PHYTOSOCIOLOGICAL STUDIES OF AZAKHEL, DISTRICT PESHAWAR

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Abstract

During phytoscociological studies, made at Azakhel, District Peshawar from December, 1979 to June, 1980, 4 plant communities wre recognized, viz. 1. Desmostachya-Suaeda community 2. Saccharum-Desmostachya community 3. Desmostachya-Saccharum-Alhagi community and 4. Phragmites community. Some environmental, particularly the edaphic factors were also studied. Investigations indicate that some tree species like *Phoenix dactylifera* and fodder plants like *Diplachne fusca* and *Juncus maritimus* can be tried successfully in the area for land reclamation and range management.

1. Introduction

The twin problem of water-logging and salinity present sone of the most er ous threat to the soil productivity of our country. During the past few decades, water-table in the irrigated tracts has risen considerably. The seriousness of the problem can be visualised from the fact that the water-table stands within 3 m of the soil surface in an area of about 5.6 million hectares. The areas most affected by water-logging and salinity lie in Sargodha, Sahiwal, Gujrat, Bahawalpur, Dadu and Peshawar Valley.

Both the WAPDA and the Agriculture Department are doing their best to solve the problem through mechanical methods, like sinking of tube wells, leaching of salts and horizontal drainage etc., and have even succeeded to some extent. These methods being costly, cheaper devices and efforts through biological amelioration need to be sorted out and the present study is an attempt in this regard.

The response of plants to saline environment has evoked interest mainly from this point of view which is concerned with the utilisation of saline soils, prevention of secondary salinisation and usage of slightly saline water in agriculture. Very little information about the type of work is, however, available in this country. Efforts must, therefore, be made to find out plant communities and salt-tolerant species, occurring on water-logged and saline habitats. Keeping this in view, the present problem was taken up.

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The study area lies at an altitude of 304 m on the Peshawar-Nowshera Highway at a distance of about 35 km from Peshawar, with river Kabul towards the north and Khattak Hills towards the South. The area, which is covered by halophytic vegetaion, has a twin problem of water-logging and salinity. This has rendered the land unsuitable for production of agricultural crops. Even the tree-growing trials have not been successful.

Geology of the study area has been described by Said and Majid (1976). Pale yellow silt-stone forms the soil parent material near Azakhel Bala village. The predominance of the silt suggests that Azakhel silt-stone is basically formed of wind-blown material, the loess, that has been primarily derived from the igneous rocks of the neighbouring areas, mainly from the previously glaciated parts of Chitral, Swat, Dir, Hazara, and Indus Kohistan. This older loess, has been reworked by streams and deposited in shallow water, as it is suggested by the horizontal bedding and fossilized roots.

As the Azakhel silt-stone also occurs at Nowshera, Akora, Ziarat Kaka Sahib and Mattani, it appears that during the second glaciation, a very large part of Peshawar valley was occupied by a fresh water lake. The surrounding foot-hills were blanketed with a thick cover of wind-blown silt (loess) which was exposed to erosion by streams and torrents. This eroded silt was ultimately deposited in the lake as thin-bedded silt-stone.

The climate is semi-arid warm subtropical continental monsoon/winter type, with a mean annual rainfall of 329.00 mm mainly received during cold period. (Table 1). The highest relative humidity of 68% is during July. The highest wind speed of 140 km/hr was recorded for November, 1978. Mean maximum temperature in June for a period of 10 years (1969—78) was found to be 41.8°C and the mean minimum temperature in January 1.01°C.

Grazing is the predominant land-use in the area. A large number of nomads are always seen in the area with their large herds of sheep, cows and donkeys grazing in the area. Rats, too, is a common feature, destroying seeds and seedlings of many species. Big krotovinas, too, are not an exception. Mounds of clay and sand can also be seen throughout in the *Desmostachya bipinnata* habitat. *Typha angustata* is cut for making ropes and praying mats and *Phragmites kakra* for thatching roofs.

Table 1. Meteorological Data of the Sutdy Area
For the period from 1969 to 1978.(1)

	January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Mean Max. Temp (^{O}C)	17.44	18.56	23.85	29.2	35.28	39.25	36.49	34.49	33.90	30.39	25.09	19.94
Mean Min. Temp (^{O}C)	2.57	4.45	9.68	13.39	19.42	24.97	25.68	24.06	21 82	14.04	6.76	3.96
R. Humidity (%)	60	63	60	48	39	46	67	69	59	50	53	66
Rainfall (mm)	14.27	41.19	43.32	40.41	15.19	12.56	45.35	68.49	22.52	5.42	9.88	10.36
No. of rainy days	3	5	7	4	3	1	5	4	3	3	1	2
Wind speed. (Km/hr.)	34.0	36.1	37.4	40.8	65.9	64.1	60.2	8.4	48.7	28.2	20.0	22.0

(1) By the courtesy of Pakistan Forest Institute, Peshawar.

