# RANGE MANAGEMENT IN ARID ZONE

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## Abstract

This paper describes the current state of art of arid rangelands, their management constraints and scope of range vegetation evaluation. The results of a case study on Lachi rangelands indicated that the area was rich in plant bio-diversity and there were 36 plant species. Out of it 18 were grass/grazing species, 2 forb species, 10 shrub species and 6 tree species. The bio-mass production was 752 kg (AD)/ha which was quite low. The study further indicated that range condition was poor to fair and the range trend was downward. The study has recommended application of specialized grazing system like; intensive repeated seasonal grazing to utilize coarse and or less palatable grass species. Further the study recommended improvement in complementary forage production, forage reserves and supplemental feed along with soil and water conservation measures to improve the range condition, trend and production.

## Introduction

Pakistan is located between 24°-37° N latitudes and 61°-75° E longitudes covering a geographical area of 87.98 million hectares (including AJK). The country, physiographically, is broadly divided into two main regions namely; plains of the Indus River, and its tributaries and huge complex of mountains and plateaus lying in north and northwestern boundaries. The plains are, by and large, level country consisting mostly of irrigated agriculture and arid and semi-arid deserts. The mountain complex comprises of broad level valleys, partially irrigated, and high, steep and rugged mountains, hills and plateaus.

More than 60 percent area of Pakistan is arid and receives less than 250 mm rainfall per annum. About 20 percent area is semi-arid where rainfall varies between 250-400 mm per annum. In these zones temperature rises steeply during summer and drops sharply in winter giving rise to great variations in diurnal temperature. Subsequently the arid and semi-arid parts of the country are characterized by low precipitation, extreme temperatures and low humidity. These conditions are inhospitable to good plant growth. There are frequent droughts and the forage capacity fluctuates greatly with precipitation. Under the circumstances appropriate grazing programmes had to be framed to prevent overgrazing. The range vegetation had to be properly utilized as once vegetation is damaged it is difficult to restore in harsh arid climatic and edaphic factors. In Pakistan proper use factor is 50 percent for proper range utilization under proper

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range management. It means that 50 percent herbage production must be left on ground after grazing for carry-over effects.

During droughts in arid areas the carry-over adds dead plant material (litter) on ground which insulates range lands and keeps soil temperature lower and hence reduces water loss. If grazing with normal stocking rate is allowed it accelerates litter break-down, intensifies drought effects and prolong range recovery. Subsequently excessive dry conditions call for specific management practices that can help reduce the impact of drought on livestock and range resources and hasten recovery after the drought is over (Anon, 2001).

## Extent of arid rangelands

About 29 million hectares (ha) or 33 percent of total land area have been classified as range lands. Out of this total about 25 million ha or 28% are degraded and only about 3 million ha 3 % are non-degraded. The balance of about 1 million ha are alpine pastures (Table 1). This clearly indicates that, by for the largest part of the ranges is arid and semi-arid and are degraded. Further, about 27 million ha or 30% have been classified to land categories like; desertic, rock/gravel, tidal flats and swamps. These areas are also supporting some vegetation as feed for livestock and wildlife. The desertic and rock/gravel land categories invariably lie in arid zone. Obviously, it is difficult to ascertain whether natural destructive processes were the causes of their degradation or the human activities were responsible for this desertification.

Table 1: Province-wise distribution of range lands in Pakistan

(000 ha)

| Range/other land categories | Balochistan | Punjab | Sindh | NWFP | Northern Areas | Azad Jammu and Kashmir | Total |
|---|---|---|---|---|---|---|---|
| **A. Range Lands** | | | | | | | |
| i. Degraded | 11674 | 4466 | 2809 | 4106 | 896 | 731 | 24682 |
| ii. Nondegraded | 892 | 1293 | 68 | 519 | - | - | 2772 |
| Iii. Alpine | - | - | - | 269 | 705 | 79 | 1053 |
| Sub-total: | 12566 | 5759 | 2877 | 4894 | 1601 | 810 | 28507 |
| **B. Other Land Categories With Some Grazing Potential** | | | | | | | |
| i. Desertic | 2802 | 1324 | 3759 | - | - | - | 7885 |
| ii. Rock/gravel | 17516 | 377 | 523 | 138 | - | - | 18514 |
| iii. Tidal flats | 54 | - | 413 | - | - | - | 467 |
| iv. Swamps | - | 27 | 96 | - | - | - | 123 |
| Sub-total: | 20372 | 1688 | 4791 | 138 | - | - | 26989 |

