

## DETERMINING CARRYING CAPACITY OF UNTREATED AND TREATED AREAS OF MARI RESERVE FOREST (POTHWAR TRACT) AFTER RESEEDING WITH *CENCHRUS CILIARIS*

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### ABSTRACT

Mari Reserve Forest of Pothwar tract covers an area of 3055 ha. Due to uncontrolled grazing, the range area has degraded and supports mainly unpalatable vegetation. In 2005-06, a 911 ha area was reseeded with *Cenchrus ciliaris* (Dhaman/Bufel grass). Forage production on both the reseeded/treated and untreated areas was measured in 2007 at the end of the growing season during October. The reseeded area produced about 16 times (7733 kg/ha) more forage than the untreated area (491 kg/ha). General Grass coverage on an average was 27% and 78% in untreated and treated pastures, respectively. Carrying capacity (Animal Units per Year) based on dry biomass of grasses/herbs was found to be 0.07 AU/ha and 1.18 AU/ha in untreated and treated areas, respectively or in other words, rakh with an area of 3055 ha can provide fodder to 3605 AU if seeded, and otherwise it will support only 214 AU. These results indicate that reseeded may be an important management practice for improving degraded rangelands of Pakistan.

**Key words:** Carrying capacity; Reseeding; Forage production; Vegetation cover; *Cenchrus ciliaris*, Animal Units per Year (AU).

### INTRODUCTION

Pakistan is an agricultural country having 154.7 million heads of livestock which contribute 11.3% towards the GDP (Anonymous, 2008-09). Nutritional requirements of these animals are met mainly through fodder crops, grasses and shrubs. Area under cultivated fodder crops in Pakistan is 2.45 million hectares (Anonymous, 2005-06). This area cannot meet the fodder requirements of the huge number of livestock. On the other hand, more area for fodder crops cannot be set aside due to ever increasing population demands for cereals and other food items. Whereas, the demands of meat, milk and milk products are also increasing due to rapid increase in human population. From existing genetic pool of animals these demands could only be met through enhancing livestock production, whereas up to 50% production can be increased by improving the quality and quantity of feed (Hasnain, 1983). Studies by Hanjra *et al.* (1995) revealed that animals in Pakistan are getting 38% of their nutritional requirements from rangelands. About 65 - 70% of the total area of Pakistan and 47% of the area of Punjab consists of rangelands which are the mainstay of country's livestock industry (Anonymous, 2005-06). Due to mismanagement, the rangelands normally become overgrazed, causing the grass and desirable vegetation to die and letting the weeds take over. Reseeding of desirable grass species can help to improve the depleted rangelands (Khan *et al.*, 1999). Mari Reserve Forest is a degraded area of Pothwar tract with many unpalatable

grass species. It covers an area of 3055 ha and comprises of 62 compartments of various sizes. The climate of the area is classified as semi-arid to sub-humid. Average annual rain fall of the district is 584.3 mm/year, most of which occurs during late summer (monsoon) season.

Evaluating carrying capacity is an important application of rangeland inventory and monitoring programs because it represents the key management tool to ensure sustainable use of natural resources (Scoones, 1992). Carrying capacity describes the number of grazing animals a management unit is able to support without depleting rangeland vegetation or soil resources (Quraishi *et al.*, 1993). Since, Mari Reserve Forest is a depleted range area, the assessment of present potential of the range resource is important in order to plan for its development. The main objective of this study was to assess the changes occurred in forage production and vegetation cover in reseeded (treated) and non-reseeded (untreated) areas and then to calculate the carrying capacity of these areas. Keeping this in view, Rakh Mari was reseeded with *Cenchrus ciliaris* (Dhaman/Bufel grass). *Cenchrus ciliaris* has already been recommended for reseeded of Pakistan rangelands and has been successfully reseeded in rangelands of Dera Ghazi Khan which are among the degraded rangelands of Pakistan (Butt *et al.*, 1990; Khan *et al.*, 1999).

## MATERIALS AND METHODS

The study was initiated in June 2005 on 3055 ha of Mari Reserve Forest in Pothwar range area. A preliminary survey was conducted of the area to determine existing species. Following the survey, 911 ha was chosen and half of the area was reseeded during July 2005 at a rate of 6 kg/ha with *Cenchrus ciliaris*. The remaining half was reseeded during July 2006 with the same rate. The seed was planted in the way as suggested by Khan *et al.* (1999).

