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Dynamics and Sustainability of Livestock Sector in Jammu & Kashmir[§]

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Abstract

The changing profile of livestock sector in relation with its sustainability has been studied in the state of Jammu & Kashmir. The share of each region in major livestock has shown a significant change during the decade of 1992-2003, though variation in concentration of different livestock species across different regions is clearly visible. Increase in proportion of some species and decrease in others in the state seem to have influenced the speed of intensification across different regions. The livestock intensity has either exhibited an increasing trend, as in the Jammu Region or has remained static as in the Ladakh Region or has declined as in the Kashmir Region, from 1992 to 2003. The estimates of coefficient of variation in the adoption of cross-bred animals/birds have indicated the scope for improving animal productivity through increase in adoption of cross-bred/improved animals. The study has suggested a need to increase meat production, especially of mutton and white meat in view of their rising demand. The coefficients of correlation have revealed higher dependence of livestock, especially small ruminants on the geographical area (excluding net area sown) and this interaction may have serious ecological implications if not addressed properly. Besides, the available common property resources (CPRs) in the state being meagre to sustain its whole livestock population, concerted efforts have to be made to arrest their deterioration through legal, social and institutional means. Considering sustainability and food security issues, the study has emphasized on an appropriate livestock mix and increasing animal productivity through scientific management for the overall social benefits from this sector. In addition, budgetary allocations to research in this sector should be enhanced to evolve innovative production technologies leading to improved animal production efficiency.

Key words: Livestock dynamics, Livestock-ecology interaction, Livestock sustainability, Veterinary institutions, Jammu & Kashmir

JEL Classification: Q01, Q19

Introduction

Livestock makes multi-faceted contribution to socio-economic development of rural masses. Due to the inelastic absorptive capacity for labour in other economic sectors, livestock sector has the scope for

generating more employment opportunities, especially for the marginal and small farmers and landless labourers who own around 70 per cent of the country's livestock. Livestock wealth is more equitably distributed than that of land (Kumar and Singh, 2008). Being an important source of income and employment for this section of society, the livestock helps in alleviating poverty and smoothening of income distribution (Birthal *et al.*, 2002). Livestock is important both as savings and investments for the poor household and provides

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§ This paper is a part of research work conducted under the ongoing ICSSR-research project, "Transformation of Rural Economy in J&K"

security or insurance through multiple ways in different production systems (Kitalyi *et al.*, 2005). In the mixed crop-livestock system, its importance goes beyond direct food production function. It supplies draught power and organic manures to the crop sector and hides, skin, bones, blood and fibres to the industries. Livestock makes substantial contributions to conservation of environment by utilizing huge amount of crop residues and by-products as feed/fodder and by supplying draught power and dung that save renewable environment polluting energy sources (chemical fertilizers, diesel, petrol, etc.). In view of the rich interaction between crop and livestock, it is being increasingly realized that integrating livestock in a system approach would arrest the sustainability concerns, which are the keys to country's food security (Sere and Steinfeld, 1996; Hann *et al.*, 1997; Patel, 1993; Singh *et al.*, 2005).

Driven by sustained economic growth and rising incomes, there is a structural shift in the consumption pattern in favour of livestock products in both rural and urban areas (Kumar, 1996; Gandhi and Mani, 1995). In addition, the income elasticity of demand for livestock products is high estimated towards unity for certain wealth groups in the rural areas (Mehta *et al.*, 2003; Kumar, 1998). Although the production of livestock and its products has been increasing over the years, serious doubts have been expressed regarding sustainability of these trends because these are by and large seen population-driven (Birthal, 2000) as also the nature of contribution of livestock has been changing over time and varies from place to place.

The livestock capital plays a crucial role, as an integral part of the age-old crop-livestock mixed farming system in the mountainous regions where livelihood options in the non-farm sectors are limited for the resource-poor hill peasantry. The dynamics of livestock have implications in this region owing to increased demand for the livestock products and issues like draught power availability and ecological pressure (Chand, 1995). In this backdrop, an attempt has been made in this paper to address the contemporary issues of growth, ecological implications and sustainability in this agricultural sub-sector from a wider dimension for integrating livestock with land-use planning across different regions of the state of Jammu & Kashmir (J&K). The specific objectives of this study were: (i) to examine the distribution/growth in livestock and

livestock products and to study the extent of adoption of cross-bred technology in the state, (ii) to analyze the livestock-ecology interactions and carrying capacity of CPRs, and (iii) to study the dynamics of budgetary allocations to this sector in relation with the growth of veterinary institutions in the state.

Data and Methodology

Jammu & Kashmir, a north-western hill state of India, has varied agro-climatic conditions across various regions and based upon this diversity/geographical locations, the state has been divided into three distinct regions, viz. Kashmir region (temperate), Ladakh region (cold arid), and Jammu region (sub-tropical). Each region provides suitable production environment to the particular crop-livestock mix, based upon its setting. This paper has addressed the growth and sustainability issues relating to the livestock sector in these three regions of J&K.

The study is based upon the secondary data obtained from diverse sources. District level data pertaining to different aspects of livestock were collected from the Livestock Census, 1992 and 2003, Basic Animal Husbandry Statistics, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. The other information perused in the paper was collected from various issues of *Digest of Statistics*, Directorate of Economics and Statistics, Planning and Development Department, Government of J&K and Integrated Sample Survey, Directorate of Economics and Statistics, Government of J&K. The optimum carrying capacity of common property resources (CPRs) was estimated by employing the following formula (Singh, 1989):

Optimum livestock population for CPRs =

$$\frac{\text{Required No. of Adult Cattle Units (ACU)/ hectare}}{\text{Required area (ha) per ACU for grazing}} \times \text{Area (ha) available as CPR}$$

Besides, simple analytical tools like compound growth rates, Pearson's correlation, etc. were employed to analyse the data.

