

Livestock in Uttarakhand: Growth patterns and determinants of composition and intensity

D BARDHAN¹, M L SHARMA² and RAKA SAXENA³

Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand 263 145 India

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Livestock activity assumes special significance in hilly states like Uttarakhand. Over 80% of the all livestock species and cent per cent of indigenous poultry population are owned by marginal and small holders. Exploitation of opportunities offered by livestock sector requires adequate policy support. In this context, it is necessary to understand the nature and significance of changes in livestock population and composition, and the factors driving such changes. These changes have important bearing on understanding of related policy issues like changing demand for livestock products, animal and mechanical power relationship and ecological pressure. Several studies documenting temporal and spatial changes in livestock population, determinants of livestock composition and intensity are available at all India level (Patel 1993 and Pandey 1995) and also at state levels like Himachal Pradesh (Chand 1995 and Kumar *et al.* 2004) and Andhra Pradesh (Subrahmanyam and Rao 1995). However, no such detailed studies are available in the context of Uttarakhand. The specific objectives of the paper are to study the temporal and spatial changes in livestock population and composition, and to determine the factors affecting region-wise variations in livestock composition and intensity in Uttarakhand.

The study was based on secondary data gleaned from various issues of *Sankhikiya Patrika*, published by Directorate of Economics and Statistics, Government of Uttarakhand. The annual compound growth rates (ACGR) in various categories of livestock population were estimated for the period 1993–2003. Besides tabular analysis—to analyze the compositional changes in livestock sector—simple correlation analysis was used to ascertain the effects of relevant variables on livestock composition and intensity.

Growth patterns and compositional changes in livestock population

Total livestock population in Uttarakhand increased @

Present address: ¹Assistant Professor (Veterinary Economics), Department of Veterinary and Animal Husbandry Extension, College of Veterinary and Animal Sciences; ²Professor, ³Associate Professor, CABM.

0.28% per annum during 1993–2003 (Table 1). Bovine population increased from 63% in 1993 to 66.5% in 2003, while during the same period, the share of ovine population declined from 32% per cent to 28%.

Within bovine sector, buffalo population increased by a higher rate (0.75% per annum) than cattle (0.21% per annum). As a result, proportion of cattle in bovine population declined from 70% in 1993 to 64% in 2003, while that of buffaloes increased from 30% in 1993 to 36% in 2003. Within the ovine sector, while sheep population declined by 0.36% per annum, goat population increased annually by 0.15%. Changes in composition of livestock in broad groups of bovines and ovines were more prominent in Garhwal division compared to Kumaon division. Share of bovine in livestock population increased from 59% in 1993 to 65% in 2003, while, that of ovines declined from 36 to 29.5%, during the same period. On the other hand, compositional changes in livestock population in Kumaon division were not significant. While adult male cattle declined by 0.13% annually, population of adult female cattle rose by 0.53% per annum, during the decade. This same pattern was observed in both the divisions of the state. Adult female buffalo population increased from 5.41 lakh in 1993 to 8.14 lakh in 2003 (almost similar to adult female cattle population), registering a growth rate of 0.84%, per annum. Adult male stock constituted only 5.6% of buffalo population in 2003. In contrast, the proportion of adult male stock in total cattle population in 2003 was 32%, indicating that buffalo is mainly reared for milk purpose, while cattle are reared for the purpose of milk as well as draught purposes. However, proportion of adult male cattle in total cattle population was higher in 1993 at 38%, implying that the importance of adult male cattle relative to adult female stock has declined over the period. This decline might be explained by increasing trends in mechanization, especially in the districts lying in the Tarai region of the state, which reduced the dependence on work animals. Due to higher growth rates of adult female stock, the proportion of adult female in both cattle and buffalo population increased,

Table 1. Livestock population in Uttarakhand in 2003 and growth rates during 1993–2003

(in thousand)

