Rational utilization of grazing resources for sustained primary and secondary productivity in arid zone of western Rajasthan

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INTRODUCTION

The grazing incidence for the “Tropical Cattle Unit” (T.C.U.) weighing approximately 300 kg in desert districts of Jodhpur, Barmer, Jaisalmer, Bikaner and Churu works out to be 1.9, 2.2, 11.7, 3.1 and 1.1 hectares, respectively. Keeping in view the forage resources of the range, this stocking rate is almost 4 to 6 times heavier than what these rangelands are capable of sustaining. Consequently, continued over utilization of range resources by nomadic stock owners has led to depletion of the original climax or sub-climax vegetation, accelerating thereby the processes of soil erosion, sand dune formation and loss of soil fertility. Over utilization of range resources could be checked by adopting sound and appropriate programmes for their improvement and subsequently by adopting appropriate management for their rational utilization so as to achieve sustained primary and secondary productivity. In this context, the present paper deals with the results achieved on primary and secondary productivity from the managed pastures at both the Jodhpur and Pali research stations of the Central Arid Zone Research Institute, Jodhpur.

ASSESSING UTILIZATION OF GRASSLAND RANGES

The preferential grazing habit by the live-stock of most palatable and key species tend to cause over-utilization of the forage resources. For the purpose of maintaining the grasslands in optimum level of production, the most pertinent measure would consist in regulating the degree of utilization of the key forage species to the desired extent. Therefore, studies were conducted to ascertain easy, quick, and practical “proper use” factor for different forage species constituting range vegetation in the western Rajasthan Desert.

The technique used to evolve the assessment of utilization was based on the principle that “weight is not evenly distributed throughout the height of the grass plant, but for any given species it is reasonably constant in different individuals of the species, if they are approximately of the same height. The same principle was followed by Lommassen and Jensen (1938, 1942, 1943). Five key species namely, Cenchrus ciliaris Linn., C. setigerus Vahl., Lasiusus sindicus Henr., Panicum antidotale Retz. and Dichanthium annulatum (Forsk) Stapf., were subjected to intensive studies with
respect to percentage of weight utilized by the removal of different percentages of height from the top taken at equal intervals of 5 per cent. The technique fitting orthogonal polynomials (Fisher, 1950) was applied to describe the relationship between the percentage of height clipped (X) and the percentage of weight removed (Y). The quadratic curves of the form represented by the equation \[ Y = A + BX + CX^2 \] were fitted by plotting the observed and expected values as shown in Fig. 1 (A, B, C, D and E) with values of fitted curves.

From the graphical representation of the relationship, it became obvious that the weight was not evenly distributed throughout the height of the grass plant and the same was true for all the species under study. To substantiate, 20 per cent of the weight was utilized when 45, 58, 54, 61 and 53 per cent of the height was clipped (or grazed on L. sindicus, C. ciliaris, P. antidotale, D. annulatum and C. setigerus). Keeping the species in the same order, 40 per cent utilization was achieved when 63, 73, 71, 75 and 85 per cent of the height was grazed or clipped. These differences were generally narrowed down when 75 per cent of the weight was utilized.

On the basis of the information available, these height/weight scales are of significance for assessing the degree of
DEGREE OF UTILIZATION BY DIFFERENT LIVE-STOCK AND PRODUCTIVITY

Das et al. (1963, 1965) initiated range-pasture utilization studies using Marwari sheep (wethers) under semi-arid conditions at Pali and with heifers on refractory site near Jodhpur (Kailana) under arid conditions. Utilization studies were conducted involving 18-month old steers, 1-year old wethers and castrated goats over a period of three years on natural pasture at Pali. There were 6 animals of each kind of live-stock; steers were allotted 2.4 ha and the wethers and goats 0.4 ha each. The stocking rate was fixed to have a ratio of 6:1:1 and utilization by grazing in situ was carried out on almost identical pasture plots.

In the first year, forage utilization was to the extent of 89.2 per cent in steer paddock, 91 per cent in wether paddock and 84.4 per cent in the goat paddock giving a very heavy degree of utilization. This resulted in attaining botanical composition of the pasture, all gains over the initial weight. In terms of 16.5, 20.8 and 17.3 per cent body weight the annual grasses and other forbs like Indigofera cordifolia, I. linifolia, Amaranthus spp. etc. were eaten up during the grazing period. The perennial grass cover was utilized to the extent of 69, 79, and 72 per cent in steers, wethers and goat paddocks, respectively.

In the second year, the paddocks were utilized to the extent of 53, 49 and 38 per cent, reflecting 30, 9 and 21 per cent increase over initial body weight for steers, wethers and goats, respectively. Thus, moderate grazing by steers and wethers and light grazing by goats was evident. Further, it was interesting to note that maximum extent of utilization of annuals was in case of steer paddocks, of perennial grasses in case of wether paddocks and of non-grass species in case of goat paddocks.

During the third year, net body weight gains in steers was 2.2 per cent, in wethers and in goats, 3 per cent over the initial body weight. The extent of forage utilization in respective paddocks were 59 per cent perennials and 95 per cent of other annual ground vegetation where steers grazed, while 87 and 99 per cent in case of wethers and 77 and 100 per cent in goats grazing for perennials and other forbs, respectively.

