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Research Article

GRAZING LANDS AND ADOPTION OF IMPROVED TECHNOLOGIES FOR THEIR UTILIZATION STRATEGIES IN INDIA

Manju Suman*

Indian Grassland and Fodder Research Institute, Jhansi-284 003, India

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ABSTRACT

Suitable harvesting time for quality forage peoved to be September for legumes viz. *M. lathyrus, A. scarabaeoides, Memosa invisa, S. hamata and grasses viz. C. ciliaris, C. setigerus, S. nervosum, Crysopogon fulvus, October for tothers viz. Clitoria ternatea, Desmanthus virgatus, Pueraria phaseoloides, S. guianensis, S. humilis, D. intortum, D. axillais, Styzolobium deeringianum* and *Vigna luteola*, besides for grasses like *Dichanthium annulatum, Bothrichloa pertusa*, while December for legumes such as *Glycine javonica* and *Centrosema pubescens.*Quadratic equation have been established for prediction of levels of herbage removed by measuring the grazed swards. It was found that the height weight relationship is better represented by the parabolic and quadratic curves rather than power or logarthimic curve. Separate height weight tables are required for same soecies grown under different environments and for different species grown under the same agro climatic condition. Initially quadratic equations have been established for grasses viz. *B. pertusa, C. ciliris, C. fulvus, P. antidotale, D. annulatum, H. contortus, I. Laxum, S. nervosum*

INTRODUCTION

The grazing lands in India are presently the most threatened ecosystem. Continuous and close grazing by the bovine followed by their conversion into agricultural sites as well as the industrial growth have eliminated much of the grassland wealth. In our country the cropped area (arable farming area) has recorded an increase from 110 to 145 m. ha during 1951-2001 through the process of cleaning, ruthless felling and burning of forests repeatedly, turning them into scrub jungles and rangelands. These ecosystems have been further depleted by the catastrophic role played by the biota through constant, illicit, uncontrolled, unscientific intensive grazing by their ever increasing livestock's numbers (292 to 500 m. in 2002), resulting into poor quality of grasses, unpalatable weeds, useless bushes and other rank vegetation. Studies were under taken by the grass cover survey team (1954 to 1960) and the best report of the survey was submitted to the Govt. of India.

Thereafter, Indian Grassland and Fodder Research Institute established at Jhansi and engaged in the research for four decades.

Present status of grasslands in India

In the past many research and development workers reported that there are no grasslands in India, but this is not the true picture because if grasslands are not there how such a big livestock's population can survive over the years? The grasslands of the country have been detailed by Whyte (1964) into five major grass covers on the basis of their potential species, dominance and co-dominance on the five agro-climatic regions of India. However, in 1984 planning commission of India emphasized on the 15 agro-climatic zone of the country. In the following years studies were conducted on productivity of protected, semi-protected and open grazing areas in sub-tropical north India (Choudhary, 1972, Shankar, *et al*. 1975, Asthana 1974, Trivedi, 1976, Kanodia, 1981, Lal, 1993, Suman, 1996) and in central India (Singh, 1961, Jain, 1971, Misra, 1973, Billore 1973, Naik, 1973 and Bhatt, 1994) and Shankar and Kumar 1987, Saxena, 1988) indicate a low production level and a decreasing trend of grassland productivity over the year if they are fully not care as per need and advisable production technologies(Table-2)

Technology for the Management of grasslands

On the basis of range inventory, condition classification coverage, the micro and macro biotic and a biotic factors governing each site, remedial measures are employed suiting to their needs under tree major heads viz. ecological, assisted ecological and utilization management.

