VEGETATION STUDIES AT SANGJANI (ISLAMABAD)

BY

ABDUL GHAFOOR
M.Sc. (BOT) U.A.F

A THESIS SUBMITTED TO THE QUAID-I-AZAM UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF PHILOSOPHY
IN
PLANT ECOLOGY

DEPARTMENT OF BIOLOGICAL SCIENCES
QUAID-I-AZAM UNIVERSITY
ISLAMABAD

1991

DEDICATED TO:

The last Prophet, Hazrat Muhammad Mustafa

(Peace be upon him)

those who believe that he is the

last Messenger of Allah

and to my lovely nephews Amjad & Tahir.

The thesis submitted by Mr. Abdul Ghafoor in partial fulfilment for the Degree of Master of Philosophy in the Department of Biological Sciences, Quaid-i-Azam University, Islamabad, is found satisfactory and is recommended for the award of the degree.

Internal Examiner: _____

External Examiner: _____

Chairman: _____

Dated: _____

CONTENTS

ACKNOWLEDGEMENTS

"IN THE NAME OF ALLAH , THE COMPASSIONATE, THE MERCIFUL"

I express my deepest sense of gratitude to ALMIGHT ALLAH, who enabled me to complete this manuscript. Particular depth of my venerable supervisor DR. TAHIRA AHMAD, under whose auspices I took stride in the completion of this feat. Once again I express heartfelt gratitude for her constructive suggestions and interest during the completion of this study.

I am greatly indebted to professor Dr. M.A. Hafeez, Chairman, Department of Biological Sciences and other staff members of the Department, especially Dr. Mir Ajab Khan and Dr. Rizwana Aleem Qureshi for their cooperation in plants identification during my studies.

Thanks are extended to Dr. Pervaiz Naeem, Senior Scientific Officer NARC for his cooperation in Research work.

I express my sincere thanks to Tanveer Ahmad Khan, Technical Assistant, Department of Biological Sciences for his help in analytical work.

I submit my exorbitant, sincere and hearty thanks to my college Principal Malik Manzoor Ahmad Bhutta and my colleague Muhammad Hanif Khan, Lecturer in Biology, Govt. College Taunsa to relieve me to write this manuscript.

I am also thankful to my friends,Amir Muhammad Khan, Khalid Mateen Khan, Zia (General), Abdul Majid, Masood Hashmat Nadeem, Sikandar and Arshad Mahmood for their cooperation in my research work.

Thanks are also to Mr. Abdul Qayyum, Scientific Officer, PARC and Mr. Pervez Akhtar Stenographer, PARC for Composing of thesis.

Last but not the least I express my deep sense of gratitude to my parents, brothers and lovely sisters, who inspired me to achieve Master of Philosophy degree.

(ABDUL GHAFOOR)

ABSTRACT

ABSTRACT

Phytosociological survey was performed at Sangjani (Islamabad). Twenty stands were selected purely randomly. Ten quadrats of 2x2 m were laid in each stand. Thirteen plant communities were recognized. Communities were named on the basis of I.V. of the three dominants. Six plant species viz *Adhatoda zeylanica, Carthamus oxyacantha, Acacia modesta, Carissa opaca, Olea ferruginea* and *Ziziphus jujuba* were the leading dominants. Dandrogram analysis revealed three vegetation clusters. These clusters were formed in three different zones of study area. *Carthamus oxyacantha* and *Echinops echinatus* were present in the fields from where wheat was harvested while shrubs were present in waste places and on the edges of cultivated areas.

Factors like amount of $CaCO_3$, Texture, Ca^{++} and Biota were found to be influential on vegetation structure.

CHAPTER–1

INTRODUCTION

The increasing human population is disturbing the ecosystems by supporting the required ones and destroying the unrequired ones. Man is the biggest consumer in the ecosystem. He is using both the biotic and abiotic components and is providing no remedy for this, bringing the full world towards a big destruction. Green house effect and production of holes in the ozone layer at both arctic and antarctic regions is a first indication and expected rise of temperature, increase in flooding in oceans is another one (Pak. Times, 1990).

Except these long term effects, destruction of natural forests & vegetation is reducing the wildlife and their resources. According to authoritative experts, an acre of forest is being destroyed every second (Hussain, 1990). Of the different anthropogenic activities, industrialization is a big one. The fast industrial growth is causing an enormous environmental pollution, mainly through the contamination of soil, air and water. The effects of industrial pollutants depend upon many factors such as:nature of chemicals, toxicity, time of exposure and temperature. Plants absorb ions of toxic nature by root system and by aerial parts. Suspended matter and colour of the pollutants also effect the vegetation. This discharged material therefore affects vegetation types (Iqbal et al., 1983).

Present work is a part of continuous work being done on the phytosociology of Margalla Hills & Islamabad by Hijazi (984) Akbar (1988) and Khattak (1989). The area selected for this work was Sangjani (Islamabad). The area had special attention due to:-

i. The presence of a cement factory.

ii. Blasting for breaking of stones.

iii. Heavy traffic load on the G. T. Road.

iv. Crushers working in the area.

Due to the presence of such harsh factors, the area may possess a different environment from rest of Islamabad.

Objectives of the present study therefore were:-

i. To know the floristic composition of plants

ii. To provide a quantitative and qualitative description of structure and community organization of the vegetation of the area.

iii. To bring on record, the characteristics of the vegetation which is under destruction due to various industrial processes.

CHAPTER-2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Vegetation of an area is usually affected by soil, topography, climate and other biotic factors. Amount of literature on such phytosociological work is very large and it is not possible to cover the whole of it in this review. This review therefore, has been confined to some of the studies carried out in 1980-1990 only.

Soil affects the plants growth and their composition through the availability of nutrients and water. For example Shaukat *et al.* (1981) found that progessive succession was governed intially by extrinsic properties of plants. They found that with a decrease in soil, pH, plants composition was decreased. With an increase in pH $CaCO_3$, humus silt and clay percentage were increased. Due to this, moisture regime was increased and structural changes in vegetatoin occurred due to improvement in moisture and nutrients.

Susan *et al.* (1982) analysed the vegetation of forests of the small stream bottoms in the Central Coastal plains of Virginia in relation to texture, field capcity permanent

wilting point, water availability, pH and levels of extractable Ca, Mg, Nitrate, N, K and P. Strong correlation was found between vegetation composition and soil moisture level and flooding.Full year moist areas were deminated by *Fraxinus pennsylvanica, Acer rubrum* and *Ulmus americana*. Drier swamps had high I.V. for *Carpinus caroliniana* and *Liquidambar styraciflua*.

Chaghtai *et al.* (1983) studied the plant communities of muslim graveyards at Kohat. They found the vegetation to be controlled by sand and $CaCO_3$ proportion.Climax vegetation was of *Acacia modesta, Salvadora oleoides, Capparis decidua* and *Ziziphus nummularia*. *Acacia modesta* was leading dominant on mesic sites while *Salvadora oleoides* was leading dominant on xeric sites.

Chaghtai and Khattak, 1983 found that different moisture regimes were the controling factors for the type of vegetation in dry streams in Peshawar. They noted that in early winter, moist sites were invaded by annual weeds and crops. After winter rain, only deep rooted species survived. Drought resistant species were present on raised gravel

excavated sites.

Amin *et al.* (1984) while working on the phytosociology of Lohibher range determined that: *Chrysopogon montanus* - *Adhatode vesica* - *Eleusine compressa* community was present on gravelly colluvium, dark brown, sandy loam texture soils. *Desmostachya bipinnata* - *Saccharum spontaneum* - *Chrysopogon montanus* community was present on soils of sandy loam to clayey with medium to fine texture. *Eleusine* - *Cymbopogon* - *Capparis* community was present in soils with low organic matter and *Chrysopogon* - *Heteropogon* - *Desmostachya* community was present in loamy to fine sandy loam soils.

Kayani *et al.* (1984) found six different plant communities on calcareous soil with basic reaction at the wastelands of Quetta-Pishin districts. Texture, soluble ions, salinity and sodicity levels varied in different communities.

Hijazi (1984) analysed the vegetation of Margalla Hills National Park, Islamabad and revealed calcium, sodium, cation exchange capacity and texture were influential on seven major vegetaion types of the area.

Grootjans *et al.* (1985) found an increase in nitrogen mineralization with lowering of water table. As a response of this, nitrophilous herbs like *Urtica dioica, Anthriscus sylvestris, Stellaria media* were increased but species richness was decreased.

Ahmed (1986) recognized six plant communities from 17 locations near roadside on the great silk road from Gilgit to Passu. He reported that soils texture, Na, K and organic matter had some controlling influence over vegetation.

Qadir and Shetvy (1986) studied phytosociology of some Libyan plant communities in relation to different soil types. They found that *Stipa tennacissima - Fruticosa lichen* community was present on low calcareous hills with clay loam soil; *Salicornia fruticosa - Aeluropus lagopoides* on saline flats of zwara with clay loam soils. *Paraphalis incurva - Lotus sp.- Artemesia compestris* on the sand dunes of *Bir chanam* with sandy loam soil and *Crepis sp. - Paronychia arabica - Erodium lacinatum* community was present on abundant field of zelthin with sandy clay loam soils.

Tareen *et al* (1987) surveyed the vegetaion around Chiltan in Quetta district.They found eleven different plant communities. Correlation between communities and edaphic factors showed that maximum water holding capacity, calcium carbonate, organic matter, EC and chlorides were important edaphic factors controlling the vegetation types.

Kayani *et al.* (1988) performed a phytosociological work in Nasirabad and Sibi district, Baluchistan. They recognized nine plant communities which were associated with fine to coarse textured and moderate to strongly calcareous soils.

Tareen and Qadir (1990) recognized twenty three plant communities from water courses of Quetta district. Individual communities differed due to soil characteristics. Two communities were found on sandy clay loam, two communities on sand and rest of the communities were found on loamy sand. pH, EC, $CaCO_3$, HCO_3, Cl and Ca + Mg were also found to be controlling factors of the vegetation.

Slope and Topography

Topography affects the vegetational type and its quantitative characteristics due to variations in climatic factors and soil development at a certain topographic level e.g.

Haq and Khattak (1982) conducted a phytosociological survey of the vegetation of Shahghai Hills in Khayber Agency, NWFP. Two communities viz, *Rhazya - Vicia - Withania* and *Rhazya - Cynodon - Withania* were recognized on south and north facing slopes respectively.

Amin *et al* (1984) studied vegetation in different land units at Lahibher range. They found *Chrysopogon - Adhatoda - Elusine* community on gravelly hills. *Desmostachya - Saccharum - Chrysopogon* community was present on stream beds, adjoining slopes and edges. *Eleusine - Cymbopogon - Capparis* community was present on eroded hill slopes and tops.

Khattak *et al.* (1984) studied the vegetation of the north and south facing slopes of Cherat Hills. *Acacia - Eleusine - Dodonaea, Olea - Cymbopogon - Dodonaea* and *Reptonia - Gymnosporia - Dodonaea* communities were

established on south facing slopes. The north facing slopes were inhabited by *Olea - Apluda - Chrysopogon, Reptonia - Micromaria, Acacia - Dodonaea - Gymnosporia* and *Olea - Cymbopogon - Chrysopogon* communities.

Biotic factors

Biotic factors like grazing, eradication of natural plants for cultivation of land and cutting of wood for fuel purposes affects the composition and distribution of different plants e.g.

Chaghtai *et al.* (1983) found that when there was no distrubance, climax vegetation of graveyards of Kohat was *Acacia modesta, Salvadora oleoides, Capparis decidua* and *Ziziphus nummularia* usually *Acacia modesta, Capparis decidua* and Ziziphus nummularia were used for grazing and fuel purposes.

Chaghtai *et al.* (1984) found *Dodonaea viscosa* to be cut and used as fuel by local people at Shrine of Ghalib Gul Baba in Khwarra-Nilab valley. *Acacia modesta, Maytenus royleanus* and *olea ferruginea* were used for grazing and fuel.

Khattak *et al.* (1984) while studying the vegetation of north and south facing slopes of Charat Hills, found that *Acacia, Dodonaea, Olea, Reptonia* and *Gymnosporia* were used for fuel and grazing purposes.

Tareen and Qadir (1990) found much biotic disturbance in the vegetation of water courses of Quetta district.

CHAPTER–3

MATERIALS AND METHODS

1) Study Area

Area selected for research study was Sangjani (Islamabad). The area is situated between latitudes 33° 35N to 33° 39N and longitudes 72.91° to 72.94° in North East Pothwar (Fig-I,II). Climate is semi-arid having moderate summers and winters. Rainfall is 308.5 mm (max.) to 19.7 mm (min), Annual rainfall is 1200 mm (average), mostly received in July, August and September. Hottest months are May and June with mean maximum temperature of 35.1°C and 37.1°C respectively. January is the coldest month with mean minimum temperature of 2.5°C (Table-1a, 1b).

ii) Topography

The Islamabad area is generally an uneven table land with alluvial and aeolian deposits and bed rock out crops evaluation being 494 to 610 m. The Northern most, the North West and North East parts are sub-mountaneous, while the remaining area is undulating and full of ravines. Abrupt rises and steeper slopes in the mountaneous part have created V shaped valleys and cayons which are separated by sharp ridges and spurs.

