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Seasonal changes in biomass yield, nutrient intake and its utilization by sheep maintained on public range land

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ABSTRACT

Seasonal changes in biomass yield of pasture and nutrient utilization pattern of sheep maintained round the year on village community grazing land (CGL) was assessed. The biomass yield of the CGL was similar in the 3 seasons (1.54q DM/ha). Animal preferred *Cenchrus catherticus* and *Eleucine indica* during rainy season whereas during winter the preference for *C. catherticus* increased while that of *Elucine indica* decreased. The CP of random pasture vegetation was 10.5% in monsoon which declined to 8.4 and 4.0% in winter and summer, respectively, with concomitant increase in cell wall constituents during the period. The CP of mouth grab samples was, however, 11.5% in monsoon and 10.0 and 7.8%, respectively, in winter and summer. The DMI of sheep decreased from monsoon (2.1% BW) to winter (1.8% BW) and summer (1.6% BW), while corresponding DCP intake showed significant reduction in summer (15 g/head/day) compared to winter (31.7 g/head/day) and monsoon (45.1 g/head/day). Progressive increase in maturity and lignification of plant species was reflected in gradual decline of digestibility of DM, CP, NDF, ADF, hemicellulose and cellulose from monsoon to winter and summer. It is concluded that DMI and nutrient utilization progressively decreased from monsoon to winter and summer. The DCP intake was adequate in monsoon and winter while it was grossly inadequate in summer.

Key words : Biomass yield, Dry matter intake, Grazing, Nutrient intake, Nutrient utilization, Sheep

Sheep flocks maintained in semi-arid region of the country meet their nutrient requirement primarily from community grazing land which is dominated by wide variety of vegetation, mainly native shrubs, bushes, trees and grasses. Contribution of these species in the diet of sheep is mainly influenced by their distribution on the grazing land and preference by the animals in different seasons. It is presumed that such grazing land are often inadequate to ensure required nutrition to grazing animals, especially during the lean summer season. However, no scientific data on the topic is available in the literature. Such information will form basis for development of suitable grazing management practices and/or supplementation schedule to ensure adequate nutrition to the animals. Therefore, the reported year round study was taken up to evaluate and compare seasonal changes in biomass yield of community grazing land and preference indices for forage species and nutritional status of the sheep flock maintained on the grazing land.

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MATERIALS AND METHODS

The study was conducted on a farmers' sheep flock maintained on public grazing land of Jelmia village. The site of field research was located about 8 km from the Central Sheep and Wool Research Institute, Avikanagar, in semi-arid region of Rajasthan. The flock was continuously monitored from July 1995 to June 1996, encompassing one each of monsoon, winter and summer seasons. Forage yield and botanical composition of grazing land was assessed by clipping 6 random quadrates (1 m^2) in each season (Tadmore *et al.* 1975). The digestion trials on 6 sheep of similar body weight (30 kg) and age (3-4 year) were conducted in August, December and June representing monsoon winter and summer seasons respectively. To estimate daily faecal out put of sheep, 6 animals were administered 2g of Cr_2O_3 in divided doses of 1 g each at 0800 and 1700 hr for 10 days of digestion trial period. Faecal samples were collected at the above time intervals from 5-day-onward after dosing with indicator. Diet sample of sheep were collected using mouth grab sampling by an operator following the flock. The vegetation picked up by the animals during grazing was snatched by the operator before it was contaminated by saliva and masticated. Faecal and diet samples collected over 5 day trial, were pooled for

chemical analysis. The pooled diet and faeces samples were analysed for dry matter, crude protein, ash (AOAC 1984), lignin, NDF and ADF (Goering and Van Soest 1970). Dry matter intake and apparent digestibility of nutrients were calculated following formulae of Crompton and Harris (1969). Preferences indices were calculated as percentage composition of plants species in the diet compared to percentage composition in available herbage (Krueger 1972). The data were analysed by least square difference procedure to compare seasonal means (Harvey 1990).

RESULTS AND DISCUSSION

The village range land monitored during the 3 seasons was about 150 ha which is utilized by the neighbouring villages in mixed grazing. Total 312 cattle, 423 sheep, 179 goats and 113 camels from the cluster of villages around the range land used the community grazing land facility for grazing. Accordingly, it was calculated that the stocking density on range land was 7 adult cattle unit (ACU)/ha. Considering dry matter allowance of 20 q DM/ACU the land had carrying capacity of 0.1 ACU whereas the existing stocking density on the land was 7 ACU indicating that the land over stocked to the tune of 70 times. Since the livestock were surviving on the land providing sustainable production to the farmers, it is evident that the animals were also utilizing other feed resources, viz. stubble grazing on cropped land after harvesting of standing crops and top feed resources.

