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The position of *Pinus roxburghii* in the forests of Kotli hills, Azad Jammu and Kashmir

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Thirteen plant communities were recorded from Kotli hills during Monsoon, 2010 to see the present position of *Pinus roxburghii*. The data show that in six communities *P. roxburghii* was purely dominating while in two communities *P. roxburghii* occurs in association with *Themeda anathera*, *Olea ferruginea* and the remaining five communities were dominated by *Adhatoda zeylanica*, *Acacia modesta*, *O. ferruginea*, *Malvastrum coromendelianum*, *Lespedeza juncea*, *Brachiaria eruciformis* and *T. anathera*. There were 97 plant species out of which 12 species were woody, 18 were shrubby and the remaining 67 were herbaceous. In the investigated area there was heavy deforestation and overgrazing.

Key words: *Pinus roxburghii*, *Olea ferruginea*, *Acacia* community.

INTRODUCTION

Pinus roxburghii is distributed in subtropical western Himalaya region and reported from Indian occupied Kashmir, Punjab, Himachal Pradesh, Uttarakhand, Sikkim, Nepal and Bhutan. In Pakistan this species is found in lower part of NWFP, Punjab and Azad Jammu and Kashmir. It has wide biological and economical values. *P. roxburghii* is used as antiseptic, diaphoretic, diuretic, rubefacient, tonic and vermifuge. It is also used as charcoal, pigment, herbicide, resin and wood (Ahmed et al., 2009).

Vegetation is frightening and unknown mass of green shrouded in technical terms and Latin names (Randall, 1978). Some work on the subtropical belt of Azad Jammu and Kashmir has been carried out by Malik and Hussain (1987, 1988, 1990), Malik and Zandial (1996), Dastagir et al. (1999) and Malik and Malik (2004). The present study describes the existing vegetation structure and species diversity. The result will help the environmentalists, ethnobotanists and ecologists to work in other localities of the same area.

The district Kotli lies in between longitude 73° 53 5.316" east and latitude 33° 32 9.925" north. It is surrounded on the southern side by Mirpur and Bimber, on western side by Mirpur and Rawalpindi, on northern side Sudhonooti

and Poonch, and on east by Rajori. The climate of Kotli hills is subtropical and humid type with average annual rainfall of 92.5 mm. The maximum rainfall occurs during July amounting to 277.2 mm, while least rainfall occurs during November amounting to 15.1 mm. The hottest months of the year are June and July, with mean daily maximum temperature of 37.3 and 34.3°C respectively, and minimum temperature of 19.7 and 17.9°C respectively. The average maximum and minimum relative humidity received by the area is 79.8 and 34.3% respectively.

MATERIALS AND METHODS

The area was divided in to thirteen stands on the basis of physiognomic characters. Quadrat method was used for vegetation sampling. Sampling was done in the month of Monsoon, 2010. The size of quadrat was 10 × 2 m for trees, 5 × 2 m for shrubs, 0.5 m for herbs following Malik (2005). Quadrats were laid systematically. In each community five quadrats were laid for trees, ten for shrubs, and twenty for herbs. Total quadrats in all the communities were 455. Each species was recorded in different strata due to its habitat. The trees were counted and the circumference of each tree was resolute at breast height and converted into basal area following Cox (1967), Malik and Hussain (1987) and Malik (2005).

Density, frequency and canopy cover thus measured were changed to the relative values. These three parameters were added together which gave importance value for each of the recorded species. The dominant species were used for naming the community (Curtis and McIntosh, 1950).

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The soil in each community was sampled up to depth of 15 cm which was mixed to make composite. Soil samples were analyzed for their physical and chemical characteristics following Richards (1954) and Jackson (1962). Vegetation was sampled during Monsoon, 2010. Stewart (1972) has been followed for nomenclature of the species in this study.

RESULTS

The results have been abridged in the form of importance value (Table 1). Following thirteen plant communities were established at Kotli hills during Monsoon, 2010.

***Olea-Malvastrum-Adhatoda* community**

This community was harboured in Dehri Grave-yard at an altitude of 590 m. *Olea ferruginea*, *Malvastrum coromendelianum* and *Adhatoda zeylanica* were dominant species with importance values of 45.89, 42.31 and 31.87 respectively. The co-dominant species were *Acacia modesta* and *Xanthium strumarium*, having importance values of 30.15 and 22.53 respectively, whereas *Brachiaria eruciformis* and *Physalis divaricata* were associated species. 16 species were recorded as rare in distribution.

