

PHYTOSOCIOLOGY OF THE VANISHING TROPICAL DRY DECIDUOUS FORESTS IN DISTRICT SWABI, PAKISTAN, I. A COMMUNITY ANALYSIS

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Abstract

The vegetation of 20 different graveyards in District Swabi was sampled quantitatively. Three main communities: *Dalbergia sissoo-Melia azedarach*, *Ziziphus mauritiana* with 2 subtypes, and *Acacia modesta* with 5 subtypes, were recognized on the basis of similarity indices, importance values and floristic composition of the stands. *A. modesta* community was widely distributed in the area. The first two communities represent secondary succession in the area. The vegetation of all the stands was stratified into tree, shrub and herb layers. The variation in the dominant species was due to edaphic and biotic disturbance. It is suggested that the existing vegetation might further change due to underground seepage of water from nearby Tarbela dam. A vegetation profile of all the communities is given.

Introduction

The Swabi district occupies the south and south-west part of Peshawar valley with an average elevation varying from 300 to 650 meters. The research area is situated roughly between latitude 34° C and 34° 35' N and longitude 72° 9' and 72° 40' E. Lithologically the area is composed of quartz to dolomite, schist and granite, sandstones, mudstones and conglomerates. Geologically it consists of sedimentary and metamorphic rocks of ordovician and devonian origin. Geomorphologic features include piedmont plains, rolling sand plain, loessal plain, infilled basin, cover flood plain and local fans (Said, 1978). The climate of the area shows wide diurnal and annual ranges in temperature due to its inland position and is therefore, classified as continental type. The total rainfall is small and erratic which shows variation due to contrasting relief differences in the area. The summer is hot, with mean monthly temperature remaining at 27°C from May to September. June and July are the hottest months with mean maximum temperature of 42°C and 40°C, respectively. There is slight drop in temperature in August (37°C) with oppressive heat due to high humidity. October is a transition from summer to winter. Winters are cold. The mean monthly winter temperatures are below 20°C. January is the coldest month (10°C). Ground frost is limited to 10 weeks from December upto mid February. There is a well marked change from winter to summer during March-April.

Since the area is a transition between summer monsoon and western disturbances, therefore, rain is received both during monsoon (350 mm) and winter (275 mm). August is the wettest month (177-75 mm), receiving more than 50% of the total rainfall. The annual rainfall increases from east (550 mm in Swabi) to west (775 mm in Tarbela) and from south (650 mm in Topi) to north (800 mm at Utlā) (Said, 1978).

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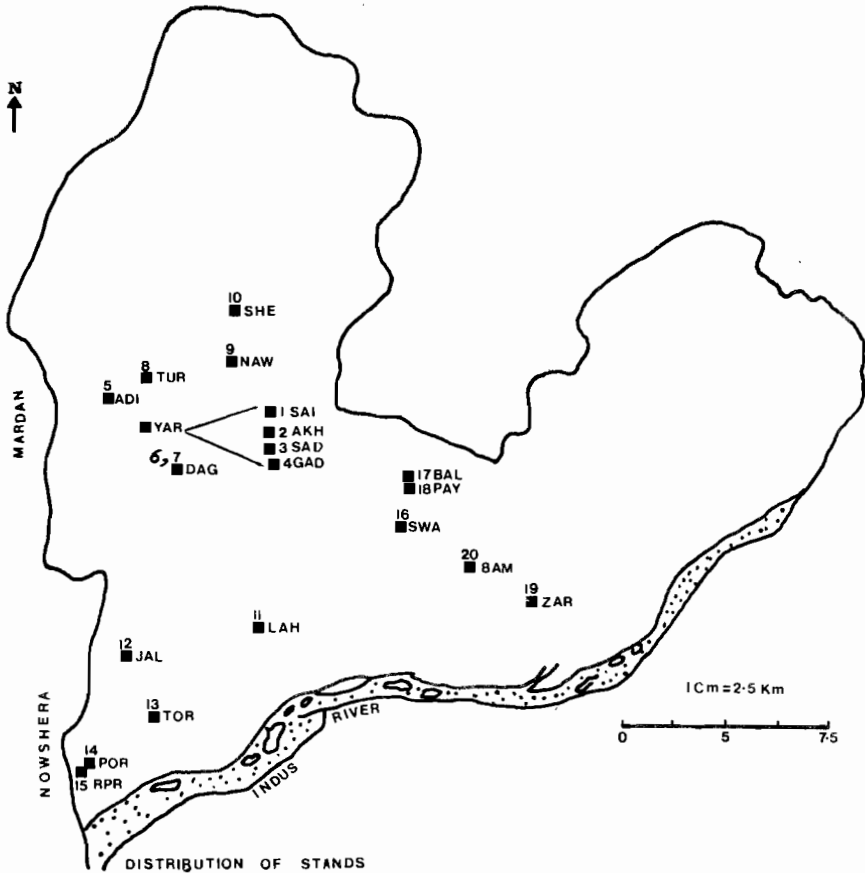


Fig.1. Distribution of stands in Swabi District. The serial numbers correspond to the stand Nos mentioned in the table. Elevation of the stands are shown within the parenthesis.

1) SAI = Said Khan, Yar Hussain (322 m), 2) AKH = Akhoon Baba, Yar Hussain (315 m), 3) SAD = Saisado, Yar Hussain (315 m), 4) GAD = Gado maidan, Yar Hussain (315 m), 5) ADI = Adina (318 m) near Chanderi, 6) and 7) DAG = Dagai (329 m), 8) TUR = Turlandi (364 m), 9) NAW = Nawakili (337 m), 10) SHE = Shewa (352 m), 11) LAH = Lahore (318 m), 12) JAL = Jalbai. (313 m), 13, TOR = Tordher (292 m), 14) POR = Poray Jehanghira (296), 15) RPR = Raporay Jehanghira (296 m), 16) SWA = Swabi (330 m), 17) BAL = Maneri Bala (345 m), 18) PAY = Maneri Payan (337 m), 19) BAM = Bam Khel (312 m) and 20) ZAR = Zarobi (321 m).

