Range Mgmt. & Agroforestry 30 (2) : 88-97, 2009

ISSN 0971-2070

Invited Review Article

Free range grazing in India: Present status and policy suggestions

M. M. Roy

Indian Grassland and Fodder Research Institute, Jhansi (UP)-284003 India

Corresponding author e-mail*: mmroyster@gmail.com*

Received: 11th December, 2009 Accepted: 29th December, 2009

Abstract

The range grazing is the cheapest way to feed the livestock, especially the small ruminants. It provides house hold security to pastoral as well as a large number of farming families through livestock gains. The government policies have a great influencing factor in livestock farmers' choice towards free range grazing and or managed feeding. The analysis of the present scenario of free range grazing in India, livestock-environment interaction, technological options (including scientific grazing management); suggest that there is an urgent need for proper enabling policies and guidelines at government of India as well as state government levels. Such measures will lead to better utilization of the available natural resources and its further improvement to meet the objectives of livelihood security of the pastoralists and a large number of farmers with environmental amelioration.

Key Words : Community lands, Forest acts, Grazing management, Livestock management, Small ruminants

Introduction

The huge livestock population of India, especially the small ruminants like sheep and goats, play an important role in securing the livelihood of small and marginal farmers as well as landless labourers. Almost 73 per cent of the rural households keep animals of one kind or another, and livestock play a special role in household security, particularly in smallholder farming systems (Tyagi and Singh, 1988). In areas with high livestock population, income from livestock accounts for 30 to 50 percent of total farm income (Patnayak, 1994). The small ruminants have the ability to thrive on low inputs and local resources and rangelands (World Bank, 2000; Birthal and Rao, 2002).

In the coming years, the livestock sub-sector of the agriculture in India is expected to drive future growth and development in rural India by the way of generating employment, providing draft power and earnings through exports. The demand for consumption of foods of animal origin is rising in the country and such demands can benefit millions of land less and small holders who constitute over 60 percent of total rural population and possess about three fourths of country's livestock wealth. In 1993-1994 per capita consumption of milk (51 kg) and meat (17 kg) was much less than the world average of 75 kg (milk) and 34 kg (meat). By 2020 per capita consumption of milk is likely to be more than double and that of meat more than triple (Delgado *et al*., 1999).

However, the extent of benefit to the rural poor will actually depend on the integration of livestock to the developing markets and how the cheaper livestock products are obtained. The rangelands or free grazing lands are shrinking on account of pressures of rising human population (GOI, 2001a, 2001b; 2002). Several livestock, especially goats are regarded as threat to ecology and environment so there are increased restrictions on their grazing in the ranges, especially forest areas (Jodha, 1990, 1995). The wastelands available for livestock production are also decreasing. The diversion of crop residue has already started for uses other than fodder (World Bank, 1996).

Rising human population is leading to a reduction in the area of open-access grazing land, and hence to dependence on crop residues and by-products—mainly straws, brans and cakes is on a rise. Recently, there has been increased interest in the use of fodder trees and soil protection crops as additional sources of protein-rich animal feed. Major constraints to the utilization of straws include their bulkiness and poor nutritive value. In addition, there is a tendency for better feeds (brans, cakes) to be removed to cities, thereby depriving rural areas. Other common problems across the various parts of the country are droughts or floods resulting in seasonal or local shortages of feeds. Also, since bulky crop residues have high transport costs, their role is limited in overcoming these shortages (Jodha, 2008).

Grazing saves the costs of harvesting pasture species, work up the soil through livestock's hooves and break the top crust of the soil, thereby encouraging better percolation of water for plant use and better range production (Rangnekar, 2006). However, availability of areas for free range grazing is going to be further reduced in the coming years (GOI, 2007).

In such a scenario it becomes very important to have a well defined policy that encourages free range grazing in available areas in a regulated manner, improves the degraded community lands and shift focus from extensive to semi-intensive systems. This paper is an attempt to elaborate on these issues from a policy perspective. Some suggestions are also provided.

Free range grazing vs managed feeding

The policies of the government influence the choice of farmers for free range grazing (FRG) and managed feeding (MF). The pastoralists/farmers practice range grazing because it is the best allocation of their capital whereas many farmers who practice managed feeding do so for not having enough land to graze their animals.

Pastoral communities: The majority of India's indigenous livestock breeds are associated with specific tribal and caste communities. The evolution of these breeds is the result of efforts of specific castes of professional breeders who were nomadic and took cattle to graze over long distances (Table 1).