Results and Discussion

The livestock population in the state was 9.8 million, of which nearly two-thirds was cattle and one-third

was sheep population (Livestock Census, 2003). The livestock showed a diverse scenario across different regions; in the Kashmir region (KMR) livestock population reduced by 0.3 million during 1992 to 2003, and it increased significantly in the Jammu region (JMR) and Ladakh region (LDR). Although, the composition of cattle has been changing in favour of milch animals largely due to increasing mechanization of agricultural operations, the maintenance of a sufficient number of draught animals, buffaloes, sheep, goats and equines for various purposes has been a tradition (Birthal and Taneja, 2006). The poultry sector has also demonstrated an increase from 46 lakhs to 56 lakhs between 1992 and 2003. The variation in distribution and composition of livestock was examined to understand the dynamics of livestock population in the three regions of J&K and has been discussed under specific heads in the following sections.

Distribution of Livestock across Different Regions

The distribution of major livestock species across the three geographical regions of J&K is documented in Table 1. Barring a few exceptions, the share of each region in major livestock has shown a significant change

during the decade of 1992-2003, though variation in concentration of various livestock species across various regions is clearly visible. A higher proportion of all the species of livestock (about 98% of buffalo, 71% of goat, 66% of sheep and 55% of cattle population in the state) was concentrated in the JMR. The share of JMR in the total livestock population, except goat had increased during 1992 to 2003. Within JMR, the districts of Udhampur, Doda and Rajouri accounted for a higher proportion of the total livestock population in the state owing to their natural niches and availability of pastures. Yet surprisingly, the share of KMR in the cattle and sheep population in the state had declined from about 49 per cent and 39 per cent to 42 per cent and 28 per cent, respectively. This scenario is in consonance with the decline in both male and female population of indigenous species of these animals. The cross-bred species of these animals have increased during 1992 to 2003, though they have not fully compensated for the decline in indigenous cattle and sheep population. The share of KMR in the total buffalo population in the state has also declined over the years. The least preference for buffalo milk and its products could explain the decline in buffalo population in the KMR. The distribution of various livestock species across

Table 1. Distribution of major livestock species across different regions of J&K

(in per cent)

Region	Cattle		Buffalo		Sheep		Goat		Total livestock	
	1992	2003	1992	2003	1992	2003	1992	2003	1992	2003
Kashmir region	49.29	42.03	4.26	1.85	39.54	28.04	10.90	14.24	34.04	26.69
Anantnag	12.10	11.19	0.95	0.79	11.32	7.35	1.75	2.48	8.69	6.82
Baramulla	9.93	9.15	1.35	0.73	8.61	8.51	2.44	4.72	7.20	7.02
Budgam	6.61	5.57	0.15	0.05	4.79	3.11	1.19	2.00	4.31	3.32
Kupwara	7.89	5.91	0.74	0.20	5.52	2.15	3.40	2.09	5.50	3.21
Pulwama	8.78	6.14	0.86	0.00	5.86	4.03	1.29	1.72	5.51	3.73
Srinagar	3.98	4.07	0.21	0.08	3.45	2.90	0.84	1.24	2.83	2.59
Ladakh region	2.09	2.49	4.96	0.00	8.78	5.76	11.93	14.35	7.00	6.58
Kargil	1.27	1.46	3.34	0.00	6.08	2.75	5.65	3.69	4.16	2.55
Leh	0.81	1.03	1.62	0.00	2.70	3.00	6.28	10.66	2.84	4.03
Jammu region	48.62	55.48	90.78	98.15	51.68	66.20	77.16	71.41	58.96	66.73
Doda	10.69	15.69	5.48	9.71	13.52	19.87	7.65	9.52	10.61	15.21
Jammu	14.31	7.79	35.09	20.85	3.01	2.61	13.83	9.09	12.14	7.56
Kathua	6.75	7.53	10.21	8.38	9.43	6.68	22.32	8.97	11.06	7.51
Poonch	3.04	5.50	10.29	18.11	6.33	8.12	6.05	7.99	5.33	8.19
Rajouri	4.36	6.74	12.15	19.42	6.86	12.00	13.92	15.84	7.82	11.93
Udhampur	9.47	12.23	17.57	21.68	12.54	16.91	13.40	19.99	12.00	16.33

districts of KMR revealed that Baramulla and Anantnag had a higher share of all the species as compared to other districts in this region. The LDR registered enhancement in the share of population of goats and other animals owing to suitability of climate and altitudinal location. The goats yield highly-priced fine wool called “pashmina”, which encourages more of their population in this region. The LDR constituted around 5 per cent of the total buffalo population in 1992, but by 2003 this species became almost invisible in this region due to poor performance of this species in its cold arid climate. While the share of LDR in sheep population declined during 1992 to 2003, its share in total cattle population showed a marginal increase. Although the share of KMR in poultry has gone down during 1992 to 2003, a higher proportion of poultry was concentrated in this region, followed by JMR.

