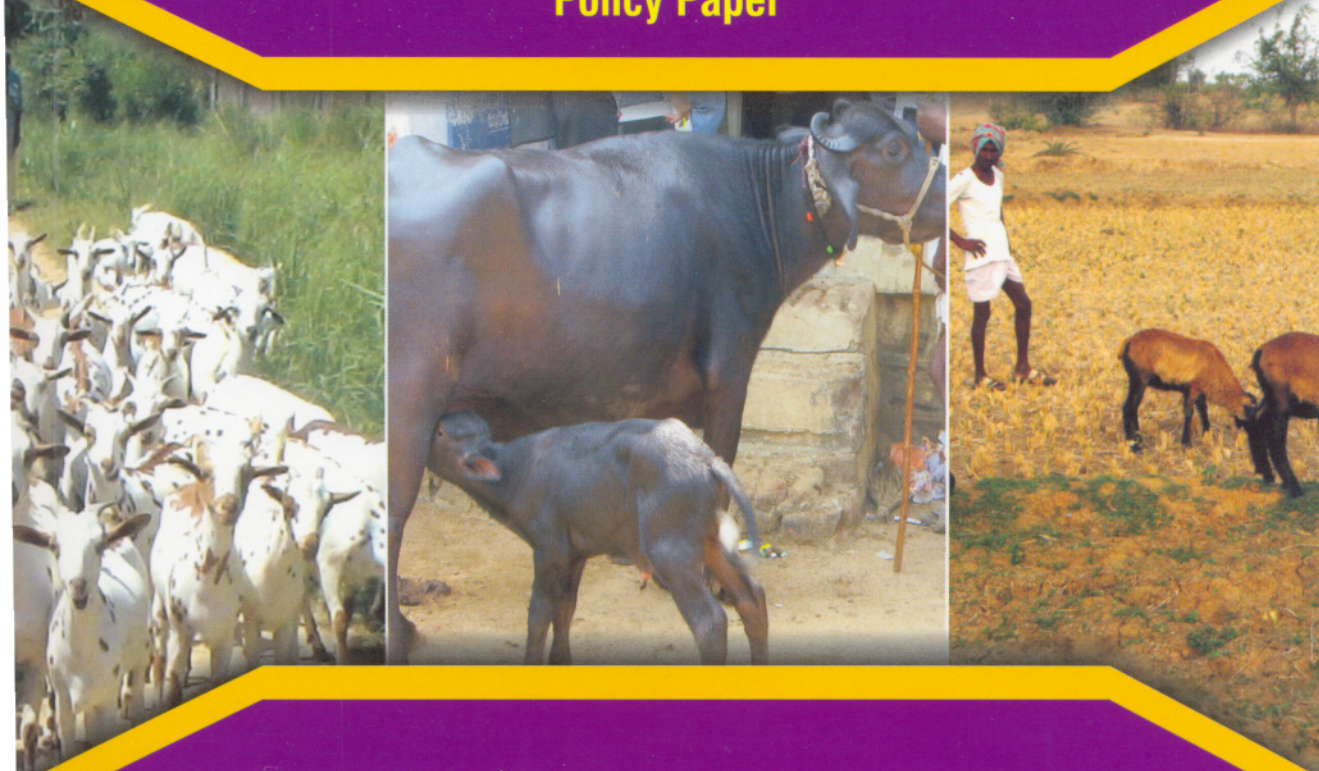


# Livestock in Rainfed Agriculture: Status and Perspective

## Policy Paper



D.B.V. Ramana, Shalander Kumar,  
K. Kareemulla, C.A. Rama Rao,  
Sreenath Dixit, K.V. Rao  
and  
B. Venkateswarlu



**Central Research Institute for Dryland Agriculture**  
Santosh Nagar, Hyderabad - 500 059 India

# **LIVESTOCK IN RAINFED AGRICULTURE : STATUS AND PERSPECTIVE**

## **Policy Paper**

**D.B.V. Ramana, Shalander Kumar,  
K. Kareemulla, C.A. Rama Rao,  
Sreenath Dixit, K.V. Rao & B. Venkateswarlu**



**Central Research Institute for Dryland Agriculture  
Santoshnagar, Saidabad P.O., Hyderabad 500059, India**

### **Citation :**

Ramana DBV, Kumar Shalander, Kareemulla K, Rama Rao CA, Dixit Sreenath, Rao KV and Venkateswarlu B. Livestock in Rainfed Agriculture : Status and Perspective. 2009. Policy Paper: SEPR Series-2, Central Research Institute for Dryland Agriculture, ICAR, Hyderabad, pp: 1-46.

**November, 2009**

© All rights reserved

### **Published by**

Director

CRIDA, Hyderabad

### **Credits :**

Data Analysis : S. Raghava Sarma

Word Processing: C. Kanaka Durga





# CONTENTS

<b>Sl.No.</b>	<b>Topic</b>	<b>Page No.</b>
1.	Introduction	1
2.	Contribution	3
3.	Population and Composition	4
4.	Highly livestock populous rainfed districts as leverage points	10
5.	Density	17
6.	Growth	28
7.	Grazing Incidence	30
8.	Fodder Supply and Demand	31
9.	Milk Production	34
10.	Meat Production	35
11.	Growth of Dairy	36
12.	Milk Availability	37
13.	Veterinary Infrastructure	38
14.	Animal Breeding	39
15.	Proposed Strategies	40
	References	44



## Introduction

Livestock is an integral component of rainfed farming systems. Rainfed agriculture being risk prone, possession of livestock both large and small ruminants, often acts as a cushion and liquidity for the farmers. In fact, rainfed agriculture supports more than 60% of the livestock population (CRIDA, 2007). The country has vast resources of livestock, which play a vital role in improving socio-economic conditions of the rural masses and their food and nutrition security. With the advent of operation flood programme and consequent white revolution, dairy development got great fillip. This movement to a large extent was encouraged by the promotion of dairy cooperatives through operation flood programmes. These developments promoted marketing of milk and livestock breeding through introduction of high yielding exotic cattle germ plasm and grading up of non-descript buffaloes with indigenous superior breeds and provision of better health services. Initially, the resource rich regions took advantage of the policy and market environment for enhancing the production. Subsequently, rainfed regions also caught up with the trend. These development efforts were mostly confined to the large ruminants, i.e., cattle and buffaloes, while the small ruminants did not get the benefit of such development.

Like crop production systems, livestock production systems also vary according to the agro-climatic conditions. However, there exists a close relationship between the crop and livestock production systems, for the reason that the two have a close knit relationship with each other. The crops supply feed and fodder for the livestock and in turn the livestock provides manure and draught power. Besides agro-ecological conditions, the livestock rearing and management is also dependent on the socio-cultural dimensions of communities and regions. The livestock production in rainfed regions is mainly taken up under common property resources (CPRs) based livestock production system, grassland based livestock production system and mixed farming system which are characterized by deficiency of feed and fodder, low animal productivity, subsistence nature of production and very low level of production intensification. In view of low productivity and high uncertainty in crops production, the rural people in rainfed areas are more dependent on livestock rearing for their livelihood.

Based on the agricultural area purely dependent on rainfall, the total rainfed area in the country works out to be 57% while the rest is under irrigation. Across the major states, Maharashtra and Kerala have maximum area under rainfed agriculture (81%) followed by Karnataka (71%), Orissa (68%), Gujarat (66%), Madhya Pradesh (62%), Rajasthan (61%) and Andhra Pradesh (57%). There are states like Jharkhand and Chattisgarh, which are also predominantly rainfed, but receive relatively high rainfall and hence may not be branded as

**Table 1. Rainfed area across states in India 2006-07**

State	Net Sown Area ('000 ha)	Rainfed Area ('000 ha)	% of Rainfed Area
Andhra Pradesh	10843	6199	57
Assam	2774	2760	99
Bihar	5572	2538	46
Chhattisgarh	4764	3516	74
Gujarat	9852	6464	66
Haryana	3556	566	16
Himachal Pradesh	541	436	81
Jammu & Kashmir	752	441	59
Jharkhand	1769	1605	91
Karnataka	10105	7159	71
Kerala	2089	1701	81
Madhya Pradesh	14971	9290	62
Maharashtra	17473	14177	81
Manipur	223	172	77
Meghalaya	212	157	74
Mizoram	83	67	81
Nagaland	309	242	78
Orissa	5739	3893	68
Pondicherry	20	3	14
Punjab	4243	205	5
Rajasthan	16764	10268	61
Sikkim	112	106	95
Tamil Nadu	5062	2198	43
Tripura	280	219	78
Uttar Pradesh	16573	3263	20
Uttarakhand	767	422	55
West Bengal	5295	2160	41
India	141145	80525	57

## 2. Contribution

The total contribution of livestock sector accounted for Rs.210629 crores during 2006-07 at the national level. Of this, the major contribution came from milk with 69% followed by meat (16%) and manure (7%). The growth trends in value of the output contribution by different sub-sectors of livestock during 1999-00 to 2006-07 revealed that the milk and egg sub-sectors grew at 7.31 and 7.13% per annum followed by meat at 6.62%. Within the meat sub-sector, highest annual growth was achieved in pork (9.12%) followed by sheep & goat meat (8.49%) while lowest growth rate was observed in poultry meat (5.39%) **Table 2.** The output of milk and meat during the same period grew at the rate of 3.69 and 3.29 per cent per annum respectively. Over the past few decades the total milk production has reached to 104.8 million tones in 2007-08 from 17 million tones in 1951 with 3.24 % annual growth rate. Besides increase in number, the production has increased mainly through increment in milk productivity of the animals. However during the same period, the growth in meat productivity of animals has been slow. Moreover, a wide gap exists between the current and potential meat and milk yield of the animals (Kumar and Pant, 2001; Ayra and Yadav, 2001; Birthal and Taneja, 2006 and Ranjan, 2006). Hence, there exists a good potential to increase the meat and milk production especially through buffalo and goats, which have shown greater promise. Rainfed states can benefit to a large extent from such growth opportunities.

**Table 2. Value of Output from Livestock Sector (Rs. cr at current Prices)**

Item	2006 -07	Growth Rate: 1999 -00 to 2006 -07 (%)	% Composition (TE 2006 -07)
Milk	144386	7.31	69
Meat group	34310	6.62	16
Of which			
Beef	3366	7.27	2
Chevon & Mutton (goat & Sheep)	11844	8.49	6
Pork	1837	9.12	1
Poultry Meat	12658	5.39	6
Meat Products	1131	6.66	1
By-Products (hides, skins, etc)	3473	3.86	2
Eggs	7123	7.13	3
Wool & hair	339	2.72	0
Dung	15596	5.77	7
Silk Worm Cocoons and Honey	1766	3.54	1
Increment in Stock	7110	13.46	3
<b>Total</b>	<b>210629</b>	<b>7.19</b>	<b>100</b>

Source: Central Statistical Organization, Dept. of Statistics, GOI (2008)



### 3. Population and Composition

The livestock population comprising cattle, buffaloes, sheep and goats was analyzed using data from two censuses, viz., 1992 and 2003. Across the rainfed states, cattle accounted for major share in the total livestock population ranging from 19% (Andhra Pradesh) to 61% (Kerala and Assam) with overall share of 39%. (Table 3). Goats form the next major species constituting 13 to 45% of the total livestock in different states. Over the years, the share of indigenous cattle has come down and the rate of such reduction was drastic in states like Kerala, Tamil Nadu and Andhra Pradesh. However, the decrease in the share of cattle in total livestock population was much more in irrigated states as compared to rainfed states indicating the higher utility and resilience of cattle in dry areas. The cattle though poor yielder are better adapted in low input (fodder deficiency) situations of rainfed areas. Moreover, the use of draught power in terms of bullocks is comparatively higher in rainfed areas especially on small farms. In the irrigated states, the share of buffaloes distinctly increased over the census period 1992-2003 whereas, in rainfed states the shift in buffalo share was mixed with increase in some states and decrease in others.

**Table 3: Species wise livestock composition in rainfed and irrigated states (%)**

State	Cattle		Buffaloes		Sheep		Goats		Total Livestock ('000 nos)	
	1992	2003	1992	2003	1992	2003	1992	2003	1992	2003
<b>Major Rainfed States</b>										
Andhra Pradesh	33	19	28	22	24	44	13	13	32911	48195
Assam	59	61	6	5	1	1	20	22	17062	13829
Gujarat	37	34	28	33	11	10	23	21	18598	21655
Himachal Pradesh	42	44	14	15	21	18	22	22	5106	5116
Jammu & Kashmir	35	31	8	11	34	34	20	21	8703	9899
Karnataka	45	37	14	16	18	28	21	18	29568	25621
Kerala	60	61	5	2	1	0	32	35	5834	3481
Madhya Pradesh	61	53	17	21	2	2	18	23	46744	35617
Maharashtra	48	44	15	17	8	8	27	29	36404	36763
Orissa	61	59	7	6	8	7	22	25	22742	23391
Rajasthan	24	22	16	21	26	20	32	34	48441	49136
Tamil Nadu	37	37	11	7	23	22	25	33	25007	24992
West Bengal	50	76	3	4	4	6	40	75	35090	24942
<b>Sub total</b>	<b>45</b>	<b>40</b>	<b>14</b>	<b>16</b>	<b>14</b>	<b>18</b>	<b>25</b>	<b>28</b>	<b>332210</b>	<b>322637</b>
<b>Major Irrigated States</b>										
Bihar	46	40	11	20	4	1	36	35	47930	27162
Haryana	23	17	48	49	11	7	9	5	9143	8885
Punjab	28	24	59	70	5	3	5	3	10222	8608
Uttar Pradesh	40	32	31	34	4	2	20	22	64799	58531
<b>Sub total</b>	<b>40</b>	<b>32</b>	<b>27</b>	<b>35</b>	<b>4</b>	<b>3</b>	<b>24</b>	<b>22</b>	<b>132094</b>	<b>103186</b>
<b>India</b>	<b>43</b>	<b>38</b>	<b>18</b>	<b>20</b>	<b>11</b>	<b>13</b>	<b>24</b>	<b>26</b>	<b>470860</b>	<b>485002</b>
	(204584)	(185181)	(84206)	(97922)	(50783)	(61469)	(115279)	(124358)		

The share of sheep population in the total livestock has generally decreased in both rainfed and irrigated states. An exception to this trend was seen in the case of Andhra Pradesh and Karnataka where significant increase in proportion of sheep in the total livestock population has occurred. It may be noted that both these states are predominantly rainfed states. The preference for sheep meat is higher in southern states especially Andhra Pradesh and Karnataka with current price of its meat at Rs.260-300 per kg. Moreover there has been state policy to support sheep production especially through facilitating financial, technical and market support for lamb rearing units in Andhra Pradesh. A number of self-help groups for sheep rearing were organized by many NGOs and also under the Janmabhoomi programme of the government. At the same time, there was no programme for the development of goats, rather they were subtly discriminated and painted as enemy of forest. Without probing and analyzing the real causes of deforestation, the goat was made a scapegoat. Though the poor small ruminant keepers throughout the country are totally unorganized and have no voice, however, in Andhra Pradesh there are sheep rearers' associations with some presence at village, district and state level. At least some of them have links to members of state legislature and thus, some capacity to have its concerns raised. Some such associations regularly engage in political protest and garner attention and response from the government agencies (Turner, 2004). As a result of some policy support, relatively better organized sheep rearers and higher market demand for sheep resulted in rapid increase in its population in Andhra Pradesh. As regards the share of goats in the livestock population is concerned, irrigated states showed declining trend except a marginal increase in Uttar Pradesh. Compared to this, the share of goats increased in the rainfed states except Andhra Pradesh, Karnataka and Assam. Notable increase in the share of goats in the total livestock population was seen in West Bengal and Tamil Nadu. It may be indicated that the share of buffalo, goat and sheep in the total livestock has increased and that of cattle decreased during 1992-2003 in rainfed as well as irrigated states. Moreover, the absolute number of livestock has decreased in the irrigated states and it increased significantly in the rainfed states. Similar picture emerged also from the livestock population converted into ACUs-Adult Cattle Units (**Table 4**). The analysis hence demonstrates greater relevance of goats, sheep and cattle in rainfed areas and that of buffalo in irrigated areas.