The best-known livestock breeders in Rajasthan are the *Raika* or *Rebari* (they also live in Gujarat). This Hindu caste is most closely associated with the camel, but it has also contributed substantially to the development of breeds such as *Kankrej*, *Sanchore* and *Nari* cattle, *Marwari* sheep, and *Sirohi* and *Marwari* goats. The *Rath* Muslims of north-western Rajasthan developed the Rathi dairy cattle breed. In the Himalayas, *Gaddi* pastoralists rear sheep and goat breeds that are named after them. In Orissa, the *Gauda*, also known as *Gopa, Goala*, *Gopala* or *Golla,* breed and rear cows, buffaloes (*Baudia* and *Kalahandia* breeds), goats (*Lankapuria*, *Bangiri*, *Pathuria*), and hair sheep. A sub-tribe of the *Golla*, the *Hallikars,* who had migrated to the area from the north, shaped a superior cattle breed of the same name (Iyenger, 1988; Kohler-Rollefson, 1992; Cincotta and Pangare, 1993). Another tribal group in western Orissa, the *Gonds*, have developed the *Raighar* goat breed. In South India, the *Toda* tribal community has collectively bred the *Toda* buffalo. Some breeds created by pastoralists were later developed further through royal patronage. This is true for some cattle and most camel breeds. In the 16th and 17th centuries, for instance, *Hallika*r cattle were selected by the kings of Vijayanagara and the Wadars, and developed into the *Amrit Mahal* breed. This new breed was raised under nomadic conditions, with its seasonal variations in fodder availability (Kohler-Rollefson, 2007).

Grazing areas: The land resource to support livestock numbers is highly inadequate in India, 20 percent of

Table 1 : List of some associations between pastoralists and livestock breed in selected semiarid /arid states of India

State	Community	Breed
Andhra Pradesh	*Golla*	Cattle
	Kurma	Sheep
Gujarat	*Maldhari*	Kankrej cattle, Gir cattle, Jaffarabdi buffalo
	Rabari	Cattle, Sheep, Goat
	Bharwal	Small ruminants
Karnataka	*Hallikar*	Hallikar cattle
	Karuba	Sheep
	Dhangar	Sheep
Maharashtra	*Dhangar*	Cattle, Small ruminants
	Gavli	Small ruminants
Rajasthan	*Raika*	Nari cattle (Pali and Sirohi districts); Boti sheep (Pali district)
	Raika/Rabari	Camel, Sheep, Goat
	Gayri	Baghli sheep (Udaipur district); Kuzi sheep (Udaipur district)
	Banihar	Cow, Buffalo
	Gujjar	Cow, Buffalo, Sheep
	Rath	Rathi dairy cattle
Tamil Nadu	*Toda*	Toda Buffalo
	Kuruba	Cattle, Sheep
	Idaiyan	Sheep, Cattle

(Source: adapted from Kohler-Rollefson, 2007)

world's livestock population live on only 2 percent of the world's geographical area (GOI, 2002). The major land sources of fodder in rural India include forests, permanent pastures and other grazing areas, culturable wastelands, agricultural lands (net sown area) *etc*. (Table 2). The fallow lands (all land temporarily out of cultivation for a period of not less than one year and not more than five years) also serve as fodder source by way of grazing *etc*.

The changing pattern in area under major land uses that provide fodder for livestock during 1960-61 to 2004-2005 at the national level is depicted in Table 3. While the area under agriculture (net sown area as well as net irrigated area) and fallow lands has increased; areas under permanent pasture, cultivable wasteland and miscellaneous tree crops and grooves have declined. The forest area has stabilized at 21.2 percent of the geographical area (22.8 percent of the reporting area) as against the national recommendation of 33.3 percent of the geographical area. Excepting the land under agriculture, all the land resources that supply natural fodder for the livestock are shrinking.

The free grazing areas in most parts of the country are savanna (or savannah). Such ecosystems are usually characterised by sparse tree stands. However, in some classifications, grassland savanna are either devoid of the trees or have higher tree densities and in a more regular fashion than the forest communities. Such grassland ecosystem offer sufficient light to reach to ground to support an herbaceous layer, preferably of C_4 grasses. Savannas are also characterized by seasonal water availability, with the majority of rainfall being confined to one season of the year.

Savannas can be associated with several types of biomes. Savannas are frequently seen as a transitional zone, occurring between forest and desert or prairie (Werner *et al*., 1991; Kala, 2009).

Indian rangelands generally have sparse stands of trees or shrubs in open grassy areas where grazing occurs or can occur. Such stands offer better opportunities for grazing for the domestic livestock when compared to closed canopied forests (broadleaf as well as rainforests) on account of better herbaceous growth. These areas are either under government (mainly forest department) or community control (Arnold and Stewart, 1990; Singh *et al*., 2007). The extent of use of community property resources (CPRs) for livestock rearing in various states of the country is depicted in Table 4.

