

## Plant Community and Soil Relationships in the Vicinity of International Leather Industry and Farooq Textile Mill of Landhi Industrial Area in Karachi, Pakistan.

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### ABSTRACT

Phytosociological studies were carried around the International Leather industry and Farooq Textile Mill in the vicinity of Landhi industrial estate of Karachi and compared with control area of University Campus to evaluate plant community-soil relationship in the localities. The vegetation was herbaceous, shrubs and predominantly disturbed in nature at all of the sites. Based on the composition, structure and distribution of species, plant communities of each area were recognized. Both plant communities of International Leather industry and Farooq Textile Mill had low number of plant species as related to control area. Importance value index of all the species were determined. *Senna holosericea* (Fresen.) Greuter, *Corchorus depressus* (L.) Stocks and *Amaranthus viridis* L. were found in all the communities whereas, *Corchorus trilocularis* L. and *Abutilon indicum* (L.) Sweet were present in industrial areas. A relationship between soil characteristics and plant communities of the industries of Landhi and control site were conducted. Industrial plant communities have low level of water holding capacity and organic matter and high concentrations of total soluble salts and available sulfate as relative to soil of plant community of control area. The research demonstrated that the plant species were retarded in numbers due to soil pollution as compared to control area of Karachi University Campus due to industrial existing contamination and pollution in soil in the area

**Keywords:** Dominant species, important value index, industrial pollution, phytosociological attributes, plant communities, plants-soil relationship and soil pollutants

### 1. INTRODUCTION

Community is a spatial and temporal organization of organisms with different degree of integration and composed of unequally successful species<sup>1</sup>. A dominant species which displays a pattern may impose a counter pattern on species with which it is competing<sup>2</sup>. Phytosociological studies at the sites of the polluted industrial areas were conducted by (Iqbal and Qadir<sup>3</sup>; Ahmed et al<sup>4</sup>, Iqbal et al<sup>5</sup>; Shafiq and Iqbal<sup>6, 7</sup>; Iqbal and Munir<sup>8</sup> and Shafiq et al.<sup>9</sup>, Mehmood and Iqbal<sup>10</sup>) recognized nine plant communities based on dominant species at wasteland of Valika chemical industries in the locality of Manghopir, Karachi and elaborated that the vegetation was disturbed, halophytic and dominated by *Suaeda fruticosa*, *Tamarix indica*, *Salsola imbricata* and *Cressa cretica*. Qadir et al<sup>11</sup> and Iqbal and Shafiq<sup>12</sup> have identified six plant communities in Karachi University. The vegetation was dominated by halophyte, xerophyte and disturbed plants and dominated by *Corchorus depressus* (Iqbal and Shafiq, 1997)<sup>13</sup>. Soil, air and water have been employed traditionally as sites for the disposal of all wastes. The soil of a natural community is a part of the ecosystem. There is an interactive complementary relation between soils that support the community and affects its characteristics and the community that develops and influences the character of soil<sup>14</sup>. Soil characters have been investigated in the regions of a variety of industries by many researchers. Shafiq and Iqbal<sup>6</sup> elucidated that soil was alkaline in nature, containing appreciable calcium carbonate and low level of organic matter close to National and Javedan Cement factories of Karachi. Mehmood and Iqbal<sup>10</sup> have reflected sandy loam soil, slight variations in the water holding capacity, sufficient range of CaCO<sub>3</sub> and distinct soil pH in the location of wasteland of Valika chemical industries near Manghopir road in Karachi. Wahab and Hashem<sup>15</sup> had enlightened differed moisture content, organic matter and total soluble salts, alkaline soil pH and heavy metals in the estate of Jubail industrial city in Saudi Arabia. It has been seen that, during the last few decades, soil acidification rates have intensively distinguished due to acid deposition<sup>16</sup>. Querol et al<sup>17</sup> explicated atmospheric sulphur isotopes deposition on bed rock and sediment samples, surface and ground water due to SO<sub>2</sub> emissions from the coal fired power plant in North-East Spain. Tanneries are a major source of pollution in Pakistan<sup>18</sup>. Tanneries are located at Korangi (Karachi), Kasur, Muridke, Sialkot, Multan and Gujranwala in Pakistan<sup>19</sup>. Miscellaneous industries are performing hazardous and detrimental role which are contaminating the soil in Karachi and affecting the plant communities around Landhi industrial area.

