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Trends and contribution of grazing resources to livestock in different states of India

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Abstract
This paper examines grazing pressure on livestock per unit of permanent pastures (PP) and grazing lands (GL) and its implications to small livestock holders. Carrying capacity of pastures and grazing lands was estimated in terms of number of adult cattle units sustain on this resource. Information on area under PP&GL, livestock population and number of marginal and small holdings for 14 major livestock states were compiled from diverse sources. Analysis revealed that, at country level, area under PP&GL has declined from 120 to 102 lakh hectares during 1980-81 to 2007-08. High deceleration in area under PP&GL were observed in Karnataka (4.16 lakh hectares) closely followed by Andhra Pradesh (4.15), Maharashtra (3.27) and Madhya Pradesh (2.97). However, livestock population in the country has increased from 4230 to 5297 lakh between the years 1982 and 2007. Grazing pressure in terms of livestock per unit of PP&GL at country level increased from 35 to 52 animals during 1982 to 2007 whereas, carrying capacity of per unit of PP&GL was less than 1 adult cattle unit. Increasing trends in the grazing pressure were noticed in Punjab (833 animals ha^{-2} of PP & GL) followed by Uttar Pradesh (142), Tamil Nadu (126) and Andhra Pradesh (69) during 1980-81 to 2007-08. The shrinking trends were more concerned to the states namely West Bengal, Uttar Pradesh, Tamil Nadu, Kerala, Andhra Pradesh and Karnataka where more than 75% of total land holdings belong to marginal and small farmers having high dependency on such common resources for green roughage. Hence efforts should be made to protect and rejuvenate common grazing lands to protect the interest of resource poor livestock holders. Some schemes focusing to enhance the productivity and value addition of PP & GL should be introduced, with a sense of urgency to augment the more nutritive bio-mass.

Keywords: Grazing lands, Grazing pressure, Green fodder, Pastures

Introduction

India has one of the largest livestock populations in the world, according to the FAO estimate, India had 16.6% of world's large ruminants (277 million), 9.9% small ruminants (190 million), 1.5% pigs (14 million) and 3.0% poultry (560 million) in 2007. However, country has 3.6% of world's cultivable land and 4% water. The livestock sector contributed 3.37% to total GDP during 2010-11 and about 29% value of output for total agriculture and allied activities (at 2004-05 prices) and providing gainful employment to nearly around 22.4 million working population in both principal and subsidiary status (GOI, 2012). Sector provides continuous income to the farmers particularly of arid and semi-arid regions in the country where crop failure is the recurrent phenomenon. Besides, economic contribution, livestock has many positive environmental externalities (Dikshit and Birthal, 2013). Indian agriculture is the home to small and marginal farmers, account for more than 80% of total farm households. But their share in operated area is only 44%. Small holdings play important role in raising agricultural development and poverty reduction. One of the notable characteristics of India's livestock production system is that almost its entire feed requirement is met from crop residues and byproducts; grasses, weeds and tree leaves gathered from cultivated and uncultivated lands; and grazing on common lands and harvested fields. Studies done on availability and requirement of feed fodder revealed that there is a gap between demand and supply of livestock feed (GOI, 1976; Singh and Mujumdar, 1992). As per report of the working group on Animal Husbandry & Dairying 12th five year plan (2012-17), the deficit of dry fodder, concentrates and green fodder currently is 10, 33 and 35% respectively. Major concern is the stagnation in the area under cultivated green fodder production and its increasing deficit over the years. Out of total fodder consumed by livestock, about 33% sourced from pastures, public lands, wastelands, fallows and forests (Dikshit and Birthal, 2010). Pastures

and grazing lands support vegetation that can be grazed by livestock to convert this renewable resource into high value commodities like milk, meat and fiber. The importance of these common resources can be gauged from that about 62% farmers in the rainfed region graze their livestock while, 34% of farmers graze their livestock in the irrigated regions. The importance of grazing is more prominent in arid region where 72% farmers graze their livestock (Kumar and Singh, 2008). Other studies indicated that there was an evidence of deterioration in terms of quantity and quality of common property resources particularly in rainfed region (Jodha, 1992).

