

## CARRYING CAPACITY OF PROTECTED AND OPEN PASTURES IN SCRUB-ZONE OF PABBI-RASOOL (KHARIAN-GUJRAT), PUNJAB,

Muhammad Afzal<sup>1</sup>, Amjad Ali Ch.<sup>2</sup>, Javaid Ahsan<sup>3</sup>,  
Shahzad Fazal<sup>4</sup> and Saima Tabassum<sup>5</sup>

### Abstract

Survey of Pabbi-Rasool rangeland was conducted to assess its vegetation and carrying capacity. *Cenchrus ciliaris* (Dhaman) was the principal grass sp. (47.85%). General grass coverage on average was 57.01% and 30.27% in protected and open pastures respectively. Dry matter yield of protected pastures was 1316 kg/ha while it was only 388 kg/ha from open pastures. Carrying capacity based on herbage biomass for protected and open pastures was found to be 0.40 and 0.12 AU/ha/yr respectively.

### Introduction

Pakistan has a wealth of 150.5 million heads of livestock, which accounts for 11% of the GDP (GOP, 2007-08). Nutritional requirements of these animals are mainly met through fodder crops, shrubs, grasses, fodder trees and agro industrial wastes. Akram (1990) reported that livestock are getting only 75% and 40% of the required amount of Total Digestible Nutrients (TDN) and Digestible Crude Protein (DCP) respectively. Improved quality and quantity of feed can enhance livestock production up to 50% from existing genetic pool of animals (Hasnain, 1983). Studies by Hanjra *et al.* (1995) revealed that animals in Pakistan are getting 38% of their nutritional requirements from rangelands.

Scrub areas in Pakistan are called the meat basket and protein bank due to the presence of adequate amounts of grasses/shrubs for livestock grazing. Pabbi-Rasool range is located in Kharian and Phalia Tehsils of Gujrat District. The soils of Pabbi-Rasool fall in the gullied rock-land association. The rock-land occupies ridges whereas gullied land occurs in-between. Eight percent of the area is badly dissected due to erosion. Top soil has been washed by severe erosion. Shallow gravelly soil occurs in pockets, whereas soil is comparatively deep at lower elevations. It is sandy in stream beds and slightly loamy sand elsewhere. There is an extreme variation in temperature, which may soar up to 49.2°C in summer to freezing point in winter. Frost occurs during December and January (Anonymous, 1992).

Carrying capacity describes the number of grazing animals in a management unit able to support without depleting rangeland vegetation or soil resources. It reflects the average level of sustainable production over the long term. Determining carrying capacity is a fundamental component of rangeland evaluation, because it is an important management tool that connects forage supply and its consumption. Evaluating carrying capacity is an important application of rangeland inventory and monitoring programme

---

<sup>1</sup> Director, Punjab Forestry Research Institute, Faisalabad-Pakistan

<sup>2</sup> Senior Research Officer, Punjab Forestry Research Institute, Faisalabad

<sup>3</sup> Research Officer, Punjab Forestry Research Institute, Faisalabad

<sup>4</sup> Research Assistant, Punjab Forestry Research Institute, Faisalabad

<sup>5</sup> Research Assistant, Punjab Forestry Research Institute, Faisalabad

because it represents the key management tool to ensure sustainable use of natural resources.

Species composition and vegetation cover are good indicators of a range condition. There is ample scope for increasing forage production through scientific management of rangeland areas. The assessment of present potential of a range resource is very important in order to plan for its development. Keeping this in view, Pabbi-Rasool rangeland was surveyed; (a) to determine the species composition (b) to find out the vegetation cover and (c) to assess the carrying capacity/grazing potential of the area.

### Materials and Methods

Pabbi-Rasool rangeland was divided into four categories with respect to type and condition of vegetation. From each category two compartments/pastures, one protected and one open for grazing were randomly selected for sampling. Following parameters were studied to assess the range condition.

1. Species composition
2. Vegetation cover
3. Carrying capacity

### Species composition

For species composition, method used by Chaudhry *et al.* (2000) was adopted. A 33 m measuring tape was stretched along the diagonal of the pasture in the randomly selected direction. The plant species lying vertically under every 33 cm were noted on data sheet. Twenty equidistant transacts were taken through a systematic sampling technique along the diagonal line from each pasture to determine species composition.