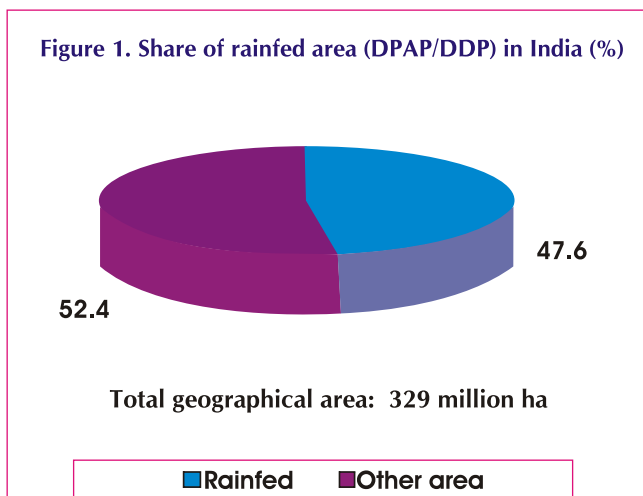
**Table 4: Species wise Livestock composition in rainfed and irrigated states (%)-ACU**

State	Cattle		Buffaloes		Sheep		Goats		Total ruminants ('000 ACU)	
	1992	2003	1992	2003	1992	2003	1992	2003	1992	2003
<b>Major Rainfed States</b>										
Andhra Pradesh	45	34	45	46	6	15	4	5	24349	27587
Assam	84	85	10	8	0	0	6	6	11989	9884
Gujarat	47	43	44	49	3	2	6	5	14379	17313
Himachal Pradesh	63	63	24	26	6	5	6	6	3445	3575

Jammu & Kashmir	63	57	18	23	12	13	7	8	4872	5448
Karnataka	64	57	25	29	5	9	6	5	20619	16675
Kerala	83	87	8	3	0	0	9	10	4255	2443
Madhya Pradesh	72	64	24	31	0	0	4	5	40093	29740
Maharashtra	66	62	25	28	2	2	7	8	26588	26433
Orissa	81	81	11	10	2	2	6	7	17040	17060
Rajasthan	44	38	35	43	9	7	12	12	26510	28923
Tamil Nadu	61	66	22	14	8	8	8	12	15093	13885
West Bengal	80	78	6	5	1	1	13	15	21799	24276
<b>Sub total</b>	<b>64</b>	<b>58</b>	<b>25</b>	<b>28</b>	<b>4</b>	<b>5</b>	<b>7</b>	<b>8</b>	<b>231032</b>	<b>223241</b>
<b>Major Irrigated States</b>										
Bihar	68	56	20	34	1	0	11	10	32406	19126
Haryana	28	22	68	75	3	2	2	1	7751	7005
Punjab	28	22	70	77	1	0	1	1	10333	9348
Uttar Pradesh	49	41	46	53	1	1	5	6	52838	45527
<b>Sub total</b>	<b>51</b>	<b>41</b>	<b>42</b>	<b>53</b>	<b>1</b>	<b>1</b>	<b>6</b>	<b>6</b>	<b>103328</b>	<b>81006</b>
<b>India</b>	<b>60</b> (204584)	<b>54</b> (185181)	<b>30</b> (101047)	<b>35</b> (117506)	<b>3</b> (10157)	<b>4</b> (12294)	<b>7</b> (23056)	<b>7</b> (24872)	<b>338844</b>	<b>339853</b>

Figures in parenthesis indicate percent of the total population/area of the country

Note: 1 buffalo = 1.2 ACU, 1 cattle = 1 ACU, 1 goat = 0.2 ACU, 1 sheep = 0.2 ACU

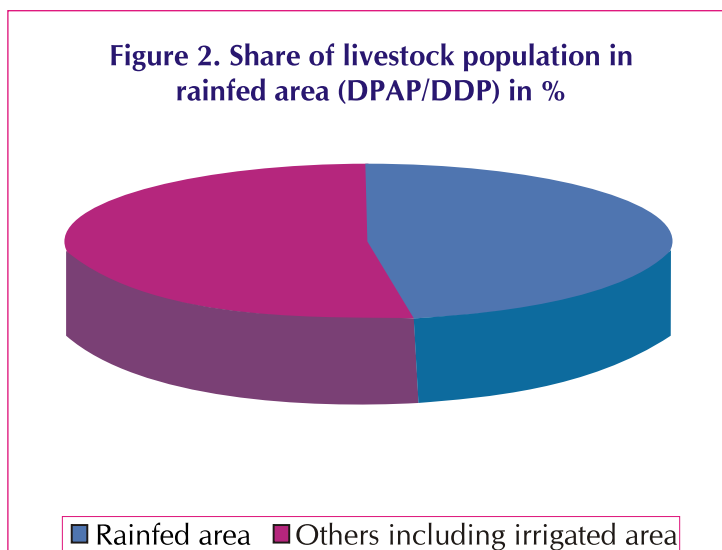


The livestock population in predominantly rainfed (dryland) districts which are labeled under Desert Development Programme (DDP) and Drought Prone Area Programme (DPAP) across the states was pooled and the same was analyzed for species composition. The rainfed area consisting 201 DPAP/DDP districts covers 47.6 percent of the total geographical area of the country and supports 45.5 percent of the total livestock population (cattle, buffalo, sheep & goat) of the country (**Table 5**). In terms of total number of livestock, Rajasthan stood first with 38.7 million animals during 2003, more or less the same number as per 1992 census.

Maharashtra had the second largest livestock in its DDP / DPAP districts, where the absolute number of livestock marginally decreased during the 11 years period from 1992-2003. Andhra Pradesh occupied the third place in terms of livestock population in the DDP / DPAP districts with almost 30 million animals. Andhra Pradesh is the only state among the DDP / DPAP covered states who have gained significantly in terms of increase in livestock population by over 10 million animals. This achievement has come mainly on account of growth in sheep population. Other rainfed states like Karnataka and Tamil Nadu have experienced decrease in the absolute livestock population (**Table 6**). Severe drought in the year 2002 may be one of the reasons of decline in livestock population in Tamil Nadu and Karnataka.

**Table 5: Livestock composition in Rainfed and other areas, 2003 (%)**

Region	Geographical area, m ha	Population, million				
		Cattle	Buffaloes	Sheep	Goats	Total
Rainfed area (DDP and DPAP districts)	156.5 (47.6)	76.5 (41.3)	39.2 (40.0)	40.7 (66.2)	56.6 (45.6)	213 (45.5)
Other areas including irrigated	172.0 (52.4)	108.7 (58.7)	58.7 (60.0)	20.8 (33.8)	67.8 (54.5)	255.6 (54.5)
India	329 (100)	185.2 (100)	97.9 (100)	61.5 (100)	124.4 (100)	468.9 (100)



**Table 6: Species wise Livestock composition in rainfed districts of different states in 2003 (%)**

State	Cattle		Buffaloes		Sheep		Goats		Total (000 nos.)	
	1992	2003	1992	2003	1992	2003	1992	2003	1992	2003
Andhra Pradesh	36.1	20.6	22.2	17.0	27.5	48.2	14.1	14.1	19528	29909
Bihar		40.5		23.9		2.9		32.7		4826
Gujarat	37.3	35.7	24.2	29.7	14.2	11.4	24.3	23.2	13667	17375
Haryana	23.3	17.3	45.6	63.6	18.3	10.9	12.8	8.2	2868	3407
Karnataka	40.5	33.4	14.3	15.8	22.2	31.6	23.0	19.3	28358	21553
Madhya Pradesh	60.3	53.9	17.6	20.1	2.2	1.7	19.9	24.3	19665	20172
Maharashtra	47.4	44.3	13.5	15.5	9.4	9.6	29.7	30.6	31623	30050
Orissa	57.1	56.2	12.0	10.2	9.4	9.2	21.5	24.4	5599	5334
Rajasthan	23.4	21.2	15.2	19.5	28.2	23.1	33.2	36.3	38829	38779
Tamil Nadu	34.3	33.3	11.0	8.3	23.5	24.2	31.2	34.3	17307	15400
Uttar Pradesh	50.6	45.0	22.4	26.0	4.8	3.6	22.2	25.5	14306	12852
West Bengal	57.5	52.2	3.0	2.7	4.5	4.4	35.0	40.8	11052	12224
Chhattisgarh		69.9		14.4		0.7		15.0		5036
Jharkhand		53.0		10.6		3.8		32.5		7599
Uttaranchal		48.0		18.5		5.5		28.0		2775
Himachal Pradesh	32.3	32.5	27.2	33.9	15.7	13.4	24.8	20.3	934	923

As far as the livestock composition is concerned, Chattisgarh, Madhya Pradesh, Orissa and West Bengal had higher share of cattle in their total livestock population ranging between 52-70% during the year 2003. The share of cattle in the total livestock of the respective states has uniformly come down during the period 1992-2003. Haryana had least proportion of cattle (17%) and largest proportion of buffalo (64%) in its total livestock population. Higher share of buffalo even in dryland districts of Haryana may be due to better availability of fodder and good quality of germplasm in the state. In other states, the share of buffaloes in the total livestock population did not exceed one-third of the total animals. States like Tamil Nadu and West Bengal had lower share (8 and 3%) under buffaloes. The share of buffaloes in the total livestock population has increased in states like Gujarat, Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh. On the other hand, such shares have come down in Andhra Pradesh and Tamil Nadu, where the crossbred cattle movement has occurred significantly.

The share of sheep accounted for the maximum (48%) in Andhra Pradesh during 2003 in the total livestock of the state. The next higher share was in the case of Karnataka (31.6%) followed by Tamil Nadu and Rajasthan (24.2 and 23.1%). The share of goats in the total livestock population of the DDP / DPAP states during the two census periods, viz., 1992-2003, increased especially in Tamil Nadu, Madhya Pradesh, West Bengal, Orissa, Uttar Pradesh and Rajasthan. Moreover, the goats as compared to sheep were more evenly distributed across the states.



Among the 201 rainfed districts, the population of cattle was concentrated more in eastern states, followed by Uttar Pradesh and Madhya Pradesh. The buffalo population was higher in north (Uttar Pradesh, Madhya Pradesh and Haryana) followed by western part (Rajasthan and Gujarat) of the country. Sheep had higher concentration in Andhra Pradesh, Rajasthan and Karnataka, and that of goats in West Bengal, Rajasthan, Tamil Nadu and Maharashtra. Agro-ecology, fodder and germplasm availability, consumer preferences and availability of market for livestock products and services are the factors that affect the level of concentration of particular livestock species in a state.

The livestock population in the DDP/DPAP (rainfed) districts across major states was analyzed in terms of Adult Cattle Units (ACU). The same was compared as shares of different animal categories for the two census periods. After conversion into ACU, Maharashtra emerged as the largest ACU populated state under the dryland districts during 2003. Rajasthan followed closely with Madhya Pradesh and Andhra Pradesh taking the next places. The weighted average share, as obtained by the conversion of actual animal stock multiplied by the conversion factor for ACU, of cattle was higher in eastern states like West Bengal, Orissa and the newly formed Chattisgarh and Jharkhand. Obviously, the buffalo dominated states, viz., Haryana and Gujarat had significant ACU share under buffaloes. Sheep accounted for a considerable share (21%) of the total livestock in terms of ACU in Andhra Pradesh for the census period 2003 (**Table 7**). In three other states, viz., Karnataka, Tamil Nadu and Rajasthan such share of sheep ranged between 10 and 12%. Across the states, Rajasthan had highest share under goats (15%) in dryland districts followed by West Bengal and Tamil Nadu with 14% share each.

**Table 7. Species wise Livestock composition in rainfed districts of different states (%) -ACU**

State	Cattle		Buffaloes		Sheep		Goats		Total ACUs (000 nos.)	
	1992	2003	1992	2003	1992	2003	1992	2003	1992	2003
Andhra Pradesh	52.2	38.7	34.4	34.7	8.8	20.6	4.5	6.0	12157	14043
Bihar		54.4		34.5				10.2		3104
Gujarat	51.9	47.1	36.1	42.7	4.4	3.4	7.5	6.9	8818	11692
Haryana	29.0	19.6	61.8	75.4	5.4	2.9	3.8	2.2	1931	2576
Karnataka	61.1	53.7	23.5	27.8	7.5	11.5	7.8	7.0	16667	11862
Madhya Pradesh	71.5	66.0	22.5	26.7	0.6	0.5	5.4	6.8	14512	14407
Maharashtra	66.8	62.8	20.8	24.3	3.0	3.1	9.4	9.8	20009	18722
Orissa	73.2	74.3	17.7	15.5	2.8	2.8	6.3	7.4	3816	3538
Rajasthan	43.2	37.6	30.3	37.8	12.1	9.6	14.3	15.0	18050	18695
Tamil Nadu	57.7	58.8	20.7	16.6	9.3	10.2	12.3	14.4	8767	7308
Uttar Pradesh	62.4	56.1	29.8	35.4	1.4	1.0	6.4	7.4	9871	8829
West Bengal	81.4	78.8	5.4	5.2	1.5	1.6	11.7	14.5	6636	6862

Chhattisgarh	76.0	19.9	0.2	3.9	3891					
Jharkhand	71.9	16.9	1.2	10.1	4917					
Uttaranchal	62.0	27.9	1.6	8.4	1847					
Himachal Pradesh	43.6	42.4	43.4	47.9	5.0	3.9	7.9	5.9	586	639

## Highly livestock populous rainfed districts as leverage points

It is well understood that livestock plays a greater role in the rural economy of rainfed areas and has good potential as a source of additional income and employment ensuring livelihood security of rural people in such areas. Hence to identify the most potential areas, ten most populous rainfed districts of cattle, buffalo, goat and sheep each were identified and mapped (**Figures 3 to 6**). Among the rainfed districts, Bankura of West Bengal (WB) had the highest cattle population (1.23 million) followed by Ahmednagar of Maharashtra (MS); Nadia, Birbhum (WB), Udaipur of Rajasthan (Raj)), Nasik (MS), Sidhi of Madhya Pradesh (MP), Durg of Chattisgarh (Chh) and Adilabad and Chittoor of Andhra Pradesh (AP). The districts which had the largest population of a particular livestock species may become the starting points for launching livestock development programme/ project with focus on that species. In case of buffalo, Prakasam district of Andhra Pradesh had the largest number of buffaloes (1.03 million) followed by Jaipur (Raj), Banaskantha of Gujarat (Guj), Belgam (Karnataka), Bharatpur (Raj), Sabarkanta (Guj), Nalgonda and Khammam (AP), Udaipur (Raj) and Sangli (MS). The concentration of sheep was comparatively very high in Andhra Pradesh followed by Rajasthan. Mahabubnagar of Andhra Pradesh had the largest number of sheep (3.36 million), followed by Ananthapur (1.9 million), Nalgonda, Prakasham and Karnool of the same state. The next most sheep populous districts were Barmar (Raj), Medak, Chittor and Cuddapah (A.P.) and Bikner (Raj). Among the ten most sheep populous districts, 8 were from Andhra Pradesh and two from Rajasthan. Nadia of West Bengal had the highest goat population (1.52 million) followed by Barmer, Udaipur (Raj), Birbhum (WB), Nagaur (Raj), Bankura (WB), Jhunjhunu (Raj), Ahmednagar (MS), Sikar (Raj) and Solapur (MS). These ten most populous districts of cattle, buffalo, sheep and goat constituted 11.6%, 16.2%, 31.4% and 17.3% of the total population of all the rainfed districts of each of these species indicating the largest concentration of sheep followed by goat, buffalo and cattle. With overlapping of few districts, the total of ten most populous districts each for cattle, buffalo, sheep and goat practically comes to 30. The grazing incidence (number of ACU/ha grazing land) in these districts was worked out and has been presented in **Table 8 and Figure 7**.