Corresponding author:* **Manju Suman
Indian Grassland and Fodder Research Institute, Jhansi-284 003, India

Table 1 Livestock population (million)

Livestock population in India over the different years													
Livestock Population in India by Species													
Category											**(in Million Numbers)**		
Species	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997	2003	2007	2012
Cattle	155.3	158.7	175.6	176.2	178.3	180	192.5	199.7	204.6	198.9	185.2	199.1	190.9
Adult Female Cattle	54.4	47.3	51	51.8	53.4	54.6	59.2	62.1	64.4	64.4	64.5	73	76.7
Buffalo	43.4	44.9	51.2	53	57.4	62	69.8	76	84.2	89.9	97.9	105.3	108.7
Adult Female Buffalo	21	21.7	24.3	25.4	28.6	31.3	32.5	39.1	43.8	46.8	51	54.5	56.6
Total Bovines	198.7	203.6	226.8	229.2	235.7	242	262.2	275.7	288.8	288.8	283.1	304.4	299.6
Sheep	39.1	39.3	40.2	42.4	40	41	48.8	45.7	50.8	57.5	61.5	71.6	65.1
Goat	47.2	55.4	60.9	64.6	67.5	75.6	95.3	110.2	115.3	122.7	124.4	140.5	135.2
Horses and Ponies	1.5	1.5	1.3	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.6	0.6
Camels	0.6	0.8	0.9	1	1.1	1.1	1.1	1	1	0.9	0.6	0.5	0.4
Pigs	4.4	4.9	5.2	5	6.9	7.6	10.1	10.6	12.8	13.3	13.5	11.1	10.3
Mules	0.1	0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2
Donkeys	1.3	1.1	1.1	1.1	1	1	1	1	1	0.9	0.7	0.4	0.3
Yak	NC	NC	0	0	0	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1
Mithun	NA	NA	NA	NA	NA	NA	NA	NA	0.2	0.2	0.3	0.3	0.3
Total Livestock	292.9	306.6	336.5	344.5	353.2	369.4	419.6	445.2	470.9	485.4	485	529.7	512.1
Poultry *	73.5	94.8	114.2	115.4	138.5	159.2	207.7	275.3	307.1	347.6	489	648.8	729.2

NC : Not Collected; NA: Not Available * Includes Chicken, ducks, turkey & other birds
Source : Livestock Censuses, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture & Farmers' Welfare, GoI

Table 2 Comparative productivity of different grassland communities in India

Grasslands	Dry Matter t/ha	Sites	Authors
Sehima dominated	0.84	Ujjain	Singh, 1961
	4.62	Ratlam	Billore, 1973
	12.22	Jhansi	Trivedi, 1976
	10.18	Jhansi	Shankar et al. 1975
Dicanthium dominated	3.76	Varanasi	Choudhary, 1977
	5.48	Ujjain	Misra, 1973
	8.23	Mauranipur	Trivedi, 1979
Bothrichloa dominated	0.66	Jhansi	Kanodia, 1981
	4.75	Ambikapur	Nike, 1973
Cynodon dominated	3.97	Gorakhpur	Asthana, 1974
	0.63	Jhansi,	Kanodia, 1981
Hetropogon dominated	8.17	Sagar	Jain, 1971
	3.33	Delhi	Varsheney, 1972
	0.94	Jhansi,	Kanodia, 1981
Eragrostis-Hitropogon dominated	0.80	Jhansi,	Kanodia, 1981
Oroptium-Bothricloa dominated	0.77	Jhansi,	Kanodia, 1981

Ecological management

Sites highly eroded gravelly/rocky substratum and highly sloppy lands of VI and VII land capability classes, affect to severe erosion hazard, are suitable for their regeneration through elimination of grazing pasture by providing enclosure, eradication of unwanted weed, bushes, tree and other rank vegetation in strips in accordance to the status of the site Kanodia (1986). Studies conducted at Jhansi have revealed that the productivity due to simple protection of degraded rangelands can be increased from 0.1 to 3.5t/ha within a period of 3 years. The plant population of desired perennial grasses also increased from 11 plants to 397 plants and that of undesirable forbs decreased from 1444 to 33 plants during a period of nine years on a rocky substratum (Trivedi and Kanodia 1982).

Besides, intensive management of natural grassland through protection-cum controlled grazing with and without burning showed the highest increase in composition of desirable grass viz, *Sehima nervosum* from 7.5% to 22.4 without grazing and 8.8% to 18.5% with grazing in 3 years with every third year burning of grassland.

