

STUDIES ON PLANT-ANIMAL RELATIONSHIP IN RAJASTHAN DESERT

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Studies carried out at the Central Arid Zone Research Institute, Jodhpur under different ecosystems with regard to plant-animal-relationship in the aridzone and aridzone like conditions reveal—

- (i) keeping in view the forage available and daily requirement, actual grazing capacity can be calculated which leads to improve simultaneously the forage and animal production.
- (ii) improvement in yield, quality of forage and animal production is much better when light grazing is imposed on deteriorated rangelands.
- (iii) enhanced plant production leads to increase in grazing capacity and thus improve plant-animal relationship.
- (iv) the improved pastures enhance the animal products such as wool, meat etc.
- (v) under similar rate of utilization of primary products, steers given highest secondary production closely followed by goat while sheep gives the least in the lot.

REVIEW OF LITERATURE

Dyksterhius (1949, 1951, 1958), Hanson (1957), Costello (1939), Parker (1952, 1954) and Renner (1948) carried out studies reflecting plant-animal relationship by applying knowledge of pasture ecology. Trumble (1938,) rightly emphasized the fact of existing relationship between soil, plant and animals under specific agro-climatic conditions.

Weaver and Darland (1948), Weaver and Tomanek (1951), Tomanek (1948), Clark, Tisdale and Skoglund (1947) and Campbell (1931) have indicated trends of plant succession and forage production in different habitat in course of their studies on relationship of plants and animals on a grazing land.

Klippel *et al.* (1960, 1961), Paulsen and Ares (1961), Lange (1955), Rogler (1944) and Hopkin, *et al.* (1952), have recommended light grazing of deteriorated range lands for establishing better plant-animal relationship in area where it is imbalanced. Light utilization of plant resources by animals (including man) has positive advantages in terms of better animal performance and progressive increase in forage production, and at the same time for its economic importance when compared with even moderate and heavy stocking on natural vegetation. Similar results were obtained by Black *et al.* (1937), Costello (1944), Dickson *et al.* (1948) where light grazing and balancing of relationship between plant production and animal population in favour of the former improves natural renewable agricultural resources. Fischknecht *et al.* (1953), Clark *et al.* (1943), Hutchings and Stewart (1953) have also indicated enhanced animal production under light grazing of range plant resources. A review of studies carried out by Halls (1957), Johnson (1951, 1953), Woolfolk (1949a, 1949b) and Beetle *et al.* (1961) also confirm the view that utilization under low stocking improves plant-animal relation-

ship and maintains a useful vegetation cover on the land for eventual better economic returns. Foot and Raymond (1957) in the course of their studies have also clearly stated that rate of utilization of vegetation in a pasture and method of its utilization cannot be completely isolated from one another. In the same manner Luces and McMeekan (1959) have also illustrated that these two factors are inter-dependent and can be interpreted accordingly.

RESULTS OF STUDIES IN RAJASTHAN DESERT

A critical examination of the grazing management studies carried out by Agrostology Section at Central Arid Zone Research Institute, Jodhpur have amply illustrated the fact that the type of plant-animal relationship in Rajasthan Desert is the principal determining factor affecting plant production as well as animal production in the region. In fact, the hub of the problem in the W. Rajasthan desert around which revolves the nature of plant cover, plant density, type and structural features of plant communities and all other factors involving their combination leading to either a well balanced system of plant-animal relationship or a relationship between plants and animals creating more of bare areas, sand drifts, erosion, dust storms and other such devastating hazards. The studies summarised below would reveal clearly how plant-animal relationship needs to be understood in the context of the Rajasthan desert and what would be the system of management manipulation leading to improvement of vegetation cover and enhancement of animal reproduction along with amortising the severity of the desert and desert like conditions.