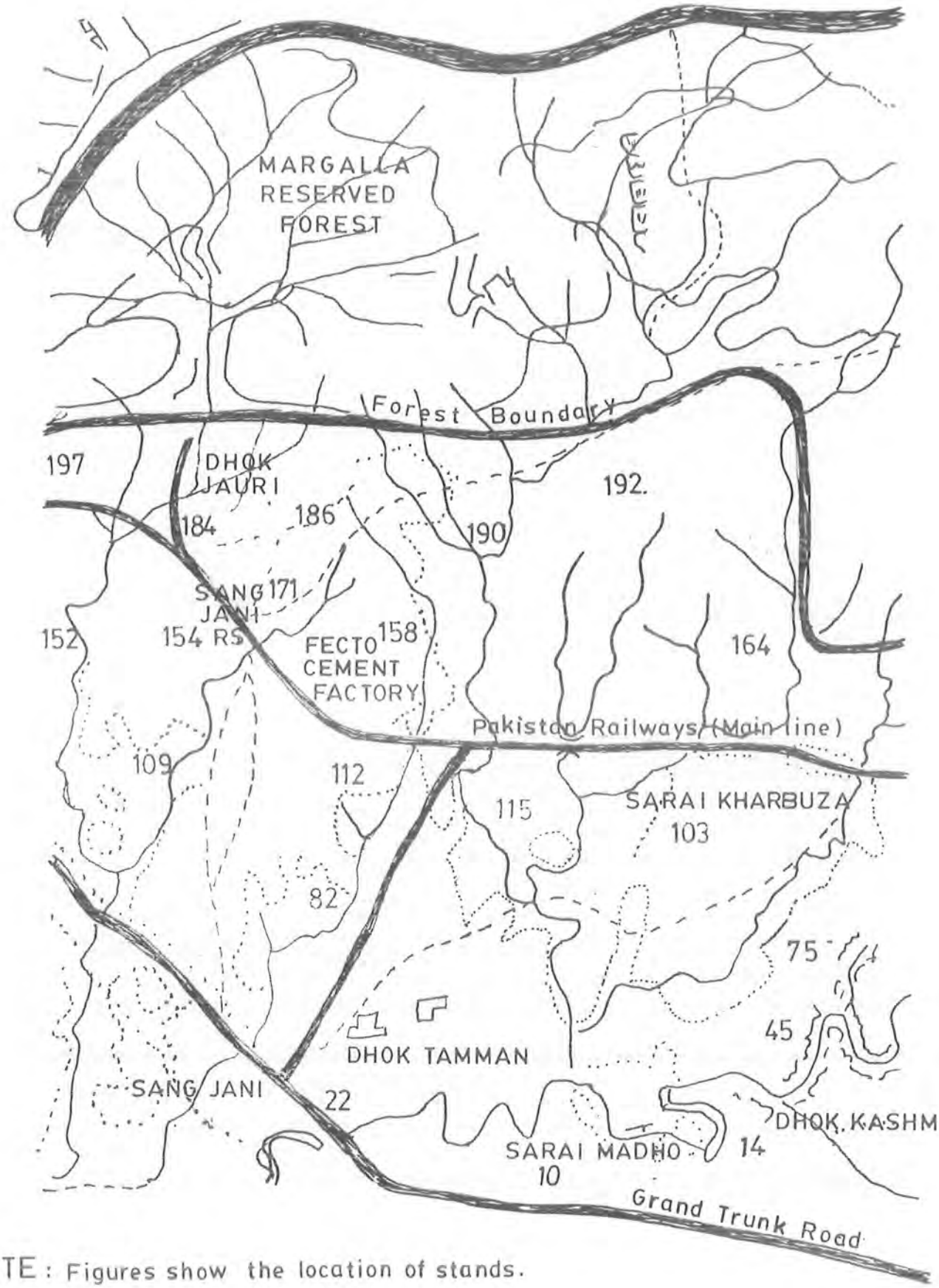
iii) Selection of Stands

A general survey was conducted in April to June in a total area of 36 square km in the vicinities of Sangjani

FIG, 1. MASTER PLAN OF ISLAMABAD 1988 (SURVEY OF PAKISTAN)

SCALE 1:30,000

FIG.2 PORTION ENLARGED FROM MAP OF ISLAMABAD AND SURROUNDINGS SURVEY OF PAKISTAN 1984.



NOTE : Figures show the location of stands.

TABLE-1(a)

Average climatic data of Rawalpindi/Islamabad for 30 years (1955-85)

Month	Mean Temp. (°C)		Highest Lowest		Humidity %		Rain Fall mm	
	Maximum	Minimum	Maximum	Minimum	0800 PST*	1700 PST	Normal Mean	Maximum in (yrs) 24 hrs.
January	17.0	2.5	26.1	-3.9	85	44	129.8	159.8 (81)
February	19.1	5.5	28.3	3.4	83	43	73.8	208.4 (76)
March	23.8	10.3	33.3	2.2	76	42	87.5	224.0 (81)
April	29.8	15.1	40.6	13.0	63	34	73.4	264.8 (83)
May	35.1	19.0	43.9	8.9	46	26	41.5	115.3 (65)
June	37.1	23.7	45.9	15.0	48	27	59.3	239.0 (71)
July	34.9	24.5	43.3	18.0	72	51	256.7	580.2 (81)
August	33.3	23.6	41.1	17.2	82	55	308.5	641.4 (83)
September	33.3	20.5	38.1	13.3	76	46	101.6	281.7 (61)
October	30.9	14.0	36.1	6.4	72	37	27.3	85.6 (69)
November	25.5	7.2	31.0	-0.[illegible]	77	40	19.7	83.0 (82)
December	20.0	3.1	36.0	-2.8	84	44	26.8	150.4 (67)

Source: Pakistan Meteorological Department, Islamabad.

PST* = Pakistan Standard Time.

TABLE-1(b)

Monthly average rainfall data of Islamabad (in m.m.)

for years (1985-1990)

Month	1985	1986	1987	1988	1989	1990
January	54.0	12.2	0.5	17.1	75.5	37.8
February	04.5	149.1	133.8	23.2	15.6	116.2
March	47.0	112.6	72.7	153.3	86.7	174.2
April	47.0	66.3	60.7	6.9	8.4	51.2
May	30.4	29.9	101.0	8.6	10.2	0.1
June	08.1	91.8	27.1	97.7	43.0	49.1
July	456.6	85.5	64.9	450.4	312.4	354.0
August	220.4	172.9	245.7	282.1	232.8	-
September	63.0	73.0	0	126.1	25.1	-
October	37.7	57.6	74.0	31.2	14.4	-
November	10.7	40.3	0	0	0.3	-
December	143.8	46.2	0	72.4	54.4	-

to observe the vegetation. Twenty stands were selected purely randomly devoid of homogeneity or heterogeneity of the vegetation. For random selection two groups of random numbers were selected from Random Number Table (Kershaw, 1973). These were spread on small squares of graph paper which comprised 225 small squares. From these 20 small squares were selected as stands. Some stands comprised cultivated areas from which wheat was harvested and only natural plants were counted for data collection. Others consisted of natural vegetation.

iv) Field Method

Quadrat method was used to study the vegetation and take the soil samples . In each stand 10 quadrats of 2 x 2 m were laid randomly.

3.1. Vegetation Analysis

3.1.1 Vegetation characteristics studied

The following physical characteristics of vegetation were observed.

i) Recognition of individuals of species (Stewart, 1972).

ii) Cover. cover is the percentage of quadrat area beneath the canopy of a given species. The cover percentage of shrubs was determined by 'Crown diameter' method (Barbour *et al.* 1980) and that of herbs and grasses by visual estimation method (Goldsmith and Harrison, 1976). Crown cover is calculated as :

$$C.C = \frac{(D_1 + D_2)^2 X}{4}$$

D_1 = First diameter of plant species
D_2 = 2nd diameter.

iii) Density: It is defined as the average number of individuals of each species per unit area sampled.

$$\text{Density} = \frac{\text{Number of individuals of a species in all Quadrats}}{\text{Total Area Sampled}}$$

iv) Frequency: It is the percentage of sampled quadrats in which a species occurs (Barbour *et al.* 1980).

$$\%\ \text{Frequency} = \frac{\text{Number of Quadrats in which a species occurs}}{\text{Total number of Quadrats sampled}} \times 100$$

3.1.2 Calculations of Relative Phyto-sociological characters

The relative density, relative cover and relative frequency of the vegetation in each stand were determined as follows:

$$\text{Relative Density} = \frac{\text{Total No. of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

$$\text{Relative cover} = \frac{\text{Total cover of individuals of a species}}{\text{Total cover of individuals of all sp.}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Frequency of all species}} \times 100$$

Following Curtis and McIntosh (1950) importance value was determined as under:

$$\text{Importance value} = \frac{\text{Relative}}{\text{Density}} + \frac{\text{Relative}}{\text{Cover}} + \frac{\text{Relative}}{\text{Frequency}}$$

The communities were established on the basis of highest importance value. The three species in each stand having the highest importance values were used in naming the communities.

3.1.4. Coefficient of Community

The community or similarity coefficient is defined as the number of species common to both communities and is expressed as a percentage of the total number for both the communities. It is based on the presence absence relationship between the number of species common to any two communities and the total number of species. Therefore, the

coefficient expresses the ratio of the common species to all species found in two vegetation groups. The similarity between the plant communities was determined by applying the expression of similarity index put forth by Sorenson (Barbour *et al.* 1980).

$$\text{Index of Similarity (I.S.)} = \frac{2W}{A + B} X100$$

Where W is the total number of species common to both communities.

A is the total number of species in one of the communities.

B is the number of species in the other community.

3.15. Matrices of Indices of Similarity(I.S)

The indices of similarity (I.S.) values were transcribed into a correlation matrix. The I.S. values are given in the triangle form on the matrix.

3.1.6. Floristic List

At the end, a complete floristic list of the species is given for a ready reference. Plants were named

following Stewart (1972).

3.2. Soil Analysis

3.2.1. Soil Sampling:

From each stand a composite soil sample was collected. Soil was taken at a depth of 0-20 cm in each quadrat and then these 10 samples were mixed to get a composite sample. This work was done with the help of a spade and "khurpi". About 2-2.5 kg of soil was taken for each composite sample and kept in polythene bags alongwith identification number of each sample and they were tied up securely.

3.2.2. Preparation of soil samples for Analysis:

After bringing the samples to the laboratory, they were air dried. The stones and roots etc. were picked out. After air drying, the samples were crushed & passed through a 2 mm sieve and were stored in duly numbered polythene bags each containing the sample number card also. Small samples were ground & passed through 0.5 mm sieve for those determinations in which one gram or less than one gram of the sample was required.

3.2.3. Soil characteristics Analysed:

Soil samples were analysed for the following soil characteristics:

i. Particle size analysis

ii. Soil pH

iii. Organic matter percent.

iv. Saturation percentage.

v. Alkaline earth carbonates.

vi. Carbonates and bicarbonates

vii. Chlorides.

viii Nitrogen

ix. Phosphorus

x. Calcium

xi. Megnesium

xii. Sodium

xiii Potassium

1. Particle Size Analysis

Bouyoucos hydrometer method was adopted for particle size analysis (Bouyoucos, 1962).

ii. Soil pH

Soil pH was determined by pH meter Model M.8E from soil extracts of soil paste.

iii. Organic Matter

For the estimation of organic matter content, Tyurin's method was used (Nikolskii, 1963).

iv. Alkaline Earth Carbonates

Alkaline earth carbonates were estimated following the method 23-C described by USDA Hand Book No. 60 (1954).

v. Carbonates and Bicarbonates

Carbonates and bicarbonates were determined following USDA Hand Book No. 60(1954) by using phenolphthalein as indicator for carbonates and methyl orange indicator for bicarbonates and titerating against 0.01 N sulphuric acid, (Method-12).

vii. Chlorides

Chlorides were determined by Method-13, USDA Hand Book 60 (1954) by titerating the extract with 0.005N silver nitrate using potassium chromate as indicator.

viii.Nitrogen

Nitrogen was estimated by the Method III described by Humphries(1956).

ix. Phosphorus

Phosphorous was determined by Olsen method (Olsen *et al.*, 1954) described by Black (1965), Method 73.4.4.2 using Shimadzu UV Visible Recording Spectrophotometer.

xi. Calcium and Megnesium

Calcium and Megnesium were determined by Atomic Absorption spectrophotometer method described by Price, (1979) for soils. Model used, Shimadzu AA 670.

xiii. Sodium and Potassium

Sodium and potassium were also determined by Atomic Absorption spectrophotometer, as described by Price (1979).Model, Shimadzu AA 670.

xvi. % Saturation Capacity

300 gms of soil were taken into a pre weighed beaker. Paste was prepared and after 24 hours, this paste was reweighed. Percent saturation capacity was determined by the formula.

$$\% \text{ saturation capacity} = \frac{\text{Wt. of the paste} - \text{Wt. of the dry soil}}{\text{Wt. of the dry soil}} \times 100$$

CHAPTER–4

RESULTS

Vegetational Composition and Structure

The vegetation of Sangjani (Islamabad) consists of herbs, shrubs and trees. However, shrubs contribute more and usually the vegetational structure is represented by them. The data regarding relative density, relative cover, relative frequency and important values(I.V) of different species in the sampled stands were represented in Table 3-15. Communities were established on the basis of the I.V. of the three dominants. In the whole study area 47 species were recorded. Only six species, viz *Adhatoda zeylanica, Carthamus oxyacantha, Acacia modesta, carissa opaca Olea ferruginea,* and *Ziziphus jujuba* were the leading dominants. The variety of vegetation found in the area has been arranged into thirteen plant communities (Table-2). The number of stands for each community varies between three and one . Results stated below are the detailed studies of the composition of vegetation of each community.