Decrease in undesirable grass viz, *Heteropogon* was from 34.0% to 5.3% under the restricted grazing for 3 years but subsequently, it again increased to 21.1% on continued grazing for another 3 years, while burning alone promoted this species (Trivedi and Kanodia 1975- 77).

Futher, studies conducted on the infestation of unwanted bushes in natural grassland also revealed 30% reduction in productivity due to their presence and the production was inversely proportionate to the intensity of bushes in a protected area as shown below, where scrub jungle is normally the climax vegetation (Whyte 1964). Under an open grazing situation, the productivity further reduced with the increasing intensity of bushes. It was recorded to be only 0.1t/ha with 1175 bushes in an open grazing land at Jhansi.

Assisted Ecological Management

Site with gentle slops and class V to Vi lands with little or no perennial plant material are apt severe erosion hazards due to slightest disturbance through bush eradication, land cleaning ploughing and other tillage operations. At the same time with the area will not also improve much even with the protection, since no good, nucleus perennial plant material is available in and around the area. In such sites, nucleus plant material of choicest species / varieties of grasses and legumes is introduced in pockets through pitter-cum- discer (evolved at IGFRI, Jhansi) after the partial clearing of land in strips with 2% land cleaning with strips of natural vegetation as well as of introduced material of dibbling in spots depending upon the slopes.

Soil and Moisture conservation: studies on changes in botanical composition due to soil and moisture conservation measures revealed that contour furrow (15cm wide and 10cm deep) at 6 m intervals increased biomass of desired grass like *Sehima nervosum* from 64.7%to 82.6%, while *Heteropogon contortus* a poor grass, decreased from 29.2% to 6.4% during a period of 3 years. The increase/ decrease of these two grasses was proportionate. In terms of total vegetation cover also 6m distant furrows had the highest percentage cover (25.9%), while the lowest (23.6%) was in the control treatment. Similar results have also been reported from arid region of Rajas than

with a three fold increase in dry forage yield (Shankarnarayan 1977).

Use of fertilizers: Application of 60kg N/ha in 3 equal splits at 3 weeks interval during the monsoon period to be superior in terms of quality and quantity of forage as compared to those of two splits or a single dose. As regards to different sources of nitrogen, the ammonium sulpahte was superior to urea, calcium ammonium nitrate and farm yard manure (Rai *et al*, 1979). The application of fertilizer was more effective when applied in 3rd week of July as compared to the 2nd week of August or 1st week of September.

Introduction of plant material Depending on the site, soil types, percentage of slopes, micro climate and need etc. plant materials have been identified suiting to a large number of sites i.e. *Chrysopogon fulvus* for red gravelly and sloppy lands, *Cenchrus ciliaris* for sandy soils, *Cenchrus setigerus* for flat lands with sandy loam soils and more arid areas, *Dicanthium annulatum* for loamy soil with better moisture status and *Iseilema laxum* and *Panicum maximum* for clayey soil with higher moisture status. Introduction of Siratro in grasslands led to nearly three times increase in crude protein of the mixed herbage. Many of these legumes can serve nearly equivalent to 40 kg N/ha. Out of 14 legumes tried, Stylosanthes (*S. hamata*), Phasey bean (*Macroptilum lathyroide*s) proved to be the most suitable, when introduced in natural grasslands (Kanodia, 1985). In *Eromopogon* dominated grassland, Siratro (*M. atropupurium*) proved to be better companion while *Clitoria ternatia* for *Cenchrus ciliaris* and *Lablab purpuria* for *Heteropogon contortus* natural grasslands.