Figure 3. Ten most cattle populous rainfed (DPAP/DDP) districts in India, 2003  
(Population in thousands)

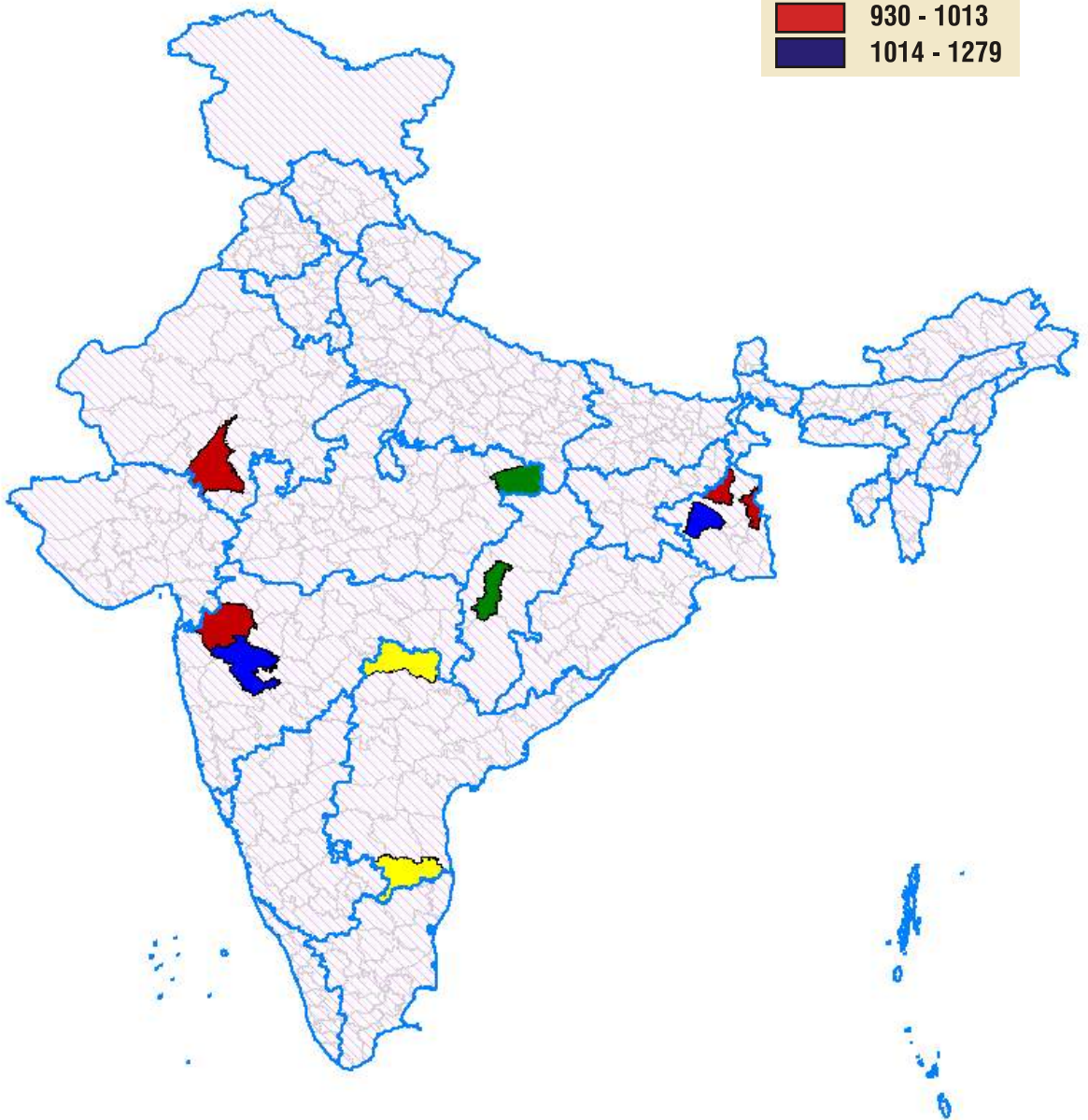
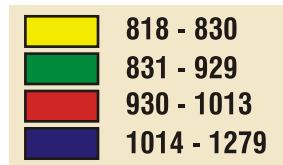


Figure 4. Ten most buffalo populous rainfed (DPAP/DDP) districts in India, 2003  
(Population in thousands)

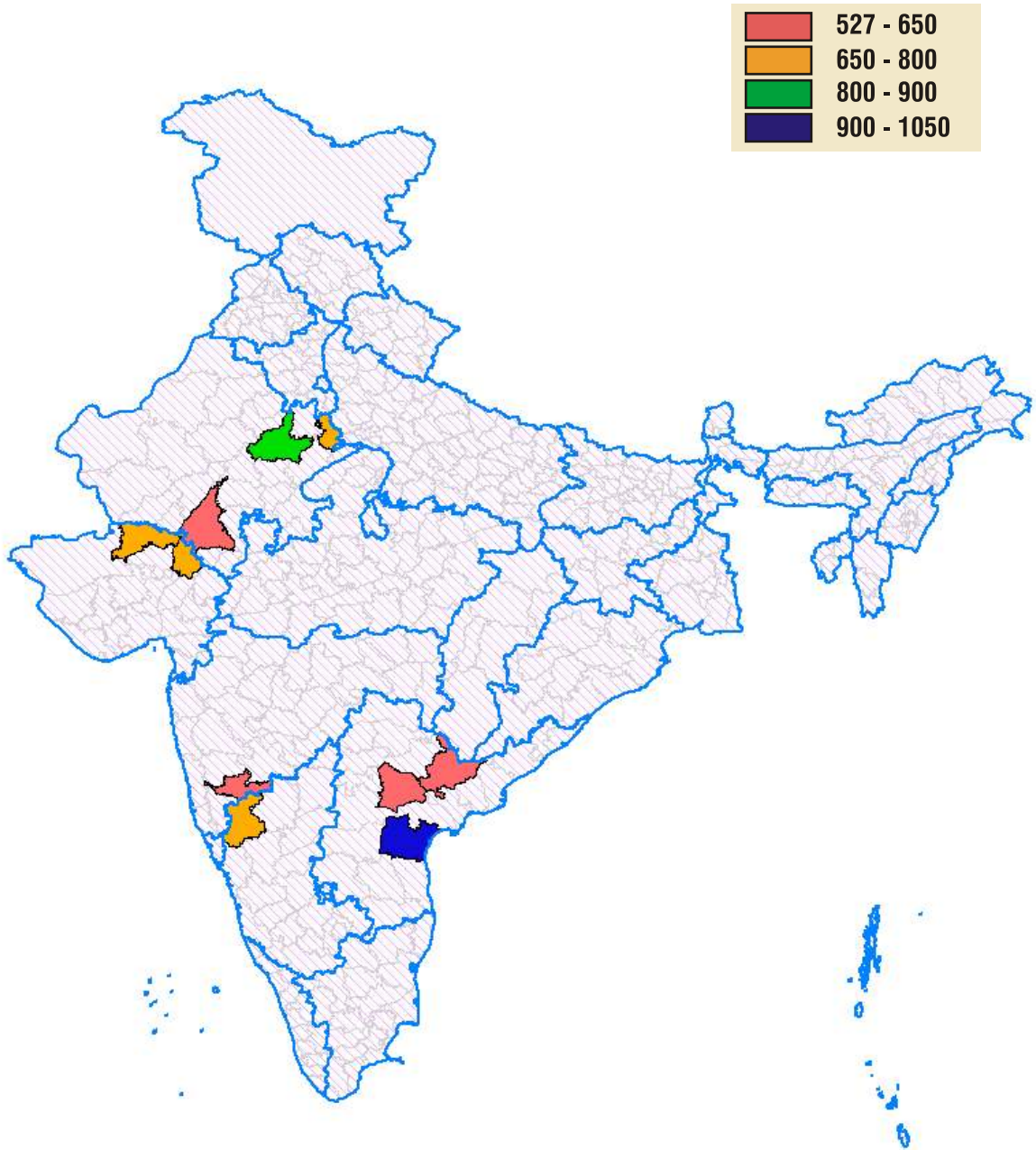




Figure 5. Ten most sheep populous rainfed (DPAP/DDP) districts in India, 2003  
(Population in thousands)

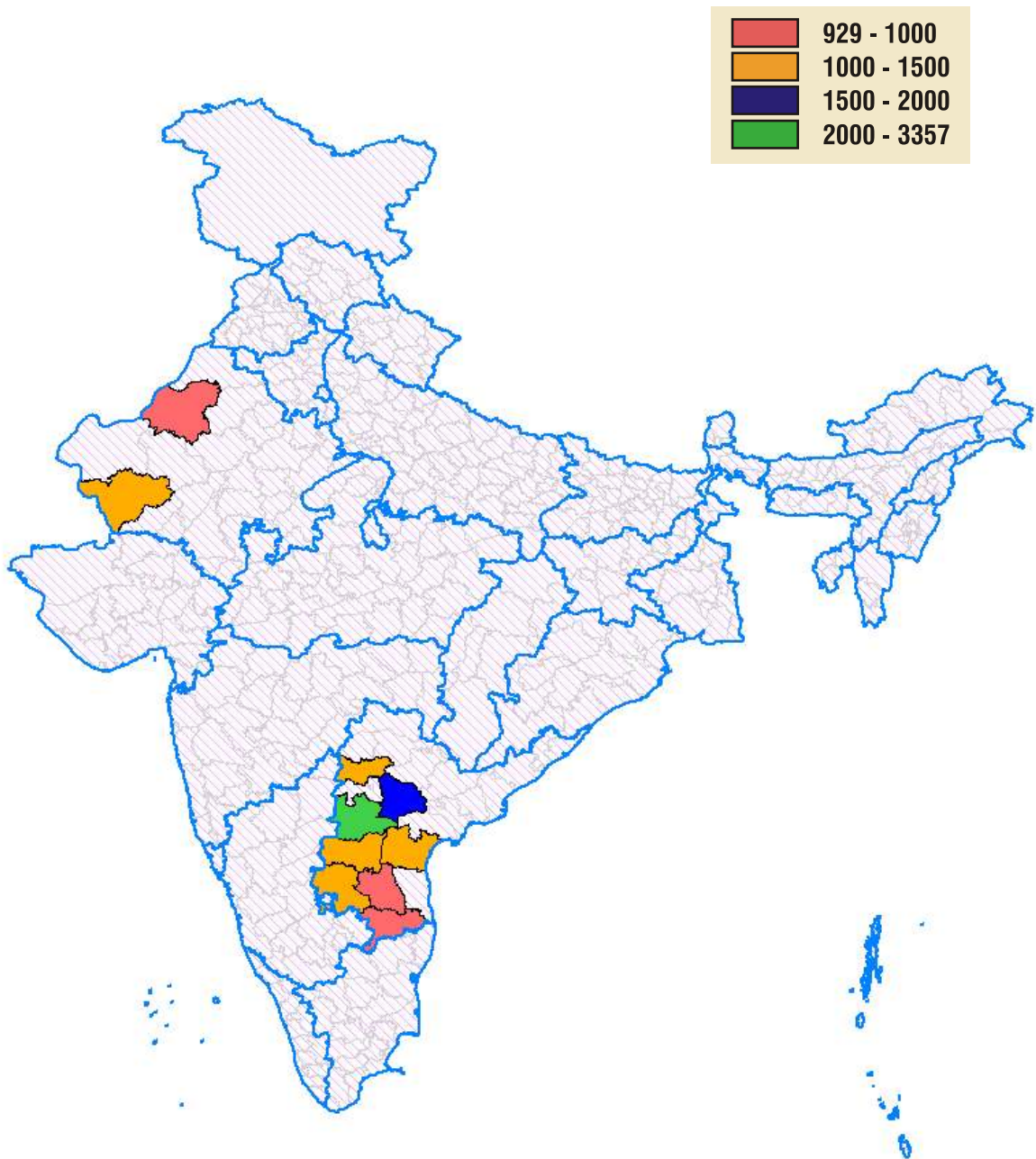
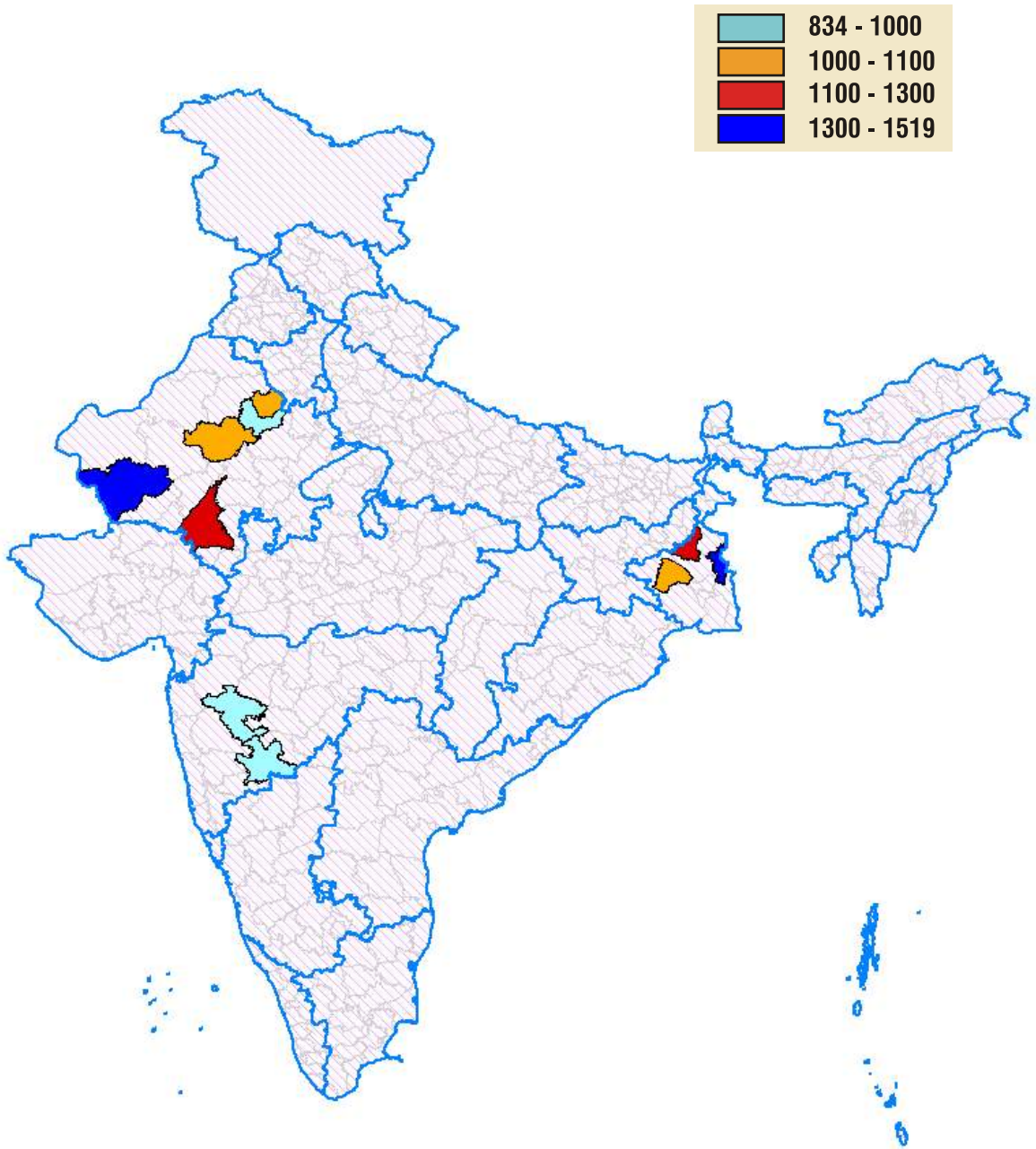