Particulars	Kumaon Division		Garhwal Division		Uttarakhand	
	Population	ACGR	Population	ACGR	Population	ACGR
Total livestock	2298	0.17	2842	0.38	5140	0.28
% Bovine	1569(68.28)	–	1853(65.21)	–	3423(66.59)	–
% Ovine	641(26.73)	–	841(29.58)	–	1455(28.31)	–
% Others	115(4.99)	–	148(5.21)	–	262(5.1)	–
Livestock per km ² NSA	620	–	732	–	677	–
Livestock per 1, 000 rural persons	840	–	795	–	815	–
Total cattle	993	0.12	1197	0.28	2191	0.21
Adult male cattle (> 2.5 yrs)	328	–0.18	379	–0.09	708	–0.13
Adult female cattle (> 2.5 yrs)	403	0.67	425	0.42	829	0.53
Proportion of ind. and CB female cattle in total female cattle						
Adult female (indigenous)	78.79	–	88.74	–	83.89	–
Adult female (CB)	21.21	–	11.26	–	16.11	–
Total buffaloes	575	0.33	655	1.19	1231	0.75
Adult male buffaloes (> 3 yrs)	34	1.22	35	4.04	69	1.98
Adult female buffaloes (> 3 yrs)	415	0.69	399	1.01	814	0.84
Total bovines	1569	0.20	1853	0.56	3422	0.39
Adult male bovines (> 2.5 yrs)	363	–0.09	414	0.05	777	–0.01
Adult female bovines (> 2.5 yrs)	819	0.68	824	0.69	1643	0.68
% Adult female stock in total population						
Bovines	819(52.21)	–	824(44.48)	–	1643 (48.02)	–
Cattle	404(40.64)	–	425(35.50)	–	829(37.83)	–
Buffalo	415(72.20)	–	399(60.88)	–	815(66.17)	–
% Adult male stock in total population						
Bovines	363(23.12)	–	414(22.36)	–	777(22.71)	–
Cattle	329(33.10)	–	379(31.69)	–	708(32.33)	–
Buffalo	34(5.91)	–	35(5.33)	–	69(5.60)	–
Sheep	60	–0.67	236	–0.27	296	–0.36
Goat	554	0.25	605	0.07	1159	0.15
Pigs	5.41	0.38	28	3.07	33.45	2.19
Horses and ponies	7.32	–0.27	12.86	–0.13	20.17	0.14
Others	101	–0.44	115	1.37	217	0.76
Poultry	1399	3.01	586	1.38	1985	2.31

Figures in parentheses indicate proportion of total population in the particular category.

from 32 and 64% in 1993 to 38 and 66% in 2003, respectively. Proportion of adult female stock in total bovine population, thus, increased from 42% in 1993 to 48% in 2003, indicating towards gradual shift in preference for bovines mainly for milk purpose. This trend in bovine compositional changes is in consonance with the national scenario (Pandey 1995, Sharma 2004). However, lower cost of labour relative to capital, small landholdings and topography may make investment in tractor mechanization in the state unjustifiable beyond a certain limit, especially in the higher reaches. Investment in farm mechanization, like in tractor, has mostly occurred in the districts located in the Tarai area or lower highlands, viz. US Nagar, Hardwar and Nainital. Animal draught power is thus likely to remain important method of cultivation in the higher regions of the state in the near future.

One significant pattern in composition of female bovines that emerged during 1993–2003, was that while share of

female cattle in total female bovines declined from 54% in 1993 to 50% in 2003, that of female buffaloes in total female bovines increased from 46 to 49.5% during the same period. This is due to the higher growth rates registered by adult female buffaloes than adult female cattle (as mentioned earlier). The growing importance of buffaloes as milch animals relative to cows might be explained by the higher fat content in buffalo milk, which fetches better price and higher productivity compared to local cows. The average productivity in the state of non-descript local cows is 1.89 kg/day, while that of buffaloes is 4.12 kg/day. Share of crossbred (CB) female cattle in adult female cattle population also increased from 7% in 1993 to 16% in 2003. This increase is due to intensive efforts made by the Government to carry out crossbreeding programme on priority basis owing to higher productivity of CB animals (6.7 kg/day). The share of female buffalo in female bovine population as well as

Table 2. Correlation between livestock composition and relevant variables (2003) (n=13)

Livestock composition category	Area under forests and pastures (ha)	Area under fruits and vegetables (ha)	Landholdings less than 0.5 ha	Food crop output per rural person	Altitude (m)
Bovine in total livestock	-0.710*	-0.009	0.125	0.376***	-0.146
Ovine in total livestock	0.702*	0.213	-0.159	-0.466**	0.247
Cattle in total bovines	0.475**	0.725*	-0.303	-0.533**	0.531**
Male cattle in total bovines	0.578**	0.094	-0.433***	-0.440**	0.222
Female cows in total cattle	-0.301	-0.243	-0.128	0.744*	-0.030
Female cows in female bovines	0.382***	0.793*	-0.320	-0.371***	0.554**
Female buffaloes in total buffaloes	0.138	-0.188	-0.359***	0.285	0.112
Female buffaloes in female bovines	-0.382***	-0.793*	0.320	0.371***	-0.554**
Female bovines in total bovines	-0.281	-0.426***	-0.102	0.711*	-0.083
CB female cows in total cows	-0.359***	-0.458**	0.009	0.788*	-0.325