In the present study, an attempt has been made to assess changes in area under permanent pastures and grazing lands (PP & GL), one of the most important common property resources for livestock in India. Shrinking of this resource over the period was worked out in terms of livestock density per hectare of PP & GL and its carrying capacity to sustain livestock.

Materials and Methods

Study used secondary data collected from diverse sources. Livestock population was collected from Indian Livestock Census, 1982 and 2007. Area under permanent pastures and grazing lands was compiled from land use pattern, Department of Economics and Statistics (DES), Government of India. Analysis was carried out to study changes in livestock population and area under permanent pastures and grazing lands in 14 major states. Selected states are home to more than 85% livestock population of the country in the year 2007, contributing about 85% to central milk and meat pool. Distribution of number of holdings by major size groups were compiled from Agriculture Census, Agricultural Census Division, Department of Agriculture and Co-operation. Grazing pressure in terms of livestock density per hectare of PP & GL has been estimated.

Carrying capacity of pastures and grazing lands was worked out on the basis of supply of fodder in terms of dry matter to sustain adult cattle having average body weight of 270 kg (as adult cattle unit). Average body weight of cattle was computed as suggested by Dikshit and Birthal (2010). Dry matter (DM) requirement per adult cattle was used as 3% of body weight per animal per day. In 1970s, the Committee on feed and fodder (Anonymous, 1976) had assumed 1.0 tonnes / hectare of green forage available from area under permanent pasture and grazing lands. In the year 2003 Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India (Anonymous, 2008-09) assumed a productivity rate of 0.75 ton / hectare from permanent pasture and grazing lands. This reduced productivity assumption in comparison to 1970s appears reasonable in view of the likely degradation of pastures due to increased livestock pressure (Dixit *et al.*, 2012). However, The National Institute of Animal Nutrition and Physiology (NIANP) in its 'Feed Base' had assumed 1.5 tonnes per hectare for forest and 5.0 tonnes/ hectare for permanent pasture and other grazing lands (Anonymous, 2001-02). Present study used 0.75 ton/hectare as productivity of PP & GL. Finally, simple tabular analysis, trends, compound annual growth rates, ratios and density were worked out between the census periods.

Results and Discussion

Trends in grazing resources and cultivated greens: The grazing resources (other than forests) in the country have shown decreasing trends in last two decades (Table 1). Any change in area of these land resources affects fodder supply. Information collected from Department of Economics and Statistics (DES) indicated that overall grazing resources have declined by 1387 thousand ha between 1980-81 and 2007-08. Culturable wastelands declined by 3700 thousand ha followed by pastures and grazing land (1627 thousand ha). However, area reported as barren unculturable land increased by 3507 thousand ha and fallow lands (sum of current fallow and other than current fallow lands) increased by 433 thousand ha. Decrease in area under pasture and grazing lands leave negative impact on livestock rearing by small farmers. Although, area reported under forest has increased by 2505 thousand ha between the same period.

Table 1. Trends in grazing resource (Area in '000 ha)

Particulars	1980-81	2007-08	Absolute change
Forests	67460 (22.2)	69965 (22.9)	2505
Permanent Pastures & Grazing Lands	11989 (3.9)	10362 (3.4)	-1627
Culturable Wastelands	16744 (5.5)	13044 (4.3)	-3700
Fallow Lands*	24546 (8.1)	24979 (8.2)	433
Barren Unculturable lands	39554 (13.0)	43061 (14.1)	3507
Total Grazing resources other than forests	92833 (30.5)	91446 (29.9)	-1387

*Sum of current fallow and other than current fallow lands; Figures in braces are percent to reporting area

