DIMENSION AND COMPOSITION OF PLANT LIFE IN TEHSIL TAKHT-E-NASRATI, DISTRICT KARAK, KHYBER PAKHTUNKHAWA, PAKISTAN

MUSHARAF KHAN

DEPARTMENT OF BOTANY
UNIVERSITY OF PESHAWAR
2012

Dedication

I dedicated this work to my whole family members and teachers with great love and gratitude



In the Name of

Allah

The Most Compassionate

The Most Merciful

UNIVERSITY OF PESHAWAR

PESHAWAR

DIMENSION AND COMPOSITION OF PLANT LIFE IN TEHSIL TAKHT-E-NASRATI, DISTRICT KARAK, KHYBER PAKHTUN KHAWA, PAKISTAN

A dissertation submitted in partial fulfillment of

the requirement for the degree of

Doctor of Philosophy

in

Botany

By

Musharaf Khan

Graduate Study Committee:

1. Prof. Dr. Farrukh Hussain, (Supervisor)
2. Prof. Dr. Syed Zahir Shah, (Member)
3. Prof. Dr. Muhammed Seed, (Member)
4. Prof. Dr. Siraj-ud-Din, (Member)
5. Madam Mussarat Jabeen, (Member)

CERTIFICATE OF APPROVAL

This Dissertation, entitled "**DIMENSION AND COMPOSITION OF PLANT LIFE IN TEHSIL TAKHT-E-NASRATI, DISTRICT KARAK, KHYBER PAKHTUN KHAWA, PAKISTAN.**" submitted by Musharaf Khan is hereby approved and recommended as partial fulfillment for the award of Degree of Doctor of Philosophy in Botany.

_____

(External Examiner)
Prof. Dr. Mufakhirah Jan Durrani
Chairperson, Department of Biology
Allama Iqbal Open University
Islamabad

_____

(Supervisor)
Prof. Dr. Farrukh Hussain
Research Supervisor,
Department of Botany,
University of Peshawar.

Dated: ……2013

PUBLICATION OPTION

I hereby reserve the rights of publication, including right to reproduce this thesis in any form for a period of 5 years form the date of submission

Musharaf Khan

Acknowledgements

This thesis would never been accomplished without the courage, strength and hope given by Almighty Allah! The most merciful, the most beneficent, who makes impossible to possible. I invoke peace for the Holy Prophet Mohammad (May peace and blessings of Allah be upon him) who is for ever atorch of guidance and knowledge for humanity as a whole.

It is worthwhile to express my extreme passionate and articulate appreciation to my respectable Research Supervisor Prof. Dr. Farrukh Hussain, Dean Faculty of life and Enviromental science and Director Center of Plant Biodiversity, University of Peshawar, for his encouragement, dedicated supervision and valuable suggestions during the course of thesis.

I am also thankful to the Prof. Dr. Muhammad Ibrar, Chairmen, Department of Botany for facilitating me through out my research work.

My special thanks to Mr. Farid Ullah Khan, Principal Scientific officer, PCSIR, Peshawar, Mr. Obaid ur Rehman, Adman Officer PCST, PCSIR Labs, Peshawar; All Staff members of Agricultural Research Farm Ahmadwala, Karak, Muhammad Qasim, DM Government High School Surdog, Karak; Mr. Ihsanulluh, Khyber Degree College Takht-e-Nasrati, Karak; Mr. Syed Ghias Ali, Center of Plant Biodiversity, Peshawar for their kind help and sincere guidance whenever needed throughout the study.

I want to express my gratitude to all friends specially Mr. Zahid Mehmood and class fellows specially Dr. Muhib Shah and Mr. Ishfaq Hameed for their help whenever needed throughout the study. I extend my thanks to all the teaching and non-teaching staff of Department of Botany, who helped me in providing necessary equipments and did valuable cooperation.

I am indebted to my loving brothers, sisters and wife for their constant support, love, kindness, encouragement and parents whose prays made me able to compile and complete the work.

During my work I have encountered many obstacles and provided with support and assistance from different institutions and personals, special thank to the people of area for providing support.

Musharaf Khan

VITAE

April 14, 1978 –- Born. Village and Post Office Bogara, District Karak.

2000 – B. Sc. University of Peshawar, Peshawar.

2004 – MSc. Gomal University D. I. Khan.

2005 – M.Ed. Sarhad university, Peshawar.

2007 – M. Phill. Kohat university of Science & technology, Kohat.

2008 – PGD (NRM). University of Peshawar, Peshawar.

25 August 2007 till now – lecturer in Biology Federal Government College Mardan.

Major Field: **Ecology**

Botany

Courses studied:		**Teacher**
1. Allelopathic Interaction	:	Prof. Dr. Farrukh Hussain
2. Soil algae	:	Prof. Dr. Farrukh Hussain
3. Vegetation Ecology	:	Prof. Dr. Farrukh Hussain
4. Edaphology	:	Prof. Dr. Muhammad Ibrar
5. Pharmacognosy	:	Prof. Dr. Muhammad Ibrar
6. Limnology	:	Prof. Dr. F. M. Sarim

ABSTRACT

DIMENSION AND COMPOSITION OF PLANT LIFE IN TEHSIL TAKHT-E-NASRATI, DISTRICT KARAK, KHYBER PAKHTUN KHAWA, PAKISTAN

By

Musharaf Khan

The present study was designed to assess plant life structure and resources of Tehsil Takht-e-Nasrati, District Karak, Khyber Pakhtun Khawa, Pakistan with respect to local people and their livestock exercise since in the investigated area no such work was done before. The study revealed that investigated area had 161 plant species belonging to 136 genera and 57 families. There are 7 families of monocotyledons having 21 genera and 25 species. Dicotyledons had 50 families, 115 genera and 136 species. Overall Poaceae was the dominant family with 17 species followed by Asteraceae had 13 species. Phenological data showed that 94 plants were found in flowering condition in spring which included 19 (11.8%) tree, 11 (6.83%) shrubs, 61 (37.9%) herbs and 3 (1.86%) parasites. In summer, 28 plants including 1 (0.62%) tree, 3 (1.86%) shrubs, 21 (13%) herbs and 3 (1.86%) grasses. In winter, 27 plants including 2 (1.24%) trees, 5 (3.11%) shrubs, 17 (10.6%) herbs and 3 (1.86%) grasses while 12 plants had through out the year included 4 (2.48%) shrubs, 5 (3.11%) herbs and 3 (1.86%) grasses. The biological spectrum revealed that therophytes was dominated by 77 plants species (47.83%) followed by hemicryptophytes (30 spp., 18.63%), megaphanerophytes (17 spp., 10.6%), nanophanerophytes (16 spp., 9.94%), chamaephytes (11 spp., 6.83%), microphanerophytes (4 spp, 2.48 %), parasite (3 spp, 1.86%) and geophytes (03 spp., 1.86%). The leaf size spectrum dominated by microphylls (85 spp. 52.8%) followed by nanophylls (32 spp. 19.9%), mesophylls (17 spp. 10.6 %), leptophylls (15 spp. 9.32%) and megaphylls (12 spp. 7.45%). Through ethnobotanical profile it was reported that the locals used 118 (73.3%) species as folk medicinal plants, 114 (70.8 %) fodder species, 47 (26.7 %) fuel species, 16 (9.94 %) timber woods, 23 (14.3 %) vegetable species, 50 (31.06 %) veterinary use plants, 90 (55.9 %) honey bee species. The 33 (20.5 %) fruit plants species and 17 (10.6 %) species were used for making agricultural tools, 19 (11.8 %) species were used for fencing field borders and 18 (11.18%) were used for making furniture.

It was a different ecological study of the investigated area. Quantitative and qualitative description of diverse plant communities at different altitude had provided some basic information about phytodiversity, plant life structure and climatic combination. The investigated area was divided on the basis of altitude i.e. stand 1 (340 – 399 m), stand 2 (400 - 499 m), stand 3 (500 - 599 m) and stand 4 (600-700 m). Community structures in diverse sites were taken into spring, summer and winter. In each season 22 plant communities were established at various sites on the basis of important value from each plant strata i.e. tree, shrub and herb. In spring aspect, 66 plant species, summer (46 spp.) and in winter 72 plant species were recorded in different plant communities. All plant communities showed heterogeneity in all seasons. With increasing altitude heterogeneity occurred in most of the communities. In plain and hilly area, the highest value was originated of class B i.e. 7.35 and 7.09 respectively. The highest value of species diversity (3.097) and equitability value (0.957) was found in spring while the highest value of species richness (5.752) was found in winter. Communities had high percentage of maturity index value in summer. In summer and winter total 12 plant communities showed similarity above 65% while winter show no similarity above 65% between communities. Hierarchical Cluster Analysis marked out distinct 4 groups association in spring i.e. *Prosopis-Fagonia-Saccharum* association, *Zizyphus-Saccharum-Acacia* association, *Fagonia-Zizyphus-Eragrostis* association, *Aerua-Acacia-Cymbopogon* association, in summer, 5 association i.e. *Cenchrus-Saccharum-Prosopis* association, *Cenchrus-Eragrostis-Calligonum* association, *Zizyphus-Cenchrus-Eragrostis* association, *Rhazya-Fagonia-Cymbopogon* association and *Aerua-Boerhavia-Zizyphus* association and in winter, 4 association i.e. *Cenchrus-Saccharum-Prosopis* association, *Cenchrus-Zizyphus-Saccharum* association, *Cenchrus-Zizyphus-Cymbopogon* association and *Aerua-Zizyphus-Acacia* association by different level, cycling and similarity of communities. The herb biomass was high 730 $Kg.hec^{-1}$ during spring at stand 1 (340 – 399 m). The grass biomass was high 173 $Kg.hec^{-1}$ during summer at stand 3 (400-499 m). The total herbs mean biomass was high during spring (536.30 $Kg.hec^{-1}$) while the grasses had (129.9 $Kg.hec^{-1}$) during summer. The total average herbaceous biomass was high at stand 1 (262.58 $Kg.hec^{-1}$) and total mean and average biomass of research area was 223.23 $Kg.hec^{-1}$.

The overall average total shrub biomass was 741.58 Kg. hec^{-1}. The total shrub biomass in different area was diverse from 13.47 Kg. hec^{-1} to 2665.12 Kg. hec^{-1}. As a whole the shrub biomass was high in winter while low in summer. The people of area rely on animals for their livelihood. The major plants are grazed in the investigated area.

Of the 161 recorded species, 29 species (18.01 %) were non palatable, 32 spp. (19.88 %) highly palatable, 43 spp. (26.71 %) mostly palatable, 34 spp. (21.12 %) less palatable and 23 spp. (14.29 %) were rarely palatable. 10 plant species were studied for phytochemical screening i.e. alkalid, carbohydrate, saponins, anthraquinone, flavonoid, steroids and tannins in three phenological stages. In mineral analysis 3 macro mineral such as sodium, potassium and calcium and 7 micro mineral like zinc, copper, manganese, chromium, nickel, cadmium and lead were analyzed in the 10 selected forage species in three phenological stages. Ten selected forage species were analyzed for proximate analysis like moisture, ash, fiber, carbohydrate, protein, fat and energy in three phenological stages. The conservation status of trees and shrubs on the basis of IUCN criteria showed that of the 45 plant species 20 (44.44 %) plant species were vulnerable, 16 (35.56 %) rare, 7 (15.56 %) endangered and 2 (4.44 %) plant species were infrequent. The current investigation highlighted that the area had great potential of plant life resources and biodiversity. It is concluded that natural habitats are crushing at dreadful speed which results in alteration of wild plant life habitat. It needs all achievable assessment for protection and sustainable exploitation of plant life.

TABLE OF CONTENTS

Contents		Page
1.	Introduction	1
	Aims and Objectives	7
2.	Review of literature	17
3.	Materials and methods	54
	3.1 General Survey	54
	3.2. Floristic Diversity	54
	3.3. Phenology	54
	3.4 Biological characteristics	54
	3.5. Ethnobotanical Profile	56
	3.6. Phytosociology	56
	3.7. Edaphology	60
	3.8. Rangeland Productivity	60
	3.9. Degree of Palatability	61
	3.10. Conservation Status of trees and shrubs	61
4.	Results and Discussion	63
	4.1. Floristic Diversity	63
	4.2. Phenological Behavior	70
	4.3. Biological Characteristics	73
	4.4. Ethnobotanical profile	88
	4.5. Phytosociology	108
	4.5.1. Vegetation Diversity and Community structure	108
	4.5.2. Degree of Similarity	224
	4.5.3. Biodiversity of Plant Species	230
	4.5.4. Maturity Index	242
	4.5.6. Degree of Homogeneity	253
	4.5.7. Classification and Ordination	263
	4.5.8. Rangeland Productivity	287
	4.6. Palatability	309
	4.7. Chemical Analysis	327
	4.7.1. Phytochemical Screening	327
	4.7.2. Mineral composition	330
	4.7.3. Proximate Analysis	353
	4.8. Conservation status of plants	367
5.	Conclusion	373
6.	Recommendations and suggestions	374
7.	References	375

LIST OF TABLES

Table	Title	Page
1.	Average climatic data of Tehsil Takht-e-Nasrati, Karak for the year 2001-2010.	10
2.	Floristic Diversity of plants with respect to its Phenology, Leaf persistence and Habitat of Tehsil Takht-e-Nasrati, District Karak.	79
3.	Ethnobotanical Profile of Plants of Tehsil Takht-e-Nasrati, District Karak.	101
4.	Floristic and ecological diversity of plant species in different communities of Tehsil Takht-e-Nasrati, Karak.	120
5.	The number of species and share relative important value of tree, shrubs, herbs and grasses among the different communities during spring of Takht-e- Nasrati, Karak.	124
6.	Phytosociological attributes of *Prosopis-Saussurea-Saccharum* community recorded at Tater Khel during spring, Tehsil Takht-e-Nasrati, Karak.	125
7.	Phytosociological attributes of *Phoenix–Saussurea-Saccharum* community recorded at Gardi Banda during spring, Tehsil Takht-e-Nasrati, Karak.	126
8.	Phytosociological attributes of *Fagonia–Prosopis-Saccharum* community recorded at Ahmad Abad, during spring, Tehsil Takht-e-Nasrati, Karak.	127
9.	Phytosociological attributes of *Prosopis-Periploca-Aerua* community recorded at Warana during spring, Tehsil Takht-e-Nasrati, Karak.	128
10.	Phytosociological attributes of *Fagonia-Zizyphus-Saccharum* community recorded at Southern area of Bogara during spring, Tehsil Takht-e-Nasrati, Karak.	129
11.	Phytosociological attributes of *Acacia-Saccharum-Citrullus* community recorded at Northern area of Bogara during spring, Tehsil Takht-e-Nasrati, Karak.	130
12.	Phytosociological attributes of *Zizyphus-Saccharum-Cynodon* community recorded at Gandiri Khattak during spring, Tehsil Takht-e-Nasrati, Karak.	131
13.	Phytosociological attributes of *Calligonum*-Zizyphus-*Saussurea* community recorded at Kiri Dhand during spring, Tehsil Takht-e-Nasrati, Karak.	132
14.	Phytosociological attributes of *Zizyphus-Aerua-Calligonum* community recorded at Jahangiri banda during spring, Tehsil Takht-e-Nasrati, Karak.	133
15.	Phytosociological attributes of *Zizyphus-Calligonum-Fagonia* community recorded at Mona Khel during spring, Tehsil Takht-e-Nasrati, Karak.	134
16.	Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Jarassi during spring, Tehsil Takht-e-Nasrati, Karak.	135
17.	Phytosociological attributes of *Cymbopogon-Rhazya-Zizyphus* community recorded at Chokara during spring, Tehsil Takht-e-Nasrati, Karak.	136
18.	Phytosociological attributes of *Aerua-Saccharum-Zizyphus* community recorded at Ambiri Kala during spring, Tehsil Takht-e-Nasrati, Karak.	137
19 .	Phytosociological attributes of *Salvia-Zizyphus-Rhazya* community recorded at Takht-e-Nasrati during spring, Tehsil Takht-e-Nasrati, Karak.	138
20.	Phytosociological attributes of *Fagonia-Phoenix-Capparis* community recorded at Siraj Khel, during spring, Tehsil Takht-e-Nasrati, Karak.	139
21.	Phytosociological attributes of *Fagonia-Withania-Zizyphus* community recorded at Shahidan Banda during spring, Tehsil Takht-e-Nasrati, Karak.	140

22. Phytosociological attributes of *Aerua -Punica -Acacia* community recorded at Zarki Nasratti, during spring, Tehsil Takht-e-Nasrati, Karak. 141
23. Phytosociological attributes of *Aerua-Acacia-Capparus* community recorded at Shawa Hills, during spring, Tehsil Takht-e-Nasrati, Karak. 142
24. Phytosociological attributes of *Eragrostis-Zizyphus-Capparis* community recorded at Kandu Khel during spring, Tehsil Takht-e-Nasrati, Karak. 143
25. Phytosociological attributes of *Aerua-Rhazya-Acacia* community recorded at Shadi Khel, during spring, Tehsil Takht-e-Nasrati, Karak. 144
26. Phytosociological attributes of *Dichanthium-Withania-Zizyphus* community recorded at Sarki Lawager during spring, Tehsil Takht-e-Nasrati, Karak. 145
27. Phytosociological attributes of *Zizyphus-Aerua-Capparus* community recorded at Shnawa Hills during spring, Tehsil Takht-e-Nasrati, Karak. 146
28. Physiochemical analysis of soil of Tehsil Takht-e-Nasrati, District Karak. 163
29. The number of species and share relative important value of tree, shrubs, herbs and grasses among the different communities during summer of Takht-e- Nasrati, Karak. 165
30. Phytosociological attributes of *Eragrostis-Calotropis-Prosopis* community recorded at Tater Khel, during summer, Tehsil Takht-e-Nasrati, Karak. 166
31. Phytosociological attributes of *Phoenix-Saccharum-Cenchrus* community recorded at Gardi banda during summer, Tehsil Takht-e-Nasrati, Karak. 167
32. Phytosociological attributes of *Aerua-Prosopis-Saccharum* community recorded at Ahmad Abad during summer, Tehsil Takht-e-Nasrati, Karak. 168
33. Phytosociological attributes of *Tribulus-Prosopis-Saccharum* community recorded at Warana during summer, Tehsil Takht-e-Nasrati, Karak. 169
34. Phytosociological attributes of *Eragrostis-Saccharum-Zizyphus* community recorded at Southern Bogara during summer, Tehsil Takht-e-Nasrati, Karak. 170
35. Phytosociological attributes of *Tribulus-Acacia-Saccharum* community recorded at Nothern Bogara during summer, Tehsil Takht-e-Nasrati, Karak. 171
36. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Gandiri Khattak during summer, Tehsil Takht-e-Nasrati, Karak. 172
37. Phytosociological attributes of *Calligonum-Tribulus*-Zizyphus community recorded at Kiri Dhand during summer, Tehsil Takht-e-Nasrati, Karak. 173
38. Phytosociological attributes of *Calligonum-Cenchrus-Zizyphus* community recorded at Jahangiri banda during summer, Tehsil Takht-e-Nasrati, Karak. 174
39. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Mona Khel during summer, Tehsil Takht-e-Nasrati, Karak. 175
40. Phytosociological attributes of *Saccharum-Zizyphus-Cynodon* community recorded at Jarassi during summer, Tehsil Takht-e-Nasrati, Karak. 176
41. Phytosociological attributes of *Cymbopogon–Rhazya-Zizyphus* community recorded at Chokara during summer, Tehsil Takht-e-Nasrati, Karak. 177
42. Phytosociological attributes of *Cymbopogon-Saccharum-Zizyphus* community recorded at Ambiri Kala during summer, Tehsil Takht-e-Nasrati, Karak. 178
43. Phytosociological attributes of *Fagonia-Rhazya-Zizyphus* community recorded at Takht-e-Nasrati during summer, Tehsil Takht-e-Nasrati, Karak. 179

44. Phytosociological attributes of *Cleome-Phoenix-Capparis* community recorded at Siraj khel during summer, Tehsil Takht-e-Nasrati, Karak. 180
45. Phytosociological attributes of *Cenchrus-Cassia-Zizyphus* community recorded at Shahidan during summer, Tehsil Takht-e-Nasrati, Karak. 181
46. Phytosociological attributes of *Capparus-Aerua-Acacia* community recorded at Zarki Nasrati during summer, Tehsil Takht-e-Nasrati, Karak. 182
47. Phytosociological attributes of *Boerhavia-Acacia-Capparus* community recorded at Shawa during summer 183
48. Phytosociological attributes of *Eragrostis -Zizyphus -Capparis* community recorded at Kandu Khel during summer, Tehsil Takht-e-Nasrati, Karak. 184
49. Phytosociological attributes of *Aerua -Acacia -Capparis* community recorded at Shadi Khel during summer, Tehsil Takht-e-Nasrati, Karak. 185
50. Phytosociological attributes of *Tribulus- Periploca -Zizyphus* community recorded at Sarki Lawager during summer, Tehsil Takht-e-Nasrati, Karak. 186
51. Phytosociological attributes of *Boerhavia Zizyphus Capparus* community recorded at Shnawa during summer, Tehsil Takht-e-Nasrati, Karak. 187
52. The number of species and share relative important value of tree, shrubs, herbs and grasses among the different communities during winter of Takht-e- Nasrati, Karak. 201
53. Phytosociological attributes of *Cenchrus- Saccharum -Prosopis* community recorded at Tater Khel during winter, Tehsil Takht-e-Nasrati, Karak. 202
54. Phytosociological attributes of *Cenchrus-Saccharum-Phoenix* community recorded at Gardi Banda during winter, Tehsil Takht-e-Nasrati, Karak. 203
55. Phytosociological attributes of *Cenchrus-Prosopis-Saccharum* community recorded at Ahmad Abad during winter, Tehsil Takht-e-Nasrati, Karak. 204
56. Phytosociological attributes of *Cenchrus- Periploca-Prosopis* community recorded at Warana during winter, Tehsil Takht-e-Nasrati, Karak. 205
57. Phytosociological attributes of *Cenchrus-Saccharum-Zizyphus* community recorded at Bogara during winter, Tehsil Takht-e-Nasrati, Karak. 206
58. Phytosociological attributes of *Cenchrus-Saccharum-Acacia* community recorded at Northern Bogara during winter, Tehsil Takht-e-Nasrati, Karak. 207
59. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Gandiri Khattak during winter, Tehsil Takht-e-Nasrati, Karak. 208
60. Phytosociological attributes of *Calligonum-Cenchrus-Zizyphus* community recorded at Kari Dand during winter, Tehsil Takht-e-Nasrati, Karak. 209
61. Phytosociological attributes of *Cenchrus-Calligonum-Acacia* community recorded at Jahangiri Banda during winter, Tehsil Takht-e-Nasrati, Karak. 210
62. Phytosociological attributes of *Zizyphus-Cenchrus- Calligonum* community recorded at Mona Khel during winter, Tehsil Takht-e-Nasrati, Karak. 211
63. Phytosociological attributes of *Cenchrus-Zizyphus-Saccharum* community recorded at Jarassi during winter, Tehsil Takht-e-Nasrati, Karak. 212
64. Phytosociological attributes of *Cymbopogon-Rhazya-Zizyphus* community recorded at Chokara during winter, Tehsil Takht-e-Nasrati, Karak. 213
65. Phytosociological attributes of *Astragalus-Aerua-Zizyphus* community recorded at Ambiri Kala during winter, Tehsil Takht-e-Nasrati, Karak. 214

66. Phytosociological attributes of *Cenchrus-Rhazya-Zizyphus* community recorded at Takht-e-Nasrati during winter, Tehsil Takht-e-Nasrati, Karak. 215
67. Phytosociological attributes of *Phoenix-Fagonia-Capparis* community recorded at Siraj khel during winter, Tehsil Takht-e-Nasrati, Karak. 216
68. Phytosociological attributes of *Cassia-Zizyphus-Fagonia* community recorded at Shahidan during winter, Tehsil Takht-e-Nasrati, Karak. 217
69. Phytosociological attributes of *Capparus-Aerua-Acacia community* recorded at Zarki Nasratti during winter, Tehsil Takht-e-Nasrati, Karak. 218
70. Phytosociological attributes of *Aerua-Acacia-Capparus* community recorded at Shawa during winter, Tehsil Takht-e-Nasrati, Karak. 219
71. Phytosociological attributes of *Zizyphus-Capparis-Phragmites* community recorded at Kandu Khel during winter, Tehsil Takht-e-Nasrati, Karak. 220
72. Phytosociological attributes of *Aerua-Capparis-Acacia* community recorded at Shadi khel during winter, Tehsil Takht-e-Nasrati, Karak. 221
73. Phytosociological attributes of *Fagonia-Zizyphus-Saccharum* community recorded at Sarki Lawager during winter, Tehsil Takht-e-Nasrati, Karak. 222
74. Phytosociological attributes of *Zizyphus-Aerua-Capparus* community recorded at Shnawa during winter, Tehsil Takht-e-Nasrati, Karak. 223
75. Comparative indices of similarities between communities in spring of Tehsil Takht-e-Nasrati, Karak. 227
76. Comparative indices of similarities between communities in summer of Tehsil Takht-e-Nasrati, Karak. 228
77. Comparative indices of similarities between communities in winter of Tehsil Takht-e-Nasrati, Karak. 229
78. Diversity parameters of plants during spring in Tehsil Takht-e-Nasrati, District Karak. 239
79. Diversity parameters of plants during summer in Tehsil Takht-e-Nasrati, District Karak. 240
80. Diversity parameters of plants during winter in Tehsil Takht-e-Nasrati, District Karak. 241
81. Maturity Index of communities during spring of Tehsil Takht-e-Nasrati, Karak. 246
82. Maturity Index of communities during summer of Tehsil Takht-e-Nasrati, Karak. 247
83. Maturity Index of communities during winter of Tehsil Takht-e-Nasrati, Karak. 248
84. Degree of homogeneity of stand 1 Tehsil Takht-e-Nasrati, Karak. 256
85. Degree of homogeneity of stand 2 Tehsil Takht-e-Nasrati, Karak. 257
86. Degree of homogeneity of stand 3 Tehsil Takht-e-Nasrati, Karak. 258
87. Degree of homogeneity of stand 4 Tehsil Takht-e-Nasrati, Karak. 259
88. Mean relative importance value of species in different associations during spring distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak. 266
89. Mean relative importance value of species in different associations during summer distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak. 273

90.	Mean relative importance value of species in different associations during winter distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak.	282
91.	The herbaceous biomass (Kg. hec^{-1}) producing during different seasons at stand 1,Tehsil Takht-e-Nasrati, Karak.	292
92.	The herbaceous biomass (Kg. hec^{-1}) producing during different seasons at stand 2, Tehsil Takht-e-Nasrati, Karak.	293
93.	The herbaceous biomass (Kg.hec^{-1}) producing during different seasons at stand 3, Tehsil Takht-e-Nasrati, Karak.	294
94.	The herbaceous biomass (Kg.hec^{-1}) producing during different seasons at stand 4, Tehsil Takht-e-Nasrati, Karak.	295
95.	Altitudinal variation in the average biomass productivity of shrubs (Kg. hec^{-1}) of Tehsil Takht-e-Nasrati, District Karak.	306
96.	The seasonal and altitudinal variation in the biomass productivity of shrubs (Kg. hec^{-1}) of Tehsil Takht-e-Nasrati, District Karak.	307
97.	Differential palatability plant species, Plant parts, various parts, preference by livestock.	321
98.	Phytochemical screening of different forage plant species of Takht-e-Nasrati, District Karak.	329
99.	Concentration gradient of macro elements i.e. Na, K and Ca of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	349
100.	Analysis of variance of Na, K and Ca contents of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	350
101.	Concentration gradient of micro elements i.e. Zn, Cu, Mn, Ni and Cr of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	351
102.	Analysis of variance of Na, K and Ca contents of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	352
103.	Proximate composition (moister, Ash and Fiber) of selected forage species of Tehsil Takht-e-Nasrati, District Karak.	365
104.	Proximate composition (Carbohydrate, Fat, Protein and energy value) of selected forage species of Tehsil Takht-e-Nasrati, District Karak.	366
105.	Floristic list and conservation status of shrubs and tree species of Tehsil Takht-e-Nasrati, District Karak.	371

LIST OF FIGURES

S. No	Title	Page
Fig. 1.	Map of District Karak.	8
Fig. 2.	Map of Tehsil Takht-e- Nasrati showing research spots.	9
Fig. 3.	Drinking water is a serious problem in the area. Camel cart being used for transporting drinking water.	11
Fig. 4.	Open storage water tank for collection of rain water.	11
Fig. 5.	A rare spring of soft water used for drinking and other purposes.	12
Fig. 6.	Small Dam for water storage at Sarki Lawager.	12
Fig. 7.	Irrigation Well used for irrigation purposes.	13
Fig. 8.	Dried well due to scarcity of water level.	13
Fig. 9.	Cutting of trees in the area is a common ecological problem.	14
Fig. 10.	Cutting of *Acacia modesta* for fuel and fodder purposes is common in the area.	14
Fig. 11.	Over Grazing has caused *Zizyphus maurtiana* to assume bushy habitat.	15
Fig. 12.	Grazing of trees by goat.	15
Fig. 13a.	Soil erosion is common ecological problem in the area. See exposed hard bed rock.	16
Fig. 13b.	Plant species like *Saccharum bengalense* is effected by wind erosion in plains area.	16
Fig. 14.	Plant families sharing floristic diversity of Tehsil Takht-e-Nasrati, District Karak	67
Fig. 15.	Stratification of plant layers in Tehsil Takht-e-Nasrati, District Karak.	68
Fig. 16.	Ecological charecteristic of Plants of Takht-e-Nasrati, District Karak.	69
Fig. 17.	Phenological stages of plants at different seasons in Takht-e-Nasrati, District Karak.	72
Fig. 18.	Biological spectrum of plants of Tehsil Takht-e-Nasrati, District Karak.	75
Fig. 19.	Comparison of investigated area with Normal Biological Spectrum.	76
Fig. 20.	Leaf form spectrum of Flora of Tehsil Takht-e-Nasrati, District Karak.	78
Fig. 21.	Ethnobotanical Profile of plant species of Tehsil Takht-e-Nasrati, District Karak.	100
Fig. 22.	Uprooting of medicinal plant i.e. *Launaea nudicaulis* (L.) Hook. f.	100
Fig. 23.	Comparison of number of plant species among stands during winter, Tehsil Takht-e-Nasrati, Karak.	199
Fig. 24.	Comparison of TIV by plant species among stands during winter Tehsil Takht-e-Nasrati, Karak.	199
Fig. 25.	Comparison of number of plant species between plain and hilly areas during winter Tehsil Takht-e-Nasrati, Karak.	200
Fig. 26.	Comparison of TIV gathered by species among plain and hilly area during winter Tehsil Takht-e-Nasrati, Karak.	200
Fig. 27.	Species diversity in different seasons in various stands, Tehsil Takht-e-Nasrati, Karak.	232
Fig. 28.	Species richness in different seasons in various stands, Tehsil Takht-e-Nasrati, Karak.	232
Fig. 29.	Equitability of species in different seasons in various stands, Tehsil Takht-e-Nasrati, Karak.	237

Fig. 30.	Mean species diversity, richness and equitability of plant in the plain and hilly areas of Tehsil Takht-e-Nasrati, Karak.	237
Fig. 31.	Cultivation of gram and wheat in the plain area of Tehsil Takht-e-Nasrati, Karak.	238
Fig. 32.	Hills sides serve as grasslands that show increase of non palatable plants like *Calotropis procera* and *Rhazya stricta* due to overgrazing in Tehsil Takht-e-Nasrati, Karak.	238
Fig. 33.	Herbaceous vegetation grazed by goat, sheep and cow that reduced maturity index.	249
Fig. 34.	Shrubby and woody species being heavily grazed by goat and sheep that is hampering vegetation and maturity index.	249
Fig. 35.	Cutting of trees in Saraj Khel for fuel is a common practice leading to low species diversity and maturity index.	250
Fig. 36.	Pruning of wild *Zizyphus maurtiana* during winter for fodder.	250
Fig. 37.	Effect of increasing altitude maturity index in spring.	251
Fig. 38.	Maturity Index decreased with increasing altitude in summer.	251
Fig. 39.	Maturity Index increased with increasing altitude during winter in Tehsil Takht-e-Nasrati, District KARAK.	252
Fig. 40.	Over all picture of Maturity Index of plant life in Tehsil Takht-e-Nasrati, District Karak.	252
Fig. 41.	Frequency classes in stand 1, Tehsil Takht-e-Nasrati, Karak.	260
Fig. 42.	Frequency classes in stand 2, Tehsil Takht-e-Nasrati, Karak.	260
Fig. 43.	Frequency classes in stand 3, Tehsil Takht-e-Nasrati, Karak.	261
Fig. 44.	Frequency classes in stand 4, Tehsil Takht-e-Nasrati, Karak.	261
Fig. 45.	Comparative homogeneity between plains and hilly area of Tehsil Takht-e-Nasrati, Karak.	262
Fig. 46.	Seasonal differences in homogeneity of plants of Tehsil Takht-e-Nasrati, Karak.	262
Fig. 47.	Two way cluster dendrogram showing grouping of different communities into association during spring, Tehsil Takht-e-Nasrati, Karak.	269
Fig. 48.	Detrended Correspondence Analysis (DCA) of communities during spring, Tehsil Takht-e-Nasrati, Karak.	270
Fig. 49.	Two way cluster dendrogram showing grouping of different communities into association during summer, Tehsil Takht-e-Nasrati, Karak.	275
Fig. 50.	Detrended Correspondence Analysis (DCA) of communities during summer, Tehsil Takht-e-Nasrati, Karak.	276
Fig. 51.	Dendrogram showing grouping of different communities into association during winter, Tehsil Takht-e-Nasrati, Karak.	285
Fig. 52.	Detrended Correspondence Analysis (DCA) of communities during winter, Tehsil Takht-e-Nasrati, Karak.	286
Fig. 53.	Fresh biomass in stand 1, show seasonal variation.	296
Fig. 54.	Fresh biomass in stand 2, show seasonal variation.	296
Fig. 55.	Fresh biomass in stand 3, show seasonal variation.	297
Fig. 56.	Female fold generally collect fodder and transport.	297

Fig. 57.	Fresh biomass in stand 4, show seasonal variation.	298
Fig. 58.	Fresh altitudinal biomass of herbs in different seasons.	298
Fig. 59.	Fresh altitudinal biomass of grasses in different seasons.	299
Fig. 60.	Fresh average altitudinal biomass of herbs and grasses in different seasons.	299
Fig. 61.	The shrubs biomass (Kg. hec^{-1}) productivity during different seasons and stands in Tehsil Takht-e-Nasrati, Karak.	303
Fig. 62.	Biomass of *Calotropis procera* was high due to useless in fuel through out the area.	303
Fig. 63.	Dormant condition of *Calligonum polygonoides* in plains during winter.	304
Fig. 64.	*Cassia angustifolia* restricted to small hillocks through out the area.	304
Fig. 65.	Shrubby life form of *Capparis decidua* due to grazing throughout the area.	305
Fig.66.	The shrubs biomass (Kg. hec^{-1}) productivity during different seasons in Tehsil Takht-e-Nasrati, Karak.	305
Fig.67.	Differential palatability of plant species in Tehsil Takht-e-Nasrati, Karak.	315
Fig. 68.	Differential palatability percentage in each stratum of plant species in Tehsil Takht-e-Nasrati, Karak.	315
Fig. 69.	Plant parts preferred by animals in Tehsil Takht-e-Nasrati, Karak.	316
Fig. 70.	The preference by lives stock for fodder in fresh and dry condition of Tehsil Takht-e-Nasrati, Karak.	316
Fig. 71.	Animal preference for plant species in Tehsil Takht-e-Nasrati, Karak.	317
Fig. 72.	Sheep graze upon nonpalatable plants under compulsion.	317
Fig. 73.	*Dalbargia sissoo* is being grazed by cow due to their preference.	318
Fig. 74.	The goats reach to inaccessible area due to non available of forage.	318
Fig. 75.	Goat try to reach high shoots due to non availability of forage in the area.	319
Fig. 76.	*Saccharum bengalanse* grazed as a preference by cow during spring and winter due to unavailability of other forage plants.	319
Fig. 77.	Goat preferred *Acacia modesta* in summer.	320
Fig. 78.	Sodium contents (g/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	341
Fig. 79.	Potassium contents (g/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	341
Fig. 80.	Calcium contents (g/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	342
Fig. 81.	Zinc contents (mg/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	342
Fig. 82.	Copper contents (mg/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	343
Fig. 83.	Manganese contents (mg/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	343
Fig. 84.	Nickel contents (mg/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	344

Fig. 85.	Chromium contents (mg/Kg) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	344
Fig. 86.	Comparison of vegetative stages of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	345
Fig. 87.	Comparison of reproductive stage of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	346
Fig. 88.	Comparison of post reproductive stages of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	347
Fig. 89.	Comparison of mean value of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.	348
Fig. 90.	Moisture contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	360
Fig. 91.	Ash contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	360
Fig. 92.	Fibre contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	361
Fig. 93.	Fat contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	361
Fig. 94.	Carbohydrate contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	362
Fig. 95.	Protein contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	362
Fig. 96.	Energy value (K Cal/100g) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	363
Fig. 97.	Mean nutrien value (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak.	363
Fig. 98.	Mean nutrien value (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.	364
Fig. 99.	Conservation status of shrubs and tree species of Tehsil Takhti-e-Nasrati, District Karak.	370

Chapter 1

INTRODUCTION

1.1. District Karak

1.1.1. History of District Karak

Karak was declared as District by separating from Kohat on July 1st, 1982. It is bounded by District Mianwali on the South East, District Bannu and District Lakki Marwat on the South West, District Kohat on the North and by North Wazeristan Agency on the West (Fig. 1). It is generally believed that Pathan has a Jewish origin and they came from Palestine. Karak is an important town in the Southern Jordan. The Pathan might have adopted this name in their new abode. In Hindi, Karak means a "crab" and kirak means "grafts or small stones". Having less water, the area has stones everywhere. The third notion is that the word Karak is the adopted name of "Kara koo". In Urdu language Khara means saltish water as salt is found abundantly in the major parts of Karak. Similarly, in Persian language the word Karak means quail. As quails were available in this area in large number so it is possible that on the account of the abundance of quails, this area might have adopted this name (Khan, 2007). About 700 years ago, the Khattak tribe came from Koh Sulaiman (Shawal) area in the district Bannu. They lived in the area for about 200 years. But due to tribal conflicts, they shifted to the area which is now called Karak. At the beginning of 19th century, the Karak was a part of District Kohat. At that period Samad Khan (Nawab of Teree) governed Kohat and Hangu areas but due to internal mutual conflict this area came under the control of Sikh government. After sometimes, Sikh were defeated by the British Government and the area was then controlled by them. At that time it was a part of Punjab Province and was called Kohat District. But in 1901, when Khyber Pakhtun Khawa (Ex-NWFP) was given a separate entity as a Province, Kohat was also declared as a district of Khyber Pakhtun Khawa. When the Muslims of Sub-Continent started struggles for an independent state, the people of the area had played an important role by participating in the struggle completely till creation of Pakistan on 14th August 1947.

1.1.2. Geography

Total population of District Karak is about 536,000 with a total area of 264,775 hactor (ha). Majority area of the District consists of curved dry hills and rough fields. The major source of income of the people is on rain agriculture. The dry hills are full of precious mineral resources like salt, coal, gypsum, uranium, oil and gas etc.

1.1.3. Culture

The culture of District Karak is same with other Pathan's areas of the Khyber Pakhtun Khawa, Pakistan. However, there are present some uniqueness in the culture due to people of single tribe i.e. Khattak living in the district. Majority of the people are in the armed forces because they are traditionally worriers. Other major sources of income in Karak are transport and business. In fine arts, Khattak have devoted themselves to literature alone. Among the professions, they have adopted only agriculture. Khattak's mentality have created arts in which its character is reflected usually disregard other professions. In authority, they notice greater charm itself. Due to the area, climatic conditions and availability of raw material for crafts, the arts are produced by women. In the history no effort of painting is associated to Khattak because painting is considered as un-Islamic. Nearly all the crafts and arts are made from Mazri palm which is present in abundance in the western parts of Tehsil Band Daud Shah. The marvalous goods including boxes (Phachai), beauty box, hand fans, trays, book shelves, bowls trays, utensils and other daily use items are made very delicately from the leaves of Mazri palm. Some of the items of arts are Lungi Bafi, Nazar Band and Kulla. The love for freedom and aggressive opposition to any violation of their independence / honour is one of the most outstanding characteristic of Khattak. They have preserved their freedom by force of arms. For various purposes like waging war, maintaining peace and tribal or inter-tribal affairs, Khattak use Jirga system for quick and sound administration and cheap justice. Jirga usually gather either in a Hujra, village mosque and open fields or under a shady tree where members usually sit in a ring like Round Table Conference without a head that showed evidently a signal of their love of democratic system and rule of parity irrespective of birth, wealth, position, dignity etc. The special provisions used in Jirga system are Melmastia, Badal, Rogha, Nanawotay, Lashkar and Balaandra.

1.1.4. Life system

Khattak are extremely social, humanitarian, hospitable, pleasant and friendly. They contribute to each other's pleasure and grief. Their compassionate conduct can be vivid from the facts that they present great weight to share in memorial service processions and joyful event like wedding ceremony etc. The attractive characteristic of Khattak's life is joint living system which proven their deep love for the family's harmony and pleasure. The aspiration of joint family living originates from a deliberation of financial protection and honour. All relatives' associate even marital children lived mutually in a home to provide independent accommodation. Each married pair under the power of the father, who, as chief of the family unit, controls the family relationships and movements, possessed a vast authority in his personal sphere.

1.1.5. Education

The people of Karak realized that education plays an important role in the progress of an area and that's why most people of Karak are educated. The ratio of education is highest. But unfortunately, there are not that much resources for the development of education. Female education ratio is also high in this area because the people send their girls to schools and colleges without any hesitation. A brief of educational units is given below.

1.	Total population:	536000
2.	Educated people:	85.23%
3.	Female education:	85%
4.	Male education:	97%
5.	Primary Schools	200 Approx)
6.	High Schools	100 (Approx)
7.	Girls Colleges	2 (KDA Karak, Takht-e-Nasrati)
8.	Commerce Colleges	1 (Commerce College Zarki Nasrati)
9.	Degree Colleges:	05; (Located at Ahmad Abad, Sabir Abad, Latambar, Banda Daud Shah, Takht-e-Nasrati)
10.	Technical college:	03 (Karak)
11.	Post Graduate College:	01 (Karak)

1.1.6. Administrative division

The District consists of Tehsil Karak, Tehsil Takht-e-Nasrati and Tehsil Banda Daud Shah.

1.2. Research Area

Tehsil Takht-e-Nasrati is situated between 32.47^{o} to 33.28^{o} North and 70.30^{o} to 71.30^{o} East. The research area is bounded by Tehsil Karak on the North East, District Mianwali on the East, District Lakki Marwat on the South West and Tribal area adjoining District Bannu on the West (Fig. 2). Takht-e- Nasrati is situated at 340 m above the sea level spreading over about 613.66 Sq. km. Majority of the area consists of rigged dry hills and rough field i.e. 323.97 Sq. km. Agriculture land is about 289.7 Sq. km.

1.2.1. Climate

The area is located in semi-arid climatic region having very hot summer and very cold winter. The rainfall is scanty and uncertain. Winter's rains are generally of long duration and of low intensity. Summer monsoon's rains are torrential in heavy shore intensity. In the year 2001 - 2010, 121.6 mm of average rainfall per 10 year was recorded on district level. June and July are the hottest months whereas December and January are the coldest months. The mean maximum temperature was 39.5 C^{o} in the month of the June and the mean minimum temperature was as low as 4.26 C^{o} during January. The wind velocity is slightly above 5 km/h in summer and in winter it lies below 2.9 to 3.5 km/h. In summer the wind direction is variable. In July wind comes from Eastern side carrying clouds and rainfall. During the hottest months, especially in June, whirl winds are developed on the plain area in the afternoon due to local heating and convectional uprising. Sometimes strong, dry and hot dusty winds blow in the area. Most of the winter season is calm, when February approaches, high velocity winds blow in the area. In winter season breeze blows from Banda Daud Shah's side for weeks making the winter colder. The average humidity is between 23.49 to 25.76 during summer. It is lowest from December to February. The average soil temperature is high from 21.87 C^{o} to 26.37 C^{o} during summer while low in winter (Table 1).

1.2.3. Physiography

Physiography of the area is uneven. It can be divided into mountainous area, plain and small hillocks. The soil is generally clay, sandy or stony with rare fertile loamy soil. Hilly area consists of Naray Khowra, Chokara, Lakerka, Saraj Khel, Kanda Khel, Takht-e-Nasrati, Zarki Nasrati, Shahidan, Shawa, Shanawa. The main and the largest types of hills that are situated in East are called "Sheen-Ghar". The desert area lies on the south of Chokara and Warana adjoining district Bannu and on the east side with Zarki Nasrati and Shanawa. The name of this desert is called "Thall". It Consists of Bogara, Gandiri Khattak, Warana, Ahmad Abad, Gardi Banda, Jahangiri Banda, Zarin Kala, Moni Khel and Jarassi.

1.2.4. Hydrography

No river is present in the area and that is why this Tehsil is dry and rough. However flood streams (Khowrs) are present. Major seasonal flood streams are in the plain areas of “Thall” comes from Sheen-Ggar Mountains. They includ Lawagar, Algada Zarki Nasrati, Myanki and Shanawa streams.

1.2.5. Irrigation

The lack of irrigation resources has always been a problem which is of vital importance. Wells (Tubewells, Hand Pump and wells) are being used for irrigation purposes in some places. Most areas are rain dependent. There is a problem drinking water which the people bring water from remote places (Fig. 3). At some places, drinking water is saltish and unhygenic as in Warana. Rain water is also stored in tanks and embankment ponds which are utilized for different purposes including drinking as in Jarassi and Mona Khel (Fig. 4).

Hills streams are rare and provide good quality water as in Sarki Lawager like Dargga which provides potable water to the entire Tehsil (Fig. 5). Small storage dam is under construction at Sarki Lawagar for storing rain and stream water (Fig. 6). This water will be used for drinking and an agriculture purposes. The old wells, run by cattle, have been replaced by fuel or electricity as seen in Sirki Khel (Fig. 7). In some areas the wells become dried as the water level has gone too low to be used as in Kandu Khel (Fig. 8). The construction of small dam may raise the water level in the area. Oil seeps and gas resources have also been identified indicating geological environmental conducive for the

generation of hydrocarbons.

1.2.6. Mines and minerals

Limestone, sand stone and shals / clay are found abundantly. The area also hosts some occurrences of calcium detonate and secondary uranium minerals but their evaluation has not yet yielded commercially exploitable reserve as in Shanawa.

1.3. Ecological Problems

Some serious ecological operating problems facing to the area are as follows:

1.3.1. Deforestation

A serious ecologically operating problem is rapid cutting of plants (Figs. 9, 10).

1.3.2. Over Grazing

Grazing, browsing, and trampling by domestic livestock is a serious problem in the area (Figs. 11, 12). Grazing has caused to decline vegetation where palatable species have been reduced and non-palatable species increased.

1.3.3. Shortage of water

Water shortage is one of the most threatening factors for irrigation and drinking and it is transported from far off places by donkey, Camel etc or on heads.

1.3.4. Soil Salinity

Some areas like Warana is facing salinity hazard. The water is neither suitable for cultivation nor for drinking. It has poor sparse vegetation.

1.3.5. Soil erosion

Soil erosion by the seasonal torrential stream water / wind in the plain and by rainwater in sloping area is also a threat to habitat (Figs. 13a, b).

Aims and Objectives

The area of Tehsil Takht-e-Nasrati, District Karak has a great diversity of plant species and the study was made to search out a record, dimension and composition of plant life. The study will be focused on the following aim and objectives due to the lack of biological study of plant life in the region:

1. Study of flora, ethnobotany and its ecological characteristics.
2. Correlate vegetation with its edaphic and climatic condition.
3. Determine seasonal productivity of the area.
4. Classify plants into various palatability classes.
5. Suggest possible ecological approaches for the improvement of plant resources and socio-economic status of the area.
6. To chemically evaluate some forage plant species of the area.
7. To determined conservation status of trees and shrubs of the area.

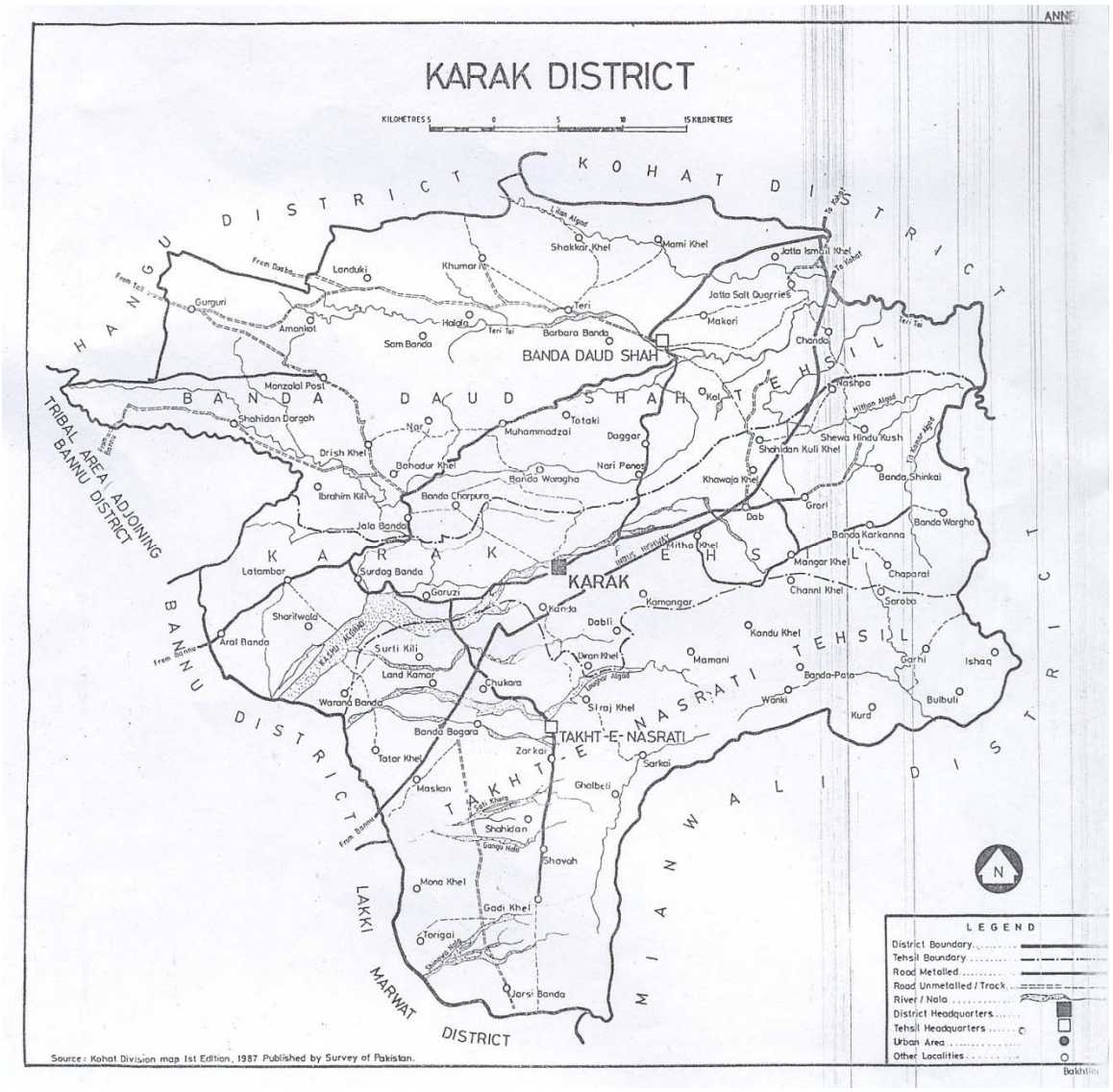


Fig. 1. Map of District Karak.

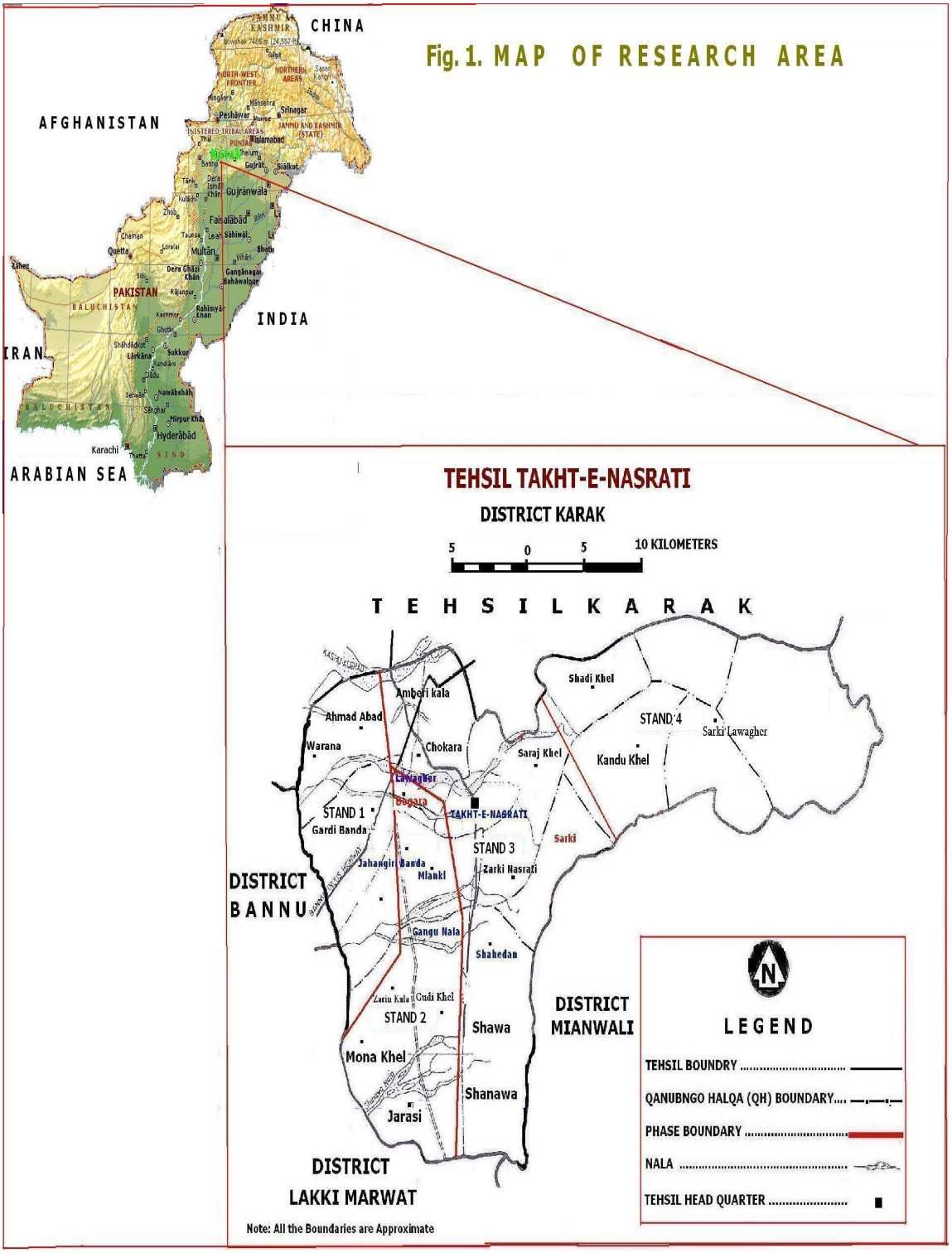


Fig. 2. Map of Tehsil Takht-e- Nasrati showing research spots.

Table 1. Average climatic data of Tehsil Takht-e-Nasrati, Karak for the year 2001-2010.

Months	**Temperature (C°)**		**Humidity (%)**		**Rainfall (mm)**	**Soil temperature (C°) Average**	**Wind speed (km/h)**
	Max	**Min**	**Max**	**Min**			
January	19.18	4.26	75.80	35.24	27.43	7.03	2.9
February	21.69	7.29	77.39	42.23	37.72	9.14	3.2
March	28.20	12.06	75.38	35.23	37.17	13.89	3.5
April	34.74	17.94	66.12	29.42	36.54	19.02	5.2
May	38.32	22.33	59.66	30.73	31.6	21.87	5.4
June	39.50	25.9	59.96	32.89	74.24	25.78	5.5
July	38.44	25.76	73.33	38.76	121.6	26.77	5.2
August	36.66	25.29	75.68	42.61	108.3	26.37	4.1
September	35.47	21.95	77.21	39.29	61.58	23.49	3.7
October	32.33	16.79	71.55	35.51	15.13	20.09	3.5
November	26.71	10.01	71.56	36.66	5.80	14.10	3.2
December	21.93	5.67	75.20	35.90	15.38	8.96	3.1
Mean	**31.1**	**16.27**	**71.57**	**36.21**	**47.71**	**18.04**	**4.04**

Source: Agricultural Research Farm Ahmadwala Karak.



Fig. 3. Drinking water is a serious problem in the area. Camel cart being used for transporting drinking water.



Fig. 4. Open storage water tank for collection of rain water.



Fig. 5. A rare spring of soft water used for drinking and other purposes.



Fig. 6. Small Dam for water storage at Sarki Lawager.



Fig. 7. Irrigation Well used for irrigation purposes.



Fig. 8. Dried well due to scarcity of water level.