Significant at *1%, **5% and ***10% levels of significance, respectively.

share of CB female cattle in total female cattle population in 2003 was higher in Kumaon division (51 and 21%, respectively) as compared to Garhwal division (42 and 11%, respectively). Relative to bovines and ovines, population of other livestock species is quite low. Poultry population registered significant annual growth rate of 2.35% from 7.62 lakh in 1993 to 19.85 lakh in 2003. This growth in poultry sector was mainly accounted for by growth of poultry population in Kumaon division by 3 %, per annum during the period.

Factors affecting livestock composition

The results of correlation analysis between livestock composition and relevant variables are presented in Table 2. Sheep and goats are entirely fed by grazing and browsing grasses, while cattle and buffalo are mainly stall-fed with crop by-products and residues. Dependence of bovines on grazing is limited. Thus, abundance of area under forests and pastures is relatively more beneficial to ovines than to cattle and buffaloes. This explains the positive association between area under forests and pastures (AFP) and share of ovines in total livestock. Crop output per person negatively affected share of ovine in total livestock, while its effect on bovine composition was positive. Higher per capita crop output results in increased demand for those livestock which compliments crop sector through dung and draught power. Thus, demand for bovines is less in areas where per capita crop output is low and lower income from crop sector increases dependence on supplementary sources of livelihood like goat or sheep rearing. Proportion of male cattle in bovines had significant and positive association with AFP. Male cattle are generally fed by grazing, rather than being stall-fed and hence availability of area under pastures and free grazing favour keeping of more male cattle. The same reason could explain the negative association between crop output per person and share of male cattle in total bovine population. The reason for negative effect of number of landholdings less than 0.5 ha on share of adult male cattle in total bovines, and

also share of female buffaloes in total buffaloes appears that marginal landholders, who are poor, are mainly dependent on earning income from livestock by rearing young stock and selling them at a profit after a few years, when they are ready to work as draught animals or when they come to lactation. Crop output per person was positively associated with share of female bovines in total bovines implying that higher crop output increases dependence on bovines mainly for their ability to compliment crop sector through supply of dung and better utilization of crop residues. The findings thus indicate that complementarity between bovines and crop sector might be more in terms of supply of dung and use of crop by-products, rather than supply of draught power. Shares of female cattle and female buffaloes in total female bovines, were significantly correlated with the same set of variables; only the signs of correlation coefficients were interchanged. The positive effect of area under fruits and vegetables on share of female cattle in female bovines and its negative effect on share of female buffaloes and share of CB cattle in female cattle might be due to the reason that increase in area under fruits and vegetables limits the availability of crop feeds. Since, buffaloes and CB cattle are fed with crop by-products and grains, decrease in crop output has adverse effect on their population. Local cows can however be fed by limited grazing and unavailability of crop feeds does not have significant effect on their population. The positive effect of per capita crop output on share of CB female cattle in total female cattle and share of female buffaloes in female bovines, while its negative effect on share of female cattle in female bovines, could be due to the reason that both, buffaloes and CB cattle are high yielding animals and are fed mainly upon crop by-products and grains. Thus, availability of increased crop output beneficially effect keeping of such animals.

Livestock intensity

Intensity of livestock in relation to per km² of geographic area, and per km². NSA express biotic pressure exerted by livestock on land area and livestock intensity in relation to

per 1000 rural population expresses economic dependence of human population on livestock (Chand 1995). In Uttarakhand, there are 91 livestock per km² of geographic area, 677 livestock per km² of NSA and 815 livestock per 1000 rural population (Table 3). Livestock per km² geographic area is higher in Kumaon division (114) than Garhwal (78), indicating greater biotic pressure of livestock on natural resource base in the former division. On the other hand, livestock per km². NSA is higher in Garhwal (732) than in Kumaon (620), probably due to greater NSA in Kumaon division. Livestock per 1000 rural population is higher in Kumaon division (840) than Garhwal (795), indicating comparatively greater dependence of humans on livestock in the former division.