Trends in area under cultivated green fodder indicated that land allocation to cultivation of green fodder crops is limited and has hardly ever exceeded 5% of the gross cropped area (GOI, 2009). Area deployed under green fodder cultivation declined from 8.7 to 8.1 million ha during 2001-02 to 2007-08. Roughly 30% of this area was reported as irrigated in 2007-08. Trends showing change in area under green fodder in major livestock states were given in Table 2. Area under green fodder production was declined from 8702 to 8144 thousand ha between 2001-02 and 2007-08. It was more pronounced in Gujarat (-253 thousand ha) followed by Punjab (-176), Rajasthan (-158) and Madhya Pradesh (-153). Decreasing trend with comparatively less deviation was observed in Tamil Nadu (-28), Uttar Pradesh (-19), Karnataka (-11) and West Bengal (-4). In contrast, Haryana and Andhra Pradesh have added to its area under green fodder cultivation by 121 and 97 thousand ha respectively between 2001-02 and 2007-08. Similar trends were observed in Maharashtra, Jammu & Kashmir, Bihar and Kerala during the same period.

Table 2. Change in area under green fodder production ('000 ha)

States	2001-02	2007-08	Absolute change
Gujarat	1103	850	-253
Punjab	715	539	-176
Rajasthan	3387	3229	-158
Madhya Pradesh	666	513	-153
Tamil Nadu	200	172	-28
Uttar Pradesh	878	859	-19
Karnataka	46	35	-11
West Bengal	8	4	-4
Assam	8	8	0
Kerala	3	5	2
Bihar	9	16	7
Maharashtra	843	851	8
J & K	45	61	16
Andhra Pradesh	104	201	97
Haryana	634	755	121
All India	8702	8144	-558

Source: land use statistics, DES, Govt. of India.

Shrinking pasture and grazing lands and increasing grazing pressure: The gap between demand and supply of fodder has widened over the periods due to increase in livestock population and degradation of fodder resources. The problems further aggravate due to the critical dependence of millions of marginal, small households and landless labourers on shrinking pastures and grazing lands. Trends furnished in table-3 are based on state wise information on land use pattern for the periods of 1980-81 and 2007-08 and livestock census1982 and 2007. It is apparent from the table that area under permanent pasture and grazing lands (PP & GL) has declined from 120 to 102 lakh ha between 1980-81 and 2007-08. In absolute term 18 lakh ha area reduced between the same periods. Among the major livestock states, Rajasthan had about 18 lakh ha under PP & GL during 1980-81, closely followed by Madhya Pradesh (17 lakh ha), Maharashtra(16 lakh ha), Karnataka(14 lakh ha), Andhra Pradesh (10 lakh Ha) and Gujarat (9 lakh ha). These six states together accounted for about 70% of total country's area under PP & GL during the same period.

On an average the share of individual state to their respective reporting area in these six states was 5 percent which was more than the country's PP & GL share to it's reporting area at 4% during 1980-81. During 2007-08, almost all the states reported fall in area under PP & GL except West Bengal and Jammu & Kashmir where marginal increase in area has been reported during the same period. Andhra Pradesh and Karnataka have lost about 4 lakh ha of area under PP & GL during 1980-81 to 2007-08 whereas; Maharashtra and Madhya Pradesh each lost about 3 lakh ha of land during the same period. Decline in commons have also been observed by Jodha (1986) and Iyengar (1989).

On the other hand, livestock population in the country increased 423 to 530 million during 1982 to 2007. In absolute term 107 million heads added to country's livestock. Livestock population has increased in majority of the states except Madhya Pradesh between the 1982 and 2007 census periods (Table 3). A significant increase has been reported in the states of Andhra Pradesh (24 million heads) followed by West Bengal (8), Rajasthan (7), Tamil Nadu (6) and Maharashtra (5). Species wise growth trends in livestock population indicated that, it was in favour of small ruminants as raising these species requires less initial investment and provide a quick and regular income. As discussed in preceding section that more than 75% of sheep and goats are reared by the millions of marginal, small farmers and landless labourers whose dependency on this vocation is very high.