Fig. 9. Cutting of trees in the area is a common ecological problem.



Fig. 10. Cutting of *Acacia modesta* for fuel and fodder purposes is common in the area.



Fig. 11. Over Grazing has caused *Zizyphus maurtiana* to assume bushy habitat.

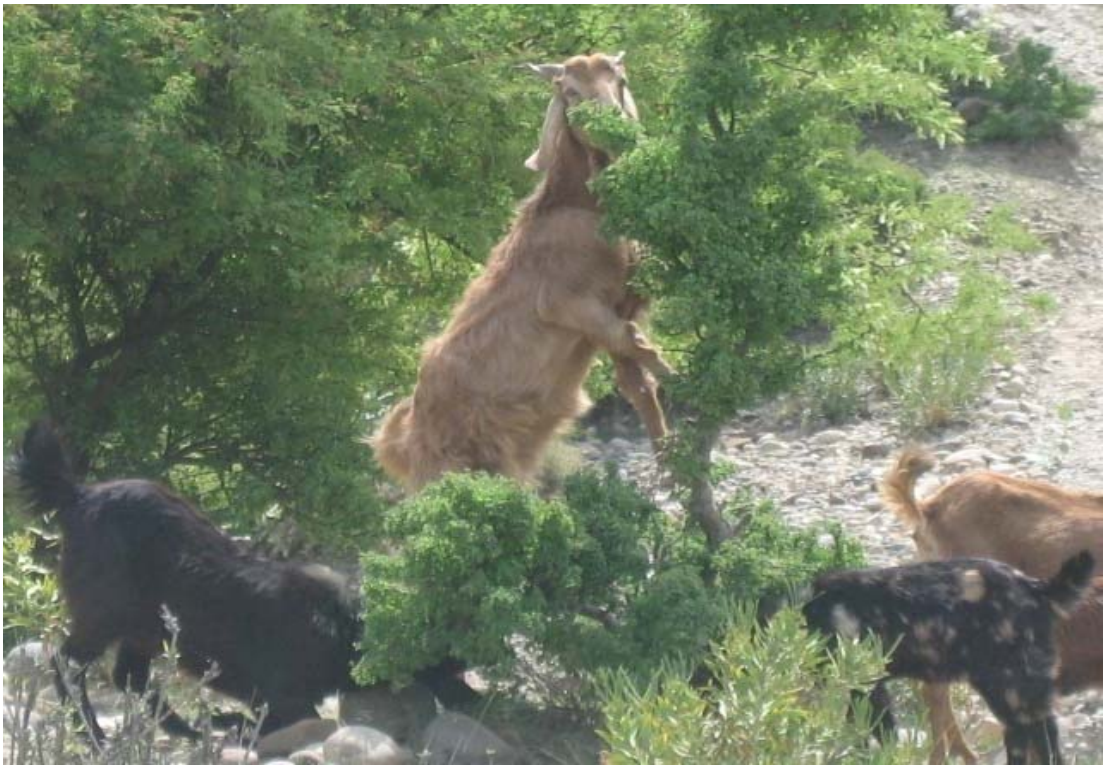


Fig. 12. Grazing of trees by goat.



Fig. 13a. Soil erosion is common ecological problem in the area. See exposed hard bed rock.



Fig. 13b. Plant species like *Saccharum bengalense* is effected by wind erosion in plain area.

Chapter 2

REVIEW OF LITERATURE

2.1. Floristic Diversity

Floristic composition is an expression of physiognomy, floristic variety, biological and biotic pressures. Local flora constantly saves time and present particular information. Thus, there is a dire need to arrange a complete floristic list from ecological, taxonomic and wildlife point to establish baseline data. Internationally lot of work has been done, which is briefly reviewed as follows:

Changwe & Balkwill (2003) enlisted 254 taxa in 172 genera and 63 families from Dunbar Valley in Barberton Greenstone Belt (BGB). The genus Senecio was the most specious genus. The level of species endemism was 2.0%. Lehnebach (2003) compiled checklist of the orchids of Chile by using databases. The list comprised of seven genera (Aa, Bipinnula, Brachystele, Chloraea, Codonorchis, Gavilea and Habenaria) and 50 taxa (49 species and one variety), 25 of which are believed to be endemic to Chile. El-Ghani & Amer (2003) reported 203 vascular species of 39 families. Asteraceae, Fabaceae, Chenopodiaceae and Poaceae were the largest families. Grasses constitute only 9% of the recorded species, woody perennials (shrubs and sub-shrubs) were 46%. There were 46% uniregional: Saharo-Arabian species. Some 50% species were biregional and pluriregional, extending their distribution all over the Saharo-Arabian, Sudano-Zambezian, Irano-Turanian and Mediterranean regions.

Muoghalu & Okeesan (2005) reported 49 climber species consisting of 35 (34%) liana and 14 (13.7%) vine species distributed over 41 genera and 28 families in the forest of Ile-Ife, Nigeria. The number of species, genera and families and basal area increased with altitude. Forty-two per cent (42%) of the trees in the forest carried climbers. There was significant positive correlation ($P \leq 0.05$) between girth sizes of host trees of 31–50 cm with the girths of climbers on them indicating that trees of these girth sizes are highly susceptible to climber infestation. While observing changes in tree, liana, and under story plant diversity and community composition in five tropical rain forest fragments in the Valparai plateau, Western Ghats, Muthuramkumar *et al*. (2006) reported 144 tree species, 60 lianas,

and 108 understory plants distributed among 103 families. Understory species density was highest in the highly disturbed fragment, due to weedy invasive species occurring with rain forest plants.

Ssegawa & Nkuutu (2006) reported 179 species belonging to 70 families and 146 genera from Lake Victotia Central Uganda. Rubiaceae was the dominant family with fourteen species followed by Euphorbiaceae (13 spp.), Apocynaceae (10 spp.) and Moraceae (9 spp.). The remaining 35 families were represented by one species each. Species diversity was higher in trees (72 spp.) followed by herbs (58 spp.), lianas (39 spp.) and shrubs (10 spp.). Yadav & Gupta (2007) quantified the diversity of herbaceous species in relation to various micro-environmental conditions and human disturbance in the Sariska Tiger Project in Rajasthan, India. They concluded that disturbance adversely affected the species richness of the herbaceous vegetation. Several species were observed to be very sensitive to human disturbance and have disappeared from the disturbed areas.

Faridah-hanum *et al*. (2008) reported that a 5-ha plot contained a total of 6621 trees (for trees greater than 5cm dbh) in Ayer Hitam Forest, Puchong Malaysia. These belonged to 319 species in 148 genera and 51 families and that is 11% species, 28% genera and 51% families of the total tree taxa found in Peninsular Malaysia. Endemism and new records were high, 33 species and 30 species respectively. Kwiatkowski (2008) presented the list of vascular plants from Kaczawskie and Plateau, Poland. Approximately 600 of the selected species, 160 rare, interesting and endangered taxa of vascular flora were found, most of them new. Exemplary rare and endangered species include *Alchemilla subcrenata, Allium angulosum, Cardamine flexuosa, Elatine hydropiper, Epipactis purpurata, Linaria arvensis, Omphalodes scorpioides, Pyrola media, Sagina ciliata, Thlaspi perfoliatum*. While *Carex umbrosa, Epipactis albensis, Eryngium planum, Euphorbia virgultosa*, *Fumaria officinal* is subsp. *wirtgenii, Galium rivale, Gnaphalium norvegicum, Ononis repens, Poa subcaerulea and Symphytum bohemicum* were the new record for the area. Santos *et al.* (2008) listed 43 families, 130 genera, and 225 species along with species richness and distribution from northeastern Brazil. Precipitation and altitude were considered as possible predictors of species richness.

Euphorbiaceae had the highest richness (34 sp.), with the genus Croton (11 sp.). Four species were found to be widely distributed, 33 demonstrated intermediate distribution, and 188 had restricted distribution.

Bocuk *et al.* (2009) reported the survival of 589 species belonging to 314 genera classified within 67 families under natural and anthropogenic effects in Phrygia Region (Central Anatolia, Turkey). The largest family was Asteraceae (72 sp.) and the richest genus was Centaurea (13 sp.). Primary vegetation was destroyed in low and high parts around steppe plains and replaced by secondary vegetation with antropogenic characteristics in the area. Reddy & Pattanaik (2009) studied the plant resources of Gandhamardan hill range, India. A total of 912 vascular species belonging to 556 genera under 142 families were recorded. Herbs dominate the flora followed by trees, climbers and shrubs. Al-Yemeni & Sher (2010) prepared a floristic list of 189 species belonging to 74 families from Asir Mountain of the Kingdom of Saudi Arabia. There were 65 dicots and 4 monocots, while gymnosperms and pteridophytes were represented by one family each. Asteraceae was the dominating family in the study area. Yavari & Shahgolzari (2010) reported 213 specimens belonging to 164 genera and 45 families of Khan-Gormaz protected area in Hamadan province, Iran. The largest families in the area are Asteraceae (24 genera), Brassicaceae (17 genera), Lamiaceae (16 genera), Poaceae (15 genera) and Apiaceae (10 genera). The life form spectrum observed was: Hemichryptophyte (48.07%), Therophyte (29.83%), Geophyte (9.94%), Chamaephyte (8.29%) and Phanerophyte (3.87%). The largest phytocory distribution species is Irano-Turanian (37.50%). Singh (2011) reported 329 vascular plant species in the main campus of Banaras Hindu University, India including 5 Pteridophytes and 324 species angiosperms. No natural occurrence of gymnosperms was reported from the University Campus. Angiosperms were represented by 76 families of which the Asteraceae, Poaceae and Fabaceae are the dominant families of the flora of Banaras Hindu University. Kambhar & Kotresha (2011) reported 141 species belonging to 112 genera in 40 families from the Gadag District in India. Among the total number of the species 54% are native to Tropical America. Analysis of the habit shows that herbs having included 86 species, followed by 25 shrubs, 16 trees and 14 climbers.

Among 40 families, Fabaceae is the most dominantly invasive family with 21 species.

In Pakistan, countless floristic work has been done. Durrani *et al*. (2005) reported 202 species of 45 plant families from Harboi rangeland (Kalat, Pakistan). Asteraceae, Papilionaceae, Poaceae, Brassicaceae and Lamiaceae were the leading families. *Juniperus macropoda* was the only tree species while *Artemesia maritima, Sophora griffithii, Hertia intermedia, Nepeta juncea, Perovskia abrotanoides, Convolvulus leiocalycinus* and *Astragalus* spp. were the most common shrubs. Hussain *et al*. (2007) recorded 111 species belonging to 46 families including 39 Dicot (98 spp), 5 monocot (11 spp) and 2 gymnosperms (2 spp.) from Mastuj, District Chitral. The monocot families were Alliaceae, Iridaceae, Juncaceae, Poaceae and Typhaceae. The two gymnosperms were Cupressaceae and Ephedraceae. Asteraceae (11 spp.); Papilionaceae (10 spp.); Rosaceae (9 spp.); Brassicaceae and Polygonaceae (5 spp. each); Chenopodiaceae, Lamiaceae, Salicaceae and Solanaceae (each with 4 spp.), Alliaceae, Apiaceae and Poaceae (each with 3 spp.) were the leading families in terms of number of species. The remaining families had less than 3 species. Parveen & Hussain, (2007) recorded 74 plant species representing 62 genera and 34 families from Gorakh Hill District Dadu. Out of these 3 families belonged to monocot; Poaceae, Palmae and Liliaceae and 31 to Dicots. Sher & Khan (2007) reported 222 plant species belonging to 88 families from Chagharzai Valley, District Buner. Of them 78 families were Dicots; 7 Monocots and 3 Pteridophytes. Pinaceae was the only Gymnosperm. Asteraceae had 21 species which was followed by Papilionaceae (12 spp.), Lamiaceae (10 spp.), Poaceae and Rosaceae (each with 9 spp.), Ranunculaceae (7 spp.), Moraceae (6 spp.). Each of the Amaranthaceae, Brassicaceae, Solanaceae, Apiaceae, Euphorbiaceae and Polygonaceae had 5 species. Chenopodiaceae, Mimosaceae and Papaveraceae had 4 species, while the remaining families had 3 or less than 3 species. Parveen *et al*. (2008) recorded 79 plants species, 66 genera under 32 families from Dureji game reserve. The largest family was Poaceae (12 sp.), followed by Papilionaceae (7 sp.) and Asteraceae (6 sp.). No endemic species was found. Cometes surattensis, Desmostachya bipinnata and Solanum surattense were reported as rare species. Qureshi (2008a) identified 136 plant species including one fern, one gymnosperm, 6 sedges from Sawan Wari of

Nara Desert. These species were distributed to 73 genera and 44 families. The leading plant families were Poaceae (18.38%), Fabaceae (8.82%), Amaranthaceae (5.15%), Convolvulaceae and Cyperaceae (4.14% each).

Durrani *et al.* (2010) concluded that in Aghberg rangelands of Quetta Pakistan, the protected sites had 123 species of 36 families, while unprotected sites had only 28 species. The study showed that Asteraceae, Fabaceae, Poaceae, Brassicaceae, Lamiaceae and Boraginaceae were important families in the protected area. *Seriphedium qutensis, Sophora mollis, Hertia intrmedia, Nepeta juncea, Astragalus* Spp. and *Convolvulus leiocalycinus* were most common shrubs. *Pennisetum orientale, Bromus tectorum, Bromus sericeus, Schismus arabicus, Poa pratensis, Cymbopogon jwarancusa, Lolium temulentum, Eremopyrum benouepartes, Tanantherum crinatum* and *Saccharum bengalense* were most common grasses. Qureshi & Bhatti (2010) recorded 93 plant species belonging to 67 genera and 30 families of Pai forest, Nawab Shah, Sindh, Pakistan. Poaceae was the largest family that contributed 14 species (15.05%), followed by Amaranthaceae with 7 species (7.53%), Capparidaceae and Tiliaceae with 5 spp., (5.38% each); while 7 families contributed 4 species (4.30%). Khan *et al.* (2011a) studied the flora of Tehsil Banda Daud Shah, District Karak, Pakistan. They reported total of 155 species, comprising 24 monocot and 131 dicot species belonging to 54 families and 25 orders. The dominant families were Poaceae and Papilionaceae with 16 species, followed by Compositae with 13 species, Amaranthaceae, Cruciferae, Labiatae with 7 species each. Khan *et al.* (2011b) documented 54 plant species belonging to 30 families of Coal Mine area of Darra Adam Khel, Khyber Pakhtun Khawa, Pakistan. The dominant families were Asteraceae, Lamiaceae and Solanaceae with 4 species, followed by Euphorbiaceae, Mimosaceae, Moraceae and Zygophyllaceae with 3 species. Each of the Amaranthaceae, Apocynaceae, Capparidaceae, Poaceae, Rhamnaceae, Verbenaceae had 2 species.

The review of literature shows that no information exists on the flora of Tehsil Takht-e-Nasrati, therefore, there is a dire need to record the floristic diversity of this unexplored area.

2.2. Biological Spectrum

Deteriorating environmental conditions such as aridity, soil salinity, soil erosion and acid rain are potential threats to biodiversity. The life form and leaf size spectra are important physiognomic attributes characterizing vegetation. The life form is indicator of micro and macroclimate condition. Some recent work done on the biological spectra is summerised as follows.

Gimenez *et al.* (2004) working on the flora and biodiversity of Iberian Peninsula reported 516 vascular endemic species or subspecies. The endemicity rate was 13%. The biological spectrum did not follow the usual patterns observed either in local flora in the south of the Iberian Peninsula or in other regions of the Mediterranean Basin. Chamaephytes (46.08%) and hemicryptophytes (31.37%) are very abundant, whereas therophytes (11.96%) and phanerophytes (0.98%) are comparatively rare. Chamaephytes had their highest density rates within 1400–2000 m however, these decrease with increasing rainfall. Abundance of hemicryptophytes is directly dependent on rainfall and inversely dependent on temperature. The altitudinal distribution pattern of therophytes is opposite to that of hemicryptophytes, but without any clear correlation with rainfall gradient. Costaa *et al*. (2007) stated that life-form spectrum of Caatinga vegetation consisted of therophytes (42.9%), phanerophytes (26.3%), camaephytes (15.8%), hemicryptophytes (12.8%), and cryptophytes (2.3%). The herbaceous/woody ratio was 1.4. Mood (2008) recorded that phanerophytes comprised 11.45%, chamaephytes 20%, hemicryptophytes 27%, chryptophytes 5.7% and therophytes 33% in the flora of Birjand (Iran). Reddy & Pattanaik (2009) studied the floristic diversity of Gandhamardan hill range, Orissa, India. The life-form spectrum in the study showed predominance of phanerophytes (349 spp., 38.3%) followed by therophytes (298 spp., 32.7%), geophytes (128 spp., 14%), hemi-cryptophytes (119 spp., 13%) and chamaephytes (18 spp., 2%). Messias, *et al*. (2011) studied the Life-form spectra of quartzite and itabirite rocky outcrop sites, Minas Gerais, Brazil. 263 vascular species were collected, belonging to 64 families, of which 135 (51.3%) were considered phanerophytes; 88 (33.5%), hemicryptophytes; 23 (8.8%), chamaephytes; 9 (3.4%), cryptophytes and 8 (3%), therophytes.

Some recent works on biological characteristics of plant life examined in different area of Pakistan is given below:

Nazir & Malik (2006) stated the life form of plant species in Sarsawa hills district Kotli was dominated nanophaneropytes followed by therophytes, hemicryptophytes and megaphanerophytes in the area. Geophytes were low in number where as quantitatively nanophanerophytes were also dominant. They were followed by megaphanerophytes and hemicryptophytes. Therophytes and geophytes were low in number. Sher & Khan (2007) stated that the biological spectrum of the vegetation of Chagharzai Valley, District Buner consisted of therophytes (86 spp., 38.56%) and nanophanerophytes (41 spp., 18.38%) were the most abundant, followed by megaphanerophytes (38 spp., 17.04%). Geophytes (18 spp., 8.07%), hemicryptophytes (17 spp., 7.62%), chamaephytes (14 spp., 6.27%) and lianas (9 spp., 4.03%) had low occurrence in the investigated area. Leaf spectra of plants consisted of microphylls (54.70%), mesophylls (19.28%), nanophylls (13.00%), leptophylls (8.96%) and megaphylls (4.03%). Parveen *et al*. (2008) reported high percentage of chaemophytes from Dureji game reserve followed by phanerophytes, therophytes, hemicryptophytes and climbers. Bocuk *et al*., (2009) stated that the dominant biological types in Phrygia Region consisted of hemicryptophytes (37%) and therophytes (29.9%). Hussain & Parveen (2009) stated that the life form of plants from Tiko Baran, Khirthar range was dominated by chamaephytes which was followed by therophytes, phanerophytes, hemicryptophytes and climbers.

Qureshi & Bhatti (2010) recorded 93 plant species of Pai forest, Nawab Shah, Sindh, Pakistan. The most common life form class of the existing flora was Phanerophyte with the large number of species (37), followed by Therophyte (33), Chaemophytes (12), Hemicryptophyte (6) and Cryptophyte (3). Al-Yemeni & Sher (2010) showed that therophytes (36.5%) followed by hemicryptophytes (15%) and geophytes (12.5%) were dominant in Asir Mountain of the Kingdom of Saudi Arabia. Chaemophytes 6.5%, mesophanerophytes 3%, megaphanerophytes 2%, nanophaneorophytes 13% and climbers 1.5% contributed towards the establishment of vegetation structure. The leaf size spectra revealed that

microphylls (38.5%) followed by nanophylls (24%), leptophylls (13.5%), mesophylls (12%), macrophylls (3%) and megaphylls (1%) were important. The biological spectrum of the high altitude was characterized by phanerophytes mainly representing nanophanerophytic followed by hemicryptophytic and geophytic species. These were increasing with the rise in elevation while the megaphanerophytic species were decreasing. Khan *et al*. (2011b) documented 54 plant species belonging to 30 families of Coal Mine area of Darra Adam Khel, Khyber Pakhtun Khawa, Pakistan. The biological spectrum showed that therophytes (16 spp., 29.6%), megaphanerophytes (14 spp., 25.9%). nanophanerophytes (10 spp., 18.5%), chamaephytes (06 spp., 11.1%), hemicryptophytes (05 spp., 9.26%), Geophytes (03 spp., 5.56%), had occurrence in the investigated area. Leaf spectra of plants consisted of microphylls (50%), mesophylls (25.9%), leptophylls (16.7%), nanophylls (5.56%) and megaphylls (1.85%).

No such information is available on the plant life of the investigated area. Therefore, the present fills this gap.

2.3. Ethnobotanical Profile

Plants are fundamental to almost all life on the earth, providing protection and sustenance for organism ranging from bacteria to large mammals. With their unique capacity for photosynthesis, they form the basis of biological food web, meanwhile producing oxygen and mopping up excess levels of greenhouse gas carbon dioxide. Plants perform a number of important environmental services, recycling essential nutrients, stabilizing soils, protecting water catchment areas, and helping to control rainfall via the process of transpiration. Today ethnobotany is widely accepted as a science of human interaction with plants and its ecosystem. Due to changes in life style and knowledge, its material base is endangered and rapidly disappearing. The major benefits of ethnobotany are preservation and improvement in traditional knowledge, community development, conservation and development of wild crop species and the endangered useful plants (Cotton, 1996).

Mood (2008) reported 160 species belonging to128 genera and 37 families from Birjand, located near the Afghanistan border in eastern Iran, of them 40% are used as medicinal plants, 47.8% pastoral, 8.3% poisonous and 4% with industrial

uses. Ozturk *et al*. (2008) described ethnoecological aspects of 474 taxa belonging to 64 families of highly poisonous plants in Turkey and Northern Cyprus, which can prove fatal. The families contained the highest number of poisonous species are Fabaceae (50), Ranunculaceae (48), Asteraceae (44) and Liliaceae (28). One has to be very cautious before using these plants as the plants used for the purpose of treatment of diseases as a whole or parts thereof or consumed by the public directly could prove dangerous for the health. Ragunathan & Abey (2009) done an ethnomedicinal survey on folk drugs used by different ethnic groups in Bahirdar Zuria district northwestern Ethiopia. Most of the herbal remedies were given in the form of fresh juice. 27 plant species belonging to 26 genera, 24 species and 21 families applied for therapeutic purposes by the different ethnic group of Bahirdar Zuria district are enumerated. Rethy *et al*. (2010) carried out the ethnobotanical study of Dehang–Debang Biosphere Reserve (DDBR) of Upper Siang district which are inhabited by Membas. 88 useful plant species belonging to 47 families and 58 genera documented, 24 species are used as vegetable, 18 species are used as medicine and 13 species are used as edible fruits. Some selected species are used for stupefying and trapping fishes, spice, edible oil, fodder, and fiber, packaging material and for religious practices. Adebisi & Bello (2011) carried out the ethnobotanical study in targeted areas of south-western Nigeria to ascertain the patronage of traditional healers for non orthodox contraceptives by males and to take an inventory of plants used for such purposes. According to them the plants *Aframonium melegueta* and *Carica papaya* were the most widely used herbs as male contraceptives. Reddy *et al*. (2011) carried out an ethnobotanical survey among the ethnic groups of Yerukala,Yanadi, Sugali tribals inhabited in Sheshachala hill range of Kadapa District, Andhra Pradesh, India. Ethnobotanical information of 60 plant species belonging to 33 families was reported from the ages of 50 to 82 years. Amiri *et al.* (2112) documented the ethnobotanical potential from Zangelanlo District, Northeast Iran. Of 52 plants species belonging to 48 genera and 26 families. The major plant families which contributed in folk herbs included Lamiaceae (9 spp.), Asteraceae (8 spp.), Apiaceae (4 spp.) and Fabaceae (3 spp.). The main uses of the herbal drugs were as febrifuge, anthelmintic and in digestive problems, jaundice, respiratory ailments, urinary diseases,

skin diseases and diabetes.

In Pakistan, some recent research on ethnobotany is summarized as follows.

Ahmad *et al*. (2006) presented traditional medicinal uses of 15 weeds species belonging to 15 genera of flowering plants with special reference to ecological diversification and their botanical description of District Attock. It was found that the area is rich in indigenous knowledge related to weeds. Panhwar & Abro (2007) revealed that the local people use 50 species of plants in traditional health care system and miscellaneous uses in Mahal Kohistan (Khirthar National Park). They also discussed different diseases and miscellaneous uses tools for which these plants are used. Hussain *et al*. (2008) collected information from traditional healers on the use of 45 medicinal plants in Hattar region, District Haripur, NWFP, Pakistan. Out of 45 plant species, 17 were perennials/biannual, 20 were found in spring, while 8 species were found in autumn season. Taj *et al*. (2009) revealed the ethnobotanical study of 29 plants species belonging to 25 families were medicinal used in Godi Khel District Karak. Zahoor *et al*. (2009) conducted ethnobotanical study of 52 plant species belonging to 45 genera and 30 families of Darra'e Pezo District, Lakki Marwat, Pakistan for various purposes. Some of useful species are under serious threat due to unsustainable activities. Hence, a proper documentation of useful plants with their present status and local traditional knowledge as well as practices is urgently needed in the area. Shah *et al.* (2009) gathered information of 36 medicinal plants belonging to 23 families traditionally used by the tribal and rural women of northern areas of NWFP, Pakistan for birth control. Study provides information on local names, mode of administration and dosages as practiced by rural and tribal women. The women of the area used plant for family planning, induce abortion and as contraceptives. Sher & Hussain (2009) conducted an ethnobotanical study on the medicinal and economic plants of Malam Jabba valley, District Swat with the aims of documenting the inventory of medicinal plants, examining the current status of the medicinal plants trade and investigating the linkages in the market chain starting from collectors to consumers. The survey reported 50 species of plants belonging to 33 families as ethnobotanically important. Marwat *et al.* (2009) documented ethnobotanical importance of 3 plant species: *Salvadora persica, Tamarix aphylla*

and *Zizyphus mauritiana* in the light of Islam, mentioned in the 16th Ayat of Sura Saba in Holy Quran and Ahadith. They also concluded that herbal medicines are being widely used in the world because of better cultural acceptability, least injurious with none or much reduced side effects. Jan *et al*. (2009) presented the uses of 42 plant species belonging to 28 families of Dir Kohistan Valleys, NWFP, Pakistan for the treatment jaundice. Effort should also be initiated to implement appropriate conservation measures for preservation and sustainable uses of these useful species.

Jan *et al.* (2010) presented traditional medicinal uses of 26 weeds species belonging to 16 families of Dir Kohistan. Asteraceae is the leading family with 8 plant species. It was found that the area is rich in indigenous knowledge related to weeds but still there is large number of underutilized weeds which could not prove useful yet. Abbasi *et al.* (2010) reported therapeutic uses of 27 medicinal species belonging to 23 families for wounds healing by the tribal communities of Northern Himalayan Range, district Abbottabad. Study provides baseline data on wound healing properties of native plants that can be exploited by pharmaceutical industry for screening new active compounds. Shinwari (2010) reviewed the status of medicinal plants research in Pakistan. According to him majority of the people in Pakistan rely on medicinal plants to find treatment for their minor, even in some cases major diseases. Some wild plants are now being commonly used e.g *Ephedra, Artimisia*, St. John's wort, Hippophae beside some that have been domesticated e.g Garlic, Ginseng and Cumin etc. Hazrat *et al*. (2010) enlisted 50 medicinal plants, belonging to 32 families of Usherai Valley. Ullah *et al*. (2010) documented the traditional knowledge of 34 medicinal plant species belonging to 25 families used in Darra Adam Khel NWFP Pakistan. These medicinal plants are used to cure about 30 - 35 types of ailment. The main ailments in this area were cough, diabetes, stomach problem, headache, jaundice, toothache and skin diseases. Leaves are the most frequently used plant part against diseases. Khan *et al*. (2011c) documented the traditional knowledge of 33 medicinal halophytes belonging to 18 families of Noshpho Salt Mine District Karak, Khyber Pakhton Khwa (KPK), Pakistan. These medicinal plants are used to cure different types of diseases like, cough, diabetes, stomach problem, headache, jaundice, toothache and skin. Leaves are the most

frequently used plant part against diseases. Sher *et al*. (2011) recorded 216 ethnobotanically important plant species from Chagharzai Valley, District Buner, Pakistan. Of them, 138 were medicinal species, 72 multi-purpose species, 66 fodder and forage species, 51 fuel wood species, 36 vegetable /pot-herb species, fruit yielding and thatching/ roofing 25 species each, 21 timber species, 19 ornamental species, 15 poisonous plants, 14 fencing/ hedges plants, 12 agricultural tools making species, 9 honeybee species and one species used to repel evils. Mahmood *et al*. (2012) conducted an ethnobotanical study of common medicinal plants of Dudial area, district Mirpur, Azad Jammu and Kashmir, Pakistan. They investigate the traditional medicinal knowledge of 35 plant species belonging to 30 families with the help of semi-structured and close ended questionnaires.

The review clarifies that plant of the research area need documentation of ethnobotanical knowledge resting in the area.

2.4. Vegetation Diversity

Vegetation is an ecological expression of an area showing complex inter-relationships among the various components including plant-plant, plant-animal and plant-physical environment interactions. It is the general effect produced by the growth of some or all species in various combinations forming associations or communities. A review to highlight the vegetation studies are briefly resented as below.

El-Ghani & Amer (2003) while using TWINSPAN techniques classified the vegetation of El-Qaa plain along the Gulf of Suez (south Sinai, Egypt) into five groups. Each of the definite vegetation and soil characters could be linked to a specific geomorphological unit. *Capparis spinosa* var. spinosa occupied the terraces, *Cornulaca monacantha, Convolvulus lanatus* and *Deverra tortuosa* inhabited the alluvial plains, Launaea nudicaulis and Artemisia judaica characterized the wadi channels, *Acacia tortilis* subsp. raddiana and *Leptadenia pyrotechnica* characterized the alluvial fans and *Tamarix nilotica, Zygophyllum album* and *Nitraria retusa* on the playas and the coastal shore. Ordination techniques as detrended correspondence analysis (DCA) and canonical correspondence analysis (CCA) are used to examine the relationship between the vegetation and studied

soil parameters. Brown & Bredenkamp (2004) developed a structural classification of the woody component using species size (SPIZE) classes. They indicated that structural SPIZE classes could be used to explain the spatial distribution of woody species within and between various plant communities. Based on frequency, density, percentage crown cover and importance value for each woody species a classification of the woody component was done using a TWINSPAN classification algorithm. DeWalt & Chave (2004) determined the effect of soil fertility by measuring the density and basal area of trees, lianas, and palms on two soil types differing in fertility at each site. Cocha Cashu and KM41 had higher tree basal area and above ground biomass than La Selva or Barro Colorado Island. Although total stem density, basal area, and some biomass components differed significantly among forests, they seemed less variable than, species richness. El-Deen (2005) analyzed the phytosociological behavior and size structure of Rhazya stricta distributed in many parts of Saudi Arabia. He identify 5 vegetation groups associated with the distribution of *Rhazya stricta*, namely *Acacia trotilis-Capparis decidua* and *Senna italica-Citrullus colocynthis* (group A), *Acacia hamulosa- Acacia ehrenbergiana* (group B), *Aerva javanica-Blepharis ciliaris* (group C), *Lycium shawii-Acacia tortilis* subsp. *raddiana* (group D) and *Fagonia acerosa- Euphorbia granulata* (group E) through multivariate techniques such as TWINSPAN, DCA and CCA. From the intraset correlations of the environmental variables, CCA axis 1 was negatively correlated with silt, clay and pH, while axis 2 was positively correlated with sand.

Davidar *et al*. (2007) reported that species abundance distribution did not differ significantly from log normal indicative of a diverse tropical community. Species diversity as measured by Fisher's alpha index was 13.15 for trees and 4.54 for lianas, and basal area was 62 m^2 ha^{-1} for trees and 0.58 m^2 ha^{-1} for lianas. Montane evergreen forests, which are unique to the higher elevations of the Western Ghats, should be conserved on a priority basis. Wahab *et al*. (2008) carried out phytosociological sampling, structure, age and growth rates studies in 5 places of District Dangam, Afghanistan and two monospecific and one bispecific communities were recognized in the study area. It is shown that in *Picea smithiana* (Wall.) Boiss., Dbh, age and growth rates are not significantly correlated. Lack of tree seedlings

indicates poor regeneration status of the forests. Abdullahi *et al*. (2009) carried out the assessment of herbaceous species of Yankari Game Reserve Bauchi-Nigeria. They record of 5 plant communities on the basis of Importance Value Index (IVI) from 5 habitats sample i.e.,1) *Hyperrhenia cyanensis-Sateria pumila-Ctenium newtoni;* 2) *Digitaria horizontalis-Loudetia annua*; 3) *Rynchospora corymbosa-Acroceras amplectans-Sateria pumila;* 4) *Sateria barbata-Hyperrhenia cyanensis-Digitaria gayana* and 5) *Echinochloa pyramidalis-Urena lobota-Ludwigia abyssinica.* The most densely populated species were Rynchospora corymbosa, Hypertherlia cyanensis and Digitaria horizontalis with the highest mean IVI values. Noroozi *et al*. (2011) working on the phytosociology and ecology of the high alpine zone of Tuchal Mts. (Central Alborz) recognized two provisional orders, four alliances and 13 associations of vegetatiion. Besides duration of snow-cover, edaphic, and hydrological quality of micro-sites was more important for the species composition and vegetation mosaic than the regional climatic gradient. About 90% of the species of the study area are Irano-Turanian elements.

Some research work on the vegetation of Pakistan is summarized as follows.

Malik & Malik (2004) recognized *Adiantum-Olea, Acacia modesta, Dodonaea-Acacia- Themeda, Pinus-Themeda, Imperata-Pinus, Pinus roxburghii and Pinus-Carissa-Themeda* communities in Kotli Hills in Chir pine forest which shows heavy deforestation and overgrazing Hussain *et al.* (2005) recognized i. subtropical semi-evergreen forest (*Adhatoda-Cynodon- Olea, Olea-Cynodon- Adhatoda, Plectranthus-Indigofera-Dodoneae* communities); ii. subtropical pine forest (*Pinus-Indigofera-Themeda, Pinus-Plectranthus-Indigofera* communities) and iii. blue pine temperate forests (*Quercus-Stachiopsis-Fragaria, Pinus-Fragaria-Dryopteris* communities) from Ghalegay Hills, District Swat. Malik & Hussain (2006) reported four plant communities from Lohibehr reserve forest, Rawalpindi. Remotely sensed data was used as an alternative in identifying and locating field sites from where floristic composition, environmental and spatial data were collected. Classification and ordination techniques provided very similar results based on the floristic composition. The results formed the basis for the mapping spatial distribution of vegetation communities using image analysis techniques.

Nazir & Malik (2006) recorded the highest index of similarity in between *Themeda-Carissa-Adhatoda* and *Adhatoda-Themeda* in the plant communities of Sarsawa hills district Kotli. It was followed by *Myrsine-Themeda* and *Themeda-Carissa-Adhatoda, Adhatoda-Themeda* and *Carissa-Themeda-Dodonaea*. *Pinus-Poa-Maytenus* and *Colebrookea-Themeda-Dodonaea* in addition to *Adhatoda-Themeda* and *Themeda-Carissa-Adhatoda*. Ahmed *et al*. (2007) which determining the diversity of leguminous plants in Soone valley reported that the relationship between vegetation types, elevation, soil composition and soil mineral contents is an informative criterion to describe the plant diversity. Parveen & Hussain (2007) determined the plant biodiversity and phytosociological attributes of vegetation of the Gorakh hill, District Dadu. Peer *et al*. (2007) apply TWINSPAN & CCA and recognized 11 communities in Hindu Kush Mountains. The vegetation types were 1) the desert steppe comprising *Artemisea fragrans-Haloxylon thomsonii* community, *Stipa orientalis-Kraschenninkovia pungens* community, *Eremurus stenophyllus-Seutellaria multicaulis* community and *Koelpinia linearis-Mathiola chorassanica* community. 2) the Artemisea brevifolia steppe comprising *Brumus danthonae- Artemisea brevifolia* community, *Acantholimon kokandense-Artemisea brevifolia* community and *Cerastium cerestioides-Aconitum rotundifolium* community. 3) the alpine scree vegetation comprising *Acantholimon kokandense-Psychrogeton andryaloides* community and *Androsace baltistanica-Elymus schugnanicus* community. 4) the alpine mates comprising *Oxytropis hunifusa-Crepis mult*icaulis community and *Leontopodium ochroleocum-Festuca alaica* community. Ecological factors such as altitude, geographical position, grazing intensity and organic matter contents influencing the above vegetation types and plant communities.

Ahmad *et al.* (2008a) worked on the vegetation of Kufri site in the Soone Valley, Punjab, Pakistan. Based on topography, soil type and the nature of prevailing disturbances *Acacia modesta* and *Propsopis juliflora* communities were recognized at low altitude while *Olea- Acacia* association at high altitude. *Dodonaea viscosa* and *Justicia adhatoda* occurred very abundantly throughout the site because both species had resistance for grazing. Arshad *et al.* (2008) analysed the plant distribution in

Cholistan desert. They reported the association of certain plant species to certain soil types was common indicating the influence of chemical composition of the soils. *Suaeda fruticosa* and *Haloxylon recurvum* the high salinity levels and low organic matter. *Calligonum polygonoides, Aerva javanica, Dipterygium glaucum, Capparis decidua* and *Haloxylon salicornicum* indicated better organic matter and low salinities. Malik & Hussain (2008) conducted a study to work out the relationship between remote sensing data and vegetation communities of ecological importance using multivariate techniques such as TWINSPAN, Principal Component Analysis (PCA) and Correspondence Canonical Analysis (CCA) in the Lohibehr scrub forest in the Foothills of Himalaya, northeast of Pakistan. Ordination analyses indicated positive correlation between floristic species composition and DN values along the first ordination axis, with the NIR. The ordination methods proved effective in summarizing basic, general structure of the plant community types and to some extent indicated correspondence with their spectral signatures. Parveen *et al.* (2008) documented the floristic and phytosociology in the threatened habitats of Dureji Game Reserve. They stated that vegetation cover varied from place to place depending upon the texture and structure of the soil while vegetation structure and density is greatly influenced by the rainfall. Qureshi (2008b) recognized *Phragmites-Typha-Saccharum* in wetland, *Calligonum-Dipterygium-Salvadora* in desert, *Saccharum-Pluchea-Typha* in marshland, *Desmostachya-Brachiaria-Cynodon* in agriculture habitat and *Salvadora-Desmostachya-Posopis* in protected forest in Sawan Wari of Nara Desert. The most frequent species, *Euphorbia prostrata*, was present in all habitats, followed *Alhagi maurorum, Desmostachya, Saccharum spontaneum* found in 4 habitats. Qureshi & Bhatti (2008) concluded that species composition in the different habitat of Nara Desert, Pakistan showed differences in species richness with highest species richness of 77.24% in flat habitats. The vegetation over major area is characterized by xerophytic adaptation. Wazir *et al.* (2008) identified 5 vegetation types viz: crassulescent steppes, chamaephytic steppes, erme, moist sub-alpine pastures and riverine pseudo-steppes through cluster analysis in Chapursan Valley, Gilgit. Abbas *et al.* (2009) reported that Pinus roxburghii was indicator species in north Himalayan mountains and

Azad Kashmire. TWINSPAN and Sorenson's coefficient of similarity suggested high species diversity (99; trees 22, shrubs 24, herbs 31, grasses 52) in different stands (22–77). The canopy was fairly open and trees (3.80-44.42%), shrubs (6.20-68.73%) and herbs/grasses (9.89–59.54%) contributed different covers in different stands. Trees and shrubs constituted perennial layers, while herbs and grasses dry up during autumn and winter. Ahmed *et al.* (2009a) recognized 10 plant communities in forests dominated by *Olea ferruginea* with similar floristic composition having different quantitative values. Though no significant relation between density and basal area, elevation and density and elevation ans basal area were obtained. Ahmed *et al.* (2009b) analyzed the floristics of roadsides vegetation of Abbottabad and recognized 5 major communities on 5 major roadsides. Hussain & Parveen (2009) worked on the species diversity and phytosociological in Tiko Baran, Khirthar range. The cutting of trees and shrubs by people and the digging of valuable medicinal herbs are increasingly altering the composition and distribution of plants in the study area and its surrounding valleys. Qureshi *et al.* (2009) recognized ten plant communities on the basis of Summed Dominance Ratio (SDR) from District Sanghar, Sindh, Pakistan. These communities were 1) *Fagonia-Senna-Calotropis*; 2) *Pluchea-Dactyloctenium-Ochthochloa*; 3) *Dactyloctenium-Desmostachya-Pluchea;* 4) *Calotropis-Acacia-Alhagi;* 5) *Dactyloctenium;* 6) *Indigofera;* 7) *Desmostachya-Gynandropsis;* 8) *Desmostachya-Dactyloctenium-Indigofera*; 9) *Dactyloctenium* and 10) *Indigofera-Dactyloctenium-Indigofera.* There were 16 species which contributed in the formation of plant communities of the area. Siddiqui *et al.* (2009) conducted a phytosociological study of *Pinus roxburghii* in Lesser Himalayan and Hindu Kush range of Pakistan. Pine seedlings were recorded in nine stands showing regeneration. The common angiospermic species were found in association with Chir pine like *Dodonaea viscosa, Punica granatum, Erodium cicutarium, Medicago denticulata* and *Vicia sativa.*

Ahmed *et al.* (2010 a) described the communities of 47 stands of deodar (*Cedrus deodara* Roxb. ex Lamb. G Don.) forests covering its natural limits in Pakistan. They described *Deodar–Juglans* community, *Deodar–Quercus* community, *Deodar–Taxus* community, *Deodar–Picea* community, *Deodar–Abies* community,

Deodar–Pinus gerardiana community, *Deodar–Pinus wallichiana* community and monospecific *Deodar* forests. Ahmad *et al*. (2010 b) identified four communities differing mainly on the basis of their ecological amplitudes along the road verges of motorway (M-2). Out of the four major communities, community number 1 occurred mostly in highly disturbed areas. The community number 2, which was the major and largest community, showed its appearance in areas seemed to be highly favorable for the flora as indicated by the occurrence of maximum number of species. The community number 3 occurred in habitat with relatively high temperature and low rainfall. Community 4 indicated quite hot and dry habitat loving species. Ali & Malik (2010) identified *Broussonetia-Populus* and *Panicum-Conyzanthes* community types in Islamabad. The distribution pattern of vegetation was influenced by soil physico-chemical properties, invasive species and human disturbance. Farooq *et al*. (2010) established *Pinus-Abies-Sophora, Pinus-Abies, Abies-Cedrus, Abies-Pinus* and *Pinus-Abies* communities in Push Ziarat area. These communities composed of economically valuable timber, firewood, medicinal and aromatic plants. Naz *et al.* (2010) stated that community structure and distributional pattern of the species was mainly dependent on the salinity gradient in the Cholistan desert. Salt tolerant species like *Sporobolus ioclados, Aeluropus lagopoides, Haloxylon recurvum* and *Suaeda fruticosa* were the dominants in highly saline sites, whereas, moderately saline habitats supported less tolerant species *Fagonia indica, Cymbopogon jwarancusa* and *Ochthochloa compressa*. Ahmad & Yasmin (2011) analyzed natural vegetation of two zones along Hanna Lake, Baluchistan using TWINSPAN and DECORANA and classify the vegetation into plant communities. They recorded 38 species belonging of 16 families were recorded from Zone 1 and Zone 2.

2.5. Productivity of Rangeland

Internationally productivity of plant life research was review as follows.

Angassa (2005) studied the ecological impact of woody encroachment and the responses of herbage yield to encroachment at three locations in Borana rangeland. The assessment was based on the yield and floristic composition of the herbaceous layer. The grasses *Cenchrus ciliaris, Chrysopogon aucheri* and *Panicum coloratum*

were common or dominant in both encroached and non-encroached sites. The relative yield increased with non-encroached sites and varied at different altitude ranges from about 106% to about 150%, thus increases ranged from 75% in Medhecho to 350% in Dubluk as determined from the lower values of the ranges. Differences based on altitude range were also significant for *Eragrostis papposa* and *Pennisetum stramineum*, while the three areas showed a significant difference for the mean yield of *Aristida adscensionis, Cenchrus ciliaris* and *Eragrostis papposa*. Zheng *et al.* (2006) reported that forest biomass ranged from 362.1 to 692.6 Mg/ha and its allocation patterns in tropical seasonal rain forests of Xishuangbanna. Biomass of trees with diameter at 1.3 m breast height (DBH) ≥ 5 cm accounted for 98.2 percent of the rain forest biomass, followed by shrubs (0.9%), woody lianas (0.8%), and herbs (0.2%). Biomass allocation to different tree components was 68.4–70.0 percent to stems, 19.8–21.8 percent to roots, 7.4–10.6 percent to branches, and 0.7–1.3 percent to leaves. Biomass allocation to the tree sub layers was 55.3–62.2 percent to the A layer (upper layer), 30.6–37.1 percent to the B layer (middle), and 2.7–7.6 percent to the C layer (lower). Biomass of *Pometia tomentosa*, a dominant species, accounted for 19.7–21.1 percent of the total tree biomass.

Kharkwal *et al.* (2010) studied the dynamics and biomass production ($g \cdot m^{-2}$) of understory (herbaceous) plant community in central Himalaya, India. With increasing altitudes, the density and biomass decreased significantly across the three types of forests. Banj-oak forest harboured the maximum biomass among the other sampling sites. Across the sites, total production declined significantly with increasing altitude of the sites ($p<0.05$), and Banj-oak forest presented the highest production.

Joshi & Rawat (2011) analyzed the net primary productivity of herbaceous vegetation of banj-oak (*Quercus leucotrichophora A. Camus*) forest in Kumaun Himalaya, India. Maximum above-ground production occurred during rainy season (132.5 g m^{-2}) and minimum during winter season (2.8 g m^{-2}). Below-ground production was maximum (85.9 g m^{-2}) during winter season and minimum (14.9 g m^{-2}) during summer season. Annual net shoot production was 150 g m^{-2} and below-ground production was 138 g m^{-2}. Of the total input 61 % was

channeled to aboveground parts and 39% to below-ground parts.

Joshi *et al.* (2012) determined the plant biomass and net primary productivity of herb layer of banj oak (*Quercus leucotrichophora* A. Camus)-chir pine (*Pinus roxburghii* Sarg) mixed forest in Kumaun, central Himalaya, India. The monthly live shoots biomass exhibited a single peak growth pattern with highest live shoot biomass of 185 $g \cdot m^{-2}$ in August. The seasonal pattern showed that the maximum above-ground production (131 $g \cdot m^{-2}$) occurred during the rainy season and the minimum (1 $g \cdot m^{-2}$) during winter season. The below-ground production was maximum during winter season (84 $g \cdot m^{-2}$) and minimum during summer season (34 $g \cdot m^{-2}$). The annual net shoot production was 171 g·m−2 and total below-ground production was 165 $g \cdot m^{-2}$.

Some studies made on the productivity of rangeland in Pakistan are as follows.

Hussain & Durrani (2007) determined productivity and dry biomass production on monthly basis. They recorded 10772.5 kg/ha/year in Herboi range lands. The months of July and August were the most productive months (2120.7 and 2012.7 kg/ha, respectively). The total dry biomass, biomass contributed by grasses, herbs and shrubs generally increased from April through August and thereafter it progressively decreased till October. It was observed that the range is suffering with overgrazing, over exploitation and soil erosion, which must be cared for. Khattak *et al.* (2007) evaluated 100 seed weight ranged from 19 to 23.1 g 100^{-1} seed weight. The mutants CMN-35-23 and CMN-20-7 exhibited the larger seed size. The mutants produced 760 to 1620 kg ha^{-1} seed yield and the mutant CMN-15-4 produced the maximum seed yield. The 100 seed weight of all the mutants of C-44 ranged from 19.8 to 23.9 g 100^{-1} seed weight. The seed yield ranged from 885 kg ha-1 to 1552 kg ha^{-1}. The mutant CMN-4-25-13 produced the highest seed yield of 1552 kg ha^{-1} among the mutants derived from the parent C-44. Daur *et al.* (2008) studied the variability of grain yield and shoot dry weight in genotypes of *Vicia faba.* Shoot dry weight varied from 6602 kg ha^{-1} for genotype 97 ETA 727 to 4041 kg ha^{-1} for genotype 98 ETA 296, with an average value of 4980 kg ha^{-1}. Similarly, variation in grain yield was from 4828 kg ha^{-1} for genotype FİLİZ-99 to 3638 kg ha^{-1} for

genotype SEVİL, with an average value of 4287 kg ha^{-1}. Ahmad *et al.* (2009c) evaluated the above ground current season growth biomass and dead accumulated biomass of *Chrysopogon aucheri* and *Cymbopogon jwarancusa* in a protected site of Hazarganji-Chiltan National Park in highland Balochistan. *Cymbopogon jwarancusa* current season biomass ranged from 27 kg/ha in April to 51 kg/ha in June whereas *Chrysopogon aucheri* current season biomass production ranged from 2 kg/ha in April to 54 kg/ha in June. Above ground dead biomass of *Cymbopogon jwarancusa* ranged from 77 to 310 kg/ha whereas the dead biomass of *Chrysopogon aucheri* ranged from 50 to 320 kg/ha. Arshadullah *et al.* (2009) carried out to investigate the response of various warm season forage grass species under semi-arid conditions of hills, Kharian range. Fresh biomass production was highest in Blue panic followed by Finger grass during spring season. Dry matter yield was also higher in Blue panic than other grasses during spring In Monsoon season, more fresh biomass was produced by Finger grass followed by Vetiver grass and Pangola grass and more dry matter production by Finger grass followed by Vetiver grass. Khalil *et al.* (2010) observed the grain yield on the basis of planting dates and plant density and recorded that crop planted on October produced highest grain yield (4153 kg ha^{-1}), followed by September planted crop producing 3936 kg grains $ha^{-1,}$ while lowest grain yield (589.7 kg ha^{-1}) in December planted crop.

Agha *et al.* (2011) evaluated production of three exotic herb species (*Hyssopus officinalis* L., *Salvia officinalis* L. *and Thymus vulgaris* L.) in highlands of Balochistan. The fresh production of sage, thyme and hyssop at Quetta was recorded 8192, 4743 and 3398 kg/ha, respectively. The dry production of these herbs at Quetta was 3170, 2192 and 1521 kg/ha for sage, thyme and hyssop, respectively. Arshadullah *et al.* (2011) recorded biomass of 5 strains of Buffel grass, including RMF-267, RMF-268, RMF-269, RMF-270 & RMF-271. During spring season, the highest fresh biomass (24.4 t ha^{-1}) was in RMF-269 strain followed by RMF-270 and RMF-268. The lowest fresh biomass (18.1 t ha^{-1}) during this season was that of RMF-267 strain. Dry matter yield (6.93 t ha^{-1}) was at the highest in RMF-269 among other strains. Similar trend was also in monsoon season. However, forage yield was higher in monsoon than in spring season due to prolonged growing period and more

rainfall. Khan *et al.* (2011) recorded the fresh and dry biomass data of chickpea varieties including KC-98, Sheenghar, Lawaghir, KK-1, KK-2, SL-01-13, SL-02-13, SL-02-20, SL-02-22, SL-02-29, SL-03-29 and SL-04-29. Sheenghar variety produced the best fresh weight (13.7 g) fol1owed by KC-98, Lawaghir and KK-1 (13.1, 12.24 and 13.0 g), respectively while minimum fresh biomass was recorded at 1½ X dose (8.8). 1X dose produced intermediate fresh weight (11.3). For dry biomass untreated check produced maximum (3.45 g) fol1owed by ½x dose (3.40 g) while, 1½X dose of either herbicide produced very low dry biomass (1.84 g).

2.6. Mineral composition

Minerals are essential for the normal growth and development of plants that ultimately effect the growth, maintenance and productivity of range animals at secondary level. Various environmental factors including edaphic, climatic, geographic and biotic stresses influence the mineral composition of plants including forage species.

Work done on the mineral composition of different plants has been extensively done. A brief review is reproduced here.

Demirezen & Aksoy (2006) determined copper, cadmium, nickel, lead and zinc levels of various vegetables (cucumber, tomato, green pepper, lettuce, parsley, onion, bean, eggplant, peppermint, pumpkin and okra) produced in Kayseri, Turkey. These micro-mineral were higher in urban area compared with rural area. The order of the elements in various vegetables and their concentration ranges in µg/g were Cu (22.19–76.5), Cd (0.24–0.97), Ni (0.44–13.45), Pb (3–10.7) and Zn (3.56–259.2). Milosevic *et al*. (2009) analyzed N, P, K, Ca and Mg concentrations during the growing season. Highest seasonal changes were observed in the contents of Mg (CV=18.19%) and N (CV=12.95%) and the lowest ones in P content (CV=4.00%). Highest leaf contents of N (1.83±0.07%), P (0.43±0.09%) and K (1.77±0.04%) during the season were produced by cv. Nochione and those of Ca (1.27±0.07%) and Mg (0.44±0.42%) by cvs. Tonda Gentile Romana and Istarski Duguljasti, respectively. Naser *et al.* (2009) reported the levels of lead, cadmium, and nickel in some vegetables and in the rizosphere soils of the industrially polluted areas of Dhaka. Lead, Cd, and Ni concentrations in the studied vegetables were higher

compared with their non-polluted counterparts. Concentrations of metals in vegetable samples were related to their concentration in the corresponding soils. Sobukola *et al.* (2010) determined the heavy metal levels in sixteen different fruits and leafy vegetables from selected markets in Lagos, Nigeria. The results showed that the levels of lead, cadmium, copper, zinc, cobalt and nickel ranged from 0.072±0.06 to 0.128±0.03; 0.003±0.01 to 0.005±0.01; 0.002±0.00 to 0.015±0.02; 0.039±0.01 to 0.082±0.01; 0.014±0.01 to 0.026±0.01 and 0.070±0.07 to 0.137±0.05 mg/kg, respectively, for the fruits. The levels of Lead, Cadmium, Copper, Zinc, Cobalt and Nickel for the leafy vegetables respectively ranged from 0.09±0.01 to 0.21±0.06; 0.03±0.01 to 0.09±0.00; 0.02±0.00 to 0.07±0.00; 0.01±0.00 to 0.10±0.00; 0.02±0.00 to 0.36±0.00 and 0.05±0.04 to 0.24±0.01 mg/kg. Anjorin *et al*. (2010) investigated the mineral composition of the various parts of *Moringa oleifera* L. The results indicated that Ca, Mg, Fe and Cu in leaves, pods and seeds from Sheda were relatively higher than that from Kuje. Relatively high contents of Ca and Fe were found in the lamina and seed shell of the plant respectively from both regions. Asaolu & Asaolu (2010) determined the trace metal distribution in some selected Nigeria leafy vegetables. On the average, zinc was the most abundant metal with averages of 2.82, 1.97 and 2.08 (mg/g) in roots, stem and leaf of the vegetables, while lead was the leafy with averages of 0.07, 0.06 and 0.07 (mg/g), in roots, stems and leaves respectively. James & Friday (2010) determined macronutrient (Ca, Mg, Na and K) and micronutrients (Ni, Zn, Pb, Fe, Cu and K) in fresh and dried Euphorbia heterophylla leaf.

Many scientists have investigated the mineral composition of plants in Pakistan.

Hashmi *et al*. (2007) determined the concentrations of trace metals (Fe, Cu, Mn, Zn, and Cr) in common vegetables of Karachi. Maximum concentration of Fe was 32.3 µg/g in spinach, Zn 8.6 µg/g in lady finger, Mn 5.6 µg/g in mint, Cu 3.3 µg/g in mustard and chromium 1.2 µg/g in coriander. The overall contents of trace metals appeared to be within the limit laid down for safe human consumption. Khan *et al.* (2007) analyzed *Cynodon dactylon, Paspalum notatum, Hypoxis hirsute,* and *Panicum maximum* for iron, copper, zinc, manganese and selenium.

