Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Applied Sciences 7 (16): 2321-2326, 2007
ISSN 1812-5654
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Determining Range Vegetation Cover and Composition of Pabbi Hills Kharian Range, District Gujrat

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Abstract: Rangeland analysis of Pabbi Hills Kharian Range in compartment No. 66 Pabbi Rasul Reserved Forest Rangeland Sub-Division Kharian was conducted to determine range vegetation and composition cover during 12-23 May, 2005. Herbage species contributed more towards forage production than the browse ones. Gangir (*Grewia populifolia*) and Phulai (*Acacia modesta*) was the major contributor in browse species. The total rang vegetation cover is 32%. In forage production, the maximum contribution was by the perennial grasses that were also true in cover composition parameters. Among all the life forms chamber (*Eleusine indica*) contribution was maximum followed by Mesquite trace.

Key words: Gangir, Phulai, Chamber, Herbage and browse vegetation cover and composition, Herbage and browse contribution

INTRODUCTION

Pakistan has a wealth of 135 million heads of livestock, which account for 110% of the GDP (MINFAL, 2003-2004). Nutritional requirements of these animals are mainly met through fodder crops, agro-industrial wastes.

The sustainable use of rangelands is vital for the development of national economy. Overgrazing of rangelands, depletion of Vegetation cover, shortage of forage and fodder resources and poor livelihood of pastoral communities as influenced by the fragile environment are some of the major issues and problems for the food security in the country.

The Pothowar plateau is a tract of 1.82 million ha that lies 32° 33′ to 34° 03′ N 71° 39′ to 73° 37 E. Being situated to the mouth of the Salt Range, it is bordered by the Jhelum and Indus rivers. Ecologically, it is located in the sub-tropical, semi-arid to sub-humid zone. It contains dry, sub-topical broad leaved thorn forests. Due to undulating topography, the livestock grazing is common in the area. Large herds of cattle and goats graze throughout the area. The area is not only grazed by the local livestock but also foraged by the nomads' livestock during winter when the nomads return from alpine pastures. As the livestock is the main component of rural economy, people tend to increase livestock number which leads to overgrazing of the rangelands. Due to overgrazing, the carrying capacity of rangelands is low and most of the area is infested with unpalatable plants such as *Heteropogon contortus*, *cymbopogon jwarancusa*, *Desmostachya* sp., *Prosopis juliflora* and *Capparis decdiua*. Removal of vegetation cover and unscientific use of resource have accelerated soil erosion, low soil fertility, loss of biodiversity and minimal carry over of range areas. Moreover, livestock producers have also not been involved in range improvement and grazing management programmes, therefore, proper range management has not been demonstrated yet to them to educate that their livestock can perform better with proper grazing management and range improvement.

One of the major constrains in the management of rangelands is lack of authentic scientific inventory of range resources. In the absence of such data, the management and improvement plan cannot be developed and implemented affectively.

Species composition and vegetation cover are good indicators of a range conditions. This is ample scope for increasing forage production through managing areas scientifically. The assessment of present potential of a range resource is very important in order to plan its development. Therefore, a study entitled, determining range vegetation cover and composition of Pabbi Hills Kharian Range, District Gujrat was planned in an area.

An area representative of Pothowar Plateau was acquired from the Pabbi-Rasul Reserved Forest, Kharian, District, Gujrat with the objective of systematic acquisition and analysis of resource information needed for planning and for scientific rangeland management of the area. Out of 15,732 ha, only 400 ha in compartment No. 66 have been acquired for study purposes.

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Description of the study area: The plateau is approximately 46 to 107 m above the surrounding landscape. The elevation of the highly dissected plateau varies from 252 to 414 m above mean sea level. Terrain is rugged and undulating which is interspersed by deep and wide ravines. The hillocks are detached from each other by terraces and gullies formed by severe erosional dissection of the anticline. They consist of a series of serrated ridges.