Considering the overall picture of utilization and animal gains over a total of 3 years period, it was found that for approximately comparable degree of utilization of range-forage (61.4 by steers, 63.9 by wethers and 59.9 by goats) the average percentage body weight increase for the entire period was 111.2, 59.6 and 96.4, respectively. Thus, it was evident that for the same degree of utilization, different types of live-stock exhibited different levels of productivity under similar conditions revealing thereby higher returns from cattle followed by goat and sheep.

UTILIZATION UNDER DIFFERENT SYSTEMS

Investigations were carried out by
effecting changes in the pattern of utilization (continuous or deferred rotational grazing system) on a similar pasture by identical live-stock (sheep). Three years studies revealed that pattern of utilization significantly influenced not only the trend and condition of pasture plant community but also enhanced the animal production per unit of land when deferred rotational system was adopted. There was an increase of 22 per cent dry matter in paddocks under deferred rotational grazing while in case of continuous grazing, the increase was only 6.3 per cent. Also, stocking rate increased under deferred rotational grazing system from 0.49 to 0.73 sheep/ha, whereas under continuous grazing system it was only 0.53 sheep/ha.

Both in continuous and deferred rotational grazing paddocks, alternate 10 metre wide strips were seeded with equal mixture of *C. ciliaris* and *C. setigerus* and the alternate non-seeded strips were subjected to natural changes in botanical composition each year. When the qualitative improvement in grass establishment was observed, that seeded species like *Cenchrus ciliaris* and *Cenchrus setigerus* were found to increase to an extent of 4.50 per cent or more in paddocks grazed under deferred rotational system as compared to the paddocks under continuous grazing (Fig. 2). The increase was mainly by non-seeded strips, while in seeded strips, the production continuously increased under deferred grazing.

The sheep days in the first year, in case of both continuous as well as deferred grazing, were 109 but in the second year under deferred grazing it increased to 275 while for continuous it was 193 only. In the third year of grazing, again in case of deferred grazing the total sheep days were 301 in comparison to 261 for continuous grazing.

Thus, improvement in primary as well as secondary productivity was evident when the grass utilization was through deferred rotational system as compared to continuous grazing.

**UTILIZATION OF VARYING PASTURES BY BREEDING SHEEP**

The studies conducted by grazing identical groups, each of 6 breeding ewes (Marwari breed), on different types of pastures revealed the superiority of sown pastures over natural one in terms of not only primary productivity but also in terms of secondary production like wool production, lamb production, increase in animal body weight gains and rate of growth of lambs. The different pastures consisted of mixed sowings of (i) *C. ciliaris* + *L. sindicus* (ii) *C. ciliaris* + *C. setigerus* (iii) *C. ciliaris* + *C. setigerus* + *L. sindicus* and were compared with natural pasture dominated by *E. eusine—Aristida* community. The studies commenced from December 1972 and continuous controlled grazing under the system of flexible stocking rate was followed. The results obtained upto the period of June 1977 are presented in Table 1.

It was interesting to observe that among sown pastures, inclusion of grass species *L. sindicus* had enhanced both an important and secondary productivity. Pasture, having a mixed stand of both the *Cenchrus* species and *L. sindicus*, gave more stocking rate and produced higher dry matter, more number of lambs
and higher wool yield per unit of land in comparison to pastures having both the species of *Cenchrus*. The natural pasture having dominant species like *Eleusine compressa*, *Aristida funiculata* and *C. ciliaris* and *C. setigerus* gave lowest production in spite of fairly good stocking rate.

Fig. 2. Effect of management on production of seeded species (C. C. + C. S.) in non seeded area at Pali (dry matter yield).
Table 1. Mean values of primary and secondary productivity of different pastures

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Pasture type</th>
<th>Dry matter (q/ha)</th>
<th>Stocking rate (sheep/ha)</th>
<th>Lambs born (per ha)</th>
<th>Wool production (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>C. ciliaris</em> + <em>L. sindicus</em></td>
<td>24.11</td>
<td>4.82</td>
<td>3.39</td>
<td>3.21</td>
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<td>2.</td>
<td><em>C. ciliaris</em> + <em>C. setigerus</em></td>
<td>16.97</td>
<td>3.23</td>
<td>2.20</td>
<td>2.08</td>
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<td>3.</td>
<td><em>C. ciliaris</em> + <em>C. setigerus</em> + <em>L. sindicus</em></td>
<td>25.18</td>
<td>5.54</td>
<td>4.30</td>
<td>3.58</td>
</tr>
<tr>
<td>4.</td>
<td>Natural</td>
<td>19.98</td>
<td>2.98</td>
<td>1.56</td>
<td>1.95</td>
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</tbody>
</table>

‘F’ test

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<th>SE ±</th>
<th>Sig.</th>
<th>H. Sig.</th>
<th>H. Sig.</th>
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<tr>
<td>1.8</td>
<td>0.31</td>
<td>0.39</td>
<td>0.23</td>
<td></td>
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<tr>
<td>5.77</td>
<td>0.99</td>
<td>1.25</td>
<td>0.74</td>
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<td>6.68</td>
<td>1.42</td>
<td>1.79</td>
<td>1.06</td>
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<td>7.49</td>
<td>13.59</td>
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REFERENCES