Species-mix

The spatio-temporal composition of livestock had changed noticeably during the period 1992 to 2003, as shown in Table 2. The sheep and cattle dominated the livestock production system and constituted over 65

per cent of livestock population in the state, despite significant variations from 1992 to 2003. While the share of buffaloes and other animals increased significantly, the share of cattle reduced from 35 per cent in 1992 to 31 per cent in 2003 of the livestock population during this period. The share of sheep in total livestock population in the state exhibited a marginal increase during 1992 to 2003. Goat and sheep dominated the livestock production system in the cold arid region of Ladakh. This region has comparative advantage in raising ‘*changra*’ goats known worldwide for production of fine ‘*pashmina*’ wool which fetches a handsome price in both national and international markets. Although the share of goats, cattle and other animals had increased, the share of sheep had declined towards 2003 in this region. The KMR is cattle-dominated, followed by sheep despite their declining share towards 2003. The JMR is dominated by sheep, followed by cattle and goats. The dominance of cattle in the livestock production system of KMR could be explained by the fact that cattle (cross-bred and buffaloes) feed on the crop by-products and residues, which are related to net sown area, irrigation and rising demand for cow milk.

Table 2. Species-mix of livestock in different regions of J&K

Region	(in per cent)									
	Cattle		Buffalo		Sheep		Goat		Total livestock ('000 No.)	
	1992	2003	1992	2003	1992	2003	1992	2003	1992	2003
Kashmir region	50.81	49.06	1.05	0.73	39.32	36.20	6.50	11.08	2963	2642
Anantnag	48.86	51.11	0.92	1.21	44.12	37.12	4.08	7.54	756	675
Baramulla	48.39	40.59	1.57	1.09	40.46	41.76	6.88	13.95	627	695
Budgam	53.78	52.22	0.30	0.15	37.64	32.21	5.61	12.51	375	329
Kupwara	50.34	57.44	1.13	0.67	33.95	23.13	12.54	13.53	479	317
Pulwama	55.88	51.27	1.31	0.00	35.95	37.18	4.73	9.54	480	370
Srinagar	49.47	48.94	0.64	0.33	41.31	38.57	6.00	9.96	246	256
Ladakh region	10.45	11.79	5.95	0.00	42.43	30.16	34.57	45.29	610	651
Kargil	10.73	17.85	6.74	0.00	49.39	37.27	27.53	30.11	363	252
Leh	10.05	7.96	4.80	0.00	32.21	25.67	44.89	54.88	247	399
Jammu region	28.94	25.90	12.95	15.44	29.67	34.18	26.54	22.21	5134	6606
Doda	35.36	32.15	4.34	6.70	43.13	45.03	14.62	13.00	924	1505
Jammu	41.35	32.10	24.31	28.95	8.39	11.90	23.09	24.94	1057	749
Kathua	21.41	31.22	7.76	11.72	28.85	30.65	40.91	24.80	963	744
Poonch	20.05	20.91	16.26	23.22	40.22	34.17	23.02	20.26	464	811
Rajouri	19.55	17.60	13.06	17.09	29.67	34.65	36.09	27.56	681	1181
Udhampur	27.70	23.33	12.32	13.94	35.37	35.68	22.65	25.41	1044	1617
J&K	35.09	31.15	8.41	10.50	33.85	34.45	20.28	20.76	8707	9899

The temporal study of composition revealed that the population of cattle had declined in both KMR and JMR, but it was more pronounced in the JMR. However in the LDR, their share had gone up. There had been an increase in the proportion of buffaloes in all the districts of JMR. Harsh climatic conditions during a major part of a year in the KMR and LDR had culminated into a decline in the share of buffalo in livestock- mix. The proportion of sheep in the total livestock had gone up in the JMR and was quite perceptible in the Rajouri and Jammu districts. Sheep-owners migrate from Jammu to Kashmir region along with their flock for grazing in lush green pastures during summers and return back to their own regions during winters, thus leaving no room for Kashmir sheep rearers to migrate to places with better pasture availability which demand formulation of appropriate grazing strategy for a rational use between the regions, otherwise the existing system deprives one region of harnessing the benefits of CPRs and creates regional disparity with respect to this species. It is more warranted in view of the fact that there is great demand for mutton in the Kashmir region throughout the year, especially during important festival periods. Though the absolute number of goats has increased more in JMR relative to other regions, their proportion has shown a significant decline owing to the better growth performance of sheep. Although the other animals including horses, ponies, mules, etc. had a lower share in livestock in all the regions, their share grew up from 1992 to 2003.

As far as poultry is concerned, it is highly dominated by fowl with its share ranging from about 87 per cent in the Kashmir region to over 99 per cent in the Jammu region (Livestock Census, 1992; 2003). This scenario is in consonance with the increasing consumption of white meat in the state.