No differences were seen between winter and summer for forage in Fe, Cu, Zn, Mn and Se. Forage Cu concentrations increased in summer for Paspalum from 20.3 to 23.1 μg/g. This species had the highest zinc concentrations 90.8 μg/g in winter and had the highest level of Fe and Cu of 130.0 and 23.1 μg/g, respectively in summer. Hypoxis had the highest Mn concentrations (250.8 μg/g) in winter while its Se concentrations increased in summer from 0.033 to 0.042 μg/g. Se was showed greatest increase in Panicum from 0.028 to 0.049 μg/g in summer. Ahmad *et al.* (2008a) assessed the concentrations of Cu, Mn, Fe and Zn of some legume forage plants in the Soone valley, Punjab, Pakistan. Mn ranged between 3.92-5.09 and 5.90-6.83; Zn; 0.027-0.076 and 0.028- 0.064, Fe; 20.72-25.43 and 25.35-32.94, Cu; 0.38-0.54 and 0.34-0.51 mg g-1 in the leaves and pods, respectively. The forage species had varying mineral composition in both leaves and pods. The plants showed significant differences for Zn and Mn contents of leaves and non-significant differences for pods, while Fe exhibited non-significant difference for the plant parts. Litter on Ahmad *et al.* (2008b) analyzed some forage grasses and legumes for Na, P, K, Ca and Mg composition in the Soone Valley, Punjab, Pakistan. It was concluded that most of the forage samples had sufficient Na, P, K, Ca and Mg to meet the requirement of ruminants grazing there in. Comparatively, the macro-mineral concentrations in pods were higher than those found in the leaves and leaflets showing no need of mineral supplementation. Farooq *et al.* (2008) determined the contents of lead, copper, chromium, zinc and cadmium in various leafy vegetables grown in an effluent irrigated fields in the vicinity of an industrial area of Faisalabad, Pakistan. The concentrations of Pb, Cu, Cr, Zn and Cd in the leaves, stems and roots of spinach, coriander, lettuce, radish, cabbage and cauliflower were found to be 1.1331-2.652, 1.313-2.161, 1.121-2.254; 0.252-0.923, 0.161-0.855, 0.221-0.931; 0.217- 0.546, 0.376-0.495, 0.338-0.511; 0.461-1.893, 0.361-0.874, 0.442-1.637; 0.033-0.073, 0.017-0.061, 0.011-0.052 mg kg^{-1} on dry matter basis, respectively. The leaves of spinach, cabbage, cauliflower, radish and coriander contained higher levels of Cu (0.923 mg kg^{-1}), Cd (0.073 mg kg^{-1}), Cr (0.546 mg kg^{-1}), Zn (1.893 mg kg^{-1}) and Pb (2.652 mg kg^{-1}) as compared to other parts of each vegetable. Hussain & Durrani (2008) analyzed the mineral composition of some forage grasses

and shrubs at three phenological stages from Harboi rangeland, Kalat, Balochistan. The differences were nonsignificant between grasses and shrubs in K, P, Fe and Zn contents. The concentration of Cu was higher in shrubs than grasses while Mn was higher in grasses than shrubs. The differences in the K, P, Mn, Fe and Zn were insignificant among the various phenological stages. Generally K and Fe were sufficient while P and Zn were deficient in most of the analyzed forage plants. The mineral concentration of forage plants generally increased / decreased inconsistently with the advancing phenological growth stages in most plants. Rehman & Iqbal (2008) reported the accumulation of Fe, Pb, Cu, Cr and Zn in the foliage of naturally growing plants of *Prosopis juliflora, Abutilon indicum* and *Senna holosericea* growing in the industrial areas of Karachi. High concentration of these metals were observed in the foliage of above naturally growing plants collected from the industrial areas when compared with the control. Sultan *et al*. (2008a) determined macro-minerals (Ca, P, K and Mg) and micro-minerals (Cu, Zn, Mn and Co) in some rangeland grasses from Chagharzai, District Bunair. The mean percentage values for Ca, P, K and Mg at early bloom stage were 0.26±0.022, 0.025±0.004, 0.69±0.113 and 0.044±0.006, respectively. The mean ppm values for Cu, Zn, Mn and Co at early bloom stage were 22.75±2.671, 14.70±2.065, 10.12±1.770 and 0.023±0.003, respectively. The mean percentage values for Ca, P, K and Mg at maturity were 0.30±0.049, 0.031±0.006, 0.68±0.108 and 0.028±0.004, respectively. The mean ppm values for Cu, Zn, Mn and Co at maturity were 29.8±2.962, 8.96±2.0701, 6.14±1.034 and 0.029±0.005, respectively. Ahmad *et al*. (2009) concluded that the concentration of Pb, Ni and Cr was significantly higher than their critical levels in some leguminous plant species (*Acacia farnesiana, Acacia modesta, Acacia nilotica, Medicago denticulata, Melilotus indica, Sophora mollis, Lathyrus aphaca* and *Vicia sativa*) and grasses (*Cynodon dactylon, Saccharum munja, Saccharum spontaneum* and *Cyperus rotundus*) of Salt Range. The Pb concentration in the leaves ranged from 0.034 to 0.069 mg g^{-1} in different pastures, while in pods it ranged from 0.040 to 0.065 mg g^{-1}. The leaf Cr varied from 0.156 to 0.285 mg g^{-1} and in pods it was from 0.166 to 0.223 mg g^{-1}. The leaf Ni concentration ranged from 0.030 to 0.068 and that in pods from 0.037 to 0.084 mg g^{-1}. Thus, these forages may

cause some toxic effects in grazing animals of the area. Khan *et al.* (2009a) analyzed forage samples for macro-minerals (Na, K, Ca and Mg) and micro-minerals (Mn, Fe, Zn and Cu). These results showed that pasture grasses/ forages had sufficient levels of K, Ca, Mg, Mn, Fe and Zn to meet the requirements of ruminants being reared there but the occurrence of marginal to deficient supplies of Na and Cu appears very likely in this area of investigation. Khan *et al.* (2009b) studied the seasonal effect on Ca, Mg, Na and K status in both plants and goats at a particular Livestock Experimental Station in the Punjab, Pakistan. It was concluded that the mean concentration of these metals in the forage was high in summer than winter. Malik *et al.* (2010) assessed total contents of Pb, Cu, Zn, Co, Ni, and Cr in the soil and 16 plant samples collected from industrial zone of Islamabad, Pakistan. Total metal concentrations of Pb, Zn, Cu, Co, Ni, and Cr in soils varied between 2.0-29.0, 61.9-172.6, 8.9 to 357.4, 7.3-24.7, 41.4-59.3, and 40.2-927.2 mg/Kg Total metal concentrations pattern in roots were: Cu>Cr>Zn>Ni>Pb>Co. Grasses showed relatively higher total Zn concentration. Accumulation of Cu was highest in shoots followed by Zn, Cr, Pb, Co and Ni. Bangash *et al.* (2011) analyzed 10 vegetables namely Pot purslane, Spinach, Turnip, Garlic, Mustard (Sarson), Radish, Bitter gourd, Lady finger, Bath sponge and Brinjal for their mineral contents. Maximum concentration of macro minerals K, Ca, Mg, and Na, observed was (400, 210, 109, and 55) mg/100 g, respectively, with a minimum concentration (26, 15, 17, and 10) mg/100 g, respectively. Maximum concentration of micro minerals Fe, Cu, Zn, Mn and Cr observed was (29, 0.33, 3.05, 1.70, and 0.36) mg/100g with a minimum concentration (2, 0.05, 0.43, 0.21, and 0.06) mg/100g, respectively. Cheema *et al.* (2011) explored the mineral composition of *Morus alba, Acacia nilotica, Syzygium cumuni* and *Ziziphus jujuba* leaves where Ca and K were highest in *A. nilotica*, P in *M. alba* and Mg and Na in *Z. jujuba*. Hussain *et al*. (2011) carried out the mineral contents of four medicinal plants viz., *Aerva javanica, Calotropis procera, Datura alba* and *Nepeta suavis* of the Northwest Pakistan. Fe was high in Nepeta suavis followed by *Calotropis procera* and *Aerva javanica*. Higher concentration level of Cu was detected in *Nepeta suavis*. The concentration of Na and Mg was higher than other elements and the amount of Pb, Cd and Mn was

minimum 0.057 to 1.663 ppm.

2.7. Nutritional Composition

The nutritional demands of livestock vary with age and physiological functions of the grazing animal such as development safeguarding, growth, stuffing and lactation etc. Range animal efficiency depends upon the quantity and nutritive value of plant species available to primary consumers. Plant material is dividable into fibrous and nonfibrous portions. In consumers, fiber parts that give energy are significant because celluloses and hemicelluloses are easily digested.

The work on the nutritional Composition of plants done is elsewhere summarized.

Starks *et al.* (2006) determined the nutritive value of pastures including neutral-detergent fibre (NDF), acid-detergent fibre (ADF) and crude protein (CP) concentrations of herbage bermudagrass (*Cynodon dactylon*), and the relationships between these descriptors of nutritive value of herbage and canopy reflectance in broad spectral wavebands. Ratios of canopy reflectance in blue to red (R(blue)/R(red)) and in near infrared to red (R(NIR)/R(red)) wave bands were highly correlated with concentrations of CP in herbage and herbage mass of CP but the relationships between reflectance ratios and NDF and ADF concentrations of herbage were relatively low. Bukhsh *et al.* (2007) worked on the nutritional value of some medicinal plants of families Asteraceae, Cruciferrae and Plantaginaceae. Results showed that crude proteins, total proteins in seeds and total carbohydrates were significantly higher in leaves of *Eruca sativa* as compared to *Carthamus oxyacantha* and *Plantago ovata*. The amount of total fats was significantly higher in seeds of *C. oxyacantha as compared to E. sativa* and *P. ovata.* While the concentration of crude fiber was significantly higher in seeds of *P. ovata* than seeds and leaves of both *E. sativa* and *C. oxyacantha.* Taiga *et al.* (2008) carried out the proximate chemical analyses of dry vegetables in Nigeria, it was observed that *M. esculentum* and *C. odorata* contained higher protein (29.30 and 32.40%, respectively), than *T. occidentalis* (13.33%). Also, the Carbohydrate content of *P. guineese* and *V. subteranea* (77.17 and 89.42% respectively) was higher than that of *T. occidendalis* (63.64%). Onwordi *et al*. (2009) analyzed the proximate

composition of three commonly consumed vegetables *Amaranthus cruentus, Celusia argenta* and *Corchorus olitorius* leaves. The mean leaves moisture content is 23.57, 15.58 and 30.90% respectively for *A. cruentus, C. argenta* and *C. olitorius*. The mean protein, carbohydrate and crude fibre content are: 12.66, 29.41, 7.83%; 9.35, 32.84, 11.70%; 11.24, 31.34, 6.6% respectively for *A. cruentus, C. argenta* and *C. olitorius*. All the studied vegetables have low fat content - *A. cruentus* (0.45%), *C. argenta* (0.21%), *C. olitorius* (0.32%). The leaves have energy values of 177.55 cal/100 g for *C. olitorius* followed by *A. cruentus* with energy value of 176.67 cal/100 g and *C. argenta* having the least energy value of (174.93 cal/100g) of food . Nwalo (2010) determined the proximate composition of four varieties of maize; sweet corn, pop corn, white corn and yellow corn. The percentage crude protein of seed was at the range of 7.00 - 8.75%. Sweet corn had the highest protein content and is expected to posses the highest hydration capacity, followed by yellow corn (7.88%). Pop corn and white corn had 7.88 and 7.00%, respectively. Yellow corn had the highest total carbohydrate of 76.52%, white corn 76.00%, while sweet corn and pop corn recorded 69.25 and 74.12%, respectively. Generally, the seeds recorded low crude fat content of 0.5 - 1.5%. Henry-Unaeze (2011) compared the micronutrients content of complementary foods used by Igbo mother (maize pap (akamu), marshed yam + red oil and jollof rice + beans) and Hausa mothers (Dawa gruel (guinea corn), tuwoshinkafa and acha porridge) in Umuahia urban. Biochemical analysis of the samples revealed that the moisture content ranged from 37.6% in tuwoshinkafa to 81.62% in akamu. The ash content of jollof rice + beans was the highest (8.72%). Fat (15.59%), protein (35.04%) and energy (468.3 kcal) were highest in acha porridge; while akamu (89.84%) had the highest carbohydrate content. Jollof rice + beans had the highest iron (5.83 mg/100 g) content while acha porridge had the highest calcium contents (23.02 mg/100 g). The phosphorus content was more in tuwoshinkafa (555.2 mg/100 g). Sowemimo *et al*. (2011) study the proximate analysis of *Detarium senegalense* JF Gmelin's seeds and revealed that the seeds contain 24.43% carbohydrate, 7.23% protein, 31.16% fiber, 5.89% moisture and 1.93% ash. Ingale & Shrivastava (2011) determined proximate composition and nutritional value of seeds of new variety of groundnut (Arachis hypogaea L) JL-24. According to them

that the groundnut seed contain moisture (5.529%), crude fibre (1.149%), lipid (46.224%), crude protein (25.20%), carbohydrate (21.26%), ash (2.577%), calcium (0.087%), phosphorus (0.29%) and energy (601.856%). The total fatty acid composition was 10.44 and 33.51% for saturated and unsaturated fatty acid, respectively. Chinedu & Nwinyi (2012) carried out the proximate analyses of two traditional grain legumes consumed in Eastern Nigeria- Bambara groundnut (*Voadzeia subterranean*) and African yam beans (*Sphenostylis stenocarpa*). *Bambara groundnut* was found to contain 2.86±0.02% moisture, 32.40±0.02% protein, 7.35± 0.02% fat, 5.78±0.02% ash, 2.68±0.02% crude fiber and 51.78±0.02% total carbohydrates. African yam beans contained the following: 1.96± 0.02% moistuire, 37.21±0.02% proteins, 9.49±0.02% fat, 5.35±0.02 Ash, 3.55±0.02 crude fiber and 44.4±0.02% total carbohydrates.

Nutritional value of plant species has also been performed in Pakistan. It is briefly reviewed as follows.

Sultan *et al.* (2007) investigated the nutritive value of locally available 12 marginal land grasses from Chagharzai, District Bunair. Dry matter (DM), organic matter (OM), ash, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemi-cellulose, and lignin contents were determined. The mean percentage values for DM, OM, ash, CP, NDF, ADF, hemi-cellulose and lignin at early bloom stage were 30.1±1.08, 27.6±0.92, 8.1±0.33, 8.7±0.39, 52.3±0.25, 25.8±1.36, 26.6±1.75 and 3.7±0.17, respectively. The mean percentage values for DM, OM, ash, CP, NDF, ADF, hemi-cellulose and lignin at mature stage were 39.4±0.75, 36.1±0.67, 8.2±0.28, 5.7±0.25, 60.9±2.04, 31.1±1.22, 29.8±2.27 and 4.5±0.19, respectively. Sultan *et al.* (2008b) determined the DM, OM, ash, CP, NDF, ADF, hemi-cellulose, and lignin of the ten grasses in Chagharzai valley, District Bunair. The mean percentage values for DM, OM, ash, CP, NDF, ADF, hemi-cellulose and lignin at early bloom stage were 33.1±0.69, 30.6±0.55, 7.4±0.42, 7.8±0.33, 54.7±2.08, 24.7±0.89, 30.0±2.11 and 3.9±0.22, respectively. The mean percentage values for DM, OM, ash, CP, NDF, ADF, hemi-cellulose and lignin at mature stage were 43.6±1.03, 41.4±0.86, 7.1±0.42, 5.5±0.25, 61.9±1.44, 29.4±1.16, 31.5±2.14 and 4.7±0.17, respectively. Sultan *et al*. (2008a) analyzed 12 fodder tree

species for dry matter (DM), organic matter (OM), ash, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), hemi-cellulose and lignin contents in Chagharzai valley. It was seen that the mean percentage values for DM, OM, ash, CP, NDF, ADF, hemi-cellulose and lignin were 27.65±1.64, 26.87±1.37, 5.72±0.43, 14.29±1.00, 55.50±1.82, 28.83±1.63, 26.67±1.09 and 6.02±0.54, respectively. The mean In vitro dry matter digestibility (IVDMD) and metabolizable energy (ME) of fodder tree leaves were 54.16±2.06% and 7.24±0.30 MJ/kg DM, respectively. Hameed *et al.* (2008) reported the highest ash contents, proteins, crude fibers, fats & oils, moistures and carbohydrates in various parts of *Rumex hastatus, Rumex dentatus, Rumex nepalensis, Rheum australe, Persicaria maculosa* and *Polygonum plebejum.* Bano *et al.* (2009) determined protein, proline, sugar and abscisic acid (ABA) contents in the leaves of four herbaceous alpine plants. Galium aparine showed the maximum endogenous ABA; Onobrychis dealbata showed the highest sugar and protein content, whereas *Polygonum alpinum* exhibited maximum proline. All the plant species showed a general trend for increased accumulation of protein, sugar, proline and free endogenous ABA in leaves at high altitude. Hussain & Durrani (2009a) determined the proximate composition and cell wall contents of some fodder species from Harboi rangeland, Kalat, Balochistan at three phenological stages. It was concluded that grasses generally had more DM, CF, carbohydrates, NFE, NDF, ADF and hemicelluloses than shrubs while shrubs were generally high in ash, CP, EE, N, GE, ADL contents than grasses. There were insignificant differences in TDN, DE and ME between grasses and shrubs. Generally DM, CF, NDF, ADF, ADL, carbohydrate and hemicellulose contents increased with the maturity of plants; while ash, CP, EE, N and ME declined with maturity of plants. Some parameters like NFE, GE, DE and TDN did not differ among various phenological stages. Hussain *et al.* (2010) determined proximate composition including ash, carbohydrate, protein, fiber, fat and moisture (both dry and wet) of 4 medicinal plant species, viz. *Rhazya stricta, Dalbergia sisso, Phlomis cashmeriana* and *Phlomis bracteosa*. They described that *Phlomis bracteosa* has highest percentage of fiber, fat and energy values compared to other species. Ali *et al*. (2010) studied the nuts of six different walnut cultivars grown in Pakistan namely Chitral-1,

SW-1, Chitral-3, Chitral-2, SW-3 and Dir-2 for Nutritional composition. They found moisture contents (2.76- 4.20%), ash contents (1.27-1.95%), fats (63.54-69.92%), protein (15.96-19.15%) and total carbohydrates (8.04-12.14%). Kernels of Dir-2 and Chitral-2 cultivars had high protein contents (>18% protein) while Chitral-1 and SW-1 contained high carbohydrates contents of >10%. The energy value of the kernels of these cultivars was determined in the range of 698.10-732.44 Kcal/100 g, which shows that the fruits of these varieties are rich source of energy. Adnan *et al*. (2010) determined the proximate composition of five medicinal plant species, *Bupleurum falcatum* and *Valeriana officinalis* belongs to humid regions, while *Forsskalea tenacissima, Lavandula angustifolia* and *Otostegia limbata* belongs to sub-humid regions of Northwest Pakistan. They concluded that sub-humid region's species had higher nutritional value than humid region's species.

Bangash *et al*. (2011) analyzed 10 vegetables namely Pot purslane, Spinach, Turnip, Garlic, Mustard (Sarson), Radish, Bitter gourd, Lady finger, Bath sponge and Brinjal for their proximate composition. All vegetables contain appreciable amount of essential nutrients. The maximum content of moisture, carbohydrate, crude protein, crude fat, crude fiber, and ash recorded in these vegetables was (92.50 %, 26.88 %, 5.0%, 0.40%, 1.4% and 1.9%), respectively, with a minimum content (66.80 %, 3.91 %, 0.7%, 0.08%, 0.4% and 0.38%), respectively. Cheema *et al.* (2011) explored the nutrational value of *Morus alba, Acacia nilotica, Syzygium cumuni* and *Ziziphus jujuba* leaves. Chemical analyses revealed that dry matter (DM) ranged from 25% to 47% in *M. alba* and *S. cumunii*, organic matter was higher (94%) in *S. cumuni* and *Z. jujuba. M. alba* had higher (23%) crude protein, whereas, neutral detergent fiber (NDF) was greater in *Z. jujuba* (32%). Acid detergent fiber was higher in *S. c*umuni (23%), while, acid detergent lignin was greater (7%) in *M. alba* and *S. cumuni*. Hemicellulose (15%) and ash content (10%) were higher in *Z. jujuba* and *M. Alba*, respectively. Metabolizable energy was higher (10.5 MJ/kg) in *M. alba* than the other species. Hussain *et al.* (2011) carried out the nutritional value of 4 medicinal plants of the Northwest Pakistan. Proximate analysis of plant sample determines that protein (21.353%) and ash (18.803%) was highest in *Datura alba*, carbohydrate (70.123 %) in *Aerva javanica*, energy (398.496 Kcal/100g), fats (12.595%) and fibre (40.150%)

was highest in *Nepeta suavis*, while highest moisture (11.255%) was reported in *Calotropis procera.*

2.8. **Degree of Palatability**

Palatability or grazing is very positive effect to the environment. It is beneficial towards the soil and grasses, promoting nutrient dense soil and motivating the development of plant life. Grazing may also support biodiversity.

Studies on the differential palatability of plant by livestock are outlined below.

Hirata *et al*. (2005) assessed the grazing impact by calculating the differences between the total available forage at the end of growing season and the end of dry season. They concluded that higher cover of herbaceous vegetation showed higher grazing impacts which reduced the total available forage at the end of the growing season by 0·817 (0·199) at the end of the dry season. Although these dense herbaceous vegetation types could possibly produce more available forage, they would incur more intensive grazing impact. On the contrary, lighter grazing impact would occur with a higher cover of shrub vegetation types. Milewski & Madden (2006) reported that A. seyal lost shoot tips, produced long thorns, and had relatively few flowers and fruits exposed to intensive browsing Increased lateral branching in A. drepanolobium and with an increased occurrence of short, thickened spines in B. glabra were recorded due to intensive browsing Thorns, spines and flowers were measurable indicators of relative browsing Smit *et al.* (2006) stated that unpalatable plants can enhance tree regeneration in wooded pastures under grazing intensity. Sapling survival was significantly high near unpalatable plants, and significantly higher in plots with Gentiana than with Cirsium. These results have important management implications for the endangered and disappearing wooded pastures in Western Europe. Transplanting tree saplings near unpalatable plants could be an alternative reforestation technique in intensively grazed wooded pastures. Loeser *et al.* (2007) determined that grazing declined the perennial forb cover and increased annual plants, particularly the exotic cheatgrass (*Bromus tectorum*) in semiarid grassland in Arizona. The results suggested that some intermediate level of cattle grazing may maintain greater levels of native plant diversity than the alternatives of cattle removal or high-density, short-duration. Osuga *et al.* (2008)

evaluated the feeding value of five browse foliages (*Acacia brevispica, Acacia mellifera, Berchemia discolor, Zizyphus mucronata* and *Maerua angolensis*) in semiarid area of Kenya. The rank order of preference (highest to least) for goats was *A. brevispica, Z. mucronata, B. discolor, A. mellifera* and *M. angolensis* while the rank order of preference for sheep was *A. brevispica, B. discolor, A. mellifera, Z. mucronata* and *M. angolensis*. The goats had higher intakes of all the browse foliages than sheep. Ukoima *et al*. (2009) determine the palatability of three edible mushrooms namely; *Volvariella volvacaea, Pleurotus tuber-regium* and *Pleurotus sajor caju* in Nigeria. Organoleptic analysis showed that all the mushroom species contained alkaloids (Tannins), a good medicinal property. Basic sensory food evaluation showed that *V. volvacaea* (1.06) was the best in terms of palatability, followed by *P. tuber-regium* (1.01) and the least was *P. sajor caju* (0.5). Campanella & Bisigato (2010) reported decreased plant cover, changes in species composition and losses in soil nutrient due to grazing. Grazing caused reduction in leaf litter fall and in the inputs of nitrogen, soluble phenolics and lignin to the soil. This reduction was not only a result of the decrease in plant cover but also due to changes in species composition. Ekblom & Gillson (2010) reported that variability in vegetation cover, and other factors such as grazing, herbivory and nitrogen availability was important as controlling mechanisms for woody cover in Limpopo National Park, Mozambique. They used palaeoecological data (i.e. pollen assemblages, charcoal abundance, C/N ratio, stable isotopes and herbivore-associated spore abundance) in order to test the relationship between vegetation cover and hydrology, nutrient availability and disturbance from grazing and fire over the last 1,200 years.

Work on the palatability of plants in different area of Pakistan is summarized as follows.

Sultan *et al.* (2008) determined palatability of locally available free rangeland grasses in Bunair district. In free grazing rangeland grasses the highest ($p<0.05$) potential intake rate (PIR) was observed for *Heteropogon contortus* (53.80±15.82 g/4 minute) and lowest for *Cymbopogon schoenanthus* (35.8±.12.16 g/4 minute). However, the highest ($p<0.05$) relative preference (RP) was noted for

Dichanthium annulatum (81.15±0.61%) and lowest for *Cymbopogon schoenanthus* (19.33±1.84%). Rahim *et al.* (2008) determined the palatability of marginal land grasses of Trans-Himalayan Grasslands of Pakistan. In marginal land grasses the highest potential intake rate (PIR) was observed for *Cynodon dactylon* (55.25±12.26 g/4 minute) and lowest for *Andropogon squarrosus* (7.30±2.39 g/4 minute). However, the highest relative preference (RP) was noted for *Setaria pumila* (83.40±2.42%) and lowest for *Andropogon squarrosus* (2.25±0.66%). Ali *et al.* (2009) determined the dry matter intake by sheep fed basal and basal + corn stover treated with different nitrogen sources. Dry matter intake was higher ($P<0.01$) for sheep fed the basal diet compared to other diets. Intake was higher ($P<0.05$) for sheep fed NH3- and urea treated corn stover diets, compared to untreated stover. Similarly, the intake was higher ($P<0.01$) for sheep fed 3% NH3 treated corn stover than urea treated stovers. Hussain & Durrani (2009) found 129 palatable species including 50.4% (65 species) highly palatable, 41.1% (53 species) mostly palatable, 4.65% (6 species) less palatable and 3.87% (5 species) rarely palatable species in Harboi rangeland Kalat, Pakistan. In 99 species (63%) shoots/whole plants were used; in 30 species (19%) foliage/leaves were used while in 29 species (18%) floral parts were consumed. Goats browsed on 104 species including 60% herbs, 27% shrubs, 12% grasses and 1% tree species. Sheep consumed 98 species that included 54% herbs, 22% shrubs, 23% grasses and 1% tree species. Rafiq *et al.* (2010) studied the foraging preferences of free ranging sheep and goats on the native vegetation of Rangelands of Pubbi hills. It was noticed that the sheep mainly grazed (57% of the diet composition) on the seeded pods of Phulai (*Acacia modesta*). The second largest component of sheep diet was *Cymbopogon jwarancusa* (18%), which constituted the largest component (39%) of the goat diet. Badshah and Hussain (2011) find out the herdsmen and farmers preference of local fodder species in semi arid region of District Tank. A total of 38 different local fodder species were used by farmers and herdsmen in the area. The three most preferred species were *Acacia nilotica, Zizyphus mauritiana* and *Convolvulus arvensis*.

2.9. Conservation Status of Plants

Linkie *et al.* (2004) observed that it must need fine scale information to use their budget for law enforcement and identified the forest area which is most susceptible to deforestation. According to them low elevation and surrounding of roads are more prune to deforestation as compared to others. In the future this methodology could be used in conservation planning for the protection of the vulnerable areas. Toledo & Salick (2005) discussed three issues of secondary succession in tropical forests i.e. under storey and over storey changes, continuous as opposed to phase changes and integration of forest succession with indigenous fallow management and plant uses. They sampled 28 fallows, stratified by four success ional stages and ten stands of mature forests. 20 × 50m plot was used for over storey and 2×5m for under storey. Canopy height, basal area liana density of over storey increased with secondary forest age. Early stage has low specie density and diversity in over storey. Lagenberge *et al.* (2006) aimed to analyze forest remnants and to evaluate their role as refuge to the largely destroyed low land forest vegetation. A total of 49 plots were studied. Records represent 8% of the known Philippine vascular plant species. 52% of the species are endemics. 41 (6% of all taxa) tree species are included in the IUCN red list, either as vulnerable, endangered or critically endangered. Phanerophytes dominate life form followed by lianas and chamaephytes. The most common families were the Rubiaceae and Euphorbiaceae. The area provides an important gene bank and high value for biodiversity conservation. Hernandez-Stefanoni & Dupuy (2007) estimated the number of species in a tropical forest landscape in Quintana Roo, Mexico, based on the relationship between reflectance values of satellite imagery and field measurements of plant species density. Total species density as well as that of tree, shrub and vine species were identified from 141 sampling quadrats. Heenan *et al.* (2008) reported new records of Naturalized and Casual plants for the flora of New Zealand during 2004 to 2006. Six species were fully naturalized and 162 plants were considered to be new records of casual plants. They proposed a new scheme of classification for the modes of establishment of weeds in the casual category that further subdivides this into cultivation escape, spontaneous occurrence, garden discard and intentional release.

Naughton-Treves *et al.* (2008) viewed that parks are effective at protecting deforestation. Initiatives were taken to link protected areas to local socioeconomic development. Some of them are successful, but in general, expectations need to alleviate poverty. Attention must be paid to the broader policy biodiversity loss, poverty, and unsustainable land use in developing countries. Winter *et al.* (2008) evaluated a common approach to forest biodiversity. The results show positive possibilities for achieving a moderate level of European-wide harmonization. De Lange *et al.* (2009) used the 2008 version of the threat classification system for conservation status of the indigenous New Zealand vascular plants. The list comprises 6 extinct, 180 threatened, 651 at risk, 25 plants listed as either Vagrant (12) or colonizer (13), and 35 as Data Deficient. Overall, the conservation status of the New Zealand indigenous vascular plant flora is worsening, with 7.6% of this flora now regarded as threatened with extinction. Mark *et al.* (2009) updated the conservation (protected area) status of New Zealand. A substantial increase in the indigenous protected grassland was found due to at its high altitude and government's continued review of high country leasehold tenures but low to mid-altitude systems continue to be poorly protected and are undergoing rapid land transformation. Ubom (2010) identified 339 species in the Niger Delta, Nigeria in which 32 were endemic and 23 were endangered. Al-Quran (2011) studies the threatened status of medicinal plants of Ajloun, Jordan in which 31 species were non endangered species, vulnerable (5), endangered (5) i.e. *Alchemilla vulgaris, Crocus hyemalis, Pistacia palaestina, Rubia tinctorum* and *Salvia triloba* while 4 were critically endangered i.e. *Eryngium creticum, Majorana syriaca, Mandragora autumnalis* and *Matricaria aurea*.

In Pakistan there are only few reports available on the conservation status of plant species. Ali & Qaiser (2009) collected 83 plants from Chitral valley in which 7 medicinal plants are extensively exploited locally. Unsustainable collection methods, poor post harvest methods, soil erosion and intense deforestation are the main causes of the depletion of local flora. As the Chitrali people still partly depend on medicinal plants for majority of their ailments, therefore loss of these plant resources will, to a certain extent, hamper the existing healthcare system in the area. Measures for the conservation of plant resources especially medicinal plants of Chitral valley are

urgently needed. Sher *et al.* (2010) conducted research to evaluate the growth performance of six medicinal species (*Aconitum laeve, Bunium persicum, Saussorea lappa, Podophyllum hexandrum, Delphynum roylei* and *Hypericum perforatum*) from upper Swat, Pakistan. Experiments were conducted at four different locations in the upper Swat valley at altitudes ranging from 1200 to 1900 m.a.s.l. Khan *et al.* (2011d) documented the conservation status of 22 plant species belonging to 16 families in Tehsil Karak, Pakistan. Among these 12 species were found to be rare, vulnerable (6 species), Infrequent (2 species), endangered (one specie) and dominant (2 species). After two years extensive field studies on the basis of questioner including availability of plant, collection of plant, growth of plant, plant parts, population size, geographic range and habitat they concluded that *Salvadora oleoides* is an endangered specie in area. Ali *et al.* (2012) declared the *Delphinium nordhagenii* is an endemic species in District Chitral, Pakistan. This taxon was previously known from 2 localities of Barum Gol and Sher Ghora. The main threat posed to the existence of the taxon is its habitat destruction. In 3 localities i.e., Torikhoo-Chato Doke Ghari, Mastooj-Shandoor Top and Torikhoo-Khoot Ghari, 28.57%, 10.12% and 36.12% decrease has been observed in its population size, respectively, caused by grazing, soil erosion resulted from deforestation and agricultural land extensions.

Chapter 3

MATERIALS AND METHODS

3.1. General Survey

After going through the topographic map of area followed by frequent field visits during the initial stages of study, the entire area was divided into 22 stands. The stand identification was based on altitude, physiognomy aspect, degradation stage and floristic composition of the area. Each stand was approximately located at a distance of 2-3 Km from each other. The data was collected in all the three seasons i.e. winter, summer and spring

3.2. Floristic Diversity

Regular field trips were conducted during winter, summer and spring for two successive years 2009 and 2010. Plant specimens were collected in triplicate. They were dried, preserved and mounted on standard herbarium sheets. Plants were identified with the help of available literature (Nasir & Ali, 1970-1994; Ali & Qaisar, 1995- 2011) and confirmed at Herbarium Department of Botany, University of Peshawar. A complete alphabetical floristic list along with families was compiled. The voucher specimens were deposited in the Herbarium Department of Botany, University of Peshawar. Observation on the life form and phenological behavior were recorded on the spot.

3.3. Phenology

The phenological observations were recorded every month for two consecutive years during 2009 and 2010. The plants were assigned following phenological stages.

a. Pre-reproductive (vegetative young and pre- flowering)
b. Reproductive (Flowers and Fruiting)
c. Post-reproductive (life cycle completed or fruiting completed).

3.4. Biological characteristics

a. Life form

Life form reflects the adaptation of plants to climate. The relative proportion of different life forms for a given region or area is called its biological spectrum or biospectrum. The plants were classified into following life form classes after Raunkiaer (1934) and Hussain (1989).

Phanerophytes

Species with perennating buds emerging at least 25 cm above from aerial parts of the plants. They were further subdivided into following sub-classes.

a. Evergreen Phanerophytes without bud scales,
b. Evergreen Phanerophytes with bud scales,
c. Deciduous Phanerophytes with bud scales.

Each of these types was further classified according to height of plants:

i. Megaphanerophytes (> 30m and 8-30 m),
ii. Microphanerophytes (2-8 m),
iii. Nanophanerophytes (> 2m).

Chamaephytes

The perennial shoots or buds that lies with in 25 cm from the growth.

Hemicryptophytes

The perennial buds are located parts lying on surface of the ground where soil and leaves protecte them. The perennial buds lie at ground level and dying back at the on set of unfavorable conditions. Stolon may or may not be present.

Geophytes

The perennial buds lie below the ground level or submerged in water. Rhizome, bulb and tuber over-wintered by food stores under ground from which arises buds to produce the next season's aerial shoots.

Therophyte

All annual species that complete their life history from seed to seed during favorable season of the year. Their life span can from few weeks to one season. These are the characteristics of desert grassland region and cultivated soil where the interference of man protects them from their (lower ground) natural competitors.

a. Leaf size classes

The leaf size knowledge helps in understanding physiological process of plants and their communities and is useful in classifying the association. The plants were divided into following leaf size classes as described by Raunkiaer (1934).

i. Leptophyll (L): The leaf size is 25 sq. mm
ii. Nanophyll (N): The leaf size is 225sq. mm

iii. Microphyll (Mi): The leaf size is 2025 sq. mm

iv. Mesophyle (Me): The leaf size is 18225 sq. mm

v. Megaphyll (Ma): The leaf size is 164025 sq. mm

3.5. Ethnobotanical Profile

Ethnobotanical information was gathered from each site by using a semi-structured questionnaire (Annex I). Information about the local uses of the plants such as medicinal, fuel wood, timber and fodder etc were obtained through random sampling by interviewing locals from different walks of life, different age group and gender. Individual questionnaire was filled from plant collectors, housewives, shopkeepers, elders, plant traders and local healers (Hakims), who are the actual users and have a lot of indigenous knowledge about the plants and their traditional uses. The data was analyzed and conclusion was drown. Plants were divided into tree, shrubs and herbs mentioning botanical name, local name, family, parts used, floral period and application.

3.6. Phytosociology

A. Community Structure

Size and number of quadrats

Based on species area curve, the suitable size of the quardrat for trees, shrubs and herbs was determined to be 10 x 10 m, 5 x 5 m and 1 x 1 m, respectively.

Distribution of quadrats

A combination of systematic and random quadrats that gives better results was used. The distance between the two adjacent stands was approximately 2-3 km.

The following phytosociological attributes were measured in each stand for each plant.

Frequency

It is the percentage of sampling plots in which a given species occurs.

$$\text{Frequency} = \frac{\text{Number of quadrats in which a species occur}}{\text{Total number of quadrats}} \times 100$$

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

Density

Density is the nomber of individuals of a specie with in a unit area. It shows numerical strength of the species.

$$\text{Density} = \frac{\text{Number of individuals}}{\text{Total number of quadrats}}$$

$$\text{Relative density} = \frac{\text{Density of a species}}{\text{Total number of all species}} \times 100$$

Cover

The cover of herbs and shrubs were calculated using cover scale of Braun- Blanquet (1951). For trees diameter at breast height (dbh at 1.5 m) was recorded and changed. Basal area using standard tables (Hussain, 1989; Mueller-Dombois & Ellenberg 1974).

$$\text{Relative Basal area} = \frac{\text{Basal area of a species}}{\text{Total basal area of all species}} \times 100$$

Importance Value

The importance value of each species was compiled adding RD, RF and RC following Hussain (1989).

Importance value = Relative density + Relative frequency + Relative basal area/Cover

The species within each stand were arranged on the basis of importance values and named after 3 leading species with the highest importance values from each group i.e. tree, shrub and herbs later. Total importance value (TIV) for dominant results was calculated by adding IV of 3 dominant species with in a community and while IV of remaining plants were added separately to get there TIV.

B. Similarity Index

It is used for comparison of communities within an area.

It is defined as the percentage of the number of species common to two communities and has least important value multiplied by 2 and then divided by adding TIV of same communities. This index was calculated after Sorenson (1948) as followed by using importance values:

$$Is = 2C / (A+B) \times 100$$

Where

C = Number of species common to two communities having least Important value.

A = Total number of importance value in community A.

B = Total number of importance value in community B

Is = Sorenson Index of similarity

C. Species Diversity

The index of diversity is used for the comparison of the diversity of plant communities at various altitudes. It was calculated after Shanon & Wiener (1949) as follows:

The average degree of uncertainty in predicting what species an individual chosen at random from a sample will belong to its species.

$$H = -\Sigma Pi .lnePi$$

H: The value of the Shanon and Wiener diversity index

Pi: The proportion of its species

lnPi: The natural logarithm of pi

S: The number of species in the community

Where ni = Actual number of individual of the one species in stand.

N = Total number of individual of all the species present in that stand.

D. Species Richness

It is the richness of flora of an area. It is an expression of simple ratio between number of species and the square root of the total number of individuals of all the species. The species richness was determined after Margalef (1958).

$$R = (S - I)/ In (n)$$

Where

R= Species richness

S = Total number of species in a community

In =Natural log

n =Total number of individual of all species in a community.

E. Equitability or Evenness

It is a component of diversity and presents the ratio of the observed diversity to the maximum diversity possible for the same number of species. The equitability components are related to the evenness of allotment of individuals among the species (Peet, 1974). The equitability was determined by using Pielou's methods (1975) as follows:

E : lnH/lnS

E : Equitability

lnH : Nutural log of expected value from Shanom –Wiener index

lnS : Natural log of total species in a community

F. Maturity index

Maturity index is an indicator of maturity of stand or community. A value more than 60% indicates maturity of the stand. It was measured using Pichi-Sermolli's (1948) farmula as follows:

$$\text{Degree of maturity} = \frac{\text{Frequency values of all species in a stand}}{\text{Total number of species in a stand}}$$

G Degree of Homogeneity

The degree of homogeneity in vegetation was determined by classifying plants into various frequency classes by applying Raunkiaerian (1934) law of frequency as follows:

Frequency Class	Range
1	01-20
2	21-40
3	41-60
4	61-80
5	81-100

The normal distribution of the frequency percentage derived from such classification is expressed as:

A>B>C=D<E

and this is termed as Raunkiaer's law of frequency.

H. Classification and Ordination

The data was classified using standard methods Hierarchical Cluster Analysis (HCA) and Detrended Correspondence Analysis (DCA) (Hill, 1979) to summarize biological records and position of communities in groups during spring, summer and winter. The plant life associations were named after the highest value of three dominant species. DCA ordination offered two significant ordination axes on the basis of weight for communities. All analysis was performed using the software PCORD ver. 4.16 (McCune & Mefford, 1999).

3.7. Edaphology

Two kg soil sample was collected from 22 sites of Tehsil Takht-e-Nasrati up to 15 cm depending upon the area situation using the outer periphery of plants canopy or at the centre of plants with the help of soil auger and mixed to make a composite sample. It was dried and passed through 2 mm sieve and stored in a polythene bag There were 5 replicates from each site. These were analyzed for different chemical and physical parameters including soil texture, organic matter, lime contents, pH, EC, phosphorus and potassium as following standard methods (Bouyoucos, 1962; Hussain, 1989; Jackson, 1962).

3.8. Rangeland Productivity

It was the standing amount of above ground plant material present in a unit area at a given time measured in the herbaceous and shrub biomass.

A. Herbaceous Biomass

It was determined by harvest method using 5 quadrats (I x I m^2 / quadrat) in each community during spring, summer and winter. Plant were weighted in the field to obtain fresh mass. The results were expressed in gm / unit area and then changed to per hectare using standard methods of Hussain & Durrani (2009b).

B. Shrub Biomass

Shrub biomass was estimated by reference unit technique (Kirnse & Noston, 1985, Hussain & Durrani, 2009b). A small representative part of a plant like shoot was designated as reference unit. The size of the reference unit was 10- 20 % of the foliage weight of average plant. The numbers of reference unit of plants were counted and multiplied by average weight of clipped reference unit to estimate shrub Biomass production.

3.9. Degree of Palatability

a. Differential Palatability

Palatability was known by direct observation at the spot and further supplemented with information gathered from local inhabitants, nomads and herders. The plants were classified into following palatability classes.

1. Non – palatable: These plants are not eaten by animals.

2. Palatable: All those plant that are eaten partially or wholly by animals. They were further separated on the basis of preference of animals, parts grazed, freshness / dryness of plants and availability in various seasons. The palatable species were classified into the following categories.

i. Highly palatable: Those plant which are highly preferred by animals over other plant throughout the growing seasons.
ii. Medium palatable: The plant which are reasonable preferred by animals.
iii. Less palatable: All those plant which are less preferred by animals.
iv. Rarely palatable: Those plant that are rarely palatable under compulsion.

b. Palatability by parts used by animals

The palatable plants were classified on the basis of parts grazed by the livestock in the following categories:

i. Whole plant grazed
ii. Leaves / twigs grazed
iii. Flowers and fruits grazed

c. Palatability by animal preferences

The grazing animals differ in their choice of selection of food in the same rangeland. In the present case the plants were classified whether grazed by goats, sheep and cow etc.

d. Palatability by freshness / dryness of forage

Plants were classified whether grazed in fresh condition, dry condition or both.

3.10. Conservation Status of Trees and Shrubs

Information on demographic (age, gender) and conservation status of trees and shrubs were gathered from each site. Information about the availability of plant, collection of plant, growth of plant, plant parts i.e. root, stem etc, local uses of the species

as medicinal, fuel wood, timber and fodder etc were obtained through random sampling by interviewing more than 1000 respondents from different aged and young gender and sex. During survey personal observation was also recorded. The data was collected using IUCN (2001) recent criteria as follow.

Availability of plant	**Collection of plant**
0 = Uncommon or very rare	0 = More than 1000kg/yr
1 = Less common or rare	1 = Consumed from 500-1000kg/yr
2 = Occasional	2 = Consumed from 300-500kg/yr
3 = Abundant	3 = Consumed from 100-200kg/yr
Growth of plant	**Part used of plant**
0 = Regrowth in more 3 years	0 = Root/Whole plant
1 = Regrowth within 3 years	1 = Bark
2 = Regrowth within 2 years	2 = Seeds, Fruits
3 = Regrowth within 1 year	3 = Flowers
4 = Regrowth in a season	4 = Leaves/Gum/Latex

Total Score for plant conservation

0-4	=	Endangered
5-8	=	Vulnerable
9-12	=	Rare
5-16	=	Infrequent
5-16	=	Dominant

1. Availability is the accessibility of plants in an area. It is documented whether the species is rare, less common, occasional or abundant.
2. Collection is the accumulated part of the species that how much part of the plant is collected per year in Kg
3. Growth is the form of plant and it was observed that how much time a species takes to regenerate if it is stock up.
4. Part used i.e. which part of the plant is used by the local people of a species whether they use its root, bark, seeds, flowers or leaves.

Chapter 4

RESULTS AND DISCUSSION

4.1. Floristic Diversity

An extensive significance in ecological work has been given to floristic diversity and its characteristics because it is essential to discriminate species that arrange the vegetation. The floristic diversity is just a catalog of the species and its biological characteristic. The study revealed that there 161 plant species belonging to 136 genera and 57 families in the area. There are 7 families of monocotyledons having 21 genera and 25 species. Dicotyledons had 50 families, 115 genera and 136 species. Overall Poaceae was the dominant family with 17 species. Asteraceae had 13 species followed by Papilionaceae (12 species), Solanaceae (8 species), Amaranthaceae and Brassicaceae (7 species each), Cucurbitaceae and Lamiaceae had 6 species each while Mimosaceae had 5 species. There were 4 species in each of Convolvulaceae, Euphorbiaceae and Malvaceae. Boraginaceae, Capparidiaceae, Chenopodiaceae, Rhamnaceae, Verbenaceae and Zygophyllaceae had 3 species while 2 species were present in Alliaceae, Apiaceae, Asclepiadaceae, Ceasalpiniaceae, Cyperaceae, Moraceae, Myrtaceae, Orobanchaceae, Plantaginaceae, Polygonaceae and Tamaricaceae. The remaining 28 families i.e. Aizoaceae, Aloaceae, Apocynaceae, Arecaceae, Asparagaceae, Asphodelaceae, Cactaceae, Caryophylaceae, Celastraceae, Cuscutaceae, Fumaraceae, Geraniaceae, Hypericaceae, Meliaceae, Menispermacea, Nyctaginaceae, Oxalidaceae, Pedaliaceae, Primulaceae, Punicaceae, Ranunculaceae, Rosaceae, Salvadoraceae, Sapindaceae, Sapotaceae, Scrophulariaceae, Tiliaceae and Vitaceae had single specie (Table 2; Fig. 14).

There are 22 (13.7 %) trees, 23 (14.3 %) shrubs, 104 (64.6 %) herbs, 9 (5.59 %) grasses and 3 (1.86 %) parasite species (Fig. 15). There are 12 wild plants, 8 cultivated and 5 were found both wild as well as cultivated among monocotyledons while in dicotyledons, 99 wild, 29 cultivated and 8 were present both wild as well as cultivated. Of the 161 species, 109 species were annual and 52 were perennial. There were 142 (88.2%) deciduous and 19 (11.8%) evergreen species. Based on light requirements 6 species were sciophytes and 155 species heliophytes. It was clear that the majority of the plants were heliophyte. Sciophytes were limited to the lower layer which was

restricted to the shady and moist places. Based on water relation 6 plant species were hydrophytes and 155 plants species were mesic or xerophytic. Furthermore, 132 plants was found spineless including 11 trees (6.83 %), 16 shrubs (9.93 %), 93 herbs (57.76 %) and 9 grasses (5.59 %) while 29 spinney including 11 trees (6.83 %), 7 shrubs (4.35 %) and 11 herbs (6.86 %) (Table 2; Fig. 16).

Taxonomists are interested to record flora of certain geographical areas. Floristic diversity is a sign of the vegetation wealth of an area. Floristic diversity of an area could be affected by harsh grazing, deforestation, soil erosion, local population, nomads and natural adversity. The investigated area showed a total of 161 species that were distributed among 57 families. Poaceae, Asteraceae, Papilionaceae and Solanaceae were the dominant families in the area. Stewart (1972) reported that these families are well represented in Pakistan. Some other studies like Nasir & Ali (1971-94), Khan (2004), Parveen *et al.* (2008) and Ali & Qaisar (1995-2011) also indicated these families to be the major families in the flora of Pakistan. Our results are in accord with those of Qureshi & Bhatti (2010), Khan *et al*. (2011 a, b) who observed the floristic diversity in Nawab Shah, Sindh, Tehsil Banda Daud Shah, District Karak and Darra Adam Khel, Khyber Pakhtun Khawa. Jafri & Akhani (2008) reported 607 plants belonging to 85 families while Hussain & Parveen (2009) reported 70 plants from Dureji game reserve in which Poaceae and Asteraceae had the maximum species and this agree with the present result. All these studies agree with our finding as same families as represented by us are having utmost number of species in their results.

Eight dominant families of the present work are phylogenetically advanced and all are herb dominating. The prevalence of microclimatic conditions provided suitable habitats for herb-dominating flora. At genus level, *Solanum* and *Zizyphus* showed the maximum diversity with 3 species. Analysis of flora shows that most of the genera (111) are represented by single species and 22 genera are represented by 2 numbers of species. These results indicates that the area bear high taxonomic diversity. According to Pielou (1966) and Magurran (1988) the taxonomic diversity will be higher in an area in which the species are separated amongst many genera.

It is noticed that floristic diversity is related to elevation, rain, temperature and other local environmental features of the area. According to Berg *et al*. (2000) the precipitation and elevation strongly manipulate the floristic distinctions among diverse forests. The study area with at least parity of rain but they had different plant life. The floristic diversity in the area is due to variation in altitude. Adam & Mamat (2005) stated that the topographic changes influence forest composition along topographic incline. It is clear in the study area that diverse topography supported floristic diversity with assortment of plant life. In present study it came into view that topography and feature delineated the floristic diversity and plant life.

It was noticed that soil moisture and water availability in the investigated area is low and these are important factors which manage seed germination and survival of plants life. Water lack had noticeably not only decreased the plants' accessibility but had also affect availability of plant life and floristic diversity in the area. Cayuela *et al*. (2008) stated that water demands decreased floristic diversity. The diversity is changed with fire and land sliding. Land sliding and fire occurrence is very rare in the area but the poor floristic diversity due to low rainfall. According to Morrison *et al*. (2006) that fire occurrence changed about 60 % floristic diversity and plant life. The research area had floristic diversity due to diverse topography and accessibility, which can not protect it from overgrazing and inhabitants pressure. The study area is under harsh grazing pressure through out the year. In these processes, palatable species are selected and these elements make the non-palatable species to increase. Sasaki *et al*. (2005) concluded that the floristic diversity of area is manage under diverse grazing force and changed with the high grazing pressure. Durrani *et al*. (2010) strengthened our view that in the study area no protected zone is present therefore, grazing occurs freely and highly disturbed.

With the passage of time population increases and outcome of natural habitats are declining. The natural wealth is being over-used, distorted and mess up. One factor of natural habitats declining and over-used is the raise in the requirement of amenities in the culture. Madsen & Ilgaard (2008) sated that floristic diversity altered notably with the passage of time. Putten *et al*. (2010) stated that climatic change control plant life associations. Irrigation facilities are very less in the area. Cultivated flora of

the research area has much difference from highly irrigated areas of Khyber Pakhtun Khawa due to irrigation. No fruit orchards have been seen in the area. Qureshi & Bhatti (2010) supported our observation that floristic diversity is affected by anthropogenic activities with connected with irrigation water shortage. Our study area not had basic health, income and living facility i.e. gas, electricity and coal and this is the key reason of interference in local flora.

In the investigated area, three strata i.e. herbaceous layer (72.05 %), shrubby layer (14.29 %) and tree layer (13.66 %) could easily be recognized. The composition of plant life is also obvious by the stratification of flora. The investigation of area confirmed clear stratification of plant life vary from herbs strata and tree strata to more complex arrangement with herb layers, shrub layers and seedling layers and generally tree layer. It is one of the characteristics aspects of the tropical forest. On hills trees like *Monotheca buxifolia, Acacia modesta*; shrubs like *Rhazya stricta* and different grasses like *Cymbopogon jwarancusa* exist while in plains, *Prosopis farcta, Calligonum polygonoides* and *Vitex trifolia* etc are commonly found. Typically xerophytes such as *Tamarix aphylla, Calotropis procera, Zizyphus* spp. and *Acacia nilotica* are found on road sides while *Capparis decidua* and *Aloe vera* are commonly found in Graveyards. Most of the floral elements of the area are found as weeds in cultivated crops. For example, in wheat crops different weeds such as *Silene conoidea, Melilotus indicus, Anagalis arvensis, Echinops echinatus, Asphodelous tenuifolius* and *Coronopus didymus* etc are very common.

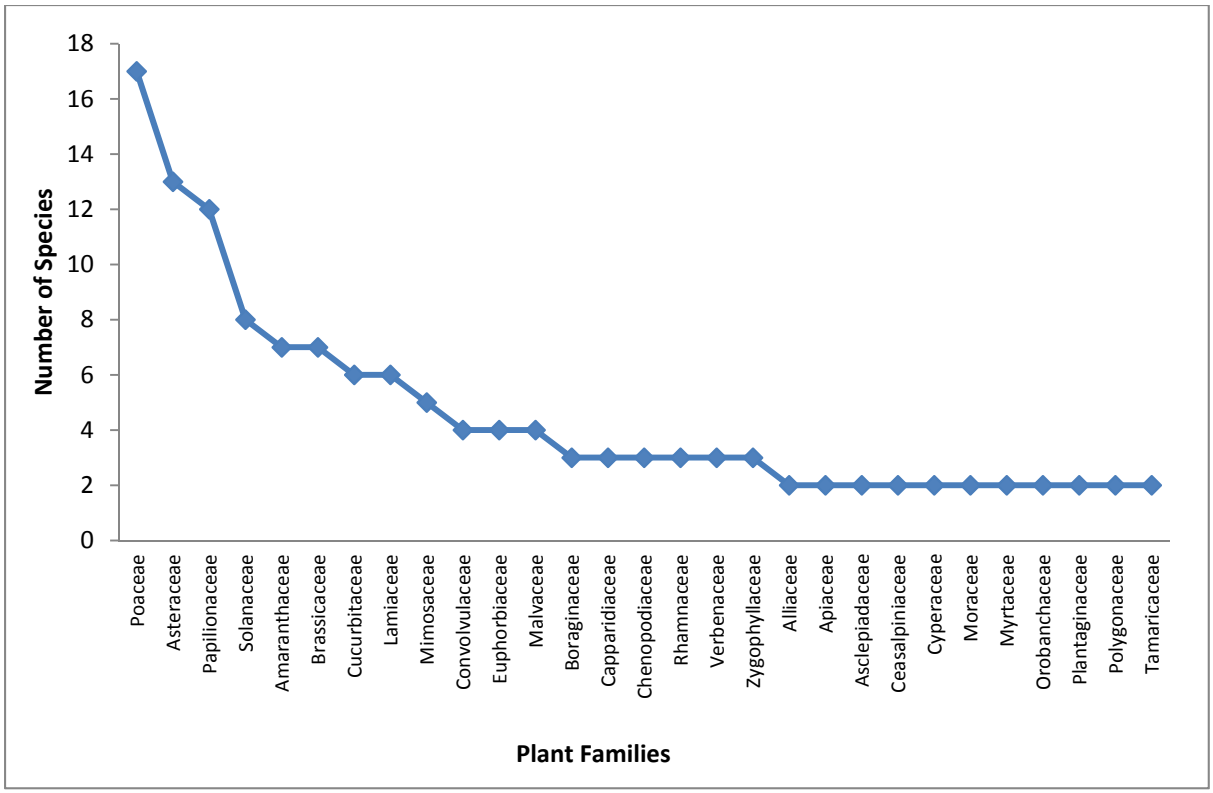


Fig. 14. Plant families sharing Floristic diversity of Tehsil Takht-e-Nasrati, District Karak

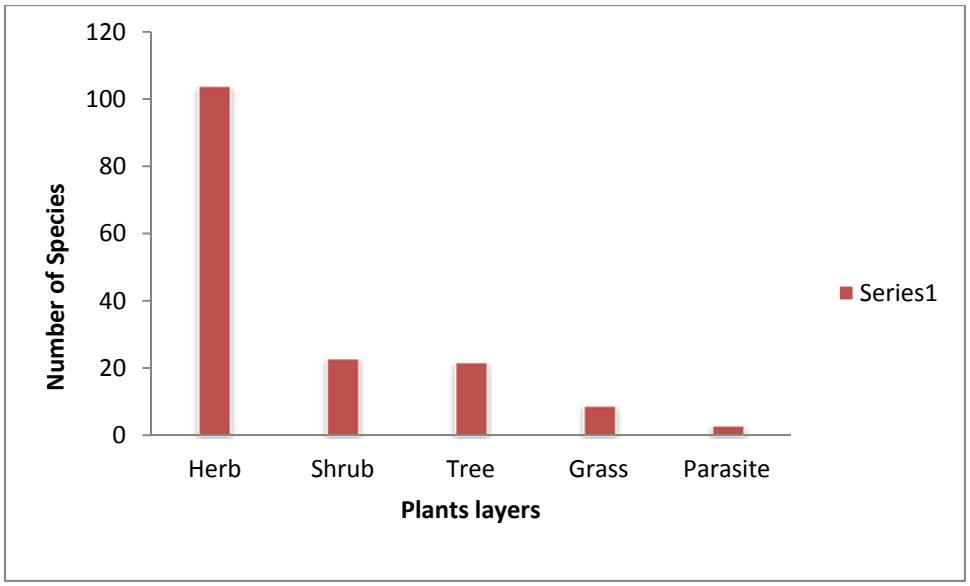


Fig. 15. Stratification of plant layers in Tehsil Takht-e-Nasrati, District Karak.

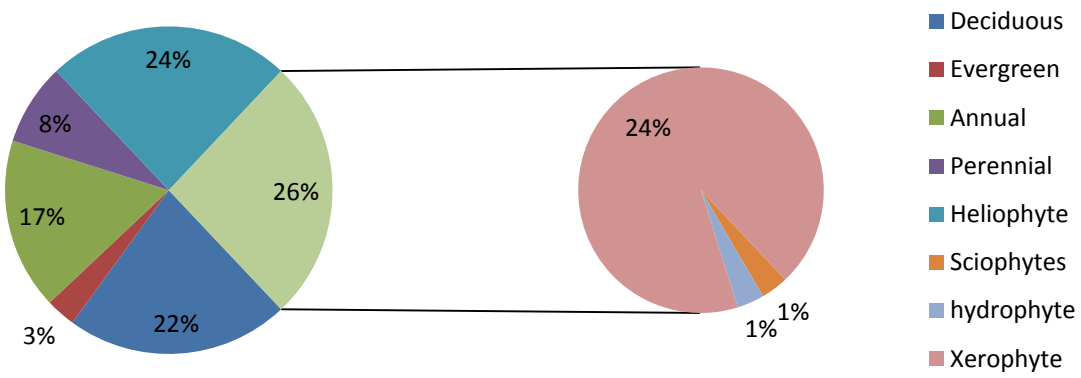


Fig. 16. Ecological charecteristic of Plants of Takht-e-Nasrati, District Karak.