The soils of the area, developed on a variety of parent material, are yellowish brown to brown and gray-brown in colour with medium to fine texture. Profile development is generally weak. Soils have good drainage (Said, 1978).

Indus River borders the south-western side of the district. Pehura Canal originating north of Topi commands almost the entire Swabi plains. Large number of area is drained by torrents called Khwars. They include Badha Badri, Zindai, Muqam and Narangi Khwars. The water drains south to north and Tarbela dam lies at the southern most

corner of district. The water, therefore, seeps to low lying northern areas. This has raised the level of underground water that severely affects the vegetation and crops in the area. The plains and submontaneous tract of Swabi have tropical dry deciduous and subtropical forests which merge with subtropical chirpine and temperate forests at higher altitudes (Beg, 1978). Extreme biotic disturbances have almost precluded the original plant cover. However, the relics of the past vegetation yet can be seen in the graveyards. (Chaghtai & Yousaf, 1976; Chaghtai *et al.*, 1978, 1983, 1984; Chaghtai & Shah, 1978; Hussain & Shah, 1989). This paper, therefore, records the vegetation of grave-yards as an example of vanishing tropical dry deciduous forests of Swabi District.

Materials and Methods

Twenty graveyards, each considered as a stand, were sampled in the various parts of district Swabi during August, 1982 (Fig.1). Each stand was systematically sampled by using 10 quadrats for trees and 20 for the shrubby and herbaceous plants. The quadrat size used was 10x10 m, 4x4 m and 1x1 m for trees, shrubs and herbs, respectively, laid in nested manner. Density, frequency and basal area were recorded to calculate the importance values in each of the layer separately for every species following Muller-Dumbois & Ellenberg (1974). The species in each stand were ranked according to their importance values. The similarity between the stands was calculated after Bray & Curtis (1957). Various plant communities were recognized on the basis of similar dominants and index of similarity. Stands showing more than 55% similarity were merged together.

Results and Discussion

The summaries of quantitative sampling for trees, shrub and herb layers is presented in Table 1.

Vegetation Characteristics: Ten trees and 19 shrub species dominated the area (Table 1). The vegetation was distinctly stratified which is characteristic of climax and relatively undisturbed plant communities. Naqvi (1974), Beg (1978), Tajal-malook & Naqvi (1982) and Hussain & Tajal-malook (1984) observed similarly for other plant communities in the same area. Chaghtai & Yousaf (1976) and Chaghtai *et al.*, (1978, 1984) also reported the same for other graveyards. *Acacia modesta* was the most abundant and widely distributed tree species that exhibited high importance value presumably due to protection as there is hardly any *Acacia* cover in the non-protected sites in the same area. This native species had pure forests sometimes in the past. After degradation, *Dalbergia sissoo* and *Ziziphus mauritiana* might have emerged as the leading tree species in the area. *Dalbergia*, an introduced and naturalized tree, colonizes the habitat subsequent to removal of *A. modesta* and *Z. mauritiana*. The second dominant position was occupied by *Acacia nilotica*, *Prosopis glandulosa*, *Ficus palmata*, *Melia azedarach* and *Morus alba*. The first two species appear to be the component of native vegetation and the remaining have gained dominance owing to naturalization, domestication and spread by birds. *Ficus palmata* also seeks protection due to superstition related to it. In most of the stands second stratum was invariably dominated by the young plants of dominant tree species and shrubs like *Ziziphus nummularia*, *Asparagus gracilis*, *Opuntia delenii*, *Maytenus royleanus*, *Ehretia obtusifolia*, *Broussonettia papyrifera* and *Justicia adhatoda* (Table 1).

Table 1. Summary of Phytosociological data for Tree, Shrub and Herb layers.

S.No. Species	Points of Occurrence	Density/hectare		Importance Value		Dominant Position in stands				
		X	Min	Max	X	Min	Max	1st	2nd	3rd
A. Tree Layer										
1. <i>Acacia modesta</i> Wall	19	62	12	200	68.88	12.73	100.00	17	1	1
2. <i>Dalbergia sissoo</i> Roxb	8	13	4	30	19.58	4.83	41.59	1	4	3
3. <i>Acacia nilotica</i> (Linn) Delile	7	6	2	20	6.47	4.80	10.18	-	1	1
4. <i>Ziziphus mauritiana</i> Lam.	7	21	4	70	27.91	7.21	66.43	2	2	2
5. <i>Ficus palmata</i> Forssk	6	4	2	8	7.51	5.01	9.96	-	1	2
6. <i>Melia azedarach</i> L.	6	37	6	138	20.87	10.73	39.78	-	2	4
7. <i>Morus alba</i> L.	5	8	2	16	12.04	5.88	21.38	-	2	1
8. <i>Prosopis glandulosa</i> Torr	1	12	0	12	22.33	0.00	22.33	-	1	-
9. <i>Broussonetia papyrifera</i> Vent	1	10	0	0	10	8.55	0.00	8.55	-	-
10. <i>Olea ferruginea</i> Royle	1	4	0	4	11.28	0.00	11.28	-	1	-
B. Shrub Layer										
11. <i>Acacia modesta</i> Wall	17	234	3.0	856	28.82	3.11	81.40	6	6	1
12. <i>Melia azedarach</i> L.	11	82	3.0	469	15.43	2.07	51.81	1	1	2
13. <i>Asparagus gracilis</i> Royle	10	265	3.0	619	19.75	2.55	44.16	2	5	2
14. <i>Ficus palmata</i> Forssk	9	43	6.0	244	14.36	2.63	24.28	-	2	2
15. <i>Acacia nilotica</i> (Linn) Delile	8	70	3.0	313	31.45	0.43	88.64	2	1	2
16. <i>Ziziphus mauritiana</i> Lam.	6	76	6.0	247	12.59	2.28	43.69	-	-	3
17. <i>Z. nummulana</i> (Burm. f.) Wight & Arn.	5	47	3.0	134	16.61	1.14	29.37	2	1-	-
18. <i>Opuntia delenii</i> Haw	5	1891	3.0	750	24.11	1.04	95.91	1	-	-
19. <i>Morus alba</i> L.	4	27	3.0	56	5.87	2.45	12.16	-	1	-
20. <i>Dalbergia sissoo</i> Roxb.	4	22	3.0	47	4.56	1.14	8.39	-	-	-