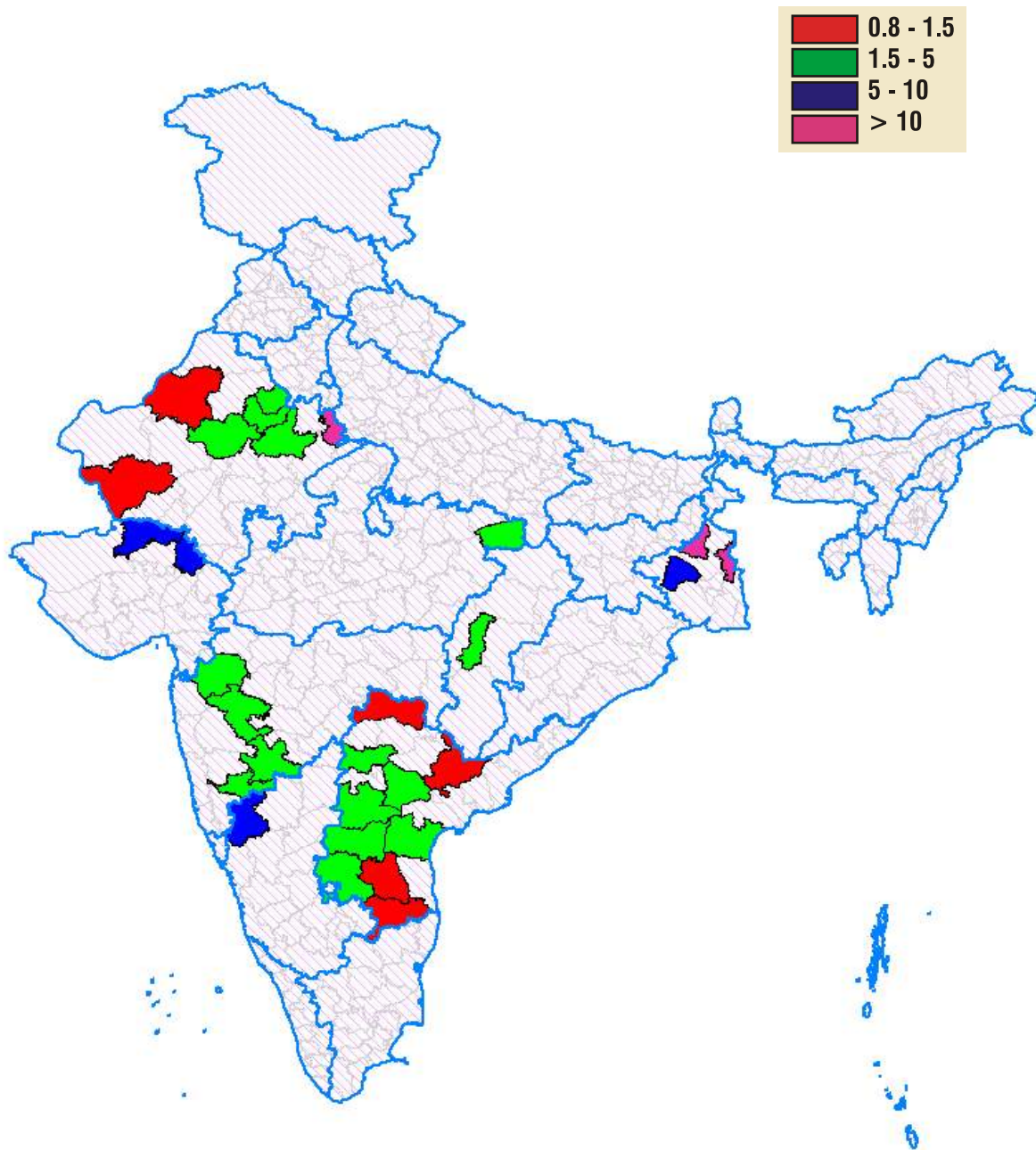
Figure 6. Ten most goat populous rainfed (DPAP/DDP) districts in India, 2003  
(Population in thousands)



**Table 8. Grazing incidences in ten most cattle, buffalo, sheep and goat (each) populous Rainfed (DPAP/DDP) districts, 2003**

<b>District</b>	<b>ACU, 000</b>	<b>Grazing land, 000 ha</b>	<b>Grazing incidence, ACU/ha</b>
Mahbubnagar	1753	546.42	3.2
Udaipur	1662	1043.35	1.6
Ahmednagar	1536	455.30	3.4
Anantapur	1497	597.80	2.5
Bankura	1480	154.82	9.6
Nalgonda	1455	460.74	3.2
Belgaum	1434	280.01	5.1
Jaipur	1388	308.85	4.5
Prakasam	1376	836.87	1.6
Nasik	1315	565.20	2.3
Nadia	1269	-	-
Sabarkanta	1242	210.90	5.9
Banaskantha	1196	224.40	5.3
Birbhum	1186	22.28	53.2
Adilabad	1185	859.93	1.4
Solapur	1159	315.00	3.7
Kurnool	1134	608.03	1.9
Khammam	1128	923.70	1.2
Sidhi	1101	558.23	2.0
Chittor	1077	817.44	1.3
Barmer	1054	902.83	1.2
Nagaur	1051	257.99	4.1
Medak	990	308.21	3.2
Durg	933	215.97	4.3
Bikaner	928	1129.31	0.8
Sangali	870	173.80	5.0
Sikar	840	175.26	4.8
Cuddapah	838	897.76	0.9
Bharatpur	776	75.35	10.3
Jhunjhunu	565	268.49	2.10

Figure 7. Grazing incidence in ten most cattle, buffalo, sheep and goat (each) populous rainfed districts, 2003, ACU/ha



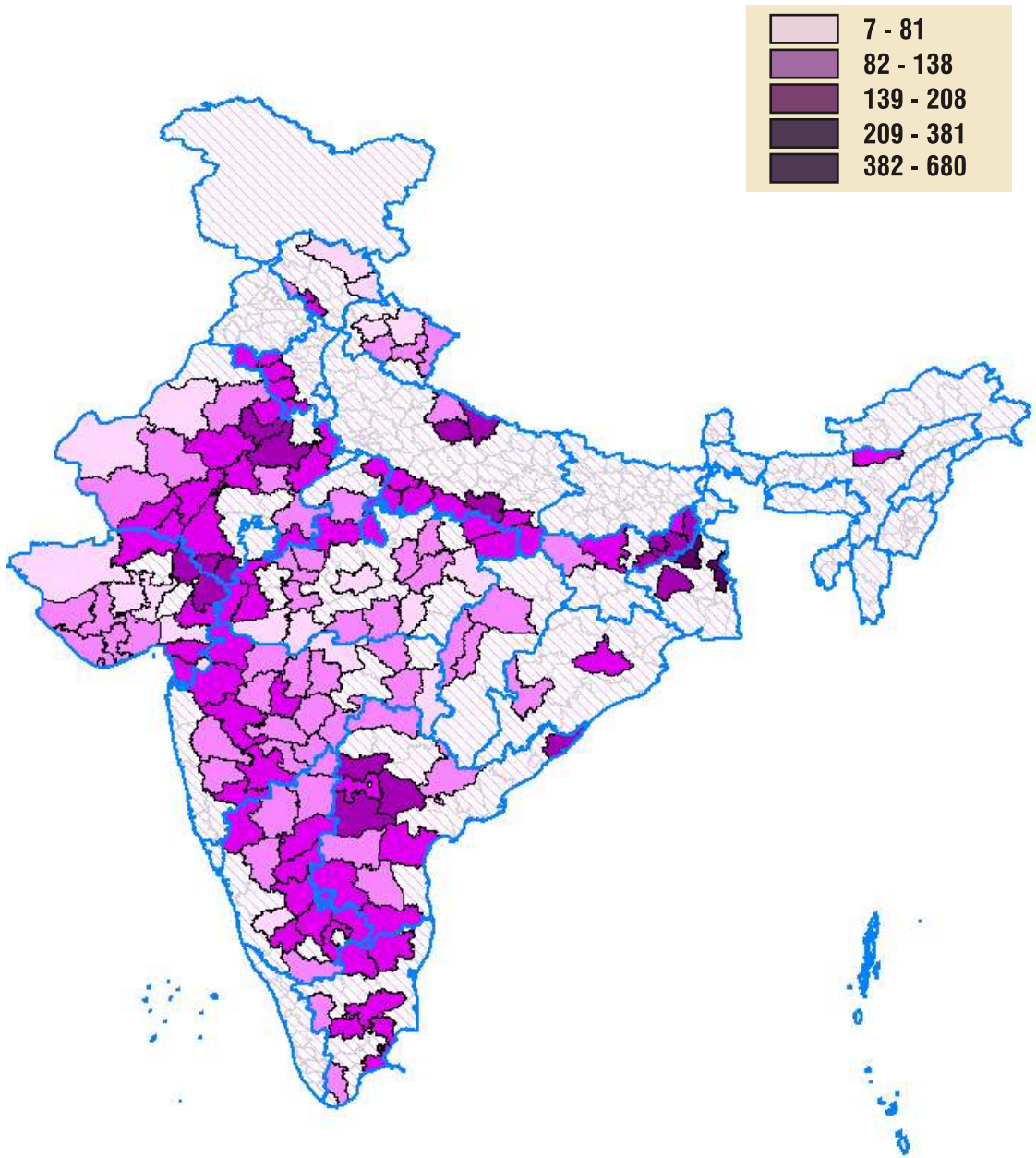
For any livestock development programme to succeed in the dryland areas, access to fodder would be the most critical requirement besides other factors like market, infrastructure and genetic potential of the animals. Among these 30 districts, Mahabubnagar of Andhra Pradesh has the highest number of ACUs (1.75 million) followed by Udaipur in Rajasthan (1.73 million) and Ahmedabad and Ahmednagar (1.54 million each). The grazing incidence in the 31 districts varied from 0.9 - 53.2 ACUs/ha. Though the fodder availability/yield of pasture depends on the quality of grazing lands, nevertheless the districts with lower grazing incidence (<5) might be able to sustain their livestock mostly maintained under extensive systems. However, improved management of common feed resources would be the pre-condition. There are some rainfed districts with higher concentration of livestock population, namely, Birbhum and Bankura in west Bengal, Bharatpur in Rajasthan, Sabarkantha and Banaskantha in Gujarat and Belgaum in Karnataka which have higher grazing incidence ranging from 5.1 to 53. In order to realize the livestock production potential in these districts, greater efforts would be required to produce more cultivated fodder. Sustainability and intensification of livestock production in these districts may be brought by producing more cultivated fodder or importing fodder from nearby areas which have surplus fodder.

#### 4. Density

The density of livestock (covering only cattle, buffalo, sheep and goat) per hectare of geographical area in DDP / DDAP districts across the states was worked out. The livestock density was highest in West Bengal (around 11 livestock per ha) followed by Bihar and Tamil Nadu, while it was the lowest in Chattisgarh and Himachal Pradesh. The areas of concentration of livestock (heads / km<sup>2</sup>) right from West Bengal to Tamil Nadu via Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Karnataka are shown in **Figure 8**. The density of livestock was as low as 21 animals per Sq. Km in Lahaul and Spiti in Himachal Pradesh and as high as 680 animals per sq.km in Nadia district of West Bengal. The livestock density was also estimated for the two broad categories of livestock, viz., large and small ruminants. The density of large ruminants was highest in West Bengal followed by Bihar, Uttar Pradesh and Haryana and it was low to moderate in Rajasthan, Gujarat and Andhra Pradesh. The small ruminant density increased significantly in Andhra Pradesh and West Bengal during the period 1992-2003 compared to the general decrease in other states and it was highest in West Bengal followed by Tamil Nadu and Andhra Pradesh (**Table 9**). Sheep in Andhra Pradesh and goats in West Bengal contributed in the increased density of small ruminants. West Bengal state with highest goat population and density is also the hometract of the most prolific goat breed (Black Bengal) of the country. Moreover, the market price of goat meat drastically increased in West Bengal (relatively higher than other states), which was mainly due to its larger proportion of non-vegetarian human population, higher preference for goat meat over the other and large scale illegal export of live goats to Bangladesh. Similarly, in Tamil Nadu, the price of



Figure 8. Livestock density in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>





goat meat increased relatively at faster rate creating incentive for higher production. Among the rainfed districts, the small ruminant's higher density areas are mostly in northwest and southern India and that of large ruminants in east, north and northwest India (**Figure 9 and 10**). The density of cattle, buffalo, sheep and goat in rainfed districts has been depicted in **Figures 11-14**. The goat density ranged from 1 (Lahaul and Spiti) to 387 (Nadia) per sq.km. The number of sheep was less than one per sq.km. in 14 rainfed districts and only 1 sheep / sq.km. in 30 districts, however the highest density was as high as 182 sheep / sq.km. in Mahaboobnagar district of Andhra Pradesh.

**Table 9: Livestock Density in DPAP/DDP Districts, heads / ha**

State	Large ruminants (cattle and buffalo)		Small ruminants (goat and sheep)		Total	
	1992	2003	1992	2003	1992	2003
Andhra Pradesh	0.66	0.66	0.47	1.08	1.14	1.74
Bihar		1.67		0.92		2.59
Gujarat	0.50	0.68	0.31	0.36	0.82	1.04
Haryana	0.94	1.32	0.43	0.31	1.37	1.64
Karnataka	1.04	0.70	0.85	0.72	1.89	1.42
Madhya Pradesh	1.13	0.98	0.32	0.34	1.45	1.32
Maharashtra	0.71	0.71	0.46	0.47	1.17	1.18
Orissa	0.92	0.84	0.41	0.43	1.33	1.27
Rajasthan	0.51	0.53	0.80	0.78	1.31	1.31
Tamil Nadu	1.05	0.92	1.27	1.29	2.31	2.21
Uttar Pradesh	1.38	1.29	0.51	0.53	1.89	1.82
West Bengal	5.87	5.89	3.83	4.84	9.69	10.73
Chhattisgarh		0.65		0.12		0.77
Uttaranchal		0.55		0.28		0.83
Himachal Pradesh	0.72	0.33	0.49	0.17	1.21	0.49

Adopting the conversion of livestock into ACU, the livestock density was calculated once again. This would give a realistic picture of the livestock pressure on the limited available land resources in a state. The livestock density (in ACU terms) did not increase in most of the DDP/DPAP districts in different states except in West Bengal, Haryana, Gujarat and Rajasthan (**Table 10**). However, the density of small ruminants even in terms of ACU increased in most of the states with exception to Haryana and Karnataka mainly. The decrease in the overall density was due to decline in cattle population.