2. Review of Literature

Not much work has been done on the subject in the country. Elsewhere, Grillot (1960) has summarised the findings of various authors in respect of salinity and sensitivity of various plants. Beeftink (1966) graded some plants according to degree of resistance.

In Pakistan, Chaudhri (1952) has described vegetation of water-logged areas of Sheikhupura District. Some work on forestry measures against water-logging and salinity was done by Repp (1957). Bangash (1974) has studied the effect of varied salt concentrations on the germination of seeds and growth of seedlings of different tree species. It was found that *Melia azedarach* survives in a salt concentration of 0.6%. The salt limits for normal germination and good growth in *Ailanthus altissima* were found to be respectively 0.6% and 0.5%, while *Robinia pseudoacacia* behaved as less so tolerant.

Som afforestation experiments have been done in water-logged and saline areas of Azakhel by Sheikh (1974). According to him, *Eucalyptus* spp. can do well on such sites.

3. Materials and Methods

Vegetation was sampled, laying 32 one-and two-metre quadrats on comparatively homogeneous sites in all directions, with a quadrat to quadrat distance of 70 m. Plant communities were determined after method of Braun-Blanquet (1965), modefied by Cetik (1973). Ecological observations like parent rock material and Hcl reaction were also recorded.

Twenty one soil samples were collected from different sites investigated, at depths of 15 cm and 15—30 cm, recording drainage, moisture, stoniness, permeability and root distribution. Soil colour, texture, consistency, reaction and porosity were also noted. Texture was determined by Day method, making use of Bouyocos hydrometer and interpreting it after texture triangle method and pH with the help of pH paper and Thymol blue indicator.

Soil chemical analysis were made at the Soil Section, Tarnab Research Institute. $CaCo_3$ was determined by calcimeter method. Total K, Na and Ca were determined by Flame photometer. Phosphorus was determined by Olsen method.

Organic matter percentage was determined by Wa-kling and Black method of Jackson (1958). Total nitrogen percentage was determined by Kjeldahl's method. Total soluble salts were determined, using conductivity Bridge.

4. Results

Analysis of the data on soils-vegetation resulted in recognition of the following four plant communities:

i. Desmostachya-Suaeda community

This plant community is restricted to extreme halophilous silty-sandy clay loams, silty clays sandy loams rich in $Na_2 Co_3$ and Nacl, too, with a white crust on the surface due to heavy

NaCl deposition. (Table 2) . The textural components of the soil are silt 32—52%, clay 7—39% and sand 21—47%. Total soluble salts range from 0.57 to 3.04%, phosphorus and nitrogen being deficient and respectively 35—80 ppm and 0.041—0.063%, $CaCO_3$ from 6.50 to 8.75% and organic matter as low as 0.63—1.20%. pH is 9.5 to 10.2.

Table 2. Physical and chemical characteristics of soil under Desmostachya-Suaeda Community.

1. PHYSICAL ANALYSIS OF SOIL

Soil Sample No.	Depth (Cm)	Clay (%)	Silt (%)	Sand (%)	Texture
1	1—15	25.0	52.0	23.6	Scl silty clay loam
2	15—30	39.0	40.0	21.0	Sc silty clay
3	1—15	15.0	38.0	47.0	Sl sandy loam
4	15—30	29.0	40.0	31.0	Scl sandy clay loam
5	1—15	7.0	32.0	61.0	Sl sandy loam

2. CHEMICAL ANALYSIS OF SOIL

Soil Sample No.	Total Soluble Salt (%)	pH	Conduc-tivity	ppm of available P 2 05	ppm of exchange able P2 05	Nitrogen (%)	Organic Matter (%)	Ca Co_3 (%)
1	1.44	9.9	4.5	80	780	0.063	1.24	7.5
2	0.576	9.7	1.8	48	780	0.057	1.17	7.25
3	1.344	10.2	4.2	110	682	0.041	0.63	8.75
4	3.040	10.0	9.5	87	645	0.60	1.10	8.75
5	0.640	9.5	2.0	35	495	0.058	1.07	6.50

The vegetation typically comprises *Desmostachya bipinnata*, an exclusive characteristic species of the community, with 85% coverage and *Suaeda fruticosa* with 45%. Among the associates were *Kochia indica* and *Atriplex* sp.