To study the availability of PP & GL per livestock, grazing pressure/ concentration of livestock per hectare of permanent pasture and grazing lands in different states have also been worked out (Table 3). Grazing pressure

Table 3. Trends in area under PP&GL and livestock population in major states

States	PP&GL (lakh ha.)			Livestock (million heads)			Grazing Pressure (livestock ha^{-2} of PP&GL)		
	1980-81	2007-08	Change	1982	2007	Change	1982	2007	Change
Rajasthan	18.34	17.03	-1.31	50	57	7	27	33	6
Madhya Pradesh	16.49	13.52	-2.97	43	41	-2	26	30	4
Maharashtra	15.76	12.49	-3.27	31	36	5	20	29	9
Karnataka	13.46	9.3	-4.16	25	31	6	19	33	15
Andhra Pradesh	9.86	5.71	-4.15	36	60	24	37	105	69
Gujarat	8.48	6.9	-1.58	21	24	2	25	35	10
Odisha	5.6	4.94	-0.66	22	23	1	39	47	7
Assam	1.69	1.6	-0.09	13	17	4	77	106	29
J & K	1.25	1.26	0.01	6	11	5	48	87	39
Tamil Nadu	1.6	1.1	-0.5	25	31	6	156	282	126
Uttar Pradesh	0.73	0.65	-0.08	57	60	4	781	923	142
Haryana	0.3	0.26	-0.04	8	9	1	267	346	79
West Bengal	0.04	0.06	0.02	30	37	8	7500	6167	-1333
Punjab	0.04	0.03	-0.01	6	7	1	1500	2333	833
All India	120	101.98	-18.02	423	530	107	35	52	17

Source: Directorate of Economics and Statistics, Govt. of India, (2012); Indian Livestock Census, (1982); Anonymous (2007).

of livestock at country level has increased from 35 to 52 animals' ha^{-2} of PP&GL during the livestock census 1982 and 2007. In absolute term dependence of additional 17 animals on the same piece of land was found between 1982 and 2007. The grazing pressure has increased in all the states except West Bengal. The states showing significant increase in livestock per hectare of PP & GL are Punjab (833 livestock ha^{-2} of PP & GL), Uttar Pradesh (142) and Tamil Nadu (126) during the period 1982 to 2007. An incremental stock ranges 4 to 79 animals in rest of the states during the same period. West Bengal show decline in livestock per hectare of PP & GL for the same period, albeit with very high incidence of livestock per hectare. Extensive and indiscriminate biotic activities in grasslands and forest grazing lands like cultivation, burning, grazing and lopping for leaf fodder and fuel-wood, have led to deterioration of productive capacity of these lands. The grazing pressure has mounted twice to six times the carrying capacity of these lands. The most possible reason for decrease in area under PP & GL was diversion of grazing lands for non-pasture uses. Increase in population, privatisation of CPRs, overgrazing were the major causes for depilation of CPR. Other studies also corroborate this observation (Iyengar, 1989; Beck and Gosh, 2000 and Chopra and Dasgupta, 2002). There is an immediate need to map the grazing lands in the country, demarcate these on the ground and initiate policy steps to maintain their land use (GOI, 2011).

***Changes in carrying capacity of PP & GL*:** In the present section effort has been made to estimate biomass production from permanent pastures and grazing lands using biomass yield of 0.75 ton/hectare. The carrying capacity represents the maximum number of adult cattle unit (ACU) that can be sustained on available biomass from PP & GL. Carrying capacity of PP&GL has been worked out in terms of number of adult cattle unit (having body weight of 270 Kg) may sustain on PP & GL with their maintenance requirement (3% of body weight). Annual maintenance requirement of a cattle unit has been calculated and total biomass production in terms of dry matter (DM) is divided by the annual maintenance requirement of adult cattle unit. Finally, total numbers of adult cattle units that can be sustained on available biomass from PP & GL were estimated.