4.1.1 Community Characteristics

i. *Adhatoda-Acacia-Carissa* Community.

This type of vegetation was found in two stands. *Adhatoda zaeylanica* was the leading dominant with average I.V. 117.14 *Acacia modesta* had also appreciably high importance value. Third dominant in this community was *Carissa opaca.* Other species like *Cousinea minutao, Z. Jujuba* and *Ipomoea carnea* also had considerable I.V. but

Table-2: List of Plant Communities recognized in the Area

	Community	No. of stand in which present
1.	Adhatoda-Acacia-Carissa	75, 103
2.	Carthamus-Echinops-Ziziphus	109, 112, 154
3.	Acacia-Carissa-Olea	186
4.	Acacia-Ziziphus-Cousinea	45
5.	Acacia-Adhatoda-Carissa	197
6.	Adhatoda-Ziziphus-Dodonaea	184
7.	Carthamus-Ziziphus-Ipomoea	82
8.	Carissa-Ziziphus-Adhatoda	158, 164
9.	Carthamus-Adhatoda-Ziziphus	171
10.	Olea-Adhatoda-Ziziphus	190, 192
11.	Ziziphus-Acacia-Dichanthium	115, 152
12.	Ziziphus-Cousinea-Carthamus	14, 10
13.	Carthamus-Cousinea-Calotropis.	22

these were much lower than the dominant ones. Totally twelve species were found in each, stand in Stand NO 75 and Stand No. 103. However floral composition was different, in the two stands of this community. *Dichanthium annulatum, Serratula pallida, Calotropis procera C. minuta, I. cornaea* were present in stand No. 75 and absent in stand No. 103. Similarly *Maytinus royleanus, Achyranthes bidentata, Lantana camara Abutilon indicum and Dicliptera roxberghiana* were present in stand No. 103 and absent in Stand No. 75. Out of total 17 species found in this community, ten plant species were of herbaceous nature and seven species were shruby. No herbaceous plant was dominant and contributed to the formation of community. Also variation in plants, found in the two stands of this community was present mostly in the herbaceous species. Permanent framework of this community is formed by shrubs which are perennial in nature (Table-3).

ii. *Carthamus - Echinops-Zizyphus* Community

This community is dominated by *Carthamus oxyacantha, Echinops echinatus and Zizyphus jujuba.* The average importance values of these species are 149.72 , 68.71 and 36.66 respectively. This community is comprised of three stands. All the three stands (Nos. 109, 112, 154) comprised of a total of 8, 7 and 7 species respectively. Thirteen types of plant species were present in all the three stands. Comparing the three stands for types of

Table-3: Phytosociological data of Adhatoda-Acacia-Carissa Community.

Stand No. 75

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V
Acacia modesta Wallich	0.27	14.83	34.61	30.77	50	21.73	67.33	68.86
Adhatoda zeylanica Medic	0.55	30.21	68.43	60.84	70	30.43	121.48	
Asparagus gracilis Royle	0.05	2.74	0.032	0.028	10	4.34	7.10	7.4
Calotropis procera (Willd.) R.Br.	0.025	1.37	0.32	0.28	10	4.34	5.99	
Carissa opaca Stapf ex Haines	0.40	21.97	0.17	0.15	10	4.34	26.46	34.49
Carthamus oxyacantha	0.025	1.37	0.02	0.017	10	4.34	5.72	
Cousinea minuta Boiss	0.10	5.49	2.61	2.32	20	8.69	16.5	
Dichanthium annulatum (Forssk.) Stapf	0.025	1.37	0.21	0.18	10	4.34	5.89	
Ipomoea Carnea Jacq	0.10	5.49	5.54	4.92	10	4.34	14.75	
Rhynchosia minima (L.)DC.	0.075	4.12	0.04	0.035	10	4.34	8.49	
Serratula pallida DC.	0.025	1.37	0.07	0.06	10	4.34	5.77	
Ziziphus jujuba Miller	0.17	9.34	0.41	0.36	10	4.34	14.04	

Table-3
Contd:-
Stand - 103

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Abutilon Indicum (L.) Sweet	0.025	1.10	0.00096	0.00054	10	3.22	4.32
Acacia modesta Wallich	0.27	11.94	97.47	42.33	50	16.12	70.39
Achyranthes bidentata Blume	0.025	1.10	0.13	0.073	10	3.22	4.39
Adhatoda zeylanica Medic	0.87	38.49	78.75	44.76	90	29.03	112.28
Asparagus gracilis Royle	0.10	4.42	0.12	0.068	10	3.22	7.70
Carissa opaca Stapf ex Haines	0.37	16.37	17.66	10.03	50	16.12	42.52
Dicliptera roxberghiana Nees	0.025	1.10	0.00049	0.00027	10	3.22	4.32
Lantana Camara L.	0.05	2.21	0.028	0.015	10	3.22	5.44
Maytinus royleanus (Wall ex Lawson)Cufodontis	0.15	7.32	8.53	4.99	20	8.11	20.42
Olea ferruginea Royle	0.075	3.31	1.23	0.69	20	6.45	10.45
Rhynchosia minima (L.)DC.	0.35	15.48	0.21	0.11	30	9.67	25.26
Ziziphus jujuba Miller	0.10	4.42	3.31	1.88	20	6.45	12.75

species, it is found that *Boerhaavia diffusa, Capparis decidua* and *Adhatoda zeylanica* were present in only Stand No. 109 and absent in 112 and 154. *A. modesta* was common in stands 109 and 154 but absent in stand 112. *Asparagus gracilis* was common in the Stands 109 and 112 but absent in 154. Similarly *Calotropis procera* and *solanum nigrum* were absent in Stand No. 109 in this community. Except the 3 dominants of this community, *Asparagus gracilis* in Stands 109, and 112, *Calotropis procera* and *Cousinea minuta* in Stand 112 had a considerable I.V. The community was established by two herbs and one shrub. Although perennial shrubs like *A. modesta A. Zeylanica, C. opaca Capparis decidua,* and *Calotropis procera* were present with *Z. jujuba* but their I.V. was quite low (Table -4).

3. *Acacia-Carissa-Olea* Community

This community comprised only one stand (No.186). *Acacia modesta* was the leading dominant species with I.V. 134.82, possessing higher cover and frequency. This shows that it was a well distributed species of this area. This plant is followed by *Carissa opaca* and *Olea ferruginea*. This community also possessed a mixture of shruby and herbaceous vegetation but was dominated by shrubs only. In shrubs besides to the three species after which the community was named, others were *Z. jujuba, Otostegia limbata, D. viscosa and Morus alba. Herbaceous species were Boerhaavia diffusa,*

Table-4: Phytosociological data of Carthamus-Echinops-Ziziphus Community.

Stand - 112 Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V.
Asparagus gracilis Royle	0.025	0.85	0.18	1.17	10	7.14	9.16	
Carthamus oxyacantha M. Bieb	1.77	60.20	9.93	64.77	30	21.42	146.39	149.72
Calotropis procera (Willd.)R.Br.	0.25	8.5	0.32	2.08	10	7.14	17.72	
Cousinea minuta Boiss	0.10	3.40	0.11	0.71	20	14.28	18.39	
Echinops echinatus Roxb	0.67	22.78	2.48	16.17	50	35.71	74.66	68.71
Solanum surattense Burm.f.	0.05	1.70	0.19	1.23	10	7.14	10.07	
Ziziphus jujuba Miller	0.075	2.55	2.12	13.82	10	7.14	23.51	36.66

Table-4
Contd:-
Stand - 109

Species Name	D	R.D.	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.075	2.24	0.29	0.17	10	5.88	8.29
Adhatoda zeylanica Medic	0.025	0.74	0.12	0.07	10	5.88	6.69
Asparagus gracilis Royle	0.10	2.99	0.92	0.54	20	11.76	15.29
Boerhaavia diffusa	0.025	0.74	0.36	0.21	10	5.88	6.83
Carthamus Oxyacantha M.Bieb	1.27	38.05	163.49	96.75	80	47.05	181.85
Capparis decidua (Forssk.) Edgew	0.12	3.59	1.62	0.95	10	5.88	10.42
Echinops echinatus Roxb	1.35	40.41	1.60	0.94	20	11.76	53.11
Ziziphus jujuba Miller	0.375	11.22	0.57	0.33	10	5.88	17.43

Contd:-

Table-4

Contd:-

Stand - 154

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.025	0.38	2.35	2.63	10	5.55	8.56
Calotropis procera (willd.)R.Br.	0.05	0.76	0.57	0.63	10	5.55	6.94
Carthamus oxyacantha M. Bieb	1.77	26.94	49.25	55.12	70	38.88	120.94
Carissa opaca Stapf ex Haines	0.025	0.38	0.46	0.51	10	5.55	6.44
Echinops echinatus Roxb	3.75	57.07	4.15	4.64	30	16.66	78.37
Solanum nigrum Linn	0.25	3.80	0.22	0.24	10	5.55	9.59
Ziziphus jujuba Miller	0.70	10.65	32.34	36.19	40	22.22	69.06

Heteropogon contortus, Dicliptera roxberghiana and Solanum surrattense. All these species except *Heteropogon contortus* which is a grass, had very low I.V. values and were rarely distributed. Grasses could be of other kinds also but they could not be identified due to their strongly grazed condition (Table-5).

4. *Acacia-Ziziphus, Cousinea* community

The dominant species of this community were *Acacia modesta, Ziziphus jujuba and Cousinea minuta*. They had importance values of 92.06, 50.11 and 45.62 respectively. This community was present in only one stand (No. 45). It possessed a total of ten species. Permanent vegetation structure was formed by shrubs, all of which possesed a considerable I.V. (Table-6). *Acacia modesta* was the leading dominant species. *Adhatoda zeylanica, Otostegio limbata, Carissa opaca* were the shrubs, which possessed a significant I.V. next to the 3 dominants after which the community was named. Herbs like *Rhynchosia minima* and *Carthamus oxyacantha* had much lower I.V. and poor distribution. However *Cousinea minuta* was much densly present, forming patches in the area. Highest percent frequency was for *Acacia modesta* (Table-6).

5. *Acacia - Adhatoda - Carissa* Community

This community was also present in only one stand (No.197). Important thing to be noted was that no herbaceous

Table-5: Phytosociological data of Acacia-Carissa-Olea Community

Stand - 186

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.45	29.80	171.38	82.80	60	22.22	134.82
Boerhaavia diffusa L.	0.025	1.65	0.03	0.014	10	3.70	5.36
Carissa opaca Stapf ex Haines	0.225	14.90	11.11	5.36	40	14.81	35.07
Dicliptera roxberghiana Nees	0.055	3.64	0.26	0.12	10	3.70	7.46
Dodonaea viscosa (L.) Jacq.	0.15	9.93	2.26	1.09	30	11.11	22.13
Heteropogon contortus (Linn) P. Beauv.	0.05	3.31	7.65	3.69	20	7.40	14.40
Morus alba L.	0.10	6.62	1.28	0.61	20	7.40	14.63
Olea ferruginea Royle	0.20	13.24	5.18	2.50	30	11.11	26.85
Otostegia limbata (Benth) Boiss	0.10	6.62	1.12	0.54	20	7.40	14.56
Solanum surattense Burm.f.	0.025	1.65	0.05	0.024	10	3.70	5.37

Table-6: Phytosociological data of Acacia-ziziphus-Cousinea Community

Stand - 45

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.275	11.31	31.24	52.75	70	28.00	92.06
Adhatoda zeylanica Medic	0.075	3.08	2.21	3.73	20	8.00	14.81
Calotropis procera (Willd.) R.Br.	0.025	1.02	0.95	1.60	10	4.00	6.62
Carissa opaca Stapf ex Haines	0.25	10.28	9.02	15.23	40	16.00	41.51
Cousinea minuta Boiss	0.90	37.03	0.35	0.59	20	8.00	45.62
Carthamus oxyacantha M. Bieb	0.025	1.02	0.0049	0.008	10	4.00	5.02
Lantana camara L.	0.075	3.08	0.06	0.10	20	8.00	11.18
Otostegia limbata (Benth) Boiss	0.15	6.17	8.04	13.57	20	8.00	27.74
Rhynchosia minima (L.) DC.	0.025	1.02	0.0007	0.001	10	4.00	5.02
Ziziphus jujuba Miller	0.625	25.72	7.34	12.39	30	12.00	50.11

plants had come in this community. Flora was much restricted and only shrubs formed the full vegetational structure of this community. Only six plant species were present in the stand and all of them were pererinnial shrubs. *Acacia modesta, Adhatoda zeylanica and Carissa opaca* were the three dominant species having I.V. 145.21, 68.57 and 37.98 respectively. Other plants were *Z. Jujuba, D. viccosa and Olea ferruginea.* In this community Acacia modesta was densly and uniformly distributed which possessed a much higher biomass as indicated by relatively density, relative frequency & relative canopy cover (Table-7). Out of all the plants in the community, *Ziziphus Jujuba* possessed the lowest I.V. This was due to its lower R.C.C. and thus resulting in lower biomass. *Olea ferruginea* was next higher to *Z. jujuba* having I.V. 10.26, with less relative frequency. It's distribution was not uniform (Table-7).

