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PHYTOSOCIOLOGICAL STUDIES AROUND THE INDUSTRIAL AREAS OF KORANGI KARACHI

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A quantitative phytosociological survey was conducted around industrial areas of Korangi, Karachi, alongwith soil analysis. Four communities were indentified based on dominant species. Most of the species were halophytic in nature, while some of them were disturbed types. *Prosopis juliflora* and *Suaeda monoica* were very prominant in most of the stands investigated. The soil of study area was coarse in texture ranging from loamy sand to sandy loam. The soil was basically alkaline in nature, containing appreciable amount of calcium carbonate and soluble salts with scanty organic matter.

Key words: Korangi industrial areas, Phytosociology, Soil.

INTRODUCTION

Karachi is situated at 64° longitude and 27° lattitude on the shore of Arabian Sea. Strong coastal winds, temperature and relatively high humidity are the physical factors which are in direct contact with the study area. Karachi is densely populated and has the biggest centre of trade and industry in Pakistan. It has quite a few industrial estates including Korangi Industrial Estate. The industrialisation has taken place on extensive scale and thousands of job seekers migrate to the city. The population of Karachi is increasing at a rate of six percent per annum against the national increase of three per cent and has reached approximately eight million. The haphazard and fast industrial growth is causing an enormous environmental pollution mainly through the contamination of water, soil and air. The industrial units in Pakistan produce or use chemicals which dispose off dangerous waste matter in the environment. Thus environmental change in turn can seriously affects human health and vegetation. We must be aware with a wide array of toxic substances because plants absorb ions of toxic nature by roots and aerial parts. (Lagerwerff and Specht [12]; Reiquam [17]; Page *et al*; [14]; Buchauer [3]; Haghiri [7]; Rolfe [18].

In the previous years some of the vegetational study around Karachi was conducted by many workers (Chaudhry and Qadir [4]; Chaudhry, [5]; Qadir *et al* [15]; Shaukat and Qadir, [20]; Iqbal and Qadir, [8]; Ahmed [1]; Iqbal *et al,* [4]; Shafiq and Iqbal, (in press). No work has so far been reported about the phytosociology around the Korangi Industrial Area. The aim of this work was the quantitative estimation of the vegetation alongwith soil analysis in the vicinity of Korangi Industrial Estates.

MATERIALS AND METHODS

(A) *Vegetational survey.* A phytosociological survey was conducted around the industrial area of Korangi. Sampling was done during June in 1986 by point centred method of Cottom and Curtis (1956). 25 sampling points were employed randomly in each sampling area and 15 stands were analysed. Relative cover, density and frequency were calculated. An important value index was obtained by the addition of the above community attributes. The community was named according to the dominant species which had the highest importance value.

(B) *Soil analysis.* One soil sample was obtained from every stand at 0-2′ feet depth. These samples were brought to the laboratory in polythene bags for physical and chemical analyses.

(1) Mechanical analysis of the soils was carried out by the pipette method of U.S.D.A. [21].

(2) Maximum water holding capacity of soil was calculated by the following formula :–

$$MWHC\% = \frac{\text{Loss in weight}}{\text{oven dried weight of soil}} \times 100$$

(3) Soil pH was determined by direct pH reading meter (Model Jenway pHM 6).

(4) Calcium carbonate was determined by a method of acid neutralization, which was described by Qadir *et al.* [16].

(5) Estimation of organic matter was done by Jackson [10].

(6) Soluble salts were determined by mixing 10 grams of soil in 100 ml of distilled water. Filtered and the filtrate was oven dried at 80°. The loss in weight was the amount of soluble salts.

RESULTS

Phytosociological data are summarized in Table 1. Among 44 species, *Prosopis juliflora* DC attained the highest importance value followed by *Suaeda monoica* Gmel, *Cressa cretica* L. and *Haloxylon recurvum* bunge, respectively. *P. juliflora* also attained the constancy class

Table 1. Summary of phytosociological data.