4.2. Phenological Behavior

The phenological data was recorded in the field. In the investigated area, there were three flowering seasons i.e. spring from March to April followed by summer (Jun to September) and winter (November to December). As a result 94 plants were found in flowering condition in spring which included 19 (11.8%) tree, 11 (6.83%) shrubs, 61 (37.9%) herbs and 3 (1.86%) parasites. In summer, 28 plants including single (0.62%) tree, 3 (1.86%) shrubs, 21 (13%) herbs and 3 (1.86%) grasses. In winter, 27 plants including 2 (1.24%) trees, 5 (3.11%) shrubs, 17 (10.6%) herbs and 3 (1.86%) grasses while 12 plants had through out the year included 4 (2.48%) shrubs, 5 (3.11%) herbs and 3 (1.86%) grasses (Table 2; Fig. 17).

A large number of herbs flowered during the dry season. Differences in flowering pattern among different genera and species in different seasons indicates the significance of animal-plant interactions. It was observed that spring is the main blooming seasons. Summer and autumn aspects were poor in flowering. Altitudinal gradient split these seasons in plain and hilly areas. Most of the species bloomed in spring where 94 bloomed compared to summer and autumn. In plain area the plant bloomed in spring at the beginning of March and completed at mid of April. In hilly area the vegetation bloomed at beginning of April and final to end of April. The phonological performance was early in the plain area while late in the hilly area. Usually, the spring was almost less vigorous and dormant than summer and winter in the form of vegetation condition.

Phenology is prospectively an influential tool for monitoring the reactions of plants to climatic revolutionize. According to the Menzel (2003) phenological study is a helpful source of information for examining the link between climate and weather difference and plant and animal growth. Sparks *et al*. (2000) stated that the timing of phenological stages, such as flowers and leaf formation at the start of rising season are extremely dependent on temperature while Spano *et al*. (1999) declared that flowering is the most important phenological stages to assess the sensitivity of plants to climatic variation. Chmielewski & Rotzer (2001) declared that spring flowers are strongly influenced by air temperature of the preceding month and higher temperature in spring points out an earlier set up of plant maturity within the year. The use of standardized assessment techniques in Phenology would assist observer to precisely observe plants and

develop the feature of observation.

During research work it was noticed that many plants began to flowers later in the area than in open fields. The reason for later blooming is probably due the climatic conditions including weather, edaphic factors. Spring temperature had been noted in the research area. The earlier flowering in spring indicates the rising temperature. This has not only reduced the winter span but also had lost the moisture from soil and as a consequent diversity declined as happened in 2009-2010. In the sessions the region received little winter rain. According to Visser & Both (2005) phenological activities of many plants were untimely due to climatic alteration. Plant phenology may be the most perceptive and noticeable sign of plant reaction to climate variation in spring due to internal annual change. The phenology of semi arid zone is generally determined by temperature. Therefore, diversity in phenological feedback may different in investigated area. The functioning of trees is closely adapted to their local climate. It was noticed that the tree species are able to subsist harsh conditions and utilize accessible resources in the area. Furthermore, if a plant reacts differently to an environmental change, in that case and in term of long competition will change the competitive association among species, the species diversity of area and probably the geological diversity of plant species.

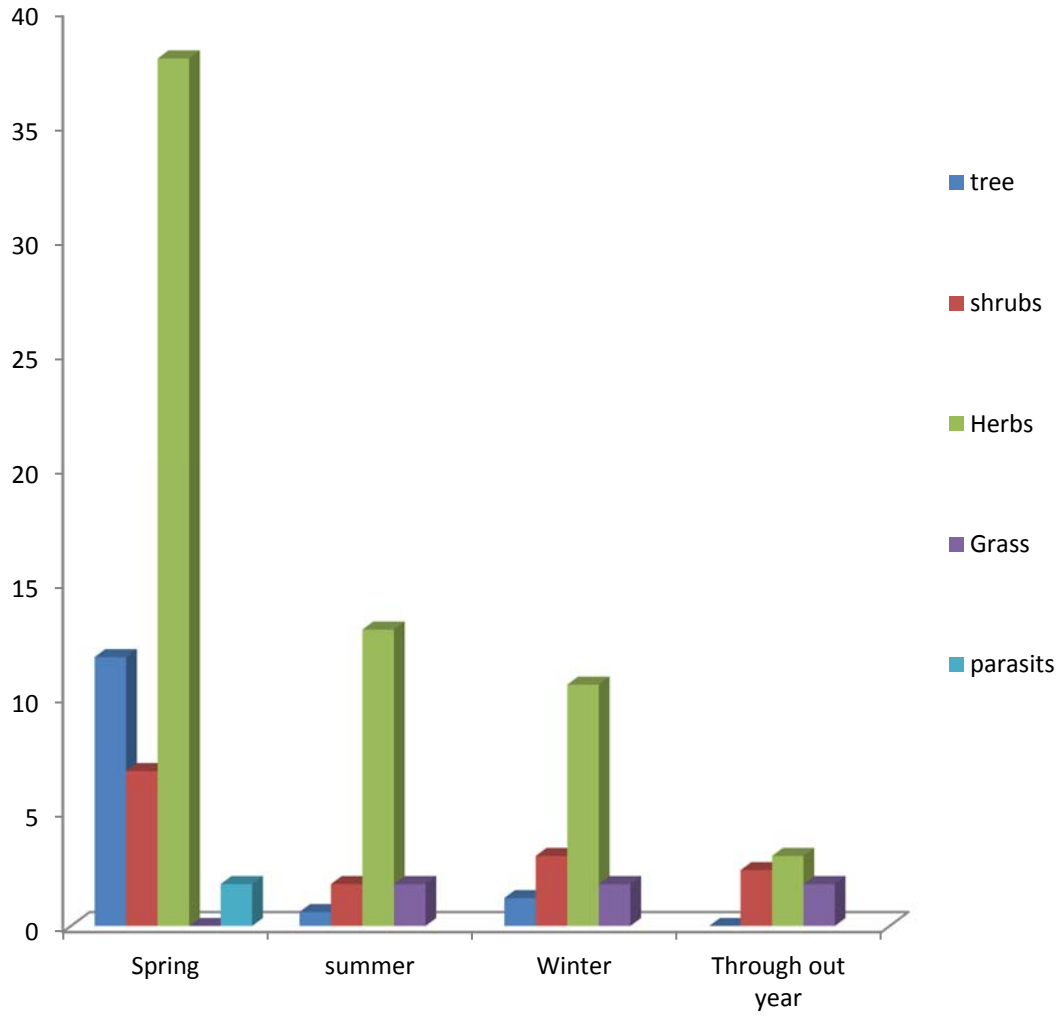


Fig. 17. Phenological stages of plants at different seasons in Takht-e-Nasrati, District Karak

4.3. Biological Characteristics

The life form spectra are supposed to be the signal of micro and macroclimate (Shimwell, 1971). Leaf size classes have been set up to be very positive for plant links. The leaf size knowledge may help out in the accepting of physiological processes of plants and plant communities (Oosting, 1956). Life form and leaf size spectra indicates climatic and creature fracas of a particular area (Cain & Castro, 1959). The life form and leaf size spectra are significant physiognomic features of vegetation. Disturbances such as deforestation can have a vast outcome on life forms, phenology and distribution of plant populations. Disturbances caused by man and animals such as fire, scraping and profound grazing frequently reappear within the life period of a plant life and may comprise significant constituent of its life cycle (Agrawal, 1989).

a. Life Form spectrum

The present study indicated that biological spectrum dominated by therophytes (77 spp., 47.83%) followed by hemicryptophytes (30 spp., 18.63%), megaphanerophytes (17 spp., 10.6%), nanophanerophytes (16 spp., 9.94%), chamaephytes (11 spp., 6.83%), microphanerophytes (4 spp, 2.48 %), parasite (3 spp, 1.86%) and geophytes (03 spp., 1.86%) (Table 2; Fig. 18). The biological spectrum of the flora of Tehsil Takht-e-Nasrati revealed that it is mainly shaped as therophytic vegetation and dry subtropical deciduous scrub forest type with an open canopy of *Acacia modesta, Zizyphus maurtiana and Prosopis farcta* trees. The study area is semi arid and had diverse vegetation of herbs, shrubs and trees. The result showed that the study area is affluent in phytodiversity by means of therophanerophytic phytoclimate.

Comparisons of the life form classes of the investigated area with Raunkiaer normal biological spectrum, the therophytes and hemicryptophytes are more but phanerophytes, chamaephytes and cryptophytes were less than Raunkiaer normal biological spectrum (Fig. 19). The high amount of therophytes and smallest amount of phanerophytes than normal biological life form give the impression to be a response with to the warm dried up weather, topographic difference, human being and consumer disturbance. Asri (2003) stated that therophytes are adapted to the dryness of the area and deficiency of rain because such plants spend more vegetative period in the nature of seed. According to the Manhas *et al*. (2009) that the dominating of therophytic life form in

marshland, symbolizing high anthropogenic interruption in the area and limited space for vegetation. Gue *et al*. (2009) reported that phanerophytes were dominant in *Thuja sutchuenensis* community. Hemicryptophytes modified to habitat conditions by means of different manners such as reserving water, beneath soil water, lose their leaves to reduce their water need and decline of vegetative development. Nadaf & Mortazvi (2011) reported that hemicryptophytes (39.74 %) were the dominant life form class in protected region Sarigol, Iran.

Basically life forms of the plants give the possibility of adjustment of plants to ecological situation particularly climatic situation. Moradi *et al.* (2010) also reported the dominance of therophytes and hemicryptophytes than normal biological spectrum in Posthband region, Khonj, Fars Provivce, Iran. They declared that phanerophytes less than normal spectrum and therophytes more than normal spectrum that is representing the area is arid climate. The predominance of therophytes reproduced and valuable approach for keeping away from water losses due to water shortage and humidity intense. The impact of therophytes increases through decreases of precipitation and vice versa. Variation in phanerophytses and therophytes in the investigated area is too much with Raunkiaer normal biological spectrum and this may be an outcome of aridness of the area. Many plant species were decreasing in the area like *Monotheca buxifolia* and *Salvadora oleoides* and special care is needed for their plant life.

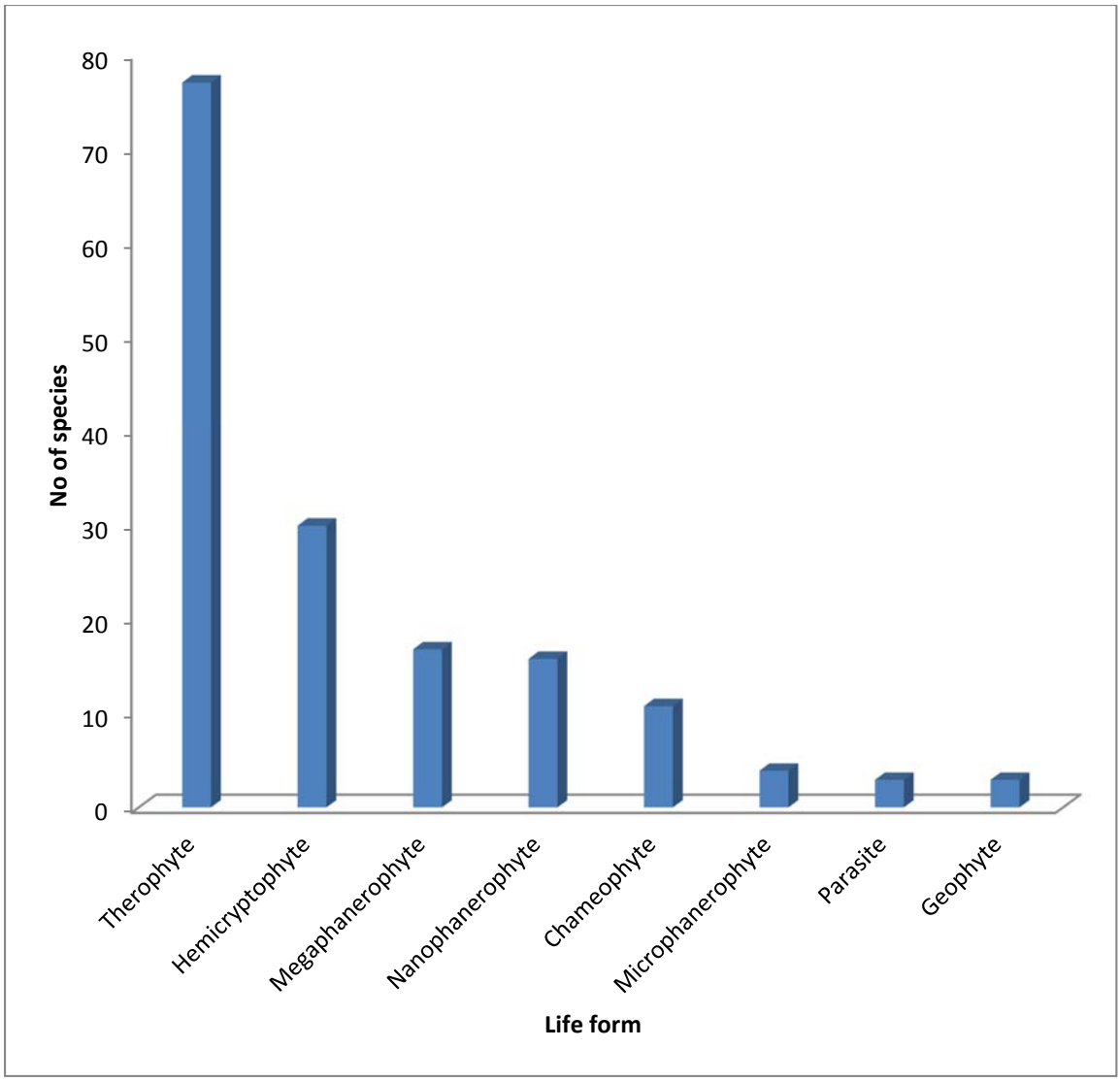


Fig. 18. Biological spectrum of plants of Tehsil Takht-e-Nasrati, District Karak.

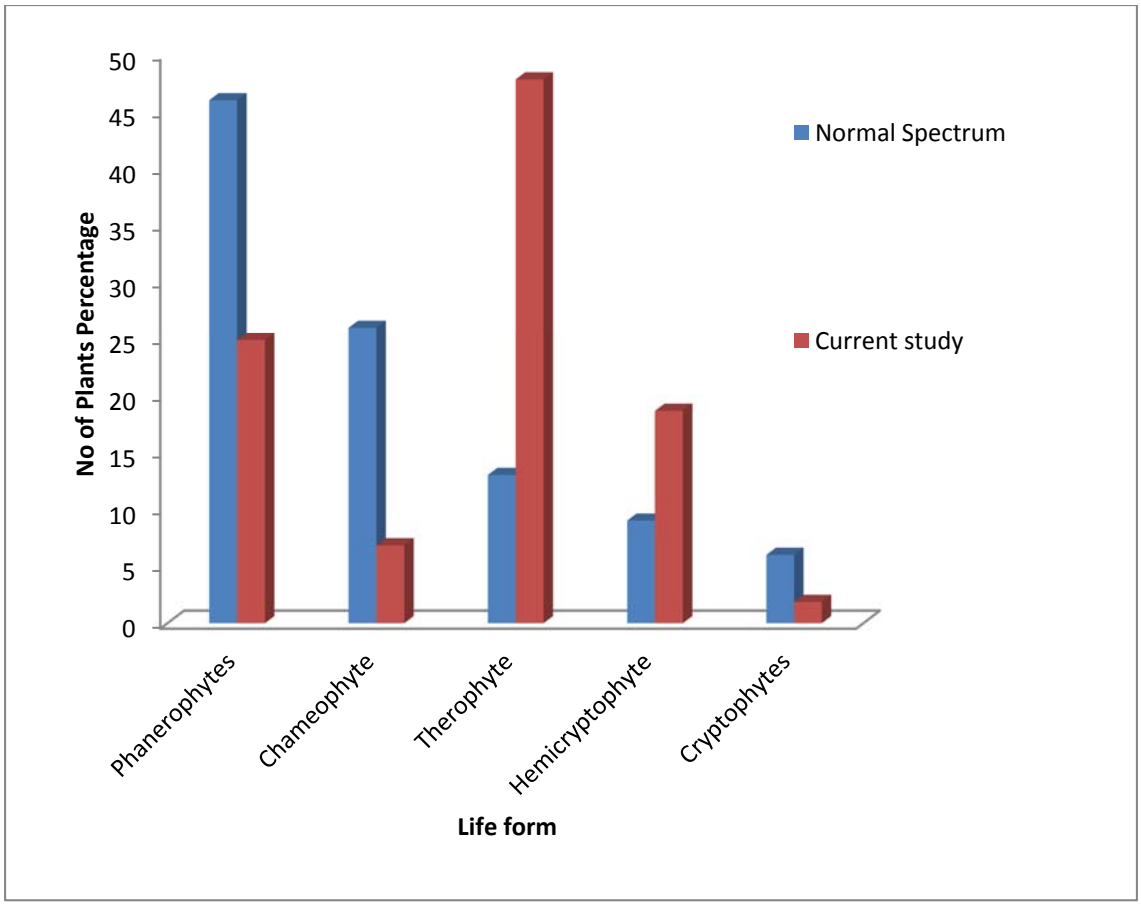


Fig. 19. Comparison of investigated area with Normal Biological Spectrum.

b. Leaf size spectrum

The present study indicated that leaf size spectrum dominated by microphylls (85 spp. 52.8%) followed by nanophylls (32 spp. 19.9%), mesophylls (17 spp. 10.6 %), leptophylls (15 spp. 9.32%) and megaphylls (12 spp. 7.45%) (Table 2; Fig. 20).

The plant life is deciduous. Wergerand & Ellenbroek (2004) discussed that leaf size classes and leaf constancy type of the woody species revealed a diversification of leaf sizes as the climate changed from temperate to hot and arid and particularly microphylls became relatively less important and were replaced by smaller leaves in the hot area.. Guo *et al.* (2009) studied that dominated leaf size in *Thuja sutchuenensis* community was microphy (60.8 %) and Khan *et al*. (2011b) also illustrate leaf spectra of plants dominated by microphylls in Darra Adam Khel, Khyber Pakhtunkhwa. Their results are similar to us. Al-Yemni & Sher (2010) illustrated that microphyll dominated in Asir Mountain of South West, Saudi Arabia followed by nanophyll, leptophyll and mesophyll. The leaf size spectra showed that the study area was dominated with micro-nanophyllous species. Sher & Khan (2007) also explained that microphylls (54.70%) was dominant in Chagharzai Valley, District Buner.

The dominance of therophytes occurs due to un-favorable environment conditions as definite by a lot of researchers (Malik *et al*., 2007; Khan, *et al*., 2011b). Qadir & Shetvy (1986) considered chamaephytes and therophytes is the major life form in unfavorable environment in desert region. In the investigated area arid conditions, low temperature in winter, high temperature in summer, wind and biotic factors result in un-favourable conditions paving way for therophyte. Saxina, *et al*. (1987) stated that hemicryptophytes dominated temperate zone in overlapping and loose continuum. Therophytes endure in unfavorable condition during seeds production. The predominance of therophytes in variable conditions such as dry, hot or cold met for low to higher elevation might be the reason for their higher percentage in the investigated area.

In the current study, the high percentage of therophyte is evidenced in the study region for the reason that the region is semi arid zone of Khyber Pakhtun Khawa. The dominance of therophytes indicates that the investigated area is under heavy biotic pressure due to deforestation and over grazing. Most of the plants were uprooted for burning purposes and grazed by the livestock.

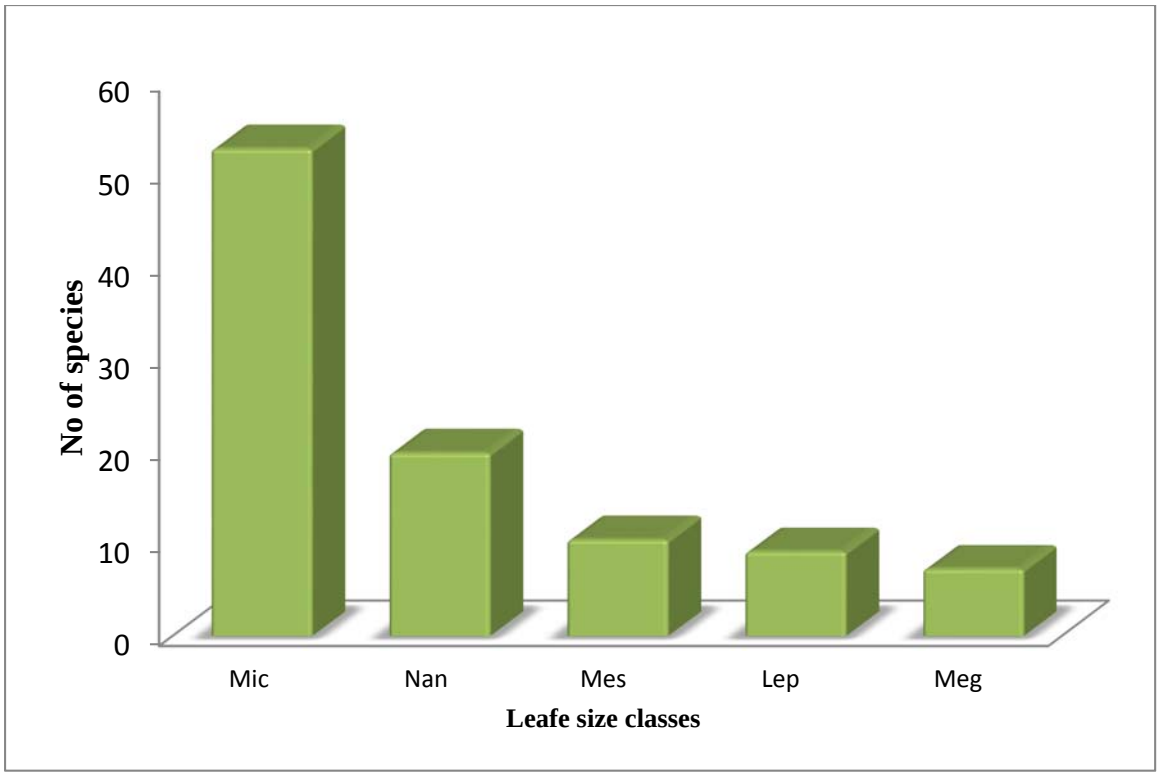


Fig. 20. Leaf form spectrum of Flora of Tehsil Takht-e-Nasrati, District Karak.

Table 2. Floristic Diversity of plants with respect to its Phenology, Leaf persistence and Habitat of Tehsil Takht-e-Nasrati, District Karak.

Family	Species	Life Form	Leaf Size	Habit	Cultivation		Phenology			Spine presence		Leaf Persistence		Life Span		Light Demand		Habitat	
					Cul	Wil	Sp	Su	win	Np	Spn	D	E	A	P	L	Sh	Sc	He
Monocottyledons																			
Alliaceae	*Allium cepa* L.	Geo	Mi	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Allium sativum L.	Geo	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
Aloaceae	*Aloe barbadensis* Mill.	Nan	Mg	H	+	+	-	+	-	+	-	-	+	-	+	+	-	-	+
Apiaceae	*Coriandrum sativum* L.	Th	Na	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
Arecaceae	*Phoenix dactylifera* L.	Meg	Mi	T	+	+	+	-	-	+	+		+	-	+	+	-	-	+
Asphodelaceae	*Asphodelous tenuifolius* Cavan.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Cyperaceae	*Cyperus rotundus* L.	Hem	Le	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
	Cyperus scarlosus R.Br.	Hem	Le	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
Poaceae	*Avena sativa* L.	Th	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Cenchrus biflorus Hook. f.,	Th	Na	G	-	+	-	+	-	-	+	+	-	+	-	+	-	-	+
	Cenchrus ciliaris L.	Th	Na	G	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
	Cymbopogon jwarancusa (Jones) Schult.	Hem	Na	G	-	+	-	+	-	+	-	+	-		+	+	-	-	+
	Cynodon dactylon (L) Pers.	Hem	Le	G	-	+	+	+	+	+	-	+	-		+	+	-	-	+
	Desmostachya bipinnata	He	Mi	G	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+

	(L) Stapf.	m																	
	Dichanthium annulatum (Forssk) Staph.	Hem	Mi	G	-	+	+	+	-	+	-	+	-	+	-	+	-	-	+
	Echinochloa colonum (L) Link.	Th	Mi	G	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
	Eragrostis poaoides Beauv.	Th	Mi	G	-	+	+	+	+	+	-	+	-	-	+	+	-	-	+
	Hordeum vulgare L.	Th	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Pennisetum typhoideum (Burm) Stapf.	Th	Mi	H	+	-	-	+	-	+	-	+	-	+		+	-	-	+
	Phragmites karka (Retz) Trin. Ex. Steud.	Hem	Mi	H	+	+	-	-	+	+	-	+	-	-	+	+	-	+	-
	Saccharum bengalense Retz	Hem	Mg	S	+	+	-	-	+	+	-	+	-	-	+	+	-	-	+
	Saccharum spontaneum L.	Hem	Mg	S	+	+	-	-	+	+	-	+	-	-	+	+	-	-	+
	Sorghum vulgare (L.) Pers.	Hem	Mi	G	-	+	-	+	-	+	-	+	-	-	+	+	-	-	+
	Triticum aestivum L.	Th	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Zea mays L.	Th	Mg	H	+	-	-	+	-	+	-	+	-	+		+	-	-	+
Dicotyledons																			
Aizoaceae	*Trianthema portulacastrum* L.	Nan	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Amaranthaceae	*Aerua persica* (Burm.f.) Merrill.	Nan	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Achyranthus aspera L.	Hem	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Alternanthra pungens Kunth.	Th	Mi	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
	Amaranthus viridis L.	Hem	Mi	H	-	+	+	+	-	+	-	+	-	+	-	+	-	-	+
	Celosia argentea L.	Th	Na	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
	Digera muricata (L). Mart.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+

	Pupalia lappacea (L.) Juss.	Th	Mi	H	-	+	-	-	+	+	-	+		+	-	+	-	-	+
Apiaceae	*Daucus carrota* L.	Th	Le	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
Apocynaceae	*Rhazya stricta* Decne.	Nan	Mi	S	-	+	+	-	-	+	-	+	-		+	+	-	-	+
Asclepiadaceae	*Periploca aphylla* Decne.	Nan	Mi	S	-	+	+	-	-	+	-	-	+	-	+	+	-	-	+
	Calotropis procera (Wild) R.Br.	Ch	Mgs	S	-	+	+	+	+	+	-	+	-	-	+	+	-	-	+
Asparagaceae	*Asparagus gracilis* Royle.	Th	Le	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Asteraceae	*Calendula arvenis* L.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Carthamus oxycantha Bieb	Th	Mi	H	-	+	+	-	-	S	+	+	-	+	-	+	-	-	+
	Centaurea iberica Trev.Ex. Spreng	Th	Na	H	-	+	+	-	-	S	+	+	-	+	-	+	-	-	+
	Echinops echinatus D.C	Ch	Mi	H	-	+	+	-	-	S	+	+	-	+	-	+	-	-	+
	Helianthus annus L.	Th	Mg	H	+	-	-	-	+	+	-	+	-	+	-	+	-	-	+
	Ifloga fontanesii Cass.	Th	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Lactuca sativa L.	Th	Na	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Lactuca serriola L.	Th	Na	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Launaea nudicaulis (L.) Hook. f.	Hem	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Saussurea heteromalla (D.Don) Hand.	Th	Mi	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
	Sonchus asper (L) Hill.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+		+	-	-	+
	Taraxacum officinale Weber.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Xanthium strumarium L.	Th	Mg	H	-	+	-	+	-	-	+	+	-	+		+	-	-	+
	Lithospermum arvense L.	Th	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Heliotropium europaeum L.	Th	Na	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+

Boraginaceae	*Heliotropium strigosum* Willd.	Th	Mi	H	-	+	-	-	+	-	+	+	-	+	-	+	-	-	+
Brassicaceae	*Brassica rapa* L.	Th	Mgs	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Coronopus didymus (L) Smith.	Th	Le	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Descurainia Sophia (L.) Webb.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Eruca sativa Millel.	Th	Mgs	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Malcolmia africana (L) R.Br.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Raphanus sativus L.	Th	Mgs	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Sissymbrium irrio L.	Th	Na	H	-	+	+	-	-	+	-	+	-	+		+	-	-	+
Cactaceae	*Opuntia ficus indica* (L.) Mill	Nan	Le	S	-	+	+	-	-	+	+	-	+		+	+	-	-	+
Capparidiaceae	*Cleome viscosa* L.	Th	Mi	H	-	+	-	+	-	+	-	+	-	+		+	-	-	+
	Capparis spinosa L.	Ch	Mi	S	-	+	-	-	+	-	+	-	+	-	+	-	+	-	+
	Capparis decidua (Forssk). EdgeWorth.	Mic	Na	T	-	+	-	+	-	+	+	-	+	-	+	+	-	-	+
Caryophyllaceae	*Silene conoidea* L.	Th	Na	H	-	+	+	-	-	+	-	+		+		+	-	-	+
Ceasalpiniaceae	*Parkinsonia aculeata* L.	Th	Na	T	-	+	+	-	-	+	+	-	+	-	+	+	-	-	+
	Cassia angustifolia Vahl.	Ch	Mi	H	-	+	+	-	-	-	+	+	-	+	-	+	-	-	+
Celastraceae	*Gymnosporia royleana* Wall.	Nan	Mi	T	-	+	+	-	-	+	+	+	-		+	+	-	-	+
Chenopodiaceae	*Spinacia oleraceae* L.	Th	Mi	H	+	-	+	-	-	+	-	+	-	+		+	-	-	+
	Chenopodium album L.	Th	Mi	H	-	+	+	+	+	+	-	+	-	+	-	+	-	-	+
	Chenopodium murale L.	Th	Mgs	H	-	+	+	+	+	+	-	+	-	+	-	+	-	-	+
	Evolvulus alsinoides L.	Th	Na	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+

Convolvulaceae	*Convolvulus arvensis* L.	Hem	Mgs	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Convolvulus pluricaulis Choisy	Hem	Mi	H	-	+	+	-	-	+	-	+	-	+	-		+	-	+
	Ipomoea hederacea (L.) Jack.	Th	Mi	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
Cucurbitaceae	*Cucurbita maxima* Duchesne.	Th	Mg	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Cucurbita pepo L.	Th	Mg	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Luffa acutangula Roxb.	Th	Mgs	H	+	-	-	-	+	+	-	+	-	+	-	+	-	-	+
	Luffa aegyptiaca (L) M.J.Rocm.	Th	Mgs	H	+	-	-	-	+	+	-	+	-	+	-	+	-	-	+
	Momordica charantia L.	Th	Mgs	H	+	-	-	-	+	+	-	+	-	+	-	+	-	-	+
	Citrullus colocynthis L. Schrad.	Hem	Mgs	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
Cuscutaceae	*Cuscuta reflexa* Roxb.	Pa	Na	P	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Euphorbiaceae	*Chrozophora obliqua* (Vahl) A. Juss.	Ch	Mgs	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
	Euphorbia helioscopia L.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Euphorbia prostrata Ait.	Th	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Ricinus communis L.	Nan	Mg	S	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Fumaraceae	*Fumaria indica (Haussk.)* Pugsley.	Th	Le	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Geraniaceae	*Erodium malacoides* Willd	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Hypericaceae	*Hypericum pendulum* L.	Th	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Ajuga bracteosa Wall.ex Benth.	Ch	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Mentha arvensis L.	Hem	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	+	
	Micromeria biflora (Buchi .Ham exD. DonBenth).	Hem	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+

Lamiaceae	*Ocimum basilicum* L.	Hem	Mi	S	+	-	-	-	+	+	-	+	-	+		+	-	-	+
	Otostegia limbata (Benth.) Boiss.	Nan	Mi	S	-	+	+	-	-	-	+	+	-		+	+		-	+
	Salvia moorcroftiana Wallich ex Benth.	Th	Mg	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Malvaceae	*Malva neglecta* Wallr.	Hem	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Malva parviflora L.	Hem	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Malvastrum coromandelianum (L.) Gareke.	Hem	Mi	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
	Abelmoschus esculentus (L.) Moench.	Th	Mi	H	+	-	+	-	-	-	+	+	-	+	-	+	-	-	+
Meliaceae	*Melia azedarach* L.	Meg	Mi	T	+	-	+	-	-	+	-	-	+		+	+	-	-	+
Menispermacea	*Cocculus pendulus* (Forst) Diels	Ch	Na	S	-	+	-	-	+	+	-	+	-	-	+	+	-	-	+
Mimosaceae	*Albizia lebbeck* (L.) Benth.	Meg	Le	T	+	-	+	-	-	+	-	+	-	-	+	+	-	-	+
	Acacia nilotica (L) Delice. ssp. nilotica.	Meg	Le	T	+	+	+	-	-	-	+	+	-	-	+	+	-	-	+
	Acacia modesta Wall.	Meg	Le	T	+	+	+	-	-	-	+	-	+		+	+	-	-	+
	Prosopis farcta (Banks & Sol.) J.F. Macbr.	Meg	Mi	T	-	+	+	-	-	-	+	-	+		+	+	-	-	+
	Prosopis juliflora (SW.) DC.	Meg	Mi	T	-	+	+	-	-	-	+	-	+		+	+	-	-	+
Moraceae	*Morus alba* L.	Meg	Mgs	T	+	-	+	-	-	+	-	+		-	+	+	-	-	+
	Morus nigra L.	Me	Mgs	T	+	-	+	-	-	+	-	+	-	-	+	+	-	-	+

		g																	
Myrtaceae	*Eucalyptus globules* L.	Meg	Mi	T	+	+	+	-	-	+	-	+	-	-	+	+	-	-	+
	Eucalyptus lanceolatus L	Meg	Mi	T	+	+	+	-	-	+	-	-	+	-	+	+	-	-	+
Nyctaginaceae	*Boerhaavia diffusa* L..	Ch	Mi	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
Orobanchaceae	*Cistanche tubulosa* (Schenk) Wight.	Pa	Na	P	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Orobanche ramose L.	Pa	Na	P	-	+	+	-	-	+	-	+	-	+			+	-	+
Oxalidaceae	*Oxalis corniculata* L.	Geo	Mi	H	-	+	+	-	-	+	-	+	-	+	-		+	-	+
Papilionaceae	*Alhagi maurorum* Medic.	Th	Na	S	-	+	+	-	-	-	+	-	+	-	+	+	-	+	-
	Arachis hypogaea L.	Th	Mi	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Astragalus psilocentros Fisch.	Th	Le	S	-	+	-	+	-	-	+	+	-		+	+	-	-	+
	Cicer arietinum L.	Th	Na	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Crotalaria medicaginea Lam.	Th	Na	H	-	+	-	-	+	+	-	+	-	+	-	+	-	-	+
	Dalbergia sissoo Roxb.	Meg	Mi	T	-	+	+	-	-	+	-	+	-		+	+	-	-	+
	Indigofera linifolia (L.f.) Rets.	Th	Na	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
	Lens culinaris Medic.	Th	Mi	H	+	-	-	+	-	+	-	+	-	+	-	+	-	-	+
	Medicago laciniata (L.) Mill.	Th	Le	H	-	+	+	-	-	-	+	+	-	+		+	-	-	+
	Melilotus indicus (L.) All.	Th	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Trifolium alexandrianum L.	Th	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Vicia sativa L.	Th	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Pedaliaceae	*Sesamum indicum* L.	Th	Mi	H	+	-	-	-	+	+	-	+	-	+	-	+	-	-	+

Plantaginaceae	*Plantago ciliata* Desf.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+		+	-	-	+
	Plantago ovata Forssk.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+		+	-	-	+
Polygonaceae	*Rumex dentatus* L	Hem	Mgs	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
	Calligonum polygonoides L.	Mic	Na	S	-	+	+	-	-	+	-	+	-	-	+	+	-	-	+
Primulaceae	*Anagalis arvensis* L.	Th	Mi	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Punicaceae	*Punica granatum* L.	Meg	Mi	T	-	+	+	-	-	+	-	-	+		+	+	-	-	+
Ranunculaceae	*Ranunculus muricatus* L.	Th	Le	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
Rhamnaceae	*Zizyphus nummularia* (Burm.f) W.&A.	Nan	Mi	S	+	+	+	-	-	-	+	+	-	-	+	+	-	-	+
	Zizyphus oxyphylla EdgeW	Meg	Mi	T	+	-	+	-	-	-	+	+	-	-	+	+	-	-	+
	Zizyphus maurtiana Lam	Meg	Mi	T	-	+	+	-	-	-	+	+	-	-	+	+	-	-	+
Rosaceae	*Rosa indica* L.	Nan	Mi	S	+	-	+	+	+	-	+	-	+	-	+	+	-	-	+
Salvadoraceae	*Salvadora oleoides* Decne.	Meg	Mi	T	-	+	+	-	-	+	-	-	+	-	+	+	-	-	+
Sapindaceae	*Dodonaea viscosa* L.	Nan	Mi	S	-	+	+	-	-	+	-	-	+	-	+	+	-	-	+
Sapotaceae	*Monotheca buxifolia* (falk) A.DC.	Meg	Mi	T	-	+	+	-	-	-	+	-	+	-	+	+	-	-	+
Scrophulariaceae	*Kickxia ramosissima* (Wall) Jan.	Hem	Mi	H	-	+	+	-	-	+	-	+	-		+		+	+	
Solanaceae	*Capsicum annum* L.	Ch	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Datura metel L.	Nan	Mg	S	-	+	+	+	+	+	-	+	-	+	-	+	-	-	+
	Lycopersicom esculentum Mill.	Th	Mi	H	+	-	+	-	-	+	-	+	-	+	-	+	-	-	+
	Solanum nigrum L.	Hem	Mi	H	-	+	+	+	+	+	-	+	-	+	-	+	-	-	+

	Solanum incanum L.	Hem	Mgs	H	-	+	+	-	-	-	+	+	-	+	-	+	-	-	+
	Solanum surattense Burm.f	Hem	Mgs	H	-	+	+	+	+	-	+	+	-	-	+	+	-	-	+
	Withania coagulans (Stocks) Dunal	Ch	Mi	S	-	+	+	-	-	+	-	-	+	-	+	+	-	-	+
	Withania somnifera (L) Dunal.	Ch	Mgs	S	-	+	+	+	+	+	-	+	-	-	+	-	+	-	+
Tamaricaceae	*Tamarix decidva* Roxb.	Mic	Na	T	-	+	-	-	+	+	-	+	-	-	+	+	-	-	+
	Tamarix aphylla (L.) Karst.	Mic	Na	T	-	+	-	-	+	+	-	+	-	-	+	+	-	-	+
Tiliaceae	*Corchorus trilocularis* L.	Th	Mi	H	-	+	-	+	-	+	-	+	-	+	-	+	-	-	+
Verbenaceae	*Lippia nodiflora* (L.) L.C. Rich.ex. Michaux.	Hem	Na	H	-	+	+	-	-	+	-	+	-	+	-	+	-	-	+
	Vitex negundo L.	Nan	Mi	S	+	+	-	+	-	+	-	+	-	-	+	+	-	+	-
	Vitex trifolia L.	Nan	Mi	S	+	+	-	+	-	+	-	+	-	-	+	+	-	+	-
Vitaceae	*Vites vinifera* L.	Nan	Mg	S	+	+	+	-	-	+	-	+	-	-	+	+	-	-	+
Zygophyllaceae	*Fagonia cretica* L.	Th	Le	H	-	+	+	-	-	-	+	+	-	+	-	+	-	-	+
	Peganum harmala L	Hem	Mi	H	-	+	-	-	+	+	-	+	-	-	+	+	-	-	+
	Tribulus terrestris L.	Hem	Mi	H	-	+	-	+	-	+	-	+	-		+	+	-	-	+

Key Words: Cul = Cultivated, Wil = Wild, sp = Spring, su= Summer, win = Winter, Np = Non spiny, Spn = Spiny, D = Decidous, E = Evergreen,

A = Annul, P = perennial, L = Light, Sh = shad, Sc = Sciophytes, He = Heliophytes, T = Tree, S = Shrub, H = Herbs, G = Grass

Th = Therophytes, Cr = Cryptophytes, He = Hemicryptophytes, Ch = Chameophytes,

Mi = Microphanerophytes, Me = Mesophanerophytes, Migaphanerophytes.

Mi = Microphyll, Na Nanophyll, Mg = Megaphyll, Mes = Mesophyll and Le = Leptophyll

4.4. Ethnobotanical profile

The investigated area possesses a very rich ethnobotanical heritage in the far plunge area. Even today, the inhabitants are using various plant species for various purposes. In the investigated area, the locals used 161 plants belonging to 136 genera and 57 families. The ethnobotanical important plants included 22 trees, 23 shrubs, 104 herbs, 9 grasses and 3 parasite species. The result showed that the locals used 118 (73.3%) species as folk medicinal plants, 114 (70.8 %) fodder species, 47 (26.7 %) fuel species, 16 (9.94 %) timber woods, 23 (14.3 %) vegetable species, 50 (31.06 %) veterinary use plants and 90 (55.9 %) honey bee species. The fruit plants included 33 (20.5 %) species, 17 (10.6 %) species were used for making agricultural tools, 19 (11.8 %) species were used for fencing field borders and 18 (11.18%) were used for making furniture. Poaceae and Asteraceae were the most important families in the area (Table 3; Fig. 21).

It was documented that the locals used plants for simple or multiple purposes. Most of the plants had multiple uses. These multiple purposes plants included *Acacia modesta* and *Zizyphus maurtiana* (10 local uses), *Acacia nilotica, Albizia lebbeck, Dalbergia sissoo, Morus alba, Morus nigra, Prosopis farcta* and *Salvadora oleoides* (9 local uses), *Capparis decidua, Phoenix dactylifera, Tamarix aphylla, Tamarix decidva* and *Zizyphus nummularia* (8 local uses), *Calligonum polygonoides, Gymnosporia royleana* and *Monotheca buxifolia* (7 local uses), *Brassica rapa, Cicer arietinum* and *Eucalyptus lanceolatus* (6 local uses). There were 5 reported local uses for *Arachis hypogaea, Capparis spinosa, Chenopodium album, Chenopodium murale, Convolvulus arvensis, Coriandrum sativum, Cucurbita maxima, Cucurbita pepo, Eruca sativa, Eucalyptus globules, Melia azedarach, Mentha arvensis, Parkinsonia aculeate, Prosopis juliflora, Punica granatum, Saccharum bengalense, Tribulus terrestris, Vitex trifolia, Withania coagulans* and *Zizyphus oxyphylla.* Our result agrees with Durrani *et al.* (2009) who reported 72 multi-purpose species in Chilton National Park. Sher *et al.* (2011) recorded 124 important plant species from Chagharzai Valley, District Buner, Pakistan. Our result is also similar with that of Khan (2007) who reported the important medicinal plant of Tehsil Karak, NWFP, Pakistan.

1. Plant used as a folk medicinal

For curing various diseases the locals partially depend on the medicinal plants. Each plant has some medicinal value. In the present study 118 medicinally important plants were reported which make 73.3 % of the local plant life. These folk medicinal plants generally used in the investigated area are *Acacia modesta*, *Acacia nilotica, Albizia lebbeck, Allium cepa, Allium sativum, Aloe barbadensis, Amaranthus viridis, Capparis decidua, Chenopodium album, Cistanche tubulosa, Citrullus colocynthis, Convolvulus arvensis, Coriandrum sativum*, *Crotalaria medicaginea, Cucurbita maxima*, *Cucurbita pepo, Cymbopogon jwarancusa, Dalbergia sissoo, lanceolatus, Fagonia cretica, Gymnosporia royleana, Helianthus annus, Heliotropium europaeum, Heliotropium strigosum, Hordeum vulgare*, *Kickxia ramosissima, Lactuca sativa, Launaea procumbens*, *Mentha arvensis, Momordica charantia*, *Monotheca buxifolia, Ocimum basilicum*, *Orobanche ramose, Peganum harmala, Phoenix dactylifera*, *Plantago ciliata, Plantago ovate, Rhazya stricta, Rumex dentatus, Salvadora oleoides, Tamarix decidva, Trianthema portulacastrum, Tribulus terrestris*, *Vitex trifolia*, *Withania coagulans*, *Withania somnifera* and *Zizyphus maurtiana* (Table 3).

The commercially significant medicinal plants included *Acacia modesta*, *Cistanche tubulosa, Citrullus colocynthis, Crotalaria medicaginea, Fagonia cretica, Heliotropium europaeum, Kickxia ramosissima, Monotheca buxifolia, Phoenix dactylifera*, *Peganum harmala, Rhazya stricta, Tribulus terrestris*, *Vitex trifolia*, *Withania coagulans*, *Withania somnifera* and *Zizyphus maurtiana.* The result agrees with Sher & Hussain (2009) who reported 50 recipes of medicinal plants belonging to 30 families of Malam Jaba. Hussain *et al.* (2004), Hussain *et al.* (2005), Hussain *et al.* (2007), Jan *et al*. (2010), Sher *et al.* (2011) and Mahmood *et al*. (2012) also documented valuable medicinal plants from different parts of the country. Our finding concerning medicinal used were similar with them. Khan *et al*. (2011c) also documented similar ethnobotanical work from Tehsil Karak. They reported 33 plant species belonging to 18 families of medicinal importance and some of them have been reported in the present study. They also stated the importance of *Rhazya stricta* and *Withania coagulans* in the area. Mood (2008) reported 160 species belonging to

128 genera and 37 families from Birjand, located near the Afghanistan border in eastern Iran, of them 40% are used as medicinal plants.

People of the investigated areas are poor and those living in the isolated partition depend on the used of medicinal plants and prepared crude drugs in form of juice, paste, infusion, decoction, water extract and powder pills. Such type of study was also taken by Hussain *et al*. (2006). Ragunathan & Abey (2009) done an ethnomedicinal survey on folk drugs used by different ethnic groups in Bahirdar Zuria district northwestern Ethiopia. Most of the herbal remedies were given in the form of fresh juice. In the investigated area, the people used the plants for different medicinal purposes like anthelmintic problems, digestive problems, jaundice, respiratory ailments, urinary diseases, skin diseases and diabetes. Ullah *et al*. (2010) documented the traditional knowledge of 34 medicinal plant species used in Darra Adam Khel NWFP Pakistan which also supported our finding Rethy *et al*. (2010) described 18 species for curing diseases from Dehang–Debang Biosphere Reserve of Upper Siang district with similar result. Species of *Withania* such as *Withania coagulans* and *Withania somnifera* had multiple medicinal values. Our results agree with Khan *et al.* (2011c), who reported uses of *Withania* having folk therapeutic plants in southern area of Pakistan. Our result agrees with Amiri *et al*. (2112) who documented the ethnobotanical potential of 52 plants species from Zangelanlo District, Northeast Iran with similar results.

In the investigated area, the basic health facilities were rare. The locals depend on traditional uses of folk medicinal plants. During investigation it was observed that the elders, mostly the women were more information about traditional exercises of plant species. The locals collect plant species and sell them (Fig. 22). Such people have prosperous knowledge in therapeutic health problems through plants. The investigated area is floristically prosperous and there had also special medicinal plants. The locals of the area wish that if government should support them financially for cultivation of medicinal plants it will bring green revolution and help in national economy.

2. Fodder species

The result showed that there are 114 (70.81%) plant species are being used as fodder of grazing animals which includes goat, sheep and cattle. The important fodder species included *Acacia modesta, Acacia nilotica, Achyranthus aspera,*

Aerua persica, *Arachis hypogaea*, *Astragalus psilocentros*, *Avena sativa*, *Cenchrus biflorus*, *Cenchrus ciliaris*, *Cicer arietinum*, *Convolvulus arvensis*, *Convolvulus pluricaulis*, *Cymbopogon jwarancusa*, *Cynodon dactylon*, *Dalbergia sissoo*, *Eragrostis poaoides*, *Eruca sativa*, *Euphorbia prostrata*, *Fagonia cretica*, *Gymnosporia royleana*, *Heliotropium europaeum*, *Hordeum vulgare*, *Launaea procumbens*, *Melia azedarach*, *Morus alba*, *Morus nigra*, *Pennisetum typhoideum*, *Prosopis farcta*, *Punica granatum*, *Salvadora oleoides*, *Tamarix aphylla*, *Tribulus terrestris*, *Trifolium alexandrianum*, *Triticum aestivum*, *Vicia sativa*, *Zea mays*, *Zizyphus maurtiana* and *Zizyphus nummularia* (Table 3).

Grasses and herbaceous plants are abundant in early winter. The people harvest the grasses for storing them for later use during winter. A number of fodder species are valued that are preferred by goat, sheep and cattle due to high nutritive values. The highly valued fodder species that used in winter season included *Acacia modesta*, *Astragalus psilocentros*, *Avena sativa*, *Cenchrus ciliaris*, *Convolvulus arvensis*, *Cymbopogon jwarancusa*, *Cynodon dactylon*, *Eragrostis poaoides*, *Euphorbia prostrata*, *Heliotropium europaeum*, *Prosopis farcta*, *Punica granatum*, *Salvadora oleoides*, *Vicia sativa*, *Zizyphus maurtiana* and *Zizyphus nummularia*. Most of fodder plants belonged to family poaceae. Our finding agrees with Hussain *et al*. (1995) who stated that *Convolvulus arvensis* is used as fodder in Swat. It is also reported in the study area and has same uses. Ibrar *et al*. (2007) recorded 37 forage species from Ranyal hill, District Shangla. Dilshad *et al.* (2010) reported 25 fodder species alike to the current study used for some cattle diseases. Sardar & Khan (2009) also recorded many fodder species. Barakatullah *et al*. (2009) mentioned 18 fodder or forage species from Charkotli Hills, Batkhela District. All the above researchers had mentioned the same fodder species but only some of them used in the investigated area. Sher *et al.* (2011) recorded 66 fodder plant species from Chagharzai Valley, District Buner, Pakistan.

3. Fuel wood species

The result reveled that the locals cuts and collect 43 species (26.7 %) including 22 tree, 15 shrub and 6 herb species for fuel purposes. These plants are harshly used by the locals due to lack of gas facility and some other alternate resources. The plant species

used as fuel included *Acacia modesta, Acacia nilotica, Aerua persica, Albizia lebbeck, Alhagi maurorum, Astragalus psilocentros, Brassica rapa, Calligonum polygonoides, Calotropis procera, Capparis decidua, Capparis spinosa, Cymbopogon jwarancusa, Dalbergia sissoo, Dodonaea viscosa, Eucalyptus globules, Eucalyptus lanceolatus, Gymnosporia royleana, Monotheca buxifolia, Morus alba, Morus nigra, Otostegia limbata, Parkinsonia aculeate, Pennisetum typhoideum, Periploca aphylla, Phoenix dactylifera, Phragmites karka, Prosopis farcta, Prosopis juliflora, Punica granatum, Rhazya stricta, Ricinus communis, Saccharum bengalense, Saccharum spontaneum, Salvadora oleoides, Tamarix aphylla, Tamarix decidva, Vitex trifolia, Withania coagulans, Zizyphus maurtiana, Zizyphus nummularia* and *Zizyphus oxyphylla* (Table 3; Fig. 21). These plant species have high fuel value and are therefore preferred.

In winter, temperature drops to low level in the area and life activities become limited to home. The locals have sorted the plant species as fuel on the basis of easy availability and heat value. They preferred those species which have high heat value, burn for longer time and produce less smoke such as *Acacia modesta, Acacia nilotica, Albizia lebbeck, Dalbergia sissoo, Morus alba, Morus nigra, Prosopis farcta, Tamarix aphylla, Tamarix decidva* and *Zizyphus maurtiana.* Sher *et al.* (2011) recorded 51 fuel wood species from Chagharzai Valley, District Buner, Pakistan. Some people smuggle plant species and cuts ruthlessly due to which the species become lost in the mountains area. In the hilly areas, more than 80 % people depend upon surrounding hills for fuel plants collection. Deka *et al*. (2007) reported 10 indigenous fuel wood species.

According to Scurlock & Hall (1990) fuel wood species is the major source for three quarters of the world population who live in developing countries. Nowadays the innovation in sciences and production of new resources of fuel energy, plants still remain key foundation of fuel and energy in the developing countries, including Pakistan. The daily ramble in modern fuel, low production, lack of accessibility might be causes of utilization of plants as a fuel. Siddique & Ayaz (1997) stated that sub standard of living and low revenue forced the people to rely on traditional uses, it is supported by the present study. The results showed that 43 plants were being used as fuel wood in the area, which included herb, shrub and tree species. Toledo (1996) reported 80 plant species and stated that 20 species of trees used as fuel wood by the local people.

Singh & Pandey (1998) stated that due to easily availability and access to plant species in Rajistan, India, the local used more than 60 plant species for burning purposes. All these statements agree with our finding because plant species still easily and freely available in the investigated area.

4. Timber wood species

Timber wood species is the key source of making livelihood in the investigated area. All construction assets are completed from plant resources. In the present it was seen that timber wood was obtained from 16 (9.94%) species which includes *Acacia modesta, Acacia nilotica, Albizia lebbeck, Dalbergia sissoo, Eucalyptus globules, Eucalyptus lanceolatus, Gymnosporia royleana, Morus alba, Morus nigra, Parkinsonia aculeate, Phoenix dactylifera, Prosopis farcta, Salvadora oleoides, Tamarix aphylla, Tamarix decidva* and *Zizyphus maurtiana* (Table 3; Fig. 21).

Since long time wood is used for construction by human being Although in many cases, synthetic materials and industries replacing wood, yet in the investigated area wood is easily available and economical resource of construction. The quality of timer wood species varies due to strength, durability, appearance, density and structure. Traditional identification of timber wood had a various physical properties like color, fragrance and wood's appearance. The present study recorded 16 plant species as cited above on the basis of people uses. Some timber species like *Acacia nilotica, Dalbergia sissoo, Zizyphus maurtiana, Prosopis farcta* and *Morus alba* are used commonly in the area. Our result is similar with Sher *et al.* (2011) who recorded 21 timber species from Chagharzai Valley, District Buner, Pakistan.

5. Vegetable Species

23 species wild as well as cultivated used as vegetables (14.3 %) by the locals in the area they included *Abelmoschus esculentus, Allium cepa, Allium sativum, Amaranthus viridis, Brassica rapa, Capsicum annum, Chenopodium album, Chenopodium murale, Cicer arietinum, Convolvulus arvensis, Coriandrum sativum, Cucurbita maxima, Cucurbita pepo, Daucus carrota, Eruca sativa, Lactuca sativa, Lactuca serriola, Lens culinaris, Luffa acutangula, Luffa aegyptiaca, Mentha arvensis, Raphanus sativus* and *Spinacia oleraceae* (Table 3; Fig. 21).

Vegetables form an integral part of the economy and culture. There are a variety

of cooking species. The leaves especially the young shoot of wild plants are used as a vegetable included *Amaranthus viridis, Chenopodium album, Chenopodium murale Convolvulus arvensis* and *Spinacia oleraceae.* These vegetables are generally called saag and are very delicious. Young generation is unaware and had poor awareness about wild vegetables plant species, so it is important to save these data of traditional delicious food. Similar works were reported by Ahmad *et al.* (2004) and Hamayoun (2005) that supported the present findings.

In some parts of the investigated area, the regularly cultivated plants including *.Abelmoschus esculentus, Allium cepa, Allium sativum, Brassica rapa, Capsicum annum, Cicer arietinum, Coriandrum sativum, Cucurbita maxima, Cucurbita pepo, Daucus carrota, Eruca sativa, Lactuca sativa, Lactuca serriola, Lens culinaris, Luffa acutangula, Luffa aegyptiaca, Mentha arvensis* and *Raphanus sativus.* Our result is similar with Sher *et al.* (2011) who recorded 36 vegetable /pot-herb species. *Cicer arietinum* and *Brassica rapa* leaves are boiled and eaten with *Pennisetum typhoideum* (Bajra) bread and shoomley. This is special food of older and a tradition of the area especially in winter season. Our result is agree with the Durrani *et al.* (2009), Razaq *et al.* (2010), Badshah & Hussain (2011), Hazart *et al.* (2011) and Sher *et al.* (2011) who have similar results.

6. Plants used as Veterinary medicines

The local used 50 (31.06 %) plant species in which 32 herb, 10 shrub and 8 tree species for curing different diseases of animals. Majority of species are used for curing stomach disorders. These plants included both wild and cultivated. They included *Acacia modesta, Albizia lebbeck, Aloe barbadensis, Boerhaavia diffusa, Brassica rapa, Calligonum polygonoides, Capparis decidua, Chenopodium album, Chenopodium murale, Citrullus colocynthis, Convolvulus arvensis, Coriandrum sativum, Cymbopogon jwarancusa, Dalbergia sissoo, Eruca sativa, Heliotropium europaeum, Kickxia ramosissima, Launaea procumbens, Mentha arvensis, Ocimum basilicum, Peganum harmala, Rhazya stricta, Rumex dentatus, Saccharum bengalense, Salvadora oleoides, Sesamum indicum, Solanum incanum, Sonchus asper, Tamarix aphylla, Tamarix decidva, Taraxacum officinale, Tribulus terrestris, Trifolium alexandrianum, Vicia sativa, Vitex negundo, Vitex trifolia,*

Withania coagulans, Withania somnifera, Zizyphus maurtiana and *Zizyphus nummularia* (Table 3; Fig. 21).