Density and Quantum of Growth in Livestock

To ascertain the extent of intensification of livestock, livestock density was studied for the state and the results presented in the Table 3, revealed that livestock intensity in the state increased from 86 animal/sq km in 1992 to 98 animals/ sq km of geographical area in 2003. The increase in proportion of some species and a decrease in the others seem to have influenced the speed of intensification in the state. The livestock density exhibited a considerable variation across

different regions of J&K (Table 3). The livestock production system was found more intensified in the JMR (251 animals/sq km), followed by KMR in 2003. As far as the growth of livestock intensity was concerned, it had declined from 186 animals/sq km (1992) to 166 animal/sq km (2003) in the KMR, while it had increased significantly in the JMR and remained almost stagnant in the LDR. Though the density of cattle in the KMR had declined from 94 /sq km in 1992 to 81/sq km in 2003, their density was still higher in this region than in JMR and LDR. The cattle density in LDR was meagre, although it showed a marginal increase during 1992 to 2003. The density of buffalo was higher in the JMR and had increased from 1992 to 2003 with respect to the geographical area. The buffalo density in the KMR and the cold-arid LDR was very low in 1992 and declined further by 2003. The density of sheep was higher in the KMR, followed by JMR. The JMR registered a considerable increase in sheep density, which had significantly declined in other regions. On the other hand, the density of other animals showed a small increase in all the regions of J&K. As regards poultry, its density with respect to geographical area was higher in the KMR, followed by JMR. The density of poultry has shown an increase in all the regions, although the increase was higher in JMR.

The growth trends in population of different species showed a consistent pattern (Table 3). Cattle population increased in all the regions, except in KMR, which showed a decline owing to reduction in both indigenous male and female cattle. Within the Jammu region, the districts of Jammu and Poonch registered a negative growth in cattle population; it could be attributed to expansion of cities and towns in these districts. The buffalo population increased in the JMR at a higher rate (5.0%), however, in the KMR buffalo population declined significantly at an annual growth rate of 14 per cent. Except for the JMR, the two other regions expressed a negative growth in sheep population. Goats grew significantly in all the regions, although its growth rate (3.1%) was relatively higher in JMR.

To sum up, the increase in livestock intensity in the state was experienced due to intensification of livestock, especially population of sheep in the JMR, indicating that this region has better availability of and access to resources like feed and fodder and has comparative advantage in livestock production. Increasing intensification of livestock depicted a good picture from

the point of view of availability of livestock products; and the sustainability issue of livestock production system, in respect of increasing livestock population, did not seem to pose a challenge, though appropriate species-mix and enhancing productivity of livestock animals still remain a major challenge. However, this intensification has raised the issues of sustainability in the state in respect of decreasing holding size and availability of CPRs. Accordingly, it was imperative to study the association between livestock intensification and the available resources.

Adoption of Cross-bred/Improved Animals

Cross-breeding of indigenous stock with exotic animals is a well known strategy for improving the productivity of indigenous stock, mainly of cattle, sheep and pigs (Kumar and Singh, 2008). Various centrally and state sponsored cattle development schemes were implemented for the improvement of indigenous breeds in the state. With an intention to find out the extent of adoption of cross-bred animals, percentages were estimated and are presented in Table 4. In the cattle,

cross-breds comprised 42 per cent in 2003, as against only 26 per cent in 1992. During this period, the proportion of cross-bred sheep and pig increased from 40.59 per cent and 0.07 per cent to 58.70 per cent and 36.63 per cent, respectively. Regional variations in the adoption of cross-bred technology are glaring. In 2003, about 62 per cent of the cattle were cross-bred in the KMR. In the KMR, Pulwama district had the highest population of cross-bred cattle in 2003, followed by Budgam and Srinagar. In the LDR and JMR, about 39 per cent and 29 per cent cattle were cross-bred, respectively. A higher proportion of cross-bred cattle in the KMR compared to other regions was not only due to adoption of cross animals but was more due to a significant decline in the population of both indigenous male and female cattle. In JMR, the proportion of cross-bred cattle did not increase significantly; it could partly be attributed to higher preference for the buffalo milk. In the case of sheep, the maximum adoption of cross-breds was observed in the KMR, followed by JMR. Pigs were visible in only few districts of JMR and about 37 per cent pigs were cross-bred in this region while

Table 3. Density and compound growth rates in livestock population in different regions of J&K: 1992-2003

(Density in per sq km of geographical area & growth in per cent)

Region	Cattle			Buffalo			Sheep			Goat			Livestock		
	1992	2003	G	1992	2003	G	1992	2003	G	1992	2003	G	1992	2003	G
Kashmir region	94	81	-0.2	2	1	-14.0	73	60	-1.9	12	18	0.5	186	166	-1.04
Anantnag	93	87	-0.6	2	2	1.5	84	63	-2.6	8	13	4.7	190	169	-1.03
Baramulla	66	61	-0.7	2	2	-2.4	55	63	1.2	9	21	7.6	137	151	0.94
Budgam	147	125	-1.5	0.8	0.4	-7.1	103	77	-2.6	15	30	6.3	274	240	-1.19
Kupwara	101	77	-2.5	2	0.9	-8.2	68	31	-7.0	25	18	-3.0	201	133	-3.67
Pulwama	192	135	6.7	4	0.0	-	123	98	-2.7	16	25	-9.6	343	264	-2.35
Srinagar	55	56	0.3	0.7	0.4	-5.4	46	44	-0.2	7	11	5.1	110	115	0.38
Ladakh region	1	1	1.7	0.6	0.0	-	4	3	-2.5	4	5	3.1	10	11	0.6
Kargil	3	3	1.3	1.7	0.0	-	13	7	-5.7	7	5	-2.5	26	18	-3.25
Leh	0.5	0.7	2.3	0.3	0.0	-	2	2	2.3	2	5	6.4	5	9	4.45
Jammu region	56	65	0.3	25	39	5.0	58	86	3.7	52	56	1.3	195	251	2.32
Doda	28	41	3.6	3	9	8.7	34	58	5.0	11	13	3.4	79	129	4.54
Jammu	141	78	-5.3	83	70	-1.5	29	29	0.0	79	60	-2.4	341	242	-3.09
Kathua	78	88	1.1	28	33	1.4	105	86	-1.8	149	69	-6.7	363	280	-2.33
Poonch	55	101	-4.1	45	112	36.2	111	165	4.4	64	98	19.7	277	484	5.21
Rajouri	51	79	4.1	34	77	7.7	77	156	6.6	93	124	2.6	259	449	5.13
Udhampur	64	83	2.4	28	49	5.2	81	127	4.1	52	90	5.1	229	355	4.05
J&K	30	30	0.1	7	10	3.2	29	34	1.3	17	20	1.4	86	98	1.17

Notes: *includes pig, horses, ponies, etc.