Species composition, vegetation cover and forage production data on both untreated and treated areas were recorded during October 2007. The data on species composition was collected using line transect sampling (Khan *et al.*, 1999; Chaudhry *et al.*, 2000). A 33 m measuring tape was stretched along the diagonal of the pasture in the randomly selected directions. The plant species, after every 30 cm, were recorded on data sheet. Twenty equidistant transects were taken in a systematic sampling from each compartment along the diagonal line. Species percentage was determined by simple mathematical calculations. After making inventories or data collection for species composition, 1.0 m<sup>2</sup> quadrat was put along each transect at 10, 20 and 30 m intervals to determine vegetation cover. Percent area covered by grasses/herbs was estimated by visual observation in each quadrat.

Carrying capacity was assessed after cutting the forage in each quadrat at 2.5 cm above the ground surface with the help of a sickle. The harvested material was immediately weighed at the spot with the help of a sensitive spring balance. Weighed samples were packed in paper bags and air dried for 15 days to determine average dry weight (in grams) per quadrat. The values thus obtained were multiplied by 10 to get average dry matter forage production (kg/ha). Available forage was calculated on the basis of 50% of the total as use factor. Carrying capacity in Animal Units per Year (AUY) per hectare was calculated taking into account that a cow weighting about 450 kg consumes 9 kg of air dry forage daily (Ahmad *et al.*, 2006). The data were analyzed with one-way analysis of variance (ANOVA).

## RESULTS AND DISCUSSION

**Grass species and vegetation cover:** Vegetation present in the Mari Reserve Forest were recorded by grass species and presented in (Fig. 1). Most of the species found on the nonreseeded/untreated area were less palatable. *Eleusine flagellifera* (Chimber) was the dominant grass and this species alone comprised 65% of the grasses. The remaining 35% of the grasses were *Aristida adscensionis* (Lumb), *Bothriochloa pertusa*

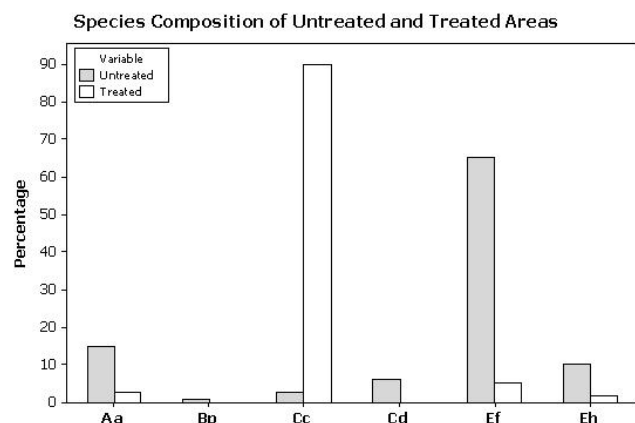
(Pulwan), *Cenchrus ciliaris* (Dhaman/Buffel Grass), *Cynodon dactylon* (Khabal), and *Elionurus hirsutus* (Gorkha). On the other hand, the reseeded grass (*Cenchrus ciliaris*) completely dominated the treated area. These results were consistent with research conducted by Khan *et al.* (1999) who have reported dominance of reseeded grass in the treated area. These authors also mentioned *Eleusine flagellifera* as a low quality grass than *Cenchrus ciliaris* which is considered as highly palatable especially when it is green.

The vegetation cover of the treated pastures was found to be significantly higher than the vegetation cover of the untreated pastures ( $P < 0.01$ ). It was 3 times higher than of the untreated pastures on an average basis (Fig. 2). This high vegetation cover may be attributed to the presence of *Cenchrus ciliaris* as the single dominant grass species in the reseeded area. Since health of a rangeland is normally determined by measuring the vegetation cover (Holechek *et al.*, 1989), higher vegetation cover of treated pastures showed that the treated areas attained good health after reseeding. Vegetation cover not only relates to forage availability for livestock but it is also a useful indicator of how well a site is protected against erosion. In untreated pastures, more than 70% of the area was bare ground which was most probably due to the reason that the most of the unpalatable species like *Eleusine flagellifera* and *Aristida adscensionis* dominated the area and accompanied by reduction in the percentage cover of the desirable species like *Cenchrus ciliaris*.