Table 1 (Cont'd)

21.	<i>Maytenus royleanus</i> (Wall ex Lawson Culodentus)	4	166	9.0	356	29.35	7.60	58.03	2	1	-
22.	<i>Calotropis procera</i> (Willd) R.Br.	3	16	3.12	31	4.70	1.97	7.01	-	-	-
23.	<i>Ehretia obtusifolia</i> Hochst ex DC.	3	211	37.5	406	18.37	1.25	56.58	1	-	-
24.	<i>Cocculus laevis</i> (Del) Dc	2	8	3.12	12	2.37	0.00	2.37	0	-	-
25.	<i>Broussonetia papyrifera</i> Vent	2	38	12.5	62	20.69	8.72	42.61	1	-	-
26.	<i>Ailanthus altissima</i> (Mill) Swingle	2	25	21.87	28	35.09	0.00	35.09	-	1	-
27.	<i>Justicia adhatoda</i> L.	2	442	325	559	26.83	11.07	442.06	1	-	1
28.	<i>Sida cordifolia</i> L.	1	3	0	3	0.86	0.00	0.86	-	-	-
29.	<i>Abutilon bidentatum</i> Hochst & A.Rich.	1	25	0	25	1.95	0.00	1.95	-	-	-
30.	<i>Boerhaavia repens</i> L.	19	438	25	975	0.99	0.18	2.30	-	-	-
31.	<i>Torilis nodosa</i> (L) Sartn.	19	4374	25	47500	4.27	0.20	23.78	1	1	1
32.	<i>Cynodon dactylon</i> (L) Pers	19	39319	375	492500	16.61	0.54	52.58	8	3	1
33.	<i>Shismis arabicus</i> Nees.	17	4383	50	32500	3.379	0.39	9.29	-	1	2
34.	<i>Conyze bonariensis</i> (L) croguist	17	322	25	2500	0.81	0.70	3.39	-	-	-
35.	<i>Rumex dentatus</i> L.	16	3364	50	42500	12.02	0.46	9.10	-	-	-
36.	<i>Oxalis corniculata</i> L.	16	8578	100	47500	7.98	0.50	21.29	1	4	4
37.	<i>Desmostachya bipinnata</i> (L.) Stapf.	15	21506	250	65000	17.00	0.74	48.83	6	3	1
38.	<i>Carthamus lanatus</i> L.	15	3700	25	5000	1.31	0.24	8.31	-	-	1
39.	<i>Bromis japonicus</i> Thunb.	15	3193	25	15000	2.36	0.28	6.36	-	-	1
40.	<i>Achyranthus aspera</i> L.	15	1157	25	40000	2.12	0.20	9.93	-	-	1
41.	<i>Geranium malacoides</i> L.	13	3886	50	27500	7.18	0.41	9.93	-	-	-
42.	<i>Melia azedarach</i> L. (Seedlings)	12	389	25	700	2.19	0.18	9.40	-	-	-

Table 1 (Cont'd)

43.	<i>Cerastium dichotomum</i> L.	12	4360	50	27500	3.30	0.27	12.03	-	1	1
44.	<i>Dicliptera roxburghiana</i> Nees	12	7031	25	32500	4.47	0.40	9.20	-	-	2
45.	<i>Carthamus oxycantha</i> N.B.	12	67	25	200	0.36	0.18	0.61	-	-	-
46.	<i>Cenchrus ciliaris</i> L.	11	4729	75	11475	5.68	0.37	22.45	1	2	1
47.	<i>Setaria viridis</i> (L.) p. Beauv.	11	795	25	50000	0.81	0.24	2.44	-	-	-
48.	<i>Inula cappa</i> & Ham. DC.	11	223	25	650	1.12	0.56	2.25	-	-	1
49.	<i>Spergula arvensis</i> L.	11	8938	100	25000	2.05	0.31	4.61	-	-	-
50.	<i>Gallium aparine</i> L.	11	764	25	20000	1.610	0.17	2.97	-	-	-
51.	<i>Malvastrum trichospermatum</i> (Bit) A. Stray.	11	6389	25	32500	5.39	0.26	15.12	-	2	-
52.	<i>Asparagus greccillis</i> Royle	11	3991	25	40000	2.23	0.20	4.92	-	-	-
53.	<i>Calandula arvensis</i> L.	11	1820	25	17500	1.12	0.37	3.41	-	-	-
54.	<i>Chenopodium murale</i> L.	10	385	25	2500	0.62	0.17	5.62	-	-	-
55.	<i>Acacia modesta</i> Mall (Seedlings)	10	1297	75	2950	2.39	0.19	5.62	-	-	-
56.	<i>Dichanthium annulatum</i> (Forsk) Stapf.	10	1092	25	6350	2.14	0.20	7.07	-	-	1
57.	<i>Euphorbia granulata</i> Forsk.	10	130	25	400	0.53	0.18	1.13	-	-	-
58.	<i>Xanthium strumarium</i> L.	10	85	25	250	0.53	0.19	1.13	-	-	-
59.	<i>Anagallis arvensis</i> L.	10	340	25	2500	0.50	0.17	1.14	-	-	-
60.	<i>Erodium cicutarium</i> (L.) Hirt & Ait.	10	785	25	5050	1.19	0.20	5.06	-	-	-
61.	<i>Capsella bursa-pastoris</i> (L.) Medic.	10	120	25	250	0.63	0.24	1.33	-	-	-
62.	<i>Erythraea rammoissima</i> Pers	9	1633	25	7500	1.35	0.20	4.33	-	-	-
63.	<i>Hordeum murinum</i> L.	9	1746	350	49000	2.33	0.17	8.27	1	1	1
64.	<i>Medicago polymorpha</i> L.	9	2668	225	12560	2.74	0.04	7.37	-	-	-
65.	<i>Silybum marianum</i> Gaertn.	88	297	25	10000	0.78	0.18	1.69	-	-	-
66.	<i>Corononis didymis</i> (L.) Sp.	8	600	50	2500	0.95	0.20	2.38	-	-	-