Tabuti *et al*. (2003) documented veterinary medicine plants from Uganda used for different diseases of livestock. Some of the plant species with similar uses are the same as reported by the present study. For making easy life the locals generally rely on their domestic animals. In the grazing animals especially in goats and sheep the mouth and foot diseases are very common. The locals used fluid of *Rhazya stricta* leaves for their treatment. Similarly cutting of animals body due to high weight especially in donkey and camel treated with the ash of *Tamarix aphylla* leaves. Such type of study is also done by Kamatenesi-Mugisha *et al*. (2006), Lindsey *et al*. (2006), Bonet & Valles (2007), Ajaib *et al*. (2010), Yousifzai *et al*. (2010) and Qureshi *et al*. (2011) who reported the plants used in veterinary medicines. The current study documented the exploitation of plant life knowledge resting in the area. This is the first effort to clarify and search the ethnoveterinary medicinal plants in the area. This practice is continuing since long ago. It is a dire need to preserve the knowledge.

7. Honey bee plants

Honey production was widespread in investigated area. It is the source and income in the area. In the investigated area, 90 honeybee plant species including 19 tree, 15 shrub and 56 herb species were present. The most important indigenous flora for honey production includes *Abelmoschus esculentus, Acacia modesta, Acacia nilotica, Achyranthus aspera, Albizia lebbeck, Amaranthus viridis, Arachis hypogaea, Astragalus psilocentros, Avena sativa, Brassica rapa, Calendula arvenis, Capparis decidua, Capparis spinosa, Carthamus oxycantha, Cassia angustifolia, Chenopodium album, Chenopodium murale, Cicer arietinum, Citrullus colocynthis, Convolvulus arvensis, Convolvulus pluricaulis, Coriandrum sativum, Cucurbita maxima, Cucurbita pepo, Cyperus rotundus, Cyperus scarlosus, Dalbergia sissoo, Daucus carrota, Dodonaea viscosa, Eruca sativa, Euphorbia prostrata, Fagonia cretica, Fumaria indica, Gymnosporia royleana, Helianthus annus, Heliotropium europaeum, Hordeum vulgare, Kickxia ramosissima, Lactuca sativa, Lactuca serriola, Launaea procumbens, Luffa acutangula, Luffa aegyptiaca, Lycopersicom esculentum, Malva neglecta, Malva parviflora, Medicago laciniata, Melia azedarach,*

Mentha arvensis, Momordica charantia, Monotheca buxifolia, Morus alba, Morus nigra, Ocimum basilicum, Otostegia limbata, Pennisetum typhoideum, Phoenix dactylifera, Plantago ciliata, Plantago ovate, Prosopis farcta, Prosopis juliflora, Punica granatum, Raphanus sativus, Rhazya stricta, Rosa indica, Rumex dentatus, Salvadora oleoides, Salvia moorcroftiana, Sesamum indicum, Sissymbrium irrio, Solanum surattense, Tamarix aphylla, Tamarix decidva, Taraxacum officinale, Tribulus terrestris, Trifolium alexandrianum, Triticum aestivum, Vicia sativa, Vites vinifera, Vitex negundo, Vitex trifolia, Withania coagulans, Withania somnifera, Zea mays, Zizyphus maurtiana, Zizyphus nummularia and *Zizyphus oxyphylla* (Table 3; Fig. 21).

In Muslim society, honey is very consecrated and uses as a self medicine. Apiculture is a source of revenue of the inhabitants of the area. In the investigated area, it is a common and valuable practice. It plays an important role in the economy of the inhabitants. It is common due to the important honey bee flora. The inhabitants nurture the honey bee as a source of food and income. *Ber* honey is very popular in the area. Due to the fine quality of Ber honey, it is exported to markets at international level. Most of the honey entrepreneurs producing *Ber* honey are outsiders. They sell it for Rs. 1000 to 1500/Kg depending upon the quality which is depends on flowers nature, collection time and seasons of the year. Rehman (1997) recorded 130 honeybee plant species from Peshawar and adjoining area. Zabihullah *et al.* (2006) reported 5 species.

Honey production is relatively high and people focus to use it a permanent income source. The production of wild honey that nurtured in Farms has more value and sold 10-20 times more expensive than domesticated bees. The prices of honey vary in diverse seasons of the year. Its productivity depends on the availability of flowers. According to Iqbal & Hamayun (2003) that 31 honeybee plant species were found in Kindukush Kimalayan region Malam Jaba. Sher *et al.* (2011) reported 9 honeybee plant species from Chagharzai Valley, District Buner, Pakistan. This small scale industry needs to present scientific and technical sources for the locals to improve the quality of honey and health conditions of bees. The following suggestion should be given to improve the quality, quantity and health of honey and honeybees.

1. The hives should be formed in open places.
2. The wooden boxes should be used.

3. The honey should be extracted in right time in right place.
4. The marketing method, packing and collection of honey should be improved.

8. Fruit yielding plants

The people of the area get fruit from 33 (20.49 %) species including 13 trees, 8 shrubs and 12 herbs. Some of the fruits are also exported to the various parts of the country. Among them there are 18 (54.55 %) wild and 15 (45.45 %) cultivated plants; they include *Acacia modesta, Acacia nilotica, Albizia lebbeck, Arachis hypogaea, Capparis decidua, Capparis spinosa, Capsicum annum, Cassia angustifolia, Cicer arietinum, Citrullus colocynthis, Cucurbita maxima, Cucurbita pepo, Dalbergia sissoo, Luffa acutangula, Luffa aegyptiaca, Lycopersicom esculentum, Monotheca buxifolia, Morus alba, Morus nigra, Peganum harmala, Phoenix dactylifera, Prosopis farcta, Punica granatum, Tribulus terrestris, Triticum aestivum, Vites vinifera, Vitex negundo, Vitex trifolia, Withania coagulans, Withania somnifera, Zizyphus maurtiana, Zizyphus nummularia* and *Zizyphus oxyphylla* (Table 3; Fig. 21).

In the investigated area, the locals do not know proper processing, collection and packing of these precious fruits and there is urgent need to preserve the wild species. Moreover, there is also need to develop grafting and budding in *Zizyphus maurtiana*. It is essential to protect these plant species and to improve its nurturing. Lubna (2001) stated that forests covered 4.8 % area of land in Pakistan. Ali & Tor (2004) reported that forest property is under stress from successive land degradation and deforestation. Ibrar *et al.* (2007) reported 18 edible species from Ranyal Hill, Shangla. Sher & Al-Yemni (2011) reported 14 wild fruit species from higher altitude coniferous forest of Malam Jaba, Swat. Our result is similar with the above sited work.

9. Plants used for Fencing Field

Locals of the area protect their fields and crops by fencing the borders by using species. Such as *Acacia modesta, Acacia nilotica, Calligonum polygonoides, Capparis decidua, Eucalyptus globules,* L*Eucalyptus lanceolatus, Morus alba, Morus nigra, Opuntia ficus indica, Parkinsonia aculeate, Phoenix dactylifera, Phragmites karka, Prosopis farcta, Prosopis juliflora, Saccharum bengalense, Saccharum spontaneum, Salvadora oleoides, Zizyphus maurtiana* and *Zizyphus nummularia* (Table 3; Fig. 21).

Mostly spiny and bush making species are chosen. Once plant it remains for year. This type of fencing materials is economical and present for long times. Our results are similar with those of Zabihullah *et al.* (2006), Ibrar *et al.* (2007), Barakatullah *et al.* (2009), Durrani *et al.* (2009), Sher *et al.* (2011) and Sher & AlYemni (2011) who reported similar use of plants from the other parts of the country. Field fencing is common near villages to protect successively their field from shortcut path and grazing.

10. Species used for making agricultural appliances

Agriculture is the back bone of the area. The locals have small farmlands which are cultivated with using indigenous agricultural tools. They use camel, bullocks and donkey to plough n their fields. Various agriculturists' tools are made of *Acacia modesta, Acacia nilotica, Albizia lebbeck, Calligonum polygonoides, Capparis decidua, Dalbergia sissoo, Gymnosporia royleana, Monotheca buxifolia, Morus alba, Morus nigra, Prosopis farcta, Prosopis juliflora, Salvadora oleoides, Tamarix aphylla, Tamarix decidva, Zizyphus maurtiana* and *Zizyphus nummularia* (Table 3; Fig. 21).

Some of the appliances used in agriculture practices are shovel, rake, harrows, hoe, scythe and trowel are larger equipment such as larger racks and plough that are either drawn by human or animals. Zabihullah *et al.* (2006), Ibrar *et al.* (2007), Durrani *et al.* (2009), Sher *et al.* (2011) and Sher & AlYemni (2011) had also reported plants used in making agricultural tools from various parts of the country. For traditional agriculture uses, it is common to have wooden tools or partly wooden tools. The wood may differ in different parts of the country for the same use. The wood of *Zizyphus maurtiana* is used for making handles and plough of axes.

11. Furniture plants

Locally furniture is made from 18 (11.18 %) plant species. The valued species for making furniture are *Acacia modesta, Acacia nilotica, Albizia lebbeck, Dalbergia sissoo, Eucalyptus lanceolatus, Euphorbia helioscopia, Gymnosporia royleana, Melia azedarach, Monotheca buxifolia, Morus alba, Morus nigra, Parkinsonia aculeate, Prosopis farcta, Salvadora oleoides, Tamarix aphylla, Tamarix decidva* and *Zizyphus maurtiana*. Furniture made in this area is used only for local people requirements (Table 3; Fig. 21).

Our finding agrees with Durrani *et al*. (2009), Sher *et al*. (2011), Sher & Alyemni (2011) who documented similar plant uses from different part of the area.

Health authorities in Pakistan were not able to provide services to greater part of the rural population. According to WHO reports more than 80% of Asia's population could not afford formal health care facilities and therefore relies on wild medicinal plant species owing to their cultural familiarity, easy access, simple use and effectiveness (Anon., 2008). Many of the important medicinal plants were sold at higher prices in the market. Most of the plants used by the local people were not conserved but were over exploited. The present study showed that the people of area has possessed good knowledge of herbal drugs but as people were going to modernization, their knowledge of traditional uses of plants might be lost in due course. The investigated area has a rich diversity of medicinal plants and provides a conductive habitat and ideal conditions for their growth. Native healers should be encouraged to accurately share their knowledge to others. Such studies might also provide some information to biochemist and pharmacologist in screening of individual species and in rapid assessing of phyto-chemical constituent and bioanalysis for authentic treatment of various diseases.

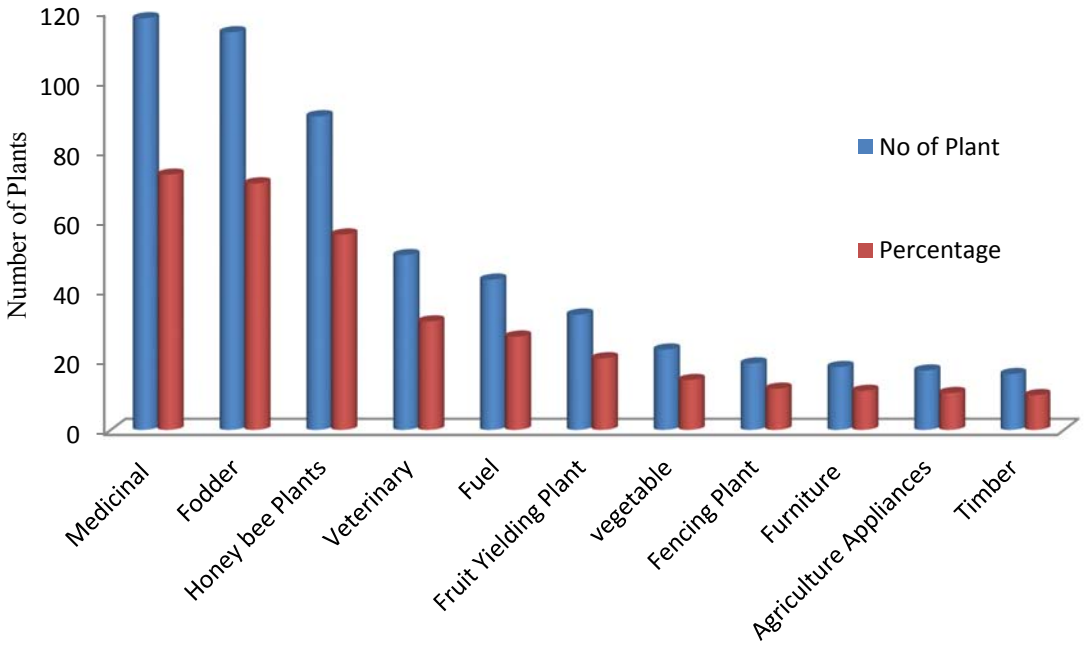


Fig. 21. Ethnobotanical profile of plant species of Tehsil Takht-e-Nasrati, District Karak.



Fig. 22. Uprooting of medicinal plant i.e. *Launaea nudicaulis* (L.) Hook. f.

Table 3. Ethnobotanical Profile of Plants of Tehsil Takht-e-Nasrati, District Karak.

S. No	Species	Medicinal	Fodder	Fuel	Timber	vegetable	Veterinary	Honey bee Plants	Fencing Plant	Agriculture Appliances	Fruit Yielding Plant	Furniture
1	*Abelmoschus esculentus* (L.) Moench.	+	-	-	-	+	-	+	-	-	-	-
2	*Acacia modesta* Wall.	+	+	+	+	-	+	+	+	+	+	+
3	*Acacia nilotica* (L) Delice.	+	+	+	+	-	-	+	+	+	+	+
4	*Achyranthus aspera* L.	-	+	-	-	-	+	+	-	-	-	-
5	*Aerua persica* (Burm.f.) Merrill.	+	+	+	-	-	-	-	-	-	-	-
6	*Ajuga bracteosa* Wall.ex Benth.	+	-	-	-	-	-	-	-	-	-	-
7	*Albizia lebbeck* (L.) Benth.	+	+	+	+	-	+	+	-	+	+	+
8	*Alhagi maurorum* Medic.	-	+	+	-	-	-	-	-	-	-	-
9	*Allium cepa* L.	+	+	-	-	+	-	-	-	-	-	-
10	*Allium sativum* L.	+	+	-	-	+	-	-	-	-	-	-
11	*Aloe barbadensis* Mill.	+	-	-	-	-	+	-	-	-	-	-
12	*Alternanthra pungens* Kunth.	+	-	-	-	-	+	-	-	-	-	-
13	*Amaranthus viridis* L.	+	+	-	-	+	-	+	-	-	-	-
14	*Anagalis arvensis* L.	-	+	-	-	-	-	+	-	-	-	-
15	*Arachis hypogaea* L.	+	+	+	-	-	-	+	-	-	+	-
16	*Asparagus gracilis* Royle.	-	+	-	-	-	-	+	-	-	-	-
17	*Asphodelous tenuifolius* Cavan.	+	-	-	-	-	-	-	-	-	-	-
18	*Astragalus psilocentros* Fisch.	+	+	+	-	-	-	+	-	-	-	-
19	*Avena sativa* L.	+	+	-	-	-	-	+	-	-	-	-
20	*Boerhaavia diffusa* L..	+	+	-	-	-	+	-	-	-	-	-
21	*Brassica rapa* L.	+	+	+	-	+	+	+	-	-	-	-
22	*Calendula arvenis* L.	+	+	-	-	-	-	+	-	-	-	-
23	*Calligonum polygonoides* L.	+	+	+	-	-	+	+	+	+	-	-
24	*Calotropis procera* (Wild) R.Br.	+	-	+	-	-	-	-	-	-	-	-
25	*Capparis decidua*	+	+	+	-	-	+	+	+	+	+	-

	(Forssk). EdgeWorth.											
26	*Capparis spinosa* L.	+	+	+	-	-	-	+	-	-	+	-
27	*Capsicum annum* L.	+	+	-	-	+	-	-	-	-	+	-
28	*Carthamus oxycantha* Bieb	+	-	-	-	-	-	+	-	-	-	-
29	*Cassia angustifolia* Vahl.	+	-	-	-	-	-	+	-	-	+	-
30	*Celosia argentea* L.	+	-	-	-	-	+	-	-	-	-	-
31	*Cenchrus biflorus* Hook. f.,	-	+	-	-	-	-	-	-	-	-	-
32	*Cenchrus ciliaris* L.	-	+	-	-	-	-	-	-	-	-	-
33	*Centaurea iberica* Trev.Ex. Spreng	+	+	-	-	-	-	-	-	-	-	-
34	*Chenopodium album* L.	+	+	-	-	+	+	+	-	-	-	-
35	*Chenopodium murale* L.	+	+	-	-	+	+	+	-	-	-	-
36	*Chrozophora obliqua* (Vahl) A. Juss.	+	+	-	-	-	+	-	-	-	-	-
37	*Cicer arietinum* L.	+	+	-	-	+	+	+	-	-	+	-
38	*Cistanche tubulosa* (Schenk) Wight.	+	-	-	-	-	+	-	-	-	-	-
39	*Citrullus colocynthis* L. Schrad.	+	-	-	-	-	+	+	-	-	+	-
40	*Cleome viscosa* L.	+	-	-	-	-	-	-	-	-	-	-
41	*Cocculus pendulus* (Forst) Diels	+	-	-	-	-	-	-	-	-	-	-
42	*Convolvulus arvensis* L.	+	+	-	-	+	+	+	-	-	-	-
43	*Convolvulus pluricaulis* Choisy	+	+	-	-	-	-	+	-	-	-	-
44	*Corchorus trilocularis* L.	-	-	-	-	-	-	-	-	-	-	-
45	*Coriandrum sativum* L.	+	+	-	-	+	+	+	-	-	-	-
46	*Coronopus didymus* (L) Smith.	-	+	-	-	-	-	-	-	-	-	-
47	*Crotalaria medicaginea* Lam.	+	-	-	-	-	-	-	-	-	-	-
48	*Cucurbita maxima* Duchesne.	+	+	-	-	+	-	+	-	-	+	-
49	*Cucurbita pepo* L.	+	+	-	-	+	-	+	-	-	+	-
50	*Cuscuta reflexa* Roxb.	+	-	-	-	-	-	-	-	-	-	-
51	*Cymbopogon jwarancusa* (Jones) Schult.	+	+	+	-	-	+	-	-	-	-	-
52	*Cynodon dactylon* (L) Pers.	-	+	-	-	-	-	-	-	-	-	-

53	*Cyperus rotundus* L.	+	+	-	-	-	-	+	-	-	-	-
54	*Cyperus scarlosus* R.Br.	+	+	-	-	-	-	+	-	-	-	-
55	*Dalbergia sissoo* Roxb.	+	+	+	+	-	+	+	-	+	+	+
56	*Datura metel* L.	+	-	-	-	-	-	-	-	-	-	-
57	*Daucus carrota* L.	-	+	-	-	+	-	+	-	-	-	-
58	*Descurainia Sophia* (L.) Webb.	-	-	-	-	-	+	-	-	-	-	-
59	*Desmostachya bipinnata* (L) Stapf.	+	-	-	-	-	+	-	-	-	-	-
60	*Dichanthium annulatum* (Forssk) Staph.	+	+	-	-	-	-	-	-	-	-	-
61	*Digera muricata* (L). Mart.	+	+	-	-	-	-	-	-	-	-	-
62	*Dodonaea viscosa* L.	+	-	+	-	-	-	+	-	-	-	-
63	*Echinochloa colonum* (L) Link.	-	+	-	-	-	-	-	-	-	-	-
64	*Echinops echinatus* D.C	-	+	-	-	-	-	-	-	-	-	-
65	*Eragrostis poaoides* Beauv.	+	+	-	-	-	-	-	-	-	-	-
66	*Erodium malacoides* Willd	-	+	-	-	-	-	-	-	-	-	-
67	*Eruca sativa* Millel.	+	+	-	-	+	+	+	-	-	-	-
68	*Eucalyptus globules* L.	+	+	+	+	-	-	-	+	-	-	-
69	*Eucalyptus lanceolatus* L	+	+	+	+	-	-	-	+	-	-	+
70	*Euphorbia helioscopia* L.	-	-	-	-	-	-	-	-	-	-	+
71	*Euphorbia prostrata* Ait.	+	+	-	-	-	-	+	-	-	-	-
72	*Evolvulus alsinoides* L.	-	+	-	-	-	-	-	-	-	-	-
73	*Fagonia cretica* L.	+	+	-	-	-	-	+	-	-	-	-
74	*Fumaria indica (Haussk.)* Pugsley.	-	-	-	-	-	-	+	-	-	-	-
75	*Gymnosporia royleana* Wall.	+	+	+	+	-	-	+	-	+	-	+
76	*Helianthus annus* L.	+	+	-	-	-	-	+	-	-	-	-
77	*Heliotropium europaeum* L.	+	+	-	-	-	+	+	-	-	-	-
78	*Heliotropium strigosum* Willd.	+	-	-	-	-	-	-	-	-	-	-
79	*Hordeum vulgare* L.	+	+	-	-	-	-	+	-	-	-	-
80	*Hypericum pendulum* L.	+	-	-	-	-	-	-	-	-	-	-

81	*Ifloga fontanesii* Cass.	+	+	-	-	-	-	-	-	-	-	-
82	*Indigofera linifolia* (L.f.) Rets.	-	-	-	-	-	-	-	-	-	-	-
83	*Ipomoea hederacea* (L.) Jack.	+	-	-	-	-	+	-	-	-	-	-
84	*Kickxia ramosissima* (Wall) Jan.	+	-	-	-	-	+	+	-	-	-	-
85	*Lactuca sativa* L.	+	+	-	-	+	-	+	-	-	-	-
86	*Lactuca serriola* L.	+	+	-	-	+	-	+	-	-	-	-
87	*Launaea nudicaulis* (L.) Hook. f.	+	+	-	-	-	+	+	-	-	-	-
88	*Lens culinaris* Medic.	+	+	-	-	+	-	-	-	-	-	-
89	*Lippia nodiflora* (L.) L.C. Rich.ex. Michaux.	-	-	-	-	-	-	-	-	-	-	-
90	*Lithospermum arvense* L.	-	-	-	-	-	-	-	-	-	-	-
91	*Luffa acutangula* Roxb.	-	+	-	-	+	-	+	-	-	+	-
92	*Luffa aegyptiaca* (L) M.J.Rocm.	-	+	-	-	+	-	+	-	-	+	-
93	*Lycopersicom esculentum* Mill.	-	+	-	-	-	-	+	-	-	+	-
94	*Malcolmia africana* (L) R.Br.	-	+	-	-	-	-	-	-	-	-	-
95	*Malva neglecta* Wallr.	+	+	-	-	-	-	+	-	-	-	-
96	*Malva parviflora* L.	+	+	-	-	-	-	+	-	-	-	-
97	*Malvastrum coromandelianum* (L.) Gareke.	-	+	-	-	-	-	-	-	-	-	-
98	*Medicago laciniata* (L.) Mill.	-	+	-	-	-	-	+	-	-	-	-
99	*Melia azedarach* L.	+	+	+	-	-	-	+	-	-	-	+
100	*Melilotus indicus* (L.) All.	-	-	-	-	-	-	-	-	-	-	-
101	*Mentha arvensis* L.	+	+	-	-	+	+	+	-	-	-	-
102	*Micromeria biflora* (Buchi .Ham exD. DonBenth).	-	+	-	-	-	-	-	-	-	-	-
103	*Momordica charantia* L.	+	-	-	-	-	-	+	-	-	-	-
104	*Monotheca buxifolia* (falk) A.DC.	+	+	+	-	-	-	+	-	+	+	+
105	*Morus alba* L.	+	+	+	+	-	-	+	+	+	+	+
106	*Morus nigra* L.	+	+	+	+	-	-	+	+	+	+	+
107	*Ocimum basilicum* L.	+	+	-	-	-	+	+	-	-	-	-
108	*Opuntia ficus indica* (L.) Mill	-	-	-	-	-	-	-	+	-	-	-

109	*Orobanche ramose* L.	+	-	-	-	-	-	-	-	-	-	-
110	*Otostegia limbata* (Benth.) Boiss.	+	+	+	-	-	-	+	-	-	-	-
111	*Oxalis corniculata* L.	-	+	-	-	-	-	-	-	-	-	-
112	*Parkinsonia aculeata* L.	-	+	+	+	-	-	-	+	-	-	+
113	*Peganum harmala* L	+	-	-	-	-	+	-	-	-	+	-
114	*Pennisetum typhoideum* (Burm) Stapf.	-	+	+	-	-	-	+	-	-	-	-
115	*Periploca aphylla* Decne.	+	+	+	-	-	-	-	-	-	-	-
116	*Phoenix dactylifera* L.	+	+	+	+	-	-	+	+	-	+	+
117	*Phragmites karka* (Retz) Trin. Ex. Steud.	-	-	+	-	-	-	-	+	-	-	-
118	*Plantago ciliata* Desf.	+	+	-	-	-	-	+	-	-	-	-
119	*Plantago ovata* Forssk.	+	+	-	-	-	-	+	-	-	-	-
120	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	+	+	+	+	-	-	+	+	+	+	+
121	*Prosopis juliflora* (SW.) DC.	-	+	+	-	-	-	+	+	+	-	-
122	*Punica granatum* L.	+	+	+	-	-	-	+	-	-	+	-
123	*Pupalia lappacea* (L.) Juss.	-	+	-	-	-	-	-	-	-	-	-
124	*Ranunculus muricatus* L.	+	-	-	-	-	-	-	-	-	-	-
125	*Raphanus sativus* L.	+	+	-	-	+	-	+	-	-	-	-
126	*Rhazya stricta* Decne.	+	-	+	-	-	+	+	-	-	-	-
127	*Ricinus communis* L.	+	-	+	-	-	-	-	-	-	-	-
128	*Rosa indica* L.	+	+	-	-	-	+	+	-	-	-	-
129	*Rumex dentatus* L	+	+	-	-	-	+	+	-	-	-	-
130	*Saccharum bengalense* Retz	+	+	+	-	-	+	-	+	-	-	-
131	*Saccharum spontaneum* L.	+	+	+	-	-	-	-	+	-	-	-
132	*Salvadora oleoides* Decne.	+	+	+	+	-	+	+	+	+	-	+
133	*Salvia moorcroftiana* Wall	+	-	-	-	-	-	+	-	-	-	-
134	*Saussurea heteromalla* (D.Don) Hand.	-	+	-	-	-	-	-	-	-	-	-
135	*Sesamum indicum* L.	+	+	-	-	-	+	+	-	-	-	-

136	*Silene conoidea* L.	-	-	-	-	-	-	-	-	-	-	-
137	*Sissymbrium irrio* L.	+	+	-	-	-	-	+	-	-	-	-
138	*Solanum incanum* L.	+	+	-	-	-	+	-	-	-	-	-
139	*Solanum nigrum* L.	-	-	-	-	-	-	-	-	-	-	-
140	*Solanum surattense* Burm.f	+	-	-	-	-	-	+	-	-	-	-
141	*Sonchus asper* (L) Hill.	+	+	-	-	-	+	-	-	-	-	-
142	*Sorghum vulgare* (L.) Pers.	-	+	-	-	-	-	-	-	-	-	-
143	*Spinacia oleraceae* L.	-	+	-	-	+	-	-	-	-	-	-
144	*Tamarix aphylla* (L.) Karst.	+	+	+	+	-	+	+	-	+	-	+
145	*Tamarix decidva* Roxb.	+	+	+	+	-	+	+	-	+	-	+
146	*Taraxacum officinale* Weber.	-	+	-	-	-	+	+	-	-	-	-
147	*Trianthema portulacastrum* L.	+	+	-	-	-	-	-	-	-	-	-
148	*Tribulus terrestris* L.	+	+	-	-	-	+	+	-	-	+	-
149	*Trifolium alexandrianum* L.	+	+	-	-	-	+	+	-	-	-	-
150	*Triticum aestivum* L.	+	+	-	-	-	-	+	-	-	+	-
151	*Vicia sativa* L.	-	+	-	-	-	+	+	-	-	-	-
152	*Vites vinifera* L.	+	+	-	-	-	-	+	-	-	+	-
153	*Vitex negundo* L.	+	-	-	-	-	+	+	-	-	+	-
154	*Vitex trifolia* L.	+	-	+	-	-	+	+	-	-	+	-
155	*Withania coagulans* Dunal.	+	-	+	-	-	+	+	-	-	+	-
156	*Withania somnifera* (L) Dunal.	+	-	-	-	-	+	+	-	-	+	-
157	*Xanthium strumarium* L.	-	-	-	-	-	-	-	-	-	-	-
158	*Zea mays* L.	+	+	-	-	-	-	+	-	-	-	-
159	*Zizyphus maurtiana* Lam	+	+	+	+	-	+	+	+	+	+	+
160	*Zizyphus nummularia* (Burm.f) W.&A.	+	+	+	-	-	+	+	+	+	+	-
161	*Zizyphus oxyphylla* EdgeW	+	+	+	-	-	-	+	-	-	+	-
Total		118	**114**	**43**	**16**	**23**	**50**	**90**	**19**	**17**	**33**	**18**
Percentage		**73.3**	**70.8**	**26.7**	**9.94**	**14.3**	**31.06**	**55.9**	**11.8**	**10.6**	**20.5**	**11.18**

4.5. PHYTOSOCIOLOGY

4.5.1. Vegetation Diversity and Community structure

The study was carried out in two successive years (2009-2010) in three seasons, i.e. spring, summer and winter. The area was divided into 4 stands and 22 sites on the basis of plant life position and altitude. The communities were named on the basis of the highest important value of three different plant species of each group i.e. herb, shrub and tree. 66 plant communities were identified on different aspects.

A. Spring aspect

The spring aspect exists from February to April. There were 66 plant species consisting 10 tree, 15 shrub, 35 herb and 6 grass species in 22 plant communities. The biological spectrum dominated by therophytes (25 spp., 37.88%) followed by hemicryptophytes (17 spp., 25.75%), megaphanerophytes (9 spp., 13.64%). nanophanerophytes (7 spp., 10.61%), chamaephytes (5 spp., 7.58%) and microphanerophytes (3 spp, 4.54 %) while leaf size spectrum dominated by microphylls (34 spp. 51.51%) followed by nanophylls (14 spp. 21.21%), leptophylls (8 spp. 12.12%), mesophylls (5 spp. 7.57 %) and megaphylls (5 spp. 7.57 %) (Table 4). Environmental data showed that air temperature was 12.43C^{o}, soil temperature was 14.02C^{o}, relative humidity 35.63 %, wind speed was 3.96 Km/h, rainfall 37.14mm indicated dry condition in the area during spring (Table 1).

Stand - 1

At an altitude 340-399 m 32 species containing 6 trees, 6 shrubs, 18 herbs and 2 grasses structured the *Prosopis-Fagonia-Saccharum* community (PFS). Furthermore, 4 communities i.e. *Prosopis-Saussurea-Saccharum* community (PSS), *Phoenix-Saussurea-Saccharum* community (PSS), *Fagonia-Prosopis-Saccharum* community (FPS), *Prosopis-Periploca-Aerua* community (PPA); were recorded at Tater Khel, Gardi Banda, Ahmad Abad and Warana respectively. In stand 1, the highest number of species (23) were present in PSS. The highest number of shrubs (6) and herbs (12) were present in FPS. The highest TIV contributed by three dominant species was 117.11 in PSS while low (86.76) in PSS. The highest TIV of tree (IV = 74.48), shrubs (IV = 74.62), herbs (IV = 158.75) and grasses (IV=38.7) were present

in PPA, PSS, FPS and PSS respectively (Table 5). The different plant communities established are discussed below:

1. *Prosopis-Saussurea-Saccharum* community (PSS)

This community was established at Tater Khel at altitude 360 m. This community was composed of 23 plant species including 4 tree, 5 shrub, 12 herb and 2 grass species. The dominant species were *Prosopis farcta* (IV = 37.6), *Saussurea heteromalla* (IV = 30.26) and *Saccharum bengalense* (IV = 18.9). The Importance value contributed by tree was 71.53, shrubs (IV = 54.08), herbs (IV = 135.69) and grasses (IV = 38.7) (Table 6). The biological spectrum dominated by therophytes (9 spp., 39.13%) followed by hemicryptophytes (6 spp., 26.09%) while leaf size spectrum dominated by microphylls (10 spp. 43.48%) followed by mesophylls and nanophylls. Consequently the community is thero-microphylous exhibiting ruthless environmental situation (Table 4).

2. *Phoenix-Saussurea-Saccharum* community (PSS)

This community developed at Gardi Banda at altitude of 390 m. The dominant species were *Phoenix dactylifera* (IV = 54.3), *Saussurea heteromalla* (IV = 33.72) and *Saccharum bengalense* (IV = 29.09). The Importance value contributed by tree was 72.01, shrubs (IV = 74.62), herbs (IV = 137.36) and grasses (IV = 16.01). The community consisted of 17 species comprising 3 tree, 5 shrub, 8 herbs and grass layer had only *Eragrostis poaoides* (Table 7). Therophytes dominated the community with 35.29 % while leaf form spectrum showed that microphyll 52.94 % were dominated (Table 4).

3. *Fagonia-Prosopis-Saccharum* community (FPS)

This site covered Ahmad Abad at altitude of 350 m. A total of 21 species were present in the community. Tree contributed 4, 6 shrub, 9 herbs and 2 grass species. The dominant species with importance values were *Fagonia cretica* (IV = 68.28), *Prosopis farcta* (IV = 29.3) and *Saccharum bengalense* (IV = 17.13). The Importance value contributed by tree was 57.16, shrubs (IV = 60.68), herbs (IV = 158.75) and grasses (IV = 23.41) (Table 8). Therophytes and hemicryptophytes dominated the life form spectrum with 33.33 % and 23.88 % contribution and microphyll 52.38% was the dominant leaf form (Table 4).

4. *Prosopis-Periploca-Aerua* community (PPA)

Site 4 at Warana was the saline and sandy area at altitude of 340 m had PPA community comprised of 4 tree, 4 shrub, 11 herb and single grass species. It was present at the west side of Tehsil. The leading species of the community on the basis of important value were *Prosopis farcta* (IV = 46.8), *Periploca aphylla* (IV = 31.79) and *Aerua persica* (IV = 22.48). The Importance value contributed by tree was 74.48, shrubs (IV = 71.79), herbs (IV = 143.39) and grasses (IV = 10.34) (Table 9). Therophytes was in highest percentage 50 % in life form spectrum and microphyll 60 % was the dominant leaf form (Table 4).

Stand - 2

In stand 2 between altitude 400 -499 m, total 43 plant species comprising 4 tree, 6 shrub, 30 herb and 3 grass species were recorded in *Zizyphus-Saccharum-Cenchrus* community (ZSC). Total 7 communities were present during spring on the basis of altitude and plant availability in area. In stand 2, highest numbers of species (30) were present in FZC. The highest numbers of tree (4) and shrubs (6) were present in FZC and ASC. The highest number of herbs (17) were present in FZC. The highest TIV contributed by three dominant species (153.47) were found in ZCF while low TIV (77.33) in FZC. The highest TIV of tree (117.65), shrubs (68.21), herbs (166.51) and grasses (55.83) were present in ZCF, ASC, FZC and ZCS (Table 5). The different plant communities established are discussed below:

5. *Fagonia-Zizyphus-Saccharum* community (FZS)

This community was present in southern Bogara at altitude 420 m. The plants dominating the site were *Fagonia cretica* (IV = 35.85), *Zizyphus maurtiana* (IV = 24.45) and *Saccharum bengalense* (IV = 17.03). A total 30 plants were recorded in the site which consisted of 4 tree, 6 shrub, 17 herbs and 3 grass species. The Importance value contributed by tree was 48.45, shrubs (IV = 54.91), herbs (IV = 166.51) and grasses (IV = 30.13) (Table 10). The diversity of plants was high in the site. The highest number of plants were recorded for *Calligonum polygonoides, Cenchrus ciliaris* and *Phoenix dactylifera.* The site was close to the village and biotic interference in the form of grazing and deforestation was high. Trees were cut off for clearing the land. Therophytes 33.33% and hemicryptophytes 30 % dominated the life form

spectrum. Leaf form spectrum consisted of microphyll 50 % and nanophyll 16.66% (Table 4).

6. *Acacia-Saccharum-Citrullus* community (ASC)

A total of 24 plant species were identified in the northern Bogara at 430m altitude which consisted of 4 tree, 6 shrub, 13 herb and single grass species. The habitat was dry and open stand. The dominant species were *Acacia nilotica* (IV = 63.29), *Saccharum bengalense* (IV = 22.54) and *Citrullus colocynthis* (IV = 17.36). The Importance value contributed by tree was 99.32, shrubs (IV = 68.21), herbs (IV = 120.68) and grasses (IV = 11.79) (Table 11). Biological spectrum indicated that hemicryptophytes and therophytes were the most prevailing classes of life form while microphyll and nanophyll were dominant in leaf form spectrum (Table 4).

7. *Zizyphus-Saccharum-Cynodon* community (ZSC)

The *Zizyphus-Saccharum-Cynodon* community consisted of 17 species in which 2 tree, 4 shrub, 8 herb and 3 grass species were developed at 490 m altitude in Gandiri Khattak. The Importance value contributed by tree was 91.29, shrubs (IV = 62.85), herbs (IV = 97.73) and grasses (IV = 48.13). The dominant species were *Zizyphus maurtiana* (IV = 82.4), *Saccharum bengalense* (IV = 28.66) and *Cynodon dactylon* (IV = 20.43). Other important species were *Ifloga fontanesii* (IV = 19.93), *Fagonia cretica* (IV = 12.71) and *Calotropis procera* (IV = 12.95) (Table 12). In ZSC community therophytes 35.29% and hemicryptophytes 29.41 % dominated the life form spectrum. Leaf form spectrum consisted of microphyll 29.41 %, leptophylls and nanophyll 23.53% each (Table 4).

8. *Calligonum-Zizyphus-Saussurea* community (CZS)

The site was present in Kiri Dhand at 480 m altitude. This community was established by *Calligonum polygonoides* (IV = 27.74), *Zizyphus maurtiana* (IV = 27.34) and *Saussurea heteromalla* (IV = 25.16) as dominants. Other important species were *Malva neglecta* (IV = 15.29), *Acacia nilotica* (IV = 11.92) and *Saccharum bengalense* (IV = 10.46). The Importance value contributed by tree was 47.04, shrubs (IV = 63.29), herbs (IV = 155.33) and grasses (IV = 34.34) (Table 13). Biological spectrum exhibited that therophytes 40% and hemicryptophytes 25 % had the highest proportion in biological spectrum while leaf form spectrum was dominated by micro-nanophyllous

leaf size classes (Table 4). Dominance of the therophytes indicates disturbed ecological situation in the site. Khan *et al*. (2010) stated that plant cutting, soil erosion, overgrazing and human pressures decreases the mecrophyll, as a result therophytes had taken the place that were not previously taken by plant.

9. *Zizyphus-Aerua-Calligonum* community (ZAC)

This site was present in Jahangiri Banda at 475 m altitude. The community consisted of 17 plant species in which 3 were tree, 4 were shrubs and 10 were herbs dominance of *Zizyphus maurtiana* (IV = 44.6), *Aerua persica* (IV = 31.68) and *Calligonum polygonoides* (IV = 23.68). The associated species included *Saccharum bengalense* (IV = 21.43), *Dalbergia sissoo* (IV = 16.62) and *Solanum surattense* (IV = 16.05). The Importance value contributed by tree was 68.27, shrubs (IV = 65.88) and herbs (IV = 165.85) (Table 14). Biological spectrum showed therophytic vegetation dominated with 35.29 % followed by hemicryptophytes 23.53 % (Table 4). It gives the idea that the plants like phanerophytes were dominant earlier than degradation. Ram & Arya (1991) stated that degraded flora keeps therophytic and hemicryptophytic type of flora. In the leaf form classes microphyll 41.18 % dominated the community which proved disturbed plant life in the area.

10. *Zizyphus-Calligonum-Fagonia* community (ZCF)

The *Zizyphus-Calligonum-Fagonia* community was present in Mona Khel at 492 m above sea level. It consisted of 17 species in which 2 tree, 4 shrub, 8 herb and 2 grass species were present. The Importance value contributed by tree was 117.65, shrubs (IV = 60.68), herbs (IV = 106.07) and grasses (IV = 15.6). *Zizyphus maurtiana* (IV = 98.5), *Calligonum polygonoides* (IV = 27.61) and *Fagonia cretica* (IV = 27.36) were the dominant species. The associated species included *Ifloga fontanesii* (IV = 20.23) and *Saccharum bengalense* (IV = 17.56) (Table 15). The community mostly had therophytes. Therophytes 52.94 % was dominant in life form while microphyll 41.18 % and nanophyll 23.53 % were dominant leaf form spectrum (Table 4).

11. *Zizyphus-Cenchrus-Saccharum* community (ZCS)

The *Zizyphus-Cenchrus-Saccharum* community was established at 495 m altitude in Jarassi. This community had 18 plant species in which 3 were tree, 4 shrubs, 9 herb and 2 were grass species. The dominants were *Zizyphus maurtiana* (IV = 48.1),

Cenchrus ciliaris (IV = 34.53) and *Saccharum bengalense* (IV = 18.41). Other important species were *Dalbergia sissoo* (IV = 27.89), *Eragrostis poaoides* (IV = 21.3), *Saussurea heteromalla* (IV = 20.49) and *Calotropis procera* (IV = 11.76). The Importance value contributed by tree was 83.84, shrubs (IV = 48.34), herbs (IV = 111.99) and grasses (IV = 55.83) (Table 16). Microphyll and nanophyll were dominant leaf form spectrum while therophytes was dominant in life form spectrum.

Stand – 3

Stand 3 was present at altitude of 500 – 599 m asl with 37 plant species covering 6 trees, shrubs (12), herbs (14) and grasses (5) formed the *Aerua-Rhazya-Zizyphus* community (ARZ). In stand 3, the high number of plant species (21) were found in APA. The highest number of shrubs (7) and herbs (9) were present in APA. The highest TIV presented by three dominant species (157.24) were found in AAC while low TIV (84.19) in ASZ. The highest TIV of trees (71.95), shrubs (93.35), herbs (153.04) and grasses (121.42) were present in FPC, SZR, APA and CRZ respectively (Table 5). The different plant communities established are discussed below:

12. *Cymbopogon-Rhazya-Zizyphus* community (CRZ)

In Chokara the *Cymbopogon-Rhazya-Zizyphus* community was established at 530m and supported by 19 species in which 4 were trees, herbs, shrubs and grasses were 5, each. The Importance value contributed by tree was 47.46, shrubs (IV = 68.65), herbs (IV = 62.47) and grasses (IV = 121.42). The dominant were *Cymbopogon jwarancusa* (IV = 77.3), *Rhazya stricta* (IV = 34.95) and *Zizyphus maurtiana* (IV = 17.3). The other important species were *Fagonia cretica* (26.45), *Aerua persica* (20.12) and *Acacia modesta* (14.27) (Table 17). Biological spectrum showed hemicryptophytic vegetation dominated with 31.58 % followed by therophytes 26.31%. In the leaf form classes microphyll 52.63 % and leptophylls 21.05% dominated the community (Table 4). *Rhazya stricta* is a regularly grown shrub in the area. It is said by the inhabitants that they heard from their forefather that such plant was rare in the area. Dominance of this shrubs species pointed out disruption in the area. Hussain *et al*. (1995) stated that nonpalatable plants in nature were found in the grazing area.

13. *Aerua-Saccharum-Zizyphus* community (ASZ)

In Ambiri Kala the *Aerua-Saccharum-Zizyphus* community was structured at 565m asl. It is composed of 19 species which comprised of 4 tree, 6 shrubs, 4 herb and 5 grass species. The dominant members of the community were *Aerua persica* (IV = 44.26), *Saccharum bengalense* (IV = 26.16) and *Zizyphus maurtiana* (IV = 13.77). *Aerua persica* and *Saccharum bengalense* grew plentifully from base to the top hill vegetation. Other important species included *Cymbopogon jwarancusa* (IV = 35.91), *Dichanthium annulatum* (IV = 26.09), *Rhazya stricta* (IV = 20.03) and *Acacia modesta* (IV = 10.86). The Importance value contributed by tree was 33.73, shrubs (IV = 86.54), herbs (IV = 71.68) and grasses (IV = 108.05) (Table 18). According to Daubenmire & Daubenmire (1968) each plants layer was examined separately however the activities of plant components of the lower layer are to a large degree proscribed by the tree or dominant canopy strata. Similarly, all dominant groups of herbs, shrubs and trees were under these three major groups (Hussain *et al*., 1995). *Zizyphus maurtiana* is a regularly diminishing tree in the site. It is said by the local community that the area was affluent in that tree. People have cut the tree. The leaf form classes showed the microphyll and leptophylls dominated the community while in biological spectrum thero-hemicryptophytic vegetation dominated the community.

14. *Salvia-Zizyphus-Rhazya* community (SZR)

The *Salvia-Zizyphus-Rhazya* community at Takht-e-Nasrati developed with 580 m altitude was dominated by *Salvia moorcroftiana* (IV = 74.59), *Zizyphus maurtiana* (IV=39.9) and *Rhazya stricta* (IV = 36.84). *Withania coagulans* (IV = 25.44), *Eragrostis poaoides* (IV = 20.98) and *Saccharum bengalense* (IV = 15.08) were next important species. The community comprised of 16 species including 3 tree, 5 shrub, 5 herb and 3 grasses. The Importance value contributed by tree was 53.1, shrubs (IV = 93.35), herbs (IV = 114.22) and grasses (IV = 39.33) (Table 19). Malik *et al*. (2007) stated that the woody and perennial plant species stayed the similar while structure of community changed due to domination of annual plant species during spring which explained seasonal effects. Biological spectrum showed hemicryptophyte 31.25 % was dominated followed by therophytes 25%. In the leaf form classes microphyll 56.25 % dominated the community (Table 4).

15. *Fagonia-Phoenix-Capparis* community (FPC)

This community was developed at Siraj Khel. It is dominated by *Fagonia cretica* (IV=49.7), *Phoenix dactylifera* (IV = 48.5) and *Capparis decidua* (IV = 15.51). *Aerua persica* (IV = 31.97), *Cynodon dactylon* (IV = 16.32) and *Acacia nilotica* (IV = 10.29) were other important species. A total of 20 species were recorded containing 4 tree, 6 shrub, 5 herb and 5 grass species. The Importance value contributed by tree was 71.95, shrubs (IV = 53.12), herbs (IV = 105.77) and grasses (IV = 69.16) (Table 20). Qualitative evaluation of biological spectrum showed that therophytes and hemicryptophyte were dominant while microphyll 45 % followed by leptophylls 30 % was leading leaf size classes (Table 4). Sharma & Upadhyaya (2002) had same result and described that herbaceous flora was therophytic in nature. Grassland flora distinguished by hemicryptophytic whereas plant life as a whole was therophytic in nature (Saxena *et al*., 2004). Our results explained that habitat elimination had altered the composition of plant life from phanerophytes flora to therophytic. Leaf form spectrum also had the same finding with the results that microphyll and leptophyll determined the plant life of anxious situation.

16. *Fagonia-Withania -Zizyphus* community (FWZ)

The vegetation of Shahidan Banda at 577 m altitude, was composed by the dominance of *Fagonia cretica* (IV = 51.24), *Withania coagulans* (IV = 26.7) and *Zizyphus maurtiana* (IV = 25.53), along with *Aerua persica* (IV = 37.73), *Rhazya stricta* (IV = 26.11) and *Cassia angustifolia* (IV = 19.11) of the 15 recorded species. Furthermore, herbs, shrub and grasses were 4 in each and 3 were trees. The Importance value contributed by tree was 39.44, shrubs (IV = 81.27), herbs (IV = 111.93) and grasses (IV = 67.36) (Table 21). Biological spectrum showed that therophytes with 26.67% followed by hemicryptophytes and nanophanerophytes with 20% each were dominant while microphyll 53.33% and leptophylls 26.67 % were leading groups of leaf size classes (Table 4). The plant life was therophytic and site also showed degraded flora. Ali & Malik (2010) stated that human disturbance and seasonal behavior changed the pattern of flora. Overall plant life of Shahidan Banda was dominated by therophytes and microphyll followed by leptophyll. As altitude increases, leaf size reduced notably representing dry and xeric situation of the area.

17. *Aerua-Punica-Acacia* community (APA)

Community at Zarki Nasrati site was composed of 21 species including 2 trees, 7 shrubs, 9 herbs and 3 grasses. The Importance value contributed by tree was 36.44, shrubs (IV = 69.32), herbs (IV = 153.04) and grasses (IV = 41.2). *Aerua persica* (IV = 65.36), *Punica granatum* (IV = 22.18) and *Acacia modesta* (IV = 21.28) were dominant. *Echinops echinatus* (IV = 21.94), *Zizyphus maurtiana* (IV = 15.16) and *Cynodon dactylon* (IV = 13.79) were associated species (Table 22). The biological spectrum showed that hemicryptophytes (7 spp., 33.33%) was the dominant life form followed by therophytes (5 spp., 23.81%). Leaf spectra showed that microphyll was dominant (11 spp., 52.38%) followed by leptophyll (5 spp., 23.81%) (Table 4). Hemicryptophytes and therophytes were the dominating and showed that habitat maintained the plants for short lived annuals (Shah & Hussain, 2008).

18. *Aerua-Acacia-Capparis* community (AAC)

This site was located at Shawa at 590 m altitude. The habitat situation maintained *Aerua persica* (IV = 82.3), *Acacia modesta* (IV = 44.53) and *Capparis decidua* (IV = 30.41). A total of 14 species were documented. Among them 5 were shrubs while 3 were tree, herb and grasses in each. The Importance value contributed by tree was 70.98, shrubs (IV = 83.82), herbs (IV = 98.04) and grasses (IV = 47.16) (Table 23). The life form spectrum showed that therophytes (4 spp., 28.57%) was dominant. Leaf form spectrum showed that microphyll (7 spp., 50%) was dominant leaf form class followed by leptophyll (4 spp., 28.57%) and nanophyll (2 spp., 14.28%) (Table 4).

Stand - 4

In stand 4, 4 communities were present in different sites. 34 plant species consisting of 7 trees, 12 shrubs, 10 herbs and 5 grasses were present and shaped the *Zizyphus-Eragrostis-Rhazya* community (ZER). In stand 4, the highest number of species (15) were recorded in ARA. The highest number of trees (5), herbs (6) and grasses (5) were also found in ARA. The highest TIV contributed by three dominant species (109.61) was originated in ZAC whereas low (78.57) in DWZ. The highest TIV of trees (69.44), shrubs (93.79), herbs (101.79) and grasses (103.4) was found in EZC, ARA, DWZ and EZC respectively (Table 5). The different plant communities established are discussed below:

19. *Eragrostis-Zizyphus-Capparis* community (EZC)

This EZC community (*Eragrostis-Zizyphus-Capparis*) was developed at elevation of 540m in Kandu Khel. The habitat condition was dry. The plant species dominating the site were *Eragrostis poaoides* (IV = 50.5), *Zizyphus maurtiana* (IV = 48.47) and *Capparis decidua* (IV=20.6). A total of 19 plant species were recorded in the site which consisted of 3 species of trees, 7 species of shrubs, 5 species of herbs and 4 species were grasses. Co dominant species including *Fagonia cretica* (28.05), *Cenchrus ciliaris* (20.43) and *Rhazya stricta* (14.75) were present. The Importance value contributed by tree was 69.44, shrubs (IV = 72.92), herbs (IV = 54.24) and grasses (IV = 103.4) (Table 24). The qualitative analysis of biological spectrum indicated that hemicryptophytic vegetation (6 spp., 31.58 %) dominated followed by therophytes (5 spp., 26.31%). In leaf form analysis microphyll (8 spp., 42.11%) followed by leptophyll (6 spp., 31.58) were the dominant classes (Table 4).

20. *Aerua-Rhazya-Acacia* community (ARA)

The *Aerua-Rhazya-Acacia* community was located at elevation of 685 m in Shadi Khel. A total of 23 plant species were recorded in the community consisted of 5 trees, 7 shrubs, 6 herbs and 5 grass species. The dominant members included *Aerua persica* (IV=44.67) and *Cenchrus ciliaris* in herbaceous layer. *Rhazya stricta* (IV = 33.1) followed by *Astragalus psilocentros, Punica granatum and Saccharum bengalense* in shrubby layer. *Acacia modesta* (IV = 24.77) and *Phoenix dactylifera* were recorded in tree layer. The Importance value contributed by tree was 46.63, shrubs (IV = 93.79), herbs (IV = 77.05) and grasses (IV = 82.53) (Table 25). Microphyll and leptophyll were the dominant leaf size classes represented by 52.17% and 21.74% plants respectively and hemicryptophyte (8 spp., 34.78 %), megaphanerophytes (6 spp., 26.09) and therophytes (4 spp., 17.39) were the dominant life form classes (Table 4).

21. *Dichanthium-Withania-Zizyphus* community (DWZ)

This community was supported by 19 plant spceis comprised of 4 tree, 7 shrubs, 4 herbs and 4 grasses. The community was present in Sarki Lawager at 695 m altitude and dominated by *Dichanthium annulatum* (IV = 36.78) in herbaceous layer, *Withania coagulans* (IV = 19.95) in shrub layer and *Zizyphus maurtiana* (IV = 21.84) in

tree layer. The Importance value contributed by tree was 44.44, shrubs (IV = 64.69), herbs (IV = 101.79) and grasses (IV = 89.08). Co dominant species in ground strata included *Echinops echinatus, Fagonia cretica, Aerua persica* and *Cynodon dactyl. Capparis decidua, Saccharum spontaneum* and *Rhazya stricta* in second layer. *Acacia modesta* and *Monotheca buxifolia* in tree layer (Table 26). Hemicryptophyte, megaphanerophytes and nanophanerophytes were the dominant life form classes and microphyll was the leading dominant leaf size classes (57.89%) while other classes made only 42.11% (Table 4).

22. *Zizyphus-Aerua-Capparis* community (ZAC)

The community was established in Shnawa at 475 m altitude and comprised 15 plant species in which 3 tree, 4 shrubs, 5 herbs and 3 species belong to grass layer. The dominant members of the community in different layers were *Zizyphus maurtiana* (IV=48.69), *Aerua persica* (IV = 39.95) and *Capparis spinosa* (IV = 20.97). The co dominant species including *Eragrostis poaoides, Punica granatum* and *Acacia modesta* were there. The Importance value contributed by tree was 65.32, shrubs (IV = 66.21), herbs (IV = 98.38) and grasses (IV = 70.09) (Table 27). The biological spectrum revealed that megaphanerophytes followed by hemicryptophyte and therophytes were dominant classes. Microphyll followed by leptophyll were most representative classes of leaf form spectrum (Table 4). The aggregation of communities in the drier area can be easily construed to sustain the assumption (Malik & Hussain, 2006). The tree's cutting by natives and excavating of important medicinal herbs are increasingly changing the composition and distribution of plants life in the study area and its adjoining region. Hussain & Parveen (2009) stated that the goats and sheep are the major threat for the plant life. Grazing stress, becoming more vigorous every year and the habitat is being modified as seen in various locations.

The plant life riches of the area consisted of 161 plant species. The environment, ecological factors and plant life nature determined composition of communities. Communities are obliging in identification, naming and classification of plant life in area. According to Muller Dumbois & Ellenberg (1974) communities structures analyze, understand the plants at various exposures and give actual information regarding vegetation and are source for prophecy of expectations changes. Amigo *et al*. (2009)

revealed that phytosociological data give sound resources of ecological, chronological and taxonomic information. Biotic and abiotic factors are linked to each other and alteration in anybody aspect might cause a change in related structure. Brinkmann *et al*. (2009) analyzed the vegetation response to environmental condition of open woodlands along an altitudinal and a grazing gradient. Anthropogenic activities, overgrazing, habitat demolition, soil erosion, and accidental arrangement are factors that influenced plant life composition.

The current study links the vegetation composition to the edaphic and climatic position and planned possible environmental approaches for the development of plant resources and socioeconomic position of the area. A lot of work has been done by Osem *et al*. (2004), Rahbek (2005), Singh *et al*. (2005) and Abd El-Ghani & Abdel-Khalik (2006). The vegetation of Tehsil Takht-e-Nasrati was analyzed in three seasons, i.e. spring, summer and winter. In the study area, perennial and woody species continued nearly the same. Only annual herbs and some perennial shrubs species changed during different seasons that changed the structure of communities. Our results are similar with that of Malik (2005) and Ahmad *et al*. (2009a). Champion *et al*. (1965) stated that the different communities recognized in different seasons reflect different aspects. In each site of the investigated area the community structure were different due to the water stress and environmental condition. Cayuela *et al*. (2008) pointed out that water anxiety reduce the diversity in community development. Overgrazing, distressing, deforestation had distressed the natural flora to large level which had resulted deduction of shrubs species, tree and some medicinal plants. This has cause patchy vegetation on the hills and graveyards.

Table 4. Floristic and ecological diversity of plant species in different communities of Tehsil Takht-e-Nasrati, Karak.