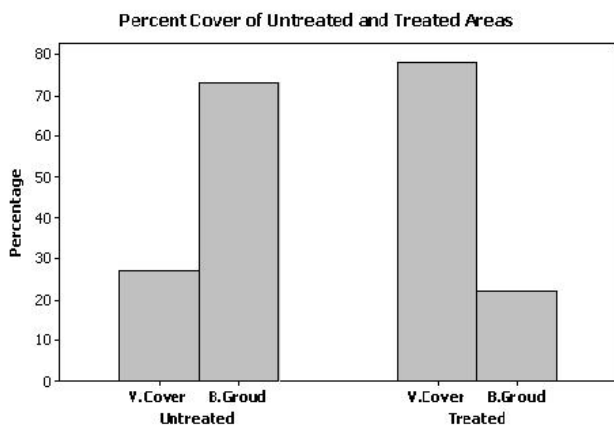
**Forage production and Carrying capacity:** Mean forage production (Dry matter yield) from the reseeded/treated area was 7733 kg/ha compared to 491 kg/ha from the untreated areas (Fig. 3). This 16 times higher forage production of the reseeded areas was consistent with the findings of Khan *et al.* (1999) who have reported up to 10 times more forage production in the reseeded areas as compared to native range area which was reseeded with *Lasiurus indicus* and *Cenchrus ciliaris*. Because of its high biomass production, *C. ciliaris* has not only been considered suitable to get maximum dry fodder yield, when planted in combination with *Zizyphus mauritiana* (Ber; a timber & browse spp.) in a silvipastoral system (Arya, 2006), but it is also believed to be suitable for eroded soils (Arshadullah *et al.*, 2009).

Production potential of the reseeded area was assessed in terms of carrying capacity (Animal Units per Year per hectare). Carrying capacity calculated was 0.07 AUY/ha and 1.18 AUY/ha for untreated and treated areas, respectively, if taking 50% as grazing intensity. The untreated area showed about 16 times decline in carrying capacity which means that an area of 3055 ha would be able to provide fodder to 3605 AUY if it is

treated, otherwise it will support only 214 AUy. In other



**Figure 1.** Species composition of Untreated and Treated/Reseeded areas in Mari Reserve Forest of Pothwar tract (October 2007). Since, the vertical bars are not shown for the grasses, Bp and Cd in the treated area, these grasses were present in traces.

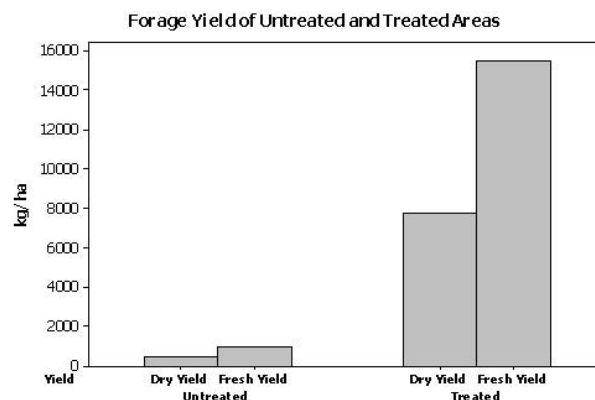


**Figure 2.** Vegetation cover (V. Cover) and Bare ground (B. Ground) of Untreated and Treated / Reseeded areas in Mari Reserve Forest of Pothwar tract during October 2007.

Aa (*Aristida adscensionis*; Lumb), Bp (*Bothriochloa pertusa*; Pulwan), Cc (*Cenchrus ciliaris*; Dhaman/Bufel Grass), Cd (*Cynodon dactylon*; Khabal), Ef (*Eleusine flagellifera*; Chimber), Eh (*Elionurus hirsutus*; Gorkha)

words, we can say that about 14 hectares are required to feed 1 AUy if the area is not reseeded whereas, less than 1 ha would be enough to support 1 AUy when the area is reseeded with *C. ciliaris*. Since carrying capacity was calculated on the basis of dry forage production taken at the end of growing season in the month of October which was taken as an estimation of annual production of consumable vegetation, the actual value for carrying

capacity might be slightly different. Nevertheless, carrying capacity could be used as a useful parameter to access the production potential of a rangeland.



**Figure 3.** Average dry and fresh forage yield (kg/ha) of Untreated and Treated/Reseeded areas in Mari Reserve Forest of Pothwar tract during October 2007.

**Recommendations:** Based on the results of the study, rangeland reseeded may be recommended as a possible management practice to improve forage production. The degraded/depleted rangelands could be reseeded with Buffel grass (*Cenchrus ciliaris*) to enhance productivity and to increase carrying capacity. *C. ciliaris* may also be recommended for eroded soils of Pothwar on the basis of having high biomass production.

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