An estimate of non-forest common property land (CPL) in selected 16 states is presented in Table 5. These resources are accessed by private persons or local bodies. Total common property land in the 16 states is 70.042 million ha. Of this 44.983 m ha or about 64.23

Table 2 : The major land resources for providing fodder to livestock in rural India

Land classification	Explanation
Forests area	This includes all land classified either as forest under any legal enactment or administered as forest, whether state owned or private, and whether wooded or maintained as potential forestland. The areas of crop cultivation in the forest and grazing lands or areas open for grazing within the forests remain included under the forest area.
Permanent pasture and other grazing areas	This includes all grazing land whether it is permanent pastures and meadows or not. Village common grazing land is included under this heading.
Land under miscellaneous tree crops *etc*.	This includes all cultivable land not included in the net sown area but is put to some agricultural uses. The land under trees, thatching grasses, bamboo bushes and other groves for fuel *etc*. not included under orchards are classified under this category.
Culturable wasteland	This includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or other. Such lands may either be as fallow lands or covered with shrubs and jungles which are not put to any major use otherwise. These may be accessible or un-accessible and may lie in isolated blocks or within cultivated fields.
Net sown area	Total area sown with crops and orchards. Area that is sown more than once in the same year is counted only once.

(Source: GOI, 2006)

percent is non-forest land. Further, common property land area varies from 25 to 52 percent of geographical area (GA).

In Punjab and Haryana the common property land area is low, being less than or around 10 percent of geographical area. Both the states are at an advanced level of agricultural development and are characterized by a large percentage of land under private ownership. Correspondingly, common property land area per capita is low.

In Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamilnadu and Uttar Pradesh, the common property land area falls in the range of around 10 to 30 percent. The outliers constitute a separate category. Rajasthan has a common property land area of 35 percent, which appears an overestimation. Himachal Pradesh and Jammu and Kashmir; on account of being hill states; show varying characteristics. This is because of large areas of protected forests in Himachal Pradesh, which makes the area under common property

Table 3 : The changing pattern of area under major land uses in India

Classification	1960-61		2004-2005	
	Area (million ha)	% of reported area	Area (million ha)	% of reported area
Geographical area	328.73	-	328.73	-
Reporting area	298.46	-	305.84	-
Forests	54.05	18.1	69.70	22.8
Net sown area	133.20	44.6	140.88	46.1
Net irrigated area	24.66	8.26	55.10	18.0
Permanent pastures	13.97	4.7	10.45	3.4
Cultivable wastelands	19.21	6.4	13.18	4.3
Tree crops and groves	4.46	1.5	3.37	1.1
Fallow lands	22.82	7.64	26.04	8.51

(Source: GOI, 2006)

Table 4 : The extent of use of CPRs for livestock rearing in various states of India

State*	As per cent of households						
	1	2	3	4	5	6	7
Andhra Pradesh	36	14	38	12	143	38	20
Arunachal Pradesh	68	26	38	6	44	84	10
Assam	62	24	38	15	180	41	5
Bihar	52	16	30	13	177	27	4
Gujarat	59	25	42	8	207	31	51
Haryana	74	15	20	26	1743	29	6
Himachal Pradesh	81	35	43	36	906	80	4
Jammu & Kashmir	81	25	31	3	48	55	15
Karnataka	56	25	44	16	179	41	25
Kerala	32	3	9	5	63	19	1
Madhya Pradesh	68	42	62	9	205	57	28
Maharashtra	46	11	24	11	207	54	18
Manipur	39	11	28	6	217	42	9
Meghalaya	37	6	16	2	51	92	5
Mizoram	55	5	10	21	214	100	0
Nagaland	86	16	18	22	259	65	20
Orissa	58	35	60	7	57	70	8
Punjab	55	1	2	18	1095	6	4
Rajasthan	84	28	34	3	59	35	52
Sikkim	61	2	3	33	1401	86	3
Tamil Nadu	29	9	30	7	156	43	16
Tripura	36	4	10	1	26	69	0
Uttar Pradesh	72	22	30	23	579	28	13
West Bengal	54	17	31	9	55	22	1
All India	56	20	35	13	275	38	63

(* = as per the state classification before 1999; 1 = possessing livestock; 2 = reporting grazing; 3 = possessing livestock and reporting grazing; 4 = collecting fodder; 5 = average annual quantity of fodder collected per household (in kg); 6 = forest within reach; 7 = having access to CPR of 0.1 ha or more)
(Source: GOI, 1999)

lands unduly high, and similar large areas in the category of reserve forests in Jammu and Kashmir, which decreases common property land area to an unusually low level.

In majority of the states, land to which common property land rights exist has decreased. The decrease is more pronounced in the arid and semi arid states of Madhya Pradesh, Maharashtra, Gujarat, Karnataka, and Rajasthan.

There is an interesting pattern in the levels of common property land area in different states and the changes over time (Rodgers and Pawar, 1988; Singh, 2005; Singh and Kushwaha, 2008). River basins, where crop production on private land is a profitable activity, have a low percentage of land under common property whereas high rainfall mountains and sub mountainous regions have a high percentage. Arid and semi arid states, where livestock rearing is an important activity, also have large amounts of land as common pastures adding to common property land area.