S. No	Species Name	Family	Habit	Life Form						Leaf size					Seasons		
				The	Hem	Me	Nan	Ch	Mi	Mic	Nan	Le	Mes	Meg	S	Su	W
1	*Acacia modesta* Wall.	Mimosaceae	T	-	-	+	-	-	-	-	-	+	-	-	+	+	+
2	*Acacia nilotica* (L.) Delice	Mimosaceae	T	-	-	+	-	-	-	-	-	+	-	-	+	+	+
3	*Achyranthus aspera* L.	Amaranthaceae	H	-	+	-	-	-	-	+	-	-	-	-	-	-	+
4	*Aerua persica* (Burm.f) Merrill	Amaranthaceae	H	-	-	-	+	-	-	+	-	-	-	-	+	+	+
5	*Asparagus gracilis Royle.*	Asparagaceae	H	+	-	-	-	-	-	-	-	+	-	-	+	-	-
6	*Asphodelous tenuifolius* Cavan.	Asphodelaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
7	*Astragalus psilocentros* Fisch	Papilionaceae	S	-	-	-	+	-	-	-	-	+	-	-	+	+	+
8	*Boerhaavia diffusa* L..	Nyctaginaceae	H	-	-	-	-	+	-	+	-	-	-	-	-	+	+
9	*Calligonum polygonoides*	Polygonaceae	S	-	-	-	-	-	+	-	+	-	-	-	+	+	+
10	*Calotropis procera* (Wild) R.Br.	Asclepiadaceae	S	-	-	-	-	+	-	-	-	-	+	-	+	+	+
11	*Capparis decidua* (Forssk). Edge worth.	Capparidiaceae	S	-	-	-	-	-	+	-	+	-	-	-	+	+	+
12	*Capparis spinosa* L.	Capparidiaceae	S	-	-	-	-	+	-	+	-	-	-	-	+	+	+
13	*Carthamus oxycantha* Bieb.	Asteraceae	H	+	-	-	-	-	-	+	-	-	-	-	-	+	-
14	*Cassia angustifolia* Vahl	Caesalpiniaceae	S	-	-	-	-	+	-	+	-	-	-	-	+	+	+
15	*Cenchrus biflorus* Hook. f.	Poaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	+	+
16	*Cenchrus ciliaris* L.	Poaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	+
17	*Centaurea iberica* Trev.Ex. Spreng	Asteraceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	+
18	*Chenopodium album* L	Chenopodiaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
19	*Chenopodium mural* L.	Chenopodiaceae	H	+	-	-	-	-	-	-	-	-	+	-	-	-	+
20	*Chrozophora obliqua* (Vahl) A. Juss	Euphorbiaceae	H	-	-	-	-	+	-	-	-	-	+	-	-	+	-
21	*Citrullus colocynthis* L.	Cucurbitaceae	H	-	+	-	-	-	-	-	-	-	+	-	+	+	+

	Schrad																
22	*Cleome viscosa* L.	Capparidiaceae	H	+	-	-	-	-	-	+	-	-	-	-	-	+	+
23	*Convolvulus arvensis* L.	Convolvulaceae	H	-	+	-	-	-	-	-	-	-	+	-	+	-	+
24	*Convolvulus pluricaulis* Choisy	Convolvulaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	-	-
25	*Corchorus trilocularis* L.	Tiliaceae	H	+	-	-	-	-	-	+	-	-	-	-	-	-	+
26	*Crotalaria medicaginea* Lam.	Papilionaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	-
27	*Cymbopogon jwarancusa* (Jones) Schult	Poaceae	H	-	+	-	-	-	-	-	+	-	-	-	+	+	+
28	*Cynodon dactylon* (L.) Pers	Poaceae	H	-	+	-	-	-	-	-	-	+	-	-	+	+	+
29	*Cyperus rotundus* L.	Cyperaceae	H	-	+	-	-	-	-	-	-	+	-	-	+	+	+
30	*Cyperus scarlosus* R.Br.	Cyperaceae	H	-	+	-	-	-	-	-	-	+	-	-	-	-	+
31	*Dalbergia sissoo* Roxb	Papilionaceae	T	-	-	+	-	-	-	+	-	-	-	-	+	+	+
32	*Datura metel* L.	Solanaceae	S	-	-	-	+	-	-	-	-	-	-	+	+	+	+
33	*Desmostachya bipinnata* (L.) Stapf.	Poaceae	H	-	+	-	-	-	-	+	-	-	-	-	-	-	+
34	*Dichanthium annulatum* (Forssk) Staph	Poaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	-	+
35	*Digera muricata* (L). Mart.	Amaranthaceae	H	+	-	-	-	-	-	+	-	-	-	-	-	-	+
36	*Echinops echinatus* D.C.	Asteraceae	H	-	-	-	-	+	-	+	-	-	-	-	+	+	+
37	*Eragrostis poaoides* Beauv	Poaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	+	+
38	*Erodium malacoides* (L)L Her. Ex Ait.	Geraniaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
39	*Euphorbia helioscopia* L.	Euphorbiaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	+	+
40	*Euphorbia prostrata* Ait.	Euphorbiaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	+	+
41	*Fagonia cretica* L	Zygophyllaceae	H	+	-	-	-	-	-	-	-	+	-	-	+	+	+
42	*Gymnosporia royleana* Wall. ex M. A. Lawson	Celastraceae	T	-	-	-	+	-	-	+	-	-	-	-	+	+	+
43	*Heliotropium europaeum* L.	Boraginaceae	H	+	-	-	-	-	-	-	+	-	-	-	-	+	-

44	*Hypecoum pendulum* L.	Hypericaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	-
45	*Ifloga fontanesii* Cass	Asteraceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	+
46	*Ipomoea hederacea* (L.) Jacq.	Convolvulaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
47	*Kickxia ramosissima* (Wall) Janchen.	Scrophulariaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	-	+
48	*Launaea nudicaulis* (L.) Hook. f.	Asteraceae	H	-	+	-	-	-	-	+	-	-	-	-	+	+	+
49	*Malcolmia africana* (L) R.Br.	Brassicaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	-
50	*Malva parviflora* L.	Malvaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	-	+
51	*Malva neglecta* Wallr	Malvaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	-	+
52	*Malvastrum coromandelianum* (L.) Gareke.	Malvaceae	H	-	+	-	-	-	-	+	-	-	-	-	-	-	+
53	*Medicago laciniata* (L) Mill	Papilionaceae	H	+	-	-	-	-	-	-	-	+	-	-	+	-	+
54	*Melilotus indicus* (L.) All.	Papilionaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	-
55	*Monotheca buxifolia* (Falc.) A.DC.	Sapotaceae	T	-	-	+	-	-	-	+	-	-	-	-	+	+	+
56	*Peganum hermala* L.	Zygophyllaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	+	+
57	*Periploca aphylla* Decne.	Asclepiadaceae	S	-	-	-	+	-	-	+	-	-	-	-	+	+	+
58	*Phoenix dactylifera* L.	Arecaceae	T	-	-	+	-	-	-	+	-	-	-	-	+	+	+
59	*Phragmites karka* (Retz) Trin. ex. Steud.	Poaceae	H	-	+	-	-	-	-	+	-	-	-	-	-	-	+
60	*Plantago ciliata* Desf.	Plantaginaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
61	*Plantago ovata* Forssk.	Plantaginaceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
62	*Prosopis farcta* (Banks & Soland.) J.F. Macbr.	Mimosaceae	T	-	-	+	-	-	-	+	-	-	-	-	+	+	+
63	*Prosopis juliflora* (Sw.) DC	Mimosaceae	T	-	-	+	-	-	-	+	-	-	-	-	+	+	+
64	*Punica granatum* L	Punicaceae	S	-	-	+	-	-	-	+	-	-	-	-	+	+	+
65	*Pupalia lappacea* (L.)	Amaranthaceae	H	+	-	-	-	-	-	+	-	-	-	-	-	-	+

	Juss.																
66	*Rhazya stricta* Decne.	Apocynaceae	S	-	-	-	+	-	-	+	-	-	-	-	+	+	+
67	*Ricinus communis* L	Euphorbiaceae	S	-	-	-	+	-	-	-	-	-	-	+	+	+	+
68	*Rumex dentatus* L.	Polygonaceae	H	-	+	-	-	-	-	-	-	-	+	-	-	-	+
69	*Saccharum bengalense* Retz.	Poaceae	S	-	+	-	-	-	-	-	-	-	-	+	+	+	+
70	*Saccharum spontaneum* L.	Poaceae	S	-	+	-	-	-	-	-	-	-	-	+	+	+	+
71	*Salvia moorcroftiana* Wallich ex Benth.	Lamiaceae	H	+	-	-	-	-	-	-	-	-	-	+	+	+	+
72	*Saussurea heteromalla* (D.Don) Hand	Asteraceae	H	+	-	-	-	-	-	+	-	-	-	-	+	-	+
73	*Silene conoidea* L.	Caryophylaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	-
74	*Solanum incanum* L	Solanaceae	H	-	+	-	-	-	-	-	-	-	+	-	+	-	-
75	*Solanum nigrum* L.	Solanaceae	H	-	+	-	-	-	-	+	-	-	-	-	+	-	+
76	*Solanum surattense* Burm .f.	Solanaceae	H	-	+	-	-	-	-	-	-	-	+	-	+	+	+
77	*Tamarix aphylla* (L.) Karst.	Tamaricaceae	T	-	-	-	-	-	+	-	+	-	-	-	+	+	+
78	*Tribulus terrestris* L	Zygophyllaceae	H	-	+	-	-	-	-	+	-	-	-	-	-	+	+
79	*Vicia sativa* L.	Papilionaceae	H	+	-	-	-	-	-	-	+	-	-	-	+	-	+
80	*Withania coagulans* (Stocks) Dunal	Solanaceae	S	-	-	-	-	+	-	+	-	-	-	-	+	+	+
81	*Xanthium strumarium* L.	Asteraceae	H	+	-	-	-	-	-	-	-	-	-	+	-	-	+
82	*Zizyphus maurtiana* Lam	Rhamnaceae	T	-	-	+	-	-	-	+	-	-	-	-	+	+	+
83	*Zizyphus nummularia* (Burm.f) W & A.	Rhamnaceae	S	-	-	-	+	-	-	+	-	-	-	-	+	+	+
Total				**32**	**24**	**9**	**8**	**7**	**3**	**45**	**15**	**9**	**8**	**6**	**66**	**46**	**72**

Table 5. The number of species and share relative important value of tree, shrubs, herbs and grasses among the different communities during spring of Takht-e- Nasrati, Karak.

Stands	Sites	Communities	Total Species	Tree	Shrubs	Herbs	Grasses	TIV contribution by three dominants	TIV by remaining species	TIV by tree	TIV by shrubs	TIV by herbs	TIV by grasses
1	As a whole	PFS	32	6	6	18	2	72.88	227.12	68.8	65.29	147.97	17.94
	Tater Khel	PSS	23	4	5	12	2	86.76	213.24	71.53	54.08	135.69	38.7
	Gardi Banda	PSS	17	3	5	8	1	117.11	182.89	72.01	74.62	137.36	16.01
	Ahmad Abad	FPS	21	4	6	9	2	114.71	185.29	57.16	60.68	158.75	23.41
	Warana	PPA	20	4	4	11	1	101.07	198.93	74.48	71.79	143.39	10.34
2	As a whole	ZSC	43	4	6	28	3	81.73	218.27	49.41	60.59	139.34	20.65
	S Bogara	FZC	30	4	6	17	3	77.33	222.67	48.45	54.91	166.51	30.13
	N Bogara	ASC	24	4	6	13	1	103.19	196.81	99.32	68.21	120.68	11.79
	Gandiri Khattak	ZSC	17	2	4	8	3	131.49	168.51	91.29	62.85	97.73	48.13
	Kiri Dhand	CZS	20	3	5	10	2	80.24	219.76	47.04	63.29	155.33	34.34
	Jahangiri Banda	ZAC	17	3	4	10	-	99.96	200.04	68.27	65.88	165.85	-
	Mona Khel	ZCF	17	3	4	8	2	153.47	146.53	117.65	60.68	106.07	15.6
	Jarassi	ZCS	18	3	4	9	2	101.04	198.96	83.84	48.34	111.99	55.83
3	As a whole	ARZ	37	6	12	14	5	81.36	218.64	50.44	76.58	113.35	59.63
	Chokara	CRZ	19	4	5	5	5	129.55	170.45	47.46	68.65	62.47	121.42
	Ambiri Kala	ASZ	19	4	6	4	5	84.19	215.81	33.73	86.54	71.68	108.05
	Takht-e- Nasrati	SZR	16	3	5	5	3	151.33	148.67	53.1	93.35	114.22	39.33
	Siraj khel	FPC	20	4	6	5	5	113.71	186.29	71.95	53.12	105.77	69.16
	Shahidan Banda	FWZ	15	3	4	4	4	103.47	196.53	39.44	81.27	111.93	67.36
	Zarki Nasrati	APA	21	2	7	9	3	108.82	191.18	36.44	69.32	153.04	41.2
	Shawa	AAC	14	3	5	3	3	157.24	142.76	70.98	83.82	98.04	47.16
4	As a whole	ZER	34	7	12	10	5	76.12	223.88	56.56	74.4	103.57	65.58
	Kandu Khel	EZC	19	3	7	5	4	97.12	202.88	69.44	72.92	54.24	103.4
	Shadi Khel	ARA	23	5	7	6	5	84.22	215.78	46.63	93.79	77.05	82.53
	Sarki Lawager	DWZ	19	4	7	4	4	78.57	221.43	44.44	64.69	101.79	89.08
	Shnawa	ZAC	15	3	4	5	3	109.61	190.39	65.32	66.21	98.38	70.09

Table 6. Phytosociological attributes of *Prosopis- Saussurea- Saccharum* community recorded at Tater Khel during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.4	40	0.5	2.7	4.21	1.35	8.26
2	*Phoenix dactylifera* L.	0.8	30	1.3	5.37	3.16	3.52	12.05
3	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	1.6	100	6.05	10.7	10.5	16.4	37.6
4	*Zizyphus maurtiana* Lam.	0.6	50	1.6	4.03	5.26	4.33	13.62
Shrubby layer								
5	*Calotropis procera* (Wild.) R.Br.	0.5	50	0.75	3.36	5.26	2.03	10.65
6	*Datura metel* L.	0.5	50	0.57	3.36	5.26	1.54	10.16
7	*Periploca aphylla* Decne.	0.3	30	0.18	2.01	3.16	0.49	5.66
8	*Ricinus communis* L.	0.5	40	0.42	3.36	4.21	1.14	8.71
9	*Saccharum bengalense* Retz.	1.8	50	0.57	12.1	5.26	1.54	18.9
Herbaceous layer								
10	*Citrullus colocynthis* L. Schrad.	0.1	20	1.5	0.67	2.11	4.06	6.84
11	*Convolvulus arvensis* L.	0.4	30	0.75	2.68	3.16	2.03	7.87
12	*Cynodon dactylon* (L.) Pers.	2	40	1	13.4	4.21	2.71	20.32
13	*Eragrostis poaoides* Beauv.	0.7	40	3.5	4.7	4.21	9.47	18.38
14	*Euphorbia helioscopia* L.	0.5	30	0.75	3.36	3.16	2.03	8.55
15	*Euphorbia prostrata* Ait.	0.7	30	0.75	4.7	3.16	2.03	9.89
16	*Ifloga fontanesii* Cass.	0.6	60	1.5	4.03	6.32	4.06	14.41
17	*Plantago ciliata* Desf.	0.3	30	0.75	2.01	3.16	2.03	7.2
18	*Plantago ovata* Forssk.	0.6	60	1.5	4.03	6.32	4.06	14.41
19	*Solanum nigrum* L.	0.4	40	1	2.7	4.21	2.7	9.61
20	*Saussurea heteromalla* (D.Don) Hand.	0.7	50	7.5	4.7	5.26	20.3	30.26
21	*Silene conoidea* L.	0.2	20	0.5	1.34	2.11	1.35	4.8
22	*Solanum surattense* Burm .f.	0.2	20	3	1.34	2.11	8.12	11.57
23	*Vicia sativa* L.	0.5	40	1	3.36	4.21	2.71	10.28

Table 7. Phytosociological attributes of *Phoenix –Saussurea- Saccharum* community recorded at Gardi Banda during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Dalbergia sissoo* Roxb.	0.3	30	0.35	2.16	4.11	0.95	7.22
2	*Phoenix dactylifera* L.	3.1	100	6.7	22.3	13.7	18.3	54.3
3	*Zizyphus maurtiana* Lam.	0.4	40	0.78	2.88	5.48	2.13	10.49
Shrubby layer								
4	*Calotropis procera* (Wild) R.Br.	0.5	50	0.57	3.6	6.85	1.55	12
5	*Datura metel* L.	1.5	70	0.51	10.8	9.59	1.39	21.78
6	*Periploca aphylla* Decne.	0.2	20	0.12	1.44	2.74	0.33	4.51
7	*Ricinus communis* L.	0.3	30	0.36	2.16	4.1	0.98	7.24
8	*Saccharum bengalense* Retz.	2.7	60	0.54	19.4	8.22	1.47	29.09
Herbaceous layer								
9	*Aerua persica* (Burm.f) Merrill.	0.4	40	6	2.88	5.48	16.4	24.76
10	*Citrullus colocynthis* L. Schrad.	0.3	30	3.25	2.16	4.11	8.86	15.13
11	*Eragrostis poaoides* Beauv.	0.8	50	1.25	5.76	6.85	3.4	16.01
12	*Ifloga fontanesii* Cass.	0.8	40	1	5.76	5.48	2.73	13.97
13	*Plantago ciliata* Desf.	0.5	30	0.75	3.6	4.1	2.04	9.74
14	*Plantago ovata* Forssk.	0.7	40	1	5.04	5.48	2.73	13.25
15	*Saussurea heteromalla* (D.Don) Hand.	0.9	50	7.5	6.47	6.85	20.4	33.72
16	*Solanum surattense* Burm .f.	0.2	20	5.25	1.44	2.74	14.3	18.48
17	*Vicia sativa* L.	0.3	30	0.75	2.16	4.11	2.04	8.31

Table 8. Phytosociological attributes of *Fagonia –Prosopis- Saccharum* community recorded at Ahmad Abad, during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.34	1.76	3.2	0.5	5.46
2	*Dalbergia sissoo* Roxb.	0.3	20	0.33	1.76	2.15	0.5	4.41
3	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	1.8	80	6.56	10.6	8.6	10.1	29.3
4	*Zizyphus maurtiana* Lam.	1.1	70	2.6	6.47	7.53	3.99	17.99
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	0.5	40	0.51	2.94	4.3	0.78	8.02
6	*Datura metel* L.	0.9	50	0.3	5.3	5.38	0.46	11.14
7	*Periploca aphylla* Decne.	0.5	50	0.3	2.94	5.38	0.46	8.78
8	*Ricinus communis* L.	0.7	50	0.39	4.12	5.38	0.6	10.1
9	*Saccharum bengalense* Retz.	1.8	50	0.75	10.6	5.38	1.15	17.13
10	*Saccharum spontaneum* L.	0.5	20	0.3	2.9	2.15	0.46	5.51
Herbaceous layer								
11	*Aerua persica* (Burm.f) Merrill	0.5	50	6.25	2.94	5.38	9.6	17.92
12	*Cenchrus biflorus* Hook. f.	1.6	50	1.25	9.4	5.38	1.9	16.68
13	*Convolvulus arvensis* L.	0.3	20	0.5	1.76	2.15	0.77	4.68
14	*Eragrostis poaoides* Beauv.	0.4	30	0.75	2.35	3.23	1.15	6.73
15	*Euphorbia helioscopia* L.	0.3	20	0.5	1.76	2.15	0.77	4.68
16	*Fagonia cretica* L.	2.9	90	27	17.1	9.68	41.5	68.28
17	*Peganum hermala* L.	0.9	80	10.75	5.29	8.6	16.5	30.39
18	*Plantago ciliata* Desf.	0.5	40	1	2.94	4.3	1.54	8.78
19	*Plantago ovata* Forssk.	0.5	30	0.75	2.94	3.23	1.15	7.32
20	*Saussurea heteromalla* (D.Don) Hand.	0.4	40	1	2.35	4.3	1.54	8.19
21	*Solanum surattense* Burm. f.	0.3	20	3	1.76	2.15	4.6	8.51

Table 9. Phytosociological attributes of *Prosopis- Periploca- Aerua* community recorded at Warana during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.53	1.34	2.27	1.3	4.91
2	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	1.6	90	10.64	10.7	10.2	25.9	46.8
3	*Tamarix aphylla* (L.) Karst.	0.2	20	1.86	1.34	2.27	4.52	8.13
4	*Zizyphus maurtiana* Lam.	0.7	70	0.82	4.7	7.95	1.99	14.64
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	0.5	40	0.24	3.36	4.55	0.58	8.49
6	*Datura metel* L.	0.6	40	0.19	4.03	4.55	0.46	9.04
7	*Periploca aphylla* Decne.	2.7	80	1.89	18.1	9.09	4.6	31.79
8	*Saccharum bengalense* Retz.	2	70	0.46	13.4	7.95	1.12	22.47
Herbaceous layer								
9	*Aerua persica* (Burm.f) Merrill.	0.3	20	7.5	2.01	2.27	18.2	22.48
10	*Chenopodium album* L.	0.2	20	3	1.34	2.27	7.3	10.91
11	*Eragrostis poaoides* Beauv.	0.5	40	1	3.36	4.55	2.43	10.34
12	*Euphorbia helioscopia* L.	0.5	40	1	3.36	4.55	2.43	10.34
13	*Fagonia cretica* L.	0.8	60	4	5.4	6.82	9.73	21.95
14	*Ifloga fontanesii* Cass.	1.2	50	2.5	8.05	5.7	6.08	19.83
15	*Malcolmia africana* (L) R.Br.	0.3	30	0.75	2.01	3.41	1.82	7.24
16	*Plantago ciliata* Desf.	0.8	50	1.25	5.4	5.68	3.04	14.12
17	*Plantago ovata* Forssk.	0.6	30	0.75	4.03	3.41	1.82	9.26
18	*Solanum nigrum* L.	0.5	40	1	3.36	4.55	2.43	10.34
19	*Saussurea heteromalla* (D.Don) Hand.	0.4	40	1	2.7	4.55	2.43	9.68
20	*Silene conoidea* L.	0.3	30	0.75	2.01	3.41	1.82	7.24

Table 10. Phytosociological attributes of *Fagonia-Zizyphus-Saccharum* community recorded at Southern area of Bogara during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.37	1.16	1.98	0.59	3.73
2	*Dalbergia sissoo* Roxb.	0.2	20	1.02	1.16	1.98	1.6	4.74
3	*Phoenix dactylifera* L.	1.2	50	2.27	6.98	4.95	3.6	15.53
4	*Zizyphus maurtiana* Lam.	1.4	80	5.3	8.14	7.92	8.39	24.45
Shrubby layer								
5	*Calligonum polygonoides* L.	1.2	60	0.54	6.98	5.94	0.86	13.78
6	*Calotropis procera* (Wild) R.Br.	0.7	50	0.1	4.07	4.95	0.16	9.18
7	*Datura metel* L.	0.4	40	0.19	2.33	3.96	0.3	6.59
8	*Periploca aphylla* Decne.	0.2	20	0.12	1.16	1.98	0.19	3.33
9	*Ricinus communis* L.	0.3	30	0.18	1.74	2.97	0.29	5
10	*Saccharum bengalense* Retz.	2	50	0.3	11.6	4.95	0.48	17.03
Herbaceous layer								
11	*Aerua persica* (Burm.f) Merrill.	0.3	20	12.5	1.74	1.98	19.8	23.52
12	*Asphodelous tenuifolius* Cavan.	0.7	40	3.5	4.1	3.96	5.54	13.6
13	*Cenchrus ciliaris* L.	1.3	40	1	7.56	3.96	1.58	13.1
14	*Centaurea iberica* Trev.Ex. Spreng	0.2	20	3	1.16	1.98	4.75	7.89
15	*Citrullus colocynthis* L. Schrad.	0.2	20	3	1.16	1.98	4.75	7.89
16	*Cynodon dactylon* (L.) Pers.	0.8	20	0.5	4.65	1.98	0.79	7.42
17	*Echinops echinatus* D.C.	0.3	30	0.75	1.74	2.97	1.19	5.9
18	*Eragrostis poaoides* Beauv.	0.7	40	1	4.07	3.96	1.58	9.61
19	*Fagonia cretica* L.	1.5	70	12.75	8.72	6.93	20.2	35.85
20	*Ipomoea hederacea* (L.)Jacq.	0.2	20	3	1.16	1.98	4.75	7.89
21	*Launaea nudicaulis* (L.) Hook. f.	0.3	30	0.75	1.74	2.97	1.19	5.9
22	*Cyperus rotundus* L.	0.5	40	1	2.91	3.96	1.58	8.45
23	*Malcolmia africana* (L) R.Br.	0.2	20	0.5	1.16	1.98	0.79	3.93
24	*Malva parviflora* L.	0.3	30	0.75	1.74	2.97	1.19	5.9
25	*Malva neglecta* Wallr.	0.3	30	0.75	1.74	2.97	1.19	5.9
26	*Solanum nigrum* L.	0.3	20	0.5	1.74	1.98	0.79	4.51
27	*Saussurea heteromalla* (D.Don) Hand.	0.3	30	4.5	1.74	2.97	7.13	11.84
28	*Silene conoidea* L.	0.2	20	0.5	1.16	1.98	0.79	3.93
29	*Solanum surattense* Burm .f.	0.1	10	1.5	0.6	0.99	2.38	3.97
30	*Vicia sativa* L.	0.7	40	1	4.1	3.96	1.58	9.64

Table 11. Phytosociological attributes of *Acacia-Saccharum-Citrullus* community recorded at Northern area of Bogara during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	2.5	70	14.7	17	7.69	38.6	63.29
2	*Dalbergia sissoo* Roxb.	0.3	30	0.72	2.04	3.3	1.89	7.23
3	*Phoenix dactylifera* L.	0.3	10	0.8	2.04	1.1	2.1	5.24
4	*Zizyphus maurtiana* Lam.	1.1	60	3.61	7.48	6.59	9.49	23.56
Shrubby layer								
5	*Calligonum polygonoides* L.	1.1	40	0.24	7.48	4.4	0.63	12.51
6	*Calotropis procera* (Wild) R.Br.	0.5	50	0.39	3.4	5.49	1.03	9.92
7	*Datura metel* L.	0.5	50	0.3	3.4	5.49	0.79	9.68
8	*Periploca aphylla* Decne.	0.3	30	0.18	2.04	3.3	0.47	5.81
9	*Ricinus communis* L.	0.4	40	0.24	2.72	4.4	0.63	7.75
10	*Saccharum bengalense* Retz.	2.2	60	0.36	15	6.59	0.95	22.54
Herbaceous layer								
11	*Asphodelous tenuifolius* Cavan.	0.6	50	1.25	4.08	5.49	3.3	12.87
12	*Citrullus colocynthis* L. Schrad.	0.2	20	5.25	1.36	2.2	13.8	17.36
13	*Crotalaria medicaginea* Lam.	0.3	30	0.75	2.04	3.3	1.97	7.31
14	*Eragrostis poaoides* Beauv.	0.7	40	1	4.76	4.4	2.63	11.79
15	*Erodium malacoides* (L)L Her. Ex Ait.	0.2	20	0.5	1.36	2.2	1.31	4.87
16	*Ifloga fontanesii* Cass.	0.5	30	0.75	3.4	3.3	1.97	8.67
17	*Kickxia ramosissima* (Wall) Janchen.	0.4	40	1	2.72	4.4	2.63	9.75
18	*Launaea nudicaulis* (L.) Hook. f.	0.4	40	1	2.72	4.4	2.63	9.75
19	*Cyperus rotundus* L.	0.3	30	0.75	2.04	3.3	1.97	7.31
20	*Malva parviflora* L.	0.5	50	1.25	3.4	5.49	3.3	12.19
21	*Malva neglecta* Wallr.	0.6	40	1	4.08	4.4	2.63	11.11
22	*Melilotus indicus* (L.) All.	0.3	30	0.75	2.04	3.3	1.97	7.31
23	*Solanum nigrum* L.	0.2	20	0.5	1.36	2.2	1.31	4.87
24	*Vicia sativa* L.	0.3	30	0.75	2.04	3.3	1.97	7.31

Table 12. Phytosociological attributes of *Zizyphus-Saccharum-Cynodon* community recorded at Gandiri Khattak during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.67	2.88	4.48	1.53	8.89
2	*Zizyphus maurtiana* Lam.	1.4	100	23.71	13.5	14.9	54	82.4
Shrubby Layer								
3	*Calotropis procera* (Wild) R.Br.	0.5	50	0.3	4.81	7.46	0.68	12.95
4	*Datura metel* L.	0.5	40	0.19	4.81	5.97	0.43	11.21
5	*Periploca aphylla* Decne.	0.4	40	0.09	3.85	5.97	0.21	10.03
6	*Saccharum bengalense* Retz.	1.8	70	0.42	17.3	10.4	0.96	28.66
Herbaceous layer								
7	*Cenchrus ciliaris* L.	0.6	30	0.75	5.77	4.48	1.71	11.96
8	*Cynodon dactylon* (L.) Pers.	1.1	20	3	10.6	2.99	6.84	20.43
9	*Echinops echinatus* D.C.	0.5	40	1	4.81	5.97	2.28	13.06
10	*Eragrostis poaoides* Beauv.	0.4	30	3.25	3.85	4.48	7.41	15.74
11	*Fagonia cretica* L.	0.3	20	3	2.88	2.99	6.84	12.71
12	*Ifloga fontanesii* Cass.	1	50	1.25	9.62	7.46	2.85	19.93
13	*Launaea nudicaulis* (L.) Hook. f.	0.3	30	0.75	2.88	4.48	1.71	9.07
14	*Cyperus rotundus* L.	0.2	20	0.5	1.92	2.99	1.14	6.05
15	*Melilotus indicus* (L.) All.	0.4	40	1	3.85	5.97	2.28	12.1
16	*Solanum surattense* Burm .f.	0.2	20	3	1.92	2.99	6.84	11.75
17	*Vicia sativa* L.	0.5	40	1	4.81	5.97	2.28	13.06

Table 13. Phytosociological attributes of *Calligonum*-Zizyphus-*Saussurea* community recorded at Kiri Dhand during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.5	40	0.7	4.46	4.65	2.81	11.92
2	*Dalbergia sissoo* Roxb.	0.3	30	0.4	2.68	3.49	1.61	7.78
3	*Zizyphus maurtiana* Lam.	0.8	80	2.7	7.14	9.3	10.9	27.34
Shrubby layer								
4	*Calligonum polygonoides* L.	1.5	70	1.54	13.4	8.14	6.2	27.74
5	*Calotropis procera* (Wild) R.Br.	0.4	40	0.19	3.57	4.65	0.8	9.02
6	*Datura metel* L.	0.4	40	0.24	3.57	4.65	0.96	9.18
7	*Periploca aphylla* Decne.	0.3	30	0.18	2.68	3.49	0.72	6.89
8	*Saccharum bengalense* Retz.	0.7	30	0.18	6.25	3.49	0.72	10.46
Herbaceous layer								
9	*Asparagus gracilis Royle.*	1.2	50	1.25	10.7	5.81	5.02	21.53
10	*Cenchrus ciliaris* L.	0.7	50	1.25	6.25	5.81	5.02	17.08
11	*Eragrostis poaoides* Beauv.	0.4	40	2.25	3.57	4.65	9.04	17.26
12	*Hypecoum pendulum* L.	0.6	50	2.5	5.36	5.81	10	21.17
13	*Ifloga fontanesii* Cass.	0.5	50	1.25	4.46	5.81	5.02	15.29
14	*Launaea nudicaulis* (L.) Hook. f.	0.6	50	1.25	5.36	5.81	5.02	16.19
15	*Malva parviflora* L.	0.3	30	0.75	2.68	3.5	3.01	9.19
16	*Malva neglecta* Wallr.	0.5	50	1.25	4.46	5.81	5.02	15.29
17	*Solanum nigrum* L.	0.3	30	0.75	2.68	3.49	3.01	9.18
18	*Saussurea heteromalla* (D.Don) Hand Mazz.	0.4	30	4.5	3.57	3.49	18.1	25.16
19	*Silene conoidea* L.	0.2	20	0.5	1.8	2.33	2.01	6.14
20	*Vicia sativa* L.	0.6	50	1.25	5.36	5.81	5.02	16.19

Table 14. Phytosociological attributes of *Zizyphus-Aerua-Calligonum* community recorded at Jahangiri banda during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.3	2.33	4.05	0.67	7.05
2	*Dalbergia sissoo* Roxb.	0.8	50	1.63	6.2	6.76	3.66	16.62
3	*Zizyphus maurtiana* Lam.	2.7	80	5.75	20.9	10.8	12.9	44.6
Shrubby layer								
4	*Calligonum polygonoides* L.	1.5	80	0.57	11.6	10.8	1.28	23.68
5	*Calotropis procera* (Wild) R.Br.	0.5	50	0.39	3.88	6.76	0.88	11.52
6	*Ricinus communis* L.	0.4	40	0.33	3.1	5.41	0.74	9.25
7	*Saccharum bengalense* Retz.	1.8	50	0.3	14	6.76	0.67	21.43
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.3	30	11.25	2.33	4.05	25.3	31.68
9	*Chenopodium album* L.	0.5	30	4.5	3.88	4.05	10.1	18.03
10	*Citrullus colocynthis* L. Schrad.	0.2	20	5.25	1.55	2.7	11.8	16.05
11	*Convolvulus arvensis* L.	0.4	30	0.75	3.1	4.05	1.68	8.83
12	*Asparagus gracilis* Royle.	0.5	40	2.25	3.88	5.41	5.05	14.34
13	*Euphorbia helioscopia* L.	0.6	30	2	4.65	4.05	4.49	13.19
14	*Euphorbia prostrata* Ait.	0.9	60	1.5	6.98	8.11	3.37	18.46
15	*Plantago ciliata* Desf.	0.7	60	1.5	5.43	8.11	3.37	16.91
16	*Plantago ovata* Forssk.	0.6	40	1	4.65	5.41	2.25	12.31
17	*Solanum surattense* Burm .f.	0.2	20	5.25	1.55	2.7	11.8	16.05

Table 15. Phytosociological attributes of *Zizyphus-Calligonum-Fagonia* community recorded at Mona Khel during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.23	1.35	2.7	0.51	4.56
2	*Dalbergia sissoo* Roxb.	0.7	50	1.4	4.73	6.76	3.1	14.59
3	*Zizyphus maurtiana* Lam.	4	100	26.2	27	13.5	58	98.5
Shrubby layer								
4	*Calligonum polygonoides* L.	1.9	90	1.18	12.8	12.2	2.61	27.61
5	*Calotropis procera* (Wild) R.Br.	0.3	30	0.36	2.03	4.05	0.8	6.88
6	*Datura metel* L.	0.4	40	0.24	2.7	5.4	0.53	8.63
7	*Saccharum bengalense* Retz.	1.5	50	0.3	10.1	6.76	0.7	17.56
Herbaceous layer								
8	*Cenchrus ciliaris* L.	0.7	30	0.75	4.73	4.05	1.66	10.44
9	*Chenopodium album* L.	0.3	30	2	2.03	4.05	4.43	10.51
10	*Convolvulus arvensis* L.	0.2	20	0.5	1.35	2.7	1.11	5.16
11	*Eragrostis poaoides* Beauv	0.2	20	0.5	1.35	2.7	1.11	5.16
12	*Euphorbia helioscopia* L.	0.7	40	1	4.73	5.41	2.21	12.35
13	*Euphorbia prostrata* Ait.	0.3	30	0.75	2.03	4.05	1.66	7.74
14	*Fagonia cretica* L.	1	50	6.25	6.8	6.76	13.8	27.36
15	*Ifloga fontanesii* Cass.	1.3	60	1.5	8.8	8.11	3.32	20.23
16	*Plantago ciliata* Desf.	0.5	30	0.75	3.4	4.05	1.66	9.11
17	*Plantago ovata* Forssk.	0.6	50	1.25	4.05	6.76	2.8	13.61

Table 16. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Jarassi during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.53	2.5	3.61	1.74	7.85
2	*Dalbergia sissoo* Roxb.	0.5	50	5.4	4.17	6.02	17.7	27.89
3	*Zizyphus maurtiana* Lam.	1.7	100	6.7	14.2	12	21.9	48.1
Shrubby layer								
4	*Calotropis procera* (Wild) R.Br.	0.5	50	0.48	4.17	6.02	1.57	11.76
5	*Datura metel* L.	0.4	40	0.33	3.33	4.82	1.08	9.23
6	*Periploca aphylla* Decne.	0.4	40	0.24	3.33	4.82	0.79	8.94
7	*Saccharum bengalense* Retz.	1.2	60	0.36	10	7.23	1.18	18.41
Herbaceous layer								
8	*Asphodelous tenuifolius* Cavan.	0.4	40	1	3.33	4.82	3.27	11.42
9	*Cenchrus ciliaris* L.	1.7	60	4	14.2	7.23	13.1	34.53
10	*Eragrostis poaoides* Beauv.	1.1	60	1.5	9.17	7.23	4.9	21.3
11	*Euphorbia helioscopia* L.	0.6	40	1	5	4.82	3.27	13.09
12	*Launaea nudicaulis* (L.) Hook. f.	0.4	40	1	3.33	4.82	3.27	11.42
13	*Cyperus rotundus* L.	0.3	30	0.75	2.5	3.6	2.46	8.56
14	*Malcolmia africana* (L) R.Br.	0.5	40	1	4.17	4.82	3.27	12.26
15	*Solanum nigrum* L.	0.2	20	0.5	1.67	2.41	1.64	5.72
16	*Saussurea heteromalla* (D.Don) Hand.	0.5	40	3.5	4.17	4.82	11.5	20.49
17	*Silene conoidea* L.	0.4	40	1	3.33	4.82	3.27	11.42
18	*Vicia sativa* L.	0.9	50	1.25	7.5	6.02	4.09	17.61

Table 17. Phytosociological attributes of *Cymbopogon-Rhazya-Zizyphus* community recorded at Chokara during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.8	50	0.7	5.93	6.85	1.49	14.27
2	*Acacia nilotica* (L.) Delice.	0.5	40	0.55	3.7	5.48	1.2	10.38
3	*Dalbergia sissoo* Roxb.	0.3	20	0.26	2.22	2.74	0.55	5.51
4	*Zizyphus maurtiana* Lam.	0.7	50	2.47	5.2	6.85	5.25	17.3
Shrubby layer								
5	*Periploca aphylla* Decne.	0.2	20	0.06	1.48	2.74	0.13	4.35
6	*Rhazya stricta* Decne	3.4	60	0.72	25.2	8.22	1.53	34.95
7	*Saccharum bengalense* Retz.	0.5	40	0.33	3.7	5.48	0.7	9.88
8	*Saccharum spontaneum* L.	0.2	20	0.12	1.48	2.74	0.25	4.47
9	*Zizyphus nummularia* (Burm.f.) W. & A.	0.6	60	1.1	4.44	8.22	2.34	15
Herbaceous layer								
10	*Aerua persica* (Burm.f.) Merrill.	0.2	20	7.5	1.48	2.74	15.9	20.12
11	*Asparagus gracilis* Royle.	0.5	50	1.25	3.7	6.85	2.7	13.25
12	*Cenchrus ciliaris* L.	0.3	30	0.75	2.22	4.11	1.6	7.93
13	*Convolvulus pluricaulis* Choisy.	0.2	20	1.75	1.48	2.74	3.72	7.94
14	*Cymbopogon jwarancusa* (Jones) Schult.	3	100	19.5	22.2	13.7	41.4	77.3
15	*Dichanthium annulatum* (Forssk) Staph.	0.4	30	0.75	2.96	4.11	1.6	8.67
16	*Eragrostis poaoides* Beauv.	0.9	40	1	6.67	5.48	2.12	14.27
17	*Fagonia cretica* L.	0.5	50	7.5	3.7	6.85	15.9	26.45
18	*Malcolmia africana* (L) R.Br.	0.1	10	0.25	0.74	1.37	0.53	2.64
19	*Solanum incanum* L.	0.2	20	0.5	1.48	2.74	1.1	5.32

Table 18. Phytosociological attributes of *Aerua-Saccharum-Zizyphus* community recorded at Ambiri Kala during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.6	50	0.2	3.7	6.76	0.4	10.86
2	*Acacia nilotica* (L.) Delice.	0.1	10	0.05	0.6	1.35	0.1	2.05
3	*Dalbergia sissoo* Roxb.	0.4	30	0.25	2.5	4.05	0.5	7.05
4	*Zizyphus maurtiana* Lam.	0.8	60	0.33	5	8.11	0.66	13.77
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	2.6	60	0.63	16.3	8.11	1.26	25.67
6	*Calotropis procera* (Wild.) R.Br.	0.1	10	0.06	0.63	1.35	0.12	2.1
7	*Capparis decidua* (Forssk). Edgeworth.	0.3	30	0.18	1.88	4.05	0.36	6.29
8	*Rhazya stricta* Decne.	1.8	60	0.31	11.3	8.11	0.62	20.03
9	*Saccharum bengalense* Retz.	2.3	80	0.48	14.4	10.8	0.96	26.16
10	*Zizyphus nummularia* (Burm.f.) W. & A	0.3	30	0.18	1.88	4.05	0.36	6.29
Herbaceous layer								
11	*Aerua persica* (Burm.f.) Merrill.	0.6	40	17.5	3.75	5.41	35.1	44.26
12	*Cenchrus ciliaris* L.	0.5	30	0.75	3.1	4.05	1.5	8.65
13	*Cymbopogon jwarancusa* (Jones) Schult.	0.8	40	12.75	5	5.41	25.5	35.91
14	*Cynodon dactylon* (L.) Pers.	1.6	50	1.25	10	6.76	2.5	19.26
15	*Dichanthium annulatum* (Forssk) Staph.	1.5	40	6	9.38	5.41	12	26.79
16	*Eragrostis poaoides* Beauv.	0.7	30	4.5	4.38	4.05	9.01	17.44
17	*Fagonia cretica* L.	0.4	30	0.75	2.5	4.05	1.5	8.05
18	*Launaea nudicaulis* (L.) Hook. f.	0.4	40	0.75	2.5	5.41	1.5	9.41
19	*Medicago laciniata* (L) Mill.	0.2	20	3	1.25	2.7	6.01	9.96

Table 19. Phytosociological attributes of *Salvia-Zizyphus-Rhazya* community recorded at Takht-e-Nasrati during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	30	0.23	3.68	4.05	0.5	8.23
2	*Acacia nilotica* (L.) Delice.	0.2	20	0.37	1.47	2.7	0.8	4.97
3	*Zizyphus maurtiana* Lam.	1.6	90	7.35	11.8	12.2	15.9	39.9
Shrubby layer								
4	*Rhazya stricta* Decne.	3.4	80	0.48	25	10.8	1.04	36.84
5	*Saccharum bengalense* Retz.	0.9	60	0.16	6.62	8.11	0.35	15.08
6	*Saccharum spontaneum* L.	0.4	40	0.09	2.94	5.41	0.19	8.54
7	*Withania coagulans* (Stocks) Dunal.	2.1	70	0.27	15.4	9.46	0.58	25.44
8	*Zizyphus nummularia* (Burm.f.) W. & A.	0.3	30	0.55	2.21	4.05	1.19	7.45
Herbaceous layer								
9	*Cenchrus ciliaris* L.	0.4	40	1	2.94	5.4	2.16	10.5
10	*Convolvulus pluricaulis* Choisy.	0.2	20	0.5	1.47	2.7	1.08	5.25
11	*Dichanthium annulatum* (Forssk) Staph.	0.3	30	0.75	2.2	4.05	1.6	7.85
12	*Echinops echinatus* D.C.	0.3	30	4.5	2.21	4.05	9.73	15.99
13	*Eragrostis poaoides* Beauv.	1.2	50	2.5	8.82	6.76	5.4	20.98
14	*Fagonia cretica* L.	0.5	50	1.25	3.68	6.76	2.7	13.14
15	*Launaea nudicaulis* (L.) Hook. f.	0.2	20	0.5	1.47	2.7	1.08	5.25
16	*Salvia moorcroftiana* Wallich ex Benth.	1.1	80	25.75	8.09	10.8	55.7	74.59

Table 20. Phytosociological attributes of *Fagonia-Phoenix-Capparis* community recorded at Siraj Khel, during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.3	20	0.2	1.9	2.5	0.33	4.73
2	*Acacia nilotica* (L.) Delice.	0.5	30	2.1	3.16	3.7	3.43	10.29
3	*Phoenix dactylifera* L.	3.7	90	8.57	23.4	11.1	14	48.5
4	*Zizyphus maurtiana* Lam.	0.4	30	1.35	2.53	3.7	2.2	8.43
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	0.2	20	0.12	1.27	2.47	0.2	3.94
6	*Calotropis procera* (Wild) R.Br.	0.7	50	0.3	4.43	6.2	0.5	11.13
7	*Capparis decidua* (Forssk). Edgeworth.	1.3	50	0.68	8.23	6.17	1.11	15.51
8	*Rhazya stricta* Decne.	0.5	40	0.04	3.16	4.94	0.07	8.17
9	*Withania coagulans* (Stocks) Dunal.	0.5	30	0.03	3.16	3.7	0.05	6.91
10	*Zizyphus nummularia* (Burm.f.) W. & A.	0.5	30	0.36	3.16	3.7	0.6	7.46
Herbaceous layer								
11	*Aerua persica* (Burm.f) Merrill.	0.4	40	15	2.53	4.94	24.5	31.97
12	*Asparagus gracilis* Royle.	0.5	50	1.25	3.16	6.17	2.04	11.37
13	*Cenchrus ciliaris* L.	1.1	50	1.25	6.96	6.17	2.04	15.17
14	*Cynodon dactylon* (L.) Pers.	1.8	30	0.75	11.4	3.7	1.22	16.32
15	*Dichanthium annulatum* (Forssk) Staph.	0.4	40	1	2.53	4.94	1.63	9.1
16	*Eragrostis poaoides* Beauv.	0.9	70	1.75	5.7	8.64	2.86	17.2
17	*Fagonia cretica* L.	1.4	70	19.75	8.86	8.64	32.2	49.7
18	*Launaea nudicaulis* (L.) Hook. f.	0.3	30	0.75	1.9	3.7	1.22	6.82
19	*Solanum incanum* L.	0.2	20	3	1.27	2.47	4.9	8.64
20	*Solanum surattense* Burm .f.	0.2	20	3	1.27	2.47	4.9	8.64

Table 21. Phytosociological attributes of *Fagonia-Withania-Zizyphus* community recorded at Shahidan Banda during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	40	0.34	3.05	5.19	0.99	9.23
2	*Gymnosporia royleana* Wall. ex M. A. Lawson.	0.2	20	0.3	1.22	2.6	0.86	4.68
3	*Zizyphus maurtiana* Lam.	1.3	100	1.6	7.93	13	4.6	25.53
Shrubby layer								
4	*Cassia angustifolia* Vahl.	1.8	60	0.11	11	7.79	0.32	19.11
5	*Rhazya stricta* Decne.	3.1	50	0.25	18.9	6.49	0.72	26.11
6	*Withania coagulans* (Stocks) Dunal.	2.5	80	0.38	15.2	10.4	1.1	26.7
7	*Zizyphus nummularia* (Burm.f.) W. & A.	0.4	40	0.6	2.44	5.19	1.72	9.35
Herbaceous Layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.4	40	10.5	2.44	5.19	30.1	37.73
9	*Asparagus gracilis* Royle.	0.6	50	1.25	3.66	6.49	3.6	13.75
10	*Cenchrus ciliaris* L.	1.2	70	1.75	7.32	9.09	5.02	21.43
11	*Cynodon dactylon* (L.) Pers.	1.3	30	0.75	7.93	3.9	2.15	13.98
12	*Eragrostis poaoides* Beauv.	1	60	1.5	6.1	7.79	4.31	18.2
13	*Fagonia cretica* L.	1.5	70	11.5	9.15	9.09	33	51.24
14	*Launaea nudicaulis* (L.) Hook. f.	0.4	40	1	2.44	5.19	2.9	10.53
15	*Solanum surattense* Burm .f.	0.2	20	3	1.22	2.6	8.61	12.43

Table 22. Phytosociological attributes of *Aerua-Punica-Acacia* community recorded at Zarki Nasratti, during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	1.6	100	0.82	9.7	10.2	1.38	21.28
2	*Zizyphus maurtiana* Lam.	0.9	60	2.13	5.45	6.12	3.59	15.16
Shrubby layer								
3	*Astragalus psilocentros* Fisch.	0.6	40	0.04	3.64	4.08	0.07	7.79
4	*Calotropis procera* (Wild) R.Br.	0.4	40	0.09	2.42	4.08	0.15	6.65
5	*Capparis decidua* (Forssk). Edgeworth.	0.7	40	0.24	4.24	4.1	0.4	8.74
6	*Capparis spinosa* L.	0.5	30	0.13	3.03	3.06	0.22	6.31
7	*Punica granatum* L.	2.2	80	0.43	13.3	8.16	0.72	22.18
8	*Rhazya stricta* Decne.	0.9	50	0.05	5.45	5.1	0.1	10.65
9	*Saccharum bengalense* Retz.	0.6	30	0.18	3.64	3.06	0.3	7
Herbaceous layer								
10	*Aerua persica* (Burm.f.) Merrill.	1	90	29.75	6.06	9.2	50.1	65.36
11	*Asparagus gracilis* Royle.	1	50	1.25	6.1	5.1	2.11	13.31
12	*Centaurea iberica* Trev.Ex. Spreng	0.8	30	0.75	4.85	3.06	1.26	9.17
13	*Convolvulus pluricaulis* Choisy.	0.2	20	1.75	1.2	2.04	2.95	6.19
14	*Cynodon dactylon* (L.) Pers.	1.1	20	3	6.7	2.04	5.05	13.79
15	*Echinops echinatus* D.C.	0.7	50	7.5	4.24	5.1	12.6	21.94
16	*Eragrostis poaoides* Beauv.	0.9	60	1.5	5.45	6.12	2.53	14.1
17	*Kickxia ramosissima* (Wall) Janchen.	0.4	40	2.25	2.42	4.08	3.79	10.29
18	*Launaea nudicaulis* (L.) Hook. f.	0.4	40	1	2.42	4.08	1.7	8.2
19	*Fagonia cretica* L.	0.4	40	1	2.42	4.08	1.7	8.2
20	*Malva neglecta* Wallr.	0.9	40	1	5.45	4.08	1.7	11.23
21	*Solanum surattense* Burm .f.	0.3	30	4.5	1.82	3.06	7.58	12.46

Table 23. Phytosociological attributes of *Aerua-Acacia-Capparis* community recorded at Shawa Hills, during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layers								
1	*Acacia modesta* Wall.	2.8	90	2.22	24.1	13	7.43	44.53
2	*Acacia nilotica* (L.) Delice.	0.3	30	0.11	2.59	4.35	0.37	7.31
3	*Zizyphus maurtiana* Lam.	0.9	60	0.8	7.76	8.7	2.68	19.14
Shrubby layer								
4	*Astragalus psilocentros* Fisch.	0.2	20	0.12	1.72	2.9	0.4	5.02
5	*Capparis decidua* (Forssk). Edgeworth.	1.7	90	0.81	14.7	13	2.71	30.41
6	*Capparis spinosa* L.	1.6	60	0.36	13.8	8.7	1.21	23.71
7	*Rhazya stricta* Decne.	0.5	50	0.05	4.3	7.3	0.17	11.77
8	*Withania coagulans* (Stocks) Dunal.	0.5	50	0.39	4.3	7.3	1.31	12.91
Herbaceous layers								
9	*Aerua persica* (Burm.f) Merrill.	0.8	70	19.5	6.9	10.1	65.3	82.3
10	*Asparagus gracilis* Royle.	0.9	40	1	7.76	5.8	3.35	16.91
11	*Cenchrus ciliaris* L.	0.4	40	1	3.45	5.8	3.35	12.6
12	*Convolvulus pluricaulis* Choisy.	0.3	30	0.75	2.59	4.35	2.51	9.45
13	*Eragrostis poaoides* Beauv.	0.5	40	2.25	4.31	5.8	7.54	17.65
14	*Solanum incanum* L.	0.2	20	0.5	1.72	2.9	1.67	6.29

Table 24. Phytosociological attributes of *Eragrostis-Zizyphus-Capparis* community recorded at Kandu Khel during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.6	50	0.18	3.92	7.35	0.6	11.87
2	*Acacia nilotica* (L.) Delice.	0.4	30	0.66	2.61	4.41	2.08	9.1
3	*Zizyphus maurtiana* Lam.	2.3	10	10.17	15	1.47	32	48.47
Shrubby layer								
4	*Astragalus psilocentros* Fisch.	0.4	40	0.04	2.61	5.88	0.13	8.62
5	*Calotropis procera* (Wild) R.Br.	0.3	30	0.08	1.96	4.41	0.25	6.62
6	*Capparis decidua* (Forssk). Edgeworth.	1.5	60	0.63	9.8	8.82	1.98	20.6
7	*Periploca aphylla* Decne.	0.6	40	0.04	3.92	5.88	0.13	9.93
8	*Rhazya stricta* Decne.	1.2	40	0.33	7.84	5.88	1.04	14.76
9	*Saccharum bengalense* Retz.	0.4	20	0.12	2.61	2.94	0.38	5.93
10	*Withania coagulans* (Stocks) Dunal.	0.3	30	0.03	1.96	4.41	0.09	6.46
Herbaceous layer								
11	*Cenchrus ciliaris* L.	1.4	50	1.25	9.15	7.35	3.93	20.43
12	*Convolvulus pluricaulis* Choisy.	0.4	40	1	2.61	5.88	3.15	11.64
13	*Cynodon dactylon* (L.) Pers.	1.6	30	0.75	10.5	4.41	2.36	17.27
14	*Dichanthium annulatum* (Forssk) Staph.	0.6	50	1.25	3.92	7.35	3.93	15.2
15	*Eragrostis poaoides* Beauv.	2.3	70	8	15	10.3	25.2	50.5
16	*Fagonia cretica* L.	0.5	40	6	3.27	5.88	18.9	28.05
17	*Launaea nudicaulis* (L.) Hook. f.	0.2	20	0.5	1.31	2.94	1.57	5.82
18	*Medicago laciniata* (L) Mill.	0.1	10	0.25	0.65	1.47	0.79	2.91
19	*Solanum incanum* L.	0.2	20	0.5	1.31	2.94	1.57	5.82

Table 25. Phytosociological attributes of *Aerua-Rhazya-Acacia* community recorded at Shadi Khel, during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	2.5	100	1.5	10.3	9.62	4.85	24.77
2	*Acacia nilotica* (L.) Delice.	0.4	20	0.34	1.65	1.92	1.1	4.67
3	*Dalbergia sissoo* Roxb.	0.4	20	0.52	1.65	1.92	1.68	5.25
4	*Phoenix dactylifera* L.	0.6	40	0.49	2.48	3.85	1.58	7.91
5	*Zizyphus maurtiana* Lam.	0.3	20	0.27	1.24	1.92	0.87	4.03
Shrubby layer								
6	*Astragalus psilocentros* Fisch.	1.9	60	0.36	7.85	5.77	1.16	14.78
7	*Calotropis procera* (Wild) R.Br.	0.3	30	0.18	1.24	2.88	0.58	4.7
8	*Capparis decidua* (Forssk). Edgeworth.	0.9	50	0.39	3.72	4.81	1.26	9.79
9	*Punica granatum* L.	1.6	50	0.2	6.61	4.81	0.65	12.07
10	*Rhazya stricta* Decne.	4.8	100	1.14	19.8	9.62	3.68	33.1
11	*Saccharum bengalense* Retz.	1.4	50	0.15	5.79	4.8	0.48	11.07
12	*Zizyphus nummularia* (Burm.f.) W. & A.	0.6	50	0.3	2.5	4.81	0.97	8.28
Herbaceous layer								
13	*Aerua persica* (Burm.f) Merrill.	0.6	60	11.25	2.5	5.77	36.4	44.67
14	*Cenchrus ciliaris* L.	1.5	70	3	6.2	6.73	9.7	22.63
15	*Convolvulus pluricaulis* Choisy.	0.1	10	1.5	0.41	0.96	4.85	6.22
16	*Cymbopogon jwarancusa* (Jones) Schult.	0.2	20	3	0.83	1.92	9.7	12.45
17	*Cynodon dactylon* (L.) Pers.	1.9	40	1	7.85	3.85	3.23	14.93
18	*Dichanthium annulatum* (Forssk) Staph.	1.1	60	1.5	4.55	5.77	4.85	15.17
19	*Eragrostis poaoides* Beauv.	1.2	70	1.75	4.96	6.73	5.66	17.35
20	*Kickxia ramosissima* (Wall) Janchen.	0.6	40	1	2.5	3.85	3.23	9.58
21	*Launaea nudicaulis* (L.) Hook. f.	0.9	40	0.1	3.72	3.85	0.32	7.89
22	*Fagonia cretica* L.	0.3	30	0.75	1.24	2.88	2.4	6.52
23	*Solanum incanum* L.	0.1	10	0.25	0.41	0.96	0.8	2.17

Table 26. Phytosociological attributes of *Dichanthium-Withania-Zizyphus* community recorded at Sarki Lawager during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.6	40	0.52	4.76	4.94	1.55	11.25
2	*Acacia nilotica* (L.) Delice.	0.2	20	0.4	1.59	2.47	1.19	5.25
3	*Monotheca buxifolia* (Falc.) A.D.	0.3	20	0.42	2.38	2.47	1.25	6.1
4	*Zizyphus maurtiana* Lam.	1	90	0.95	7.94	11.1	2.8	21.84
Shrubby Layer								
5	*Calotropis procera* (Wild) R.Br.	0.3	30	0.18	2.38	3.7	0.54	6.62
6	*Capparis decidua* (Forssk). Edgeworth.	0.4	40	0.24	3.17	4.94	0.71	8.82
7	*Periploca aphylla* Decne.	0.3	30	0.08	2.38	3.7	0.24	6.32
8	*Rhazya stricta* Decne.	0.4	40	0.09	3.17	4.94	0.27	8.38
9	*Saccharum spontaneum* L.	0.7	30	0.13	5.56	3.7	0.39	9.65
10	*Withania coagulans* (Stocks) Dunal.	1.4	70	0.07	11.1	8.64	0.21	19.95
11	*Zizyphus nummularia* (Burm.f.) W.&A.	0.2	20	0.3	1.59	2.47	0.89	4.95
Herbaceous layer								
12	*Aerua persica* (Burm.f.) Merrill.	0.3	30	6.75	2.38	3.7	20.1	26.18
13	*Cenchrus ciliaris* L.	0.6	50	1.25	4.76	6.17	3.7	14.63
14	*Cynodon dactylon* (L.) Pers.	2	40	1	15.9	4.94	2.97	23.81
15	*Dichanthium annulatum* (Forssk) Staph.	1.7	80	4.5	13.5	9.88	13.4	36.78
16	*Echinops echinatus* Roxb.	0.4	40	8.25	3.17	4.94	24.5	32.61
17	*Eragrostis poaoides* Beauv.	0.5	50	1.25	3.97	6.17	3.72	13.86
18	*Fagonia cretica* L.	0.5	50	6.25	3.97	6.17	18.6	28.74
19	*Launaea nudicaulis* (L.) Hook. f.	0.8	40	1	6.35	4.94	2.97	14.26

Table 27. Phytosociological attributes of *Zizyphus-Aerua-Capparis* community recorded at Shnawa Hills during spring, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	40	0.13	5.1	5.56	0.83	11.49
2	*Prosopis juliflora* (Sw.) D. C.	0.2	20	0.05	2.04	2.78	0.32	5.14
3	*Zizyphus maurtiana* Lam.	2.6	100	1.3	26.5	13.9	8.29	48.69
Shrubby layer								
4	*Capparis decidua* (Forssk). Edgeworth.	0.6	60	0.26	6.12	8.33	1.66	16.11
5	*Capparis spinosa* L.	0.9	60	0.54	9.2	8.33	3.44	20.97
6	*Punica granatum* L.	0.7	70	0.27	7.14	9.72	1.72	18.58
7	*Rhazya stricta* Decne.	0.4	40	0.14	4.1	5.56	0.89	10.55
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.6	60	4	6.12	8.33	25.5	39.95
9	*Asparagus gracilis* Royle.	0.3	30	0.75	3.06	4.17	4.78	12.01
10	*Cenchrus ciliaris* L.	1	50	1.25	10.2	6.94	7.97	25.11
11	*Echinops echinatus* D. C.	0.6	50	1.25	6.12	6.94	7.97	21.03
12	*Convolvulus pluricaulis* Choisy.	0.4	40	1	4.1	5.56	6.37	16.03
13	*Eragrostis poaoides* Beauv.	0.7	60	2.75	7.14	8.33	17.5	32.97
14	*Solanum incanum* L.	0.2	20	0.5	2.04	2.78	3.19	8.01
15	*Solanum surattense* Burm .f.	0.1	20	1.5	1.02	2.78	9.56	13.36

B. Summer Aspect

Overall 22 plant communities were recorded during summer. Entirely 46 plant species were recorded that consists of 11 trees, 14 shrubs, 18 herbs and 3 grasses (Tables 4.48, 4.49). The number of plant species differ in different communities. The biological spectrum dominated by therophytes (10 spp., 21.74%) and hemicryptophytes (10 spp., 21.74%) followed by megaphanerophytes (9 spp., 19.57%), nanophanerophytes (7 spp., 15.22%), chamaephytes (7 spp., 15.22%) and microphanerophytes (3 spp, 6.52 %) while leaf size spectrum dominated by microphylls (24 spp. 52.17%) followed by nanophylls (7 spp. 15.22%), leptophylls (6 spp. 13.04%), megaphylls (5 spp. 10.87 %) and mesophylls (4 spp. 8.69 %) (Table 4).