6. Adhatoda-Ziziphus-Dodonaea Community

Table-8 shows that *Adhatoda zeylanica* was the leading dominant species of this community. This plant species had I.V. 94.12. Next to this, dominant species of this community are *Ziziphus jujuba and Dodonaea viscosa* which had I.V. 71.71 and 52.04 respectively. This community, comprising only one stand (No.184) had very restricted flora. Only six plant species were recorded in this community. Plant species others than above three dominants

Table-7: Phytosociological data of Acacia-Adhatoda-Carissa Community.

Stand - 197

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.40	38.09	116.20	73.84	70	33.33	145.21
Adhatoda zeylanica Medic	0.30	28.57	25.5	16.20	50	23.80	68.57
Carissa opaca Stapf ex Haines	0.15	14.28	7.34	4.66	40	19.04	37.98
Dodonaea viscosa (L.) Jacq	0.10	9.52	6.78	4.30	30	14.28	28.1
Olea ferruginea Royle	0.05	4.76	1.17	0.74	10	7.76	10.26
Ziziphus jujuba Miller	0.05	4.76	0.37	0.23	10	4.76	9.75

were *Carissa opaca, Otostegia limbata and Acacia modesta.* these three species possessed significant I.V. *Otostegia limbata* however, was poorly distributed with lower biomass when compared to other five species. Vegetation structure of this community was much similar to the previously described community. No herbs were recorded in this community. Only perennial shrubs were present which formed the structure of this community (Table-8).

7. Carthamus-ziziphus-Impoea Community

This community was found in only one stand and had restricted number of species (total 6 species). However, *Carthamus oxyacantha* was herbaceous plant and was the leading dominant in the stand (No. 82). It had an I.V. 114.11. It was evenly distributed in the stand. *Ziziphus jujuba and Ipomoea carnea* were the following dominant species whose I.V. were 72.2 and 42.77 respectively and they were the perennial shrubs. Other species were *A. modesta, C. opaca* and *Lantana camara.* These plants were also important and had a considerable IV. (Table-9). In this community, growth condition of *Ziziphus jujuba* was better than all other species. Its biomass was greater than other species except *C. oxyacantha.* Density of *Carthamus oxyacantha* was greater than other species, also it was a more frequent species than other (Table-9).

Table-8: Phytosociological data of Adhatoda-Ziziphus-Dodonaea Community.

Stand - 184

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.20	15.74	7.23	5.72	30	11.53	32.99
Adhatoda zeylanica Medic	0.20	15.74	64.99	51.46	70	26.92	94.12
Carissa opaca Stapf ex Haines	0.17	13.38	9.62	7.61	40	15.38	36.37
Dodonaea viscosa (L.) Jacq	0.30	23.62	6.76	5.35	60	23.07	52.04
Otostegia limbata (Benth) Boiss	0.05	3.93	1.38	1.09	20	7.69	12.71
Ziziphus jujuba Miller	0.35	27.59	36.29	28.74	40	15.38	71.71

Table-9: Phytosociological data of Carthamus-Ziziphus-Ipomoea Community.
Stand - 82

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.025	1.33	0.13	0.59	10	9.09	11.01
Carissa opaca Stapf ex Haines	0.025	1.33	0.12	0.54	10	9.09	10.96
Carthamus oxyacantha M. Bieb	1.25	66.66	7.01	32.00	50	45.45	144.11
Ipomoea carnea Jacq	0.10	5.33	6.21	28.35	10	9.09	42.77
Lantana camara L.	0.075	4.00	1.27	5.79	10	9.09	18.88
Ziziphus jujuba Miller	0.40	21.33	7.16	32.69	20	18.18	72.2

8. Carissa – Ziziphus – Adhatoda Community

This community consisted of two stands (No. 158, 164). Total number of species present in this community were 8. Only one species i.e. *Solanum surattense* was present in stand No. 158 and absent in No. 164. Rest of the seven species were common in both the stands. The dominant plants of this community were *Carissa opaca*, *Ziziphus jujuba*, and *Adhatoda zeylanica* which had average I.V. 91.50, 74.29, 55.98 respectively. Other plants were *Olea ferruginea*, *Asparagus gracilis*, *Dicliptera roxberghiana* *Acacia modesta* and *Solanum surattense* which were present in this community and only *S. surattense*, *A. gracilis* and *D. roxberghiana* were the herbs. Thus structure of vegetation was formed only by shrubs. All the shrubs were important in the two stands as they possessed a significant I.V. *C. opaca* was densely distributed. Similarly growth of this plant was much vigorous which increased its biomass. *A. zeylanica* and *Z. jujuba* had higher quantity of biomass as is indicated by their cover. However, *A. gracilis*, *Dicliptera roxberghiana* and *S. surattense* were poorly distributed, had little biomass and were rare species of the area (Table-10).

9. Carthamus – Adhatoda – Ziziphus Community

The leading dominant species of this community was *Carthamus oxyacantha* which is a herb. Other two following dominant species were *Adhatoda zeylanica*and *Ziziphus jujuba*. the I.V. of all these species were 146.29, 35.54 and 26.6

Table-10: Phytosociological data of Carissa-Ziziphus-Adhatoda Community.
Stand - 158

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V
Acacia modesta Wallich	0.10	6.66	8.73	6.24	20	9.52	22.42	14.91
Adhatoda zeylanica Medic	0.20	13.33	40.18	28.74	30	14.28	56.35	55.98
Asparagus gracilis Royle	0.05	3.33	0.31	0.22	10	4.76	8.31	6.62
Carissa opaca Stapf ex Haines	0.40	26.66	47.50	33.97	60	28.57	89.2	91.50
Dicliptera roxberghiana Nees	0.10	6.66	0.027	0.019	10	4.76	11.43	14.24
Olea ferruginea Royle	0.10	6.66	6.14	4.39	40	1.90	12.95	27.65
Solanum surattense Burn.f.	0.025	1.66	0.05	0.035	10	4.75	6.45	
Ziziphus jujuba Miller	0.525	35.0	36.87	26.37	30	14.28	75.65	74.29

Contd...

Table - 10

Contd.

Stand - 164

Species Name	D	R.D.	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.075	3.64	1.92	2.20	20	7.40	13.24
Adhatoda zeylanica Medic	0.32	15.53	18.79	21.56	50	18.51	55.6
Asparagus gracilis Royle	0.025	1.21	0.025	0.028	10	3.70	4.93
Carissa opaca Stapf ex Haines	0.37	17.96	40.27	46.21	80	29.62	93.79
Dicliptera roxberghiana	0.27	13.10	0.22	0.25	10	3.70	17.05
Olea ferruginea Royle	0.25	12.13	10.20	11.70	50	18.51	42.34
Ziziphus jujuba Miller	0.75	36.40	15.71	18.02	50	18.51	72.93

respectively. Only one stand i.e. No. 171 was present in this community and was presented by twelve plant species. Only *C. oxyacantha* was much densely distributed, and had the highest biomass. *I. carnea, C. opaca* and *Calotropis procera* were also present in reasonable number next to the three dominants. *Dalbergia sissoo, Dodonaea viscosa* and *Asparagus gracilis* were poorly distributed species as their importance values were more or less the same. Three other plants, *Acacia nilotica. D. roxberghiana* and *Morus alba*also had I.V. less than 10 and they were quite irregularly and poorly distributed in the Stand (Table-11).

10. Olea - Adhatoda - Ziziphus Community

This community comprised two stands (Nos 190 and 192). There were 10 plants species present in this community; six plants were common to both the stands and all of them were perennial herbs which formed the structure of the community. *Cynodon dactylon, Dicliptera roxberghiana, Asparagus gracilis and Heteropogan contortus* were absent in Stand No. 190 but present in Stand No. 192. Leading dominant species of this community was *Olea ferruginea* and the two following dominant species were *Adhatoda zeylanica* and *Ziziphus jujuba*. Average I.V. of these three species were 104.78, 63.62 and 51.53 respectively. Other important species of this community were *Carissa opaca* and *Acacia modesta*. They had significant I.V. and significant biomass

Table-11: Phytosociological data of Carthamus-Adhatoda-Ziziphus Community.
Stand - 171

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia nilotica (Linn) Delile	0.05	1.27	1.11	2.61	10	5.55	9.43
Adhatoda zeylanica Medic	0.12	3.06	9.07	21.37	20	11.11	35.54
Asparagus gracilis Royle	0.025	0.63	0.41	0.96	10	5.55	7.14
Carissa opaca Stapf ex Haines	0.05	1.27	2.22	5.23	10	5.55	12.05
Calotropis procera (Willd) R.Br.	0.025	0.63	1.92	4.52	10	5.55	10.7
Carthamus oxyacantha M. Bieb	3.07	78.51	14.62	34.45	60	33.33	146.29
Dalbergia sissoo Roxb	0.025	0.63	0.02	0.04	10	5.55	6.22
Dicliptera roxberghiana Nees	0.075	1.91	0.08	0.18	10	5.55	7.64
Dodonaea viscosa (L.) Jacq	0.025	0.63	0.012	0.028	10	5.55	6.21
Ipomoea carnea Jacq	0.27	6.90	4.59	10.81	10	5.55	23.26
Morus alba L.	0.075	1.91	0.53	1.24	10	5.55	8.7
Ziziphus jujuba Miller	0.10	2.55	7.85	18.50	10	5.55	26.6

and distribution characters. *Dodonaea viscosa*presented poor figures for its I.V. cover, frequency and density parameters. Herbaceous plants, present in Stand No. 192, were also important, for their I.V. were considerably high. Even *Heteropogon contortus* had I.V. 39.13, which is next to the three dominants (Table-12).

11. Ziziphus - Acacia - Dichanthium Community

The leading dominant species of this community was *Ziziphus jujuba* and the other co-dominant species were *Acacia modesta* and *Dichanthium annulatum*. They had average I.V. 92.14, 45.69, and 36.26 respectively. Floral composition of the two stands (No. 115 and 152) was a little different from each other. *Olea ferruginea, Saccharum bengalense* and *Cousinea minuta* were important species of Stand No. 115 whereas they were totally absent in Stand No. 152. On the other hand, *Oxalis carniculata, Otostegia limbata, Carthamus oxyacantha, Malcolmia africana* and *Delphinium uncinatum* were present in Stand No.152, but absent in Stand No.115. Last three of these were important due to significant I.V. and the other two species, *O. limbata* and *O. carniculata* had I.V. values less than 10. Other common species in the two stnads of this community were *R. minima, A. zeylanica* and *C. opaca* in addition to the three dominants after which the community has been named. All of them were well distributed and contributed to the formation of structure of vegetation (Table-13).

Table-12: Phytosociological data of Olea-Adhatoda-Ziziphus Community.

Stand - 190

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V
Acacia modesta Wallich	0.025	1.58	4.83	1.73	10	4.34	7.64	14.79
Adhatoda zeylanica Medic	0.625	39.55	54.71	19.57	30	13.04	72.16	63.62
Carissa opaca Stapf ex Haines	0.25	15.82	11.30	4.04	50	21.73	41.59	34.73
Dodonaea viscosa (L.) Jacq	0.05	3.16	0.28	0.10	10	4.34	7.6	6.90
Olea ferruginea Royle	0.35	22.15	181.24	64.85	70	30.43	117.43	104.78
Ziziphus jujuba Miller	0.225	14.24	27.08	6.69	60	26.08	50.01	51.36

Contd..

Table - 12
Contd.
Stand - 192

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.075	7.35	7.69	7.18	20	7.40	21.93
Adhatoda zeylanica Medic	0.20	19.60	14.2	13.25	60	22.22	55.07
Asparagus gracilis Royle	0.075	7.35	0.45	0.42	30	11.11	18.88
Carissa opaca Stapf ex Haines	0.10	9.80	3.49	3.25	40	14.81	27.86
Cynodon dactylon (L.) Pers.	0.05	4.90	0.55	0.51	10	3.70	9.11
Dicliptera roxberghiana Nees	0.12	11.76	0.078	0.072	10	3.70	15.53
Dodonaea viscosa (L.) Jacq	0.025	2.45	0.05	0.046	10	3.70	6.19
Heteropogon contortus (Linn) P. Beauv	0.20	17.21	23.11	18.22	10	3.70	39.13
Olea ferruginea Royle	0.20	19.60	53.88	50.30	60	22.22	92.12
Ziziphus jujuba Miller	0.17	16.66	26.72	24.94	30	11.11	52.71

Table-13: Phytosociological data of Ziziphus-Acacia-DichanthiumCommunity.