S. No.	Name of species	Presence class	Total No of stands in which species occured	Total IVI	Average IVI	Maximum IVI	Minimum IVI	No. of stands 1st dominant	No. of stands 2nd dominant	No. of stands 3rd dominant
1.	*Prosopis juliflora* DC	V	13	909	70	103	9	6	–	1
2.	*Suaeda monoica* Forsk. ex Gmel.	IV	11	700	64	167	3	5	2	–
3.	*Cressa cretica* L.	IV	12	423	35	70	3	–	3	4
4.	*Haloxylon recurvum* (Moq.) Bunge	II	5	390	78	129	20	3	–	–
5.	*Tamarix indica* Willd.	IV	10	379	38	77	7	–	2	3
6.	*Abutilon indicum* (L.) Sweet	II	4	247	62	114	8	–	3	–
7.	*Aeluropus* sp.	IV	11	205	19	49	3	–	2	1
8.	*Salsola baryosma* (R.B.S.) Dandy	IV	7	167	24	57	5	–	1	1
9.	*Aerva Javanica* (Burm. f.) Juss.	III	7	125	18	44	3	–	–	2
10.	*Desmostachya bipinnata* (L.) Stapf	I	3	122	41	86	9	–	1	–
11.	*Calotropis procera* (Willd.) R.Br.	II	6	112	19	52	4	–	1	1
12.	*Alhaji maurorum* Medic.	II	4	112	28	86	3	1	–	–
13.	*Heliotropium curassavicum* L.	III	8	84	11	26	3	–	–	–
14.	*Launea nudicaulis*. Hk.f	III	8	43	5	12	3	–	–	1
15.	*Atriplex stocksi* Boiss.	I	6	42	7	12	3	–	–	–
16.	*Heliotropium lingnosum* schweinf.	I	3	39	13	21	5	–	–	–
17.	*Cassia holosericea* Fres	II	4	36	9	16	6	–	–	1
18.	*Datura metel* L.	I	3	34	11	16	6	–	–	–
19.	*Corchorus depressus* (L.) Stocks	III	5	26	5	12	3	–	–	–
20.	*Indigofera oblongifolia* Forsk.	I	3	22	7	11	5	–	–	–
21.	*Prosopis cineraria* (L.) Druce	I	3	18	6	9	4	–	–	–
22.	*Oldenlandia retrosa* Boiss	I	1	17	17	17	17	–	–	–
23.	*Amaranthus viridis* L.	II	4	16	4	7	3	–	–	–
24.	*Solanum albicaule* Kotschy	I	3	16	5	9	3	–	–	–
25.	*Indigofera argentia* Burm.f.	I	1	15	15	15	15	–	–	–
26.	*Solanum suranttense* Burm.f.	II	4	15	4	4	4	–	–	–
27.	*Capparis decidua* (Forsk.) Edgew	I	2	15	8	12	3	–	–	–
28.	*Fagonia indice* L.	I	3	13	4	7	3	–	–	–
29.	*Cucumis prophetarum* L.	I	1	10	10	10	10	–	–	–
30.	*Lycium edgworthii* Dunal	I	9	9	9	9	9	–	–	–
31.	*Crotalaria burhia* Ham. exBentham	I	2	9	4	5	3	–	–	–
32.	*Echinops echinatus* D.C	I	2	9	4	4	4	–	–	–
33.	*Arthrocinemum indicum* (Willd.) Moq.	I	2	7	4	5	3	–	–	–
34.	*Zizyphus nummularia* (Burm.f.) Wt. & Arn	I	1	7	7	7	7	–	–	–
35.	*Heliotropium ophioglossum* Stocks	I	2	7	4	4	4	–	–	–
36.	*Cenchrus setigerus* Vahl	I	1	6	6	6	6	–	–	–
37.	*Prosopis glandulosa* Torr.	I	2	6	3	3	3	–	–	–
38.	*Salvadora persica* L.	I	1	6	6	6	6	–	–	–
39.	*Zaleya pentendra* (L.) Jaffery	I	2	5	2	2	2	–	–	–
40.	*Conyza canadensis* (L.) Cronquist	I	1	5	5	5	5	–	–	–
41.	*Withania somnifera* (L.) Dunal	I	1	4	4	4	4	–	–	–
42.	*Salvia sentolinifolia* Boiss	I	1	4	4	4	4	–	–	–
43.	*Cleome brachycarpe* Vahl	I	1	3	3	3	3	–	–	–
44.	*Boerhaavia procumbens* Banks ex Roxb.	I	1	3	3	3	3	–	–	–

Symbol used = IVI = Importance Value Index.