This stand had loamy soil with basic pH, 1.9 $\mu\text{s}/\text{cm}$ electrical conductivity, 0.73% carbon, 1.26% O.M., 0.63% nitrogen, 44% saturation and 62 ppm potassium (Table 2).

***Acacia* community**

This community was established at an elevation of 620 m in Mohra Grave-yard. It is characterized by the dominance of *A. modesta* with importance value of 37.50. The co-dominant species was *O. ferruginea* with importance value of 14.90. The associated components of stand were *Celtis eriocarpa* and *Maytenus royleanus*. 14 species were recorded as rare.

This stand had loamy soil with basic pH and 1.9 $\mu\text{s}/\text{cm}$ electrical conductivity. Potassium was 116 ppm, saturation 40%, O.M less, carbon 0.77% and nitrogen was 29% (Table 2).

***Brachiaria-Themeda* community**

This community was recorded from Badana hills at an altitude of 650 m. The dominant species were *Brachiaria eruciformis* and *Themeda anathera* with importance values of 53.55 and 33.72 respectively. *Dicliptera roxburghiana* was co-dominant species. *O. ferruginea*, *A. modesta* and *Cyperus rotundus* were associated species. 18 species were rarely distributed.

The soil of the community was loamy having acidic pH.

Electrical conductivity was 2.7 $\mu\text{s}/\text{cm}$, saturation 42%, carbon 0.57%, O.M 0.98%, nitrogen 0.77% and potassium was 64 ppm (Table 2).

***Themeda-Pinus-Dodonaea* community**

This community was recorded at an elevation of 850 m from Kothian hills. It was characterised by the dominance of *Themeda anathera* and *P. roxburghii* and *Dodonaea viscosa* with importance values of 40.95, 37.28 and 34.67 respectively. *Colebrookea oppositifolia* and *Oxalis corniculata* were the codominant species. The associated species were *Cyperus rotundus*, *Dicliptera roxburghiana* and *Adiantum incisum*. 23 species were recorded as rare.

In this community soil was of clay loam type with basic pH. Electrical conductivity was 2.4 $\mu\text{s}/\text{cm}$, saturation 45%, carbon 0.89%, O.M 1.53% nitrogen 0.77% and potassium was 76 ppm (Table 2).

***Themeda-Pinus-Olea* community**

This community was established at height of 970 m from Kothian hills. *Themeda anathera*, *P. roxburghii* and *O. ferruginea* were dominant species with the importance values of 34.34, 33.11 and 21.11 respectively. *Cyperus rotundus* and *Adhatoda zeylanica* were the co-dominant species. *Bidens biternata*, *Dicliptera roxburghiana* and *Mallotus philippensis* were associated species. In this community soil was clay loam with basic pH. Electrical conductivity was 1.3 $\mu\text{s}/\text{cm}$, saturation 42%, carbon 1.005%, O.M high, nitrogen 0.87% and potassium was 98 ppm (Table 2).

***Pinus* community-I**

This community harboured at height of 1090 m from Paghwar Morah hills. The highest importance value recorded in this community was for *P. roxburghii* (72.95). It was followed by *Carissa opaca*, *Themeda anathera* and *D. viscosa* with the importance values of 26.55, 25.58 and 24.22 respectively. The associated components of this community were *Myrsine africana*, *Scutellaria linearis*, *Fragaria nubicola* and *Heteropogon contortus*.

In this community soil was loamy with acidic pH. Electrical conductivity was 1.3 $\mu\text{s}/\text{cm}$, saturation 36%, carbon 0.73%, O.M high, nitrogen 0.63% and potassium 64 ppm (Table 2).

***Pinus* community-II**

This community was recorded from Panagh Gali at an elevation of 1200 m. The dominant species was *P. roxburghii* with the importance value of 84.93. It was followed by *Themeda anathera* and *Traraxacum officinale*

Table 1. Importance value of different plant species recorded from Kotli hills during Monsoon, 2010.