Figure 9. Small ruminants density in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>

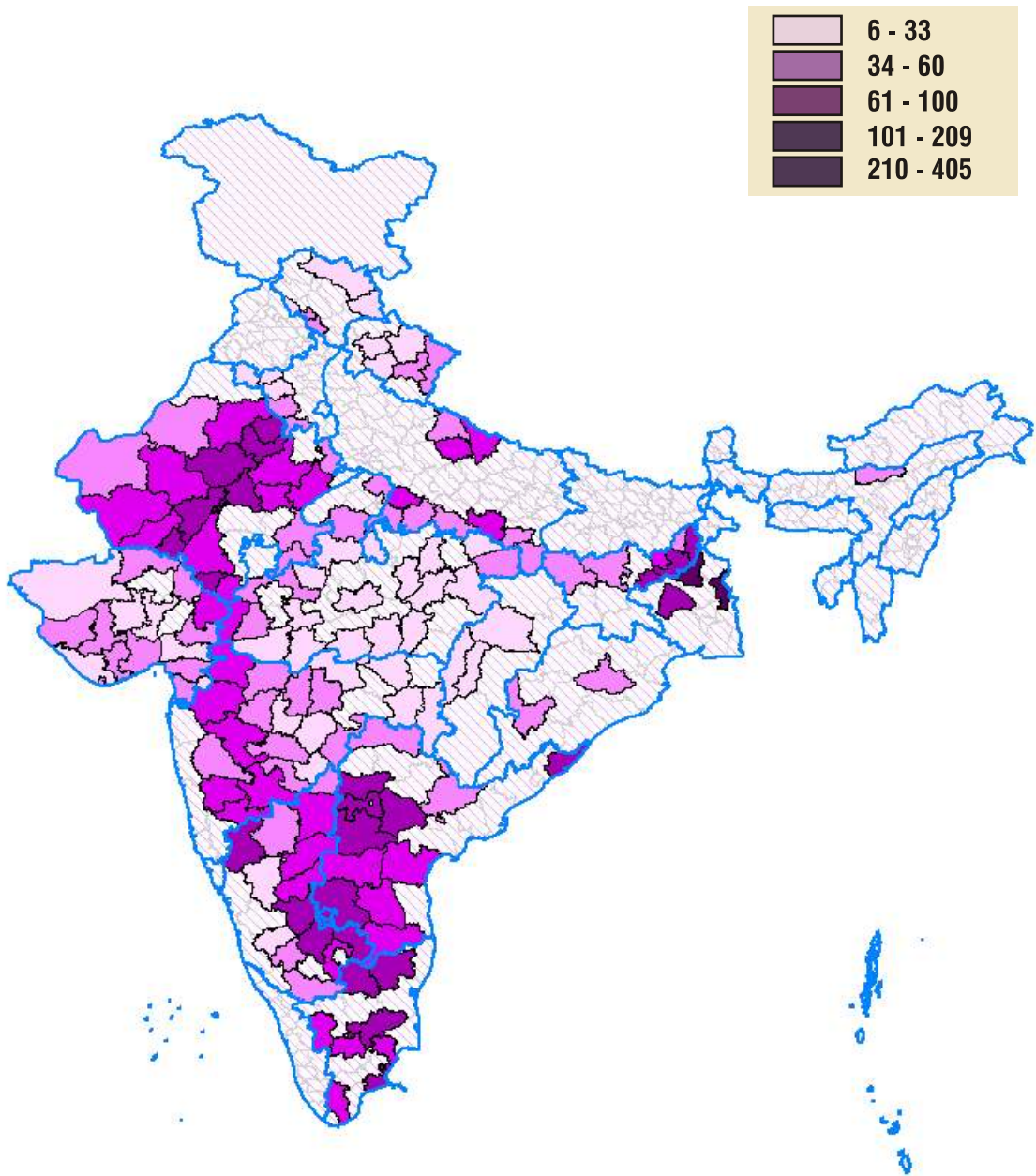


Figure 10. Large ruminants density in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>

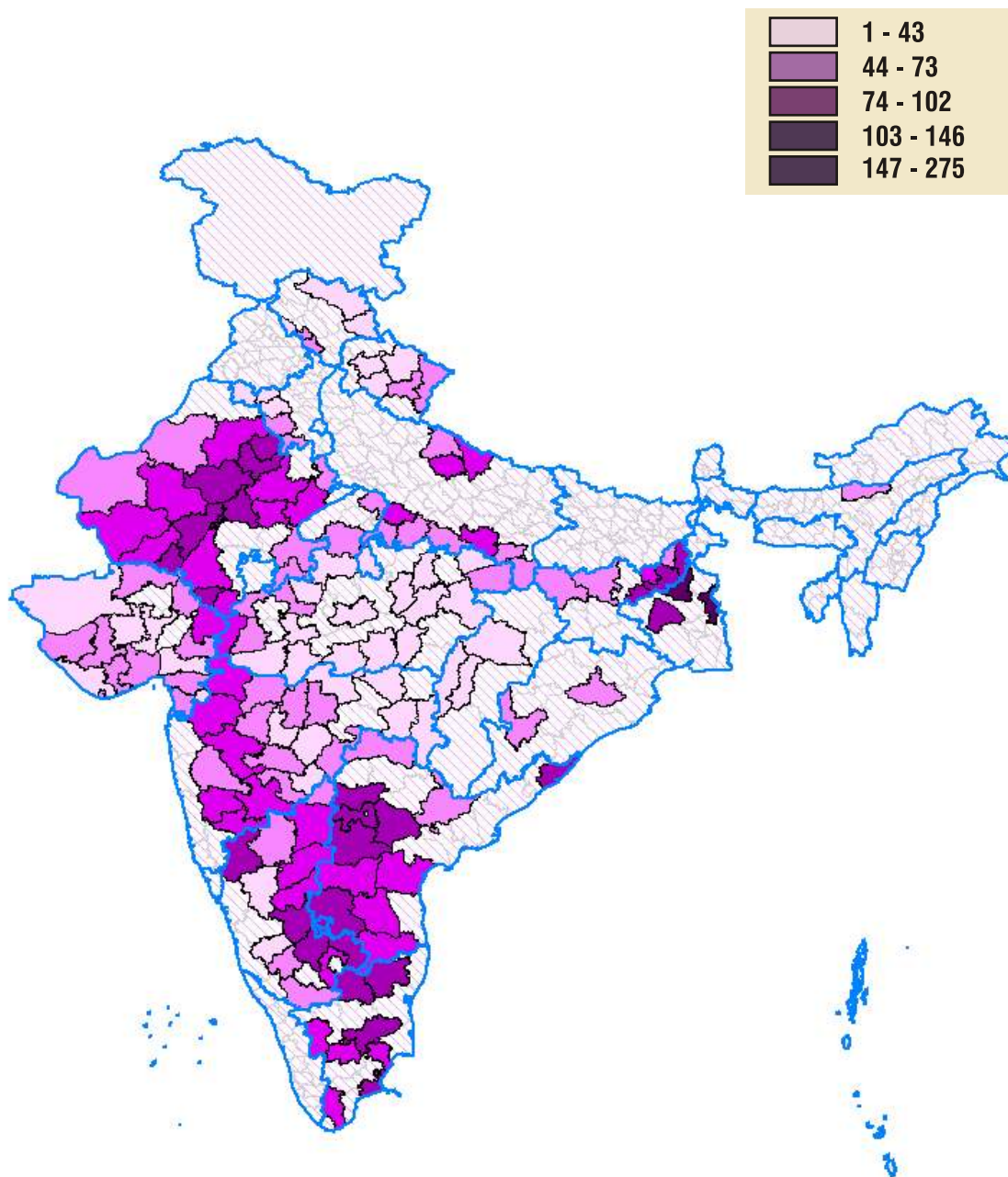


Figure 11 . Cattle density in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>

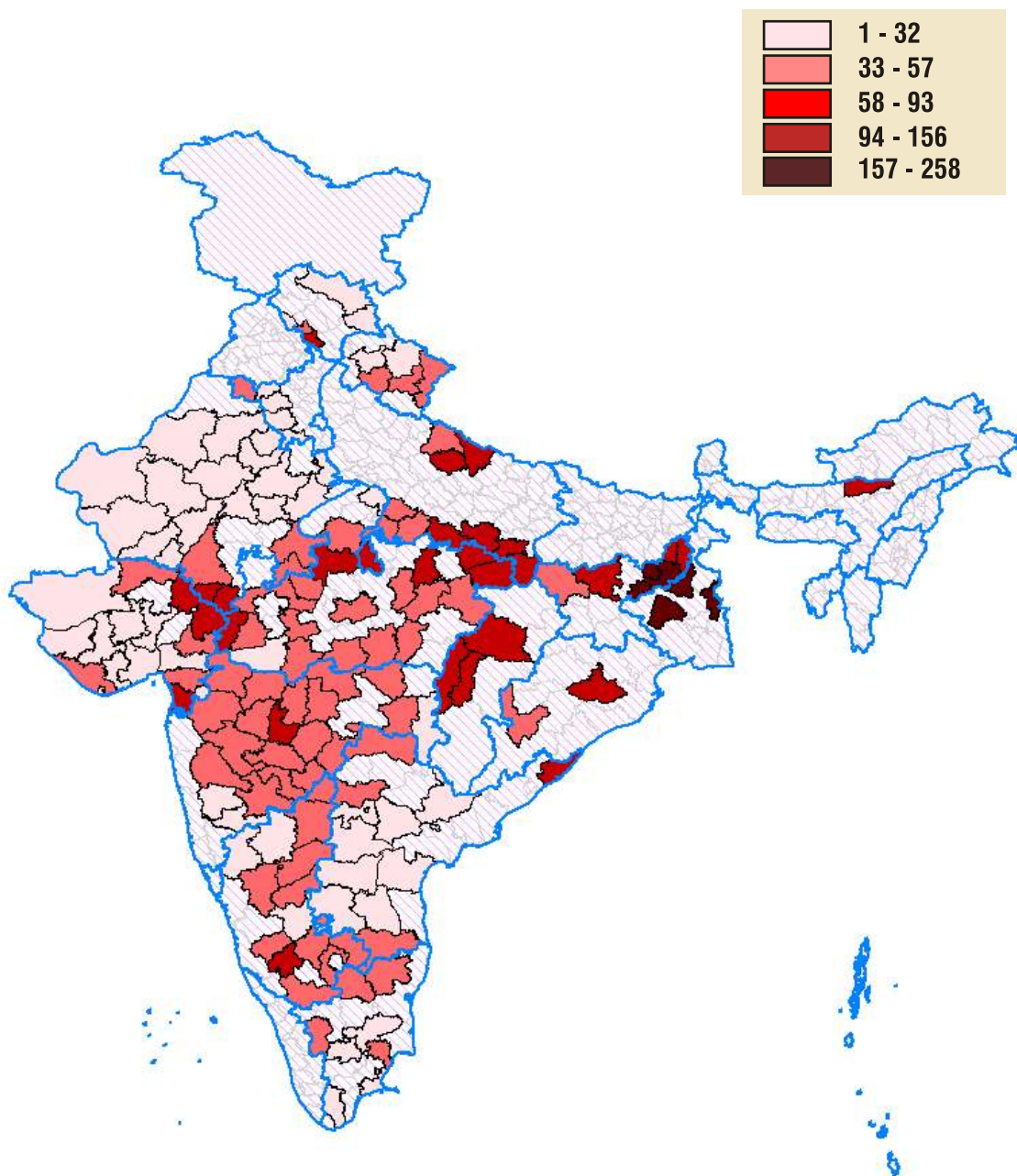




Figure 12 . Buffalo density in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>

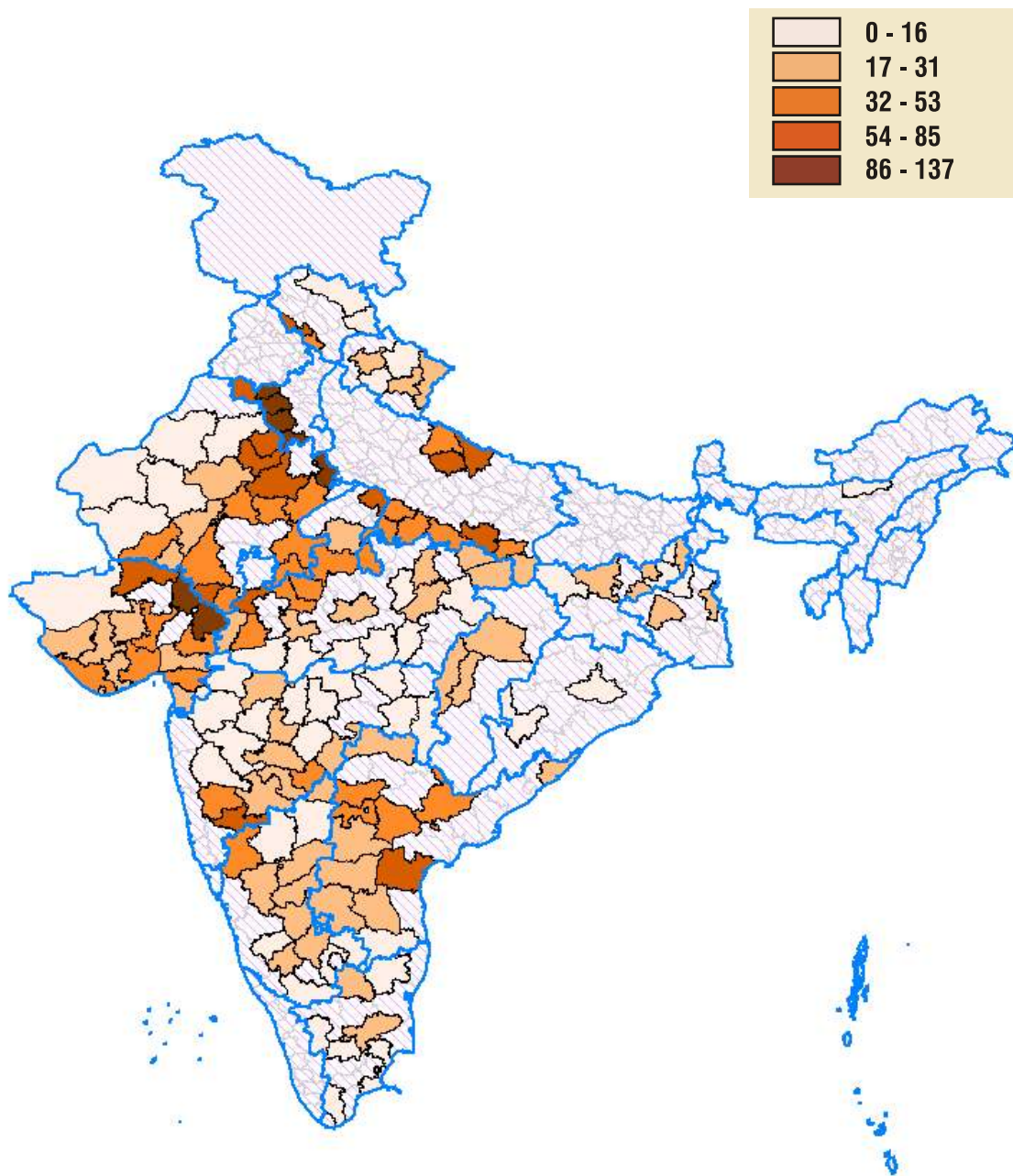


Figure 13. Sheep density (in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>)