Source: 1992 Forestry Sector Master Plan

## Range land tenure

About 6 million ha or 10% of total land categories (Table 1) are owned/controlled by the Provincial Forest Departments. The rest are privately owned, mostly collectively owned (common lands) and partly individually owned. The common lands known as "Shamilats" are accessible to every one in the community whether he is land owner or right holder. Due to this accessibility the range lands are over used and in some cases abused, however it is questionable. The common range lands are denuded and degraded as these are open to grazing year round where climatic conditions allow. These lands are suffering from the impoverishment of palatable grasses and browse species and from trampling which causes accelerated erosion and desertification. This is particularly true for arid range lands.

## The present state of rangelands

The pastoralists are the major land users producing mostly goats, sheep and cattle at subsistence level. Despite the vital role the range lands play in rural economy no or negligible scientific inputs by the state departments have been made. Accordingly, these areas are stocked as high as twice the number of livestock, in addition to wildlife, that these can support. It is estimated that the rangelands provide about 60 percent of total requirement of feed of sheep and goats, 40 percent of equines, and camels and 5 percent of cattle and buffaloes. Other land uses are marginal cultivation with or without irrigation, mining, conservation, wildlife etc.

The arid range resource degradation is one of the major issues in the country. Unless the present deterioration is reversed these are prone to further degradation resulting in complete denudation. It is of paramount importance that appropriate management techniques, economically feasible, socially acceptable and technically sound, are developed. These may help improve forage production and consequent upon the socio-economic conditions of poor livestock holders. Further, the biodiversity conservation could also be improved.

## Range land management constraints

The vast range lands of the country have diversified biophysical factors and hence pose different management constraints. These could be grouped together as environmental, technical, managerial, social, economic and financial due to which the important renewable range resources are deteriorating at faster pace. Supper-imposed on these is the low priority and neglect by the policy makers and the managers.

appropriate or on decline due to absence of any studies carried out in the past. However, reasonably large number of plants were growing in the study area. There is need for effective measures to conserve and improve the bio-diversity status of these arid rangelands.

## Biomass production

The study estimated that the aerial biomass of all plants was about 752 kg (AD)/ha. Out of this total 437 Kg (AD)/ha or 58 percent was produced by grasses. Among grasses about 200 kg (AD)/ha or 27 percent was contributed by *Cymbopogon jwarancusa,* alone, a less preferable grass species. It was followed by 8 percent contribution by *Saccharum spontaneous,* a coarse grass but has Fair (F) palatability ranking. The results indicated that the range vegetation of Lachi could be classified as 'grass land' type having *Cymbopogon - Saccharum* sub type. The patches of scrub forests and shrubby plants were also found in certain localities of the Tehsil.

Table 2. Species-wise palatability ranking, cover, frequency composition and Aerial biomass of arid range lands of Lachi tehsil (November, 2001)