Geology and soil: The Pabbi hills are a part of Himalayan foot-hills. The rocks consist of semi-consolidated, weakly cemented calcareous, coarse, friable sandstone, underlain by layers of clay, shale and sandstone. At many places the bed-rocks stands exposed. Soil is mostly gravelly in nature, especially on slopes. Gully formation and erosion hazard are serious. Overall condition of the soil is poor, bare soil and rock range between 50 to 60%. Eighty percent of the area is badly disserted due to erosion profile development has not taken place except for a weak zone of lime which accumulated at varying depths. Out crops: of red marble are also common. Top soil has been washed away be severe erosion. Shallow gravelly soil occurs in packets, where as soil is comparatively deep at lower elevations. It is sandy in stream beds and slightly loamy soils elsewhere. Chemical analysis of 10 soil samples collected at the depth of 15 cm showed pH ranges 7 to 8.07 with average value of 7.7. Soil organic matter is very low (0.53%), indicating soil is very poor in fertility. The nitrogen status is also very low (0.04%) whereas the phosphorus and potash status lies between medium fertile soil. The soil analysis report of the samples collected during the survey is as Table 1.

Climate: Climatically the area falls in the sub-tropical continental and sub-humid regions of northern Punjab.

Table 1: Analysis report of soil samples

S. No.	ECe (dS m^{-1})	pH	N (%)	P (ppm)	K (ppm)	OM (%)
R_1	1.40	7.80	0.04	4.42	70.12	0.52
R_2	1.00	7.70	0.03	4.30	70.16	0.60
R_3	0.80	7.90	0.04	4.49	72.01	0.58
Av.	1.06	7.80	0.04	4.40	70.76	0.57
R_1	1.30	6.90	0.03	5.20	65.20	0.68
R_2	1.60	7.70	0.05	4.95	66.15	0.72
R_3	1.50	8.60	0.04	4.80	68.05	0.65
Av.	1.46	7.70	0.04	4.98	66.47	0.68
R_1	0.90	8.20	0.04	5.50	74.50	0.52
R_2	1.60	8.40	0.02	6.30	76.00	0.44
R_3	0.70	7.60	0.02	6.20	72.45	0.64
Av.	1.07	8.07	0.03	6.00	74.32	0.53
R_1	1.20	8.10	0.01	6.50	69.31	0.44
R_2	1.20	8.10	0.04	5.60	69.29	0.49
R_3	1.00	7.30	0.03	6.40	68.50	0.52
Av.	1.13	7.83	0.03	5.83	69.03	0.48
R_1	0.90	8.30	0.02	5.90	70.16	0.63
R_2	0.70	7.20	0.05	6.20	68.40	0.42
R_3	1.60	7.40	0.03	5.60	68.25	0.51
Av.	1.07	7.63	0.03	5.90	68.94	0.52
R_1	1.40	7.60	0.02	4.50	69.30	0.54
R_2	1.00	7.60	0.02	6.30	70.50	0.48
R_3	1.60	7.00	0.03	6.90	66.30	0.44
Av.	1.30	7.40	0.03	5.90	68.70	0.49
R_1	0.80	7.70	0.04	5.40	69.60	0.51
R_2	1.40	7.70	0.04	5.20	69.10	0.55
R_3	1.20	7.80	0.03	5.20	69.50	0.49
Av.	1.10	7.70	0.04	5.30	69.40	0.52
R_1	1.30	7.50	0.05	6.00	63.30	0.43
R_2	1.70	7.40	0.02	5.80	70.20	0.49
R_3	0.90	7.60	0.02	4.30	70.20	0.41
Av.	1.30	7.50	0.03	5.40	67.90	0.44
R_1	1.00	7.80	0.03	4.80	69.70	0.47
R_2	1.40	7.70	0.03	5.10	76.20	0.52
R_3	1.40	7.30	0.05	5.50	77.10	0.51
Av.	1.30	7.60	0.04	5.10	74.30	0.50
R_1	1.50	7.60	0.05	5.60	70.40	0.60
R_2	1.00	7.60	0.03	5.00	72.90	0.59
R_3	1.30	7.50	0.04	6.10	70.30	0.52
Av.	1.30	7.60	0.04	5.60	71.20	0.57
Average of 10 samples	1.21	7.70	0.04	5.44	70.10	0.53

Table 2: Mean monthly temperature (°C) for the last two years 2003 and 2004, Kharian, district Gujrat