Presently, there is no official grazing policy (it is only at draft stage) in the country. However, the states have some or the other kind of regulations/restrictions on grazing, including interstate migrations. In some states like Andhra Pradesh the grazing rules were relatively flexible in the past. It used to be heaven for cattle traders from other states like Rajasthan, Madhya Pradesh, Maharashtra and Chhattisgarh. It is estimated that about 6 lakh cattle enter Andhra Pradesh from Rajasthan and other states every year. Most of the cattle are brought to Adilabad, Nallamalla Hills, Kawal Wildlife Sanctuary and other forests areas. Traders bring in truckloads of animals and strike deals with locals living near forest tracts to mind their cattle for six months or a year. Locals use cattle dung to make their lands fertile. With increase in cattle population in the state from 276.6 lakh in 1961 to 475.80 lakh in 2006 have led to very high pressure on grazing resources and recently the state government has decided to impose strict curbs on grazing of animals brought into forests from within the state as well as from other states. However, rapid mobilization of sheep and goat farmers associations and their NGO allies, led to the creation of the AP Forestry Committee. Because livestock producers are represented, along with forestry and animal husbandry officials, the committee provides a venue through which producers can advocate livestock-friendly forest policies. Now, there is an increased realization that if producers' needs are addressed with government, NGOs and international donors; the conditions on common lands improve in forests and watershed areas (Turner, 2004).

Livestock population: India possesses a great livestock wealth comprising of cattle, buffaloes, yaks, mithuns, sheep, goats, pigs, horses and ponies, mules, donkeys, camels *etc.* (Table 6). In fact, the total livestock population in the country has actually decreased from 485.385 million to 485.002 million during 1997-2003, showing a negligible decrease of 0.08 percent (GOI, 2005).

Table 5 : Extent of non forest common property lands and wastelands in selected states of India

State	Total CPL (000 ha)	Non Forest CPL (000 ha)	Total Wasteland (000 ha)	CPL/GA	CPL per Capita (ha)	Non Forest CPL/GA
Andhra Pradesh	5989	4624	5932	0.22	0.09	0.16
Bihar	5267	2850	2474	0.30	0.06	0.16
Gujarat	3269	2707	4189	0.17	0.08	0.14
Haryana	190	44	357	0.04	0.01	0.009
Himachal Pradesh	5188	1619	1069	0.93	1.00	0.29
Jammu & Kashmir	278	278	3714	0.012	0.06	0.012
Karnataka	3207	2203	2680	0.17	0.07	0.11
Kerala	331	207	163	0.08	0.01	0.05
Madhya Pradesh	13,890	6446	8872	0.32	0.21	0.15
Maharashtra	8039	5926	6209	0.26	0.10	0.19
Orissa	4882	1537	2045	0.31	0.15	0.09
Punjab	359	73	370	0.07	0.01	0.014
Rajasthan	11977	11697	9605	0.35	0.27	0.34
Tamil Nadu	2773	2387	2272	0.21	0.05	0.18
Uttar Pradesh	3756	2221	5007	0.13	0.03	0.07
West Bengal	647	164	435	0.07	0.01	0.018
Total	70,042	44,983	55393	-	-	-

(CPL = Common property land; GA = Geographical area)
(Source: adapted from NRSA, 1989)

Table 6 : Present livestock population and past trends of change in India

Livestock	Population	Changing pattern		
	2003	1997-2003	1972-1982	1982-1992
	(000)	Growth rate	Compound Growth Rate	
		(%)	(% annum)	
Crossbreed cattle	24786	22.82		
Indigenous cattle	160394	(-) 10.23		
Total cattle	185180	(-) 6.89	0.8	0.6
Buffaloes	97922	8.90	2.0	1.9
Yaks	65	10.17		
Mithuns	278	57.06		
Total bovines	283445	(-) 1.93	-	-
Sheep	61470	6.91	2.0	0.5
Goats	124357	1.33	3.5	1.9
Pigs	13519	1.72	3.8	3.4
Horses and Ponies	751	(-) 9.19		
Mules	176	(-) 20.36	(-) 0.3	(-) 0.9
Donkeys	650	(-) 26.30	-	-
Camels	617	(-) 30.70	(-) 0.3	(-) 0.4
Total	484985	(-) 0.08	-	-

(Sources: after Birthal and Rao, 2002; GOI, 2005)

In earlier times there has been a tradition in India to own greater livestock numbers as an indicator of the status in the society. This tradition still continues in several parts of the country. The livestock sector is both expanding and adapting in response to economic, technological and environmental factors. There is a gradual shift in favour of livestock that are less capital intensive, have short generation intervals and better feed-conversion and economic efficiency. The draught animals have witnessed negative and decelerating trends. In other categories of animals despite deceleration there is a tendency of stabilization of the population in the long run (Birthal and Rao, 2002).