| Name of species | Palatability* Ranking | Cover (%) | Frequency (%) | Species composition ( %) | Aerial biomass Kg/ha (DM) |
|---|---|---|---|---|---|
| **A- Grasses and grass likes** | | | | | |
| *Aristida depressa* | P | 0.14 | 8.4 | 0.4 | 2.8 |
| *Bothriochloa pertusa* | E | 0.37 | 4.0 | 1.0 | 2.1 |
| *Carex sp.* | F | 0.38 | 6.2 | 1.0 | 1.8 |
| *Cenchrus ciliaris* | E | 2.16 | 7.5 | 6.0 | 4.6 |
| *Chrysopogon montanus* | E | 3.10 | 48.1 | 8.6 | 35.4 |
| *Cymbopogon jwarancusa* | V.P | 13.17 | 59.2 | 36.7 | 199.7 |
| *Desmostachya bipinnata* | P | 0.02 | 0.2 | 0.1 | 0.6 |
| *Digtaria nodosa* | G | 0.14 | 4.8 | 0.4 | 3.3 |
| *Enneapogon persicus* | G | 0.51 | 15.5 | 1.4 | 6.1 |
| *Eragrostis minor* | G | 0.02 | 1.3 | 0.1 | 0.7 |
| *Eulaliopsis binata* | V.P. | 1.74 | 9.7 | 4.8 | 34.7 |
| *Eleusine compressa* | G | 1.02 | 14.1 | 2.8 | 8.4 |
| *Heteropogon contortus* | F | 1.24 | 19.2 | 3.5 | 21.8 |
| *Lasiuris scindicus* | G | 0.04 | 0.4 | 0.1 | 0.8 |
| *Pennisetum orientale* | G | 0.95 | 5.2 | 2.6 | 9.6 |
| *Saccharum munja* | P | 1.53 | 8.5 | 4.3 | 42.4 |
| *Saccharum spontaneum* | F | 0.64 | 2.9 | 1.8 | 60.8 |
| *Tetrapogon villosus* | F | 0.09 | 3.6 | 0.3 | 1.0 |
| Sub-total: | | 27.26 | - | - | 436.6 |

| | | | | | |
|---|---|---|---|---|---|
| **B-Forbs** | | | | | |
| *Carthamus oxyacantha* | P | 0.03 | 1.6 | 0.1 | 1.0 |
| *Echinops niveus* | P | 0.03 | 1.6 | 0.1 | 1.0 |
| Sub-total: | | 0.06 | - | - | 3.7 |
| **C- Shrubs** | | | | | |
| *Aerua persica* | P | 0.01 | 0.4 | 0.02 | 1.0 |
| *Carissa spinarum* | F | 0.27 | 5.6 | 0.8 | 2.7 |
| *Dodonaea viscose* | P | 3.05 | 20.5 | 8.5 | 49.7 |
| *Gymnosporia spinosa* | F | 0.53 | 6.3 | 1.8 | 8.4 |
| *Justicia adhatoda* | Nil | 0.66 | 4.0 | 1.1 | 33.1 |
| *Leptadenia pyroterhnica* | P | 0.16 | 1.7 | 0.7 | 8.6 |
| *Rhazya stricta* | Nil | 0.27 | 5.6 | 0.8 | 2.2 |
| *Sophora sp.* | P | 0.08 | 0.4 | 0.2 | 2.1 |
| *Withania coagulense* | Nil | 0.41 | 4.4 | 1.1 | 20.4 |
| *Ziziphus nummularia* | F | 0.22 | 3.4 | 0.6 | 6.6 |
| Sub-total: | | 5.66 | - | - | 168.3 |
| **D-Trees** | | | | | |
| *Acacia modesta* | G | 1.71 | 9.9 | 4.8 | 64.7 |
| *Capparis aphylla* | P | 0.19 | 3.6 | 0.5 | 9.3 |
| *Grewia sp.* | P | 0.01 | 0.4 | 0.2 | 0.3 |
| *Monotheca buxifolia* | F | 0.80 | 6.0 | 2.2 | 43.7 |
| *Olea ferruginea* | F | 0.11 | 0.8 | 0.4 | 6.9 |
| *Tecoma undulate* | P | 0.13 | 1.2 | 0.4 | 18.6 |
| Sub-total: | | 2.95 | - | - | 143.5 |
| Grand-total: | | 35.93 | - | - | 752.1 |