Factors affecting livestock intensity

The magnitudes of correlation coefficients indicate strong

Table 3. Livestock intensity

Particulars	Kumaon	Garhwal	Uttarakhand
<i>Livestock</i>			
Per km ² of geographic area	114	78	91
Per km ² of NSA	620	732	677
Per 1000 rural persons	840	795	815
<i>Cattle</i>			
Per km ² of geographic area	49	33	39
Per km ² of NSA	268	309	289
Per 1000 rural persons	363	335	347
<i>Buffalo</i>			
Per km ² of geographic area	29	18	22
Per km ² of NSA	155	169	162
Per 1000 rural persons	210	184	195
<i>Bovines</i>			
Per km ² of geographic area	78	51	60
Per km ² of NSA	423	478	451
Per 1000 rural persons	573	519	542
<i>Sheep</i>			
Per km ² of geographic area	3	6	5
Per km ² of NSA	15	61	39
Per 1000 rural persons	22	66	47
<i>Goat</i>			
Per km ² of geographic area	28	17	20
Per km ² of NSA	150	156	153
Per 1000 rural persons	202	169	184
<i>Ovines</i>			
Per km ² of geographic area	30	23	26
Per km ² of NSA	166	217	192
Per 1000 rural persons	224	235	231
<i>Female animals per km² NSA</i>			
Female cattle (>2.5 years)	109	110	110
Female buffaloes (>3 years)	112	103	107
Female bovines (>2.5 years)	221	212	217
<i>Female animals per 1000 rural persons</i>			
Female cattle (>2.5 years)	148	119	131
Female buffaloes (>3 years)	152	112	129
Female bovines (>2.5 years)	300	231	260

positive association between livestock intensity in geographic area and DRP (Table 4). Livestock density in geographic area is also strongly and positively associated with MLH. There are also indications that AFP negatively effects livestock intensity. Disaggregating livestock into bovine and ovine, it was observed that bovine density in geographic area was significantly and positively associated with DRP and MLH and negatively associated with AFP and Altd. The only variable which has significant correlation with ovine density is MLH. The ovine density increases with increase in MLH. The positive association between number of marginal landholdings with both bovine and ovine density in geographic area appears due to the reason that majority of farmers in the state are marginal farmers, who are spread over large area and almost all such households rear livestock, bovines or ovines, to supplement their limited income from crop enterprises. The substantial association between density of rural population and bovine density in geographical area and lack of any significant association between human population density with ovine density might be due to the reason that bovines are reared by almost all rural households, either for milk or draught purpose, while ovines, comprising sheep and goats are reared by relatively very few households, in large herds. As expected, area under forests and pastures had negative influence on bovine density as bovines are mainly stall-fed owing to difficulty in movement of mainly of CB animals and buffaloes for grazing along hilly terrains. Intensity of livestock per capita rural population was significantly and positively correlated with AFP, AFV and Altd, while being significantly and negatively associated with DRP and CRP. Bovine density per capita rural population was significantly associated with DRP, AFV, CRP and Altd. Ovine density per capita rural population had significant and negative association with DRP and CRP, while association with AFP was significant and positive. The negative influence of rural human population density on bovine and ovine density per capita rural population implies that dependence on livestock for livelihood is more in sparsely populated regions than in densely populated areas. Area under forests and pastures favourably impacted ovine density per capita rural population as, sheep and goats are almost entirely fed by grazing.

Number of male cattle per km² NSA exhibited significant association with all the explanatory variables, except adult female bovine density per km². NSA was significantly and negatively associated with DRP and significantly and positively associated with Altd. Female bovine population per capita rural population was significantly associated with DRP, AFV and Altd. While the association with DRP was negative, those with AFV and Altd. were positive. Female cattle density per capita rural population was also influenced by the same variables which influenced female bovine intensity. There were also indications that DRP might negatively influence female cattle intensity. Number of

Table 4. Correlation between livestock intensity and relevant variables (2003)