Stand - 115

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V.
Acacia modesta Wallich	0.75	23.92	2.77	7.40	30	14.28	45.6	45.69
Adhatoda zeylanica Medic	0.125	3.98	1.86	4.97	30	14.28	23.23	29.66
Asparagus gracilis Royle	0.125	3.98	0.63	1.68	30	14.28	20.61	13.39
Carissa opaca Stapf ex Haines	0.125	3.98	0.63	1.68	30	14.28	19.94	19.99
Cousinea minuta Boiss	0.77	24.56	0.88	2.35	10	4.76	31.67	
Dichanthium annulatum (Forssk.) Stapf	0.76	24.59	0.90	2.37	20	9.52	36.48	36.26
Olea ferruginea Royle	0.25	7.97	0.005	0.013	10	4.76	12.74	
Rhynchosia minima (L.) DC.	0.12	3.82	0.43	1.14	20	9.52	14.48	14.31
Saccharum bengalense Retz	0.15	4.78	5.80	15.49	10	4.76	25.03	
Ziziphus jujuba Miller	0.72	22.96	24.17	64.59	40	19.04	106.59	92.14

Table - 13
Contd..
Stand - 152

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Acacia modesta Wallich	0.225	12.93	3.04	14.68	40	18.18	45.79
Adhatoda zeylanica Medic	0.15	8.62	4.5	21.73	10	4.54	34.89
Asparagus gracilis Royle	0.025	1.43	0.0012	0.005	10	4.54	5.97
Carissa opaca Stapf ex Haines	0.10	5.74	2.02	9.75	10	4.54	20.03
Carthamus oxyacantha M. Bieb	0.2	11.49	0.05	0.24	10	4.54	16.27
Delphinium uncinatum Hooker fil and Thomson	0.35	20.1	0.06	0.28	10	4.54	24.53
Dichanthium annulatum (Forssk.) stapf	0.05	2.87	0.5	2.41	80	30.76	36.04
Malcolmia africana (L.) R.Br.	0.15	8.62	0.05	0.24	20	9.09	17.95
Otostegia limbata (Benth) Boiss	0.029	1.66	0.56	2.70	10	4.54	8.9
Oxalis corniculata L.	0.01	0.57	0.02	0.09	10	4.54	5.2
Rhynchosia minima (L.)DC	0.01	5.74	0.8	3.86	10	4.54	14.14
Ziziphus jujuba Miller	0.35	20.11	9.1	43.96	30	13.63	77.7

10

12. Ziziphus – Cousinea – Carthamus Community

The three dominant species of this community were *Ziziphus jujuba*, *Cousinea minuta*, and *Carthamus oxyacantha* with their average importance values 116.85, 43.09, and 30.13 respectively. This community was also consisted of two stands (No.14 and 10) in total 16 plant species were present. Three plants named *Anagalis arvensis C. procera*, *C. dactylon* were absent in Stand No.10, but present in Stand No. 14, it was 10 but in Stand No. 10, there were 14 plants. Seven of this stand named *Delphinium kohatense*, *Asparagus gracilis*, *Dichanthium annulatum*, *Carissa opaca*, *Acacia modesta*, *Otostegia limbata* and *Lantana camara* were absent from Stand 14, among which *O. limbata*, *D. annulatum* and *L. camara* were not important for vegetation structure because their I.V. were less than 10 (Table-14).

13. Carthamus – Cousinea – Calotropis Community

This community was found in only one stand (No.22). There were 24 plant species present in this community. The vegetation structure comprised both of herbs and shrubs. Two of these three dominants named *C. oxyacantha*, *C. minuta* were herbs. Their I.V. were 108.72, 41.83 whereas *Calotropis procera* was a shrub and its I.V. was 31.06. Sixteen plant species were herbs and most of them had little I.V. which was even less than 5. Therefore, they were not considered among the important ones. Shrubs were

Table-14: Phytosociological data of Ziziphus-Cousinea-Carthamus Community.
Stand - 10

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V
Acacia modesta Wallich	0.05	1.58	8.04	18.06	20	8.00	27.64	
Adhatoda zeylanica Medic	0.05	1.58	1.03	2.31	20	8.0	7.22	
Asparagus gracilis Royle	0.25	7.94	0.88	1.97	30	12.00	21.91	
Boerhaavia diffusa L.	0.25	7.94	0.24	0.53	10	4.00	12.47	
Carissa opaca Stapf ex Haines	0.075	2.38	1.05	2.35	20	8.00	12.73	
Carthamus oxyacantha M. Bieb	0.1	3.17	8.28	18.60	30	12.00	33.77	
Convolvulus arvensis L.	0.05	1.58	0.0049	0.01	10	4.00	5.59	
Cousinea minuta Boiss	0.67	21.30	2.94	6.60	30	12.00	39.9	
Delphinium kohatense (P. Brushl) Munz	0.50	15.89	1.38	3.10	10	4.00	22.99	
Dichanthium annulatum (Forssk.) Stapf	0.05	1.53	1.03	2.31	20	8.00	7.22	
Lantana camara L.	0.025	0.79	0.02	0.04	10	4.00	4.83	
Otostegia limbata (Benth) Boiss	0.075	2.38	0.48	1.07	10	4.00	7.45	
Rhynchosia minima (L.)DC.	0.025	0.79	0.16	0.35	10	4.00	5.14	
Ziziphus jujuba Miller	0.975	31.00	19.28	43.31	30	12.00	86.31	

Table - 14
Contd..

Stand - 14

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V	Average I.V.
Adhatoda zeylanica Medic	0.025	1.15	0.0049	0.008	10	5.00	6.15	6.69
Anagalis arvensis Linn	0.05	2.30	0.0049	0.008	10	5.00	7.30	
Boerhaavia diffusa L.	0.20	9.21	0.15	0.26	10	5.00	14.47	13.47
Calotropis procera (Willd.) R.Br.	0.025	1.15	1.35	2.41	10	5.00	8.56	
Carthamus oxyacantha M. Bieb	0.1	4.60	9.45	16.88	50	25.00	26.48	30.15
Convolvulus arvensis L.	0.12	5.52	0.05	0.08	20	10.0	15.6	10.60
Cousinea minuta Boiss	0.62	28.57	1.52	2.71	30	15.0	46.28	43.09
Cynodon dactylon (L.) Pers.	0.1	4.60	0.079	14.19	10	5.00	23.79	
Rhynchosia minima (L.) DC.	0.05	2.30	0.09	0.16	10	5.00	7.46	6.3
Ziziphus jujuba Miller	0.975	44.93	43.35	77.45	50	25.00	147.38	116.85

Ziziphus jujuba, Calotropis procera Adhatoda zeylanica, Carissa opaca, Ziziphus nummularia. In these shrubs only *Ziziphus jujuba and Calotropis procera* were important plants. *Calotropis procera* was the third dominant of this community. Other plants had non-significant *Dalbergia sissoo* and *Eucalyptus* species were tree but they did not contribute much to the formation of this community. Next important plant species were *Cannabis sativa* and *Cynodon dactylon.* They had moderate I.V., cover and density values (Table-15).

4.1.2 Similarity relations between communities

Community coefficients and indices of dis-similarity have been shown in Table-16 to determine the similarity of vegetation structure among different plant communities recognized in the area. Generally the similarity coefficients between different communities were moderate. However some communities had lower coefficients and others had higher ones.

1. Adhatoda - Acacia - Carissa Community

This community had moderate similarity with *Carthamus - Echinops - Ziziphus, Acacia - Ziziphus - Cousinea, Acacia - Adhatoda - Carissa, Carissa - Ziziphus - Adhatoda, Carthamus - Adhatoda - Ziziphus* communities and higher values with the communities which are led by *Ziziphus jujuba.* It had lower similarity values with rest of other communities ranging between 27.5 to 42.85.

Table-15: Phytosociological data of Carthamus-Cousinea-Calotropis Community.

Stand - 22

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Adhatoda zeylanica Medic	0.025	0.32	0.012	0.07	10	2.63	3.02
Anagalis arvensis Linn	0.1	1.30	0.004	0.02	10	2.63	3.95
Asparagus gracilis Royle	0.05	0.65	0.05	0.32	10	2.63	3.6
Asphodelus tenuifolius Cavan	0.01	0.13	0.08	0.51	10	2.63	3.27
Calotropis procera (Willd.) R.Br.	0.025	0.32	4.35	28.11	10	2.63	31.06
Carissa opaca Stapf ex Haines	0.2	2.61	0.2	1.29	10	2.63	6.53
Cannabis sativa L.	1.22	15.96	0.35	2.26	30	7.89	26.11
Carthamus oxyacantha M. Bieb	3.07	40.18	6.94	44.86	90	23.68	108.72
Chenopodium album L.	0.15	1.96	0.028	0.18	10	2.63	4.77
Convolvulus arvensis L.	0.1	1.30	0.004	0.02	10	2.63	2.98
Cousinea minuta Boiss	1.45	18.97	1.91	12.34	40	10.52	41.83
Cynodon dactylon (L.) Pers.	0.47	6.15	0.28	1.80	10	2.63	10.58
Dalbergia sissoo Roxb.	0.025	0.32	0.025	0.16	10	2.63	3.11
Eucalyptus sp.	0.025	0.32	0.025	0.16	10	2.63	3.11

Contd... Table-15

Species Name	D	R.D	C.C	R.C.C	%F	R.F	I.V
Euphorbia prostrata Ait	0.05	0.065	0.03	0.19	10	2.63	2.88
Fumaria indica (Hausskn.) H.M. Pugsley	0.025	0.32	0.015	0.096	10	2.63	3.04
Medicago minima L.	0.075	0.98	0.07	0.45	10	2.63	4.06
Oxalis carniculata L.	0.15	1.96	0.15	0.96	10	2.63	5.55
Pegnum harmala L.	0.075	0.98	0.07	0.45	10	2.63	4.06
Plantago major L.	0.05	0.065	0.03	0.19	10	2.63	2.88
Rhynchosia minima (L.) DC.	0.05	0.065	0.07	0.45	20	5.26	5.77
Serratula pallida DC.	0.025	0.32	0.025	0.16	10	2.63	3.11
Ziziphus jujuba Miller	0.1	1.30	0.72	4.65	10	2.63	8.58
Ziziphus nummularia (Burm f.) Wight & Arn.	0.025	0.32	0.025	0.16	10	2.63	3.11

TABLE

Community Co-efficient

1	2	3	4	5	6	7	8	9	10	11	12	13
	51.61	28.57	64.28	41.66	33.33	50.00	53.84	53.33	50.00	60.60	62.85	42.85
		34.78	60.86	42.10	42.10	42.10	57.14	48.00	43.47	57.14	60.00	37.83
			30	50.00	50.00	25.00	55.55	36.36	60.00	32.00	59.25	5.88
				50	62.5	62.5	44.44	43.45	40.00	64.07	74.07	82.35
						50.00	71.42	44.44	75.00	47.61	34.78	20.00
						50.00	57.14	44.44	62.5	47.61	43.47	20.00
							42.85	44.44	37.5	38.09	34.78	20.00
								50.00	77.77	52.17	40.00	25.00
									54.54	37.03	41.37	38.88
										48.00	44.44	29.41
											62.5	41.02
												53.65

2. Carthamus - Echinops - Ziziphus Community

This community had moderate community Coefficient values with all other communities except *Carthamus - Cousinea - Calotropis* where its value was lower (37.83) than others.

3. Acacia - Carissa - Olea Community

This community had moderate similarity with *Acacia-Adhatoda-Carissa* and *Adhatoda-Ziziphus-dodonaea* communities; lower values with *Acacia - Ziziphus - Cousinea, Carthamus - Ziziphus - Ipomoea, Carthamus - Adhatoda - Ziziphus, Ziziphus - Acacia - Dichanthium* and *Ziziphus - Cousinea - Carthamus* communities. It had much lower coeffient values (11.42) with *Carthamus - Cousinea - Calotropis* community. Coefficient values were a little higher with *Carissa - Ziziphus - Adhatoda* and *Olea - Adhatoda - Ziziphus* communities.

4. Acacia - Ziziphus - Cousinea Community

This community had lower vlaues of Community Coefficient with *Acacia - Adhatoda - Carissa, Carissa - Ziziphus - Adhatoda, Carthamus - Adhatoda - Ziziphus, Olea - Adhatoda - Ziziphus* and *Carthamus - Cousinea - Calotropis* communities. These values were moderate with *Adhatoda-Ziziphus-Dodonaea* and *Ziziphus-Acacia-Dichanthium* communities and some what higher with *Carthamus - Ziziphus -*

- *Ipomoea* and *Ziziphus* - *Cousinea* - *Carthamus* communities.

5. Acacia - Adhatoda - Carissa Community

This community had higher similarity with *Adhatoda* - *Ziziphus* - *Dodoneaea, Carissa* - *Ziziphus* - *Adhatoda and Olea* - *Adhatoda* - *Ziziphus* communities, the values being 83.33, 71.42 and 75.0 respectively. it comprised a moderate value with *Carthamus* - *Ziziphus OIpomoea* community. These values were lower when compared with *Carthamus* - *Adhatoda* - *Ziziphus, Ziziphus* - *Acacia* - *dichanthium, Ziziphus* - *Cousinea* - *Carthamus and Carthamus OCousinea* - *Calotropis* communities; the range of values was between 47.61 and 20.00.