G denotes compound growths rates

Table 4. Extent of adoption of cross-bred technology in livestock in different regions of J&K

Region	(in per cent)							
	Cattle		Sheep		Pig		Poultry	
	1992	2003	1992	2003	1992	2003	1992	2003
Kashmir region	25.32	61.60	38.21	65.15	-	-	15.66	15.72
Anantnag	35.26	65.21	37.71	64.66	-	-	7.52	11.49
Baramula	19.83	49.74	28.46	60.26	-	-	11.78	12.93
Budgam	37.55	81.22	41.09	76.93	-	-	27.84	11.80
Kupwara	12.49	22.62	33.34	31.53	-	-	13.09	4.54
Pulwama	7.22	89.99	51.20	81.96	-	-	17.65	26.48
Srinagar	27.72	65.25	44.12	69.73	-	-	33.03	38.03
Ladakh region	21.47	38.50	21.13	41.88	-	-	40.14	61.51
Kargil	29.14	49.86	22.87	28.54	-	-	45.96	65.21
Leh	9.47	22.43	17.22	54.12	-	-	18.72	36.88
Jammu region	26.61	28.76	45.80	57.44	0.07	36.63	39.82	51.05
Doda	3.39	28.09	40.80	49.37	-	-	11.25	30.57
Jammu	53.96	50.00	22.60	82.14	4.39	32.78	64.59	87.82
Kathua	14.97	28.37	39.72	57.37	42.48	53.42	64.18	89.00
Poonch	52.51	24.25	45.21	63.37	-	-	30.86	32.42
Rajouri	4.81	25.99	49.74	57.73	1.45	62.81	5.48	25.89
Udhampur	5.84	19.87	59.45	60.07	2.73	37.32	14.40	18.80
J&K	25.94	42.80	40.59	58.70	0.07	36.63	25.49	32.71

this species was non-existent in other regions of the state.

It is interesting to note that poultry population was highly dominated by the indigenous birds, although there was an increase in the proportion of cross-birds from 25.49 per cent (1992) to 32.71 per cent of total poultry population (2003). While there had been a significant shift towards improved birds in the LDR and JMR between 1992 and 2003, the proportion of indigenous birds continued to be around 84 per cent in the KMR despite the fact that this region constituted more than 50 per cent of the total poultry population. This level of adoption signifies a high potential of dissemination and replacement by improved birds of poultry.

Studies have shown that a high value of coefficient of variation (explaining varying level of adoption of cross-bred technology, higher in some regions/districts and lower in others) indicates that livestock sector still had the potential which could be harnessed through a higher adoption of cross-bred animals in places where its adoption was comparatively lower for productivity gains (Chandel and Malhotra, 2006). Accordingly, an attempt was made to estimate the coefficients of

Table 5. Estimates of coefficient of variance of adoption of crossbred technology

Species	(in per cent)	
	1992	2003
Cattle	76.93	52.96
Sheep	31.66	26.81
Poultry	77.27	75.15

variation in adoption of cross-bred technology and the results revealed that the adoption of cross-bred animals was more in some districts than in others even in the same region. The value of coefficient of variation had declined between 1992 and 2003, though the existence of variation indicated a higher potential of improving animal productivity through replacement of indigenous breed with improved animals (Table 5).

Output from Livestock Sector

Consistent with the increasing livestock population, output from this sector had witnessed an increase (Table 6). The contribution of livestock to state gross domestic product has shown an absolute increase over the years, but its percentage share had gone down from 13 per cent (1995) to 11 per cent (2005) (Integrate

Table 6. Growth of output from livestock sector: 1997 to 2006

Year	Milk		Meat		Eggs		Wool	
	P	PCA	P	PCA	P	PCA	P	PCA
1997	1167	347.23	0	0.00	5182	0.15	4616	501.3
1998	1232	357.49	25.56	7.42	5200	0.15	5450	577.2
1999	1286	364.14	25.81	7.31	5593	0.16	5440	562.2
2000	1321	365.21	26.29	7.27	5689	0.16	5583	563.4
2001	1360	367.32	26.64	7.20	6065	0.16	5810	572.8
2002	1389	366.70	27.05	7.14	6220	0.16	6034	581.4
2003	1414	365.07	27.00	6.97	6370	0.16	6200	584.3
2004	1422	359.21	27.00	6.82	6105	0.15	7120	656.5
2005	1400	346.19	27.00	6.68	6320	0.16	7400	667.9
2006	1485	359.61	26.61	6.44	6264	0.15	6857	606.1
CGR (%)	2.30*	0.01	0.60*	-1.65*	2.35*	0.06	4.49*	2.20*
	(0.27)	(0.25)	(0.18)	(0.16)	(0.40)	(0.38)	(0.55)	(0.55)

Notes: * Significance at 5 per cent or lower probability level

P= Production (milk & meat in '000 tonnes, wool in '000 kg and eggs in lakh Nos.)