V while five species (*S. monoica, C. cretica, Tamarix indica* Willd, *Salsola baryosma* Pandy, *Aeluropus* sp.) had constancy class IV. Whereas other species had the lower constancy classes. Four leading dominant species were selected and mean importance value index of each species was calculated (Table 2). Out of 15 stands, six stands, showed the presence of *P. juliflora* as a leading dominant species, while *S. monoica* was present five time as a first dominant. Both these species showed very strong association with each other. On the other hand *H. recurvum* showed association only with *S. monoica. Alhaji maurorum* medic was present only in one stand as a leading dominant.

Table 2. Mean I.V.I. of species in stands in which a given species occurs as a leading dominant.

		Leading dominant.			
No. of stands in which the species is leading dominant	Species	*P. juliflora*	*S. monoica*	*H. recurvum*	*A. maurorum*
6	*P. juliflora*	123	18	–	–
5	*S. monoica*	36	115	–	–
3	*H. recurvum*	–	53	114	–
1	*A. maurorum*	–	–	–	86

Soil characteristics. The soil of the study area was calcareous and basic in nature. It had appreciable amount of calcium carbonate with moderate percentage of maximum water holding capacity. It also showed the presence of soluble salts but the amount of organic matter was poor (Table 3).

Four communities based on leading dominant species were determined and were correlated with the edaphic factors.

(1) *Prosopis community. P. juliflora* formed main association with disturbed species (*Aerva javanica* Juss., *Cassia holosericea* Pres., *Abutilon indicum* Sweet, *Calotropis procera* R.Br.) and with halophytes (*C. cretica, H. curassavicum, Aeluropus sp.*). This community preferred higher percentage of total sand (81.27 %) with low percentage of silt and clay (9.36 %). Water holding capacity of the soil was low (26.50 %). The pH was also low with low percentage of soluble salts and organic matter (Table 3). The soil of this community contained appreciable amount of calcium carbonate (25.81 %).

(2) *Suaeda community. S.monoica* with other halophytic species *Desmostachys bipinnata* stapt., *S. baryosma, T. indica, Aeluropus* sp., *C. cretica*) also preferred high percentage of total sand (78.21 %) and low silt and clay (10.80 %). The soil had moderate maximum water holding capacity and it was more (30.55 %) than that for previous community (Table 3). However, soluble salts and amount of organic matter were higher. The level of pH was also higher (8.94) as compared with the previous community.

(3) *Haloxylon community.* This community was also found on such soil which had higher percentage of total sand (74.05 %) and low percentage of silt and clay (12.97 %). The maximum water holding capacity was moderate and pH was 8.73 (Table 3). This community also preferred high amount of $CaCO_3$ (23.02 %) and low percentage of organic matter (0.79 %). However, it preferred higher amount of soluble salts (4.25 %) as compared with others.

(4) *Alhaji community.* Alhaji community was distinct from the other three communities described. This community preferred better soil conditions, such as comparatively low percentage of total sand (64.28%) and high amount of silt and clay fractions (17.86%). The soil had also better maximum water holding capacity (38%) and organic matter contents (1.80%). The percentage of $CaCO_3$ was lower in this community than in the other communities studied. However, pH and soluble salts were higher (Table 3).