The habitat naturally does not support any tree or other shrub flora due to high concentration of salts.

ii. Saccharum-Desmostachya community

This plant community is mostly confined to sandy-clay loamy (sometimes clay) moderately saline soils (Table 3). It was noticed that *Desmostachya bipinnata* starts declining with increasing salinity.

The profile examination upto 90 cm depth showed that while Ao horizon was completely missing, the position being occupied by whitish crust of salts, A horizon was mostly sandy loam and B and C clay loams at a depth of 60—80 cm. Sand ranged between 23 to 56%, silt 44—56% and clay 5—34%.

Soils are generally deficient in nitrogen and phosphorus. Nitrogen stands at 0.039—0.057% Phosphorus 11—24% and Potassium 195—1290 ppm. The organic matter was 0.79—1.14% and $CaCo_3$ 2.85—7.0%, giving a strong HCI reaction. pH was 9—10.3.

The plant community typically comprises *Saccharum spontaneum* with a coverage of 93% and *Desmostachya bipinnata* with that of 38%. The associates included *Atriplex turcomanica, Cyperus rotundus, Cenchrus ciliaris, Alhaqi camelorum, Dichanthium annultaum, Melilotus parviflora, Senebiera didyma* and *Taraxacum officinale*.

It was observed that *Melilotus parviflora* and *Senebiera didyma* were declining with increasing salinity. Some members of Cruciferae, in spite of the fact that they were occurring in saline soils, are not included as obligate or facultative haloplytes. However, they can be placed in the preferential halophytes.

This soil only supports graminaceous plants with fibrous root-system.

iii. Desmostachya-Saccharum-Alhagi community

The plant community was found on calcareous silty clays sometimes clay loams. (Table 4) The soil profile, examined down to a depth of 80 cm, shows clear horizons. While Ao horizon was absent, A horizon was mostly silty clays and B horizon clay loams.

The silt was dominating in the soils, being 47—50%, while clay and sand were respectively 22—37% and 13—31%. Soils fre generally deficient in nitrogen and Phosphorus. Nitgoren ranges between 0.041—0.078%, phosphorus 19—108% and potassium 915—1050 ppm. The organic matter was 0.82—1.52%, $CaCO_3$ 4.25—7.75%. pH was 9.6—10.4%.

The community typically comprises *Desmostachya bipinnata* and Saccharum spontaneum, with a canopy coverage of 90% and 15% respectively. *Alhagi camelorum* occurred in the subdominat capacity, with a canopy coverage of 2%. Among the associates were *Chenopodium*

sp., *Cynodon dactylon*, *Suaeda fruticosa*, *Sporobolus* sp., *Cyperus rotundus*, *Rumex nepalensis*, *Alopecurus nepalensis* and *Raunculus muricatus*.

iv. Phragmites community

The plant community is mostly confined to waterlogged soils rather than saline soils and, therefore, can be called a community of water-logging. (Table 5) The soil is wanting in Ao horizon but B and C horizons are prominent. The soils in B and C horizons are sandy clay-loams or salty clays with 23—30% clay, 40—49% silt and 21—34% sand. Soils are generally deficient in nitrogen and phosphorus with nitrogen 0.044—0.72% and phosphorus 7—44% and potassium 555—597 ppm. The organic matter was 0.88—1.45%, $CaCO_3$ 3.50—7.0%. pH was 7.4—9.8.

The community typically comprises *Phragmites karka* with 40—80% canopy coverage. Among the associates are *Alhagi camelorum*, *Saccharum spontaneum*, *Cenchrus ciliaris*, *Sporobolus* sp., *Desmostachya bipinnata*, *Phalaris minor*, *Dichanthium annulatum*, *Cyperus rotundus*, *Juncus maritimus*, *Typha angustata*, *Atriplex turcomanica* and *Cynodon dactylon*.

5. Discussion and Recommendations

The vegetation growing on various soils investigated is specific to and characteristic of the respective habitats. It is poor in species number due to the twin problem of salinity and water-logging. For most herbs, it is difficult to establish because of high salinity while for trees and shrubs lack of oxygen and presence of chlorides and carbonates in the underground water is the main problem.

The raised sites, with strongly saline soils, support Desmostachya-bipinnata-Suaeda fruticosa community. While the low-lying areas, cut off from the sweet flood water and with brackish water often standing on the surface, bear Phragmites karka community, those flooded periodically with the sweet river water bear Desmostachya bipinnata-Saccharum spontaneum-Alhagi camelorum and Saccharum spontaneum-Desmostachya bipinnata communities, depending upon the degree and frequency of inundation.