Environmental data showed that mean air temperature was high in month of June (39.5^{o} C) and low in month of September (21.95^{o} C), relative humidity was high (77.21%) in month of September and low (30.73 %) in May, rainfall (121.6 mm) was high in July and low (31.6 mm) in May, soil temperature (26.77^{o} C) was high in month of July, wind speed was high in month of June (5.5 Km/h) and low (3.7 Km/h) in September, which indicated dry condition during summer (Table 1). Summer season started from May to September in the area and 22 plant communities were recognized. The investigated area shows altitudinal variation i.e. from 340m - 700m. This also caused deviation in plant life structure. The soil of the area had better calcium carbonate in the range of (12.3 – 12.7 %), with soil pH (6.06 – 8.13). The concentrations of P AND K content were found in the range of (3.64-3.86 mg Kg^{-1}) and (112-127 mg Kg^{-1}). The EC was found in the range of (0.15-0.21 dS m^{-1}). The soil texture was found from sandy clay to sandy clay loam (Table 28).

Stand - 1

In stand 1, collectively 27 plant species consisting of 6 trees, 6 shrubs, 13 herbs and 2 grasses constructing the *Cenchrus-Saccharum-Prosopis* community (CSP). On the basis of area, 4 communities i.e. *Eragrostis-Calotropis-Prosopis* community (ECP), *Phoenix-Saccharum-Cenchrus* community (PSC), *Aerua-Prosopis-Saccharum* community (APS) and *Tribulus-Prosopis-Saccharum* community (TPS) were found in Tater Khel, Gardi Banda, Ahmad Abad and Warana respectively. The highest number of plant species (18) were present in APS and low (14) in PSC. The least number of trees (3)

were found in PSC. The number of shrubs (6), herbs (8) and grasses (2) was high in APS, TPS and ECP respectively. The TIV contributed by three dominant plant species forming a community was high (109) in ECP while low 89.71 in TTS. The highest amount of TIV of tree (64.24) and grasses (61.72) was found in ECP while shrubs (81.85) and herbs (171.5) were found in APS and TTS respectively (Tables 29). The details are as follows:

1. *Eragrostis-Calotropis -Prosopis* community (ECP)

Eragrostis- Calotropis -Prosopis community was composed of 15 species comprising 4 tree, 4 shrubs, 5 herb and 2 grass species at Tater Khel. The Importance value contributed by three dominants species i.e. *Eragrostis poaoides, Calotropis procera* and *Prosopis farcta* was 109.09 while total importance value of 190.91 was provided by the remaining species. The contribution by tree was 64.2, shrubs 67.58, herbs 106.49 and grass 61.73. The associated species in herbaceous stratum included *Cenchrus biflorus* (IV=29.12), *Heliotropium europaeum* (IV = 26.14) and *Chrozophora obliqua* (IV = 25.25), *Saccharum bengalense* (IV = 16.51) and *Datura metel* (IV = 10.52) in shrubby stratum. In tree stratum, the important species were *Zizyphus maurtiana* (IV=12.39) and *Phoenix dactylifera* (IV 10.04) (Table 30).

The life form spectrum showed that therophytes (5 spp., 33.33%) was dominant life form class followed by megaphanerophytes (4 spp., 26.67%) while hemicryptophytes and nanophanerophytes (2 spp., 13.33 %) shared each. The vegetation was theromegaphanerophytic. In the leaf form classes, microphyll with 40 % was the leading group (Table 4). The community preferred to grow on high percentage of sand (63%) and low amount of silt (6%) and clay (31 %) particles. The soil of the community had better calcium carbonate (12.57 %) with alkaline soil pH (7.31). The concentrations of P AND K content were found in the range of 3.78 & 119.1 mg Kg^{-1}. The community preferred EC in the range of 0.18 dS m^{-1}. The soil texture was found sandy clay loam (Table 28)

2. *Phoenix- Saccharum -Cenchrus* community (PSC)

Phoenix–Saccharum-Cenchrus community was present at Gardi Banda. This community was supported by 14 plant species in which 3 trees, 4 shrubs, 6 herbs and single grass specie. The dominant plant species were *Phoenix dactylifera* (IV = 38. 6) in tree stratum followed by *Saccharum bengalense* (IV = 37. 9) in shrub stratum and *Cenchrus biflorus* (IV = 37. 5) in herb stratum. *Zizyphus maurtiana* (7. 67) and

Dalbergia sissoo (5.14) were associated member in tree stratum. The important species in shrub stratum were *Saccharum spontaneum* (IV = 19. 84) and *Calotropis procera* (IV = 9. 19) (Table 31). Ground cover consisted of herbaceous plants had high variety in this period. Biological spectrum showed that therophytes (4 spp., 28.57%), megaphanerophytes (3 spp., 21. 43%) and hemicryptophytes (3 spp., 21. 43) were the dominant life form classes and microphyll (10 spp., 71. 43 %) was the major leaf form classes in the community (Table 4).

The community preferred to grow on high percentage of sand (65%) and low amount of silt (3%) and clay (32 %) particles. The soil of the community had better calcium carbonate (12.34%) with alkaline soil pH (7.66). The concentrations of P AND K content were found in the range of 3.79 & 125.6 mg Kg^{-1}. The community preferred electrical conductivity (EC) in the range of 0.16 dS m^{-1}. The soil texture was found sandy clay loam (Table 28).

3. *Aerua- Prosopis -Saccharum* community (APS)

Aerua- Prosopis -Saccharum community was established at Ahmad Abad and is dominated by *Aerua persica* (32. 1), *Prosopis farcta* (31. 62) and *Saccharum spontaneum* (30. 64). The associated species of the tree stratum included *Zizyphus maurtiana* (18. 12) and *Acacia nilotica* (IV = 5. 16). Co dominant species included *Cenchrus biflorus* (23.57), *Fagonia cretica* (23.4) and *Peganum hermala* (22. 03) in ground stratum; *Saccharum bengalense* (IV=21.76) and *Calotropis procera* (IV = 10. 08) were making shrubby stratum (Table 32). The community was composed of 18 species comprising of 4 tree, 6 shrubs, 7 herb and 1 grass species. The Importance value contributed by tree was 58.97, shrubs 81.85, herbs 140.8 and grass 18.38. Hemicriptophytes were the dominant class of the biological spectrum (5 spp., 27.77%) followed by therophytes, nanophanerophytes and megaphanerophytes (4 spp., 22.22%) shared each. In leaf size classes, (9 spp., 50 % microphyll followed by megaphyll (4 spp., 22.22%) and leptophyll (2 spp., 11.11%) (Table 4). The community preferred to grow on high percentage of sand (70%) and low amount of clay (26 %) and silt (4%) particles. The soil of the community had better lime (12.6 %) with alkaline soil pH (7.13). The concentrations of p and K content were initiated in the range of 3.77 & 114 mg Kg-1. The community preferred EC

and SOM in the range of 0.19 dS m-1 and 1.27 % respectively. The soil texture was found sandy clay loam (Table 28).

4. *Tribulus - Prosopis -Saccharum* community (TPS)

TPS community was composed of 17 species comprising 4 tree, 4 shrubs, 8 herb and 1 grass species at Warana. The Importance value contributed by three dominants species i.e. *Tribulus terrestris, Prosopis farcta* and *Saccharum bengalense* was 89.68 while total importance value of 210.32 was provided by the remaining species. Associated species included *Carthamus oxycantha* (IV=28.9), *Cyperus rotundus* (IV = 28.6), *Cenchrus biflorus* (IV = 26.7) of ground stratum and *Periploca aphylla* (IV=22.4) and *Calotropis procera* (IV = 10.7) were making shrubby stratum. The associated species of the tree stratum *Zizyphus maurtiana* (IV =10.87) and *Tamarix aphylla* (IV = 5.6) (Table 33). The qualitative examination of biological spectrum showed that therophytes (5 spp., 29.41 %) dominated followed by hemicryptophytes, nanophanerophyte and megaphanerophyte (3 spp., 17.65 %) each. In leaf size examination, microphyll (9 spp., 52.94 %) was the dominant class (Table 4). The community preferred to grow on high percentage of sand (61%) and low amount of clay (33 %) and silt (6%) particles. The soil of the community had better lime content (12.4 %), SOM (1.28 %), EC (0.21 dS m^{-1}), P (3.76 mg Kg^{-1}) and K (121 mg Kg^{-1}) with alkaline soil pH (8.13). The soil texture was found sandy clay loam (Table 28).

Overall plant life of stand 1 was dominated by therophytes and hemicryptophytes (7 spp., 25.92%) each and microphyll (12 spp., 44.42 %) followed by leptophyll, nanophyll and megaphyll (4 spp., 14.81 %) each. Small leaf size indicating dry and xeric condition while large size leaves indicated cool and moist conditions. As a whole the plant life was dry tropical in nature during summer.

Stand - 2

In this Stand, 7 communities of 45 plant species comprising 4 trees, 5 shrubs, 32 herbs and 4 grasses that structured *Cenchrus-Zizyphus-Saccharum* community (CZS). The *Cenchrus-Saccharum-Zizyphus* community (CSZ) was found in Southern area of Bogara, *Cenchrus-Saccharum-Acacia* community (CSA) in Northern area of Bogara, *Zizyphus-Cenchrus-Saccharum* community (ZCS) in Gandiri Khattak, *Saccharum-Cenchrus-Zizyphus* community (SCZ) in Kiri Dhand, *Cenchrus-Calligonum-*

Acacia community (CCA) in Jahangiri Banda, *Zizyphus-Cenchrus-Calligonum* community (ZCC) in Mona Khel and *Cenchrus-Zizyphus-Saccharum* community (CZS) in Jarassi. The highest number of species (30) was present in CSZ. The highest number of trees (4) was found in CSZ and CSA while the highest number of shrubs and herbs in SCZ and CSZ respectively. The highest TIV contributed by three dominant species was 200.63 in ZCS at Gandiri Khattak while low 89.90 in SCZ at Kiri Dhand. Furthermore, the highest TIV contributed by trees (93.70), shrubs (90.29), herbs (134.58) and grasses (90.94) in ZCS, CCA, SCZ and CSA respectively (Table 29).

5. *Eragrostis -Saccharum -Zizyphus* community (ESZ)

Eragrostis- Saccharum -Zizyphus community was established at Southern area of Bogara and composed of 24 species consisted of 4 tree, 4 shrubs, 14 herb and 2 grass species. This community was dominated by *Eragrostis poaoides* (IV = 34.6) in herb strata, *Saccharum bengalense* (IV = 21.4) in shrubby strata and *Zizyphus maurtiana* (IV=15.3) in tree strata. The Importance value contributed by tree strata was 30.67, shrubby strata (IV = 52.56) and herbaceous strata (IV = 216.77) (Table 34). The qualitative result of life form classes revealed that hemicryptophytes (7 spp., 29.17%) followed by therophytes (6 spp., 25 %) were dominant classes. Microphyll (12 spp., 50%) followed by leptophyll and mesophyll (4 spp., 16.17%) each were most signifying classes of leaf form spectrum (Table 4). The community preferred to grow on high percentage of sand (72%) and low amount of clay (24 %) and silt (4%) particles. The soil of the community had better lime contents (12.6 %) with soil pH (6.86). The concentrations of P and K content were initiated in the range of 3.67 & 123 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.17 dS m^{-1} and 1.31 % respectively The soil texture was found sandy clay loam (Table 28).

6. *Tribulus –Acacia- Saccharum* community (TAS)

Tribulus-Acacia-Saccharum community was developed at Northern area of Bogara and was dominated by *Tribulus terrestris* (IV = 41.8) in herbaceous strata, *Acacia nilotica* (IV = 27.1) in tree strata and *Saccharum bengalense* (IV = 26.1) in shrubby strata. *Eragrostis poaoides* was the second leading dominant associate of herbaceous strata with (IV = 25.1). This community was supported by 19 plant species included 4 tree, 4 shrubs, 10 herb and 1 grass species (Table 35). The Importance value

contributed of important value by tree was 46.34, shrubs (IV = 47.07), herbs (IV=181.47) and grass (IV = 25.12). Hemicryptophytes and therophytes (5 spp., 26.31 %) each were dominating all the life form classes followed by Megaphanerophyte (4 spp., 21.05 %). Microphyll (10 spp., 52.63 %) had represented leading leaf form spectrum (Table 4). The community preferred to grow on high percentage of sand (51%) followed by clay (43 %) and silt (6%) particles. The soil of the community had lime contents (12.7 %) with soil pH (6.72). The concentrations of P and K content were initiated in the range of 3.68 & 116 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.18 dS m^{-1} and 1.44 % respectively. The soil texture was found sandy clay (Table 28).

7. *Zizyphus- Cenchrus- Saccharum* community (ZCS)

This community was developed at Gandiri Khattak and composed of 17 species. There were 1 tree, 3 shrubs, 11 herb and 2 grass species. Dominant plant species on the basis of important values were *Zizyphus maurtiana* (IV = 81.8) in tree strata, *Cenchrus biflorus* (IV = 39.2) in herbaceous strata and *Saccharum bengalense* (IV = 36) in shrubby strata. The Importance value contributed by tree was 81.9, shrubs (IV =49.98), herbs (IV = 136.5) and grass (IV = 31.62) (Table 36). Mirophyll was the dominant leaf size class represented by 9 plant species (52.94 %) and therophytes were the leading dominant life form classes (7 spp., 41.18 %) followed by hemicryptophytes (5 spp., 29.41%) (Table 4). The community preferred to grow on high percentage of sand (67 %) followed by clay (30 %) and silt (3 %) particles. The soil of the community had lime contents (12.7 %), EC (0.18 dS m^{-1}) and SOM (1.29 %) with soil pH (6.97). The concentrations of P and K content were initiated in the range of 3.64 & 117 mg Kg^{-1}. The soil texture was found sandy clay loam (Table 28).

8. *Calligonum- Tribulus-* Zizyphus community (CTZ)

Calligonum-Tribulus-Zizyphus community was established at Kiri Dhand was composed of 19 species. There were 3 tree, 5 shrubs, 9 herb and 2 grass species. The Importance value contributed by three dominants species i.e. *Calligonum polygonoides, Tribulus terrestris* and *Zizyphus maurtiana* was 82.78 while total importance value of 217.22 was provided by the remaining species. The contribution by tree was 25.82, shrubs (IV = 65.45), herbs (IV = 159.88) and grass (IV = 48.83) (Table 37). The biological spectrum showed that therophytes and hemicryptophytes were the leading life

form classes (5 spp., 26.32 %) followed by chamophytes (3 spp., 15.79%). Mirophyll and nanophyll were the dominant leaf size classes represented by (8 spp., 42.10%) and (4 spp., 21.05 %) plant species respectively (Table 4). The community preferred to grow on high percentage of sand (45 %) followed by clay (28 %) and silt (27 %) particles. The soil of the community had lime contents (12.6%) with soil pH (6.43). The concentrations of P and K content were initiated in the range of 3.79 & 120 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.19 dS m^{-1} and 1.33 % respectively. The soil texture was found clay loam (Table 28).

9. *Calligonum-Cenchrus-Zizyphus* community (CCZ)

Calligonum-Cenchrus-Zizyphus community at 500m was composed of 21 species in Zarin Kala. There were 3 tree, 4 shrubs, 12 herb and 2 grass species. Dominant plant species on the basis of important values were *Calligonum polygonoides* (IV = 42.5), *Cenchrus biflorus* (IV = 30.2) and *Zizyphus maurtiana* (IV = 20.5). The Importance value contributed by tree was 32.61, shrubs (IV = 70.55), herbs (IV = 165.04) and grass (IV=31.8) (Table 38). Mirophyll (10 spp., 47.62%) was dominant leaf size class followed by leptophyll (4 spp., 19.05%). The biological spectrum showed that hemicryptophytes was the leading dominant life form class (7 spp., 33.33 %) followed by therophytes (6 spp., 28.57%) in the community (Table 4). The community preferred to grow on high percentage of sand (62%) followed by clay (34 %) and silt (4 %) particles. The soil of the community had lime contents (12.6 %) and SOM (1.25 %) with soil pH (6.83). The concentrations of P and K content were initiated in the range of 3.81 & 123 mg Kg^{-1}. The community preferred EC in the range of 0.16 dS m^{-1}. The soil texture was found sandy clay loam (Table 28).

10. *Zizyphus- Cenchrus- Saccharum* community (ZCS)

ZCS community was established at Mona Khel and dominated by *Zizyphus maurtiana* (IV=58.6) in tree stratum, *Cenchrus biflorus* (IV = 37.5) in herbaceous stratum and *Saccharum bengalense* (IV = 24.6) in shrubby stratum. Other important plant species with respect to importance values were *Euphorbia helioscopia* (IV = 30.5), *Eragrostis poaoides* (IV = 22.7) and *Calligonum polygonoides* (IV = 13.5). A total of 17 plant species in the site composed of 3 tree, 4 shrubs and 10 were included in herbaceous stratum. The Importance value contributed by tree was 71.56, shrubs (IV = 48.95),

herbs (IV=156.81) and grass (IV = 22.66) (Table 39). Therophytes (6 spp., 35.29%) were the dominating all the life form classes followed by hemicryptophytes (4 spp., 23.53%) and megaphanerophytes (3 spp., 17.65%). Mirophyll (35.29%) had comprised leading leaf form class (Table 4). The community preferred to grow on high percentage of sand (63%) followed by clay (32 %) and silt (5 %) particles. The soil of the community had lime contents (12.7%) and SOM (1.26 %) with soil pH (6.19). The concentrations of P and K content were originated in the range of 3.67 & 125 mg Kg^{-1}. The community preferred EC in the range of 0.19 dS m^{-1}. The soil texture was found sandy clay loam (Table 28).

11. *Saccharum-Zizyphus-Cynodon* community (SZC)

Saccharum-Zizyphus-Cynodon community was developed at Jarasi and composed of 19 species. There were 3 tree, 4 shrubs, 10 herb and 2 grass species. The Importance value contributed by three dominants species i.e. *Saccharum bengalense, Zizyphus maurtiana* and *Cynodon dactylon* was 88.79 while total importance value of 211.21 was provided by the remaining species. The contribution by tree was 41.69, shrubs (IV = 55.88), herbs (IV = 140.96) and grasses (IV = 61.46) (Table 40).

Mirophyll (8 spp., 42.10%) and leptophyll (4 spp., 21.05%) were leading leaf form classes while hemicryptophytes (7 spp., 36.84%) and therophytes (4 spp., 21.05%) were the dominating life form classes in community (Table 4). The community preferred to grow on high percentage of sand (42%) followed by silt (33 %) and clay (25 %) particles. The soil of the community had lime contents (12.7%) and SOM (1.2 %) with soil pH (6.06). The concentrations of P and K contents were originated in the range of 3.84 and 127 mg Kg^{-1}. The community preferred EC in the range of 0.17 dS m^{-1}. The soil texture was found sandy clay loam (Table 28).

Stand - 3

In stand 3, total 7 sites were studied i.e. Chokara, Ambiri Kala, Takht-e- Nasrati, Siraj Khel, Shahidan Banda, Zarki Nasrati and Shawa in which 7 communities i.e. *Cymbopogon-Rhazya-Zizyphus* community (CRZ), *Cymbopogon-Saccharum-Zizyphus* community (SCZ), *Fagonia-Rhazya-Zizyphus* community (FRZ), *Cleome-Phoenix-Capparis* community (CPC), *Cenchrus -Cassia -Zizyphus* community (CCZ), *Capparus -Aerua -Acacia* community (CAA), *Boerhavia –Acacia- Capparus* community

(BAC) were recorded respectively. Entirely 34 plant species consist of 6 trees, 12 shrubs, 13 herbs and 3 grasses were documented forming the *Zizyphus-Aerua-Rhazya* community (ZAR). The highest number of plant species (23) were present in CPC. The highest number of tree (4) were present in CRZ, SCZ and CPC while shrubs (8) in CAA and herbs (10) in CPC. The Importance value contributed by three dominants species was 63.98 while total importance value of 236.02 was provided by the remaining species. Furthermore, the highest TIV given by trees (65.83) was present in BAC, shrubs (103.72) in SCZ at Shawa and Ambiri Kala respectively while TIV of herbs (146.78) and grasses (116.29) were found high in CPC and CRZ respectively (Table 29).

12. *Cymbopogon-Rhazya-Zizyphus* community (CRZ)

Cymbopogon-Rhazya-Zizyphus community established at Chokara. A total of 18 species were recorded in the site which consisted of 4 tree, 5 shrub, 6 herb and 3 grass species. The Importance value contributed by three dominants species i.e. *Cymbopogon jwarancusa, Rhazya stricta* and *Zizyphus maurtiana* was 145.25 while total importance value of 154.75 was provided by the remaining species. The contribution by tree was 28.33, Shrubs 84.82, herbs 70.56, and grasses 116.29 (Table 41). The qualitative examination of biological spectrum showed that hemicryptophytes (6 spp., 33.33 %) dominated followed by nanophanerophyte and megaphanerophyte (4 spp., 22.22 %) each. In leaf size examination, microphyll (10 spp., 55.55 %) was the dominant class in this community (Table 4). The community preferred to grow on high percentage of clay (49 %) and low amount of sand (47 %) and silt (4 %) particles. The soil of the community had better lime contents (12.3 %) with soil pH (7.26). The concentrations of P and K content were initiated in the range of 3.81 and 121 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.15 dS m^{-1} and 1.31 % respectively. The soil texture was found sandy clay (Table 28).

13. *Cymbopogon-Saccharum- Zizyphus* community (SCZ)

This community was developed at Ambiri Kala. The dominated plant species on the basis of importance value were *Cymbopogon jwarancusa* (IV = 64.8) in herbs stratum, *Saccharum bengalense* (IV = 39.6) in shrubby stratum and *Zizyphus maurtiana* (IV = 10.8) in tree stratum. Other important species included *Astragalus psilocentros* (IV = 39.2), *Aerua persica* (IV = 36.4) and *Acacia modesta*

(IV = 8.64). In this community, 18 plant species were recorded which composed of 4 tree, 6 shrubs, 4 herb and 3 grass species. The Importance value contributed by tree was 27.52, shrubs (IV = 103.72), herbs (IV = 63.08), and grasses (IV = 105.69) (Table 42). The qualitative biological spectrum examination of leaf size showed that microphyll (9 spp., 52.94 %) was the dominant class. In life form examination, hemicryptophytes (6 spp., 33.33 %) dominated followed by nanophanerophyte and megaphanerophyte (4 spp., 22.22 %) each (Table 4). The community preferred to grow on high percentage of clay (51 %) and low amount of sand (46 %) and silt (3 %) particles. The soil of the community had better lime contents (12.4 %) with soil pH (7.34). The concentrations of P and K content were initiated in the range of 3.84 & 123 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.16 dS m^{-1} and 1.19 % respectively. The soil texture was found sandy clay (Table 28).

14. *Fagonia-Rhazya-Zizyphus* community (FRZ)

FRZ community (*Fagonia-Rhazya-Zizyphus*) was structured at Takht-e-Nasrati and composed of 18 species. There were 3 tree, 5 shrubs, 8 herb and 2 grass species. The dominated plant species on the basis of importance value were *Fagonia cretica* (IV = 46.8), *Rhazya stricta* (IV = 40.4) and *Zizyphus maurtiana* (IV = 28.3). Other important species included *Withania coagulans* (IV = 15.1) in shrubby stratum, *Cymbopogon jwarancusa* (IV = 31.1), *Carthamus oxycantha* (IV=27.5), *Eragrostis poaoides* (IV = 26.4) in herbaceous stratum and *Acacia modesta* (IV = 5.53) in tree stratum. The Importance value contributed by tree was 37.72, shrubs (IV = 76.16), herbs (IV=120.73) and grasses (IV = 65.88) (Table 43). The biological spectrum showed that hemicryptophytes were the leading life form classes (33.33 %) followed by therophyte (28.77%). Mirophyll and leptophyll were the dominant leaf size classes represented by (44.44%) and (27.78 %) plant species respectively (Table 4). The community preferred to grow on high percentage of sand (56 %) followed by clay (38 %) and silt (6 %) particles. The soil of the community had better lime contents (12.5 %) with soil pH (7.21). The concentrations of P and K content were initiated in the range of 3.72 & 117 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.18 dS m^{-1} and 1.23 % respectively. The soil texture was found sandy clay (Table 28).

15. *Cleome-Phoenix-Capparis* community (CPC)

This community was developed at Siraj Khel. Dominant plant species on the basis of important values were *Cleome viscosa* (IV = 35.1) in herbaceous stratum, *Phoenix dactylifera* (IV=30.9) in tree stratum and *Capparis decidua* (IV = 24.7) in shrubby stratum. In this community 23 plant species were recorded which composed of 4 tree, 6 shrubs, 10 herb and 3 grass species. The Importance value contributed by tree was 46.79, shrubs (IV = 71.35), herbs (IV = 146.74) and grasses (IV = 35.04) (Table 44). The biological spectrum showed that therophytes was the leading dominant life form class (7 spp., 30.43 %) followed by hemicryptophytes (5 spp., 21.74 %). Mirophyll (11 spp., 47.83 %) was dominant leaf size class followed by leptophyll (6 spp., 26.09 %) and nanophyll (4 spp., 17.39 %) in the community (Table 4). The community preferred to grow on high percentage of sand (53 %) followed by clay (45 %) and silt (2 %) particles. The soil of the community had better lime contents (12.4 %) with soil pH (7.93). The concentrations of P and K content were initiated in the range of 3.64 and 112 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.15 dS m^{-1} and 1.23 % respectively. The soil texture was found sandy clay (Table 28).

16. *Cenchrus -Cassia-Zizyphus* community (CRZ)

In Shahidan the *Cenchrus-Cassia-Zizyphus* community was established and dominated by *Cenchrus biflorus* (IV = 38.2) in herbaceous stratum, *Cassia angustifolia* (IV = 35.7) in shrubby stratum and *Zizyphus maurtiana* (IV = 25.2) in tree stratum on the basis of important values. Other important plant species with respect to Importance values were *Rhazya stricta* (IV = 33.9), *Withania coagulans* (IV = 23.8), *Fagonia cretica* (IV = 28.5) and *Acacia modesta* (IV = 8.62). A total of 15 plant species in the site composed of 3 tree, 4 shrubs, 8 were included in herbaceous stratum. The Importance value contributed by tree was 38.4, shrubs (IV = 100.3), herbs (IV = 112.38) and grasses (IV = 48) (Table 45). Therophytes (4 spp., 26.67%) was the dominating life form class. Mirophyll (10 spp., 66.67%) had comprised leading leaf form class followed by leptophyll (3 spp., 20 %) (Table 4). The community preferred to grow on high percentage of clay (51 %) followed by sand (43 %) and silt (6 %) particles. The soil of the community had better lime contents (12.4 %) with soil pH (6.89). The concentrations of P and K content were initiated in the range of 3.67 & 115 mg Kg^{-1}.

The community preferred EC and SOM in the range of 0.17 dS m^{-1} and 1.26 % respectively. The soil texture was found clay (Table 28).

17. *Capparis -Aerua -Acacia* community (CAA)

Capparis- Aerua- Acacia community was composed of 20 species comprising 2 tree, 8 shrubs, 7 herb and 3 grass species at Zarki Nasrati. Importance value contributed by three dominants species i.e. *Capparis spinosa, Aerua persica* and *Acacia modesta* was 87.35 while total importance value of 212.65 was provided by the remaining species. The contribution by tree was 36.89, shrubs 97.9, herbs 119.91 and grasses 45.3. The associated species in herbaceous stratum included *Cynodon dactylon* (IV = 31.6), *Tribulus terrestris* (IV = 29.6) and *Fagonia cretica* (IV=23), *Saccharum bengalense* (IV = 12.2) and *Astragalus psilocentros* (IV = 12) in shrubby stratum. In tree stratum, the important species was *Zizyphus maurtiana* (IV = 15.9) (Table 46). The life form spectrum showed that hemicryptophytes (5 spp., 25%) was dominant life form class followed by therophytes and chemophytes (4 spp., 20%) each. Microphyll (11 spp., 55 %) was dominant group of the leaf size class followed by leptophyll (4 spp., 20 %) (Table 4). The community preferred to grow on high percentage of sand (57 %) followed by clay (39 %) and silt (4 %) particles. The soil of the community had better lime contents (12.4 %) with soil pH (7.18). The concentrations of P and K content were initiated in the range of 3.71 & 114 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.16 dS m^{-1} and 1.24 % respectively. The soil texture was found sandy clay (Table 28).

18. *Boerhavia –Acacia- Capparis* community (BAC)

Boerhavia –Acacia- Capparis community was established at Shawa and is dominated by *Boerhavia diffusa* (IV = 50.5), *Acacia modesta* (IV = 41.2) and *Capparis spinosa* (IV = 34.3). Co dominant species included *Aerua persica* (48.21) in ground stratum; *Capparis decidua* (IV = 25.2) and *Withania coagulans* (IV=9.02) were making shrubby stratum. The associated species of he tree stratum included *Zizyphus maurtiana* (IV = 17.9). The community was composed of 12 species comprising of 3 tree, 5 shrubs and 4 herb species. The Importance value contributed by tree was 65.61, shrubs (IV=88.28) and herbs (IV = 146.10) (Table 47). Megaphanerophytes and chamophytes were the dominant class of the biological spectrum (3 spp., 25%) each.

In leaf size classes, microphyll (8 spp., 66.67 %) followed by leptophyll (3 spp., 25%) (Table 4). The community preferred to grow on high percentage of sand (63 %) followed by clay (32 %) and silt (5 %) particles. The soil of the community had better lime contents (12.4 %) with soil pH (7.41). The concentrations of P and K content were initiated in the range of 3.86 and 125 mg Kg^{-1}. The community preferred EC and SOM in the range of 0.16 dS m^{-1} and 1.28 % respectively. The soil texture was found sandy clay loam (Table 28).

Stand – 4

In stand 4, 4 communities i.e. *Zizyphus-Capparis-Phragmites* community (ZCP), *Aerua-Capparis-Zizyphus* community (ACZ), *Fagonia-Zizyphus-Saccharum* community (FZS), *Zizyphus-Aerua-Capparis* community (ZAC) consist of 36 plant species in which 6 trees, 11 shrubs, 15 herbs and 4 grasses were present in Kandu Khel, Shadi Khel, Sarki Lawager and Shnawa respectively. The highest number of herbs (7) and grasses (5) were present in ACZ and ZCP respectively. The highest TIV contributed by three dominant species is 132.56 present in ZAC at Shnawa while low (79.48) in FZS at Sarki Lawager. The highest TIV of trees (72.56), shrubs (IV = 97.73) were present in ACZ while herbs (IV = 107.59) and grasses (IV = 112.9) were present in FZS and ZCP respectively (Table 29).

19. *Eragrostis-Zizyphus-Capparis* community (EZC)

Eragrostis-Zizyphus-Capparis community was composed of 16 species included 2 tree, 7 shrubs, 5 herb and 2 grass species at Kandu Khel. The Importance value contributed by three dominants species i.e. *Eragrostis poaoides, Zizyphus maurtiana* and *Capparis decidua* was 132.79 while total importance value of 167.21 was provided by the remaining species. The contribution by tree was 50.94, shrubs (IV = 76.24), herbs (IV=103.36) and grasses (IV = 69.46). Other important plant species on the basis of important value were *Rhazya stricta, Astragalus psilocentros, Boerhavia diffusa* and *Cenchrus biflorus* (Table 48). The biological spectrum showed that hemicryptophytes and therophytes were the leading life form classes (4 spp., 25 %) followed by chamophytes (3 spp., 18.75%). Mirophyll and leptophyll were the dominant leaf size classes represented by 37.5 % and 31.25 % plant species respectively (Table 4). The community preferred to grow on high percentage of clay (41 %) followed by

sand (39 %) and silt (20 %) particles. The soil of the community had better lime contents (12.5 %), EC (0.19 dS m^{-1}) and SOM (1.27 %) with soil pH (7.64). The concentrations of P and K content were initiated in the range of 3.78 and 119 mg Kg^{-1} respectively. The soil texture was found clay (Table 28).

20. *Aerua-Acacia-Capparis* community (AAC)

This community was established at Shadi Khel. The dominated species on the basis of important value were *Aerua persica* (IV = 48.3) in ground stratum, *Acacia modesta* (IV = 24.3) in tree stratum and *Capparis decidua* (IV = 23.5) in shrubby stratum. In this community 20 plant species were recorded which composed of 4 tree, 7 shrubs, 7 herb and 2 grass species. The Importance value contributed by tree was 56.72, shrubs (IV = 79.76), herbs (IV=133.05) and grasses (IV = 30.42) (Table 49). Hemicriptophytes were the dominant class of the biological spectrum (6 spp., 30 %) followed by megaphanerophytes (5 spp., 25 %). In leaf size classes, microphyll (9 spp., 45 %) were dominant followed by leptophyll (5 spp., 25 %) (Table 4). The community preferred to grow on high percentage of sand (57 %) followed by clay (38 %) and silt (5 %) particles. The soil of the community had better lime contents (12.4 %), EC (0.2 dS m^{-1}) and SOM (1.28 %) with soil pH (7.74). The concentrations of P and K content were present in the range of 3.71 and 128 mg Kg^{-1}. The soil texture was found sandy clay (Table 28).

21. *Tribulus -Periploca -Zizyphus* community (TPZ)

The TPZ community (*Tribulus–Periploca-Zizyphus*) was established at Sarki Lawger. This community was supported by 19 plant species including 4 tree, 7 shrubs, 7 herb and 3 grass species. The Importance value contributed by three dominants species i.e. *Tribulus terrestris, Periploca aphylla* and *Zizyphus maurtiana* was 83.78 while total importance value of 216.22 was provided by the remaining species. The contribution by tree was 39.42, shrubs (IV = 88.2), herbs (IV = 138.49) and grasses (IV = 33.88) (Table 50). The life form spectrum showed that hemicryptophytes (5 spp., 26 %) was dominant life form class followed by nanophanerophytes and chamophytes (4 spp., 21.05 %) each. Microphyll (10 spp., 52.63 %) was leading group of the leaf form classes (Table 4). The community preferred to grow on high percentage of sand (59 %) followed by clay (33 %) and

silt (8 %) particles. The soil of the community had better lime contents (12.5 %), EC (0.2 dS m^{-1}) and SOM (1.19 %) with soil pH (7.24). The concentrations of P and K content were present in the range of 3.79 and 109 mg Kg^{-1}. The soil texture was found sandy clay loam (Table 28).

22. *Boerhavia-Zizyphus-Capparis* community (BZC)

This community was developed at Shanawa and composed of 11 species. There were 3 tree, 4 shrubs and 4 herb species Dominant plant species on the basis of important values were *Boerhavia diffusa* (IV = 61.84) in herbaceous strata, *Zizyphus maurtiana* (IV=42.6) in tree strata, and *Capparis spinosa* (IV = 34.93) in shrubby strata. The Importance value contributed by tree was 59.13, shrubs (IV = 78.82) and herbs (IV=162.05) (Table 51). Mirophyll was the dominant leaf size class represented by 8 plant species (72.73 %) and megaphenerophytes were the leading dominant life form classes (4 spp., 36.36%) (Table 4). The community preferred to grow on high percentage of sand (56 %) followed by clay (37 %) and silt (7 %) particles. The soil of the community had better lime contents (12.5 %), EC (0.21 dS m^{-1}) and SOM (1.21 %) with soil pH (7.62). The concentrations of p and K content were present in the range of 3.69 and 131 mg Kg^{-1}. The soil texture was found sandy clay. Soil erosion was high resulted in low mineral composition in the soil (Table 28).

The investigated area comprised of 46 species in the 22 communities during summer. The environmental factors, habitat and different plant life determined communities' structure. Plants communities are useful in classification, naming and identification of plant life structure. Muller Dumbois & Ellenberg (1974) stated that plant community structure interpret and analyze the plant life at diverse revelation and offer immediate information regarding plant life and are origin for deduction of future alteration. Brinkmann *et al*. (2009) evaluated the plant life reaction to ecological situation of open woodlands along an altitudinal and animal platabality preference. The factors which influenced plant life structure are unplanted settlements, overgrazing, erosion, land sliding, habitat destruction, poverty and anthropogenic activities. In summer, 22 plant communities were identified at various parts of the investigated area at different altitudes. In summer, the plant number are limited due to unavailability of water and high

temperature. The diverse plant communities documented in diverse seasons reflected different remains as recognized by Champion *et al*. (1965).

Soil is essential that has continued life on earth and it also helps the plants' growth that increased the competition of grazing animals and human. According to Turner *et al*. (2004) and Shameem *et al*. (2011) stated that the distinctive habitation altered due to increasing human transportation and population. Other progression results into increased the expected attack of organism has been happening the world over. Plant life changed the physical and chemical properties of soil. It improves the soil inliltration, structure and prevents erosion. Shameem *et al*. (2011) and Buckman & Brady (1967) described that the resources of soil is limited and its physical and chemical properties are restricted mostly by humas and clay. Several research works dealing with different features of plant life from diverse parts of the state have been taken out form time to time (Stewart, 1982; Dar *et al*., 2001). The investigated area presents a limited number of animal and plant species. The investigated area is more suitable for the legume plant due the presence of high content of sand particles in the area. The texture of the stands 1, 2 and 3 are also changed with soil erosion due to the presence of hilly area of stand 4 in east. The mountains range present in the east of the consisted of sandy hills therefore it is called SHINGHAR (In local language Pashto; Shin: sand, Ghar: Hill). The water flow was occure from east to west due to altitudinal difference. Plant growth somewhat indirectly manipulated through soil structure. It also effects the seedling growth which is very sensitive to physical condition of soil texture. The rigid compacted layer slows down the growth of the seedling for root cannot penetrate easily in such soil.

Table 28. Physiochemical analysis of soil of Tehsil Takht-e-Nasrati, District Karak.

Stand	Sites	Communities	PH (1:2)	EC dS m-1 (1:2)	Lime (%)	SOM(%)	P mg/Kg	K mg/Kg	Sand	Clay	Silt	Textural Class
1	Tater Khel	ECP	7.31	0.18	12.6	1.24	3.78	119	63	31	6	Sandy Clay Loam
	Gardi Banda	PSC	7.66	0.16	12.3	1.26	3.79	126	65	32	3	Sandy Clay Loam
	Ahmad Abad	APS	7.13	0.19	12.6	1.27	3.77	114	70	26	4	Sandy Clay Loam
	Warana	TTS	8.13	0.21	12.4	1.28	3.76	121	61	33	6	Sandy Clay Loam
	Average		**7.56**	**0.19**	**12.5**	**1.26**	**3.78**	**120**	**64.8**	**30.5**	**4.7**	**Sandy Clay Loam**
2	S Bogara	ESZ	6.86	0.17	12.6	1.31	3.67	123	72	24	4	Sandy Clay Loam
	N Bogara	TAS	6.72	0.18	12.7	1.44	3.68	116	51	43	6	Sandy Clay
	Gandiri Khattak	ZCS	6.97	0.18	12.7	1.29	3.64	117	67	30	3	Sandy Clay Loam
	Kiri Dhand	CTZ	6.43	0.19	12.6	1.33	3.79	120	45	28	27	Clay Loam
	Jahangiri Banda	CCZ	6.83	0.16	12.6	1.25	3.81	123	62	34	4	Sandy Clay Loam
	Mona Khel	ZCS	6.19	0.19	12.7	1.26	3.67	125	63	32	5	Sandy Clay Loam
	Jarasi	SZC	6.06	0.17	12.7	1.2	3.84	127	42	25	33	Loam
	Average		**7.66**	**0.2**	**14.4**	**1.48**	**4.27**	**139**	**66.7**	**35.3**	**12**	**Sandy Clay Loam**
3	Chokara	CRZ	7.26	0.15	12.3	1.31	3.81	121	47	49	4	Sandy Clay
	Ambiri Kala	SCZ	7.34	0.16	12.4	1.19	3.84	123	46	51	3	Sandy Clay
	Takht-e-Nasrati	FRZ	7.21	0.18	12.5	1.23	3.72	117	56	38	6	Sandy Clay
	Siraj Khel	CPC	7.93	0.15	12.4	1.23	3.64	112	53	45	2	Sandy Clay
	Shahidan	CCZ	6.89	0.17	12.4	1.26	3.67	115	43	51	6	Clay
	Zarki Nasrati	CAA	7.18	0.16	12.4	1.24	3.71	114	57	39	4	Sandy Clay
	Shawa	BAC	7.41	0.16	12.4	1.28	3.86	125	63	32	5	Sandy Clay Loam
	Average		**7.32**	**0.16**	**12.4**	**1.25**	**3.75**	**118**	**52.1**	**43.6**	**4.3**	**Sandy Clay**
4	Kandu Khel	EZC	7.64	0.19	12.5	1.27	3.78	119	39	41	20	Clay

	Shadi Khel	AAC	7.74	0.2	12.4	1.28	3.71	128	57	38	5	Sandy Clay
	Sarki Lawager	TPZ	7.24	0.2	12.5	1.19	3.79	109	59	33	8	Sandy Clay Loam
	Shanawa	BZC	7.62	0.21	12.5	1.21	3.69	131	56	37	7	Sandy Clay
	Average		**7.56**	**0.2**	**12.4**	**1.24**	**3.74**	**122**	**52.8**	**37.3**	**10**	**Sandy Clay**
Grand Average			**7.17**	**0.18**	**12.5**	**1.26**	**3.75**	**120**	**56.2**	**36**	**7.8**	**Sandy Clay**

Table 29. The number of species and share relative important value of tree, shrubs, herbs and grasses among the different communities during summer of Takht-e- Nasrati, Karak.

Stands	Sites	Communities	Total Species	Tree	Shrubs	Herbs	Grasses	TIV contribution by three dominant	TIV by remaining species	TIV by tree	TIV by shrubs	TIV by herbs	TIV by grasses
1	As a whole	CSP	27	6	6	13	2	79.09	220.91	56.35	73.03	142.5	27.97
	Tater Khel	ECP	15	4	4	5	2	109	191	64.24	67.52	106.52	61.72
	Gardi Banda	PSC	14	3	4	6	1	108.41	191.59	51.37	75.4	151.45	21.78
	Ahmad Abad	APS	18	4	6	7	1	94.34	205.66	58.97	81.85	140.8	18.38
	Warana	TTS	17	4	4	8	1	89.71	210.29	50.95	67.57	171.5	9.98
2	As a whole	ZCS	27	4	5	15	3	86.64	213.36	47.21	55.77	158.99	37.9
	S Bogara	ESZ	24	4	4	14	2	71.36	228.64	30.67	52.53	172.9	43.9
	N Bogara	TAS	19	4	4	10	1	94.91	205.09	46.34	47.07	181.47	25.12
	Gandiri Khattak	ZCS	17	1	3	11	2	156.98	143.02	81.9	49.98	136.5	31.62
	Kiri Dhand	CTZ	19	3	5	9	2	82.78	217.22	25.84	65.45	159.88	48.83
	Jahangiri Banda	CCZ	21	3	4	12	2	93.23	206.77	32.61	70.55	165.04	31.8
	Mona Khel	ZCS	17	3	4	9	1	113.84	186.16	71.56	48.95	156.83	22.66
	Jarasi	SZC	19	3	4	10	2	88.79	211.21	41.69	55.89	140.96	61.46
3	As a whole	RCZ	34	6	12	13	3	63.98	236.02	40.11	88.9	112.48	58.39
	Chokara	CRZ	18	4	5	6	3	145.25	154.75	28.33	84.82	70.56	116.29
	Ambiri Kala	SCZ	18	4	6	4	3	91.6	208.94	27.52	103.72	63.07	105.69
	Takht-e- Nasrati	FRZ	18	3	5	8	2	115.35	184.65	37.65	76.21	128.66	57.48
	Siraj Khel	CPC	23	4	6	10	3	90.69	209.31	46.79	71.35	146.78	35.08
	Shahidan	CCZ	15	3	4	6	2	99.1	200.9	38.4	100.3	112.38	48.92
	Zarki Nasrati	CAA	20	2	8	7	3	87.35	212.65	36.89	97.9	119.91	45.3
	Shawa	BAC	12	3	5	4	-	126.09	173.91	65.83	88.09	146.08	-
4	As a whole	ZBC	29	6	11	9	3	84.41	215.59	51.55	80.76	134.24	33.44
	Kandu Khel	EZC	16	2	7	5	2	132.79	167.21	50.94	76.24	103.36	69.46
	Shadi Khel	AAC	20	4	7	7	2	96.08	203.92	56.75	79.78	133.05	30.42
	Sarki Lawager	TPZ	19	4	7	7	3	83.78	216.22	39.4	88.2	138.5	3.9
	Shanawa	BZC	11	3	4	4	-	139.35	160.65	59.13	78.82	162.05	-

Table 30. Phytosociological attributes of *Eragrostis-Calotropis-Prosopis* community recorded at Tater Khel, during summer, Tehsil Takht-e-Nasrati, Karak.

S.No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.4	40	0.5	1.61	4.55	1.36	7.52
2	*Phoenix dactylifera* L.	0.8	30	1.27	3.23	3.41	3.4	10.04
3	*Prosopis farcta* (Banks & Soland.) J.F. Macbr.	1.6	100	6.05	6.45	11.4	16.4	34.25
4	*Zizyphus maurtiana* Lam.	0.6	50	1.58	2.42	5.68	4.29	12.39
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	4.8	100	1.71	19.4	11.4	4.64	35.44
6	*Datura metel* L.	1	50	0.3	4.03	5.68	0.81	10.52
7	*Periploca aphylla* Decne.	0.3	30	0.18	1.21	3.41	0.49	5.11
8	*Saccharum bengalense* Retz.	1.2	90	0.54	4.84	10.2	1.47	16.51
Herbaceous layer								
15	*Carthamus oxycantha* Bieb.	0.9	40	1	3.6	4.55	2.71	10.86
9	*Cenchrus biflorus* Hook. f.	3.2	90	2.22	12.9	10.2	6.02	29.12
10	*Chrozophora obliqua* (Vahl) A. Juss.	1.1	40	6	4.4	4.55	16.3	25.25
11	*Cynodon dactylon* (L.) Pers.	2.5	30	3.25	10.1	3.41	8.82	22.33
12	*Eragrostis poaoides* Beauv.	3.2	90	6	12.9	10.2	16.3	39.4
13	*Euphorbia prostrata* Ait.	1.5	50	1.25	6.05	5.68	3.39	15.12
14	*Heliotropium europaeum* L.	1.7	50	5	6.86	5.68	13.6	26.14

Table 31. Phytosociological attributes of *Phoenix-Saccharum-Cenchrus* community recorded at Gardi banda during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Dalbergia sissoo* Roxb.	0.3	30	0.35	1.06	3.2	0.88	5.14
2	*Phoenix dactylifera* L.	3.1	100	6.7	11	10.8	16.8	38.6
3	*Zizyphus maurtiana* Lam.	0.4	40	0.78	1.41	4.3	1.96	7.67
Shrubby layer								
4	*Calotropis procera* (Wild) R.Br.	0.9	50	0.25	3.18	5.38	0.63	9.19
5	*Periploca aphylla* Decne.	0.7	50	0.25	2.47	5.38	0.63	8.48
6	*Saccharum bengalense* Retz.	6.3	100	1.92	22.3	10.8	4.8	37.9
7	*Saccharum spontaneum* L.	2.5	90	0.54	8.8	9.68	1.36	19.84
Herbaceous layer								
8	*Aerua persica* (Burm.f) Merrill.	1.3	60	5.25	4.59	6.4	13.2	24.19
9	*Boerhavia diffusa* L..	0.9	30	2	3.18	3.2	5.03	11.41
10	*Cenchrus biflorus* Hook. f.	4	100	5	14.1	10.8	12.6	37.5
11	*Eragrostis poaoides* Beauv.	1.9	70	3	6.71	7.5	7.5	21.71
12	*Euphorbia helioscopia* L.	1.6	60	1.5	5.6	6.4	3.77	15.77
13	*Carthamus oxycantha* Bieb.	1.5	50	8.5	5.3	5.38	21.4	32.08
14	*Tribulus terrestris* L.	2.9	100	3.75	10.3	10.8	9.42	30.52

Table 32. Phytosociological attributes of *Aerua-Prosopis-Saccharum* community recorded at Ahmad Abad during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.34	1.28	3.06	0.82	5.16
2	*Dalbergia sissoo* Roxb.	0.3	20	0.33	1.28	2.04	0.79	4.11
3	*Prosopis farcta* (Banks & Soland.) J.F. Macbr.	1.8	80	6.56	7.66	8.16	15.8	31.62
4	*Zizyphus maurtiana* Lam.	1.1	70	2.6	4.68	7.14	6.3	18.12
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	1	50	0.3	4.26	5.1	0.72	10.08
6	*Datura metel* L.	0.6	30	0.18	2.55	3.06	0.43	6.04
7	*Periploca aphylla* Decne.	0.3	30	0.13	1.28	3.06	0.31	4.65
8	*Ricinus communis* L.	0.7	50	0.3	2.98	5.1	0.72	8.8
9	*Saccharum bengalense* Retz.	2.7	80	0.85	11.5	8.16	2.1	21.76
10	*Saccharum spontaneum* L.	4.2	90	1.47	17.9	9.2	3.54	30.64
Herbaceous layer								
11	*Aerua persica* (Burm.f.) Merrill.	2	90	6	8.5	9.2	14.4	32.1
12	*Cenchrus biflorus* Hook. f.	2.5	80	2	10.6	8.16	4.81	23.57
13	*Eragrostis poaoides* Beauv.	1	50	3.75	4.26	5.1	9.02	18.38
14	*Euphorbia helioscopia* L.	1.2	50	1.25	5.1	5.1	3.01	13.21
15	*Fagonia cretica* L.	1.1	60	5.25	4.68	6.12	12.6	23.4
16	*Peganum hermala* L.	1.3	50	4.75	5.53	5.1	11.4	22.03
17	*Solanum surattense* Burm .f.	0.3	30	3.25	1.28	3.06	7.82	12.16
18	*Tribulus terrestris* L.	1.1	40	2.25	4.68	4.08	5.41	14.17

Table 33. Phytosociological attributes of *Tribulus–Prosopis-Saccharum* community recorded at Warana during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.54	0.8	1.92	0.84	3.56
2	*Prosopis farcta* (Banks &Soland.) J.F. Macbr.	1.6	90	10.6	6.4	8.65	16.4	31.5
3	*Tamarix aphylla* (L.) Karst.	0.2	20	1.86	0.8	1.92	2.88	5.6
4	*Zizyphus maurtiana* Lam.	0.7	70	0.82	2.8	6.73	1.27	10.8
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	0.9	70	0.27	3.6	6.73	0.42	10.7
6	*Datura metel* L.	0.8	50	0.2	3.2	4.81	0.31	8.32
7	*Saccharum bengalense* Retz.	3.5	100	1.53	14	9.62	2.37	26
8	*Periploca aphylla* Decne.	2.9	100	0.73	11.6	9.62	1.13	22.4
Herbaceous layer								
9	*Aerua persica* (Burm.f) Merrill.	0.3	20	3	1.2	1.92	4.65	7.77
10	*Boerhavia diffusa* L.	1.5	60	7.75	6	5.77	12	23.8
11	*Carthamus oxycantha* Bieb.	2.1	80	8.25	8.4	7.69	12.8	28.9
12	*Cenchrus biflorus* Hook. f.	2.2	90	6	8.8	8.65	9.3	26.7
13	*Cyperus rotundus* L.	3.2	60	6.5	12.8	5.77	10.1	28.6
14	*Eragrostis poaoides* Beauv.	1	30	2	4	2.89	3.1	9.99
15	*Euphorbia helioscopia* L.	0.5	30	2	2	2.89	3.1	7.99
16	*Fagonia cretica* L.	0.8	60	4	3.2	5.77	6.2	15.2
17	*Tribulus terrestris* L.	2.6	90	8.5	10.4	8.65	13.2	32.2

Table 34. Phytosociological attributes of *Eragrostis-Saccharum-Zizyphus* community recorded at Southern Bogara during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Dalbergia sissoo* Roxb.	0.2	20	1.02	0.51	1.82	0.87	3.19
2	*Acacia nilotica* (L.) Delice	0.2	20	0.37	0.51	1.82	0.31	2.64
3	*Phoenix dactylifera* L.	1.2	50	2.27	3.05	4.55	1.93	9.52
4	*Zizyphus maurtiana* Lam.	1.4	80	5.29	3.55	7.27	4.49	15.3
Shrubby layer								
5	*Periploca aphylla* Decne.	0.5	40	0.61	1.27	3.64	0.52	5.42
6	*Calotropis procera* (Wild) R.Br.	0.6	40	0.42	1.52	3.64	0.36	5.52
7	*Calligonum polygonoides* L.	4	100	1.14	10.2	9.09	0.97	20.2
8	*Saccharum bengalense* Retz.	4.5	100	1.05	11.4	9.09	0.89	21.4
Herbaceous layer								
9	*Aerua persica* (Burm.f.) Merrill.	0.3	20	3	0.76	1.82	2.55	5.13
10	*Boerhavia diffusa* L.	0.6	30	4.5	1.52	2.73	3.82	8.07
22	*Carthamus oxycantha* Bieb.	0.8	20	6	2.03	1.82	5.1	8.95
11	*Cenchrus biflorus* Hook. f.	3.4	70	10.5	8.63	6.36	8.92	23.9
12	*Chrozophora obliqua* (Vahl) A. Juss.	0.2	20	3	0.51	1.82	2.55	4.87
13	*Citrullus colocynthis* L. Schrad.	0.2	20	5.25	0.51	1.82	4.46	6.79
14	*Cynodon dactylon* (L.) Pers.	2	10	3.75	5.08	0.91	3.19	9.17
15	*Cyperus rotundus* L.	1.1	30	4.5	2.79	2.73	3.82	9.34
16	*Echinops echinatus* Roxb.	2.1	70	10.5	5.33	6.36	8.92	20.6
17	*Eragrostis poaoides* Beauv.	4.4	90	18	11.2	8.18	15.3	34.6
18	*Euphorbia helioscopia* L.	4.6	70	12.8	11.7	6.36	10.9	28.9
19	*Euphorbia prostrata* Ait.	2.8	60	7.75	7.11	5.45	6.58	19.1
20	*Fagonia cretica* L.	0.6	30	3.25	1.52	2.73	2.76	7.01
21	*Peganum hermala* L.	1.5	60	5.25	3.81	5.45	4.46	13.7
23	*Solanum surattense* Burm .f.	0.3	10	1.5	0.76	0.91	1.27	2.94
24	*Tribulus terrestris* L.	1.9	40	6	4.82	3.64	5.1	13.6