Applying Principle of Grazing Capacity

Grazing capacity studies were carried out on a rocky range at Kailana with the aim to develop the techniques of proper manipulation of the animal numbers with respect to availability of forage over an *Aristida-Zizyphus* plant community. The basis of calculation of capacity and hence for the fixing the animal numbers was on the formula (Das *et al.*, 1965).

$$\text{No. of Animal days} = \frac{\text{Total forage produced}}{\text{Daily animal requirement}}$$

By applying this concept actual and calculated grazing capacity were determined and utilization was carried out. Results obtained are given in Table I:

TABLE I
Data on plant animal performance (Rockey-Range)

Particulars	1st Year	2nd Year	3rd Year
Total area in ha.	33.1	33.1	50.5
Forage production/ha.	400.5 kg.	690.6 kg.	694.5 kg.
Total forage production	—	26241.6 „	35174.5 „
Total forage available	—	15745.0 „	21104.7 „
Calculated grazing capacity	—	2629 days	3517 days
Actual grazing capacity	—	2584 „	3441 „
Variation	—	45 „	76 „
Estimated forage consumption/animal/day	—	6.0 kg.	6.0 kg.
Actual utilised/animal/day	—	6.09 „	6.13 „
Grazing capacity/animal on yearlong basis	—	5.3 ha.	5.3 ha.

Studies keeping similar objectives in view as in No. 1 above, were carried out on a different vegetation type occurring on different eco-system where adult wethers were used as the experimental animal. These studies were spread over a period of three years under a system of controlled grazing, the effect on vegetation was investigated. The data in Table II reflects how under a suitable system by controlling animal numbers and rate of utilization, flora as well as plant cover could be improved.

TABLE II
Percentage botanical composition

Species	Initial	After 3 years controlled grazing
Perennials		
<i>Elusine compressa</i>	19.3	27.2
<i>Eremopogon foveolatus</i>	3.9	3.2
<i>Cenchrus spp.</i>	5.6	11.1
<i>Dactyloctenium scindicum</i>	0.2	—
<i>Sporobolus supp.</i>	0.2	—
<i>Tetrapogon tenellus</i>	0.9	—
<i>Heteropogon contortus</i>	0.2	—
Annuals		
<i>Aristida spp.</i>	54.8	49.5
<i>Melanocenchrus jacquamontii</i>	9.7	0.8
<i>Schone feldia gracilis</i>	2.4	—
<i>Bracharia ramosa</i>	2.1	—
<i>Oropetium thomeum</i>	0.5	8.2
<i>Sehima ischemoides</i>	0.2	—
Total	100.0	100.0

TABLE III
Percentage plant cover

Species	Initial	After 3 years controlled grazing
<i>Aristida spp.</i>	2.81	4.77
<i>Elusine compressa</i>	2.09	9.07
<i>Cenchrus spp.</i>	1.04	0.60
<i>Eremopogon foveolatus</i>	0.01	3.15
<i>Oropetium thomeum</i>	0.01	0.77
<i>Melanocenchrus jacquamontii</i>	0.30	0.12
Non-grass	2.86	9.00
Others	0.97	—
Total	10.25	28.27

Regarding the animal aspect in these studies, it was interesting to note that total number of sheep days in the initial year was 3168 while in the final year, although it increased to 6928 animal days, yet the improvement in plant composition and cover was not adversely affected as illustrated in Table II above due to controlled system of grazing management (Fig. 1). This proves that even in arid and semiarid regions a controlled system of pasture-animal management tends to improve the range plant resources as well as animal production (Das *et al.*, 1963).



FIG. 1. Controlled grazing of sheep on natural pastures.

Intensities of range plant utilization (animal grazing)

Studies under different intensities of grazing carried out on rocky ranges of Beriganga using Marwari ewes and at Kailana using heifers, have clearly reflected that improvement in yield and quality of forage plant is much better when light grazing of range vegetation is practised rather than moderate and heavy incidence of grazing is imposed. Light grazing of deteriorated rangelands gives in the last analysis an advantage even in terms of agro-economics when it is compared to even moderate and heavy stocking of the ranges.

TABLE IV (a)

Forage estimation in kgs/ha in different intensities of grazing in different years.

Species	Light intensity		Moderate intensity		Heavy intensity	
	Beriganga	Kailana	Beriganga	Kailana	Beriganga	Kailana
Perennials	+237.8	-440.3	-147.5	-131.7	-91.2	-121.8
Annuals	+154.1	+167.7	+252.4	+142.3	+587.1	+299.5
Non Grass	+452.0	+166.1	+254.7	+159.5	-103.8	+10.3

TABLE IV (b)

Percentage increase in body weight of animals in different years.