While the livestock like camels, yaks, mithuns *etc*. have significance in either specific regions or for special purposes; cattle, buffaloes, sheep and goats comprise the major portion of livestock wealth for the rural population across the country. The small ruminants, especially sheep and goats, depend mainly on free range grazing. The trend in their population since independence is presented in Table 7. The increase in population of goats is most prominent.

Goats in particular have been held responsible for causing ecological degradation and desertification because of overgrazing and because they produce methane as an end product of digestion (World Bank, 1996; Meher-Homji, 1997; Singh, 2002). The National Commission of Agriculture in 1976 recommended a reduction in goat numbers from the then 67.5 million to 40 million. However, the population has since doubled despite adequate promotional schemes from the government. The task force appointed by government of India to evaluate the impact of goat rearing in ecologically fragile zones observed that there was no definite evidence of goats posing a threat to the ecology and within desired pressure of grazing, sheep and goats are more economical and less harmful than large ruminants (GOI, 1987).

Table 7 : The trend in small ruminant population (in million heads) in India

Census	Total livestock	Sheep	Goat
1951	292.8	39.1	47.2
1956	306.6	39.3	55.4
1961	335.4	40.2	60.9
1966	344.1	42.0	64.6
1972	353.4	40.0	67.5
1977	369.0	41.0	75.6
1982	419.6	48.8	95.3
1987	445.3	45.7	110.2
1992	470.9	50.8	115.3
1997	485.4	57.5	122.7
2003	485.0	61.5	124.4
Overall Increase (%)	165.6	157.3	263.6

(Source: after Birthal and Rao, 2002; GOI, 2005)

Livestock management systems

In India, livestock reared under small scale mixed farming systems are contributing most to the total out put of animal products (Patnayak, 1994; Sharma, 2004). Essentially, livestock management systems may by classified into three types *viz*., extensive, semi-intensive and intensive.

Extensive systems: This is principally a very low resource use system including migratory, transhumance, free range, pasture and range grazing managements. Large as well as small ruminants are reared under this system. Although grazing on rangelands is considered to be the cheapest method of livestock production; overgrazing of available lands is a serious concern from many points. Another limitation of Indian rangelands is lack of adequate energy throughout the year and lack of adequate amounts of protein almost half of the year. However, there are great prospects of improving these resources at a low investment cost through reseeding with nutritious and palatable pasture grasses and legumes and large scale fodder tree establishment.

Semi-intensive systems: In this system the free range grazing and stall feeding are combined optimally. The animals are allowed to graze in the morning and evening for 4-6 hours and also supplemented with a variety of products like kitchen wastes, concentrate mixtures, crop residues, stubbles, weeds, green and dry fodder, tree leaves as per availability in the area. This system offers nutrition at around optimum levels and a definite improvement over the extensive system.

Intensive system: In this system of livestock management, livestock is almost stall fed or additionally grazed on good quality pasture land. This system is highly labour and capital intensive and thus suitable for intensive milk and meat production units. Under such systems stoking rates of 15-20 sheep/goat per ha are feasible depending on type of grass, level of fertilization and availability of legumes and fodder trees.

Livestock-environment interaction

Several groups consider free range grazing of livestock, especially goat, leads to soil erosion and other consequences detrimental to vegetation growth. However, another view is that agricultural operations, especially in arid and semiarid regions cause more soil erosion than livestock grazing does (Meher-Homji, 1997; Singh, 2002).

Many studies have demonstrated that goat farming may have role in vegetation regeneration, weed control, prevention of forest fires *etc*. Their role as regenerators of vegetation is through dispersal of seeds in their droppings and through vegetative propagation caused by browsing. In several grazing/browsing behavioural studies, goats have been found to defoliate only the smallest branches of trees. The browsing habit of goats helps in reclamation of saline soils as well. The goats consume salt laden leaves of range plants and contribute fertility to soil and seed dispersal (Shankarnarayan *et al*., 1985; Lu, 1988; Kolars, 1996; Rangnekar, 2006).

However, a balance is needed in utilization of grazing areas. It should be based on the considerations of range health *vis* a *vis* number of goats and other livestock species dependant on it. A mixed herd grazing of desired composition or grazing in sequence by a particular group of livestock may be practiced. The goats utilize the bush and low set tree branches more effectively. The cattle utilize the taller grasses whereas sheep would eat shorter and close to surface vegetation, including weeds. Well designed grazing schemes will reduce the harmful effects of livestock grazing from ecological viewpoint and also result in most efficient judicious utilization of available feed resources.