Sr. No	Species	Importance value			No of stands in which species is present
		Maximum	Minimum	Average	
Tree layer					
1	<i>Acacia modesta</i> Wall.	60.95	1.73	27.77	4
2	<i>Celtis eriocarpa</i> Decnee	12.39	4.60	8.75	3
3	<i>Ficus palmata</i> Forssk	12.55	3.18	7.87	2
4	<i>Flacourtia indica</i> (Brum.f) Merriu	13.16	-	13.16	1
5	<i>Grewia villosa</i> Willd	14.30	10.35	12.33	2
6	<i>Mallotus philippensis</i> (Lamk) Muell	12.77	-	12.77	1
7	<i>Olea ferruginea</i> Royle	45.89	1.52	18.59	9
8	<i>Pinus roxburghii</i> Sargent	85.59	27.56	55.75	10
9	<i>Prunus persica</i> Buch	3.44	3.16	3.30	2
10	<i>Punica granatum</i> L.	26.82	2.48	9.96	8
11	<i>Quercus dilatata</i> Lind	35.22	-	35.22	1
12	<i>Ziziphus jujuba</i> Miller.	12	1.84	6.92	2
Shrub layer					
1	<i>Acacia nilotica</i> (L.) Delile	3.57	-	3.57	1
2	<i>Adhatoda zeylanica</i> Nees	31.87	13.74	18.65	4
3	<i>Asparagus gracilis</i> Royle	1.85	-	1.85	1
4	<i>Astragalus floridus</i> L.	9.22	3.88	6.70	3
5	<i>Berberis lycium</i> Royle	32.16	2.03	11.28	4
6	<i>Carissa opaca</i> Stapf ex Haines	26.55	1.51	12.55	4
7	<i>Colebrookea oppositifolia</i> Sm.	20.63	2.13	7.90	6
8	<i>Desmodium gangeticum</i> (L.) DC	8.58	-	8.58	1
9	<i>Dodonaea viscosa</i> (L.) Jacq	34.67	9.51	17.56	6
10	<i>Maytenus royleanus</i> (Wall ex Lawson) cef.	34.57	2.03	9.87	7
11	<i>Myrsine africana</i> L.	22.64	6.77	18	7
12	<i>Nerium indicum</i>	3.51	-	3.51	1
13	<i>Otostegia limbata</i> (Benth). Boiss	3.86	-	3.86	1
14	<i>Plectranthus rugosus</i> Wall ex Benth	16.49	11.95	14.22	2
15	<i>Rhus cotinus</i> L.	23.85	2.10	8.60	4
16	<i>Rubus fruticosus</i> Wallich.	46.97	1.47	20.89	3
17	<i>Woodfordia floribunda</i> Salisb	17.31	-	17.31	1
18	<i>Zanthoxylum armatum</i> DC	7.01	3.82	5.42	2
Herb layer					
1	<i>Androsace rotundifolia</i> Hardw	0.94	0.72	0.78	2
2	<i>Adiantum incisum</i> Forssk	13	3.88	8.22	5
3	<i>Agrostis canina</i> auct.	5.19	-	5.19	1
4	<i>Ajuga bracteosa</i> Wall.	5.43	2.34	4.31	5
5	<i>Amaranthus viridus</i> L.	0.81	-	0.81	1
6	<i>Aristida adscensionis</i> L.	16.64	2.78	9.10	4
7	<i>Artemisia scoparia</i> Wald. And kit	9.10	-	9.10	1
8	<i>Asplenium adiantum-nigrum</i>	3.13	-	3.13	1
9	<i>Biden biternata</i> (Lour.) Merr and sherf	4.96	1.46	3.05	7
10	<i>Boerhavia procumbens</i> Banks ex Roxb	11.67	2.31	5.51	3
11	<i>Brachiaria eruciformis</i> (J.E Smith) Griseb	53.55	5.47	15.83	3
12	<i>Brachiaria reptans</i> (L.) Gardner and Hubbard	6.97	-	6.97	1
13	<i>Chenopodium album</i> L.	7.47	4.42	6.42	3
14	<i>Commelina benghalensis</i> L.	9.15	3.61	5.59	4
15	<i>Cynodon dactylon</i> L.	16.27	3.84	8.67	8