As reflected in Table 4, biomass production in terms of dry matter (DM) from PP & GL has declined from 2.25 to 1.91 million tonnes between 1980-81 and 2007-08 (Table 6). Major fall has been reported in Andhra Pradesh, Karnataka, Maharashtra and Madhya Pradesh during the same period. This may be due to decline in area under PP&GL in these states. As a result, carrying capacity of the adult cattle units has also declined from 8 lakh units to 6.5 lakh units between 1980-81 and 2007-08. In percent term, this fall was 18% at national level. The other major livestock states showing decreasing carrying capacity were Andhra Pradesh (42%) followed by Tamil Nadu (31%), Karnataka (31%), Punjab (25%), Maharashtra (21%) and Gujarat (19%). However, carrying capacity in West Bengal has increased by 50% followed by Jammu and Kashmir during 1980 - 81 and 2007 - 08. Carrying

capacity of PP & GL at country level was worked out to be 0.06 (less than 1 ACU) per hectare of PP&GL. This may increase with the increase in yield of fodder from such lands. The grazing lands, considered to be one of the most productive ecosystems in the Indian Subcontinent, have been at the receiving end for long. These lands have either already degraded or are in the process of degradation with average carrying capacity of less than 1 ACU (GOI, 2011).

Relevance of PP & GL to small livestock holders: Animal husbandry in India is pre-dominated by small and marginal livestock holders. Data for 2005-06 shows that the share of small and marginal farmers in land holdings was 83% (Chand *et al*., 2011). Thus, the small holding character of Indian agriculture is much more prominent today than even before (Dev, 2012). The patterns indicated that livestock in India is mainly reared by the marginal and small farmers. Since these groups of households operating tiny pieces of land face severe constraints of feed and fodder. Hence, the role of pastures and grazing lands for their livestock is very significant. Furthermore, weakening stake of landless households in animal husbandry was mainly due to heavy dependence on grazing based production system, deterioration of common lands quantitatively and qualitatively and poor access to harvested field due to intensive cultivation (Birthal *et al*., 2013).

One of the most typical characteristics of mixed farming system in India is that most of bovines and small ruminant are raised by the subsistence oriented small farms and their strong relationship with pastures and grazing lands. According to input survey 1996-97 and 2006-07, the numbers of marginal and small holdings have increased with an annual growth of 1.79 and 1.12% respectively (Table 5). Similarly, the share of marginal holdings to the total holdings has increased from 61 to 64% during the same period. However, average holding size of marginal and small holding remained almost same during the period under consideration while, average holding size declined in the categories of semi-medium, medium and large. Interestingly, number of bovines per holding in all categories has declined during 1996-97 and 2006-07. Similarly, numbers of small ruminants have also declined in all categories during the same period. However, the rate of deceleration was found higher in case of bovine than the small ruminants. This may be due to more requirement of feed and fodder for large ruminants than small ruminants. Dikshit *et al*. (2012) reported imbalance growth in large and small ruminant population in different livestock regions which were mainly attributed to differential demand for livestock products, availability of feed fodder resources and vanishing common pastures and grazing lands. The distribution of bovines and small ruminants during the year 2006-07 indicated that marginal and small farmers together constitute about 70% of bovines whereas the same group of farmers possesses 75% of total small ruminants. Pastures and grazing lands are life line to small and marginal livestock holders therefore their qualitative and quantitative improvement should be necessary for sustaining rural livelihood.