Table 1 (Cont'd)

67.	<i>Sisymbrium irio</i> L.	8	122	25	300	0.45	0.19	0.89	-	-
68.	<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	87	86	25	275	0.75	0.17	1.79	-	-
69.	<i>Melilotus indicus</i> (L.) All	7	82	25	325	0.54	0.18	1.44	-	-
70.	<i>Cousinia minuta</i> Boiss	6	350	25	950	1.40	0.17	3.76	-	-
71.	<i>Acacia nilotica</i> (L.) Detile	6	208	25	725	0.74	0.24	1.75	-	-
72.	<i>Salvia plebeia</i> R.Br.	6	108	25	125	0.71	0.17	1.91	-	-
73.	<i>Amaranthus viridis</i> L.	6	525	25	400	0.49	0.18	3.67	-	-
74.	<i>Thymelaea passerina</i> (L.) Coss & Germ.,	6	962	25	15500	1.53	0.18	3.67	-	-
75.	<i>Sonchus asper</i> (L.) Hill.	6	43	25	75	1.73	0.17	8.40	-	-
76.	<i>Canabis sativa</i> L.	6	221	25	375	1.09	0.17	2.19	-	-
77.	<i>Calotropis procera</i> (Willd) R.Br.	6	33	25	75	4.29	0.22	0.67	-	-
78.	<i>Crepis</i> sp.	6	435	50	1125	1.51	0.35	2.73	-	-
79.	<i>Medicago lupulina</i> L.	5	83	245	37500	2.72	1.44	4.48	-	-
80.	<i>Sporobolus arabicus</i> Boiss	5	11570	50	49450	7.92	0.38	26.17	-	1
81.	<i>Imperata cylindrica</i> (L.) P. Beauv.	5	1500	125	2500	1.57	0.27	2.97	-	-
82.	<i>Solanum nigrum</i> L.	5	140	25	600	0.44	0.18	1.36	-	-
83.	<i>Panicum antidotale</i> Retz.	5	16020	25	75025	5.86	0.17	24.83	-	-
84.	<i>Cirsium arvensis</i> L.	5	90	25	250	0.39	0.20	0.49	-	-
85.	<i>Withania somnifera</i> (L.) Danal	5	50	25	125	0.53	0.18	1.19	-	-
86.	<i>Lactuca serriola</i> L.	5	290	25	1000	2.90	0.17	12.73	-	-
87.	<i>Lactuca dissecta</i> D. Don.	4	425	50	950	0.92	0.35	1.60	-	-
88.	<i>Rhynopsis minima</i> (L.) DC.	4	56	25	100	0.43	0.18	0.80	-	-
89.	<i>Saccharum spontaneum</i> L.	4	62	25	125	1.61	0.23	4.44	-	-
90.	<i>Filago pyramidata</i> L.	4	194	100	250	0.59	0.39	0.91	-	-

Table 1 (Cont'd)

91.	<i>Ehretia obtusifolia</i> Hich. ex DC (Seedlings).	4	744	50	2500	0.60	0.17	0.96	-	-	-
92.	<i>Melva neglecta</i> Wallr.	4	112	25	225	0.55	0.38	0.74	-	-	-
93.	<i>Launaea procumbens</i> (Roxb) Amin.	4	381	25	1250	0.99	0.17	2.84	-	-	-
94.	<i>Morus alba</i> L. (Seedlings)	4	56	25	125	0.51	0.21	1.23	-	-	-
95.	<i>Cyperus rotundus</i> L.	4	1875	375	4400	1.93	0.68	4.67	-	-	-
96.	<i>Spergularia rubra</i> (L) J & C Presel	4	2056	50	6375	4.25	0.61	9.20	-	-	1
97.	<i>Convolvulus arvensis</i> L.	4	225	25	825	1.07	0.17	3.73	-	-	-
98.	<i>Abutilon bidentatum</i> Hoch. & A. Ric.	4	112	25	250	0.81	0.20	1.77	-	-	-
99.	<i>Acacia modesta</i> Seedlings	4	8731	500	32500	3.01	1.41	4.72	-	-	-
100.	<i>Elusine compressa</i> (Foorsk) Ascher & Sch.	4	5606	225	16450	4.10	0.43	10.37	-	-	-
101.	<i>Chenopodium album</i> L.	4	94	25	300	1.00	0.17	3.49	-	-	-
102.	<i>Medicago minima</i> (L) Grunf.	4	2569	25	9625	2.64	0.23	09.12	-	-	-
103.	<i>Cymbopogon jwarancusa</i> (Jones) Schultz.	3	1317	50	2575	5.10	0.59	10.24	-	-	-
104.	<i>Opuntia delenii</i> Haw.	3	2583	25	75000	5.09	0.30	13.69	-	-	1
105.	<i>Diarthron vesiculosum</i> (Fisch & Mey) C.A. Mey.	3	33	25	50	0.33	0.20	0.54	-	-	-
106.	<i>Centurea calcitrapa</i> L.	3	25	25	26	0.32	0.28	0.40	-	-	-
107.	<i>Peristrophe bicalyculata</i> (Retz) Nees.	3	2783	1250	5225	3.52	1.98	6.53	-	-	-
108.	<i>Ficus palmata</i> Forssk (Seedlings)	3	33	25	50	0.28	0.17	0.36	-	-	-
109.	<i>Ziziphus mauritiana</i> Lamb. (Seedlings)	3	153	25	425	0.32	0.17	0.63	-	-	-

Table 1 (Cont'd)