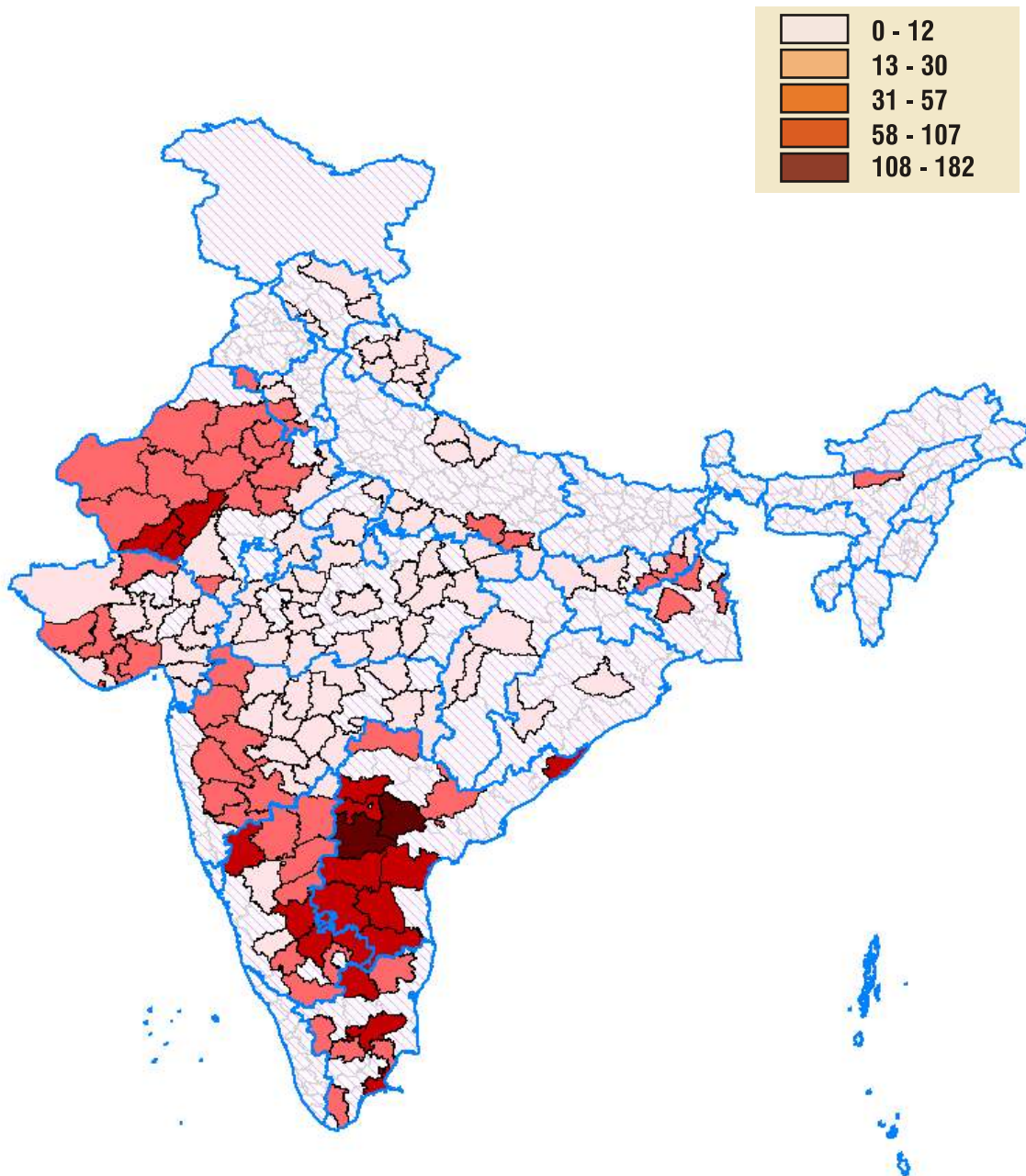
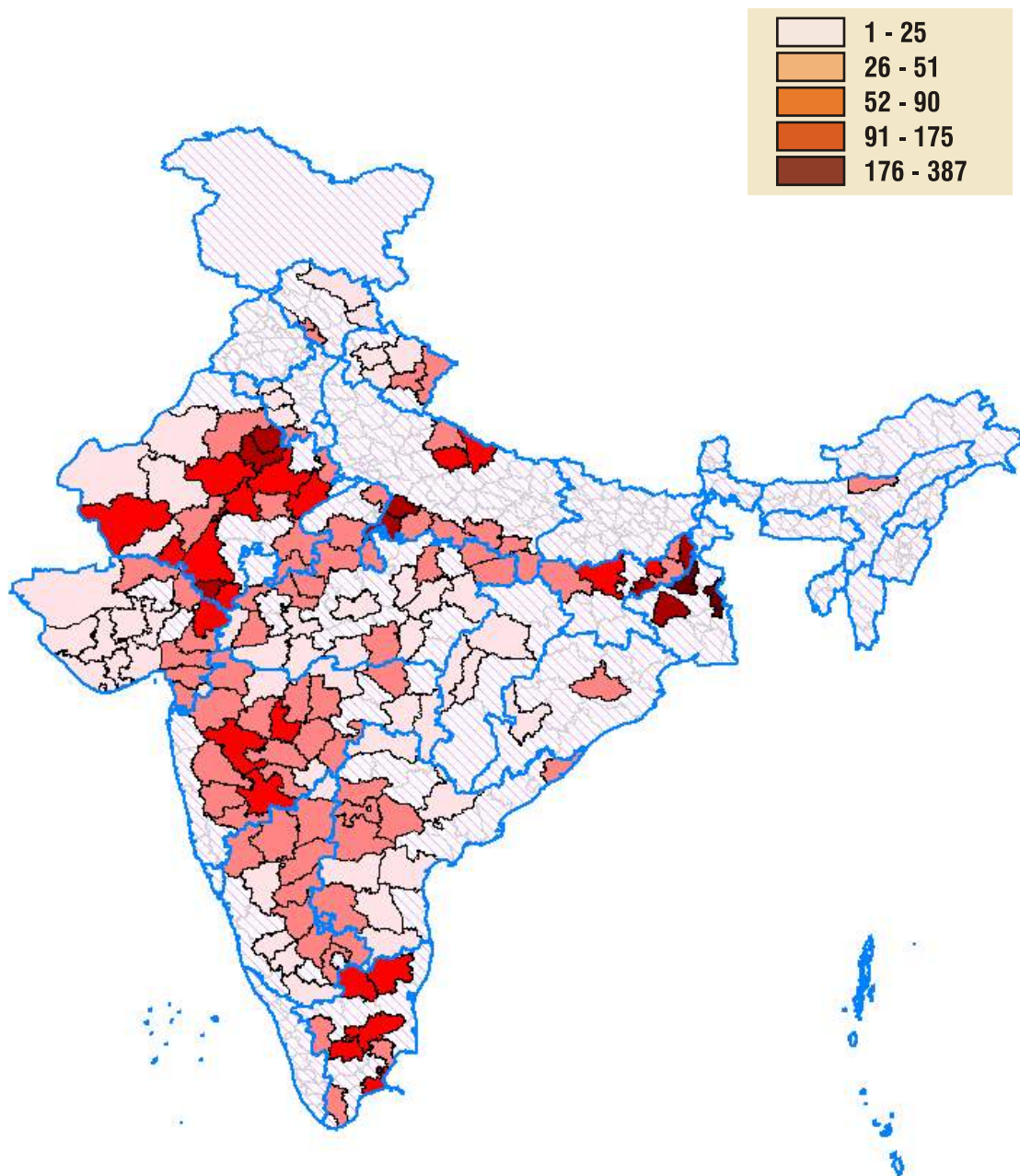




Figure 14. Goat density in rainfed (DPAP/DDP) districts, heads/km<sup>2</sup>



**Table 10: Livestock Density in DPAP/DDP Districts in different states, ACU/ ha**

State	Large ruminants		Small ruminants		Total	
	1992	2003	1992	2003	1992	2003
Andhra Pradesh	0.61	0.60	0.09	0.22	0.71	0.82
Bihar		1.48		0.18		1.67
Gujarat	0.46	0.63	0.06	0.07	0.53	0.70
Haryana	0.84	1.18	0.09	0.06	0.92	1.24
Karnataka	0.94	0.64	0.17	0.14	1.11	0.78
Madhya Pradesh	1.01	0.88	0.06	0.07	1.07	0.95
Maharashtra	0.65	0.64	0.09	0.09	0.74	0.74
Orissa	0.83	0.76	0.08	0.09	0.91	0.84
Rajasthan	0.45	0.48	0.16	0.16	0.61	0.63
Tamil Nadu	0.92	0.79	0.25	0.26	1.17	1.05
Uttar Pradesh	1.20	1.14	0.10	0.11	1.31	1.25
West Bengal	5.05	5.06	0.77	0.97	5.82	6.02
Chhattisgarh		0.57		0.02		0.60
Uttaranchal		0.50		0.06		0.55
Himachal Pradesh	0.66	0.31	0.10	0.03	0.76	0.34

## Draught Animals

Out of India's total bovine population of 283 million in 2003, over 60 million were used for work with 54.3 million bullocks among them. Bullocks are the main draught animals contributing more than 90 percent of the working animals (Table 11). Though the population of work animals has shown a negative annual growth of 2.53, but it still remains a very important source of draught power for agriculture especially for smaller holdings and agriculture in hilly terrain. It has been found that farm size, mechanization and technology have inverse relationship with work animal population density (Sharma, 2004). Moreover the new generation farmers want to use more mechanical power for agricultural operations instead of physical labour. The decrease in the population of bullocks has been highest in the northern region during 1977-2003 followed by southern and western region (Table 12). During the same period the population of bullocks increased by 18 percent in the eastern region. It may be due to smaller size of land holdings, and soils and rainfall conditions suiting bullock operated operations in agricultural fields. It may also be mentioned that the growth rate of population of bullocks in Gujrat and Madhya Pradesh during 1997-2003 was also positive indicating greater role of animal draught in these rainfed states. In case of smallholders where maintaining a pair of bullocks is not economically viable, the practice of sharing neighbour's bullock (two farmers maintain one bullock each and use them together) may be encouraged. However there is need to pragmatically plan the use of animal draught power in rainfed agriculture; as the timely completion of agricultural operations is of paramount importance in rainfed areas especially in the areas endowed with light textured soils.

**Table 11: State-wise population of work animals, in '000**

State	Cattle			Buffalo		
	1997	2003	AGR (%)	1997	2003	AGR(%)
<b>Rainfed</b>						
Andhra Pradesh	4581	3698	-3.51	537	401	-4.75
Assam	2151	2172	0.16	164	169	0.48
Gujarat	2532	2540	0.06	58	79	5.23
Himachal Pradesh	809	714	-2.06	3	1	-12.43
Jammu & Kashmir	914	614	-6.41	60	31	-10.52
Karnataka	3423	2902	-2.71	182	108	-8.33
Kerala	34	19	-9.50	13	8	-7.16
Madhya Pradesh	7031	6229	-2.00	195	204	0.72
Maharashtra	6794	6163	-1.61	258	197	-4.43
Orissa	5244	5039	-0.66	560	538	-0.68
Rajasthan	2593	2116	-3.33	68	42	-7.54
Tamil Nadu	2042	1096	-9.85	140	31	-22.38
West Bengal	4980	5094	0.38	460	582	4.00
<b>Irrigated</b>						
Haryana	400	326	-3.36	275	141	-10.58
Punjab	0	364	-	0	72	-
Uttar Pradesh	6710	5394	-3.57	1694	1462	-2.42
India	55759	54319	0.43	6802	5834	2.52

**Table 12: Distribution and growth of bullocks, in million**

Zones / states	1977	1992	2003	Growth (%) (1977-2003)
<b>Northern</b>	<b>20.90</b>	<b>13.54</b>	<b>9.36</b>	<b>-55.23</b>
Madhya Pradesh	0.82	-	-	-
Uttarkhand	-	-	0.64	-
Uttar Pradesh	13.02	9.34	5.39	-58.57
Jammu & Kashmir	0.86	0.57	0.51	-40.23
Rajasthan	3.94	2.74	2.12	-46.29
Punjab	1.32	0.43	0.36	-72.42
Haryana	0.94	0.46	0.33	-65.32
<b>Southern</b>	<b>13.54</b>	<b>11.41</b>	<b>7.72</b>	<b>-43.0</b>
Tamil Nadu	4.37	2.30	1.10	-74.90
Andhra Pradesh	5.13	4.65	3.70	-27.91
Karnataka	3.67	4.34	2.90	-20.95

Kerala	0.36	0.12	0.02	-94.40
<b>Eastern</b>	<b>15.13</b>	<b>-</b>	<b>17.90</b>	<b>18.30</b>
Jharkhand	-	-	3.12	-
Manipur	0.12	0.41	0.14	13.30
Bihar	7.21	-	2.25	-68.74
Orissa	4.80	-	5.04	4.96
West Bengal	5.00	4.83	5.09	1.80
Assam	2.46	2.70	2.17	-11.71
Sikkim	0.04	0.07	0.03	-27.50
<b>Western</b>	<b>18.66</b>	<b>18.45</b>	<b>17.97</b>	<b>-3.20</b>
Chattisgarh	-	-	3.04	-
Madhya Pradesh	9.57	9.33	6.23	-34.93
Gujarat	2.85	2.79	2.54	-10.88
Maharashtra	6.24	6.33	6.16	-1.23
<b>All India</b>	<b>73.23</b>	<b>60.88</b>	<b>54.32</b>	<b>-25.84</b>

## 5. Growth

The growth in the livestock population was worked out for the period 1992-2003 using three census data, i.e. 1992, 1997 and 2003. The annual growth in livestock population at all India level was marginal at 0.31% over a period of 11 years (covering three census periods). The annual growth rate of livestock in most of the rainfed states was positive except Kerala and Karnataka. It was highest in Andhra Pradesh (3.6%) followed by West Bengal and Gujarat. Higher slaughter rate of animals in Kerala and drought like situation during 2002 in Karnataka might be the cause of negative growth. At the same time the livestock growth rate was negative in all the major irrigated states (Table 13).

**Table 13. Growth rate of livestock in rainfed and irrigated states (CAGR) 1992-2003**

States	Cattle	Buffaloes	Sheep	Goats	Livestock
<b>Rainfed States</b>					
Andhra Pradesh	-1.5	1.4	9.8	3.4	3.6
Gujarat	0.8	2.8	0.1	0.6	1.4
Himachal Pradesh	0.3	0.9	-1.4	0.0	0.0
Kartanata	-5.0	-0.6	2.5	-3.0	-1.3
Kerala	-4.4	-12.7	-16.1	-3.8	-4.5
Madhya Pradesh	1.1	9.2	-3.8	-0.1	0.6
Maharashtra	-0.6	1.1	0.0	0.6	0.1
Orissa	0.0	-0.8	-1.2	1.4	0.3

Rajasthan	-0.7	2.7	-2.1	0.8	0.1
Tamil Nadu	-0.1	-4.8	-0.4	2.4	0.0
West Bengal	0.7	0.6	0.2	2.6	1.6
<b>Irrigated States</b>					
Bihar	-2.4	6.7	-4.3	-1.8	-1.1
Haryana	-3.1	3.0	-4.7	-5.1	-0.3
Punjab	-3.2	0.0	-7.7	-5.9	-1.6
Uttar Pradesh	-2.6	1.8	-2.9	0.7	-0.1
<b>All India</b>	<b>-0.1</b>	<b>3.1</b>	<b>1.9</b>	<b>1.3</b>	<b>0.3</b>

CAGR: Compound annual growth rate

The relative growth rate across different animal categories was also worked out. Across the species, significant stride in growth has been recorded in crossbred cattle, especially in states like Madhya Pradesh (13.5%), Rajasthan (13%), Gujarat (9.6%), Tamil Nadu (9.7%) and Karnataka (8.7%). At the same time the population of indigenous cattle declined. Among the irrigated states, the growth rate of all the three species (cattle, sheep and goat) was negative except goats in Uttar Pradesh. However, the growth rate of buffalo population was impressive. On the other hand in rainfed states, all the four livestock species had positive growth rate in some states and negative in some with bias towards small ruminants. Among all, Andhra Pradesh recorded the highest growth rate both for sheep and goats.