6. Adhatoda - Ziziphus - dodonaea Community

This community had moderate similarity with *Carthamus* - *Ziziphus* - *Ipomoea, Carissa* - *Ziziphus* - *Adhatoa and Olea* - *Adhatoda* - *Ziziphus* communities. this similarity was lower for *Carthamus* - *Adhatoda* - *Ziziphus* and other last three communities.

7. Carthamus - Ziziphus - Ipomoea Community

This community had moderate similarity with Olea-Adhatoda-Ziziphus community (50.00) but lower values of Coefficient of similarity are observed for Carissa-Ziziphus-Adhatoda, Carthamus-Adhatoda-Ziziphus and last three

communities whose leading dominants were *Ziziphus jujuba* and *C. oxyacantha.*

8. Carissa - Ziziphus - Adhatoda Community

This community was moderately similar to Carthamus-Adhatoda-Zizphus community (50.00) and Ziziphus-Acacia-Dichanthium community (52.17). It was highly similar to Olea-Adhatoda-Ziziphus (77.77) and highly dissimilar to Ziziphus-Cousinea-Carthamus and Carthamus-Cousinea-Calotropis communities, Simiarity values were 40.00 and 25.00.

9. Carthamus - Adhatoda - Ziziphus Community

This community was moderately similar to Olea-Adhotada-Ziziphus community but highly dissimilar to last three, in which the leading dominants were *Z. jujuba* and *C. oxyacantha.*

10. Olea - Adhatoda - Ziziphus Community

This community was a little similar to its following three communities.

11. Ziziphus Acacia Dicanthium Community

It is highly similar to community, value being 74.07 but has a lower similarity coefficient with Carthamus-Cousinea-Calotropis community (53.61).

12. Ziziphus - Cousinea - Carthamus Community

This community was moderately similar to Carthamus-Cousinea-Calotropis community (53.61).

4.3 Soil Characteristics of Communities

The soil characteristics of different plant communities are given in Table-17 a and 17-b.

The data on soil analysis show that the soils of the area were generally coarse textured (sandy loam), basic in reaction (pH more than 7), with calcium as a dominant ion. In general, cations and anions were low, organic matter percentage was low, however, in some communities, it was moderate. Soluble carbonates were totally absent except in one stand (No. 197). However, $CaCO_3$ was present in higher amounts, due to which soil possessed basic properties in all stands. Saturation %age of these soils ranges from 34.4% to 49.43%.

1. The soils associated with Adhatoda-Acacia-Carissa community were sandy loam and loam, moderately calcareous and basic in reaction. They had moderate saturation capacity with low organic matter percentage, high Ca^{++} and low Mg^{++}, Na^{+}, K^{+}, N, and phosphorus. Carbonates were absent and bicarbonates were present in moderate

Table 17-a Soil Variables in different stands of Plant Communities.

Community No.	Stand No.	Saturation percentage	$CaCO_3$	Clay %	Silt %	Sand %	Textural class
1	75	39.5	33.8	16.3	22	61.7	Sandy loam
	103	46%	48.6	18.3	44	37.7	Loam
2	109	39.2	49.4	8.3	33	58.7	Sandy Loam
	112	48.9	49.0	6	13	81.0	Loamy Sand
	154	37.0	48.1	8.3	20	71.7	Sandy Loam
3	186	36.66	49.6	16.3	27	56.7	Sandy Loam
4	45	37.4	49.4	8.15	21	70.85	Sandy Loam
5	197	34.4	49.5	4.3	16	79.7	Loamy Sand
6	184	40.4	49.2	5.00	47.0	48.0	Sandy Loam
7	82	49.43	30.4	10.3	27	62.7	Sandy Loam
8	158	48.90	49.3	6.09	16.0	77.91	Loamy Sand
	164	37.33	49.2	10.3	31.0	58.7	Sandy Loam

Contd...

Contd: Table 17-a

Community No.	Stand No.	Saturation percentage	$CaCO_3$	Clay %	Silt %	Sand %	Textural class
9	171	39.53	49.6	7.3	18	74.7	Sandy Loam
10	190	47.6	49.6	13.3	31	55.7	Sandy Loam
	192	48.4	49.5	8.3	18	73.7	Sandy Loam
11	115	44.4	34.3	19.3	24	56.7	Sandy Loam
	152	46.4	49.6	12.3	17.0	70.7	Sandy Loam
12	14	41.46	31.6	8.3	25.0	66.7	Sandy Loam
	10	38.1	49.7	4.15	9	86.85	Loamy Sand
13	82	44.83	49.1	7.3	19	73.7	Sandy Loam

For Community names see Table-2.

Table 17-b Analysis of Soil Samples from different stands of Plant Communities.

Community no.	Stand No.	pH	Organic matter%	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	N%	P	Cl'	CO''_3	HCO'_3
1	75	7.1	2.28	2816	3.437	4.445	9.622	1.10	9.2	1.25	0.00	12.5
	103	7.5	3.56	3526	4.566	4.240	6.028	1.05	8.5	1.25	0.00	7.5
2	109	7.2	4.54	3802	5.481	4.109	3.900	1.3	11.4	2.00	0.00	4.5
	112	7.1	2.24	4220	3.843	7.409	9.162	1.15	10.5	1.00	0.00	10.5
	154	7.5	4.27	2933	4.133	7.981	13.59	1.10	12.3	2.75	0.00	11.0
3	186	7.2	2.14	2775	4.238	5.113	10.63	0.85	13.6	1.50	0.00	11.0
4	45	7.3	2.85	3831	6.820	4.708	23.93	1.20	7.9	1.25	0.00	14.5
5	197	7.2	4.09	4442	5.582	7.333	7.668	1.50	12.6	1.25	8.00	14.5
6	184	7.1	3.92	4446	5.410	7.351	9.112	1.20	8.7	2.00	0.00	11.0
7	83	7.3	1.80	10435	3.200	7.512	14.37	0.80	7.9	1.25	0.00	10.5
8	158	7.3	6.50	3299	5.453	8.447	7.224	0.75	5.9	1.25	0.00	13.00
	164	7.3	5.52	3750	4.487	7.281	21.27	1.15	6.4	1.25	0.00	12.5
9	171	7.1	3.74	4342	6.500	8.014	3.400	0.65	7.5	1.00	0.00	7.5

Contd...

Contd. Table 17-b

Community No.	Stand No.	pH	Organic matter%	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	N%	P	Cl'	CO''_3	HCO'_3
10	190	7.2	1.78	3054	5.359	4.491	10.10	1.15	4.9	1.0	0.00	10.00
	192	7.4	4.3	3389	4.074	7.023	19.03	1.25	7.8	2.0	0.00	14.00
11	115	7.3	2.31	4375	7.268	4.401	10.99	0.75	6.3	1.25	0.00	7.5
	152	7.2	2.76	4300	6.238	7.512	9.375	1.15	12.3	1.50	0.00	11.0
12 13	14	7.1	4.72	1051	3.121	7.200	8.252	1.05	16.0	1.25	0.00	10.5
	10	7.1	4.09	4465	3.772	4.012	3.502	1.15	6.1	1.75	0.00	19.00
13	22	7.2	2.31	4340	7.141	8.212	4.178	1.2	7.2	2.0	0.00	6.5

For Community names see Table-2.

quantity, chloride contents were also low.

2. Cathamus - Echinops - Ziziphus Community

The soils of this community were sandy loam in texture, but in one stand (No.112) it was loamy sand, highly calcareous, with higher $CaCO^3$ contents (48%, 49%, 49%), moderate saturation percentage and basic in reaction (pH: 7.1-7.5). Organic matter %age of this community was moderate, but lower in one Stand (No.112). It had lower cations except calcium and lower anions, where $CO^{"3}$ were totally absent. Nitrogen and phosphorous were also present in lower amounts.

3. Acacia-Carissa-Olea Community

The soils of this community were sandy loam, highly calcareous, had moderate saturation %age, were basic in reaction, with low organic matter percentage. Calcium was the dominant cations, other cations as well anions were in much lower amounts. Nitrogen and phosphorous were also in small quantities.

4. Acacia-Ziziphus-Cousinea Community

This community was similar in soil properties to the above one. it had low organic matter percentage, high Ca^{++}, other cations and anions were lower in quantity and it was sandy loam in texture.

5. Acacia-Adhatoda-Carissa Community

Soils of this community contained moderate organic matter percentage, higher calcium (higher than the community 4th) and some quantities of CO^{-3} were also present in its soil. Loamy sand was the textural class of soil of this community.

6. Adhatoda-Ziziphus-Dodonaea Community

Soils of this community were also calcareous and basic in reaction. they had high Ca^{++}, and quite little cations. Anions were also in little quantity. Organic matter percentage was also very little.

7,8. Carthamus-Ziziphus-Ipomoea and Carissa-Ziziphus-Adhatoda Communities

Soils of these two communities were basic in reaction with same pH values (7.3) but differred from each other due to the fact that:

Soils of Carthamus dominanted community were sandy loam, had lower organic matter, lower calcium content and other anions cations were also in lower quantity.

Soils of Carissa dominated community were loamy sand, had high saturation ercentage, high calcium but other anions and cations were lowere in quantity. Organic matter

percent was present in considerably high quantity.

9,10 Carthamus-Adhatoda-Ziziphus and Olea-Adhatoda-Ziziphus Communities.

Soils of both the communities were sandy loam and had high $CaCO_3$ contents. Saturation capacity of Carthamus-Adhatoda-Ziziphus community was a little higher than that of Olea-Adhatoda-Ziziphus community. Organic matter was moderate in soils of both communities, however, in one stand of Carthamus dominated community, it was lower. The soils of the two communities had high calcium content but other cations and anions were lower in quantity . Nitrogen and phosphorus were lower in quantity.

11. ziziphus-Acacia-dichanthium Community

Soils of this community, dominated by Ziziphus jujuba had lower organic matter percentage and high calcium where other anions and cations were also low in quantity, and sandy loam textural class. $CaCO_3$ was present in moderate quantity and saturation capacity of soils was also moderate. Soils of this community were also basic in reaction.

12,13 Ziziphus Cousinea-Carthamus and Carthamus-Cousinea-Calotropis Communities

Soils of these communities, 1st dominants of which are *ziziphus jujuba* and *Carthamus oxyacantha*, were also

basic in reaction, had sufficient organic matter and high calcium. Soils of Ist of these two communities was loamy sand whereas, that of IInd was sandy loam in texture.

CHAPTER-5

DISCUSSION

Phytosociological study of Sangjani (Islamabad) revealed that vegetation of the area mainly comprised perennial shrubs (*Adhatoda zeylanica, Acacia modesta, Carissa opaca, Olea ferruginea* and *Ziziphus jujuba*). However at some places, only herbaeceous annuals were present in dominant conditions. The area was present in two different conditions:

1. Cultivated 2. Uncultivated

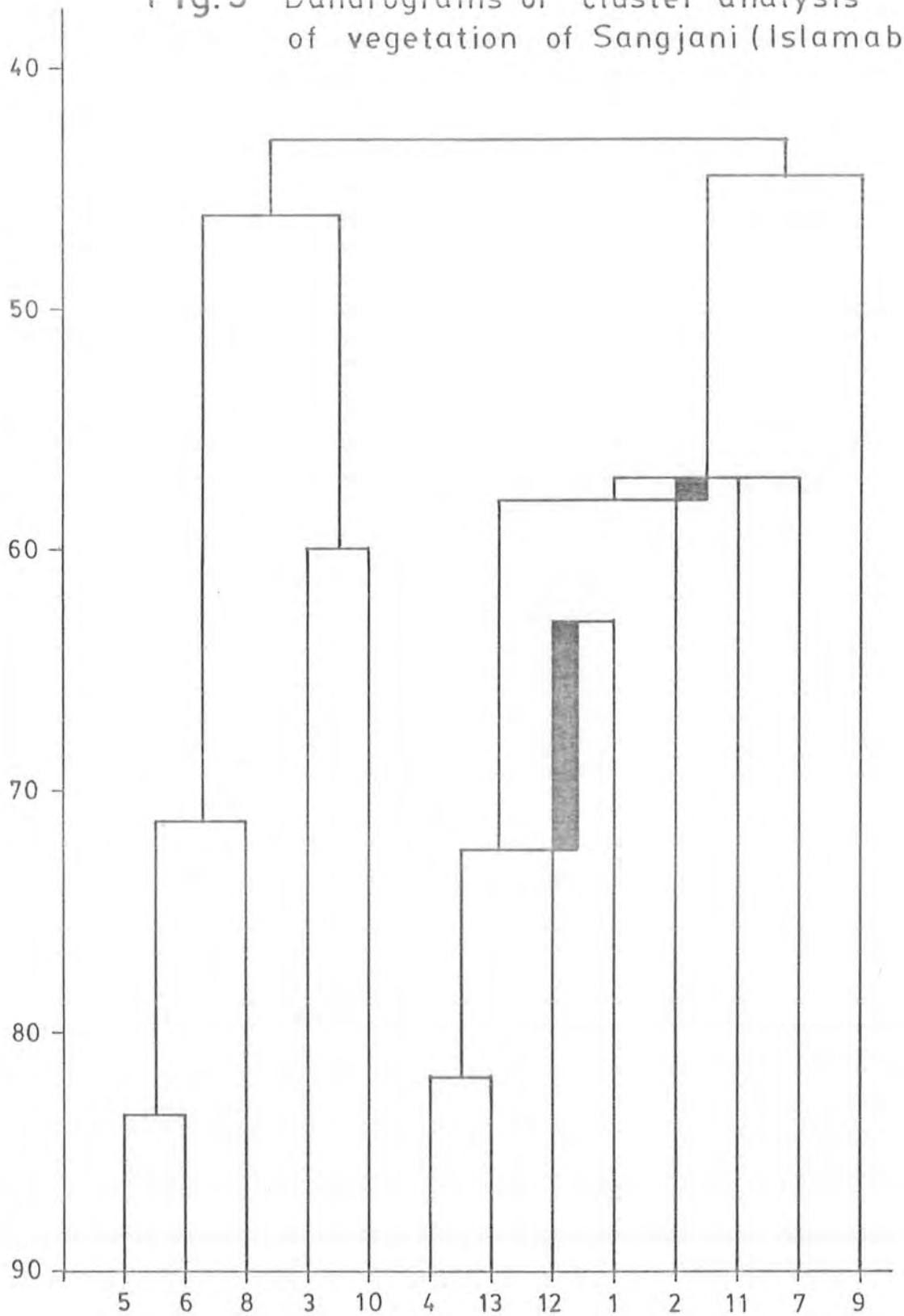
In the caltivated areas which were lying barren after the harvesting of wheat, *Carthamus oxycantha, Echinops echinatus* and *Cousinea minuta* were found very commonly. On the edges of these fields shrubs like Adhatoda and Carissa were found while on waste places only perennial shrubs formed the permanent framework. In adition some perennial grasses like *Heteropogon contortus, Cynodon daetylon* and *Dichanthium annulatum* were present. They were severely grazed and did not make a significant contribution to the vegetational composition of the area. Herbs like *Achyranthes bidentata, Dicliptera roxberghiana, Rynchosia minima, Soalanum nigrum, Solanum surattense, Boerhaavia diffusa, Delphinium uncinatum, Oxalis corniculata, Malcolmia africana, Convolvulus arvensis, Delphinium kolatense* were present in very little amounts.