Table 1. Contd

16	<i>Cyperus iria</i> L.	0.64	-	0.64	1
17	<i>Cyperus niveus</i> Retz	8.62	2.72	6.56	3
18	<i>Cyperus rotundus</i> Linn.	19.35	1.37	11.95	5
19	<i>Dichanthium annulatum</i> (Forssk). Stapf	3.57	0.35	1.96	2
20	<i>Dicliptera roxburghiana</i> Nees	23.44	1.66	14.56	9
21	<i>Digitaria setigera</i> Roth	5.92	-	5.92	1
22	<i>Eriscirpus comosum</i> Wall	4.94	2.68	3.92	5
23	<i>Euphorbia helioscopia</i> L.	13.68	3.10	8.47	3
24	<i>Euphorbia prostrata</i> Ait.	1.34	-	1.34	1
25	<i>Fragaria nubicola</i> Landle ex Lacaita	20.60	2.60	7.27	6
26	<i>Galium elegans</i> Wall.	13.56	6.04	11.70	6
27	<i>Geranium rotundifolium</i> L.	3.87	2.35	3.11	2
28	<i>Geranium wallichianum</i> D.Don	0.82	-	0.80	1
29	<i>Heteropogon contortus</i> (L.)	40.95	0.25	0.82	1
30	<i>Imperata cylindrica</i> (L.) Raeuschtn	3.91	-	3.91	1
31	<i>Indigofera heterantha</i> Wall.				
32	<i>Ipomoea pes-tigridis</i> L.	5.37	4.72	4.96	3
33	<i>Ipomoea purpurea</i> L.Roth	5.67	0.84	2.91	6
34	<i>Juncus serotinus</i> Clarke	7.99	5.42	7.01	3
35	<i>Lespedeza juncea</i> (L.F) Pers	46.20	1.55	12.69	5
36	<i>Leucas capitata</i> Desf.	1.64	-	1.64	1
37	<i>Malvastrum coromendelianum</i> (L.) Carcke	42.31	1.88	16.29	4
38	<i>Micromeria biflora</i> (Ham) Bth	18.48	2.75	9.05	11
39	<i>Oenothera rosea</i> L.	7.02	2.83	4.43	4
40	<i>Oplismenus undulatifolios</i> (Ard.) Roem and Schult	3.85	-	3.85	1
41	<i>Oxalis corniculata</i> L.	19.49	2.81	10.72	12
42	<i>Phyllanthus niruri</i> L.	5.68	4.01	4.94	3
43	<i>Physalis divaricata</i> D.Don	14.52	1.56	7.15	4
44	<i>Plantago lanceolata</i> L.	3.87	-	3.87	1
45	<i>Poa annua</i> L.	14.04	11.33	11.49	4
46	<i>Poa inferna</i> H.Bk	6.29	9.32	7.81	2
47	<i>Polytrichum</i>	5.87	-	5.87	1
48	<i>Prunella vulgaris</i> L.	20.63	2.13	7.90	6
49	<i>Rumex hastatus</i> D.Don	4.39	-	4.39	1
50	<i>Sauromatum guttatum</i> Schott	5.73	1.47	3.01	7
51	<i>Saxifraga hirculus</i> L.	10.70	-	10.70	1
52	<i>Scutellaria linearis</i> Benth	16.78	2.00	7.72	10
53	<i>Setaria palmifolia</i> (Koen) Stapf	9.32	1.00	6.16	5
54	<i>Slagenilla chrysorrhizors</i> Hook	9.49	-	9.49	1
55	<i>Solanum nigrum</i> L.	3.45	-	3.45	1
56	<i>Solanum xanthocarpum</i> Schard wendle	1.45	-	3.45	1
57	<i>Sonchus arvensis</i> L.	3.71	0.81	2.26	2
58	<i>Sonchus asper</i> Hill	18.48	3.72	3.97	3
59	<i>Sorghum halepense</i> (L.) Pers	12.49	6.11	9.53	2
60	<i>Stellaria media</i> (L.) Vill.	1.65	-	1.65	1
61	<i>Taraxacum officinale</i> Weber	18.38	1.64	6.41	7
62	<i>Themeda anathera</i> (Ness) Hack	34.34	4.57	22.47	12
63	<i>Trichodesma indicum</i> (L.) R.Br.	7.38	2.31	4.20	3
64	<i>Tylophora hirsuta</i> Wall.	2.96	2.11	2.54	2
65	<i>Viola odorata</i> L.	3.55	-	3.55	1
66	<i>Xanthium strumarium</i> L.	22.53	-	22.53	1
67	<i>Zinnia elegans</i> Jacq.	0.57	-	0.57	1

Table 2. Chemical analysis of soils from different communities of Kotli Hills during Monsoon 2006.