Age	No. of animals		Intensities		1964		1965		1966	
	Beri-ganga	Kailana	Beri-ganga	Kailana	Beri-ganga	Kailana	Beri-ganga	Kailana	Beri-ganga	Kailana
1-2 years old	25 ewes	8 heifers	1.2	6	40.0	10.7	28.0	21.3	20.0	52.3
"	"	"	0.9	5	30.0	4.2	17.0	24.1	13.0	50.4
"	"	"	0.6	4	16.0	2.7	16.0	17.2	16.3	42.0

Investigations on relative grazing capacity of sown pastures

With the view to assess plant animal-relationship with respect to sown pastures under different ecological conditions, investigations were undertaken using same type of animals (wethers) at Jodhpur as well as at Pali where tamed pastures were grazed (Figs. 2 & 3). The only point of variation between Jodhpur and Pali was that *Lasiurus indicus* was sown over sandy soils of Jodhpur while *Dichanthium annulatum* was sown over loamy soils of Pali alongwith *Cenchrus ciliaris*, *C. setigerus* and *Panicum antidotale* over an area of one acre each divided in four equal parts. Studies revealed interesting facts that with the improvement in terms of fertility and water holding capacity as at Pali, the forage production as well as animal performance was better even when same pasture species were sown and utilized. This fact is clearly illustrated by the following table.



FIG. 2. Sown pastures of *C. ciliaris* at Pali.



FIG. 3. Sown pastures of *Lesiurus scindicus*+*C. ciliaris* at Jodhpur.

TABLE V

Relative carrying capacity of sheep in sown pastures of the promising desert grass on year long basis

Species	Carrying capacity of sheep/ha.		Av. gain in body weight in kg. from Aug. to Jan.		Calculated forage consumption per day per sheep in kg. on dry matter basis	
	Jodhpur	Pali	Jodhpur	Pali	Jodhpur	Pali
<i>Lasiurus sindicus</i>	5.50	—	2.5	—	1.10	—
<i>Cenchrus ciliaris</i>	4.47	7.60	3.3	1.3	0.82	1.17
<i>Cenchrus setigerus</i>	2.60	6.01	1.6	1.8	1.20	1.16
<i>Panicum antidotale</i>	3.84	4.92	2.1	2.1	1.05	1.80
<i>Dichanthium annulatum</i>	—	6.93	—	1.8	—	1.00

Thus improved plant production lead to increased grazing capacity, and better plant animal relationship.

Studies on animal production (wool) under sown and natural pasture

The studies reveal the influence of sown pastures with and without supplementary feed in terms of wool production as compared to natural pasture. Equal groups of sheep were allowed to graze on cultivated pasture of *Cenchrus ciliaris* and on natural pasture dominated by *Eleusine-Aristida* type. The wool yield as detailed in Table VI below would reveal the superiority of sown pastures over natural pastures even when the equal amount of supplementary feed is made available to similar group of animals on both the pastures. The studies also reveal that with the improvement of feed and the fodder production in the desert, an enhanced animal production could be obtained restoring a rational relationship between the plant and animal in the desert biome.

TABLE VI

Average production of wool in grams under different treatments

Treatment	Initial	After three years	Av. yield/ ha in kg.
1. Sown pasture with supplementary feed DCP=85.6 g TDN=29.7 g	566	702	3.275
2. Sown pasture without supplementary feed	429	615	2.650
3. Natural pasture with supplementary feed DCP=85.6 g TDN=29.7 g	458	583	1.405
4. Natural pasture without supplementary feed	369	542	1.248

Using different types of animals on similar plant community

Studies were conducted at Pali with three types of animals, namely, steers, wethers and goats for the period of three years on the same type of eco-system. Results obtained are given in Table VII.

TABLE VII

Results of percentage utilization and increase in body weights

Particulars	Type of animals		
	Steers	Wethers	Goats
Percentage utilisation of the pasture	61.4	63.9	59.9
Percentage increase of body weights	111.2	59.6	96.4

It would be clear from the table VII that the percentage utilization of pastures by the different types of animals was more or less equal but percentage increase in their body weight gain during the period under study was observed to be markedly different. The percentage increase in body-weight for steer is nearly twice as much as that of wethers and goats closely follow the steers. The results also reflect that given similar rate of utilization of primary production, the secondary production in terms of meat per hectare is highest when steers are grazed followed by goat while sheep gives the least in the lot.

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