Livestock composition category	Density of rural population (No./ha)	Area under forests and pastures (ha)	Area under fruits and vegetables (ha)	Landholdings less than 0.5 ha	Food crop output per rural person	Altitude (m)
Livestock per km ² of geographic area	0.893*	-0.760*	-0.319	0.681*	0.282	-0.336
Livestock per km ² NSA	-0.770*	0.554**	0.317	-0.316	-0.600*	0.282
Livestock per 100 rural population	-0.787*	0.633*	0.540**	-0.162	-0.494**	0.538**
Bovine per km ² of geographic area	0.947*	-0.739*	-0.327	0.569**	0.324	-0.366***
Bovine per km ² NSA	-0.659*	0.217	0.402***	-0.294	-0.568**	0.297
Bovine per 100 rural population	-0.650*	0.268	0.787*	-0.128	-0.421***	0.653*
Ovine per km ² of geographic area	-0.341	-0.099	0.226	0.460**	-0.262	0.259
Ovine per km ² NSA	-0.691*	0.694*	0.128	-0.239	-0.461**	0.160
Ovine per 100 rural population	-0.715*	0.739*	0.250	-0.162	-0.432***	0.294
Male cattle per km ² NSA	-0.790*	0.434***	0.370***	-0.455**	-0.544**	0.241
Female bovine per km ² NSA	-0.494*	0.143	0.279	-0.352	-0.357	0.430***
Female bovine per 100 rural population	-0.367***	0.095	0.481**	-0.217	0.010	0.686*
Female cattle per 1000 rural population	-0.589*	0.290	0.816*	-0.300	-0.236	0.754*
Female buffalo per 1000 rural population	0.239	-0.265	-0.376***	0.073	0.360***	0.066

Significant at *1%, **5% and ***10% levels of significance, respectively.

female buffalo per capita population was significantly and negatively associated with AFV and significantly and positively associated with crop output per rural person. Indigenous local cows constitute the major share of cattle population in the state. The local cattle can be fed by limited amount of crop residues and byproducts supplemented by grazing, on account of their low productivity. Increased area under fruits and vegetables limits the crop output, which adversely affects the intensity of buffaloes as they on account of higher productivity, are entirely fed with crop feeds. But limited crop availability does not have adverse impact on local cattle density as they are not well-maintained and well-fed as the CB cattle and buffaloes. Since area under fruits and vegetables is highly associated with altitude, the negative effect of area under fruits and vegetables might also be due to adverse effect of altitude as buffaloes are less suited to higher altitudes. Local cows are sturdier and more adaptable to high altitude (comprising cold climate) than buffaloes. This explains the positive and significant association of female cattle density with altitude. The positive effect of crop output per person on female buffalo density per capita rural population might be due to the reason that buffaloes are almost entirely stall-fed with crop feeds. So higher crop output has favourable impact on female buffalo keeping. The negative effect of human population density on female cattle density per capita rural population and its insignificant effect on female buffalo density imply that economic dependence on cattle is more, relative to buffaloes, in sparsely populated regions.

SUMMARY

Trends in livestock population and compositional changes in broad groups of bovines and ovines in Uttarakhand reveal that (economic) importance of bovines is increasing, relative

to ovines. Although goat population is increasing, sheep population is declining noticeably. Within the bovine group, buffalo population is increasing at much faster rate than cattle population. The same also holds true in adult female stock as adult female buffaloes registered a much higher growth than adult female cattle. Share of female CB cattle is also increasing in female cattle population. This indicates that proportion of high-yielding bovines, viz. CB cattle and buffalo is increasing, while that of less productive cattle is declining. Share of work animals (adult male stock) in bovine population is declining, while that of female cattle and buffalo in total cattle and buffalo population is increasing, indicating that there might be gradual shift in preference for bovines for milk purpose than draught purpose. Findings regarding factors influencing livestock composition indicate that availability of crop feeds in the form of crop residues, by-products and grains favourably affect keeping of high-yielding and more productive bovines. Per capita crop output was, however, not determining factor for keeping of local cows as they were not as well-fed as more productive bovines, on account of their low productivity. There were also indications that complementarity between crop and bovine is mainly in terms of supply of dung and use of crop by-products, rather than supply of draught power. Findings in regards to determinants of livestock intensity indicated that economic dependence on livestock is relatively more in sparsely population regions. Higher availability of area under forests and pastures is associated with increase in ovine density. Area under forests and pastures positively influence adult male cattle density. Regions with higher crop output also have higher number of more productive bovine per capita rural population. There are also indications that female cattle density increases with altitude, while relationship of female buffalo density with altitude is insignificant. This might be

due to lower adaptability of buffaloes with cold climate represented by higher altitude. To address the issue of livestock pressure on natural resource base, it is essential to address the problem of feed and fodder scarcity through increasing productivity of fodder per unit area, cultivation of all-year round fodder crops, popularization of simple and cost-effective feeding technologies like chaffing of fodder and complete feed blocks and supplementation of macro and micro nutrients.

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