	Year 2003		Year 2004	
Months	Min	Max	Min	Max.
January	5.0	15.6	6.0	13.5
February	8.0	20.0	8.5	20.3
March	15.5	26.6	16.4	28.6
April	24.4	34.4	25.9	39.0
May	28.9	38.5	31.0	40.7
June	31.7	40.8	33.5	43.5
July	28.4	38.2	29.3	40.7
August	25.0	35.0	25.7	34.7
September	21.6	32.0	21.3	31.4
October	19.2	29.2	19.2	29.2
November	15.0	25.2	14.1	25.5
December	9.0	13.6	8.5	19.1

Metrological report (2003-04), District agricultural extension office, Gujrat

Table 3: Mean monthly rainfall (mm) for the last two years 2003 and 2004, Kharian, district Gujrat

Months	Year 2003	Year 2004
January	5.00	71.00
February	51.00	29.00
March	16.00	0.00
April	3.00	105.00
May	0,0028.90	0.00
June	35.00	45.00
July	28,477.00	200.00
August	25,0144.00	201.00
September	21,664.00	0.00
October	19,20.00	35.00
November	15,035.00	0.00
December	9,033.00	10.00
Total	463.00	496.00

District agricultural extension office, Gujrat

Table 4: Mean monthly relative humidity (%) for the last two years 2003 and 2004, Kharian, district, Gujrat

	Year 2003		Year 2004	
Months	8:00 am	5:00 pm	8:00 am	5:00 pm
January	66.0	43.5	70.4	41.1
February	69.0	38.8	51.0	26.2
March	61.6	34.7	42.0	24.4
April	66.8	38.1	39.8	29.5
May	65.1	38.3	37.2	25.9
June	45.1	27.8	31.2	19.0
July	55.3	32.8	37.0	24.7
August	60.4	31.7	76.9	48.8
September	57.3	27.8	60.1	50.0
October	6.1	41.1	68.8	52.0
November	67.8	53.3	69.7	48.4
December	67.6	54.7	78.8	47.6

District agricultural extension office, Gujrat

Therefore, the climate is of extreme type, characterized by high summer temperature, cold nights in winter, torrential and eratic rainfalls mainly during the monsoon season.

Summer from April to June is normally very hot and dry. The data on mean monthly temperature, rainfall and humidity percentage for the last two years (2003-2004) indicates that June is the hottest month of the year whereas temperature may go down up to 5°C in January (Table 2). Maximum rainfall is received during July and August from monsoon winds. The winter rains mostly occur in December and January. The last two years rainfall data given in Table 3 indicates high variability, i.e., 460 mm received in 2003 whereas 696 mm annual rainfall was received in 2004. During summer i.e. April to June humidity percentage falls below 40% in the afternoon. It is highest during the months of August, December and January as shown in Table 4.

Frost: Frost occurs during December, January and sometimes it may occur in February.

Wind: Windstorms are not common. Average wind velocity varies from 0.29 to 2.9 knots per hour. This information was supplied by District Agricultural Extension Office, Gujrat.

Rangeland inventory: The plant parameters namely, range vegetation over and composition were determined in this study. These plants parameter are of colossal importance as these provide base line data for manipulation of a rangeland ecosystem on scientific lines. Measurements on plant cover and composition help to know contribution of different life forms like trees, shrubs, grasses and forbs to the range area. Collection of these information helps to know vegetation details for managing the rangelands properly. Furthermore, it is not uncommon to project cover for watershed values. Plant parameters of frequency and density were not measured in this study. Frequency has been used to determine rangeland condition. Since range condition can be well assessed by plant composition measurements, so frequency was dropped to avoid duplication of work. Density is used to determine if the number of individuals of a species is increasing or decreasing. This information helps measure trend in the range vegetation. After establishment of enclosures in the study area, the measurements on density will help know improvement in range trend compared to the area open to grazing, clipping and cutting of trees. So, in the later stage, density parameter will also be measured.