S.No	Name of community	Height (m)	E.C (µs/cm)	Saturation (%)	O.M (%)	N (%)	C (%)	K (ppm)	pH	Texture
1	O-M-A	590	1.90	44	1.26	0.63	0.73	62	7.60	Loam
2	A	620	2.10	40	0.58	0.29	0.34	116	7.75	Loam
3	B-T	650	2.70	42	0.98	0.49	0.57	64	6.50	Loam
4	T-P-D	850	2.40	45	1.53	0.77	0.89	76	7.33	Clay Loam
5	T-P-O	970	1.30	42	1.73	0.87	1.00	98	7.45	Loam
6	P	1090	1.30	36	1.26	0.63	0.73	64	6.88	Loam
7	P	1200	1.50	37	1.01	0.51	0.59	40	7.20	Loam
8	P	1300	1.40	38	1.10	0.55	0.64	48	6.86	Loam
9	P	1400	1.80	41	1.29	0.65	0.75	136	6.90	Loam
10	D	1500	4.0	58	2.44	1.22	1.42	160	7.15	Clay Loam
11	P	1620	1.20	46	1.57	0.79	0.91	86	7.60	Clay Loam
12	P	1735	0.70	42	1.07	0.54	0.62	142	6.86	Loam
13	R-Q-P	1860	1.10	48	1.96	0.98	1.14	148	6.42	Clay Loam

O-M-A = *Olea-Malvastrum-Adhatoda* community, P = *Pinus* community, A = *Acacia* community, D = *Dicliptera* community, B-T = *Brachiaria-Themedra* community, R-Q-P = *Rubus-Quercus-Pinus* community, T-P-O = *Themeda-Pinus-Olea* community, T-P-D = *Themeda-Pinus-Dodonaea* community, O.M = Organic matter, N = Nitrogen, C = Carbon, K = Potassium, E.C = Electrical conductivity.

having importance values of 32.50 and 18.38 respectively. The associated components of this stand were *Carissa opaca*, *Scutellaria linearis*, *Micromeria biflora* and *Eriophorum comosum*. The soil of this community was loamy with acidic pH, 1.5 µs/cm electrical conductivity, 37% saturation, 0.59% carbon, 1.01% O.M., 0.51% nitrogen and 40 ppm potassium (Table 2).

Pinus community-III

This community was recorded at an altitude of 1300 m from Nikyal Garbi. It was characterised by dominance of *P. roxburghii* (importance value of 57.36) which was followed by *Punica granatum* and *Myrsine africana* with importance values of 24.13 and 22.46 respectively. The associated component of this stand were *Fragaria nubicola*, *Oxalis corniculata* and *Galium elegans*. 26 species were recorded as rare. Soil of this community was had loamy texture with slight acidic pH. The electrical conductivity was 1.4 µs/cm, saturation 38%, carbon 0.64%, O.M high, nitrogen 0.55% and potassium was 48 ppm (Table 2).

Pinus community-IV

This community was harboured at an altitude of 1400m from Nakyal Garbi. *Pinus roxburghii* was recorded as a dominant component of the stand with the importance value of 48.49. The co-dominant species were *Themeda anathera* (32.57) and *Punica granatum* (26.82). Whereas associated component of the stand were *Myrsine africana*, *Dicliptera roxburghiana* and *Micromeria biflora*.

23 species were recorded as rare. Soil was loamy with slight acidic pH. The soil saturation was 41%, electrical conductivity 1.8 µs/cm, carbon 0.75%, O.M 1.29%, nitrogen 0.65% and potassium was 136ppm (Table 2).

Dicliptera community

This community was established in Pir Lasoor hills at an altitude of 1500 m. The dominant species in this stand was *Dicliptera roxburghiana* with the importance value of 52.88. The co-dominants were *Rhus cotinus* and *Oxalis corniculata*. While *Myrsine africana*, *D. viscosa*, *Galium elegans*, *Micromeria biflora*, *Themeda anathera* were the associated components of this community. 20 species were recorded as rare.

Soil of this community was of clay loam texture with basic pH. Soil saturation was 58%, electrical conductivity 4.0 µs/cm, carbon 1.42%, O.M very high, nitrogen 1.22% and potassium was 160 ppm (Table 2).

