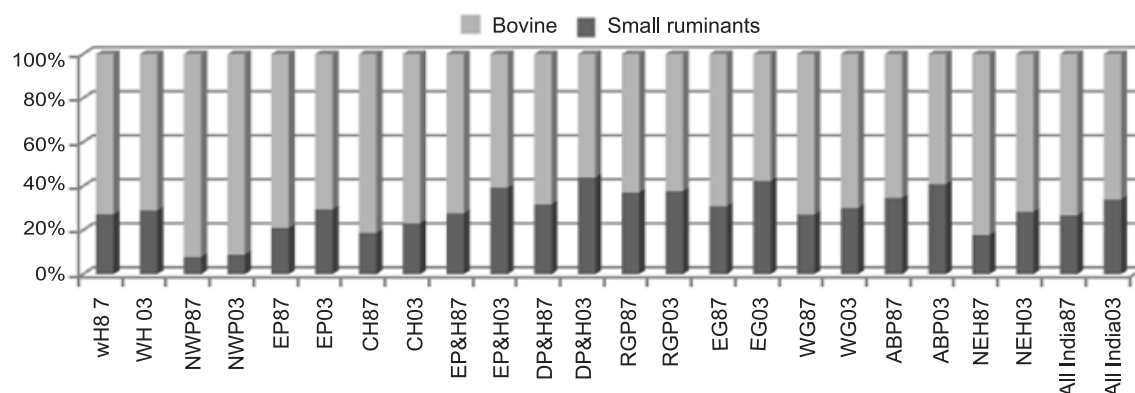


Fig. 1. Bovine to Small ruminant ratio in different livestock regions

Table 4. Annual compound growth and density in livestock population in different livestock regions 1987–2003: Authors' estimate

Livestock regions	WH	NWP	EP	CH	EP&H	DP&H	RGP	EG	WG	ABP	NEH	All
Cattle	0.48	-1.6	0.38	-0.93	2.01	-1.98	0.4	-0.14	-0.33	0.94	0.24	0.34
Buffalo	2.0	2.0	2.65	1.23	2.8	-1.41	3.06	-0.05	1.56	1.08	-1.76	1.96
Bovine	0.91	0.96	1.33	-0.39	2.19	-1.79	1.56	-0.12	0.11	0.95	0.35	0.85
Male	-0.73	-1.1	-0.84	-1.43	1.92	-3.58	-0.07	-1.31	-0.5	0.48	-0.48	-0.16
Female	1.82	1.63	2.91	0.37	2.43	-0.91	2.2	0.59	0.48	1.37	1.09	1.5
Sheep	0.98	-0.08	-1.09	-1.59	6.08	1.57	0.33	2.45	2.32	1.46	-0.11	2.27
Male	1.65	-2.16	-1.2	-1	6.12	1.18	0.67	2.55	4.9	2.24	2.06	2.69
Female	0.69	0.7	-1.03	-1.85	6.06	1.7	0.26	2.4	1.49	0.95	-1.98	2.12
Goat	1.48	1.86	4.24	1.28	4.72	0.09	1.76	2.48	1.02	2.64	4.24	2.52
Male	1.47	1.84	4.28	1.21	4.61	0.2	1.65	2.4	0.58	2.34	3.67	2.31
Female	1.48	1.86	4.24	1.28	4.72	0.09	1.76	2.48	1.02	2.64	4.24	2.52
Pigs	0.57	-2.44	0.28	1.17	4.43	-4.28	5.12	0.15	1.2	4.94	4.4	2.35
<i>Density of different species, 2003 (Per square km of Geographical area)</i>												
Cattle	36	42	92	69	71	46	33	90	53	142	16	59
Buffalo	14	140	81	27	22	23	32	26	19	10	1	31
Sheep	22	8	5	2	26	54	23	40	11	4	0.3	19
Goats	21	18	72	29	39	37	40	70	31	105	7	39
Pigs	0.2	3	10	2	5	2	1	3	2	18	12	4
Poultry	40	185	80	42	203	417	23	303	151	445	80	155

in cattle population was more pronounced in EP&H region (2.01%) during the same period.

The growth rate of buffalo was almost 2.0% in the country. The highest growth was noticed in RGP region (3.06%) followed by EP&H region (2.80%), EP region (2.65%), and 2.0% in NWP and WH regions respectively during 1987 to 2003. Encouraging growth in buffalo population indicated that buffalo replacing indigenous and crossbred cows maintained for milk production. DP&H, EG and NEH regions showed negative growth in buffalo population. The positive growth rate in bovine population per annum is probably due to growth in human population which resulted a high speed of intensification to meet increasing demand for milk and milk products in rural and urban area.