MATERIALS AND METHODS

Measuring vegetation cover and composition: The study was conducted at Pabbi Hills Kharian range District Gujrat during 12-23 May, 2005. For measuring vegetation cover (total cover of vegetation without litter, rocks and gravel), 15 m long transect was stretched randomly with measuring tape. Grasses, grass-like plants and rosette-

forming plants were measured at ground level. Forbs, herbs, shrubs and trees were measured by the vertical projection of their foliar cover intercepting on one side of the tape. If there were gaps in the canopy of herbaceous plants, then before measuring cover, each plant was compressed by hand until the ground surface is not visible through the foliage. In case of shrubs and trees, it was not possible to compress plant parts, therefore, a plant was considered as an entire clump if individual gaps were less than 2 cm^2 (Bonham, 1989). The area of dead plant parts or centre was subtracted from the area of the entire clump. The care was taken not to inadvertently move the tape to include or exclude certain plants. Plant measurements were read to the nearest quarter centimeter (Brown, 1954). Since species composition was to be determined in this study, the canopy of each species was measured regardless of any overlap with other species (Anonymous, 1996). Similarly, if two different species intermingled the cover of each species was measured regardless of intermingling with each other. Interception of the flora irrespective of grazable or ungrazable plants was recorded for measuring cover.

The intercepts by an individual species on a transect were summed up for cover measurements. The following formulae were used for cover and composition determination. The following formulae were used for computing individual species contribution towards vegetation cover and composition of the area:

$$\text{Percent cover} = \frac{\text{Sum of intercepts by a species on all the transects}}{\text{Total length of all the transects}} \times 100 \quad (1)$$

$$\text{Percent composition} = \frac{\text{Sum of intercepts by a species on all the transects}}{\text{Sum of intercepts by different species on all the transects}} \times 100 \quad (2)$$

In estimating sample size for cover estimate, the sum of interceptions of different species on a transect was taken as a sampling unit. The formula (1) as mentioned earlier was applied for sample size calculation for the cover measurement.

RESULTS AND DISCUSSION

During vegetation sampling, it was observed that gasses were heavily grazed suggesting heavy grazing pressure on the rangeland area. Keeping in view, the temperature and growth pattern of the area, the best time for vegetation sampling seemed to be just after spring during the first week of April whereas sampling was done during the mid of May 2005 which reduced the contribution of forbs towards forage production. For getting maximum forage from the standing crop, it is better to sample vegetation during the peak of growing season which is expected just after the spring when temperature and moisture conditions are favourable after the winter rains are over. Furthermore, forage production was measured while range was under utilization. It is better to establish exclosures, for having the real position forage production of the area.

Table 5 shows that herbage species contributed more towards forage production than the browse ones. The plant life forms of perennial grasses, annual grasses and forbs were included in calculating the herbage production whereas in calculating the browse, life forms of trees, shrubs, half shrubs and climbers were taken into consideration. The main contributors among the grasses were Chhamber (*Eleusine indica* syn. *flagellifera*), Pharion (*Digitaria luicornis*), Setia (*Cenchrus bifloris*) and Khabal (*Cynodon dactylon*). Dhaman (*Cenchrus ciliaris*), an important palatable grass of the area, had very low contribution in forage production indicationg high grazing pressure in the area. Except Lumb grass (*Aristida depressa*), all the other grasses were perennial. Chhimber, Dhaman and Khabal are palatable grasses. Muski Ka (*Cymbopogon jwarancusa*), Tila (*Chrysopogon aucheri*), Dab (*Desmostachya bipinnata*) and Sariala (*Heteropogon contortus*) are eaten only by the animals during winter when there is preferred forage. All these grasses are C_4 type, therefore potential exists for introduction of C_3 perennial grasses to improve green forage production during the winter times.

In browse forage type, the major contribution was by Gangir (*Grewia populifolia*) and Phulai (*Acacia modesta*). *Prosporis juliflora* was also common among trees, but it was not sampled due to non-palatable one. Potential exists for introduction of evergreen fast growing fodder trees area to improve browse potential of the area. Among fodder trees Lahura (*Tecoma undulate*), *Zizyphus numularid*, *Z. spinachriste* and *Sohanja* (*Moringa oleifera*) may be tried as an instruction to improve browsing potential of the study area.