### Vegetation cover

For finding out the vegetation cover, 1 m<sup>2</sup> quadrat was put along each transact at 9th, 18th and 27th m. Area covered by grasses/herbs was assessed to estimate the vegetation cover.

### Carrying capacity

From the vegetation cover samples, forage in each 1 m<sup>2</sup> quadrat was cut 2.5 cm above the ground surface with the help of a sickle. The harvest material was weighed on the spot with the help of a sensitive spring balance. Cut samples were packed in paper bags and were oven dried at 55°C to the constant weight for calculation of average biomass (g/m<sup>2</sup>). The value thus obtained was multiplied by 10 to get the biomass production in kg/ha. The carrying capacity was calculated as under:

Average dry forage production per ha = A kg

Available forage per ha = A/2 kg ..... (x)  
(Based on assumption that 50% of biomass is used by animals)

Annual dry forage requirement of an animal unit (AU) =  $9 \times 365 = 3285 \text{ kg} \dots (y)$

Carrying capacity (AU/ha/year) =  $x/y$

or

Carrying capacity (ha/ AU /year) =  $y/x$

## Results and Discussion

Total area of Pabbi-Rasool is 15403 ha and for management purposes, it is divided into 111 pastures/compartments. These pastures vary in size from 16 to 105.5 ha. Some pastures have been protected and reseeded with *Cenchrus ciliaris*. After three years of reseeding auction of grass is done on yearly basis for the next three years and then area is opened and grazing permits are issued on monthly basis.

## Species Composition

Species composition of Pabbi Rasool is shown in Table-1. Dhaman (*Cenchrus ciliaris*) was the main grass sp. of the area (47.85 %) followed by *Eleusine flagellifera* (18.95) and *Cymbopogon jawarancusa* (11.70).

Table 1. Species composition of Pabbi-Rasool

Botanical Name	Local Name	Percentage
<i>Cenchrus ciliaris</i>	Dhaman	47.85
<i>Eleusine flagellifera</i>	Chhimber	18.95
<i>Cymbopogon jawarancusa</i>	Khavi	11.70
<i>Heteropogon contortus</i>	Sariala	8.64
<i>Panicum antidotale</i>	Malai	2.90
<i>Bothriochloa pertusa</i>	Palwan	2.85
<i>Digitaria bicornis</i>	Pharion	2.65
<i>Cynodon dactylon</i>	Khabbal	1.55
<i>Echinochloa colonum</i>	Swank	1.30
<i>Sporobolus arabicus</i>	Lunak	1.10
<i>Cenchrus bifloris</i>	Lumber	0.18
<i>Paspalum dilatatum</i>	Dilla grass	0.15
<i>Aristida adscensionis</i>	Lumb	0.06
<i>Pisum sativum</i>	Field pea	0.05
<i>Chrysopogon montanus</i>	Dhola khar	0.03
<i>Cochia indica</i>	Bui	0.02
<i>Desmodium trifolium</i>	Kandiala	0.02
Total		100

### Vegetation Cover

As shown in Table 2, vegetation cover ranged from 46.50% - 69.86% in protected pastures whereas it varied from 11.35% - 50.33% in open pastures. On the average vegetation cover was found to be 56.84% and 29.49 in protected and open pastures respectively.

Table 2. Average vegetation cover of Pabbi-Rasool

Protected pastures		Open pastures	
Pasture #	Cover %	Pasture #	Cover %
55	50.00	56	34.50
63	46.50	61	50.33
31	61.00	36	21.80
101	69.86	100	11.35
Average	56.84	Average	29.40

### Paired Samples Test

	Paired Differences					t	df	Sig
	Mean	SD	SE	95% confidence interval of the Difference				
				Lower	Upper			
Protected vs Open	27.35	36.50	2.36	22.70	31.99	11.61	239	.000

### Carrying capacity

On the basis of dry forage production as given in Table 3, carrying capacity was calculated to be 0.40 and 0.12 animal units per ha per year for protected and open pastures respectively.