Otostegia limbata, *Ipomoea carnea*, *Maytenus royleanus*, *Asparagus gracilis*, *Capparis decidua*, *Calotropis pracera*, *Lantana camara*, *Dodonaea viscosa* and *Morus alba* were present in significant amounts and were the shrubby associates. *A. zeylanica* possessed a wide range of distribution and was present mostly on waste places. Dakshini (1972) has reported *A. zeylanica* as plant of waste places.

Plant communities of the area exhibited a moderate floristic similarity as is evident from indices of similarity values between various plant communities, whereas a little higher values were present between other communities. However, dandrogram of cluster analysis (Fig. 3) showed that there are 3-types of clusters of vegetation.

Acacia - Carissa - Olea, *Acacia - Adhatoda - Carissa*, *Adhatoda - Ziziphus - Dodonaea*, *Carissa - Ziziphus - Adhatoda* and *Olea - Adhatoda - Ziziphus* communities formed one type of cluster; communities like, *Adhatoda - Acacia - Carissa*,*Carthamus - Echinops - Ziziphus - Acacia - Ziziphus - Cousinea*, *Carthamus - Ziziphus - Ipomoea*, *Ziziphus - Acacia - Dichanthium*, *Ziziphus - Cousinea - Carthamus* and *Carthamus -*

Fig. 3 Dandrograms of cluster analysis of vegetation of Sangjani (Islamabad).



Cousinea - Calotropis were included in another cluster. *Carthaus - Adhatoda - Ziziphus* formed third independent cluster. This cluster formation differentiates the area into three zones, according to the vegetational composition. In the Ist cluster only shrubs contributed in the formation of different plant communities. *Acacia, Adhatoda, Dodonaea, Carissa, Ziziphus* and *Olea* were the shrubs by which diferent plant communities were formed. The area of those communities was at higher which therefore could not be used for any type of cultivation and was therefore, lying waste. In the 2nd cluster, communities forming plants were *Adhatoda, Acacia, Carissa, Carthamus, Echinops, Cousinea, Ipomoea, Dichanthium* and *Calotropis*. The area of these plants was at lower altitude as compared to the Ist clustre. This was the area from where wheat had been harvested and at the time of sampling it was more or less barren. Community of 3rd cluster, although was present in the area with Ist cluster, but the conditions were not the same as were for the Ist cluster of plant communities.

The compositona and distribution of plant communities is usually affected by climate, topography, soil and biotic

influence. In the surveyed area, climate was not found to be affecting the distribution of plants because the area studied was not too big to be influenced by the climate. However, the present structure of vegetation was due to the overall semiarid climatic conditions. High intensity summer rains can be observed in the form of weathered rocks and removal of topsoil due to sheet erosion. Factors like topography, biota and to some extent soil parameters were seemed to be influencing the vegetation of the area.

Conditions of soils in the Ist vegetation cluster were found to be comparatively different from the soils of 2nd and 3rd cluster of plant communities. Amount of $CaCO_3$ was more or less the same without any variations in the soils of Ist cluster of plant communities. However variations in the amount of $CaCO_3$ were more obvious in the soils of 2nd cluster. Here lower amounts of $CaCO_3$ were present in the soils of *Adhatoda - Acacia - Carissa, Carthamus - Ziziphus - Ipomoea, Ziziphus - Acacia - Dichanthium* and *Ziziphus - Cousinea - Carthamus* communities. In the soils of the rest of the plant communities of this cluster $CaCO_3$ was present in more or less the amounts just like in soils of communities

belonging to vegetation of cluster No-1 (Fig. 4a).

Ca^{++} was reasonably higher in amounts in the Ist cluster and its amount was lower in soils of those communities where total $CaCO_3$ was observed to be lower, thus showing their lower amounts in cultivated fields as compared to undisturbed areas (Fig-I for location of stands; Fig.4a).

Organic matter in the Ist vegetation cluster was in higher amounts as compared to rest of the two clusters. Also there were more variations in the organic matter of 2nd and 3rd vegetation cluster.

K^{+} was found in higher amounts in the Ist cluster with some variations within the soils of some plant communities of this cluster. The organic matter percentage was lower in soils of 2nd and 3rd clusters of plant communities.

Nitrogen percent was not influencing the vegetation types as it was present in somewhat equal amounts in soils of all plant communities. However this nitrogen was in lower quantity in the 3rd cluster which comprised of an independent

FIG. 4a

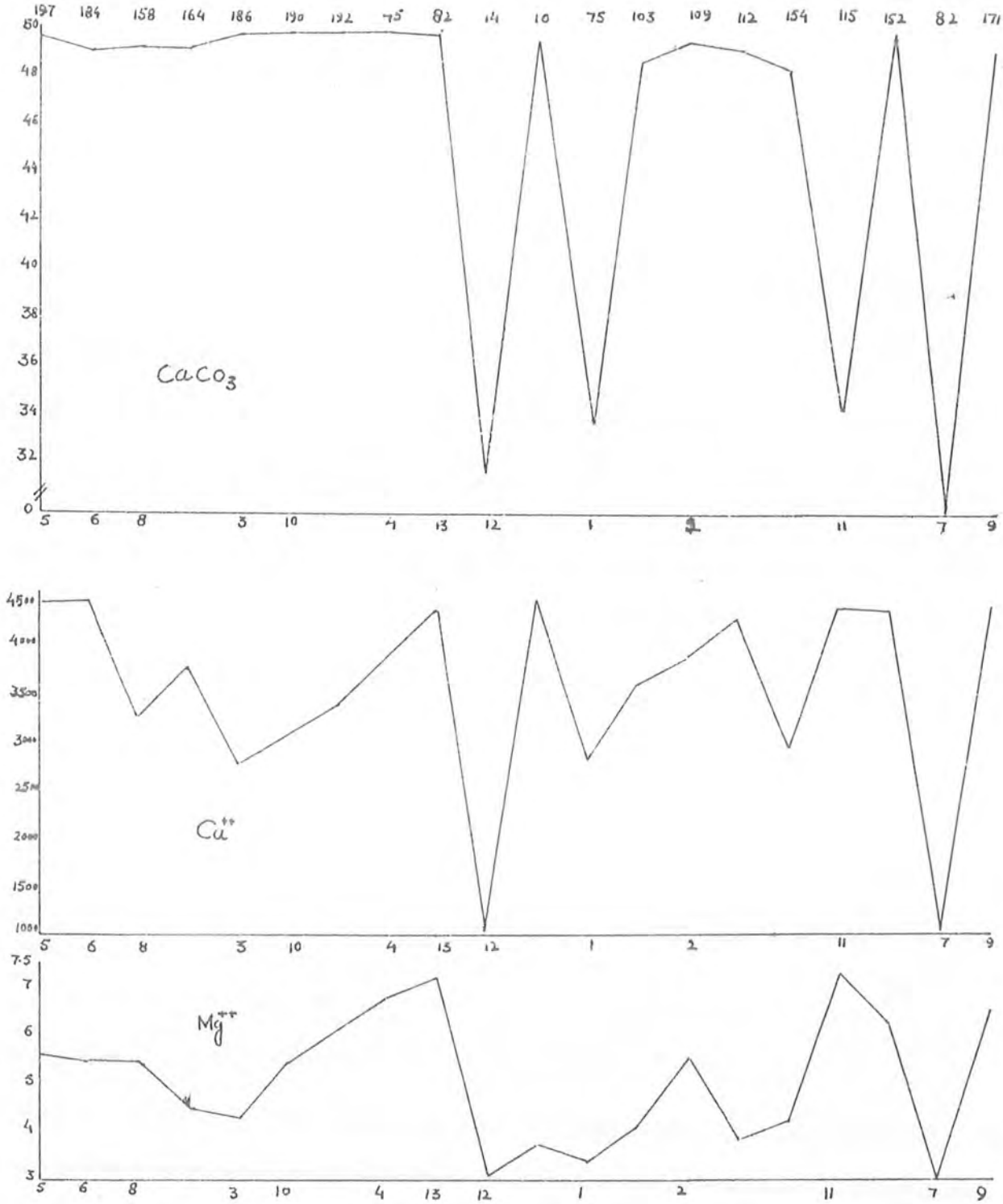
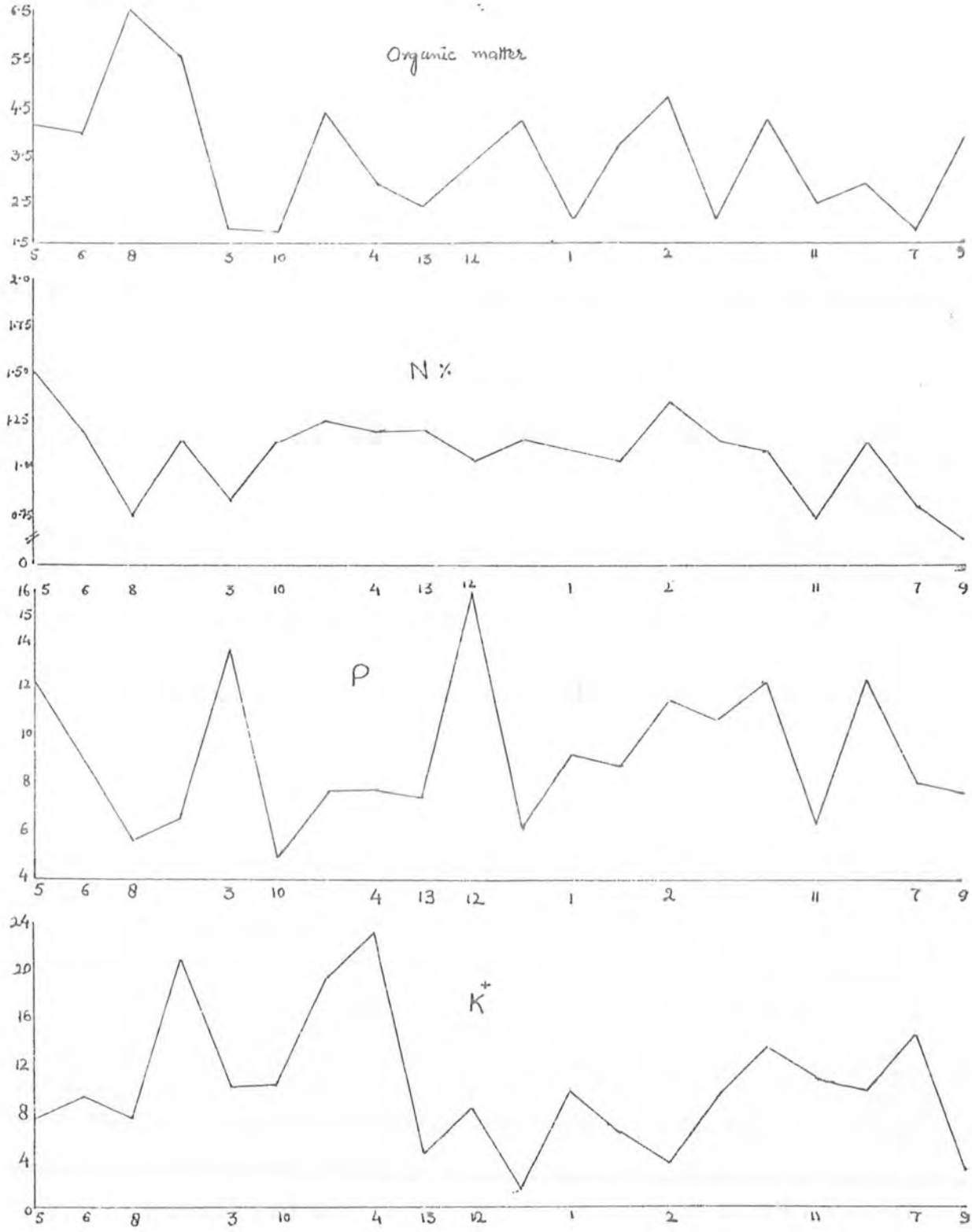

197 184 158 164 186 190 192 75 82 14 10 75 103 109 112 154 115 152 82 171
50
48
46
44
42
40
38
36
34
32
0
CaCO3
5 6 8 3 10 4 13 12 1 2 11 7 9
4500
4000
3500
3000
2500
2000
1500
1000
Ca++
5 6 8 3 10 4 13 12 1 2 11 7 9
7·5
7
6
5
4
3
Mg++
5 6 8 3 10 4 13 12 1 2 11 7 9

FIG. 4 b


Organic matter
6·5
5·5
4·5
3·5
2·5
1·5
N %
2·0
1·75
1·50
1·25
1·00
0·75
0
P
16
15
14
12
10
8
6
4
K+
24
20
16
12
8
4
0
5 6 8 3 10 4 13 12 1 2 11 7 9

plant community.