The biomass yield of public natural grazing land of the village utilized in mixed grazing round the year was 1.47 q DM/ha in monsoon season while it was 1.57 q DM/ha in winter and summer. The biomass yield of the community grazing land was similar in the 3 seasons although it is established that the biomass yield substantially decreased during summer. In the 3 seasons observed similar biomass yield was due to reduction in grazing pressure on the range land during summer attributed to utilization of cropped land of the neighbouring areas in stubble grazing. Further the method used for biomass assessment in the study (Tadmore *et al.* 1975) has the inherent limitation of clipping the vegetation 1 cm above the ground while the vegetation close to ground remained unaccounted. The grazing animals because of their adaptation to such low biomass yield would have utilized the unaccounted material in close grazing. The reported seasonal changes in biomass yield of tropical pasture (Sankhyan *et al.* 1995) are mostly based on protected range land and/or under regulated grazing while the public range land are subjected to round the year grazing without rest which is the reason for similar yield in all the 3 seasons. The observed annual average biomass yield of 1.54 q DM/ha was similar to earlier reports of village range land (Mann and Mehta 1998).

The per cent distribution of plant species in the grazing land and diet of animal for the monsoon and winter season are presented in Table 2. Such information for summer could not be collected due to the limitation of the method which is based on morphological identification of plant species and it was difficult to differentiate the vegetation composition due to drying and ultimately converted to dead litters. Further, the ground vegetation withered off in the summer rendering its sampling ineffective. Preference indices for *Cenchrus catherticus, Crotolaria burhia, Eleusine indica, Eleusine aegyptiaca* and *Vermonia cineria* in monsoon were 1.02, 0.43, 1.06, 0.62 and 0.68 and corresponding values in winter were 1.86, 0.28, 0.46, 0.60 and 0.25 respectively. Preference indices of plant species with values greater than one indicated that such species had higher preference of the species than their prevalence in the grazing land, while values lesser than one indicated its avoidance by the animals.

The crude protein (CP) of random pasture vegetation was 10.5% in monsoon season which declined ($P<0.05$) to 8.4 and 4.0% in winter and summer, respectively. During the same period the cell wall constituents showed progressive increase from monsoon to winter and summer (Table 1). The observed wide seasonal variation in nutrient composition of pasture vegetation was due to short vegetative life cycle of tropical vegetation (Patnayak and Karim 1994) and environment related changes in their chemical composition (Weston 1981).

Crude protein of diet collected by mouth grab sampling declined from 11.5% in monsoon to 10.0 and 7.8% in winter and summer, respectively, while fibre fractions (acid detergent fibre, hemicellulose and lignin) showed linear increase from monsoon to summer (Table 3). Such changes in nutrient composition of diet are mainly associated with progressive increase in age and maturity of natural vegetation from monsoon to summer in semi-arid region (Roy *et al.* 1995). CP content of diet sample in summer was higher (7.8%) in comparison to herbage sample obtained from grazing land (4.0%) indicating that animals selected quality nutrients from the available herbage especially, when the grazing resources deteriorated in quality and quantity during summer. Progressive increase in maturity and lignification of plant species in semiarid region was reflected in gradual decline of digestibility of DM, CP, NDF, cellulose and hemicellulose from monsoon to winter and summer. Such observations confirm

Table 1. Biomass yield and chemical composition (%) of herbage sampled from community grazing land

Attributes	Monsoon	Winter	Summer
Biomass yield (q/ha)			
DM	1.47	1.57	1.50
Chemical composition			
Dry matter	32.50	61.90	89.80
Crude protein	10.50	8.40	4.00
NDF	70.40	60.60	55.40
ADF	37.90	48.90	50.10
Hemicellulose	32.50	11.40	5.30
Cellulose	30.80	41.80	36.20
Lignin	5.90	7.60	13.80

Table 2. Botanical composition of herbage sampled from community grazing land and their relative preference index (PI) in different season.