Table 4. Biomass production and carrying capacity of PP & GL

States	PP & GL (Million ha)		Dry Matter Production *(Million Tonnes)		Carrying Capacity ('000 Adult Cattle Unit)		% Change
	1980-81	2007-08	1980-81	2007-08	1980-81	2007-08	
Andhra Pradesh	0.990	0.570	0.180	0.110	62.500	36.200	-42.100
Tamil Nadu	0.160	0.110	0.030	0.020	10.100	7.000	-31.300
Karnataka	1.350	0.930	0.250	0.170	85.400	59.000	-30.900
Punjab	0.004	0.003	0.001	0.001	0.300	0.200	-25.000
Maharashtra	1.580	1.250	0.300	0.230	99.900	79.200	-20.700
Gujarat	0.850	0.690	0.160	0.130	53.800	43.800	-18.600
Madhya Pradesh	1.650	1.350	0.310	0.250	104.600	85.700	-18.000
Haryana	0.030	0.030	0.010	0.005	1.900	1.600	-13.300
Odisha	0.560	0.490	0.110	0.090	35.500	31.300	-11.800
Uttar Pradesh	0.070	0.065	0.010	0.010	4.600	4.100	-11.000
Rajasthan	1.830	1.700	0.340	0.320	116.300	108.000	-7.100
Assam	0.170	0.160	0.030	0.030	10.700	10.100	-5.300
J & K	0.130	0.130	0.020	0.020	7.900	8.000	0.800
West Bengal	0.004	0.010	0.001	0.001	0.300	0.400	50.000
All India	12.00	10.20	2.250	1.910	761.000	646.800	-15.000

*Fodder yield 0.75 ton/hectare and green fodder: dry matter ratio is 0.25 (Sen *et al.* 1978)

Source: Area under PP&GL from Land Use Statistics, DES, Govt. of India. Rests are author's estimates

Table 5. Distribution of bovine and small ruminant by size of holdings, 1996-97 and 2006-07

Category	Marginal (<1 ha.)	Small (1-1.99 ha)	Semi-medium (2-3.99 ha)	Medium (4-9.99 ha)	Large (>10 ha)	All group
Livestock per holding						
Bovine						
1996-97	3.12	4.64	5.55	6.66	8.39	4.02
2006-07	1.89	2.93	3.77	4.87	6.04	2.49
Absolute change	-1.23	-1.71	-1.78	-1.79	-2.35	-1.53
Small Ruminant						
1996-97	1.38	1.82	2.09	2.65	6.22	1.7
2006-07	1.28	1.79	2.05	2.46	5.11	1.56
Absolute change	-0.1	-0.03	-0.04	-0.19	-1.11	-0.14
Distribution of population (%)						
Bovine						
1996-97	47.23	21.86	17.22	10.76	2.93	100
2006-07	48.39	21.96	16.87	10.36	2.42	100
Small Ruminant						
1996-97	49.31	20.19	15.28	10.1	5.13	100
2006-07	52.4	21.34	14.64	8.36	3.26	100

Bovine: cattle and buffalo; Small ruminants: sheep and goat
Source: Department of Agriculture and Cooperation, based on input survey

Conclusion

Area under fodder cultivation consistently showed declining trends which further putting pressure on common lands. Deceleration in grazing resources (excluding forest) by 1.4 million hectares during 1980-81 to 2007-08 is a serious concern for sustaining livelihood of resource poor people. The dependency of these categories of households on pastures and grazing lands is very high to meet fodder requirement for their livestock. Constant shrinking of pastures and grazing lands, the grazing pressure/ density of livestock per unit of pastures and grazing lands has increased from 35 to 52 animals per ha. Grazing pressure was more pronounced in the states namely Punjab, Uttar Pradesh and Tamil Nadu. Carrying capacity of permanent pastures and grazing lands has also declined by 15% during 1980-81 to 2007-08. Per unit of pastures and grazing lands not even sustain single adult cattle unit of 270 kg body weight with 3% of DM requirement for its maintenance. Preponderance of marginal and small livestock holders in most of the states have great concern to shrinking pastures and grazing lands. Therefore, proper management of pasture and grazing lands is essential for the sustainable production of fodder for livestock. Government should intervene to protect common resource in the interest of resource poor rural people. Grass and legume varieties identified for grazing and common lands need to be promoted along with the capacity building of different stakeholders to rejuvenate these common lands to benefit livestock owned by large number of small and marginal farmers.

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