The growth of livestock in the DDP/DPAP districts across states was worked out and the same is presented in **Table 14**. Out of the 12 major states, the livestock growth was negative, in seven states including Karnataka, Tamil Nadu and Uttar Pradesh. On the other hand, in Andhra Pradesh, Gujarat and Haryana, the livestock growth in rainfed districts was positive and higher than the overall livestock growth of each of these states. The growth rate of livestock, even after conversion into adult cattle units, was more or less similar, except for the level of growth. This indicates that production infrastructure and market support lead to better growth of the sector. Among the four livestock species, the growth rate was negative or static in case of cattle across all the states except Gujarat. In respect of buffaloes, the growth rate was positive in majority of the states with significant stride in Gujarat and Haryana. The decline in growth may be noted in majority of the states with regard to sheep while the growth rate of goats was positive in seven out of twelve states. Both in respect of sheep and goats, Andhra Pradesh had the highest growth rate, which in fact, pulled the overall livestock growth of the state. That may be due to the factors like relatively higher awareness of livestock keepers, favorable market price and policy support for development of sheep production.



**Table 14. Growth rate of Livestock in DPAP/DDP Districts in different states : 1993-2003 (%)**

States	Cattle	Buffalo	Sheep	Goats	Total Livestock
Andhra Pradesh	-1.26	1.53	9.79	4.19	4.10
Gujarat	1.80	4.14	0.18	1.77	2.20
Haryana	-1.27	4.62	-3.31	-2.55	1.48
Karnataka	-4.17	-1.53	0.83	-3.88	-2.39
Madhya Pradesh	-0.79	1.45	-2.10	2.07	0.23
Maharashtra	-1.07	0.80	-0.26	-0.20	-0.46
Orissa	-0.58	-1.95	-0.61	0.71	-0.44
Rajasthan	-0.98	2.26	-1.95	0.75	-0.08
Tamil Nadu	-1.33	-3.55	-0.81	-0.21	-1.05
Uttar Pradesh	-1.95	0.41	-3.60	0.31	-0.92
West Bengal	0.04	-0.10	0.67	2.33	0.92
Himachal Pradesh	0.04	1.97	-1.48	-1.88	-0.04

## 6. Grazing Incidence

The livestock in the rainfed areas are mostly dependent on grazing in common as well as in private lands to meet their nutritional requirement. The area under forests, fallows (current and permanent), pasture lands and barren lands is generally available for grazing of the livestock. The grazing incidence per unit of grazing area for two points of time (1997 and 2004) was worked out as the ratio of number of livestock (ACU) for one hectare of such potential grazing area. The land available for grazing in the DPAP/DDP districts has generally decreased across the states with marginal increase in states like Gujarat, Uttar Pradesh, Andhra Pradesh and Haryana (**Table 15**). The grazing incidence has increased in six states indicating decrease in availability of grazing land per animal. In another six states, viz., Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Tamil Nadu, it has decreased this might be due to decrease in total livestock population in these states and increased area under current fallow. The growth rate in grazing area was also worked out. Mixed trends were observed as far as the growth rate in total grazing area in dryland districts was concerned. The positive growth in the availability of grazing area may be due to expansion under current fallow during 2004. In order to realize its potential for livestock development, any area or district should have sufficient grazing resources or cultivated fodder.

**Table 15: Livestock Density - Grazing Incidence in DPAP/DDP districts in different states**

State	Per animal grazing area (ha)		Grazing incidence (livestock density/ha) ACU		Growth rate in grazing area (%)
	1997	2004	1997	2004	
Andhra Pradesh	0.502	0.359	0.851	0.764	0.170
Bihar		0.181		0.281	-0.007
Gujarat	0.674	0.480	1.045	0.713	-1.705
Haryana	0.079	0.097	0.115	0.128	0.975
Karnataka	0.271	0.260	0.443	0.473	0.421
Madhya Pradesh	0.276	0.394	0.373	0.551	3.015
Maharashtra	0.322	0.325	0.510	0.522	-0.200
Orissa	0.409	0.461	0.600	0.695	1.015
Rajasthan	0.336	0.393	0.728	0.816	0.652
Tamil Nadu	0.244	0.269	0.482	0.567	0.341
Uttar Pradesh	0.230	0.198	0.428	0.288	-1.064
West Bengal	0.040	0.039	0.067	0.069	0.341
Chhattisgarh		0.909		1.177	0.060
Uttaranchal		1.006		1.511	-0.009
Himachal Pradesh	2.170	1.924	5.118	2.780	0.001

## 7. Fodder Supply and Demand

The quantity and quality of fodder supply determines the production of livestock. Besides grazing in common lands, fodder is supplied from two basic sources, viz., crop by-products and cultivated products. The extent of crop by-products (both roughage and concentrates) to be available across major states, especially in the DPAP / DDP districts were estimated (**Table 16**). Across the states, Uttar Pradesh had the largest supply of crop by-products (roughages) followed by Andhra Pradesh and Rajasthan among the DPAP/DDP districts. However, roughage availability per ACU was highest in Haryana followed by Uttar Pradesh and Andhra Pradesh. In terms of feed and fodder availability, Haryana, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh and Maharashtra appears to have good potential for livestock production. But, the supply of concentrates in dryland districts was higher in states like Maharashtra, Madhya Pradesh, Gujarat and Andhra Pradesh on account of large areas under oilseed crops like groundnut (**Table 17**).

**Table 16. Crop by products (roughages) availability, million tones**

States	Paddy/Wheat Straw		Stover		Haulms		Total		Livestock ACU		Roughage availability per ACU	
	1997	2004	1997	2004	1997	2004	1997	2004	1997	2004	1997	2004
Andhra Pradesh	8516	9607	3330	5321	4845	7312	16691	22240	12157	14043	1.4	1.6

Gujarat	2241	2074	5343	3272	8517	6171	16101	11517	8818	11692	1.8	1.0
Haryana*	7592	9095	1512	1622	980	1000	10084	11717	1931	2579	5.2	4.5
Karnataka	3322	3921	5796	8268	3314	1965	12432	14154	16667	11862	0.7	1.2
Madhya Pradesh	7439	7377	3995	1617	9832	10206	21266	19200	14512	14407	1.5	1.3
Maharashtra	684	1016	10742	11015	4227	4407	15653	16438	20009	18722	0.8	0.9
Rajasthan	7703	6542	7993	9080	8897	5130	24593	20752	18050	18695	1.4	1.1
Tamil Nadu	6894	5062	1369	1342	4850	3578	13113	9982	8767	7308	1.5	1.4
Uttar Pradesh	24340	23337	6442	5414	5217	6157	35999	34908	9871	8829	3.6	4.0

\*Paddy straw not accounted as it is not used as livestock feed

**Table 17. Crop by products-concentrate availability, million tones**

State	Cake		Bran	
	1997	2004	1997	2004
Andhra Pradesh	1044	2343	15	100
Bihar	13	1	1	2
Gujarat	2990	3024	111	64
Haryana	697	394	5	4
Karnataka	468	489	305	292
Madhya Prade	3565	3347	145	57
Maharashtra	4979	2947	749	663
Orissa	203	321	5	4
Rajasthan	2282	184	137	142
Tamil Nadu	1002	782	49	64
Uttar Pradesh	388	358	51	39
West Bengal	35	44	1	1
Chattishgarh	41	13	5	5
Uttaranchal	12	11	2	2
Himachal Pradesh	4	16	0	6

**Table 18. Area under cultivated fodder in DPAP/DDP districts in different states, in ha**

State	Fodder area/ 000ACU		Fodder area/ 000 animals		Irrigated Fodder area/000ACU	
	1998	2003	1998	2003	1998	2003
Andhra Pradesh	1.82	1.49	3.08	3.18	0.45	0.69
Bihar		0.32		0.50		0.02
Gujarat	77.45	52.95	120.04	78.69	17.31	17.79
Haryana	56.56	112.57	81.78	148.73	51.02	92.81
Karnataka		1.82		3.31		0.47
Madhya Pradesh	19.12	14.66	25.91	20.52	1.01	0.97
Maharashtra	10.43	12.45	16.48	19.98	2.16	4.69
Tamil Nadu	7.45	8.56	14.70	18.04	1.09	1.42
Uttar Pradesh	3.72	3.70	6.92	5.39	2.46	1.86
West Bengal	0.27	0.02	0.46	0.04	0.52	0.52
Chhattisgarh		0.03		0.03		0.03
Uttaranchal		0.13		0.20		0.20
Himachal Pradesh	3.86	4.03	9.11	5.82	3.39	2.43

\* ACU consist only cattle and buffalo as cultivated fodder is mostly fed to them only.

The extent of fodder crops cultivated in the major states was worked out per 1000 ACU for two points obtained. Among the DPAP / DDP districts in different states, the unit fodder area was the highest (149 ha/1000 animals) in Haryana during 2003, which is an increase of over 80% in five years. Similarly, there was increase in unit fodder area in states like Maharashtra and Tamil Nadu. But there were states like Uttar Pradesh and Madhya Pradesh where the cultivated fodder area per livestock unit has been coming down, which need to be rectified to sustain the growth in livestock. The share of irrigated fodder area is obviously higher in states like Haryana. Gujrat also had significantly higher allocation for fodder cultivation as compared to other states.

## 8. Milk Production

Milk production data was analyzed for the rainfed and other states separately for the period 1997-98 to 2007-08. It may be noted that the All India milk production increased from 72 million tones to 105 million tones during this period with a growth rate of 3.7. Across the rainfed states, the growth in milk production was the highest (6.9%) in Andhra Pradesh followed by Gujarat (5%), Rajasthan (3.6%) and Maharashtra (3%) indicating that the growth rate in milk production in rainfed states was at par with the irrigated state. In Andhra Pradesh and Gujarat, it was even higher than the irrigated areas. Hence, it demonstrates good prospects of milk and livestock production in rainfed areas. In terms of absolute milk production, Uttar Pradesh accounted for largest share in total milk production, however in rainfed states, Rajasthan stood first followed by Andhra Pradesh and Maharashtra (Table 19).

**Table 19 : Milk Production (000 t)**

State	1997-98	2007-08	Annual growth rate (%)
<b>Rainfed states</b>			
Andhra Pradesh	4473	8925	6.9
Gujarat	4913	7911	5.0
Karnataka	3970	4244	-0.6
Kerala	2343	2253	-1.9
Madhya Pradesh	5377	6572	2.1
Rajasthan	6487	9536	3.6
Tamil Nadu	4061	5586	2.8
West Bengal	3415	4087	1.9
<b>Irrigated states</b>			
Bihar	3420	5783	6.7
Haryana	4373	5442	2.2
Punjab	7165	9282	2.6
Uttar Pradesh	12934	18861	3.8

Source: Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, GoI (2008)



## 9. Meat Production

The estimated meat production from sheep and goats across major states in India for the period 1998-99 to 2005-06 was analyzed for growth rates and average meat production. The analyzed data was classified into two categories, viz., rainfed states and irrigated states (**Table 20**). Among the rainfed states, Tamil Nadu had the highest growth rate (15.5%) in meat production followed by Andhra Pradesh (10%). The meat productivity (meat yield per animal or carcass weight) of sheep and goat had a large variation in both rainfed as well as irrigated states. The variability in the carcass weight of sheep and goat in different states has been mainly due to difference in breed and age of slaughter of these animals. The meat yield of goat is lowest in West Bengal as the breed (Black Bengal) of goat found there is of smaller size.

**Table 20: Small ruminants meat productivity and growth rate (1998-99 to 2005-06)**

State	Growth rate (small ruminants' meat production)	Yield/ carcass weight, kg (2003)	
		Sheep	Goats
<b>Rainfed States</b>			
Andhra Pradesh	10	13.0	10.9
Gujarat	5.8	10.8	11.2
Himachal Pradesh	-2.6	16.4	17.5
Karnataka	1.4	14.6	14.3
Kerala	-12.8		9.8
Madhya Pradesh	-3.4	14.2	14.5
Maharashtra	2.2	11.7	11.5
Orissa	5.3	9.3	10.9
Rajasthan	7.4	11.6	14.0
Tamil Nadu	15.5	10.9	12.2
West Bengal	2.89	7.8	7.1
<b>Irrigated States</b>			
Bihar	-5.4	9.1	8.1
Haryana	26.4	18.6	18.1
Punjab	-5.2	11.7	12.1
Uttar Pradesh	3.5	16.5	16.1
India	1.41	11.9	9.4

## 10. Growth of Dairy

As mentioned earlier the growth of organized dairy processing and marketing started in 1970s mainly by way of cooperatives. This was further complemented by promotion of private sector into dairy industry with the advent of liberalization. The growth of cooperative as well as private dairies has provided better opportunity to the small producers to market the milk. Therefore, the growth of dairy plants broadly gives an indication of the status of livestock sector especially that of the dairy animals. The number of dairy plants for one lakh dairy animals consisting cow and buffalo was worked out for different states. The density of dairy plants across the states indicated that their number was highest in Maharashtra (86 per 1, 00,000 dairy animals) followed by Gujarat (76) and Tamil Nadu (65) among the rainfed states. However, in terms of milk processing capacity, Gujarat had the highest capacity (70722 liters/lakh dairy animals) followed by Madhya Pradesh and Rajasthan, **Table 21**.

**Table 21: Dairy plant concentration and capacity - 2006 (Per lakh dairy animals)**

State	No. of dairy plants	Capacity
		Litres/lakh dairy animals
<b>Rainfed States</b>		
Andhra Pradesh	26	20823
Gujarat	76	70722
Himachal Pradesh	20	12924
Jammu & Kash	1	27346
Karnataka	31	17604
Kerala	41	5546
Madhya Pradesh	14	58045
Maharashtra	86	1190
Orissa	0	10523
Rajasthan	12	57505
Tamil Nadu	65	7330
West Bengal	10	
<b>Irrigated States</b>		
Bihar	4	1720
Haryana	76	58218
Punjab	66	47548
Uttar Pradesh	46	21975

## 11. Milk Availability

Based on the milk production in a state and its human population, the per capita milk availability was worked out and its growth rate was calculated. Rajasthan had the highest per capita milk availability (387 g) among the rainfed states during 2005-06 followed by Himachal Pradesh, Jammu & Kashmir and Gujarat. Compared to this, the milk availability was more than double in irrigated states like Punjab (943 g) followed by Haryana (628 g). However, per capita milk availability in other irrigated states, viz., Uttar Pradesh and Bihar was lower than the better performing rainfed states. The annual growth rate in per capita milk availability in most of the rainfed states was positive except Kerala, Karnataka and Jammu & Kashmir. Orissa state had the highest growth rate in per capita milk availability for the period 1998-2006. Next to Orissa was Andhra Pradesh with 5.4% growth rate followed by Gujarat (3.1%) **Table 22.** The reasons for significant increase in Milk production in AP may be the increased milk productivity of buffalo through grading up and setting up of large number of private dairies, which have been promoting high yielding cross-bred cows and importing high yielding murrah buffaloes from Haryana. In the case of irrigated states also, the growth rates in per capita milk availability were positive.

**Table 22. Per Capita availability of milk during 1998-99 to 2005-06**

State	1998-99	2005-06	Growth rate
<b>Rainfed States</b>			
Andhra Pradesh	185	260	5.4
Gujarat	290	348	3.1
Himachal Pradesh	347	373	1.1
Jammu & Kashmir	353	353	0.2
Karnataka	233	197	-3.5
Kerala	221	171	-4.8
Madhya Pradesh	262	262	-0.3
Maharashtra	168	178	1
Orissa	58	95	6.7
Rajasthan	356	387	1
Tamil Nadu	199	231	0.7
West Bengal	125	126	0.2
<b>Irrigated States</b>			
Bihar	121	154	4.2
Haryana	623	628	0.2
Punjab	883	943	0.8
Uttar Pradesh	238	262	1.5

## 12. Veterinary Infrastructure

Infrastructure in terms of livestock health centers has a bearing on the performance of livestock sector. In the absence of complete data on various infrastructure facilities catering to livestock, the data on budget allocated and spent for Animal Husbandry Department could be used as a proxy. There was a wide variability in the amount of budget allocated for livestock sector in different states. It varied from Rs.379 to Rs.4966 per ten thousand animals in different rainfed states and Rs.1116 to Rs.4026 in irrigated states in 2006-07 (**Table 23**). The budget allocation for livestock in rainfed states was at par with the irrigated states except Andhra Pradesh (Rs.379). Budget allocation for livestock in Andhra Pradesh state, which has good potential for livestock development, should be enhanced.