Grazing management

The economic success of any range livestock production system is dependent on effective utilization of herbage and top feeds. The major causes of decline in productivity of pasture or grazing lands include overstocking and introduction of single species that may be selective in nature. Overgrazing and selective grazing results in progressive decrease in vigour of desired plant population to a point from where it fails to revive. This happens in continuous grazing systems where livestock remain on the same grazing land for a long time. The productivity goes down because of selective grazing coupled with overgrazing in dry season.

It is desirable to practice schemes of improved grazing management, depending on the soil conditions, availability of pasture species, type of livestock to be grazed (Table 8). The grazing mode of utilization is not only economical but carries certain other advantages. While grazing, the livestock work up the soil through their hooves and break the top crust of the soil, thereby encouraging better percolation of water for plant use and better range production.

Technological options: A number of technological options are now available to enhance productivity of degraded range areas, including forest lands. There are opportunities to increase the present production levels by two to three times by simply reseeding with perennial grasses and legumes and six to ten times by promoting silvopastoral systems of at least 10-12 years. In certain areas receiving more than 500 mm rainfall, free pastures may be replaced by crops like pearl millet, cluster bean, moth bean and mung to explore the semi-intensive livestock management (Pathak, 2002).

Table 8: Improved grazing management schemes for native or synthesised pasture lands

Controlled grazing	Based on the availability of forage from ground vegetation as well as trees/shrubs; mixed herd grazing may be introduced based on the concept of land's carrying capacity.
Rotational grazing	The grazing area is divided into 4-6 paddocks and livestock species are allowed to graze in rotation for 7-15 days. By the time last paddock is grazed, the first one is ready again.
Deferred rotational grazing	Some of the rotational paddocks are left un-grazed for use in dry season and for proper seed formation. These paddocks should be changed every year to allow good seed bank in the soil in the entire area.
Strip grazing	Grazing animals are confined to smaller areas of pasture paddocks rather than grazing randomly. In this scheme the advantage is that the area is fully utilized and the animal gets access to just right amount of feed requirement.
Cut and carry	In certain situations, livestock are not allowed to graze but the required quantity of pasture is harvested daily and fed to animals in stalls. Although, such a scheme has its own advantage, like trampling losses are less; in most situations it is not economical.

(Source: adapted from Patnayak, 1994; Sharma, 2004)

The pasture production in India is monsoon driven; they either turn dry in arid and semiarid areas during summers or are covered under snow in temperate areas during winters. Fodder conservation technologies are the only alternative to solve this issue to a great extent. Hay making is the most practical and economic way to conserve forage grasses. They should be harvested at pre-flowering stage to maintain their nutritive quality. The conservation process should retain its green shade. In areas where due to adverse weather conditions it is not possible to conserve grasses and legumes as hay; fodder should be turned into silage in pits or trenches (Patnayak, 1994).

In forest areas and other areas if the grasses are not properly utilized, they grow tall and become unsuitable for sheep and goat grazing. In this scenario, it is advisable to harvest these grasses during July and August and conserve for lean seasons. Afterwards, sheep and goats graze these areas. The need to have effective conservation schemes is more warranted in drought prone areas where crop failures are a recurring phenomenon.

Enrichment of poor nutritive value grasses and other fodder may be accomplished through addition of suitable additives like urea, molasses, mineral mixtures *etc*. The feed compounding plants may produce complete feeds for all categories of livestock by incorporating various raw materials available that are nutritious and economical. The concept of feed and fodder banks to supplement the free range grazing for better livestock productivity is another important area. The available fodder is harvested during the period of abundance and enriched, chaffed and conserved through a variety of schemes like mesh, pellets, briquettes, blocks, leaf meals *etc*. for feeding during scarcities. There are several successful examples of such a concept through cooperatives in the country (Singh and Prasad, 2002).

Policy suggestions

The present network of protected areas (16 million ha) in the country constitute less than 5 percent of its land area. It is in form of over 100 national parks and 400 wildlife sanctuaries. This area is faced with many threats from development projects, commercial activities and local communities. The recent act passed by the parliament in 2007 – "The Scheduled Tribe and Other Forest Dwellers (Recognition of Forest Rights) Act 2007 (The Forest Rights Act)" – seeks to regularise holdings up to 4 ha per individual in forest areas, including national parks and sanctuaries. This act is expected to take away at least one third of the protected area network (Singh, 2008).

Now, bringing more area under reserve forest category and development of areas under various soil and water conservation and afforestation schemes will lead to further reduction of grazing areas (BAIF, 2003, 2006; LIFE, 2007). In villages, grazing has already become very difficult due to reduction in village community lands and other pasture lands. In such a scenario, some policy and institutional support is required to tackle this imbalanced situation. The following broad policy suggestions are offered:

(i) Instead of formulating more restrictive policies on permitting livestock (including goats) in forest areas, due weight is required on scientific results. There should be a scientific assessment about carrying capacity of forests and based on it, the guidelines for grazing (number of livestock per unit area *etc*.) and or fodder harvests should be developed.