## 2. EXPERIMENTAL

## 2.1 Phytosociological survey

Karachi is situated on the coast of Arabian sea (Latitudes 24° 50' - 25° 15' North and Longitude 65° 51' -67° 40' East) of Pakistan. Karachi is the largest and an industrial and commercial city of Pakistan. Sampling of the vegetation in the area of International Leather industry and Farooq Textile Mill of Landhi industrial district of Karachi was conducted. Stands were studied by point centered quarter method by employing twenty five sampling points in each stand. Observations were based on four plants measurement at each point. The circumference of every individual species was recorded.

**Table-1:** Importance value index (I.V.I.) of different species in stands of Karachi University and Landhi industrial areas.

	Numbers of species	Different plants species	I.V.I.
<b>Karachi University (Prosopis community)</b>	1.	<i>Prosopisjuliflora</i> Swartz	163.17
	2.	<i>Heliotropiumophioglossum</i> Boiss.	33.85
	3.	<i>Orygiadecumbens</i> Forssk.	30.32
	4.	<i>Chlorisbarbata</i> Sw.	12.80
	5.	<i>Trianthemaportulacastrum</i> L.	9.81
	6.	<i>Launaeanudicaulis</i> Hk. f. (non Less.)	9.48
	7.	<i>Indigoferahochstetteri</i> Baker	6.27
	8.	<i>Cadabafruticosa</i> (L.) Druce	5.39
	9.	<i>Abutilon fruticosum</i> Guill.	3.68
	10.	<i>Convolvulus arvensis</i> L.	3.37
	11.	<i>Sennaholosericea</i> (Fresen.) Greuter	3.21
	12.	<i>Cynodondactylon</i> (L.) Pers.	3.14
	13.	<i>Euphorbia</i> sp.	3.15
	14.	<i>Corchorusdepressus</i> (L.) Stocks	3.10
	15.	<i>Tribulusterrestris</i> L.	3.10
	16.	<i>Amaranthusviridis</i> L.	3.09
	17.	<i>Prosopisglandulosa</i> Torr.	3.08
<b>International Leather industry (Senna Community)</b>	1.	<i>Sennaholosericea</i>	53.32
	2.	<i>Sidaovata</i> Forssk.	45.38
	3.	<i>Tribulusterrestris</i>	43.25
	4.	<i>Corchorustrilocularis</i> L.	31.98
	5.	<i>Aervajavanica</i> (Burm. f.) Juss.	28.13
	6.	<i>Zaleyapentandra</i> (L.) Jeffrey	21.58
	7.	<i>Corchorusdepressus</i>	21.26
	8.	<i>Indigoferahochstetteri</i>	17.60
	9.	<i>Amaranthusviridis</i>	15.79
	10.	<i>Mollugolatioides</i> (L.) Kuntze	7.63
	11.	<i>Abutilon indicum</i> (L.) Sweet	5.04
	12.	<i>Cyamopsistetragonoloba</i> (L.) Taub.	3.93
	13.	<i>Prosopisjuliflora</i>	2.75
	14.	<i>Launaeanudicaulis</i>	2.36
<b>Farooq Textile Mill (Cyperus Community)</b>	1.	<i>Cyperusrotundus</i> L.	65.45
	2.	<i>Corchorustrilocularis</i>	48.58
	3.	<i>Corchorusdepressus</i>	40.76
	4.	<i>Convolvulus arvensis</i>	36.94
	5.	<i>Gynandropsisgynandra</i> (L.) Briq.	25.65
	6.	<i>Salvadoraoleoides</i> Dcne.	23.37
	7.	<i>Abutilon indicum</i>	18.40
	8.	<i>Leucaenaleucocephala</i> (Lam.) de-Wit	15.23
	9.	<i>Sennaholosericea</i>	12.50
	10.	<i>Amaranthusviridis</i>	5.06
	11.	<i>Tephrosiauniflora</i> Pers.	2.79
	12.	<i>Hibiscus scindicus</i> Stocks.	2.67
	13.	<i>Cynodondactylon</i>	2.60

I.V.I. = Importance Value Index

Phytosociological attributes like cover, relative cover, density, relative density, frequency, relative frequency and importance value index of each species were calculated. Afterward, in plant community of each stand, leading dominant species were recognized and plant community was named according to leading dominant species which had the fairly apparent importance value.

Sampling of the vegetation was also conducted at the Karachi University Campus in the same way as carried out at Landhi industrial area. The plant specimens were collected and identified according to Stewart<sup>20</sup> in the Department of Botany, University of Karachi.