Growth in goat population in the country was marginally higher than that of sheep during 1987 to 2003. This may due to high demand for goat meat in the country. Growth in male sheep was higher than the females while, it was reverse in

male goats. The highest growth in male goat population was noticed in EP&H region closely followed by EP region and NEH region. These regions have a significant growth in human population resulting high demand for meat and meat products.

Density of different species in various livestock regions has shown considerable variation as we observed in composition of livestock. In the year 2003, there were 142 cattle km⁻² in ABP region followed by EP region (92), EG region (90) and EP&H region (71). However, cattle density in the country was 59 cattle km⁻².

The density of buffalo was highest, 142 buffalo km⁻² in NWP region in the year 2003, this region comprises Punjab, Haryana and Western part of Uttar Pradesh where dairy production is buffalo based. The other important regions in terms of km⁻² buffalo density are EP region (81), RGP region (32) and EG region (26).

The density of sheep in the country was 19 sheep km⁻² in

Annexure 1. Livestock regions delineated for implementation of the surveys

Name of the region	Name of the states or their parts covered
Western himalaya	Jammu & Kashmir, Himachal Pradesh and Uttarakhand
North-West plain	Punjab, Haryana and Western parts of Ganga-Yamuna Plains
Eastern plain	North Bihar and part of South Bihar. Northern part of Awadh Plains (Eastern and Central Uttar Pradesh)
Central highlands	Part of Madhya Pradesh, part of Maharashtra and part of Uttar Pradesh (Bundelkhand)
Eastern Plateau and highlands	Part of Madhya Pradesh, part of Bihar, part of Andhra Pradesh, Orissa, part of Maharashtra, Mirzapur district of Uttar Pradesh, part of West Bengal
Deccan Plateau and Hills	Karnataka, Tamil Nadu, part of Andhra Pradesh
Rajasthan- Gujarat plains	Rajasthan, Gujarat excluding southern part
Eastern ghats	Part of Tamil Nadu, part of Andhra Pradesh, part of Orissa, part of Puduchery, part of West Bengal
Western ghats	Kerala, southern part of Gujarat, adjoining districts of Karnataka, adjoining districts of Maharashtra, Nilgiri district of Tamil Nadu, Daman and Diu, Andaman & Nicobar, Goa and part of Puduchery
Assam-Bengal plain	Assam, part of West Bengal
North-Eastern highlands	Sikkim, Arunachal Pradesh, Nagaland, Meghalaya, Manipur, Mizoram and Tripura

the year 2003. The highest density was found in DP&H region (54) followed by EG region (40) and the lowest density of sheep was noticed in NEH region. The density of goat in the country was 39 goats km⁻². The highest density of goat was observed in ABP region (105) followed by EP (72) and EG (70) regions. The NEH region reported lowest density of goat.

The highest density of pigs was worked out for ABP region followed by NEH region (12) and EP region (10). However, the lowest density of pig was noticed in WH region. The density of poultry birds was counted about 155 birds per square km in the country. The ABP region has the highest density with 445 birds km⁻² followed by DP&H region (417), EG region (303) and EP&H region (203). However, RGP region reported lowest density with 23 birds km⁻².

These trends indicated that among bovine, buffalo is replacing indigenous cattle population in majority of the regions. Population of meat producing animals i.e. goat, sheep, pigs have shown increasing trends in most of the regions. Poultry also follows the same pattern. The rate of intensification, which was perceived one of the major concerns for the sustainability of livestock production system, now does not seem to pose a challenge, though enhancing productivity of livestock animals still remains a major challenge.

Small ruminant rearing is emerging as an important source of livelihood particularly for marginal and small holdings in different livestock regions of India. The status of rural infrastructure and resource endowments in different regions indicated that highest share of villages (84%) were having approach paved road in NWP region while CH region having only 37% of villages with this facility. The connectivity of villages to the roads reflects market access. The majority of the regions were having more than 70% of villages with power supply. High density of livestock Ha⁻² of permanent pastures and grazing land was found in EP region, NWP region and NEH region indicates poor availability of this important common property resource associated with small ruminant rearing. Further, the share of sheep and goats in these regions showed declining trends between 1987 and 2003. The imbalances in large (cattle and buffalo) and small ruminant (sheep and goat) concentration is mainly due to share of human population reflects in terms of demand for livestock products and availability of feed and fodder resources.

There is a need to have strong efforts to protect common property resources from increasing uses for non agriculture purposes and suitable technology should be developed for their improvement. Feed management strategies should be advised according to livestock regions. Apart from feed resources, there is a need to improve accessibility to the veterinary care services, credit, insurance and marketing of small ruminants.

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