PCA = Per capita availability (g/day in case of milk and meat, No. /day in case of eggs and g/annum of wool)

Figures within the parentheses indicate standard error

Source: *Basic Animal Husbandry Statistics* (2006), Ministry of Agriculture, Government of India, New Delhi

Sample Survey, 1995; 2003). The temporal changes in livestock output (in terms of livestock products) presented in the Table 6, revealed that the total milk production in the state had gone up from 1167 thousand tonnes in 1997 to 1485 thousand tonnes in 2005. The species-wise milk production had also undergone significant changes in consonance with the adoption of cross-bred technology (Integrated Sample Survey, various issues). The increase in state milk production was accompanied with its increasing per capita availability. Another important product of livestock is meat whose production had increased in the state though, its per capita availability showed a declining trend which needs to be reversed immediately in view of its increasing demand in the state and increasing imports of sheep and goats in the state (*Digest of Statistics*, various issues). Increase in the production of meat (both mutton and white meat) assumes more importance owing to the ban on legal slaughter of cattle in the state under the Ranbir Panel Code. As regard other products, the total wool production as well as its per capita availability had significantly increased since 1997. The poultry sub-sector had made significant improvement in its contribution to the total livestock production in the form of white meat and eggs. Egg production in the state showed an increase of about

1082 lakh eggs from 1997 to 2005. The compound growth rates indicated that this sector had registered a significant growth since 1997, however, per capita availability of these products emphasized improvement in the production of major outputs for the growing population.

Livestock-Ecology Interactions

Livestock production has been a part of mixed farming systems, which has a high degree of environmental sustainability. However, the environmental sustainability of recently evolved capital-intensive livestock production systems is uncertain and has been pushed beyond its sustainable equilibrium (FAO, 1996). There is a whole range of livestock-environment interactions, both direct and indirect, which are mainly based on the livestock production systems. Some of the interactions are positive and resource-enhancing, while others are negative and resource-depleting. In this back drop, it was imperative to analyze how different livestock species interact with the land resources in J&K where common grazing land is meagre to sustain the increasing population besides scarcity of fodder resources causing import of fodder from other states to the tune of 1669 thousand quintals (*Digest of Statistics*, 2006-07).

Natural resources provide a suitable environment for livestock rearing and the degree of dependence on these resources varies with the kind of livestock species. While sheep, goats, pack animals and indigenous bovine graze on pastures, forests, and other uncultivated barren lands depend to a large extent on these resources, the improved animals and buffaloes depend partly on stall feeding. Accordingly, it is natural as these animals have a higher dependence on land other than cultivated area for their subsistence (Kumar *et al.*, 2004). To investigate how different types of animals, viz. bovines, pack animals and ovines, interact with these resources, the correlation between these animals with several variables such as geographical area, excluding net sown area per thousand of rural population [$GA = (\text{Geographical area} - \text{net sown area}) / (\text{rural population} / 1000)$], net sown area per thousand of rural population (NSA), proportion of small and marginal farmers (SMF), Cropping intensity (CI) and mechanization [$MECH = (\text{Tractors} + \text{Power tiller}) / \text{Net area sown (ha)}$] was examined (Table 7).

A correlation between bovine density and variables such GA, NSA, CI and SMF was computed (Table 7) and the results revealed a significant positive correlation between bovine and GA and this association had strengthened towards 2003, indicating that these animals depend heavily on the geographical area, excluding the net area sown for food. This interaction of livestock may have unfavourable impact on its

sustainability and could degrade the environment through excessive grazing on common resources, if appropriate sustainability measures are not devised. The positive association between bovine density and GA implies that bovine density was higher in districts having higher proportion of GA as this analysis perused the data pertaining to one point of time. Had this analysis been based upon time series data, the negative correlation between bovine and GA (increase in bovine density and decrease in GA) would really have been more fatal. The estimates of correlation between bovine and NSA turned positive, although its estimate was not statistically significant, it did provide an approximation about the fact that bovines (expectedly crossbred and buffaloes) depend partly on fodder, crop and crop residues for food. Diversification of bovine in favour of cross-bred animals coupled with strengthening of livestock-crop association would be favourable for the sustainability of bovine economy in future. The negative correlation between bovine and SMF could be explained by the fact that only well-endowed farmers had a venture in this enterprise and with the dwindling landholdings, it was becoming difficult for the resource-poor farmers to rear bovine animals.

The inter-relationship between small ruminants and environment was studied by examining the correlation between the density of small ruminants and GA, NSA, MECH and CI. Small ruminants were found to have a strong positive correlation with GA, indicating that this

Table 7. Correlation coefficients of livestock with ecological variables

Species	Year	Geographical area	Net sown area	Cropping intensity	Mechanization	Small and marginal farmers
Bovine	1992	0.49	0.21	0.16	0.07	0.02
	2003	0.78	0.34	0.62	-0.15	-0.74
Cattle	1992	0.43	0.10	0.04	-0.02	0.11
	2003	0.75	0.22	0.21	-0.39	-0.43
Buffalo	1992	0.53	0.58	0.62	0.42	-0.37
	2003	0.60	0.34	0.75	0.06	-0.78
Small ruminants	1992	0.61	0.09	0.10	-0.21	-0.12
	2003	0.61	0.32	-0.08	-0.30	-0.46
Sheep	1992	0.52	-0.03	-0.05	-0.27	0.02
	2003	0.75	0.25	0.03	-0.46	-0.56
Goat	1992	0.75	0.38	0.45	-0.02	-0.45
	2003	0.47	0.33	-0.13	-0.17	-0.35
Pack animals	1992	0.52	0.20	0.00	-0.09	-0.01
	2003	0.59	0.41	-0.40	-0.22	-0.10