As the sweet irrigation water is not available closeby, there is only one course for reclamation of soils in the raised habitats, i.e. forestry measures. Trees which can stand salinity and benefit from underground saline water may be grown. Among them are *Phoenix dactylifera*, *Tamarix aphylla*, *Populus euphratica*, *Eucalyptus camaldulensis*, *Salix tetrasperma* and *Albizzia lebbek*. Site will have to be prepared and initial watering provided. Once established, the plants will stand on their own feet. This would reclaim the soil and provide some wood as well as some fruits to the local population. As to *Phragmites karka* area nothing would ever grow successfully in this habitat. The Saccharum-Desmostachya and Desmostachya-Saccharum-Alhagi sites could be used to grow *Diplachne fusca*, a perennial grass and *Juncus maritimus*, a sedge to provide forage and fodder for the grazing livestock.

Table 3. Physical and chemical characteristics of soil under Saccharum-Desmostachya Community.

2. PHYSICAL ANALYSIS OF THE SOIL

Soil Sample No.	Depth (Cm)	Clay (%)	Silt (%)	Sand (%)	Texture
6	15–30	19.0	44.0	37.0	Sandy loam
7	1–15	5.0	46.0	49.0	Sandy loam
8	15–30	13.0	46.0	49.0	Sandy loam
9	1–15	28.0	49.0	23.0	Cley loam
10	15–30	34.0	56.0	56.0	Silty clay

2. CHEMICAL ANALYSIS OF THE SOIL

Soil Sample No.	Total Soluble Salt (%)	pH	Conduc-tivity	ppm of available P_2O_5	ppm of exchange able K_2O	Nitrogen (%)	Organic Matter (%)	Ca Co3 (%)
6	0.32	9.3	1.0	11	510	0.057	1.14	2.85
7	0.544	9.0	1.7	23	1290	0.057	1.14	5.50
8	0.224	9.9	0.7	14	1050	0.042	0.85	2.85
9	0.704	9.0	2.2	24	945	0.039	0.79	7.0
10	0.32	10.3	1.0	15	195	0.045	0.91	3.0

Table 4. Physical and chemical characteristics of soil under Desmostachya-Saccharum-Alhagi community

1. PHYSICAL ANALYSIS OF THE SOIL

Soil Sample No.	Depth (Cm)	Clay (%)	Silt (%)	Sand (%)	Texture
11	1–15	31.0	51.0	18.0	Silty clay
12	15–30	31.0	50.0	19.0	Silty clay
13	1–15	35.0	48.0	17.0	Silty clay
14	15–30	37.0	50.0	13.0	Silty clay
15	1–15	22.0	47.0	31.0	Clay loam

2. CHEMICAL ANALYSIS OF THE SOIL

Soil Sample No.	Total Soluble Salt (%)	pH	Conductivity	ppm of available P_2O_5	ppm of exchangeable K_2O	Nitrogen (%)	Organic Matter (%)	$CaCO_3$ (%)
11	1.376	9.8	4.3	71	990	0.071	1.42	6.0
12	1.334	10.4	4.2	47	975	0.052	1.14	4.25
13	2.048	10.2	6.4	108	1050	0.078	1.52	6.50
14	1.280	10.0	4.0	55	1020	0.053	1.03	7.75
15	0.928	9.6	2.9	19	915	0.041	0.82	7.75

Table 5. Physical and chemical characteristics of soil under Phragmites karka community

1. PHYSICAL ANALYSIS OF THE SOIL

Soil Sample No.	Depth (Cm)	Clay (%)	Silt (%)	Sand (%)	Texture
16	15–30	26.0	40.0	34.0	Clay loam
17	1–15	23.0	48.0	29.0	Sandy clay loam
18	15–30	29.0	44.0	27.0	Clam loam
19	1–15	28.0	49.0	31.0	Clay loam
20	15–30	30.0	49.0	21.0	Silty clay

2. CHEMICAL ANALYSIS OF THE SOIL

Soil Sample No.	Total Soluble Salt (%)	pH	Conduc-tivity	ppm of available P_2O_5	ppm of exchange-able K_2O	Nitrogen (%)	Organic Matter (%)	$Ca Co_3$ (%)
16	0.256	9.7	0.8	7	795	0.063	1.26	3.50
17	0.480	9.5	1.5	30	660	0.044	0.88	7.0
18	0.32	9.8	1.0	9	555	0.63	1.26	4.50
19	1.248	9.6	3.9	44	615	0.72	1.45	5.50
20	0.416	7.4	1.3	23	570	0.058	1.17	6.50

6. Acknowledgements

We are deeply indebted to Dr. G.M. Khattack, Director General, Pakistan Forest Institute, Peshawar for providing us the facilities to complete this project.

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