(ii) A rational and holistic grazing policy on the considerations of livelihood support to the disadvantaged communities and ecological principles of vegetation recovery is required to be formulated in respect of each state.

(iii) Formulation of suitable guidelines for usufruct rights for pastoralists and graziers in various watershed and JFM programmes.

(iv) Establishment of improved pasture systems with appropriate mixtures of grasses and legumes in open forest lands *etc*. for augmenting fodder resources for forest dependent communities.

(v) Promotion of silvi-pastoral systems for forage and other needs of the communities in CPLs and other common access areas under watershed or other programmes in a phased manner.

(vi) Develop and manage biomass resources for food, fodder and firewood, including community managed fodder banks through synchronization of the expertise and activities of communities, forest department, animal husbandry department, agriculture department, soil conservation department *etc*.

(vii) The successful examples of good practices on community lands in India (Maarse *et al*., 2008) may be considered for replication in similar areas through some sort of promotional schemes.

Conclusion

Although majority of indigenous livestock breeds in India have evolved as a part of nomadic lifestyle that took cattle to graze over long distances, presently free range grazing practice is under tremendous pressure on account of reduction in the area/access of/to grazing lands. The present trends indicate further reduction in its areas and also access due to enclosure of some or the other kind.

It is considered that in the present scenario, there is an urgent need to have proper policies backed up with institutional support to tackle such an imbalanced situation. Our policies on free range grazing should be less restrictive and rational, based on principles of scientific grazing management. The promotional schemes under watershed or other programmes need be taken up in a phased manner so that enclosures for a minimum possible period and with provisioning of alternate utilization schemes. Such measures are expected to generate more response by the communities for adoption of the technologies.

References

Arnold, J. E. M. and W. C. Stewart. 1990. *Common Property Resource Management in India*. Oxford Forestry Institute. Oxford (UK): 72 p.

BAIF. 2003. *Development of Community Silvipasture through People's Participation in Bhilwara District of Rajasthan*. BAIF Development Research Foundation, Pune: 5 p.

BAIF. 2006. *Community Pasture Development in Rajasthan*. BAIF Development Research Foundation, Pune: 2 p.

Birthal, P. and P. P. Rao. 2002. Economic contributions of livestock sub-sectors in India. In: P. S. Birthal and P. P. Rao (eds). *Technology Options for Sustainable Livestock Production in India*. NCAEPR, New Delhi and ICRISAT, Hyderabad: pp. 12-19.

Cincotta, R. and G. Pangare. 1993. *Pastoralism and Pastoral Migration in Gujarat*. Institute of Rural Management, Anand : 55 p.

Delgado, C., M. Rosegrant, H. Steinfeld, S. Ehul and C. Courbois. 1999. *Livestock to 2020: The Next Food Revolution* (*Discussion Paper 28*). IFPRI, Washington DC; FAO Rome and ILRI Nairobi: 72 p.

GOI. 1987. *Report of the Task Force to Evaluate Impact of Sheep and Goat Rearing in Ecologically Fragile Zones*. Ministry of Agriculture, Government of India, New Delhi: 67 p.

GOI. 1999. *Common Property Resources in India* (*NSS 54th round*). National Sample Survey Organization, Department of Statistics and Programme Implementation, Government of India, New Delhi; 290 p.

GOI. 2001a. *Report of Task Force on Greening India for Livelihood Security and Development*. Planning Commission, Government of India, New Delhi: 231 p.

GOI. 2001b. *National Action Programme to Combat Desertification (Volume 1)*. Ministry of Environment and Forests, Government of India, New Delhi: 352 p.

GOI. 2002. *National Report to the Third Session of the United Nations Forum on Forests*. Ministry of Environment & Forests, Government of India, New Delhi: 19 p.

GOI. 2005. *17th Indian Livestock Census - All India Summary Report*. Department of Animal Husbandry & Dairying, Ministry of Agriculture, Government of India, New Delhi: 217 p.

GOI. 2006. *Land Use Statistics (District wise 1998-99 to 2003-04)*. Ministry of Agriculture, Government of India, New Delhi: 42 p.

GOI. 2007. *Report of the Task Force on Grassland and Deserts*. Planning Commission, Government of India, New Delhi: 34 p.

Iyengar, S. 1988. *Common Property Land Resources in Gujarat: Some Findings about their Size, Status and Use*. Gujarat Institute of Area Planning, Ahmedabad: 37 p.

Jodha, N. 1990. *Rural Common Property Resource: a Growing Crisis*. International Institute of Economic Development, London: 16 p.

Jodha, N. 1995. Common property resource and the dynamics of rural poverty in India's dry regions. *Unasylva* 46: 23-29.