110.	<i>Euphorbia helioscopia</i> L.	3	33	25	50	0.37	0.24	0.61	-	-
111.	<i>Physalis minima</i> L.	3	42	25	50	0.47	0.37	0.50	-	-
112.	<i>Erodium</i> sp.	3	750	350	1500	0.84	0.23	1.36	-	-
113.	<i>Commelina obliqua</i> Ham.	3	125	25	325	0.36	0.18	0.71	-	-
114.	<i>Brassica</i> sp.	3	242	50	400	0.66	0.59	0.75	-	-
115.	<i>Astragalus scopiurus</i> Bung.	3	633	25	1700	1.46	0.24	3.81	-	-
116.	<i>Srabirosa olivieri</i> Coult	3	683	50	1150	1.43	0.25	2.39	-	-
117.	<i>Aerua javanica</i> (Burn, f.) Juss	3	58	25	100	0.44	0.20	0.175	-	-
118.	<i>Verbascum thapsis</i> L.	3	12	25	300	0.50	0.18	1.11	-	-
119.	<i>Salvia moorcroftiana</i> Wall ex Bth.	3	2375	375	3400	3.90	0.46	6.17	-	-
120.	<i>Linus strictum</i> L.	2	275	275	275	1.00	0.39	1.62	-	-
121.	<i>Medicago</i> sp.	2	225	75	375	0.64	0.53	0.76	-	-
122.	<i>Euphorbia falcata</i> L.	2	50	25	75	0.39	0.27	0.52	-	-
123.	<i>Euphorbia hirta</i> L.	2	163	125	200	0.30	0.22	0.39	-	-
124.	<i>Broussonetia papyrifera</i> Vent (Seedlings)	2	100	75	125	0.59	0.39	0.79	-	-
125.	<i>Ailanthus altissima</i> (Mill) Swingle (Seedlings)	2	75	50	100	0.49	0.27	0.72	-	-
126.	<i>Eryngium coeruleum</i> M.B.	2	125	25	225	0.84	0.17	1.51	-	-
127.	<i>Papaver hybridum</i> L.	2	144	125	200	0.36	0.33	0.39	-	-
128.	<i>Ranunculus arvensis</i> L.	2	87	75	100	0.43	0.24	0.63	-	-
129.	<i>Trigonella incisa</i> Bth.	2	100	50	150	0.31	0.25	0.38	-	-
130.	<i>Vicia sativa</i> L.	2	37	25	50	0.44	0.20	0.68	-	-
131.	<i>Taraxacum officinale</i> Weber	2	225	28	475	1.39	0.22	2.56	-	-
132.	<i>Lophochloa</i> sp.	2	187	75	300	0.91	0.71	1.11	-	-
133.	<i>Cichorium intybus</i> L.	2	37	25	50	0.25	0.24	0.26	-	-

Table 1 (Cont'd)

134.	<i>Maytenus royleanus</i> (Wall) ex Lawson	2	337	175	500	2.72	1.02	4.42	-	-	-
135.	<i>Justicia adhatoda</i> L.	2	1325	150	2500	1.51	1.255	1.78	-	-	-
136.	<i>Aristida adscensionis</i> L.	2	25	25	25	0.25	0.13	0.23	-	-	-
137.	<i>Dalbergia sissoo</i> Roxb. (Seedlings)	2	575	25	1125	0.92	0.23	1.61	-	-	-
138.	<i>Lantana indica</i> Roxb.	2	25	25	25	0.95	0.59	1.31	-	-	-
139.	<i>Plantago ciliata</i> HK.I.	2	25	25	25	0.20	0.70	0.23	-	-	-
140.	<i>Cocculus laeaba</i> (De)DC	2	175	25	325	0.93	0.18	1.68	-	-	-
141.	<i>Psammogeton bitematum</i> Edgev.	2	1812	25	3600	2.55	0.18	4.92	-	-	-
142.	<i>Lithospermum</i> sp.	2	75	25	125	0.24	0.18	0.31	-	-	-
143.	<i>Scrophularia</i> sp.	2	50	25	75	0.20	0.19	0.22	-	-	-
144.	<i>Poa</i> sp.	2	50	25	75	0.36	0.20	0.53	-	-	-
145.	<i>Descurainia sophia</i> (L) Webb & Berth.	1	50	00	50	0.28	00	0.28	-	-	-
146.	<i>Hermiaria hirsuta</i> L.	1	25	00	25	0.24	00	0.24	-	-	-
147.	<i>Lathyrus aphaca</i> L.	1	25	00	25	0.24	00	0.24	-	-	-
148.	<i>Astragalus</i> sp.	1	2525	00	2525	3.88	00	03.88	-	-	-
149.	<i>Pupalia lappacea</i> (L) Juss	1	25	00	25	0.23	00	0.23	-	-	-
150.	<i>Cynoglossum</i> sp.	1	125	00	125	0.22	00	9.22	-	-	-
151.	<i>Chorospora tennela</i> (Pali)DC	1	25	00	25	0.36	00	0.36	-	-	-
152.	<i>Silene canoidea</i>	1	25	00	25	0.18	00	0.18	-	-	-
153.	<i>Prosopis glandulosa</i> Torr	1	25	00	25	0.24	00	0.24	-	-	-
154.	<i>Allium porum</i> L.	1	100	00	100	1.0	00	1.01	-	-	-
155.	<i>Avena fatua</i> L.	1	25	00	25	0.18	00	0.18	-	-	-
156.	<i>Avena sativa</i> L.	1	25	00	25	0.26	00	0.26	-	-	-
157.	<i>Trianthema portulacustrum</i> L.	1	50	00	50	0.61	00	0.61	-	-	-
158.	<i>Caryophyllaceae</i>	1	750	00	750	0.62	00	0.62	-	-	-

Table 1 (Cont'd)