Table 5: Herbage and browse DM production

Forage type	DM production (kg ha^{-1})	Percent contribution
Herbage	(1893/80)10 = 236.62	(1893/2778)100 = 68.14
Browse	(885/80)10 = 110.63	(885/2778)100 = 31.86
Total	347.25	100.00

The sample size calculations for forage production are as follows:

$$\text{Sample Size} \quad n = \frac{t^2 S^2}{(kx)^2}$$

$$t_{(0.1,\ 80)} = 1.658$$

$$n = \frac{(1.652)^2 \times (23.09)^2}{(0.1 \times 34.73)^2}$$

$$= 121.51$$

Say 122 samples were needed to become within 10% of population mean at 90% probability level. If $t_{(0.2,\ 80)}$ = 1.289 at 80% probability distribution level, then

$$n = \frac{(1.289)^2\ (23.09)^2}{(0.2 \times 34.73)^2}$$

Therefore, 73 samples were needed to become within 20% of population mean.

Vegetation Cover and Composition: The total cover is about 32%. Perennial grasses contributed mainly towards cover and composition (Table 6). Due to late vegetation sampling in mid of May 2005, forbs contribution was minimum. As noted in forage production, the maximum contribution was by the perennial grasses that was also true in cover and composition parameters. Among all the life-forms Chhamber (*Eleusine indica*) contribution was maximum followed by Mesquite tree (please see appendix II). More tree and shrub species were recorded in cover sampling than in forage production. This was due to inclusion of both palatable and unpalatable plants while measuring the cover. Fifteen meter long transect line was used in this study. Brown (1954) suggested that the transect length should be practicable one and can be marked out, measured and recorded by two reasonably efficient men in 15 min period. However, any desired transect length can be used. Canfield (1941) recommended a 50 feet transect for the areas with a cover of 5 to 10% and a 100 feet line where the cover is from 0.5 to 3% only.

The contribution in cover and composition of the herbage forage type is on higher side than the browse one (Table 7). The same trend was also recorded in forage production measurements. Among the overwood, Mesquite was found in patches while Phulai was seen evenly spread over the entire area of the compartment. Maximum cover and composition were recorded in ravines/nullahs due to availability of more moisture and deposition of fertile soil from the surface run-off composed to out side area. The soil of the ravines was mostly sandy. Mesquite was introduced about couple of years back by the Forest Department, Kharian. Because of good germination and unpalatability, it has now infested the area. A few trees of Ipil-Ipil were also seen during vegetation sampling, suggesting this exotic fast growing tree that was also introduced in the area but could not survive well probably due to high demand of water.

Table 6: Percent vegetation cover and composition by different plant forms

Plant form	Percent cover	Percent composition
Trees	(9484/120000)100 = 7.90	(9484/38326)100 = 24.75
Shrubs	(5996/120000)100 = 5.00	(5996/38326)100 = 15.64
Perennial grasses	(21809/120000)100 = 18.17	(21809/38326)100 = 56.90
Annual grasses	(179/120000)100 = 0.15	(179/38326)100 = 0.47
Half shrubs	(330/120000)100 = 0.28	(330/38326)100 = 0.86
Climbers	(424/120000)100 = 0.35	(424/38326)100 = 1.11
Forbs	(104/120000)100 = 0.09	(104/38326)100 = 0.27
Total	31.94	100.00

Table 7: Herbage and browse contribution in vegetation cover

Forage type	Percent cover	Percent contribution
Herbage	(22092/120,000)100 = 18.41	(22092/38326)100 = 57.64
Browse	(16234/120,000)100 = 13.53	(16234/38326)100 = 42.36
Total	31.94	100.00

Determining sample size for cover estimate:

$$x = 479.08$$

$$s = 231.73$$

$$n = 80$$

$$t_{(0.1,\ 80)} = 1.658$$

$$n = \frac{t^2 s^2}{(nx)^2}$$

$$= \frac{1.658^2 \times 231.73^2}{(0.1 \times 479.08)^2}$$

$$= 64.31$$

Sixty-four samples were needed to become within 10% of population mean. Since we had taken 80 samples, so we covered more variability and are confidant to become within 10% of the population mean.

LIMITATIONS OF THE SURVEY

- The assessment of palatability of different plants was based on the experience of the local people and these information were not backed by the field observation of the sampler;
- The survey was conducted a little bit late. It was better to conduct such type of survey after the spring season when plant can attain maximum growth and are in bloom stage.

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