Another indicator that gives some picture of the status of livestock infrastructure is the number of veterinary institutions per unit population. Among the rainfed states, the number of veterinary institutions for every 10,000 livestock was higher in Kerala and Himachal Pradesh (8.2 and 7.2, respectively) (**Table 24**). This could be due to the difficult terrains of these states, which necessitate density of veterinary institutions. In the case of major livestock concentrated states like Andhra Pradesh and Rajasthan, the number of veterinary institutions was around one for every 10,000 livestock which is not at all sufficient to provide proper veterinary and breeding services to the available livestock. The figure for Gujarat was only 0.8, but there, the dairy cooperatives are providing such services effectively to large number of animals. In fact the livestock keepers suffer huge losses on account of disease and parasites in livestock especially in small ruminants (Kumar *et al.* 2003). Hence, there is need not only to increase the number of veterinary institutions, but also to increase the effectiveness of delivery of such services.

**Table 23. State wise budget allocation for livestock sector (Rs.)**

State	Amount 10000 Livestock	
	2002-03 Rainfed States	2006-07
Andhra Pradesh	283	379
Assam	1002	699
Gujarat	1898	2907
Himachal Pradesh	5449	4966
Jammu & Kashmir	147	3006
Karnataka	1617	2150
Madhya Pradesh	958	1564
Maharashtra	508	1003
Orissa	1612	2154
Rajasthan	862	1191
Tamil Nadu	905	1721
West Bengal	969	1018
	<b>Irrigated States</b>	
Bihar	955	1116
Haryana	1566	2164
Punjab	-	2055
Uttar Pradesh	-	4026

**Table 24. Number of Veterinary Institutions State wise in different states**

State	Vet. Institutions/ 10000 livestock
<b>Rainfed States</b>	
Andhra Pradesh	1.3
Assam	3.1
Gujarat	0.8
Himachal Pradesh	7.2
Jammu & Kashmir	2.8
Karnataka	2.3
Kerala	8.2
Madhya Pradesh	1.4
Maharashtra	1.7
Orissa	3.7
Rajasthan	0.9
Tamil Nadu	2
West Bengal	1.7
<b>Irrigated States</b>	
Bihar	1.4
Haryana	3.3
Punjab	4.4
Uttar Pradesh	15.8

### 13. Animal Breeding

The promotion of crossbreds with exotic blood in the case of cattle and grading up of buffaloes formed the fulcrum of livestock improvement. Increase in the share of crossbreds/improved animals has been on account of breed improvement programme by introducing high yielding germ plasm through artificial insemination (AI). Hence, the growth rate of artificial inseminations performed in local cattle and buffalo with superior germ plasm during the period 1998-99 to 2005-06 was estimated. It may be noted that the artificial insemination programme is more than four decades old and its intensity might vary depending on the resource-base for livestock production. Among the irrigated states, Haryana and Bihar had considerably higher AI growth rate compared to the rainfed states. In case of rainfed states, larger states like Maharashtra, Madhya Pradesh and West Bengal recorded double digit growth rate in AI during 1998-99 to 2005-06 (Table 25). Negative growth rate in AI in Kerala may be due to very high rate of adoption of AI in the period prior to 1998.



**Table 25: Growth rate of artificial Inseminations Performed during 1998-99 to 2005-06 - State wise**

State	Growth rate
<b>Rainfed States</b>	
Andhra Pradesh	7.5
Assam	31.8
Gujarat	-0.1
Himachal Pradesh	2.5
Jammu & Kashmir	6.3
Karnataka	9.5
Kerala	-23.6
Madhya Pradesh	12.4
Maharashtra	10.3
Orissa	2.5
Rajasthan	8.5
Tamil Nadu	0.3
West Bengal	11.4
<b>Irrigated States</b>	
Bihar	16.2
Haryana	17.4
Punjab	6.9
Uttar Pradesh	-2.1

The crossbreeding programme wherein the indigenous cattle were crossed with high yielding exotic breeds like Holstein Frisian, Brown Swiss, Jersey, etc. have surely played an important role in enhancing the milk production. However in the process there has been loss of rich germ plasm in the form of dilution of breeds like Gir, Sahiwal, Tharparkar, Haryana etc which were used for crossbreeding. Moreover the crossbred cattle may well sustain only in the areas with sufficient availability of fodder and veterinary care. Hence, the focus in future should be on grading up of non-descript cattle and buffaloes with high yielding indigenous and exotic animals on selective basis.

## **14. Proposed Strategies**

In spite of many disadvantages like scarcity of fodder and water, poor infrastructure and services, low investment capacity of farmers and poor access to market as compared to other regions, the rainfed regions (47.6% of total geographical area) support proportionately almost equal share of the total livestock (45.6%), which has also been performing equally well as in irrigated areas. Livestock rearing is thus the most stable economic activity for the rural people

(farmers as well as landless) in the rainfed areas. At the same time risk in rainfed agriculture (crop farming) during the recent past has been increasing due to frequent rainfall deficits, rising cost of production and marketing, prices crash and globalization of agricultural trade. Hence there is need to have a comprehensive livestock development programme for the rainfed areas. To begin with DPAP/DDP districts most populous with cattle, buffalo, sheep and goat as identified and discussed in the previous section may be taken up as starting points for launching the livestock development programme in the rainfed areas.

The development of livestock sector in rainfed regions has to be based on multi-pronged strategy covering production, conservation, support systems and marketing. As emerged from the analysis, the livestock composition in rainfed regions is changing more in favour of small ruminants and buffaloes. The importance of cattle though has been continuously diminishing in overall livestock production in the country but it still remains important in many rainfed regions. It is evident that small ruminants, especially goats which are most widely distributed and adapted, should get more focus in the rainfed areas followed by sheep, buffalo and cattle; however the selection of any species for promotion would depend on resource situation, socio-economic factors and market.

Strategies for strengthening livestock sector in rainfed regions must focus on all the spheres of production and marketing. The population dynamics, production factors and market have shaped the sector in the present form. The following strategies may be adopted for the development of livestock sector in rainfed areas on sustainable basis:

### ***Feed and Nutrition***

Adequate supply of feed and fodder is the most important factor for productivity and sustainability of livestock production in rainfed areas. The feed deficit is a major constraint at national level (BIRTHAL et al, 2006); however, it is more severe in the rainfed areas.

- In that order the farmers should be encouraged to allocate more area under fodder crops through improved access to seeds of high yielding varieties of fodder crops and package of practices and identifying short duration fodder crops for different rainfed regions.
- Better management of common feed resources is crucially important for improved fodder supplies in rainfed areas. In fact, each watershed should essentially have a component to develop common and private fodder resources as part of it and its compliance by the project implementing agencies (PIAs) should be monitored. As most of the PIAs are not allocating resources for development of livestock and fodder component in spite of such guidelines under the watershed programme.
- Efficient utilization of available fodder resources: Chopping of coarse cereal stover (sorghum / ragi, etc), which is not common in southern India, needs to be promoted to reduce wastage (by at least 50%) and improve digestibility. Low cost chaff cutting machines of less capacity or custom hiring services may be useful.

- When the cultivated area remains unsown due to delayed rains, such areas should be utilized for fodder production through short duration varieties.
- Collection and conservation of available green fodder as hay or silage at monthly intervals from bunds, wastelands and common lands during rainy season and storing it properly for its use in lean season. Abundant surplus of monsoon grasses are available throughout the country. There is need to develop cost effective methods for conservation of such monsoon grasses for storage and their use in lean season. Community fodder banks should also be established by involving Panchayats and farmers in most fodder deficit areas. Fodder resource development committee consisting Panchayat, livestock owners and fodder producers may coordinate the functioning of fodder banks.
- Feed incentives to those farmers adopting practices like urea molasses enrichment of paddy / wheat straw, which could be used effectively during the drought situation.
- Encouraging cut and carry system of feeding especially during lean period that reduces lot of energy requirement (used for movement over long distances for grazing) of livestock and also considered best method in terms of feeding efficiency.
- Promoting use of mineral mixture especially during summer along with concentrate mixture to mitigate nutritional deficiencies and reproductive disorders in the animals.
- Promote pastoral systems in orchards for small ruminant rearing that would reduce a little grazing pressure on pastoral lands.
- Educating the farmers about efficient use of leguminous fodders like groundnut haulms, Lucerne, etc. in appropriate quantity along with non-legume fodder.
- Encouraging cultivation of fodder including fodder trees / shrubs in CPRs and growing of perennial fodder species like subabul/hedge Lucerne, etc. in farmers' backyard and farm boundaries.
- Facilities like storing densified roughages transported from other parts of the country should also be established as drought coping strategy. It may be undertaken through community fodder banks.
- The Panchayats may be given incentives to develop common grazing resources in the village commons through convergence of NREGS (National Rural Employment Guarantee Scheme).

### **Breeding**

- The yield of animals is directly related to their genetic potential. The average milk and meat yield of our animals especially in the dryland areas is very low. Hence, there should be effective programmes for grading up of non-descript cows and buffaloes with high yielding indigenous and exotic animals on selective basis.
- Similarly low yielding goat and sheep population may be graded up with the superior indigenous breeds.

- Existing artificial insemination programmes for large ruminants need to be strengthened and good quality breeding males of different breeds of sheep and goats need to be made available in the rural areas.
- With the involvement of animal husbandry experts and other major stakeholders (farmers, local veterinary doctor, dairy cooperatives, etc.), the potential indigenous breeds of different species need to be identified at micro level (development block) considering the yield potential, resource situation and socio-economic factors and should be used for grading up programmes.
- For weeding out poor quality breeding males of cattle, buffalo, goat and sheep, especially in case of small ruminants, Panchayat may play an effective role. Once the breeds of animals to be promoted at block and village level are decided, the Panchayat may ask its members not to keep breeding males of non-descript poor breeds. The poor breeding males may be replaced as part of breed improvement programme.

### **Health**

- Protection of animals against diseases and parasites is one of the pre-requisites for sustainable livestock production.
- Production losses in large ruminants and mortality losses in small ruminants due to diseases and parasites are huge, hence there is need to run an awareness campaign through mass media (TV, Newspaper, mobile etc.) focusing on importance of prevention programme for diseases and parasites in small as well as large ruminants.
- Deworming against parasites and vaccination against major diseases should be taken up as campaign at national level continuously for at least for five years. The major diseases in large ruminants are; Foot and Mouth disease (FMD), Hemorrhagic Septicemia (HS), Black Quarter (BQ), etc. and for small ruminants; Enterotoxaemia (ET), Blue tongue, peste des petits ruminant (PPR), FMD, etc.
- Non availability of vaccines in time especially for small ruminants is one of the major constraints. There is need to address this constraint immediately.

### **Marketing**

- Poor bargaining power, low awareness, high transaction cost, smaller surplus for sale, low income (distress sale) coupled with lack of infrastructure are the main reasons for lower price realization of the livestock produce of the smallholders.
- There is need to link the stallholder producers directly with the market (processors, marketers/retailers and consumers).
- Farmers should be encouraged and supported for collective action efforts for livestock production and marketing.

### **Insurance**

The insurance of livestock is the best safeguard for minimizing the risk especially for

smallholder producers. Its importance is paramount in rainfed areas because of higher risk of loss of production and animals due to recurrent droughts and rainfall deficits. Though the insurance companies have provision for insuring the animals throughout the country, but a very small share of livestock has been insured yet. The reasons of poor coverage of animals under insurance are: high cost of premium (4.5–8.25% of the value of animal) and low awareness among the farmers and non-cooperation of insurance companies. The insurance companies many times do not entertain request for insurance by the farmers especially in case of small ruminants because of the small scale of business and higher transaction cost. Moreover the procedure for claim settlement is also not time bound and transparent. It is very difficult for the farmers to get their claims because of non-cooperating attitude of the concerned officials and agencies. Hence, there is need to increase the farmers' awareness and make mandatory provision for the companies to undertake livestock insurance of interested farmers. There should also be redressal mechanism in case of non-compliance and non-cooperation by the insurance companies and related agencies.

### **Technology**

- Because of the constraints inherent to the situation, the level of technology adoption in rainfed areas is very low.
- Besides specific package of practices suggested above, there is need to provide a basket of technological options so that farmers/livestock holders may choose as per their needs and resources conditions.
- The focus should be on development of integrated farming system with livestock and other most remunerative activities as its components.

The livestock has a great promise as source of income and employment and livelihood security in the rainfed areas of the country, provided appropriate policy and institutions are placed for transfer of need based technologies, linking smallholders with the market, value addition and safeguards mechanism in face of increased competition due to globalization and unfavourable agro-climatic conditions.

### **References:**

Arya HPS Yadav MP and Tiwari R 2002. Livestock technologies for small farm systems. In: PS BIRTHAL and PP Rao (Eds.) 'Technology options for sustainable livestock production in India', ICRIASAT, Patancheru and ILRI, Ethiopia.

BIRTHAL PS and TANEJA VK 2006. Livestock sector in India: Opportunities and challenges for smallholders. In: PS BIRTHAL, VK TANEJA and W THORPE (Eds.) 'Smallholder Livestock Production in India', NCAP, New Delhi and ILRI, Nairobi, Kenya, pp. 5-64.

DAHDF. 2006. Basic Animal Husbandry Statistics, Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhavan, New Delhi, p.198

ICAR-ICRISAT. 2008. District Level Database Documentation 19 States of India. ICAR ICRISAT Collaborative Research and Development Project CD Rom.

Kumar Shalander and Pant KP 2002. Goats in India: Status and technological possibilities for improvement. In: P.S. BIRTHAL and P.P.RAO (Eds.) 'Technology options for sustainable livestock production in India', ICRISAT, Patancheru and ILRI, Ethiopia.

Kumar S, Vihan VS and Deoghare PR 2003. Economic implication of diseases in goats in India with special reference to implementation of a health plan calendar. Small Ruminant Research, 47: 159-164.

Ranjhan SK 2006. Farmer-Industry linkage in meat production: A symbiotic relationship. In: Proceedings of National Seminar on Commercial goat & sheep farming and Marketing, March 4-5, 2006, CIRG, Makhdoom, Mathura.

Sharma VP 2004. Livestock economy of India: current status, emerging issues and long term prospects. Indian Journal of Agricultural Economics, 59 (3): 512-53.

Turner L. Robin, 2004. Livestock production and rural poor in Andhra Pradesh and Orissa states, India. PPLPI Working Paper, No.9, FAO, Rome, Italy





## ACRONYMS

ACU	Adult Cattle Units
AI	Artificial Insemination
AP	Andhra Pradesh
CAGR	Compound Annual Growth Rate
Chh	Chattisgarh
CIRG	Central Institute for Research on Goats
CPRs	Common Property Resources
CRIDA	Central Research Institute for Dryland Agriculture
DDP	Desert Development Programme
DPAP	Drought Prone Area Programme
GOI	Government of India
Guj	Gujarat
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for Semi Arid Tropics
ILRI	International Livestock Research Institute
MP	Madhya Pradesh
MS	Maharashtra
NCAP	National Centre for Agricultural Economics and Policy Research
NGOs	Non- Governmental Organizations
NREGS	National Rural Employment Guarantee scheme
PIAs	Project Implementation Agencies
Raj	Rajasthan
SEPR	Socio Economic and Policy Research
WB	West Bengal