159.	<i>Lepidium</i> sp.	1	25000	00	25000	18.12	00	18.12	-	-	-
160.	<i>Anthrithum orontium</i> L.	1	150	00	150	0.65	00	0.65	-	-	-
161.	<i>Erodium</i> sp.	1	5050	00	5050	6.40	00	6.40	-	-	-
162.	<i>Bromis pappoicus</i> Thunb.	1	25	00	25	0.27	00	0.27	-	-	-
163.	<i>Salvia</i> sp.	1	25	00	25	0.20	00	0.20	-	-	-
164.	<i>Arenaria</i> sp.	1	50	00	50	0.18	00	0.18	-	-	-
165.	<i>Solanum xanthocarpum</i> Schrad & Wendl.	1	25	00	25	0.18	00	0.18	-	-	-
166.	<i>Fumaria indica</i> (Hausk) H.N.	1	25	00	25	0.18	00	0.18	-	-	-
167.	<i>Heliotropium</i> sp.	1	25	00	25	0.28	00	0.28	-	-	-
168.	<i>Coryza</i> sp.	1	2025	00	2025	3.17	00	3.17	-	-	-
169.	<i>Chenopodium botrys</i> L.	1	75	00	75	0.34	00	0.34	-	-	-
170.	<i>Lepidium draba</i> Thol	1	175	00	175	0.95	00	0.95	-	-	-
171.	<i>Suaeda fruticosa</i> (L.) Forssk.	1	2675	00	2675	3.17	00	3.17	-	-	-
172.	<i>Verbena officinale</i> L.	1	25	00	25	0.17	00	0.17	-	-	-
173.	<i>Kickxia ramosissima</i> (Wall) Janchen	1	25	00	25	0.17	00	0.17	-	-	-
174.	<i>Polygonum plebium</i> R.Br.	1	50	00	50	0.37	00	0.37	-	-	-
175.	Acanthaceae	1	75	00	75	0.71	00	0.71	-	-	-
176.	<i>Sida</i> sp.	1	175	00	175	0.61	00	0.61	-	-	-
177.	<i>Frigeron</i> sp.	1	78	00	75	0.50	00	0.75	-	-	-
178.	<i>Veronica biloba</i> L.	1	75	00	75	0.28	00	0.28	-	-	-
179.	<i>Stellaria media</i> (L.) Cyr.	1	50	00	50	0.26	00	0.26	-	-	-
180.	<i>Veopnica anagallis-aquatica</i>	1	1125	00	1125	0.37	00	0.37	-	-	-
181.	<i>Chenopodium</i> sp.	1	25	00	25	0.33	00	0.33	-	-	-

The herb layer generally consisted of *Cynodon dactylon* and *Desmostachya bipinnata* (Table 1). Both these grasses are important component of the saline habitats (Hussain *et al.*, 1980, 1981; Malik *et al.*, 1984; Beg, 1978). Among the 152 (including seedlings of shrub and tree species) herb layer species a few like *Torilis nodosa*, *Oxalis comiculata*, *Cenchrus ciliaris*, *Panicum antidotale*, *Sporobolus arabicus*, and *Thymelaea passerina* were the leading dominants (Table 1). While *Spergularia rubra*, *Medicago polymorpha*, *Dichanthium annulatum*, *Malvastrum oromendelianum*, *Dicliptera roxburghiana*, *Cerastium dichotomum*, *Achyranthus aspera*, *Bromis japonicus*, *Carthamus lanatus* and *Lophochloa* were the 2nd or 3rd dominants. The remaining species (Table 1), though repeated themselves in many stands, had low importance values.

Community Description: Fig.2 graphically represents the various communities and sub-types of the study area. Tree layer is shown by two dominant species while shrub layer is indicated by one leading dominant species. Three major communities viz, 1) *Dalbergia sissoo-Melia azedarach*, 2) *Ziziphus mauritiana* and 3) *Acacia modesta* were recognized in the area. Although every vegetation layer was sampled independently yet the behaviour of plant components of the lower strata are to a large extent controlled by the tree or dominant canopy layer (Daubenmire, 1974). All the dominant groups of shrubs and herbs were, therefore, considered under these three major canopy groups (Table 1).

A. *Dalbergia sissoo-Melia azedarach* Community: This community was recorded in Tordher (Stand 13). *Dalbergia*, an introduced and naturalized species in Pakistan, is a very good secondary colonizer especially in wet coarse soils (Beg, 1963, 1978; Champion *et al.*, 1965). Similarly, *Melia* is a frequently grown tree in the area. The dominance of both these species strongly indicate human disturbance and secondary succession. The history of the stand (as told by local people) indicates that the original *Acacia modesta*, *Ziziphus mauritiana* and/or *A. nilotica* cover was removed in the past giving way to *Dalbergia* and *Melia* to colonize and become dominant. The third dominant position of *A. modesta* is due to the growth of left over seedlings at the time of mass felling. The stand is located near the Indus River and capillary fringe water might have helped *Dalbergia* to easily invade the site. Many seedlings of *A. modesta* and *M. azedarach* indicate the self-perpetuation of the forest. The poor dispersal and vigility of *A. modesta* and *M. azedarach* might have also caused aggregation of these species. *Desmostachya bipinnata* and *Torilis nodosa* occupy most of the ground flora. The former is a perennial abundant grass adapted to a variety of habitats (Hussain *et al.*, 1980, 1981; Malik *et al.*, 1984; Beg, 1978) while the later species is important only during spring.

B. *Ziziphus mauritiana* community: Two following sub-types can be recognized.

1. ***Ziziphus mauritiana-Prosopis glandulosa* type:** *Z. mauritiana* is a native species while *P. glandulosa* is a recent colonizer indicating the past disturbance. This community occurs in the Raporay Jehangira (Stand 15) which might receive capillary fringe water from Kabul River. The third dominant, *D. sissoo*, strengthens this view. *Ziziphus nummularia*, *Ficus palmata*, and *Asparagus gracilis* are present as the first, second and third dominants, respectively in the shrub layer. *Thymelaea passerina*, *Desmostachya bipinnata* and *Cenchrus* are abundant in the floor layer. Beg (1975, 1978) and Champion *et al.*, (1965) classified this type as *Ziziphus mauritiana* scrub.