Table 3. Average fresh and dry fodder yield of Pabbi-Rasool

Protected pastures			Open pastures		
Pasture #	Fresh Yield (kg/ha)	Dry Yield (kg/ha)	Pasture #	Fresh Yield (kg/ha)	Dry Yield (kg/ha)
55	2250	859.52	56	1330	550.03
63	1590	709.52	61	980	498.65
31	4270	1623.24	36	843	335.91
101	4920	2071.65	100	353	167.58
Average	3257.50	1315.98	Average	876.50	388.04

Paired Samples Test								
	Paired Differences					t	df	Sig
	Mean	SD	SE	95% confidence interval of the Difference				
				Lower	Upper			
Protected vs Open	927.94	1056.99	68.22	793.56	1062.32	13.60	239	.000

Table 4. Average carrying capacity of Pabbi-Rasool

Protected Pastures			Open Pastures		
Pasture #	CC (ha/AU/yr)	CC (AU/ha/yr)	Pasture #	CC (ha/AU/yr)	CC (AU/ha/yr)
55	3.82	0.26	56	5.93	0.17
63	4.62	0.22	61	6.59	0.15
31	2.00	0.49	36	9.78	0.10
101	1.58	0.63	100	19.60	0.05
Average	3.01	0.4	Average	10.48	0.12

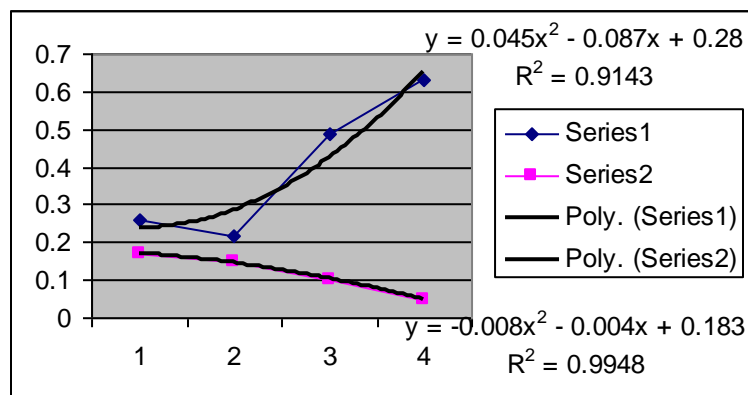


Figure 1. Trend of carrying capacity in protected and open pastures

Table 5. Equivalents of different animals in terms of animal units

Animal	Animal Units
Cow	1.0
Sheep	0.2
Goat	0.3
Camel	1.7
Buffalo	1.5
Horse	1.3
Mule	1.0
Bull	1.3
Donkey	0.6

Source: Qureshi, 1992

## Conclusion

Vegetation cover as well as the forage production is significantly higher in protected pastures where controlled grazing has been observed. Carrying capacity in these pastures is more than 3 times of the open pastures. Moreover, the trend of carrying capacity in protected pastures as depicted in Figure 1 is positive which pleads for improvement in the range condition of the area in contrast to the further deterioration of the open pastures where uncontrolled grazing is practiced.

## References

- Anonymous, 1992. Working plan for Pabbi-Rasool Reserved Forest 1991-92 to 2000-01. Punjab Forest Department. Lahore, Pakistan.
- Akram, M., 1990. Pakistan: Animal Feed Resources in Asia and Pacific. Asian Productivity Organization. Tokyo.
- Chaudhry, A. A., M. Afzal, M. Mushtaque and B. A. Awan, 2000. Assessing Carrying Capacity and Vegetation Cover of Rakh Dagar Kotli (Thal). Pakistan Journal of Forestry. 50(1-2): 37-42.
- Hanjra, S. H., J. B. Javid and M. J. A. Akhtar, 1995. Fodder Production. FAO. Pak/88/072. Smallholders Dairy Development in Punjab. Gujranwala, Pakistan.
- Hasnain, H., 1983. Feed: The Key to More Food in Pakistan. In Proceedings of FAO/PARC Workshop on Least Cost Ration Formulation 12<sup>th</sup> March, 1983. Islamabad. pp. 4-15.
- Government of Pakistan. 2007-08. Pakistan Economic Survey. Finance Division, Economic Advisor's Wing. Islamabad.
- Qureshi, M. A. A., 1992. Practical Manual for Introductory Course on Range Management. A-One Publishers. Lahore, Pakistan.