Of the introduced legumes, Phasey bean (*Macroptilitum lathyroides)* and sem *(L. purpureus*) gave the maximum forage yield with nitrogen equivalence of 40 kg N/ha and higher forage yield by 129 and 121% respectively. Another native legume viz, *Atylosia scarabaeoides* when seeded @ 8 kg/ha in lines in *Hetropogon Contortus* grassland also increased the protein content of mixed herbage to 6% as compared to 2% of the grass alone at ripe stage. In case of *Dichanthium annulatum* intercrop of *Stylosanthes hamata* was found to most suitable, which was nearly eqivalent to the 60kg N/ha.

Prolongation of Growth period of grassland: Another important limitation of the tropical grasslands is the short to3 months followed by dormancy for the rest of the period. Efforts have been made at IGFRI, Jhansi to enhance their growth period beyond October by incorporation of pure as well as mixture, of suitable varieties of the grasses, legumes, climbers, shrubs and fodder tree besides other dryland forages coupled with life saving irrigation.

The recycling of impounded water in pasture of *C. setigerus, Chrysopogon fulvus and Setaria sphacelata* proved that 17.53t/ha average green forage yield under dryland condition could be boosted to 61.29t/ha yr (Table-3) by intercropping of Japan season and barley (c.v. Jyoti) in different seasons, coupled with 2-3 life saving for the winter sowing and another during summers at the semi wilt stage of the crops (Kanodia1986).

These yields could be further enhanced by 50-605 with the application of 60kg N+40kg P2O5/ha and several folds by incorporation of suitable shrubs/ tree component In this system.

Table 3 Comparative productivity of the pasture with and without annual forage (t/ha/yr) under two systems.

Names of grasses	Under rainfed Grasses	Under water harvesting technology Grasses + Annuals Rabi	Summer	Kharif	Total
Chrysopogon fulvus	14.40	-	1.98	21.80	23.79
Cenchrus setigerus	15.20	-	3.32	5.40	18.72
Setaria sphacelata	23.00	-	3.28	26.60	29.88
Average of grasses	17.53	-	2.86	21.26	24.16
Average of annual	-	18.90	14.94	3.31	37.16
Total green yield	17.53	18.90	17.81	24.57	61.28
Dry matter yield	5.52	2.89	4.62	6.13	13.64

Utilization Managament

Proper utilization management influences the productivity and sustenance of grassland. It has to be manipulated so as to allow sufficient time to the plants to rebuild their root reserves.

Grazing Management

In *Sehima* dominated grasslands at Jhansi deferred rotational grazing system was superior providing more number of animal days (2925), as compared to those (2097animal days) in the continuous system. The average body weight gain was recorded to be 191g/heifer/ day, yet not being detrimental to the range health, although the body weight gain of heifers was slightly higher in continuous grazing system than that of the rotational systems (Upadhyay *et al*. 1971).

Studies on utilization of over ripe *Heteropogon* grassland revealed better body weight gain in case of sheep in aftermath grazing treatment which was of September, as compared to molasses spray and when both were mixed and sprayed.

Performance of Mandya Sheep under various management systems showed maximum Body weight gain and grazing days (1882/ha) in an established *Cenchrus+Siratro* pasture, followed by (1676/ha) in natural *Sehima+Stylo* pasture (1662/ha), in natural grassland+application of 60 kg N/ha and the minimum (1682/ha) in the control (natural grasslands) at Jhansi.

The carrying capacity of different grasslands at Jhansi was found to be 10.5 sheep/ha/yr. On *Cenchrus ciliaris* as well as in *H. contortus* and 6.2 in *Dichanthium annulatum* grasslands (Upadhyay *et al*. 1971).

The maximum body weight gain (342.5g/calf/day) was recorded in case of *Cenchrus ciliaris+Stylo* pasture fertilized with 40 kg N/ha while in case of heifers, maximum weight gain was recorded in mixed pasture of *Cenchrus- Sirtro*. Similar results were obtained with sheep when grazed in *Dichanthium annulatum+Stylo* pasture during July to December, while on natural grasslands these could be maintained only up to November Without any supplemental feed.