Note: Correlation values above 0.37 are statistically significant at 5 per cent or lower level

species was allowed to graze on this land-use class. It was natural owing to their higher dependence on lands other than cultivated areas for their sustenance and any increase in their population in future would have adverse impact on the environment in the state unless suitable management measures are taken. It is very interesting to note that small ruminants had a negative correlation with SMF and it could be due to the fact that this category did not possess enough capital and space to rear herd of sheep/goats. However, it has been observed that landless pastoral nomads bring up these species on a large-scale in the tribal ranges of the state and the livestock migration is followed in accordance with the traditional socially established annual routes (Wani *et al.*, 2008). In the case of landless small ruminant herders, livestock-crop integration would be completely ruled out, thereby emphasizing upon effective management practices of CPRs.

Pack animals including horses, ponies, mules and donkeys, are usually domesticated for their services in off-farm jobs and hiring-out of their services is also common in some regions of the state. Correlation was computed between the density of pack animals and GA, NSA, SMF and MECH (Table 8). The correlation of pack animal was found positive with respect to GA and this relation was found varying positively in both the periods, indicating that these animals depend increasingly on natural resources.

Conversely, the estimates of correlation with NSA indicated that these animals partly fed on fodder, crop and their residues, implying that these animals would increasingly depend on NSA for subsistence which is favouring sustainability of these animals. Though pack animals had a positive correlation with GA and NSA, the difference between correlation estimates of 1992 and 2003 revealed that pack animal-NSA relation had become stronger, highlighting the possibility that these species were increasingly stall fed. Such association would expectedly ease the burden on CPRs. Expectedly, the correlation with respect to mechanization was found negative, although the relation was statistically insignificant. These results give an idea that increasing mechanization in the state would check more intensification of pack animals.

The correlation would have been positive even when both density of pack animals and GA were declining; however, this possibility was ruled out firstly due to the increase in absolute number/density of pack

animals from 1992 to 2003; secondly, this analysis was based upon the data pertaining to one point of time; therefore, this correlation indicated that the density of pack animals was higher in areas having higher endowment of GA.

To sum up, it has been observed the production environment may be strained owing to the fact that majority of livestock species depend heavily on geographical area for their sustenance. If this problem remains unattended then it may have serious ecological implications.

Carrying Capacity of Common Property Resources (CPRs)

The common property resources (CPRs) help in sustaining a number of animals for draught and livestock production which would not have been permitted by an individual at his land, especially for small farmers (Jodha, 1986). These land resources comprise forest, village common and pasture lands, wastelands, community threshing grounds, ponds, tanks, etc. Through the supply of fodder and grazing space, the CPRs help the individuals in saving their lands for fodder crops. The attempt made to work out the carrying capacity of CPRs, revealed that one adult cattle unit (ACU) requires 0.9 hectare CPR land in northern India (GoI, 1976). Equating the number of census households (253 thousand) in the state and CPR land available per household (0.14 ha) (NSSO, 1998), the total CPR land in the state was estimated at 354 thousand hectares, which constituted as high as 15 per cent of the geographical area. The optimum figures of carrying capacity of CPRs in the state (393 thousand ACU) indicated that a major proportion of the total livestock population could not be supported by these resources. Even if the land requirement for one ACU would have been less than 0.9 ha, the available land under CPRs would not suffice to sustain the existing livestock population in the state. This problem becomes more concentrated due to the fact that the majority of livestock population depends on the geographical area (excluding net area sown) for its fodder/food requirements.

Government Support to Livestock Sector

Under various developmental plans in the state, animal husbandry and dairy development (AH&D) has undergone significant changes during the past two

Table 8. Government investment on livestock sector in J&K

(in lakhs Rs)

Plan period	Amount	Per cent of expenditure in agriculture	Per cent of total Plan expenditure
Seventh Plan (1985-90)	3833	11.19	2.34
Annual Plan (1990-91)	1310	13.04	2.51
Annual Plan (1991-92)	1345	11.75	1.63
Eighth Plan (1992-97)	6735	12.02	1.49
Ninth Plan (1997-2002)	10686	11.82	1.42
Tenth Plan (2002 - 2007)	15469	10.26	1.07
	(100.00)		
Animal husbandry	9530	6.32	0.66
	(61.61)		
Sheep husbandry	5478	3.63	0.38
	(35.41)		
Sheep products development board	165	0.11	0.01
	(1.07)		
Milk and milk products cooperative federation	296	0.20	0.02
	(1.91)		

Note: Figures within the parentheses indicate percentages of total plan expenditure under Tenth Plan

decades. Although the government expenditure on AH&D has increased over the years in absolute terms, this expenditure as a percentage of the total plan expenditure has declined from 2.34 per cent during the Seventh Five-Year Plan to 1.07 per cent during the Tenth Five-Year Plan (2002-07) (Table 8). The break-up of Tenth Plan expenditure of AH&D under four broad heads, viz. animal husbandry, sheep husbandry, sheep product development board and milk & milk product cooperative federations is given in Table 8. This allocation was made under different heads based upon new priorities in the livestock sector. The animal husbandry constituted the maximum share (61%) in the total expenditure during the 10th Five-Year Plan. The sheep husbandry accounted for about 36 per cent while the sheep product development board and milk & milk product cooperative federation had only small shares in the total expenditure on AH&D. In view of the fact that little attention is being given to the extension services to disseminate cross-breeding technology (Tisdell and Jyothi, 1999), a higher allocation of resources for providing extension services to farmers would have a higher pay-off.