*** Palatability Ranking:**

**E** stands for excellent palatability
**G** stands for good palatability
**F** stands for Fair palatability
**P** stands for Poor palatability
**VP** stands for Very Poor palatability

## Palatable biomass production

The highly palatable species with Excellent (E) ranking were very few. Their cover percent, frequency and composition values were very low in the stands. Consequently the forage biomass was 304 kg (AD)/ha. It was about 42 percent of the total biomass production and was much low. In other words 58 percent biomass was unpalatable (Table 3). Out of this total, 61 kg/ha (AD) was contributed by *S. spontaneous*, a less preferable though palatable, coarse grass. The share of highly palatable and nutritious forage species was very low. This indicates that both forage quality and quantity available to livestock were poor resulting in poor livestock production.

## Range condition

The results indicated that rangeland condition was Poor (P) to Fair (F) in Lachi Tehsil. The present state of the rangeland of the study area warrants to initiate the activities to reduce stress to livestock. This may include, beside others, intensive seasonal grazing, provision of complementary and supplemental feed, supply of conserved forage and improvement of the forage reserves. Collectively these activities are known as improvement of range resources.

Table 3. Species wise forage biomass kg/ha(DM) of palatable Species of arid range land areas of Lachi

| Vegetation Class | Forage Biomass Kg/ ha (AD) | Percent of Total |
|---|---|---|
| **A- Grasses and grass likes** | | |
| *Bothriochloa pertusa* | 2.1 | 0.7 |
| *Carex sp.* | 1.8 | 0.6 |
| *Cenchrus ciliaris* | 4.6 | 1.5 |
| *Chrysopogon montanus* | 35.4 | 11.7 |
| *Digitaria modosa* | 3.3 | 1.1 |
| *Enneapogon persicus* | 6.1 | 2.0 |
| *Eleusine comprosa* | 8.4 | 2.8 |
| *Eragrastis minor* | 0.7 | 0.3 |
| *Hebropogon contortus* | 21.8 | 7.2 |
| *Lasiuris scindicus* | 0.8 | 0.3 |
| *Pennisetum orientale* | 9.6 | 3.2 |
| *Saccharum spontaneum* | 60.8 | 20.1 |
| *Tetrapogon villusus* | 1.0 | 0.3 |
| Sub-total: | 156.4 | 51.4 |
| **B-Shrubs** | | |
| *Carissa spinarum* | 17.0 | 5.6 |
| *Gymnosporia spinosa* | 8.4 | 2.8 |
| *Ziziphus nummularia* | 6.6 | 2.2 |
| Sub-total: | 32.0 | 10.5 |
| **D-Trees** | | |
| *Acacia modesta* | 64.7 | 21.4 |
| *Grewia sp.* | 0.3 | 0.1 |
| *Monotheca buxifolia* | 43.7 | 14.5 |
| *Olea ferruginea* | 6.9 | 2.3 |
| Sub-total: | 115.6 | 38.0 |
| Grand total: | 304.0 | - |

## Range trend

The presence of large number of 'increaser, plant species - which are less palatable or less preferable to livestock - and unpalatable weeds indicated that the retrogression in the range land has taken place. Both the vegetation and soil are degrading. Though the soil characteristics were not evaluated yet the values of protective soil cover were indicative of negative soil changes. The bare ground (48.6 percent) and rock pavement (33.9 percent) indicated the poor capability of soil to support range vegetation. Similarly, plant base value (10.0 percent) was very low. Presence of litter 7.6 percent was negligible. The litter cover has its important role to play. Litter cover keeps the soil temperatures lower, reduces soil moisture loss and increase forage production during droughts. All these factors indicated that range trend was downward. This trend had to be reversed by improving vegetal cover with planting and grasses sowing of palatable grasses and shrub/tree species. The leguminous forb species had to be introduced to improve forage quality as well as amelioration of soil by addition of natural. Nitrogen (N).