2. ***Ziziphus mauritiana-Acacia modesta* type:** This type occupied Zarobi graveyard (Stand 19) where a few individuals of *M. azedarach* were also recorded in the canopy layer. No

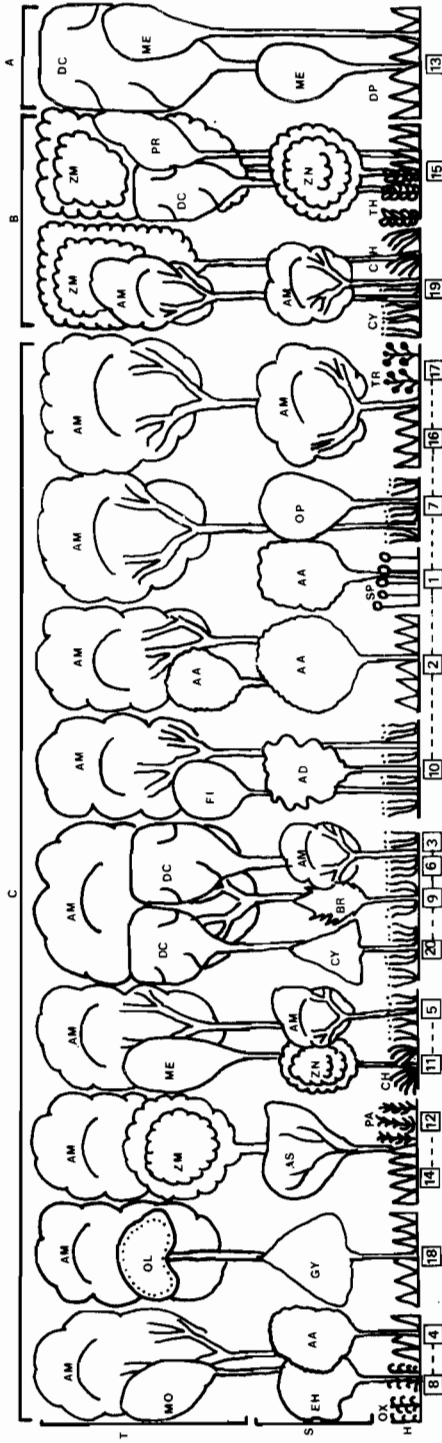


Fig. 2. Profile diagram of the study area. A, B, and C are the three major communities. T, S and H are tree, shrub and herb layers, respectively. Numbers in the boxes are stand numbers. Broken lines between the boxes indicate the stands included in a group.

AM = *Acacia modesta*, DC = *Dalbergia sissoo*, ZM = *Ziziphus mauritiana*, ZN = *Ziziphus numularia*, ME = *Melia azedarach*, PR = *Prosopis glandulosa*, AA = *Acacia nilonica*, FI = *Ficus palmata*, OL = *Olea ferruginea*, MO = *Morus alba*, DP = *Desmostachya bipinnata*, TH = *Thymelaea passerina*, CH = *Cenchrus ciliaris*, CY = *Cynodon dactylon*, TR = *Tortilis nodosa*, SP = *Sporobolus arabicus*, PA = *Panicum antidotale*, OX = *Oxalis corniculata*.
 Stands location 1 = Said Khan, Yar Hussain, 2 = Akhoonbaba, Yar Hussain, 3 = Saisado, Yar Hussain, 4 = Gadomaidan, Yar Hussain, 5 = Chandheri, Adina, 6 = Dagai-1, 7 = Dagai-2, 8 = Turlandi, 9 = Nawakli, 10 = Shewa, 11 = Lahore, 12 = Jalbai, 13 = Tordher, 14 = Poray Jehangira, 15 = Raporay Jehangira, 16 = Swabi (Koza jara), 17 = Maneri Payan, 19 Zarobi, 20 = Bamkhel.

shrub was present. However, large number of seedlings of the canopy species were observed. *Cynodon dactylon*, *Cenchrus* and *Dichanthium annulatum* were the dominant floor species. This reflects *Ziziphus-Acacia* scrub as identified by others (Champion *et al.*, 1965; Beg, 1978).

C. *Acacia modesta* Community: Stand Nos 16, 17, 7, 1, 2 and 10 are characterized by the pure dominance of *A. modesta*. The first four stands had no associated tree species whereas stands 2 and 10 had few scattered individuals of *A. nilotica* and *F. palmata*, respectively, in the canopy layer. The shrub layer of the first two stands, besides large number of seedlings of *A. modesta*, was dominated by *Asparagus gracilis*, *Maytenus royleanus* and *Z. nummularia*. In the stand 7 (Dagai) *Opuntia delenii* was the only dominant shrub while *Cynodon dactylon* was the dominant herb. The open canopy facilitated the gregarious zerophytic heliophyte *Opuntia* to dominate whereas in the nearby stand 7, it was absent owing to complete canopy. Both these stands (6 & 7) have a large number of *A. modesta* seedlings. The lower strata of stands 1 & 2 (Said Khan and Akhoonbaba) are occupied by abundant seedlings of *A. nilotica*. *Justicia adhatoda* was dominant in Shewa (Stand 10) alongwith *Maytenus royleanus*, *Asparagus gracilis* and *Cynodon dactylon*. *Sporobolus arabicus*, along with *Medicago polymorpha* and *D. bipinnata* were recorded from stand 1 only as a floor vegetation while the later species was abundant in stands 2 and 16 also.

Acacia modesta was recorded in 19 out of 20 stands with pure or mixed dominance with other species in the study area. Various *A. modesta* community types were recognized on the basis of co-dominants as follows:

1. *Acacia modesta*-*Dalbergia sissoo* type: This type was found at Saisado, Dagai, Newakaley and Bamkhel (Stand Nos 3, 6, 9 & 20, respectively). The third dominant species were respectively *A. nilotica*, *F. palmata*, *Morus alba* and *Z. mauritiana*. Similarly, the shrub stratum also varied with the site. Seedlings of *A. modesta* dominated stand 3 and 6. The later also had seedlings of *A. nilotica* and *Z. mauritiana*. Stand No.9 had *Broussonetia papyrifera* associated with *Ailanthus altissima* and *F. palmata*. *Maytenus royleanus* and *Asparagus gracilis* were common in stand 20. In all the stands, except No.9, the herb layer was dominated purely by *Cynodon*. Both, *Broussonetia* and *Ailanthus* are fast growing gregarious introduced species capable of naturalizing degraded, eroded and disturbed sites by seeds and profuse multiplication from root suckers. *Ficus* seeks protection owing to superstition affiliated to it. It is common in the subtropical zone (Champion *et al.*, 1965; Beg, 1975). The dominance of *Dalbergia* again confirms the view regarding the colonization of the disturbed habitat. *Maytenus* and *Justicia adhatoda* reflect a subtropical touch in the herbaceous species which also grow as understorey species in the dry deciduous thorn forests (Champion *et al.*, 1965; Beg, 1978). Stand 20 (Bamkhel) reflects *Justicia adhatoda* scrub where *A. modesta* has been reduced.