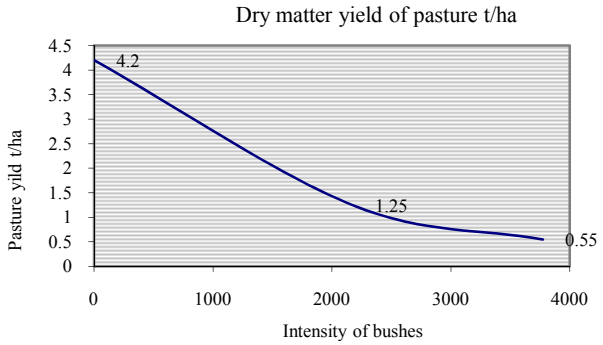
The best management practice developed at Jhansi showed that Mandya sheep could be very well maintained throughout the year on natural grasslands, if they were allowed to graze for 2 hours on Stylo+Siratro mixed pasture, in addition to six hours grazing in natural grasslands (Rai, *et al*. 1986).

Harvesting Management

The harvesting schedule of grasslands for stall feeding during lean periods is important for their efficient management.

Studies conducted at Jhansi on the intensity and intervals of cutting on a large number of grasses revealed that in almost all cases the highest productivity was maintained when harvesting was carried out at 60 days interval and at 10 cm height above the ground level with 30 kg N/ha. However, maximum crude protein content was recorded when harvested at 30 days interval (Table-4).

Treatments	*C. ciliaris*		*C. setigerus*		*S. nervosum*		*C. fulvus*		*D. annulatum*		*I. laxum*	
	DM	CP	DM	CP	DM	CP	DM	CP	DM	CP	DM	CP
Cutting intervals (days)												
10	0.33	11.7	0.40	12.9	0.77	11.1	1.07	11.5	1.09	9.3	0.42	9.9
20	0.71	9.5	0.97	10.5	1.59	8.9	1.47	9.9	1.70	8.8	0.69	7.9
30	1.01	8.1	1.14	8.6	2.10	7.6	2.19	8.7	1.95	8.5	0.98	6.9
60	2.01	6.3	2.17	7.4	4.10	6,5	4.22	7.0	2.84	7.3	1.54	5.0
CD5%	0.34	-	0.25	-	1.07	-	0.42	-	0.22	-	0.13	-
Cutting height (cm)												
5	0.84	8.9	1.05	10.0	1.83	8.4	2.06	9.3	1.64	8.9	0.78	7.5
10	1.00	9.0	1.22	9.6	2.19	8.6	2.33	9.1	1.93	8.4	0.95	7.4
15	1.20	8.8	1.51	9.9	2.41	8.5	2.32	9.2	2.12	8.2	0.99	7.4
CD 5%	0.18	-	-	0.18	-	0.51	-	0.17	-	0.18	-	0.07	-
Nitrogen levels												
0	0.60	7.7	0.98	8.9	1.92	7.3	1.57	8.1	1.80	8.2	0.69	7.03
30	1.16	9.1	1.31	9.8	2.15	8.8	2.36	9.3	1.8	8.5	0.95	7.66
60	1.27	9.9	1.50	10.8	2.36	9.5	2.76	10.3	2.00	8.6	1.08	7.74
CD5%	0.29	-	0.22	-	NS	-	0.36	-	NS	-	0.11	-



CONCLUSION

It is therefore, concluded for the proper management the grasslands need to be harvested at 30 days intervals at 10-15 cm height during the growth period (Kanodia, *et al*. 1981 and 1983). Suitable harvesting time for quality forage peoved to be September for legumes viz. *M. lathyrus, A. scarabaeoides, Memosa invisa, S. hamata and grasses viz. C. ciliaris, C. setigerus, S. nervosum, Crysopogon fulvus, October for tothers viz. Clitoria ternatea, Desmanthus virgatus, Pueraria phaseoloides, S. guianensis, S. humilis, D. intortum, D. axillais, Styzolobium deeringianum* and *Vigna luteola*, besides for grasses like *Dichanthium annulatum, Bothrichloa pertusa*, while December for legumes such as *Glycine javonica* and *Centrosema pubescens.*

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