Table 4. Protective soil cover percent of range area of Lachi

| Soil cover | Percent Values |
|---|---|
| Plant Base | 10.0 |
| Litter | 7.6 |
| Cryptogams | 0.1 |
| Rock Pavement | 33.9 |
| Bare Soil | 48.4 |

## Application of specialized grazing system

Sedentary grazing pattern is being practised by the pastoral farmers in Lachi area. Daily grazing takes place in same range/area for 6-8 hours. The herding is done by the available members of the households. In addition paid herders and or group herding is also adapted.

The prevailing conventional and round the year continuos grazing pattern in Lachi proved detrimental to forage quality and quantity. The palatable and preferred weeds/plant species are on decrease and less palatable coarse grasses and weeds (unpalatable woody plants) are on increase. The selectivity and high grazing pressure by the grazing livestock seemed to be the major causes of the range retrogression. Probably improper grazing season also contributed to the degradation.

Climate, topography, vegetation, kinds of livestock to be grazed, wildlife needs, watershed protection, labour requirement (for fencing and water development) are important considerations involved in the selection of specialised grazing system (Holecheck *et al.*, 1989). These considerations are equally applicable to Lachi where as the arid range lands have poor quality of vegetation and are grazed by mixed herds of cattle, sheep, goats, camels and donkeys. The terrain is rugged, water distribution is poor and scanty with erratic rainfall. The watershed protection is highly desired. The palatable vegetation has low grazing resistance and there is need of carefully timed grazing to fully utilize the coarse grasses and avoid damage to sensitive plants. This demands the application of a specialised grazing system.

The less preferred and or less palatable grass species like *C. jwarancusa* (37% composition) is dominant species. Its biomass contribution was 200 kg/ha (AD) or 27%. This species poses problem for proper range management. Similarly the *S. spontaneum*, a coarse grass, though is fair in palatability yet is not a preferred one. *S. munja* is also a coarse reed grass and has poor palatability. These grasses and a few more grass species had to be reduced in cover to give place to the highly palatable grasses. The presence of these grasses suggests the vegetation improvement as well as the improvement of other forage resources. The specialised grazing system and forage resource improvement had to be made side by side as under:

- **Intensive Repeated Seasonal Grazing Plan**: The palatability and utilization of coarse grasses particularly *C. jwarancusa* had to be improved by controlled burning during winter season. It would require proper planning and post-burn management. The post-burn treatment would be sowing with legumes and local highly palatable grasses. It is assumed that in spring the *C. jwarancusa* would sprout quickly and had to be grazed with intensive utilization, may be by doubling the number of Animal Units than actual carrying capacity at this stage of growth. In late autumn (prior to burning) it would also be grazed intensively. In summer, light grazing be done or deferment be applied to provide chance to palatable species for seed set and its dissemination.

- **Improvement in Complementary Forage**: Crop residues, hay and green forage production must be increased. The crop residues and hay be treated with Urea and properly stored. Green forage be conserved as silage. These feeds be supplied to livestock during stress period of winter and, hot and dry period in summer and when the low grazing or deferment is practised. This would reduce grazing pressure on already fragile rangelands.

- **Improvement of Forage Reserves**: The fodder bushes and trees are important forage reserve. The intensive planting of fodder plant species on farm boundaries, around village settlements and on rangeland is recommended. During the late autumn and winter seasons or even during dry hot period in summer fodder leaves be fed to livestock (cattle and buffaloes) by cut and carry method. Goats and sheep may browse or be fed by cut and carry practice.

- **Supplemental Feed**: During stress or when animals are in lactation or sick or fattening is required for sale in market, the supplements of concentrates (molasses, grains, oil cakes) be fed to livestock for better production.

- **Soil and Water Conservation Measures**: Erosion control measures, water conservation and water harvesting techniques had to be practised vigorously for improving soil, vegetation and other forage resources.

- **Proper Range Land Utilization**: The stocking rate must ensure that about 50 percent of total herbaceous biomass is left over on ground. This will act as mulch as well as carryover for early recovery and better plant growth and hence sustainable production.

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