2. *Acacia modesta*-*Melia azedarach* type: The third dominant position of *Dalbergia* indicates the past disturbance at Chandheri (Stand 5) and Lahore (Stand 11). Abundance of *Z. nummularia* in stand 11 was also due to the disturbed habitat condition. This species is characteristic of dry areas and is frequently found in the nearby Lahore-Baja-Jalbai sandy dry deserted patch. The site is located on a dry raised mound which increases the depth of underground available water level than the average for the area. Moreover, excessive run off water renders it dry. Small plants of the tree layer constituted the shrub layer. While *Cenchrus*, *Elusine* and *Carthamus*, all preferring dry habitats, dominated the

herb layer in Lahore. In the Chandheri stand shrubby *A. modesta* along with *Cynodon*, *Desmostachya* and *Sporobolus* formed the lower strata. This stand is relatively moist than Lahore and this difference has caused variation in the lower strata.

3. *Acacia modesta*-*Ziziphus mauritiana* Type: At Jalbai (Stand 12), *Melia* and at Poray Jehangira (Stand 14) few individuals of *Dalbergia* accompany the tree layers in this community. Both the stands have *Asparagus* in the lower strata with ample seedlings of *A. modesta* and *Z. mauritiana* (Stand 12) and *Opuntia delenii* (Stand 14). *Panicum antidotale*, *Cenchrus ciliaris*, and *Gallium aparine* in stand 12, and *Desmostachya*, *Cymbopogon jwarancusa* and *Achyranthus aspera* in stand 14 were the dominant herbs. The Jalbai (Stand 12) was comparatively moist than Poray Jehangira due to its vicinity to settlements and agricultural fields, that might have helped the spread of *Melia*.

4. *Acacia modesta*-*Olea ferruginea* Type: Maneri Payan (Stand 18) had this community. *Olea ferruginea* was scattered. *Maytenus*, alongwith few large seedlings of *A. modesta*, was the leading shrubby species. Ground layer was dominated by *Oxalis corniculata*, *Desmostachya* and *Torilis nodosa*. This community gives a glimpse of subtropical semi-evergreen vegetation (Beg, 1975, 1978; Champion *et al.*, 1965). This however, appears to be an ecotone occupying its lower most altitudinal range in the study area.

5. *Acacia modesta*-*Morus alba* Type: This vegetation type is characterized by *Ficus palmata* in Gaido maidan (Stand 4) and *Melia azedarach* in the Turlandi (Stand 8) in the tree layers. The canopy layer supported large number of *A. nilotica* seedlings with *Asparagus* and *Ficus* in the Gaido-maidan and *Ehretia obtusifolia*, *Morus alba* and *Melia* in Turlandi in the lower strata. The ground flora predominantly consisted of *Desmostachya* in Gaido-maidan and *Oxalis corniculata* in Turlandi. *Cynodon* and *Carastium* were common to both the stands. The emergence of *Ficus* and *Melia* as leading species indicate moist and disturbed condition in both the stands. Agricultural fields and human settlements surround both the stands. *Desmostachya* might be an indicator of salinity in the area (Hussain *et al.*, 1980, 1981; Malik *et al.*, 1984; Beg, 1978).

The present study indicates that the primary vegetation of the area belongs to tropical dry deciduous thorn and subtropical semi-evergreen forests (Beg, 1975, 1978; Champion *et al.*, 1975). The former is characterized by *A. modesta* cover alongwith *Z. mauritiana*, *Z. nummularia*, *Maytenus*, *Justicia*, *Ehretia*, and *Asparagus* in the understory. The only climber found was *Cocculus leaeba*. Human disturbance followed by edaphic and hydrographic factors have modified the original vegetation to the existing types dominated by *Dalbergia*, *Melia*, *Prosopis glandulosa*, *Ficus*, *Morus* and *Broussonetia* in various capacities. All these species are colonizers of the disturbed habitats. *Dalbergia sissoo*-*Melia azedarach* community is a climax stage of secondary succession in the area. The degradation resulted in the creation of *Z. mauritiana* and *Z. nummularia* scrub, which with further continued pressure changed to isolated individuals of the native plant cover as seen in the unprotected Baja, Jalbai, and Jalsai sandy deserts. *Acacia-Olea* community at Maneri exemplifies an ecotone of semi-evergreen forest. *Maytenus*, *Justicia* and *Asparagus* are typical components of the subtropical vegetation which descend also to these forests. At higher altitude, this type merges with subtropical chir pine forests in the Karamar hills and at other appropriate places in the study area (Tajal-malook & Naqvi, 1982; Hussain & Tajal-malook, 1984; Beg, 1978). The flow of water is from south to north in the district and coincidentally Tarbela dam lies at the southern most corner of the district. The underground seepage, therefore, rushes to the low lying northern

habitats in Yar Hussain, Nazar, Garhi, Dhobyan and Sodher etc. to possibly modify the existing plant cover. This is also reflected by the introduction of Upper Swat Canal which has water-logged the then fertile lands. The creation of Tarbela dam has changed the agricultural pattern of these low lying habitats to rice cultivation in the recent years. Before the introduction of Upper Swat Canal these uplands were dominated by thorny scrubs which are almost non-existent today. It is expected that these remnant forest patches in the low lying areas may change floristically in the years to come.

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(Received for Publication 9 July 1988)