## 2.2 Soil analysis

For soil analysis, two soil samples from each site were obtained from 0-30 cm depth, including soil samples from the Karachi University Campus. Soil samples were air-dried, lightly crushed and passed through 2 mm sieve and kept in the laboratory for analysis. For mechanical analysis of soil, coarse sand was determined using 0.05 mm sieve (USDA, 1951)<sup>21</sup>. Maximum water holding capacity (W.H.C.) was measured by the method of Keen<sup>22</sup>. Soil organic matter was assayed according to Jackson<sup>23</sup>. Calcium carbonate (CaCO<sub>3</sub>) was evaluated by acid neutralization, as described by Qadir et al<sup>11</sup>. Bower and Wilcox<sup>24</sup> methodology was used to ascertain total soluble salts, whereas soil pH was notified by a direct pH-reading meter (MP 220 pH Meter) (Mettler, Toledo). Available sulfate in the soil was assessed by the turbidity method, as stated by Iqbal<sup>25</sup> using colorimeter (Photoelectric Colorimeter AE-11M).

## 3. RESULTS

Based on the leading dominant species, first leading dominant species was recognized from each plant community, according to the importance value index. *Prosopis* community was found around Karachi University Campus whereas *Senna* community and *Cyperus* community was recorded in the vicinities of International Leather industry and Farooq Textile Mill, respectively (Table-1).

### 3.1 *Prosopis* community

In this community, *Prosopis juliflora* was dominant in the site of Karachi University Campus (IVI= 163.17) (Table 1). It was associated with *Heliotropium ophioglossum*, *Orygia decumbens*, *Chloris barbata* and *Trianthema portulacastrum*. Soil of this community had manifestly prominent percentage of sand (58%), water holding capacity (22%), organic matter (1.5%) and CaCO<sub>3</sub> (17.8%) with notable pH (8.4) whereas, total soluble salts (5.9%) and available sulfate (8.0 µg<sup>g</sup>) were decreased in the soil of Karachi University Campus as correlated to the industries soils (Table-2).

### 3.2 *Senna* community

*Senna holosericea* was dominant (IVI= 53.32) near the International Leather industry in the Landhi industrial area (Table 1). It was recorded along with other floras like, *Sida ovata*, *Tribulus terrestris*, *Corchorus trilocularis* and *Aerva javanica*. The coarse sand (23.0%), water holding capacity (17.0%) and organic matter (0.4%) were virtually confined extent whereas total soluble salts (5.9%) and available sulfate (63 µg<sup>g</sup>) were considerably higher as compared to other studied communities (Table-2).

### 3.3 *Cyperus* community

*Cyperus rotundus* was the primarily dominant (IVI = 65.45) at Farooq Textile Mill at Landhi industrial area (Table 1). It was noted beside with *Corchorus trilocularis*, *Corchorus depressus*, *Convolvulus arvensis* and *Gynandropsis gynandra*. Soil had restricted magnitude of sand (25.0%), water holding capacity (26.0%) and organic matter (1.0%), CaCO<sub>3</sub> (10.5%) (Table-2). It contained great amount of total soluble salts (6.5%) and available sulfate (10.0 µg<sup>g</sup>) as related to Karachi University community. The pH (8.3) of this community was slightly high than control location.

**Table-2:** Properties of different soil types.

Soils	Coarse sand (%)	*W.H.C. (%)	Organic matter (%)	CaCO <sub>3</sub> (%)	Total soluble salts (%)	pH	Available sulfate (µg <sup>g</sup> )
Karachi University	58±0	27±0	2.0±0.3	17.8±0.3	5.9±0.7	8.4±0.0	8±0
International Leather Industry	23±5	17±0	0.4±0	12.5±1.5	13.5±0.5	8.2±0.0	63±13
Farooq Textile Mill	25±7	26±1	1.0±0.3	10.5±1.5	6.5±1.5	8.3±0.1	10±3