Pinus community-V

This community was harboured at an elevation of 1620 m from Pir-klinjer hill. In this community *P. roxburghii* was dominant with 81.74 importance value. Co-dominant species in this community were *Berberis lycium* and *Myrsine africana*. While *Scutellaria linearis*, *Themeda anathera*, *Brachiaria eruciformis* and *Poa annua* were associated species. 19 species were recorded as rare (Table 2). The soil of this community had clay loam texture with basic pH. The saturation of the soil was 46%, electrical conductivity 1.2 µs/cm, carbon 0.91%, O.M

high, nitrogen 0.79% and potassium was 86 ppm (Table 2).

***Pinus* community-VI**

This community was reported from Pir-Klinjer hill at an elevation of 1735 m with the dominance of *P. roxburghii* (importance value of 85.98). *O. ferruginea* and *Galium elegans* were the co-dominant species with the importance values of 18.83 and 17.59 respectively. The associated components of this community were *Heteropogon contortus*, *Themeda anathera*, *Oxalis corniculata* and *Micromeria biflora*. 23 species were recorded as rare.

In this community soil was loamy with acidic pH. The soil saturation was 42%, electrical conductivity 1.1 $\mu\text{s}/\text{cm}$, carbon 0.62%, O.M 1.07%, nitrogen 0.54% and potassium was 142 ppm (Table 2).

***Rubus-Quercus-Pinus* community**

Rubus-Quercus-Pinus community was recorded from Pir-klinjer hill at an altitude of 1860 m. The dominant species of *Rubus*, *Quercus* and *Pinus* had importance values of 46.97, 35.22 and 27.50 respectively. The co-dominant species were *Indigofera heterantha* and *Oxalis corniculata*. The associated components of this community were *Prunella vulgaris* and *Galium elegans* and *Brachiaria eruciformis*.

The soil of this community had clay loam texture with basic pH. The soil saturation was 48%, electrical conductivity 1.1 $\mu\text{s}/\text{cm}$, carbon 1.14%, O.M high, nitrogen 0.98% and potassium was 148 ppm (Table 2).

DISCUSSION

The present finding shows that the condition of the investigated area is of scrub vegetation which was due to soil erosion, deforestation and over grazing. Looking at the tree strata *P. roxburghii* occurred in 10 stands, while *O. ferruginea* and *Punica granatum* were dominant in eight stands, while shrub species such as *Maytenus royleanus*, *Myrsine africana*, *Rhus cotinus*, *D. viscosa* and *Colebrookea oppositifolia* were dominant in stands 6-7. *Cynodon dactylon*, *Biden biterata*, *Micromeria biflora*, *Oxalis corniculata* and *Dicliptera roxburghiana* were dominant herbaceous species occurring in stands 7-12.

P. roxburghii, *O. ferruginea*, *Punica granatum* and *A. modesta* were the tree components of subtropical zone. *Celtis eriocarpa*, *Ficus palmata*, *Flacourtia indica*, *Grewia villosa*, *Mallotus philippensis*, *Prunus persica*, *Ziziphus jujuba* and *Quercus dilatata* were present in stands 1-4. These species may become endangered in near future if the disturbance conditions continue. The vegetation

might shift to an open scrub which was dominated by *Adhatoda zeylanica*, *Zantoxylum armatum* and *Berberis lycium*.

P. roxburghii and *O. ferruginea* were the only tree species which were dominant in stands 9-10. The remaining woody species did not occupy important status as these species were present with low importance values. The vegetational differences occurred due to human factor and not due to edaphic factor. In most of the communities soil erosion has exposed the soil at most localities. Hussain (1981), Malik (1986, 2005) reported the similar finding in Kotli and Bagh Hills respectively.

The present study shows that original vegetation was probably of sub-tropical chir pine, *Olea-Acacia* or *Olea-Chir* pine type (Malik and Hussain, 1987; Hussain and Illahi, 1991). It changed to scrub due to deforestation and might further change to a grassland. Non palatable species such as *Mallotus*, *Maytenus*, *Colebrookea*, *Carissa*, *Berberis* and *Adhatoda* have increased in the area. The area needs complete protection of the vegetation resources for their natural regeneration and survival. A well managed range and forest ecosystem is not only the source of productivity but also provides habitat for wild animals including game animals, birds and those which have been identified as endangered in the area.

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