Similarly phosphorus, Cl' and HCO_3' were not present in too different quantities in the soils of Ist and 2nd clusters of vegetation. However, their quantities were lower in soils of 3rd cluster (Fig. 4b.

Thus it is clear from the data on soil analysis that $CaCO_3$, organic matter and K^+ were found to be influencing the vegetation types of the area. Similar results have been reported by Susan *et al.* (1982); Chaghtai *et al.* (1983) and Hijazi (1984).

Topography of study area is dryland sloping generally towards south over which flows the water of runoff from the south facing slopes of Margalla Hills in rainy season. Topography of the area was found to be affecting the vegetation in combination with the biotic disturbances. Considering Table-2 and Fig-1. It could be observed that herbs like carthamus, *Cousinea, Echinops* and *Dichanthium.* Contributed to community formation in 2nd cluster, the stands of which were prsent at lower elevations as compared to the

stands of Ist cluster. Both these plants are weeds of wheat and were in the areas from where wheat had been harvested.Shrubs like *Acacia, Carissa, Dodonaea, Adhatoda* and *Olea* were found to be adapted to wide range of habitat. Also they had been reported to be present in lower to higher elevations of 1000 m altitudes. Khattak *et al.* (1984) reported *Acacia, Dodonaea* and *Olea* to be present on north and south facing slopes of Cherat Hills. Hijazi (1984) reported *Carissa* and *Dodonaea* to be present on Margalla Hills National Park. Chaghtai *et al.* (1988) observed that *Olea, Acacia* and *Dodonaea* were the species which dominated upto 900 m altitude of slopes with minor variations in $CaCO_3$ contents of the soil.

The separate cluster of *Carthamus - Adhatoda - Ziziphus* community was due to disturbing factors like blasting and obtaining clay for use in cement industry and due to crushers working in that area.

In addition to soil and topography, biotic influence may be considered as the major factor caussing variations in the type of vegetation of a certain area. Villagers use the land

for cultivation and cut down the shrubs for fuel purposes. Grazing and browising are also biotic factors which influence the vegetation. With the increasing human population, the use of these natural resources has been increased (Chaghtai *et al.*, 1984). In the study area grazing was very intense. *A. modesta* and *Maytenus royleanus* were grazed by sheep and goats. Grasses were grazed severly and they were not even in a condition to be identified. In stands which were under cultivation process, only herbaecous species like *Carthamus*, *Cousinea* and *Echinops* were the dominant ones. With other soil and topographic factors, this was also due to the reason that shrubby plants were eradicated from these stands.

FLORISTIC LIST

Scientific Name	Family
Abutilon indicum (L.) Sweet	Malvaceae
Acacia modesta allich	Mimosaceae
Acacia nilotica (Linn). Delile	"
Achyranthes bidentata Blume	Acanthaceae
Adhatoda zeylanica Medic.	Acanthaceae
Anagallis arvensis Linn.	Primulaceae
Asparagus gracilis Royal	Liliaceae
Asphodelus tenuifolius Cavan	Liliaceae
Boerhaavia diffusa L.	Nyctaginaceae
Calotropis procera (Willd.) R.Br	Asclepiadaceae
Cannabis sativa L.	Cannabinaceae
Capparis decidua (Forssk.)Edgew	Capparidaceae
Carissa opaca Stapf exHaines	Apocynaceae
Carthamus oxyacantha M.Bieb	Compositae
Chenopodium album L.	Chenopodiaceae
Convolvulus arvensis L.	Convolvulaceae
Cousinea minuta Boiss	Compositae

Cynodon dactylon (L.) Pers.	Poaceae
Dalbergia sissoo Roxb.	Papilionaceae
Delphinium kohatense (P.Bruhl)Munz	Ranunculaceae
Delphinium Uncinathum Hooker fil. & Thomson	Ranunculaceae
Dichanthium annulatum (Forssk.)stapf	Poaceae
Dicliptera roxberghiana Nees	Acanthaceae
Dodonaea viscosa(L.)Jacq.	Sapindaceae
Echinops echinatus Roxb.	Compositae
Eucalyptus sp.	Myrtaceae
Euphorbia prostrata Aita Ait	Euphorbiaceae
Fumaria indica (Hausskn.) H.M. Pugsley	Fumariaceae
Heteropogon contortus(Linn) P. Beauv.	Poaceae
Ipomoea carnea jaca	Convolvulaceae
Lantana camara L.	Verbenaceae
Malcolmia africana (L.).R.Br.	Cruciferae
Maytenus royleanus (Wall ex Lawson) Cufodontis	Celesteraceae
Medicago minima L.	Papilionaceae

Morus alba L.	Moraceae
Olea ferruginea Royle	Oleaceae
Otostegia limbata (Benth) Boiss	Labiatae
Oxalis corniculata L.	Oxalidaceae
Pegnum harmala L.	Zygophyllaceae
Plantago major L.	Plantaginaceae
Rhynchosia minima (L.) DC	Papilionaceae
Saccharum bengalense Retz	Graminae
Serratula pallida DC	Compositae
Solanum nigrum Linn	Solanaceae
Solanum surattense Burm.F.	Solanaceae
Ziziphus jujuba Miller	Rhamnaceae
Ziziphus nummularia (Burm f.) Wight and Arn.	Rhamnaceae

Ahmad, M. 1986. Vegetation of some foothills of Himalyan range in Pakistan. Pak. J. Bot., 18:261-269.

Akbar, K. F. 1988. Phytosociological study of the Quaid-i-Azam University Campus. M. Phil. thesis. submitted to Bio. Sci. Deptt. Q. A. U. Islamabad.

Amin, A. and R. M. Ashfaque, 1982. Phytosociological studies of Ayub National Park, Rawalpindi. Pak. J. For. 32:180-185.

Amin, A. Z. Din, R. Roohi and T. Jamil, 1984. Preliminary vegetation and soil investigations of Lohiber Range. Pak. J. For. 34:13-18.

Barbour, M.G., J.H. Burk and W.d. Pitts, 1980. Terrestrial Plant Ecology. The Benamin. Califfornia. pp. 604.

Black, C.A. 1965. Methods of Soil Analysis. Part 2. Chemical and Microbiologicla properties. Amer. Soc. of Agro. Inc. Modison Wisconsin, USA. pp:1045-1047.

Bouyoucos, C.J. 1962. Hydrometer Method for making particle size analysis of soil. Agro. J. 54:464-465.

Cheghtai, S.M., A. Sadiq and S.H. Shah, 1985. Early Succcession on an abandoned field in Peshawar, Pakistan. Pak. J. For. 35:59-69.

Chaghtai, S.M., A. Sadiq and S.Z. shah, 1984. Vegetation around the Shringe of ghalib Gul Baba in Khawarra, Nilab Valley, NWFP, Pakistan. Pak. J. For. 34:145-150.

Chaghtai, S.M. and H.R. Khattak, 1983. Ecology of dry streambed in Peshawar Pakistan, Pak. J. Bot. 15:93-98.

Chaghtai, S.M., H.R. Khattak, S.Z. Shah and J. Shah, 1988. Ecology of an upland forest near Nowshera, NWFP, Pakistan. Pak. J. Bot. 20:113-124.

chaghtai, S.M., N.P. Rana and H.R. Khattak, 1983. Phytosociology of the Muslim Graveyards of Kohat Division, NWFP, Peshawar. Pak. J. Bot. 15: 99-108.

Curtis, J.T. and R.P. Mcintosh, 1950. The inter-relations of certain analytical and synthetic phytosociological characters. Ecology, 32:476-496.

Dakshaini, K.M.M. 1972. Indian Sub-continent. In:wildland shrubs: Their biology and utilization, 3-15. C.H. Mekell, J. P. Blaisdell and .R. Goodin, eds. USDA Forest Survice, General Technical Report. INT. 1. Ogden. USA.

Goldsmith, F.B. and C.M. Harrison, 1976. Description and analysis of vegetation. In. S.B. Chapman (Ed) Methods in Plant ecology. Blackwell pp. 536.

Grootjans, A.D. D.C. Schipper and H.J. Vanderwinot. 1985. Infleunce of drainage on nitrogen mineralization and vegetation response in wet meadows.I. Calthion Palustris Stands. Acta Occol Plant. 6:403-417 (Biol. Abst. 81:293, 1986).

Haq, I. and Z. Khattak, 1982. Phytoecological studies of shahgai hills, Khyber agency, NWFP, Pakistan. Proc. Ist. Reg. Con. Plant Sci. Peshawar p:65-70.

Hijazi, S. 1984. A phytosociologicla study of margalla Hills National Park, Islamabad. M. Phil. Thesis Submitted to Bio. Sci. Deptt. Q.A.U. Islamabad.

Humphries, E.C. 1956. Minera. Components and ash analysis. K.Peach, and M.V. Tracey, Modern methods of plant analysis. Vol. I, pp> 479-481.

Hussain, M. 1990. Environmental protection. Global survival at Stake. The Pakistan Times, Midweek, 29th May.

Iqbal, M. Z., S.A. Qadir and M. Ahmad, 1983. Phytosociological studies around the polluted disposal channels of Industrial areas of Karachi. Pak. J. Sci. and Ind. Res. 26: 134-139.

Kayani, S.A., A.K. Achakzai and S.a. Qadir. 1984. Phytosociologicla studies in wastelands of Quetta Pishin districts, Baluchistan, Pakistan. Pak. J. bot. 16: 255-265.

Kayani, S.A., A.K. Chaghtai, T. Ahmad and S.A. Qureshi. 1988. Relationship between plant communities and soil conditions in Nasirabad and Sibi districts. Balochistan, Pakistan. Pak. J. bot. 20:55-62.

Kershaw, K.A. 1973. Quantitative and Dynomic Plant ecology sec. Ed. Printed in Great Bitain by William Clows and Sons Ltd. London pp. 280-285.

Khattak, Z.D. 1989. Preliminary studies on the phytosociology of Islamabad. M. Phil. Thesis Submitted to Bio. Deptt. Q.A.U. Islamabad.

Khattak, Z., I. Haq and Q.ali, 1984. Phytosociologicla study of cherat hills, NWFP, Pakistan. Pak. J. bot. 9:187-200.

Kirkpatrick, J.B. 1981. A transact study of forests and woodlands on dolerite in the eastern tiers, Tasmania. Vegetatio, 44:155-163.

Nikolskii, N. IV. 1963. Practical soil science Tech. Survice US Deptt. of Comerce Washington, 25 DC, PP: 240.

Pakistan Times, 1990. Hole in Ozone layer over north pole confirmed. Pak. Times. Monday, March, 19 p: 5.

Price, W.J. 1979. Spectrochemical analysis by Atomic absorption. Set by ETA Servives (Types Setters) Ltd. Great Britain PP: 257-259.

Qadir, S.a. and Q.A. Shetvy, 1986. Life form and leaf size spectrum and phytosociology of some Libyan plant communities. Pak. J.Bot. 18: 271-286.

Shaukat, S.S. A. Khairi and R. Ahmad, 1976. A phytosocilogical study of Gadap area. Southern Sindh, Pakistan. Pak. J. Bot. 8: 133-149.

Shaukat, S.S. , D. Khan and S.a. Qadir, 1981. On the vegetational dynamics of Calcareous hills around Karachi. Pak. J. Bot. 13:17-37.

Stewart, R.R. 1972. An annotated catalogue of the vascular plants of west Pakistan and Kashmire (ed). E. Nasir and S.I. Ali, Flora of West Pakistan; Univ. of Karachi, Pakistan 1028 pp.