#### 4. DISCUSSION

*Senna holosericea* was a principally prevailing species around International Leather industry after that of *Sida ovata* and *Tribulus terrestris*. *S. holosericea* was recorded near to diverge industries by earlier workers<sup>5, 6, 10</sup> and the land of motorways by Iqbal et al<sup>26</sup> and at less contaminated area of Karachi University Campus by Iqbal and Shafiq<sup>13</sup>. Whereas, *S. ovata* was present here of varied industries by Iqbal and Shafiq<sup>6</sup>. In the verge of Farooq Textile Mill, *Cyperus rotundus* was leading as a first dominant plant, subsequently *Corchorus trilocularis* and *Corchorus depressus* were second and third leading sorts, respectively. *C. rotundus* and *C. depressus* were detected nearly industrial proximity by Iqbal et al<sup>5</sup>. *C. depressus* was emerged in the places of disparate cement factories through Shafiq and Iqbal<sup>6</sup>, else in the territory of the Karachi University Campus<sup>13</sup>. A phytosociological study in the land of a control locality of Karachi University Campus was also conducted for comparison of vegetation with Landhi industries. Vegetation analysis gives the information necessary to review the communities and provide data that could be used to compare it with other communities. Plant community of Karachi University Campus exhibited that *Prosopis juliflora* was leading as a conspicuously prevailing type while, *Heliotropium ophioglossum* and *Orygia decumbens* were second and third foremost key assortments, in that order. Shafiq and Iqbal<sup>7</sup> have reflected that *P. juliflora* and *P. glandulosa* were considered to be the indicator of disturbance. *Prosopis glandulosa* was also searched out in Karachi University Campus. Generally, *P. juliflora* can grow in the extensive vicinities by reason of its existence and acceptance in almost every type of environment. *P. juliflora* was also found close to International Leather industry and Karachi University Campus. *P. juliflora* was too reported at National and Javedan cement factories of Karachi as a first especial type where *H. ophioglossum* was also noticed by Shafiq and Iqbal<sup>6</sup>. *P. juliflora* was also recoded around Valika Chemical industries in the region of Manghopir in Karachi<sup>10</sup>. *P. juliflora* was also observed in the location of sewage effluents channels of Lyari river via Iqbal et al<sup>26</sup>. *P. juliflora*, *Abutilon indicum* and *S. holosericea* are floras which are disseminated universally<sup>27</sup>. In the current learning, *C. trilocularis* and *A. indicum* were merely presented in contaminated territories. In spite of literally remarkable metal additions in the foliage, *A. indicum* was established in the factories surroundings of Korangi and Landhi in Karachi<sup>27</sup>. *A. indicum* was also reported through Shafiq and Iqbal<sup>6</sup>. *S. holosericea*, *C. depressus* and *Amaranthus viridis* were in attendance at cumulative proximities of contaminated else control. *A. viridis* happened along the sewage effluents channels of Malir river in Karachi<sup>28</sup>. Vegetation directly depends on the soil characteristics and circumstances necessary for their successful growth. Appropriate edaphic situations demonstrated species richness of plants was 17 in numbers at soil of Karachi University than factories locations which were 14 and 13 vegetative species in the near of international Leather industry and Farooq Textile mill, consecutively. Plant density, species richness and diversity every one retrograded with increasing in sludge rate on a degraded semi-arid broom snake weed<sup>29</sup>. The soils of plant communities of International Leather industry and Farooq Textile mill close by Landhi industrial spots of Karachi have small quantity of water holding capacity, deficient organic matter and amplified points of total soluble salts and available sulfate comparatively to soil of plant community of Karachi University Campus. Drought conditions appear in the result of paucity of organic matter, retrogressed irrigated water and noticeable salinity else loose edaphic characters. Some of them have been shown to be regulated by various stresses, including salinity and drought<sup>30</sup>. In those communities which had a greater percentage of soil organic matter, the water holding capacity of soil was consequently increased due to the colloidal nature of the organic matter<sup>31</sup>. Pakistani soils are extremely scarce in organic matter<sup>32</sup>. Soluble salts produced a considerable impact on the plant communities<sup>33</sup>. Marshall and Furnier<sup>34</sup> had expressed a significant reduction in growth and biomass accumulation in *Ailanthus altissima* seedlings due to SO<sub>2</sub>.

#### 5. CONCLUSION

In the present study would suggest that *Senna holosericea*, *Corchorus depressus* and *Amaranthus viridis* were major species which are distributed in the entire intentioned localities. The ranges of soil characters of coarse sand, water holding capacity, organic matter, CaCO<sub>3</sub>, total soluble salts and available sulfate were between 23-58%, 17-27%, 0.4-2.0%, 10.5-17.8%, 5.9-13.5% and 8.0-63.0 µg<sup>-8</sup>, respectively where above-mentioned plants were growing among wide ranged of edaphic circumstances of control and industrial soils.

The findings of this research could be helpful in monitoring the plant communities around the industrial areas. Furthermore, such information could also be useful for landscaping and urban planning.

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