Plant species	% distribution of plant species					
	Monsoon			Winter		
	Grazing land	Diet	PI	Grazing land	Diet	PI
Vermonia cineria	12.14	8.33	0.68	13.14	3.14	0.25
Cenchrus catherticus	6.50	6.64	1.02	3.11	5.80	1.86
Eleusine aegyptiaca	9.00	5.60	0.62	6.81	6.39	0.92
Crotolaria burhia	17.36	7.63	0.43	22.30	6.31	0.28
Elusine indica	7.23	7.69	1.06	9.37	4.31	0.46
Indigofera cordifolia	7.40	5.11	0.69	-	-	-
Cynodon species	17.40	9.50	0.55	20.32	12.31	0.60
Others	22.80	49.36	-	25.07	61.47	-

Table 3. Seasonal changes in chemical composition (%) of diet, nutrients digestibility and plane of nutrition of sheep

	Monsoon	Winter	Summer
Chemical composition of diet			
Dry matter	30.9	50.9	69.3
Crude protein	11.5	10.0	7.8
NDF	67.9	63.4	57.4
ADF	37.2	46.6	48.3
Cellulose	30.1	39.0	34.6
Hemicellulose	29.0	19.8	11.4
Lignin	5.6	6.3	8.0
Dry matter intake (DMI)			
DMI (g/h/d)	$649^{c} \pm 69.41$	$572^{b} \pm 44.57$	$500^{a} \pm 68.30$
DMI (g/kgBW/d)	$21.03^{c} \pm 3.41$	$18.56^{b} \pm 1.32$	$16.83^{a} \pm 2.10$
DMI (g/kg$W^{0.75}$/d)	$49.61^{c} \pm 5.19$	$43.72^{b} \pm 3.20$	$29.21^{a} \pm 4.10$
Digestibility coefficients (%)			
Dry matter	$66.44^{c} \pm 6.79$	$55.37^{b} \pm 4.17$	$40.80^{a} \pm 9.12$
Crude protein	$60.31^{c} \pm 5.62$	$55.34^{b} \pm 4.17$	$34.31^{a} \pm 7.19$
NDF	67.36 ± 6.47	63.41 ± 5.07	58.37 ± 3.03
ADF	50.41 ± 7.46	52.94 ± 6.01	40.31 ± 5.28
Cellulose	40.49 ± 9.40	42.31 ± 3.01	39.41 ± 2.99
Hemicellulose	62.00 ± 7.30	58.30 ± 4.61	50.78 ± 5.28
Digestible crude protein intake (DCPI)			
DCPI (g/h/d)	$45.04^{c} \pm 4.58$	$31.69^{b} \pm 4.21$	$13.38^{a} \pm 2.64$
DCPI (g/kgBW/d)	$1.45^{c} \pm 0.96$	$1.02^{b} \pm 0.53$	$0.45^{a} \pm 0.12$
DCPI (g/kg$W^{0.75}$/d)	$3.44^{c} \pm 0.60$	$2.42^{b} \pm 0.24$	$1.05^{a} \pm 0.34$

the earlier finding of Shinde *et al.* (1998). Further, one of the possible explanations for observed lower digestibility of DM and nutrients particularly CP in summer season could be ascribed to the ingestion of soil by sheep while grazing on semi- arid range land having very poor vegetation cover during summer (Vaithyanathan and Singh 1994). It seems that soil ingestion would have damaged the gut mucosa and increased endogenous nitrogen excretion per unit of faecal DM voided, ultimately resulting in underestimation of CP digestibility and DCP intake.

DM intake of sheep declined from 649 g/head/day in monsoon to 572 g/head/day in winter and 500 g/head/day in summer. Sheep in farmers' flock were in optimum nutrition only during monsoon season (DMI 2.0% of BW), while in summer DMI of sheep was only 1.6% of BW which is critically lower than the prescribed requirements for the animals (ICAR 1985). Moreover, DM intake of sheep in summer was 22.9% lower than the monsoon season despite farmers' efforts to supplement their flock on top feeds (fodder tree leaves) in addition to grazing. Lower DMI of range managed sheep during summer is consistent finding (Shinde *et al.* 1996).

DCP intake of sheep declined from 45g in monsoon to critical stage of 13 g/head/day in summer. The DCP intake of the animals was adequate in monsoon and winter as per ICAR (1985) standards while it was grossly inadequate during summer. Survival of animals at such low level of DCP intake under field condition is difficult to explain at this stage. One of the possible explanations to survival of animals at such low levels of DCP intake could be ascribed to their efficient urea recycling ability (Harmeyer and Marten 1980). The body weight of sheep monitored during the 3 seasons indicated that their average weight was 30 kg during monsoon which increased to 32 kg in winter followed by sharp decrease to 28 kg in summer. The body weight changes reflected the variation in plane of nutrition in respective season.

It is concluded that the public range land has annual biomass yield of 1.54 q DM/ha and the land is grossly over stocked. DMI and nutrient utilization progressively decreased from monsoon to winter and summer. The DCP intake was adequate in monsoon and winter while it was inadequate in summer which was reflected in body weight loss. Since the animals apparently survived even during summer season despite sizeably lower DCP intake, it can be inferred that they have efficient urea recycling ability and extensively supplemented with top feed resources.

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