Growth of Veterinary Institutions

As a result of huge investment, the number of veterinary institutions has increased by about two-fold in the state, from 951 (1980-81) to 1803 (2005-06)

(Table 9). The need of providing veterinary aid had led to the opening of new veterinary hospitals and dispensaries in the state during 2000s. Consequently, there has been a significant increase in the animal healthcare services. For example, there has been about 8-fold increase in the number of animals dosed/vaccinated per veterinary institution and several new frozen semen centres have been opened. All this signifies that the prevention/cure of various diseases has improved animal healthcare and productivity in the state. The incidence of parasites such as helminth, a major problem in cattle, buffalo, goats and sheep, was found to have decreased in the state over the years. Moreover, there has been a control of mouth and foot disease to a large extent and this has reduced animal mortality (unpublished records of Directorate of Animal Husbandry, Government of J&K). However, the number of veterinary institutions per lakh of livestock population has remained almost stagnant. There is a need to provide veterinary services at the block and village levels. This calls for a higher allocation of resources by the state government to AH&D.

Conclusions and Policy Implications

The study has assessed the livestock profiles and their dynamics across different agro-climatic regions of J&K. The distribution of livestock across different regions has indicated concentration of a higher

Table 9. Growth of veterinary institutions in different regions of J&K state

(Number)

Institution	1980-81	1985-86	1990-91	1995-96	2000-01	2003-04	2005-06
A. Total veterinary institutions	951	1410	1672	1587	1754	1748	1803
Tehsil units	47	49	47	40	37	33	35
Veterinary dispensaries	77	314	300	304	308	311	347
Mobile dispensaries	11	44	56	56	56	56	56
First-aid centres	48	155	169	95	145	84	118
Veterinary assistant surgeon centres	46	-	314	172	156	-	4
Intensive cattle development centres	375	480	10	387	206	349	350
Livestock development centres	99	-	158	145	164	179	231
Frozen semen centres	20	71	119	117	119	116	135
Others	228	297	499	271	563	620	527
B. Veterinary institutions per lakh of livestock population	17.38	21.10	20.75	17.66	18.39	17.66	17.78
C. Animal treated per veterinary institute	1760	2238	1765	1793	2607	2743	1940
D. Animal dosed/ vaccinated per veterinary institute	769	960	3182	1579	2798	2223	5285
E. Artificial insemination per frozen semen centre	6420	2380	1403	2406	2265	2991	1354

proportion of all the species of livestock in the Jammu region (JMR). The Ladakh region (LDR) has registered enhancement in the share of population of goats and other animals. Sheep and cattle have been found to dominate the livestock production system in the state, together constituting over 60 per cent of the livestock population. The changing species- mix of livestock population over the years in the state seems to have influenced the speed of intensification across different regions. The livestock composition has changed in favour of milch animals and the percentage of cross-bred/improved animals has been increasing, though wide regional diversities have been observed in the adoption of cross-bred/improved cattle. The coefficients of variation in the adoption of cross animals have indicated a higher potential of improving animal productivity through replacement of indigenous animals with improved species. The interaction of livestock with natural resources has indicated that a majority of livestock species depend heavily on the geographical area for its sustenance that may strain environment if the problem is left unattended.

Based upon the findings of this study following policy suggestions have emerged:

1. The livestock sector has made a stride in intensification that now does not seem to pose a challenge; however, the emphasis would rather be

on appropriate species-mix. Extension system should be strengthened to disseminate technologies of cross-bred animal production to achieve a higher adoption rate. Again increasing animal productivity through scientific management would help to improve the overall social benefits from this sector.

2. There is a clear need to augment feed and fodder resources to sustain livestock rearing. The available common property resources (CPRs) in the state are meagre to sustain the whole livestock population and the higher dependence of livestock, especially small ruminants, on the geographical area could further strain the ecology of the state. Regressive fragmentation of holdings and contracting common property resources would further aggravate this problem. Concerted efforts have to be made to arrest deterioration of CPRs through legal, social and institutional means. Though strengthening of crops-livestock relationship would make the farming sustainable/ profitable, it cannot be a sufficient measure to sustain ecology as higher input costs are associated with stall feeding. Accordingly, an effective integration of crop, livestock and CPRs with a strong grazing strategy/calendar of grazing period is needed to improve agricultural productivity, environmental sustainability and farmers' income. Therefore, emphasis should be on identification of

niches for pasture development and their protection through watershed, jointly with the stakeholders to enhance the sustainability of this system in the long-run.

3. The expansion of area under irrigation and fodder cultivation is important for rearing of cattle and buffalo. Further, the qualitative/quantitative improvement in the crop residues assumes importance for the development of livestock sector. Budgetary allocations to this sector should be enhanced to evolve innovative production technologies leading to improved animal production efficiency.

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Received: July 2010; Accepted: November 2010