DISCUSSION

Vegetation of an area is governed by a complex of environmental factors, including climate, geology, topography and biota Major [13]. The vegetation around the industrial area of Korangi was mostly halophytic and disturbed, which is indicated by the presence of *P. juliflora, H. recurvum, Aeluropus sp., A. indicum, C. holosericea* and *C. procera, P. juliflora* in association with other disturbed species (*C. procera, A. javanica, A. indicum. C. holosericea*) formed a prominent community, similar to the communities found around the cement industries of Karachi Shafiq and Iqbal, in press). This community also formed an association with *S. monoica* but did not show any association with *H. recurvum* and *A. mauroum* which might be due to the increase in soluble salt contents. An appreciable amount of calcium carbonate, poor amount of organic matter is a characteristic feature of arid zone soils (Aubert, [2]. *Suaeda monoica* community, which is a fleshy herbaceous type halophyte, preferred to grow on loamy sand with moderate percentage of maximum water holding capacity, soluble salts and organic matter. Kyani *et al.* [11] had also found similar results in waste lands of Quetta - Pishin districts in Baluchistan. *Suaeda* community formed main associaton with other species (*Aeluropus* sp., *D. bipinnata,* *T. indica, C. cretica, S. baryosmpa, P. juliflora*). Moreover, *S. monoica* alongwith *Aeluropus* sp. preferred to grow on wide range of soil pH, (8.63-9.08). Ca CO_3 (17.75-24.87%), humus content (0.39-3.49%) and soluble salts (0.43-3.02%).

Table 3. Soil characteristics with relation to plant communities.

Edaphic variables	I Prosopis community	II Suaeda community	III Haloxylon community	IV Alhaji community
	Number of stands			
	5,6,7,13,14,15	1,2,3,4,8	9,11,12	10
Coarse sand (%)	69.06 (61.24-80.27)	53.96 (45.91-60.19)	55.74 (31.53-70.74)	27.74
Fine sand (%)	12.21 (4.37-18.44)	24.25 (12.04-30.97)	18.31 (9.00-30.48)	36.54
Total sand (%)	81.27 (78.07-85.97)	78.21 (69.82-84.70)	74.05 (62.01-80.41)	64.28
Silt (%)	8.34 (6.02-14.19)	10.55 (7.41-15.64)	12.55 (7.38-19.92)	21.16
Clay (%)	10.39 (7.63-14.21)	11.23 (7.89-17.17)	13.40 (9.91-18.07)	14.56
(Silt + clay) (%)	9.36 (6.02-14.21)	10.89 (7.41-17.17)	12.97 (7.38-19.92)	17.86
Soil type	Loamy sand (Sand – loamy sand)	Loamy sand (Sand – loamy sand)	Loamy sand (Sandy loam – loamy sand)	Sandy loam
MWHC (%)	26.50 (16.22-34.60)	30.55 (26.99-33.30)	30.83 (26.01-36.98)	38.00
pH	8.32 (8.15-8.60)	8.94 (8.63-9.08)	8.73 (8.58-8.91)	9.12
$CaCO_3$ (%)	25.81 (22.96-29.75)	22.08 (17.75-24.87)	23.02 (20.29-25.31)	20.72
Soluble salts (%)	0.74 (0.18-1.35)	2.24 (0.43-3.02)	4.25 (2.59-5.52)	3.05
Organic matter (%)	0.68 (0.14-1.67)	1.92 (0.39-3.49)	0.79 (0.09-1.32)	1.80

Symbol used:
*Range of edaphic variables; MWHC Maximum Water Holding Capacity.

Similar range of edaphic variables were also observed by Qadir and Fawaris [15] in Sabkha of Zura (Libya) vegetation. Iqbal *et al.* [9] had also found *S. monoica* as a dominant species around the industrial area of Manghopir, Karachi. *Holoxylon recurvum* community was found on the highest percentage of soluble salts as compared with other communities investigated. *Alhaji maurorum* community was present on such soil which showed high level of pH as compared to *Prosopis, Suaeda* and *Haloxylon* communities. Moreover, this community preferred to grow on better textured soil which had high maximum water holding capacity.

The conclusion which could be drawn from this study is that all the vegetation types which were observe around Korangi industrial areas were disturbed by human activities, mainly through the release of chemical wastes from different industries. If the haphazard population growth, and the construction of new industrial structure goes on then probably there would be more vegetative changes in near future.

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