Jodha, N. 2008. Rural commons and livelihood strategies in dry regions of India. *European J. Development Research* 20: 507-611.

Kala, C. P. 2009. Grassland ecosystem and grazing policy. *Curr. Sci.* 96: 326.

Kohler-Rollefson, I. 1992. The Raika dromedary breeders of Rajasthan: a pastoral system in crisis. *Nomadic Peoples* 30:74-83.

Kohler-Rollefson, I. 2007. *Keppers of Genes – The Interdependence between Pastoralist, Breeds and Access to Common Lands and Livelihoods*. LIFE Network, Pali (Rajasthan): 62 p.

Kolars, J. 1996. Location aspects of cultural ecology: the case of goat in non western agriculture. *Geographical Review* 56: 577-584.

LIFE. 2007. *Livestock Keepers and Management of Animal Genetic Resources – Roles, Rights and Responsibilities*. League for Pastoral People and Endogenous Livestock Development, New Delhi: 10 p.

Lu, C. D. 1988. Grazing behaviour and diet selection of goats. *Small Rumin. Res.* 1: 205-216.

Maarse, L., M. Dhamankar and U. Pica-Gamerra. 2008. *Drawing Policies, Programmes and Institutional Lessons out of Good Practices: Common Property Resources – Livestock*. South Asia Pro Poor Livestock Policy Programme, New Delhi: 7 p.

Meher-Homji, V. M. 1997. Biodiversity conservation priorities. *Indian J. For.* 20: 1-7.

NRSA. 1989. *Manual of Nationwide Land Use/Land Cover Mapping using Virtual Interpretation Techniques – Part I*. National Remote Sensing Agency, Government of India, Hyderabad: 58 p.

Pathak, P. S. 2002. Potential technological and management interventions for improving the productivity of grasslands. In: P. S. Birthal and P. P. Rao (eds). *Technology Options for Sustainable Livestock Production in India*. NCAEPR, New Delhi and ICRISAT, Hyderabad: pp. 164-182.

Patnayak, B. C. 1994. Livestock productivity on Indian arid and semiarid pastures. In: R. P Singh and S. Singh (eds). *Sustainable Development of Indian arid Zone*. Scientific Publishers, Jodhpur: pp. 23-64.

Rangnekar, D. V. 2006. *Livestock in Livelihoods of the Underprivileged Communities in India – a Review*. International Livestock Research Institute, Nairobi (Kenya): 72 p.

Rodgers, W. A. and H. S. Pawar. 1988. *Planning a Wild Life Protected Area Network in India*. FAO and Wild Life Institute, Dehra Dun: 329 p.

Shankarnarayan, K. A., H. C. Bohra and P. K. Ghosh. 1985. The goat: an appropriate animal for arid and semiarid regions. *Economic and Political Weekly* 20; 1965-1972.

Sharma, V. P. 2004. Livestock economy of India: current status, emerging issues and long term prospects. *Indian J. Agricultural Economics*, 59: 512-554.

Singh, J. S. 2002. The biodiversity crisis: a multifaceted review. *Curr. Sci.* 82: 638-647.

Singh, J. S and S. P. S. Kushwaha, 2008. Forest biodiversity and its conservation in India. *International Forestry Review* 10: 292-304.

Singh, K. and C. S. Prasad. 2002. Potential of nutritional technologies in improving livestock productivity. In: P. S. Birthal and P. P. Rao (eds). *Technology Options for Sustainable Livestock Production in India*. NCAEPR, New Delhi and ICRISAT, Hyderabad: pp. 132-146.

Singh, K. D. 2005. *Forest Biological Diversity; Assessment and Conservation Planning*. World Wildlife Fund, New Delhi: 43 p.

Singh, M. P., J. K. Singh and R. Mohanka. 2007. *Forest Environment and Biodiversity*. Daya Books, New Delhi: 556 p.

Singh, S. 2008. The forest rights act 2007: implications for forest dwellers and protected areas. *International Forestry Review* 10: 325-330.

Turner, R. L. 2004. *Livestock Production and Rural Poor in Andhra Pradesh and Orissa States, India* (*PPLPI Working Paper no. 9*). FAO, Rome: 42 p.

Tyagi, R. K and P. Singh. 1988. Grazing resources and grazing systems in India. In: P. Singh (ed.). *Pasture and Forage Crops Research*. Range Management Society of India, Jhansi: pp. 17-34.

Werner, P. A., B. H. Walker and A. Stott.1991. An introduction to savanna ecology. In: *Savanna Ecology and Management*. Blackwell Publishing Company, Oxford (UK): pp. 181-186.

World Bank. 1996. *India Livestock Sector Reviews: Enhancing Growth and Development* (Report No. 14522-IN). World Bank, Washington DC: 33 p.

World Bank. 2000. *India: Alleviating Poverty through Forest Development*. The World Bank, Washington DC: 221 p.