Table 35. Phytosociological attributes of *Tribulus–Acacia-Saccharum* community recorded at Nothern Bogara during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	2.5	70	14.8	4.77	7.69	14.6	27.1
2	*Dalbergia sissoo* Roxb.	0.3	30	0.72	0.57	3.3	0.71	4.58
3	*Phoenix dactylifera* L.	0.3	10	0.79	0.57	1.1	0.78	2.45
4	*Zizyphus maurtiana* Lam .	1.1	60	3.61	2.1	6.59	3.56	12.3
Shrubby layer								
5	*Calligonum polygonoides* L.	1	40	0.24	1.91	4.4	0.24	6.54
6	*Calotropis procera* (Wild) R.Br.	2	50	0.3	3.82	5.49	0.3	9.61
7	*Periploca aphylla* Decne.	0.7	30	0.18	1.34	3.3	0.18	4.81
8	*Saccharum bengalense* Retz.	7.5	90	1.95	14.3	9.89	1.92	26.1
Herbaceous layer								
9	*Boerhavia diffusa* L.	1.4	40	4.75	2.67	4.4	4.68	11.7
10	*Carthamus oxycantha* Bieb.	0.7	30	4.5	1.34	3.3	4.44	9.07
11	*Cenchrus biflorus* Hook. f.	8	80	14.3	15.3	8.79	14.1	38.2
12	*Chrozophora obliqua* (Vahl) A. Juss.	0.6	30	4.5	1.15	3.3	4.44	8.88
13	*Citrullus colocynthis* L. Schrad.	0.1	10	3.75	0.19	1.1	3.7	4.99
14	*Cyperus rotundus* L.	1.9	40	6	3.63	4.4	5.91	13.9
15	*Eragrostis poaoides* Beauv.	3.7	70	10.5	7.06	7.69	10.4	25.1
16	*Euphorbia helioscopia* L.	3.3	60	9	6.3	6.59	8.87	21.8
17	*Euphorbia prostrata* Ait.	9	40	1	17.2	4.4	0.99	22.6
18	*Peganum hermala* L.	1.1	30	3.25	2.1	3.3	3.2	8.6
19	*Tribulus terrestris* L.	7.2	100	17.3	13.7	11	17.1	41.8

Table 36. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Gandiri Khattak during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Zizyphus maurtiana* Lam.	2.4	90	132	8.824	11.5	61.5	81.8
Shrubby Layer								
3	*Calotropis procera* (Wild) R.Br.	0.7	50	0.3	2.574	6.41	0.14	9.12
4	*Periploca aphylla* Decne.	0.3	30	0.08	1.103	3.85	0.04	4.99
	Saccharum bengalense Retz.	6	100	2.38	22.06	12.8	1.11	36
Herbaceous layer								
5	*Boerhavia diffusa* L.	0.6	40	6	2.206	5.13	2.79	10.1
6	*Carthamus oxycantha* Bieb.	0.8	30	4.5	2.941	3.85	2.1	8.88
7	*Cenchrus biflorus* Hook. f.	4.7	100	19.5	17.28	12.8	9.08	39.2
8	*Cynodon dactylon* (L.) Pers.	2.3	50	7.5	8.456	6.41	3.49	18.4
9	*Echinops echinatus* Roxb.	0.3	30	2	1.103	3.85	0.93	5.88
10	*Eragrostis poaoides* Beauv.	1.6	40	4.75	5.882	5.13	2.21	13.2
11	*Euphorbia helioscopia* L.	0.4	20	3	1.471	2.56	1.4	5.43
12	*Euphorbia prostrata* Ait.	1.6	30	6.75	5.882	3.85	3.14	12.9
13	*Fagonia cretica* L.	0.4	30	4.5	1.471	3.85	2.1	7.41
14	*Heliotropium europaeum* L.	1.2	30	4.5	4.412	3.85	2.1	10.4
15	*Launaea nudicaulis* (L.) Hook. f.	1.1	30	3.25	4.044	3.85	1.51	9.4
16	*Solanum surattense* Burm .f.	0.4	30	4	1.471	3.85	1.86	7.18
17	*Tribulus terrestris* L.	2.4	50	9.75	8.824	6.41	4.54	19.8

Table 37. Phytosociological attributes of *Calligonum-Tribulus*-Zizyphus community recorded at Kiri Dhand during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.5	40	0.68	1.69	3.7	1.28	6.68
2	*Dalbergia sissoo* Roxb.	0.3	30	0.37	1.02	2.78	0.7	4.49
3	*Zizyphus maurtiana* Lam.	0.8	80	2.4	2.71	7.41	4.53	14.6
Shrubby Layer								
4	*Calligonum polygonoides* L.	6.3	100	2.48	21.4	9.26	4.68	35.3
5	*Calotropis procera* (Wild) R.Br.	0.4	30	0.13	1.36	2.78	0.25	4.38
6	*Datura metel* L.	0.8	40	0.24	2.71	3.7	0.45	6.87
7	*Periploca aphylla* Decne.	1.1	80	0.48	3.73	7.41	0.91	12
8	*Saccharum bengalense* Retz.	0.8	40	0.24	2.71	3.7	0.45	6.87
Herbaceous layer								
9	*Boerhavia diffusa* L.	1.2	70	5.5	4.07	6.48	10.4	20.9
18	*Carthamus oxycantha* Bieb.	0.6	50	1.25	2.03	4.63	2.36	9.02
10	*Cenchrus biflorus* Hook. f.	3.4	90	3.5	11.5	8.33	6.6	26.5
11	*Chrozophora obliqua* (Vahl) A. Juss	0.3	30	4.5	1.02	2.78	8.49	12.3
12	*Cymbopogon jwarancusa* (Jones) Schult.	0.5	50	7.5	1.69	4.63	14.1	20.5
13	*Cyperus rotundus* L.	3	50	3.75	10.2	4.63	7.07	21.9
14	*Eragrostis poaoides* Beauv.	2.7	70	6.75	9.15	6.48	12.7	28.4
15	*Euphorbia helioscopia* L.	1.9	50	1.25	6.44	4.63	2.36	13.4
16	*Heliotropium europaeum* L.	0.3	20	3	1.02	1.85	5.66	8.53
17	*Solanum surattense* Burm .f.	1.4	70	1.75	4.75	6.48	3.3	14.5
19	*Tribulus terrestris* L.	3.2	90	7.25	10.8	8.33	13.7	32.9

Table 38. Phytosociological attributes of *Calligonum-Cenchrus-Zizyphus* community recorded at Jahangiri banda during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.28	0.6	2.75	0.38	3.73
2	*Dalbergia sissoo* Roxb.	0.8	50	1.63	1.6	4.59	2.2	8.39
3	*Zizyphus maurtiana* Lam.	2.7	80	5.74	5.4	7.34	7.75	20.5
Shrubby layer								
4	*Calligonum polygonoides* L.	15.2	100	2.2	30.4	9.17	2.97	42.5
5	*Calotropis procera* (Wild) R.Br.	0.6	40	0.24	1.2	3.67	0.32	5.19
6	*Periploca aphylla* Decne.	0.5	40	0.33	1	3.67	0.45	5.12
7	*Saccharum bengalense* Retz.	3.5	100	1.14	7	9.17	1.54	17.7
Herbaceous layer								
8	*Aerua persica* (Burm.f) Merrill.	0.3	20	1.75	0.6	1.83	2.36	4.8
9	*Boerhaavia diffusa* L.	0.8	40	3.5	1.6	3.67	4.73	10
19	*Carthamus oxycantha* Bieb.	0.8	30	0.75	1.6	2.75	1.01	5.36
10	*Cenchrus biflorus* Hook. f.	4.6	100	8.75	9.2	9.17	11.8	30.2
11	*Citrullus colocynthis* L. Schrad.	0.2	30	9.25	0.4	2.75	12.5	15.6
12	*Cynodon dactylon* (L.) Pers.	2.5	20	5	5	1.83	6.75	13.6
13	*Cyperus rotundus* L.	1.9	50	3.75	3.8	4.59	5.06	13.5
14	*Eragrostis poaoides* Beauv.	2.8	60	5.25	5.6	5.5	7.09	18.2
15	*Euphorbia helioscopia* L.	3.8	70	6.25	7.6	6.42	8.44	22.5
16	*Euphorbia prostrata* Ait.	4.4	90	3.5	8.8	8.26	4.73	21.8
17	*Fagonia cretica* L.	0.6	30	3.25	1.2	2.75	4.39	8.34
18	*Peganum hermala* L.	1.5	60	5.25	3	5.5	7.09	15.6
20	*Solanum surattense* Burm .f.	0.3	10	1.5	0.6	0.92	2.03	3.54
21	*Tribulus terrestris* L.	1.9	40	4.75	3.8	3.67	6.41	13.9

Table 39. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Mona Khel during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.23	0.64	2.27	0.3	3.21
2	*Dalbergia sissoo* Roxb.	0.7	50	1.4	2.23	5.68	1.84	9.76
3	*Zizyphus maurtiana* Lam.	4	100	26.2	12.7	11.4	34.5	58.6
Shrubby layer								
4	*Calligonum polygonoides* L.	2.6	40	0.51	8.28	4.55	0.67	13.5
5	*Calotropis procera* (Wild) R.Br.	0.4	40	0.24	1.27	4.55	0.32	6.14
6	*Datura metel* L.	0.3	30	0.18	0.96	3.41	0.24	4.6
7	*Saccharum bengalense* Retz.	3.7	100	1.14	11.8	11.4	1.5	24.6
Herbaceous layer								
8	*Boerhaavia diffusa* L.	0.8	40	3.5	2.55	4.55	4.61	11.7
9	*Carthamus oxycantha* Bieb.	0.2	20	0.5	0.64	2.27	0.66	3.57
10	*Cenchrus biflorus* Hook. f.	4.6	100	8.75	14.6	11.4	11.5	37.5
11	*Citrullus colocynthis* L. Schrad.	0.3	30	9.25	0.96	3.41	12.2	16.6
12	*Cyperus rotundus* L.	1.9	50	3.75	6.05	5.68	4.94	16.7
13	*Eragrostis poaoides* Beauv.	2.8	60	5.25	8.92	6.82	6.92	22.7
14	*Euphorbia helioscopia* L.	4.3	70	6.75	13.7	7.95	8.89	30.5
15	*Euphorbia prostrata* Ait.	3.9	90	3.5	12.4	10.2	4.61	27.3
16	*Fagonia cretica* L.	0.6	30	3.25	1.91	3.41	4.28	9.6
17	*Solanum surattense* Burm .f.	0.1	10	1.5	0.32	1.14	1.98	3.43

Table 40. Phytosociological attributes of *Saccharum–Zizyphus-Cynodon* community recorded at Jarassi during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.4	1.62	3.13	1.26	6.01
2	*Dalbergia sissoo* Roxb.	0.5	50	1.9	2.7	5.21	5.98	13.9
3	*Zizyphus maurtiana* Lam.	1.7	100	0.7	9.19	10.4	2.2	21.8
Shrubby layer								
4	*Calotropis procera* (Wild) R.Br.	0.6	60	0.36	3.24	6.25	1.13	10.6
5	*Datura metel* L.	0.8	60	0.54	4.32	6.25	1.7	12.3
6	*Periploca aphylla* Decne.	0.4	40	0.24	2.16	4.17	0.76	7.08
7	*Saccharum bengalense* Retz.	2.2	100	1.14	11.9	10.4	3.59	25.9
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.3	20	1.75	1.62	2.08	5.51	9.21
9	*Boerhaavia diffusa* L.	0.8	40	1	4.32	4.17	3.15	11.6
10	*Cenchrus biflorus* Hook. f.	1.7	100	2.5	9.19	10.4	7.87	27.5
11	*Citrullus colocynthis* L. Schrad.	0.2	20	5.25	1.08	2.08	16.5	19.7
12	*Cynodon dactylon* (L.) Pers.	1.3	30	3.25	7.03	3.13	10.2	20.4
13	*Cyperus rotundus* L.	1.7	50	1.25	9.19	5.21	3.93	18.3
14	*Eragrostis poaoides* Beauv.	3.5	100	3.75	18.9	10.4	11.8	41.1
15	*Euphorbia prostrata* Ait.	0.8	50	2.5	4.32	5.21	7.87	17.4
16	*Fagonia cretica* L.	0.5	40	1	2.7	4.17	3.15	10
17	*Launaea nudicaulis* (L.) Hook. f.	0.2	20	0.5	1.08	2.08	1.57	4.74
18	*Solanum surattense* Burm .f.	0.2	20	3	1.08	2.08	9.44	12.6
19	*Tribulus terrestris* L.	0.8	30	0.75	4.32	3.13	2.36	9.81

Table 41. Phytosociological attributes of *Cymbopogon–Rhazya-Zizyphus* community recorded at Chokara during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.8	50	0.7	2.38	5.68	0.57	8.63
2	*Acacia nilotica* (L.) Delice.	0.5	40	0.55	1.49	4.55	0.45	6.48
3	*Dalbergia sissoo* Roxb.	0.3	20	0.26	0.89	2.27	0.21	3.38
4	*Zizyphus maurtiana* Lam.	0.7	50	2.5	2.08	5.68	2.04	9.8
Shrubby layer								
5	*Periploca aphylla* Decne.	0.3	40	0.24	0.89	4.55	0.2	5.63
6	*Rhazya stricta* Decne.	16.1	100	1.23	47.9	11.4	1	60.3
7	*Saccharum bengalense* Retz.	0.6	40	0.24	1.79	4.55	0.2	6.53
8	*Saccharum spontaneum* L.	0.4	30	0.29	1.19	3.41	0.24	4.84
9	*Zizyphus nummularia* (Burm.f.) W. & A.	0.5	50	0.48	1.49	5.68	0.39	7.56
Herbaceous layer								
10	*Aerua persica* (Burm.f.) Merrill.	0.8	40	6	2.38	4.55	4.89	11.8
11	*Boerhavia diffusa* L.	0.5	50	7.5	1.49	5.68	6.11	13.3
12	*Cleome viscosa* L.	0.3	20	3	0.89	2.27	2.44	5.61
13	*Cymbopogon jwarancusa* (Jones) Schult.	4.4	100	62.3	13.1	11.4	50.7	75.2
14	*Cynodon dactylon* (L.) Pers.	3.5	50	7.5	10.4	5.68	6.11	22.2
15	*Eragrostis poaoides* Beauv.	1.6	60	9	4.76	6.82	7.33	18.9
16	*Fagonia cretica* L.	0.9	60	9	2.68	6.82	7.33	16.8
17	*Solanum surattense* Burm .f.	0.8	50	7.5	2.38	5.68	6.11	14.2
18	*Tribulus terrestris* L.	0.6	30	4.5	1.79	3.41	3.66	8.86

Table 42. Phytosociological attributes of *Cymbopogon-Saccharum-Zizyphus* community recorded at Ambiri Kala during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.6	50	0.18	1.95	6.41	0.27	8.64
2	*Acacia nilotica* (L.) Delice.	0.1	10	0.05	0.33	1.28	0.08	1.68
3	*Dalbergia sissoo* Roxb.	0.4	30	0.25	1.3	3.85	0.38	5.53
4	*Zizyphus maurtiana* Lam.	0.8	60	0.33	2.61	7.69	0.5	10.8
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	7.6	100	1.06	24.8	12.8	1.61	39.2
6	*Calotropis procera* (Wild.) R. Br.	0.3	20	0.12	0.98	2.56	0.18	3.72
7	*Capparis decidua* (Forssk). Edgeworth.	0.4	20	0.12	1.3	2.56	0.18	4.05
8	*Rhazya stricta* Decne.	1.4	50	0.25	4.56	6.41	0.38	11.3
9	*Saccharum bengalense* Retz.	7.6	100	1.34	24.8	12.8	2.03	39.6
10	*Zizyphus nummularia* (Burm.f.) W. & A.	0.1	10	0.06	0.33	1.28	0.09	1.7
Herbaceous layer								
11	*Aerua persica* (Burm.f) Merrill.	1.5	80	14	4.89	10.3	21.2	36.4
12	*Boerhavia diffusa* L.	0.4	30	0.75	1.3	3.85	1.14	6.29
13	*Carthamus oxycantha* Bieb.	0.2	10	1.5	0.65	1.28	2.27	4.21
15	*Cymbopogon jwarancusa* (Jones) Schult.	5.9	90	22.5	19.2	11.5	34.1	64.8
14	*Cynodon dactylon* (L.) Pers.	1.8	40	10.5	5.86	5.13	15.9	26.9
16	*Eragrostis poaoides* Beauv.	1	40	8.25	3.26	5.13	12.5	20.9
17	*Tribulus terrestris* L.	0.6	40	4.75	1.95	5.13	7.2	14.3

Table 43. Phytosociological attributes of *Fagonia-Rhazya-Zizyphus* community recorded at Takht-e-Nasrati during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	MC	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	30	0.23	1.7	3.66	0.37	5.73
2	*Acacia nilotica* (L.) Delice.	0.2	20	0.37	0.68	2.44	0.6	3.72
3	*Zizyphus maurtiana* Lam.	1.6	90	7.35	5.44	11	11.9	28.3
Shrubby layer								
4	*Rhazya stricta* Decne.	7.7	100	1.23	26.2	12.2	1.98	40.4
5	*Saccharum bengalense* Retz.	1.1	50	0.3	3.74	6.1	0.48	10.3
6	*Saccharum spontaneum* L.	0.4	30	0.27	1.36	3.66	0.44	5.45
7	*Withania coagulans* (Stocks) Dunal.	1.4	80	0.33	4.76	9.76	0.53	15.1
8	*Zizyphus nummularia* (Burm.f.) W. &A.	0.3	30	0.18	1.02	3.66	0.29	4.97
Herbaceous layer								
9	*Boerhavia diffusa* L.	0.3	30	0.75	1.02	3.66	1.21	5.89
13	*Carthamus oxycantha* Bieb.	4.5	50	3.75	15.3	6.1	6.05	27.5
11	*Cymbopogon jwarancusa* (Jones) Schult.	3.8	30	9	12.9	3.66	14.5	31.1
12	*Cynodon dactylon* (L.) Pers.	0.3	30	2	1.02	3.66	3.23	7.9
10	*Cyperus rotundus* L.	0.2	20	0.5	0.68	2.44	0.81	3.93
14	*Eragrostis poaoides* Beauv.	3	50	6.25	10.2	6.1	10.1	26.4
15	*Euphorbia prostrata* Ait.	0.6	30	2	2.04	3.66	3.23	8.92
16	*Fagonia cretica* L.	2	70	19.5	6.8	8.54	31.4	46.8
17	*Salvia moorcroftiana* Wallich ex Benth.	1.2	50	7.25	4.08	6.1	11.7	21.9
18	*Tribulus terrestris* L.	0.3	30	0.75	1.02	3.66	1.21	5.89

Table 44. Phytosociological attributes of *Cleome-Phoenix-Capparis* community recorded at Siraj khel during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.3	20	0.19	0.82	2.17	0.2	3.19
2	*Acacia nilotica* (L.) Delice.	0.5	30	2.1	1.36	3.26	2.24	6.87
3	*Phoenix dactylifera* L.	4.4	90	8.57	12	9.78	9.16	30.9
4	*Zizyphus maurtiana* Lam.	0.4	30	1.35	1.09	3.26	1.44	5.79
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	0.5	20	0.12	1.36	2.17	0.13	3.66
6	*Calotropis procera* (Wild.) R.Br.	1.5	40	0.19	4.09	4.35	0.2	8.64
7	*Capparis decidua* (Forssk). Edgeworth.	5.5	80	0.95	15	8.7	1.01	24.7
8	*Rhazya stricta* Decne.	3.1	60	0.36	8.45	6.52	0.38	15.4
9	*Withania coagulans* (Stocks) Dunal.	1.8	40	0.24	4.9	4.35	0.26	9.51
10	*Zizyphus nummularia* (Burm.f) W. & A.	1.3	50	0.49	3.54	5.43	0.52	9.5
Herbaceous layer								
11	*Aerua persica* (Burm.f.) Merrill.	0.6	30	4.5	1.63	3.26	4.81	9.7
12	*Boerhavia diffusa* L.	0.2	20	0.5	0.54	2.17	0.53	3.25
13	*Cenchrus biflorus* Hook. f.	2	30	6.75	5.45	3.26	7.21	15.9
14	*Cleome viscosa* L.	3.3	70	17.3	8.99	7.61	18.5	35.1
15	*Cymbopogon jwarancusa* (Jones) Schult.	0.4	20	5.25	1.09	2.17	5.61	8.87
16	*Cynodon dactylon* (L.) Pers.	2.5	50	6.25	6.81	5.43	6.68	18.9
17	*Cyperus rotundus* L.	1.2	30	4.5	3.27	3.26	4.81	11.3
18	*Eragrostis poaoides* Beauv.	0.7	20	3	1.91	2.17	3.2	7.29
19	*Euphorbia prostrata* Ait.	2	60	6.5	5.45	6.52	6.94	18.9
20	*Fagonia cretica* L.	2.6	80	16.5	7.08	8.7	17.6	33.4
21	*Carthamus oxycantha* Bieb.	0.8	20	3	2.18	2.17	3.2	7.56
22	*Solanum surattense* Burm .f.	0.6	20	3.5	1.63	2.17	3.74	7.55
23	*Tribulus terrestris* L.	0.5	10	1.5	1.36	1.09	1.6	4.05

Table 45. Phytosociological attributes of *Cenchrus-Cassia-Zizyphus* community recorded at Shahidan during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	40	0.33	2.4	4.8	1.4	8.62
2	*Phoenix dactylifera* L.	0.2	20	0.3	0.9	2.4	1.3	4.66
3	*Zizyphus maurtiana* Lam.	1.3	100	1.6	6.1	12	7	25.2
Shrubby layer								
4	*Cassia angustifolia* Vahl.	4.6	100	0.45	22	12	2	35.7
5	*Rhazya stricta* Decne.	4.8	80	0.38	23	9.6	1.7	33.9
6	*Withania coagulans* (Stocks) Dunal.	2.7	80	0.33	13	9.6	1.4	23.8
7	*Zizyphus nummularia* (Burm.f) W. & A.	0.4	30	0.3	1.9	3.6	1.3	6.81
Herbaceous Layer								
8	*Boerhavia diffusa* L.	0.4	40	1	1.9	4.8	4.4	11.1
9	*Carthamus oxycantha* Bieb.	0.5	40	1	2.4	4.8	4.4	11.5
10	*Cenchrus biflorus* Hook. f.	0.8	60	6.25	3.8	7.2	27	38.2
11	*Cynodon dactylon* (L.) Pers.	1.5	30	0.75	7.1	3.6	3.3	14
12	*Eragrostis poaoides* Beauv.	1.7	70	4.25	8	8.4	19	35
13	*Fagonia cretica* L.	1	80	3.25	4.7	9.6	14	28.5
14	*Solanum surattense* Burm .f.	0.6	40	2.25	2.8	4.8	9.8	17.5
15	*Tribulus terrestris* L.	0.2	20	0.5	0.9	2.4	2.2	5.53

Table 46. Phytosociological attributes of *Capparis-Aerua-Acacia* community recorded at Zarki Nasrati during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	1.6	100	0.82	6.8	12.5	1.8	21
2	*Zizyphus maurtiana* Lam.	0.9	60	2.12	3.8	7.5	4.6	15.9
Shrubby layer								
3	*Astragalus psilocentros* Fisch.	1.2	50	0.3	5.1	6.25	0.6	12
4	*Calotropis procera* (Wild) R.Br.	0.1	10	0.06	0.4	1.25	0.1	1.8
5	*Capparis decidua* (Forssk). Edgeworth.	1.7	30	0.27	7.2	3.75	0.6	11.5
6	*Capparis spinosa* L.	4.7	80	1.7	20	10	3.7	33.6
7	*Punica granatum* L.	1	40	0.24	4.2	5	0.5	9.75
8	*Rhazya stricta* Decne.	0.4	30	0.13	1.7	3.75	0.3	5.72
9	*Saccharum bengalense* Retz.	1.2	50	0.39	5.1	6.25	0.8	12.2
10	*Zizyphus nummularia* (Burm.f.) W. &.A.	1.4	40	0.19	5.9	5	0.4	11.3
Herbaceous layer								
11	*Aerua persica* (Burm.f.) Merrill.	1.6	70	8	6.8	8.75	17	32.7
12	*Boerhavia diffusa* L.	0.2	10	1.5	0.8	1.25	3.2	5.33
13	*Cymbopogon jwarancusa* (Jones) Schult.	0.1	10	1.5	0.4	1.25	3.2	4.9
14	*Cynodon dactylon* (L.) Pers.	2.8	50	6.25	12	6.25	13	31.6
15	*Echinops echinatus* Roxb.	0.5	20	3	2.1	2.5	6.5	11.1
16	*Eragrostis poaoides* Beauv.	0.6	20	1.75	2.5	2.5	3.8	8.81
17	*Fagonia cretica* L.	1.2	40	6	5.1	5	13	23
18	*Carthamus oxycantha* Bieb.	0.5	30	3.25	2.1	3.75	7	12.9
19	*Solanum surattense* Burm .f.	0.2	10	1.5	0.8	1.25	3.2	5.33
20	*Tribulus terrestris* L.	1.7	50	7.5	7.2	6.25	16	29.6

Table 47. Phytosociological attributes of *Boerhavia-Acacia-Capparis* community recorded at Shawa during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree Layer								
1	*Acacia modesta* Wall.	2.8	90	2.2	18.7	12.2	10.4	41.2
2	*Acacia nilotica* (L.) Delice.	0.3	30	0.1	2	4.05	0.47	6.53
3	*Zizyphus maurtiana* Lam.	0.9	60	0.8	6	8.11	3.77	17.9
Shrubby layer								
4	*Astragalus psilocentros* Fisch.	0.8	40	0.1	5.33	5.41	0.47	11.2
5	*Capparis decidua* (Forssk). Edgeworth.	1.6	90	0.5	10.7	12.2	2.36	25.2
6	*Capparis spinosa* L.	2.7	100	0.6	18	13.5	2.83	34.3
7	*Rhazya stricta* Decne.	0.6	30	0.1	4	4.05	0.47	8.53
8	*Withania coagulans* (Stocks) Dunal.	0.4	40	0.2	2.67	5.41	0.94	9.02
Herbaceous layers								
9	*Aerua persica* (Burm.f) Merrill.	2	90	4.8	13.3	12.2	22.6	48.1
10	*Boerhavia diffusa* L.	1.5	90	6	10	12.2	28.3	50.5
11	*Carthamus oxycantha* Bieb.	0.5	40	2.3	3.33	5.41	10.8	19.6
12	*Tribulus terrestris* L.	0.9	40	3.5	6	5.41	16.5	27.9

Table 48. Phytosociological attributes of *Eragrostis -Zizyphus -Capparis* community recorded at Kandu Khel during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.4	40	0.66	1.61	5.19	1.33	8.14
2	*Zizyphus maurtiana* Lam.	2.3	100	10.2	9.24	13	20.6	42.8
Shrubby layer								
3	*Astragalus psilocentros* Fisch.	0.7	40	0.14	2.81	5.19	0.28	8.29
4	*Calotropis procera* (Wild) R.Br.	0.3	30	0.08	1.2	3.9	0.16	5.26
5	*Capparis decidua* (Forssk). Edgeworth.	5.2	100	1.66	20.9	13	3.36	37.2
6	*Periploca aphylla* Decne.	0.4	30	0.18	1.61	3.9	0.36	5.87
7	*Rhazya stricta* Decne.	1.2	50	0.3	4.82	6.49	0.61	11.9
8	*Saccharum bengalense* Retz.	0.3	20	0.12	1.2	2.6	0.24	4.04
9	*Withania coagulans* (Stocks) Dunal.	0.2	20	0.12	0.8	2.6	0.24	3.64
Herbaceous layer								
10	*Boerhavia diffusa* L.	1.5	90	7.25	6.02	11.7	14.7	32.4
11	*Cenchrus biflorus* Hook. f.	2.4	50	7.5	9.64	6.49	15.2	31.3
12	*Cynodon dactylon* (L.) Pers.	2	20	3	8.03	2.6	6.07	16.7
13	*Cyperus rotundus* L.	2.8	50	3.75	11.2	6.49	7.58	25.3
14	*Eragrostis poaoides* Beauv.	4.5	80	12	18.1	10.4	24.3	52.7
15	*Fagonia cretica* L.	0.3	20	0.5	1.2	2.6	1.01	4.81
16	*Tribulus terrestris* L.	0.4	30	2	1.61	3.9	4.04	9.55

Table 49. Phytosociological attributes of *Aerua -Acacia -Capparis* community recorded at Shadi Khel during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	2.6	70	6.42	7.1	8.54	8.65	24.3
2	*Acacia nilotica* (L.) Delice.	0.4	30	0.75	1.1	3.66	1.01	5.77
3	*Dalbergia sissoo* Roxb.	0.4	20	0.52	1.1	2.44	0.7	4.24
4	*Zizyphus maurtiana* Lam.	1.3	50	9.47	3.6	6.1	12.8	22.4
Shrubby layer								
5	*Rhazya stricta* Dcne	2.3	50	0.3	6.3	6.1	0.4	12.8
6	*Astragalus psilocentros* Fisch.	2.1	80	0.53	5.8	9.76	0.71	16.2
7	*Calotropis procera* (Wild) R.Br.	0.7	40	0.18	1.9	4.88	0.24	7.04
8	*Capparis decidua* (Forssk). Edgeworth.	4.6	70	1.75	13	8.54	2.36	23.5
9	*Punica granatum* L.	2.2	30	0.27	6	3.66	0.36	10.1
10	*Saccharum bengalense* Retz.	0.4	20	0.12	1.1	2.44	0.16	3.7
11	*Zizyphus nummularia* (Burm.f.) W. & A.	0.9	30	0.18	2.5	3.66	0.24	6.37
Herbaceous layer								
12	*Aerua persica* (Burm.f) Merrill.	4.7	80	19	13	9.76	25.6	48.3
13	*Boerhavia diffusa* L.	0.4	20	3	1.1	2.44	4.04	7.58
14	*Carthamus oxycantha* Bieb.	1.8	40	6	4.9	4.88	8.08	17.9
15	*Cenchrus biflorus* Hook. f.	0.8	30	3.25	2.2	3.66	4.38	10.2
16	*Cymbopogon jwarancusa* (Jones) Schult.	0.5	20	3	1.4	2.44	4.04	7.85
17	*Cynodon dactylon* (L.) Pers.	3.5	40	6	9.6	4.88	8.08	22.6
18	*Cyperus rotundus* L.	3.5	40	6	9.6	4.88	8.08	22.6
19	*Solanum surattense* Burm .f.	1	20	5.25	2.7	2.44	7.07	12.3
20	*Tribulus terrestris* L.	2.3	40	2.25	6.3	4.88	3.03	14.2

Table 50. Phytosociological attributes of *Tribulus- Periploca -Zizyphus* community recorded at Sarki Lawager during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree Layer								
1	*Acacia modesta* Wall.	0.6	40	0.5	3.75	4.44	1.68	9.878
2	*Monotheca buxifolia* (falk.) A.DC.	0.2	20	0.4	1.25	2.22	1.35	4.819
3	*Gymnosporia royleana* Wall. ex M. A. Lawson.	0.3	20	0.4	1.88	2.22	1.35	5.444
4	*Zizyphus maurtiana* Lam.	1	90	0.9	6.25	10	3.03	19.28
Shrubbys Layer								
5	*Calotropis procera* (Wild) R.Br.	0.7	40	0.24	4.38	4.44	0.81	9.628
6	*Capparis decidua* (Forssk). Edgeworth.	0.8	50	0.2	5	5.56	0.67	11.23
7	*Periploca aphylla* Decne.	2.4	100	0.78	15	11.1	2.63	28.74
8	*Rhazya stricta* Decne	0.6	50	0.25	3.75	5.56	0.84	10.15
9	*Saccharum spontaneum* L.	1.4	70	0.42	8.75	7.78	1.41	17.94
10	*Withania coagulans* (Stocks) Dunal.	0.3	30	0.18	1.88	3.33	0.61	5.814
11	*Zizyphus nummularia* (Burm.f.) W. & A.	0.3	20	0.18	1.88	2.22	0.61	4.703
Herbaceous layer								
12	*Boerhavia diffusa* L.	0.8	80	2	5	8.89	6.73	20.62
13	*Cenchrus biflorus* Hook. f.	1.3	40	3.5	8.13	4.44	11.8	24.35
14	*Cymbopogon jwarancusa* (Jones) Schult.	0.2	20	3	1.25	2.22	10.1	13.57
15	*Cynodon dactylon* (L.) Pers.	2	40	1	12.5	4.44	3.37	20.31
16	*Echinops echinatus* Roxb.	0.5	50	2.5	3.13	5.56	8.42	17.1
17	*Fagonia cretica* L.	0.7	60	2.75	4.38	6.67	9.26	20.3
18	*Solanum surattense* Burm .f.	0.3	30	4.5	1.88	3.33	15.2	20.36
19	*Tribulus terrestris* L.	1.6	50	6	10	5.56	20.2	35.76

Table 51. Phytosociological attributes of *Boerhavia-Zizyphus-Capparis* community recorded at Shnawa during summer, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	40	0.13	4.07	6.56	0.71	11.33
2	*Prosopis juliflora* (Sw.) D.C.	0.2	20	0.05	1.63	3.28	0.27	5.177
3	*Zizyphus maurtiana* Lam.	2.6	90	1.23	21.1	14.8	6.71	42.6
Shrubby layer								
4	*Capparis decidua* (Forssk). Edgeworth.	0.8	50	0.26	6.5	8.2	1.42	16.12
5	*Capparis spinosa* L.	2.2	80	0.72	17.9	13.1	3.93	34.93
6	*Punica granatum* L.	0.9	60	0.31	7.32	9.84	1.69	18.84
7	*Rhazya stricta* Decne.	0.4	30	0.14	3.25	4.92	0.76	8.933
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	1.3	80	4.75	10.6	13.1	25.9	49.58
9	*Boerhavia diffusa* L.	1.6	90	6.25	13	14.8	34.1	61.84
10	*Cenchrus biflorus* Hook. f.	0.9	30	2	7.32	4.92	10.9	23.14
11	*Carthamus oxycantha* Bieb.	0.9	40	2.5	7.32	6.56	13.6	27.51

C. Winter Aspect

Winter season started from November to January in investigated area. 72 plant species were present comprising 10 trees, 15 shrubs and 47 herbs. Most plant species in winter were in mature state. The numbers of plant species differ in different communities. The biological spectrum dominated by therophytes (25 spp., 34.72%) and hemicryptophytes (22 spp., 30.56%) followed by megaphanerophytes (9 spp., 12.5%). nanophanerophytes (7 spp., 9.72%), chamaephytes (6 spp., 8.33%) and microphanerophytes (3 spp, 4.17 %) while leaf size spectrum dominated by microphylls (42 spp. 58.33%) followed by nanophylls (10 spp. 13.89%), leptophylls (8 spp. 11.11%), megaphylls and mesophylls (6 spp. 8.33 % each) (Table 4).

Environmental data showed that mean maximum and minimum air temperature was 22.61ºC and 6.65º C respectively. Mean maximum and minimum relative humidity was 74.19 mm and 35.93mm. The rainfall (27.43mm) was high in January and low (5.8 mm) in November, soil temperature 14.1º C was high in month of November. Wind speed was high in month of June (3.2 Km. h^{-1}) and low (2.9Km.h^{-1}) in January (Table 1). In different sites of the area, 22 plant communities were developed in winter season. Details are as follows:

Stand – 1

In stand 1, *Cenchrus-Saccharum-Prosopis* community (CSP), *Cenchrus-Saccharum-Phoenix* community (CSP), *Cenchrus-Prosopis-Saccharum* community (CPS) and *Cenchrus-Periploca-Prosopis* community (CPP) were established on the basis of important value at Tater Khel, Gardi Banda, Ahmad Abad and Warana respectively. In these 4 communities, the number of plant species were 40 comprising 6 trees, 6 shrubs and 28 herbs. The highest number of plant species (32) and herbs (24) were present in CPP at Warana. The highest TIV contributed by three dominant species (IV = 153.54) were found in CCP at Tater Khel and low (IV = 92.4) in CPS at Ahmad Abad. Furthermore, the highest TIV contributed by trees (IV = 55.54) in CCP, herbs (IV=203.14) in CPP and shrubs (IV = 60.68) in CSP were initiated at Tater Khel, Warana and Gardi Banda respectively (Table 52). The details are as follows:

1. *Cenchrus-Saccharum-Prosopis* community (CSP)

The community was established at Tater Khel and comprised 26 plant species in which 4 tree, 4 shrubs, 18 species belong to herbaceous layer. The dominant members of the community in different layers were *Cenchrus biflorus* (IV = 89.6), *Saccharum bengalense* (IV = 35.81) and *Prosopis farcta* (IV = 28.13). The co dominant species including *Ifloga fontanesii, Cynodon dactylon* and *Zizyphus maurtiana* were present. The Importance value contributed by tree was 52.1, shrubs (IV = 51.54) and herbs (IV=196.34) (IV = 48) (Table 53). The biological spectrum revealed that therophytes (10 spp., 38.46 %) followed by hemicryptophyte (8 spp., 30.77 %) and megaphanerophytes (4 spp., 15.38 %) were dominant classes. Microphyll with 57.69 % plant species were most representative class of leaf form spectrum (Table 4).

2. *Cenchrus-Saccharum-Phoenix* community (CSP)

Cenchrus-Saccharum-Phoenix community was developed at Gardi Banda. The dominant species were *Cenchrus biflorus* (IV = 112) in ground stratum, *Saccharum bengalense* (IV = 44.9) in shrub stratum and *Phoenix dactylifera* (IV= 37) in tree layer. The community consisted of 22 species comprising 3 tree, 4 shrub and 15 herb species. The Importance value contributed by tree was 55.54, shrubs (IV = 49.98) and herbs (IV = 194.48) (IV = 48) (Table 54). Therophytes dominated the community with 40.91 % followed by hemicryptophyte 27.27 % while leaf form spectrum showed that microphyll 68.18 % were dominated (Table 4).

3. *Cenchrus-Prosopis-Saccharum* community (CPS)

This community was established at Ahmad Abad. A total of 25 species were present in the community. Tree and shrub contributed 4 species each and herbs were 17 species. The dominant species with importance values were *Cenchrus biflorus* (IV = 76) in ground stratum, *Prosopis farcta* (IV=29.3) in tree stratum and *Saccharum bengalense* (IV = 24.88) in shrubby stratum (Table 55). Therophytes dominated the life form spectrum with 40 % followed by hemicryptophytes with 32 % and microphyll 56 % was the dominant leaf form followed by leptophyll 16 % (Table 4).

4. *Cenchrus-Periploca-Prosopis* community (CPP)

At Warana CPP community was established and composed of 32 plant species included 4 tree, 4 shrub and 24 herbs species. The dominant plant species of the community were *Cenchrus biflorus* (IV = 75.93), *Periploca aphylla* (IV = 28.04) and *Prosopis farcta* (IV = 27.4) (Table 56). Therophytes (43.75 %) and hemicryptophytes (28.12%) were in highest percentage in life form spectrum and microphyll 56.25 % was the dominant leaf form (Table 4).

Stand – 2

In this stand, 7 communities of 45 plant species comprising 4 trees, 5 shrubs, 32 herbs and 4 grasses that structured *Cenchrus-Zizyphus-Saccharum* community (CZS). The *Cenchrus-Saccharum-Zizyphus* community (CSZ) was found in Southern area of Bogara, *Cenchrus-Saccharum-Acacia* community (CSA) in Northern area of Bogara, *Zizyphus-Cenchrus-Saccharum* community (ZCS) in Gandiri Khattak, *Calligonum-Cenchrus-Zizyphus* community (CCZ) in Kiri Dhand, *Cenchrus*-Calligonum-*Acacia* community (CCA) in Jahangiri Banda, *Zizyphus-Cenchrus-Calligonum* community (ZCC) in Mona Khel and *Cenchrus-Zizyphus-Saccharum* community (CZS) in Jarassi. The highest number of species (30) was present in CSZ. The highest number of trees (4) was found in CSZ and CSA while the highest number of shrubs and herbs in CCZ and CSZ respectively. The highest TIV contributed by three dominant species was 200.63 in ZCS at Gandiri Khattak while low 89.90 in CCZ at Kiri Dhand. Furthermore, the highest TIV contributed by trees (93.70), shrubs ((90.29) and herbs (208.84) in ZCS, CCA and CSZ respectively (Table 52).

5. *Cenchrus-Saccharum-Zizyphus* community (CSZ)

This community was developed at southern Bogara. The plants dominating the site were *Cenchrus biflorus* (IV = 67.41), *Saccharum bengalense* (IV = 32.14) and *Zizyphus maurtiana* (IV=17.71). A total 30 plants were recorded in the site which consisted of 4 tree, 4 shrub and 22 herb species (Table 57). Therophytes 34.37 % and hemicryptophytes 30 % dominated the life form spectrum. Leaf form spectrum consisted of microphyll 37.5 % followed by leptophyll and nanophyll with 18.75% plant species (Table 4).

6. *Cenchrus-Saccharum-Acacia* community (CSA)

A total of 21 plant species were identified in the northern Bogara which consisted of 4 tree, 4 shrub and 13 herb species. The dominant species were *Cenchrus biflorus* (IV = 86.6), *Saccharum bengalense* (IV = 47.15) and *Acacia nilotica* (IV = 39.5) (Table 58). Biological spectrum indicated that therophytes (7 spp., 33.33 %) and hemicryptophytes (6 spp., 28.57 %) were the most prevailing classes of life form while microphyll (10 spp., 47.62 %) were dominant in leaf form spectrum (Table 4).

7. *Zizyphus-Cenchrus-Saccharum* community (ZCS)

The *Zizyphus-Cenchrus-Saccharum* community consisted of 17 species in which single tree, 3 shrub and 13 herb species were present and established at Gandiri Khattak. The dominant species on the basis of important value were *Zizyphus maurtiana* (IV = 93.7) in tree stratum, *Cenchrus biflorus* (IV = 57.4) in groung stratum and *Saccharum bengalense* (IV = 28.66) in shrubby stratum. Other important species were *Ifloga fontanesii*, *Cynodon dactylon* and *Boerhavia diffusa* (Table 59). In ZCS community therophytes (7 spp., 41.2 %) and hemicryptophytes (5 spp., 29.4%) dominated the life form spectrum. Leading leaf form spectrum consisted of microphyll (8 spp., 47.1 %) (Table 4).

8. *Calligonum-Cenchrus-Zizyphus* community (CCZ)

The site was present in Kiri Dhand and the community was established by *Calligonum polygonoides* (IV = 43.15), *Cenchrus biflorus* (IV=29.34) and *Zizyphus maurtiana* (IV = 17.41) as dominants. This community was consisted of 22 plant species in which 3 tree, 5 shrub and 14 herbs were present. Other important species were *Tribulus terrestris* (IV = 26.25), *Eragrostis poaoides* (IV=16.65) and *Periploca aphylla* (IV = 13.79) (Table 60). Biological spectrum showed that hemicryptophytes (8 spp., 36.36 %) and therophytes (5 spp., 22.73 %) had the highest proportion in biological spectrum while leaf form spectrum was dominated by microphyll (11 spp., 50 %) followed by nanophyll and leptophyll (4 spp., 18.18 % each) (Table 4).

9. *Cenchrus-Calligonum-Acacia* community (CCA)

The *Cenchrus*-Calligonum-*Acacia* community was established at Jahangiri Banda. The community consisted of 21 plant species in which 3 were tree, 4 were shrubs and 14 were herbs. The dominant plant species on the basis of

Important value were *Cenchrus biflorus* (IV = 87), *Calligonum polygonoides* (IV = 61.16) and *Acacia nilotica* (IV = 30.79). The associated species included *Zizyphus maurtiana* (IV = 25.39) *Saccharum bengalense* (IV = 23. 43), and *Citrullus colocynthis* (IV = 7.19) (Table 61). Biological spectrum showed therophytic vegetation dominated with (7 spp., 33.33 %) followed by hemicryptophytes (6 spp., 58.57 %). Microphyll (11 spp., 52.38 %) leaf form classes was dominated followed by mesophyll (5 spp., 23.81 %) (Table 4).

10. *Zizyphus- Cenchrus -Calligonum* community (ZCC)

The *Zizyphus-Cenchrus-Calligonum* community was established at Mona Khel. It consisted of 22 species in which 3 tree, 4 shrub and 15 herb species were present. *Zizyphus maurtiana* (IV=67.4) in tree stratum, *Cenchrus biflorus* (IV = 61.1) in ground stratum and *Calligonum polygonoides* (IV = 29.8) in shrubby stratum were the dominant species. The associated species included *Fagonia cretica* (IV = 19.3), *Saccharum bengalense* (IV = 16.9) and *Ifloga fontanesii* (IV=14.9). The importance value contributed by tree was 81.76, shrubs (IV = 60.45) and herbs (IV = 157.79) (Table 62). The community mostly had therophytes. Therophytes (10 spp., 45.46 %) was dominant in life form while microphyll (9 spp., 40.91 %) followed by nanophyll and mesophyll (4 spp., 18.18 % each) were dominant leaf form spectrum (Table 4).

11. *Cenchrus-Zizyphus-Saccharum* community (CZS)

The CZS community was established at Jarassi. This community had 26 plant species in which 3 were tree, 4 shrubs and 19 were herb species. The dominants were *Cenchrus biflorus* (IV=80.6) in ground stratum, *Zizyphus maurtiana* (IV = 29.04) in tree stratum and *Saccharum bengalense* (IV=25.92) in shrubby stratum. Other important species were *Dalbergia sissoo* (IV = 15.14), *Citrullus colocynthis* (IV = 13.72) and *Fagonia cretica* (IV = 10.25). The importance value contributed by tree was 49.68, shrubs (IV = 42.13) and herbs (IV = 208.19) (Table 63). Biological spectrum showed that thero-hemicryptophytic vegetation dominated with 34.61 % plant species each. Microphyll (12 spp., 46.15 %) leaf form classes was dominated followed by mesophyll (6 spp., 23.08 %) (Table 4).

Stand – 3

In stand 3, total 7 sites were studied i.e. Chokara, Ambiri Kala, Takht-e- Nasrati, Siraj Khel, Shahidan Banda, Zarki Nasrati and Shawa in which 7 communities i.e. *Cymbopogon-Rhazya-Zizyphus* community, *Astragalus-Aerua-Zizyphus* community, *Cenchrus-Rhazya-Zizyphus* community, *Phoenix-Fagonia-Capparis* community, *Cassia-Zizyphus-Fagonia* community, *Capparis-Aerua-Acacia* community, *Aerua-Acacia-Capparis* community were recorded respectively. Entirely 47 plant species consist of 6 trees, 12 shrubs and 29 herbs were documented forming the *Aerua-Rhazya-Zizyphus* community (ARZ). The highest numbers of plant species (23) were present in PFC and CAA. The highest numbers of shrubs (7) and herbs (14) were present in CAA at Zarki Nasrati. The highest TIV contributed by three dominant species (IV = 159.19) were present in CRZ while low (IV=79.36) in CAA. Furthermore, the highest TIV given by tree (64.85) in AAC, shrubs (110.77) in CZF and herbs (192.58) in CRZ were present at Shawa, Shahidan Banda and Takht-e-Nasrati respectively (Table 52).

12. *Cymbopogon-Rhazya-Zizyphus* community (CRZ)

The *Cymbopogon-Rhazya-Zizyphus* community was established at Chokara and supported by 19 species in which 4 were trees, shrubs 5 and herbs were 10. The dominant were *Cymbopogon jwarancusa* (IV = 95.9), *Rhazya stricta* (IV = 50.63) and *Zizyphus maurtiana* (IV = 12.66). The other important species were *Aerua persica* (IV = 18.29), *Acacia modesta* (IV = 11.12) and *Zizyphus nummularia* (IV = 9.37). The importance value contributed by tree was 36.24, shrubs (IV=76.18) and herbs (IV = 187.58) (Table 64). Biological spectrum showed hemicryptophytic vegetation dominated with 38.09 %. In the leaf form classes microphyll 52.38 % and leptophylls 19.05% dominated the community (Table 4).

13. *Astragalus-Aerua-Zizyphus* community (AAZ)

This community was established at Ambiri Kala. It is composed of 19 species which comprised of 4 tree, 6 shrubs and 9 herb species. The dominant members of the community were *Astragalus psilocentros* (IV = 50.52) in shrubby stratum, *Aerua persica* (IV = 43.06) in ground stratum, and *Zizyphus maurtiana* (IV = 13.07). Other important species included *Cymbopogon jwarancusa* (IV = 34.78),

Dichanthium annulatum (IV=19.46), *Saccharum bengalense* (IV = 29.42) and *Acacia modesta* (IV = 9.04) (Table 65). The leaf form classes showed that the microphyll (9 spp., 47.4 %) and leptophylls (5 spp., 26.3 %) dominated the community while in biological spectrum hemicryptophytic vegetation dominated the community with 26.3 % plant species (Table 4).

14. *Cenchrus-Rhazya-Zizyphus* community (CRZ)

The CRZ community was developed at Takht-e-Nasrati and dominated by *Cenchrus biflorus* (IV = 71.2), *Rhazya stricta* (IV = 37.4) and *Zizyphus maurtiana* (IV=25.94). *Fagonia cretica* (IV = 28.56), *Withania coagulans* (IV=14.58) and *Saccharum bengalense* (IV = 10.69) were next important species. The importance value contributed by tree was 35.92, shrubs (IV = 71.54) and herbs (IV=192.54). The community comprised of 18 species including 3 tree, 5 shrub and 10 herbs. (Table 66). Biological spectrum showed therophytes 38.89 % was dominated followed by hemicryptophyte 22.22 %. In the leaf form classes microphyll with 38.89% dominated the community followed by leptophyll with 27.78 % plant species (Table 4).

15. *Phoenix-Fagonia-Capparis* community (PFC)

This community was established at Siraj Khel with 570 m altitude. A total of 23 species were recorded containing 4 tree, 6 shrub and 13 herb species. It is dominated by *Phoenix dactylifera* (IV = 40.1) in tree stratum, *Fagonia cretica* (IV = 39.6) in ground stratum and *Capparis decidua* (IV = 19.23) in shrubby stratum. Other important species were *Aerua persica* (IV = 25.58), *Cenchrus biflorus* (IV = 24.56), *Rhazya stricta* (IV=10.34) and *Zizyphus maurtiana* (IV = 7.04). The importance value contributed by tree was 59.51, shrubs (IV = 58.58), herbs (IV = 181.92) (Table 67). Qualitative evaluation of biological spectrum showed that therophytes 39.13 % was dominant life form followed by megaphanerophyte 17.39 % while microphyll 47.83 % followed by leptophylls 30.43 % was leading leaf size classes (Table 4).

16. *Cassia-Zizyphus-Fagonia* community (CZF)

This community was developed at Shahidan Banda and composed by the dominance of *Cassia angustifolia* (IV = 40.61), *Zizyphus maurtiana* (IV = 37.4) and *Fagonia cretica* (IV = 33.24) along with *Rhazya stricta* (IV = 35.5), *Withania coagulans* (IV=25.8), *Cenchrus biflorus* (IV = 23.91) and *Acacia modesta* (IV = 12.23).

A total 15 plant species were recorded including 3 tree, 4 shrubs and 8 herbs (Table 68). Biological spectrum showed that therophytes with 26.67% plant species were dominant while microphyll 53.33% and leptophylls 26.67% were leading groups of leaf size classes in the community (Table 4).

17. *Capparis-Aerua-Acacia community* (CAA)

Zarki Nasratti site was composed of 23 species including 2 trees, 7 shrubs, 14 herbs. *Capparis spinosa* (IV = 28.91), *Aerua persica* (IV = 25.45) and *Acacia modesta* (IV = 25) were dominant species on the basis of important value. *Tribulus terrestris* (IV = 22.36) *Zizyphus maurtiana* (IV = 19.42) and *Saccharum bengalense* (IV = 14.72) were associated species. The importance value contributed by tree was 44.42, shrubs (IV = 99.32) and herbs (IV = 156.25) (Table 69). The biological spectrum showed that hemicryptophytes 30.43 % was the dominant life form followed by therophytes 26.09 %. Leaf spectra showed that microphyll was dominant (12 spp., 52.17 %) followed by leptophyll (5 spp., 21.74 %) (Table 4).

18. *Aerua-Acacia-Capparis* community (AAC)

The *Aerua–Acacia-Capparis* community was established at Shawa. The dominant plant species in the community on the basis of important value were *Aerua persica* (IV = 67.02), *Acacia modesta* (IV = 41.5) and *Capparis spinosa* (IV = 36.34). A total of 13 species were documented. The importance value contributed by tree was 64.85, shrubs (IV = 93.01) and herbs (IV = 142.14). Among them 3 were tree and 5 were shrub and herb species each (Table 70). The life form spectrum showed that hemicryptophytes, megaphanerophyte and chamaephytes with 23.08 % plant species each were dominant. Leaf form spectrum showed that microphyll (8 spp., 61.54%) was dominant leaf size class followed by leptophyll (4 spp., 30.77 %) (Table 4).

Stand – 4

In stand 4, 4 communities i.e. *Zizyphus-Capparis-Phragmites* community, *Aerua-Capparis- Acacia* community, *Fagonia-Zizyphus-Saccharum* community, *Zizyphus-Aerua-Capparis* community consist of 36 plant species in which 6 trees, 11 shrubs and 19 herbs were present in Kandu Khel, Shadi Khel, Sarki Lawager and Shnawa respectively. As a whole on the basis of important value *Zizyphus-Capparis- Cenchrus* community (ZCC) was established. The highest number of

herbs (7) were present in ACA. The highest TIV contributed by three dominant species was 132.56, present in ZAC at Shnawa while low (IV = 79.48) in FZS at Sarki Lawager. The highest TIV of trees (IV = 72.56), shrubs (IV = 97.73) were present in ACA while herbs (IV=170.05) were present in FZS (Tables 52).

19. *Zizyphus-Capparis-Phragmites* community (ZCP)

This *Zizyphus-Capparis-Phragmites* community was developed at Kandu Khel. The habitat condition was dry. The plant species dominating the site were *Zizyphus maurtiana* (IV = 40.38), *Capparis decidua* (IV = 38.28) and *Phragmites karka* (IV = 35.74). A total of 18 plant species were recorded in the site which consisted of 2 species of trees, 7 species of shrubs and 9 species of herbs. *Fagonia cretica* (IV = 28.05), *Cenchrus ciliaris* (IV = 20.43) and *Rhazya stricta* (IV = 14.75) were co dominant species in the community (Table 71). The qualitative analysis of biological spectrum indicated that thero-hemicryptophytic vegetation (5 spp., 27.78 % each) dominated the community. In leaf form analysis microphyll (8 spp., 44.44 %) followed by leptophyll (6 spp., 33.33 %) were the dominant classes (Table 4)

20. *Aerua-Capparis-Acacia* community (ACA)

The *Aerua-Capparis-Acacia* community was established at Shadi Khel. A total of 21 plant species were recorded in the community consisted of 4 trees, 7 shrubs and 10 herb species. The dominant members included *Aerua persica* (IV = 49.14) and *Cymbopogon jwarancusa* in herbaceous layer. *Capparis decidua* (IV = 45.1) followed by *Rhazya stricta, Punica granatum and Saccharum bengalense* in shrubby layer. *Acacia modesta* (IV = 31.6) and *Zizyphus maurtiana* were recorded in tree layer. The importance value contributed by tree was 72.56, shrubs (IV = 97.73) and herbs (IV = 129.71) (Table 72). Microphyll and leptophyll were the dominant leaf size classes represented by 47.6 % and 28.6 % plant species respectively and therophytes, hemicryptophyte and megaphanerophytes with 23.8 % plant species each were the dominant life form classes (Table 4).

21. *Fagonia–Zizyphus-Saccharum* community (FZS)

The FZS community (*Fagonia-Zizyphus-Saccharum*) was supported by 19 plant species comprised of 4 tree, 7 shrubs and 8 herbs. The community was developed at Sarki Lawager and dominated by *Fagonia cretica* (IV = 35.4) in ground layer,

Zizyphus maurtiana (IV = 25.7) in tree layer and *Saccharum spontaneum* (IV = 18.38) in shrub layer. The importance value contributed by tree was 52.37, shrubs (IV = 77.58) and herbs (IV = 170.05) (Table 73). Hemicryptophyte with 26.3 % plant species were the dominant life form classes, megaphanerophytes and chamaephytes with 21.1 % while microphyll was the leading dominant leaf size classes (52.6%) followed by leptophyll (21.1 %) (Table 4).

22. *Zizyphus-Aerua-Capparis* community (ZAC)

The community was established at Shnawa and comprised 12 plant species in which 3 tree, 4 shrubs and 5 species belong to herbaceous layer. The dominant members of the community in different layers were *Zizyphus maurtiana* (IV = 50.03), *Aerua persica* (IV = 43.63) and *Capparis spinosa* (IV = 38.9). The importance value contributed by tree was 67.47, shrubs (IV = 94.21) and herbs (IV=138.28) (Table 74). The biological spectrum revealed that megaphanerophytes were dominant life form classes. Microphyll was the leading dominant leaf size classes (75 %) while other classes made only 25 % (Table 4).

The comparison among stands in winter shows that the total number of plant species decreased with increasing altitude. The number of herbs declined while shrubs showed increase with increasing altitude. This is because of grazing animals that preferred herbaceous vegetation than shrubby and woody vegetation. Therefore, in different communities, plants species population and diversity were constant in hilly area than in plain. Kennenni & van der Maarel (1990) described that diverse plant community structure due to discrepancy in edaphic, climatic and biotic factors. The result showed that number of trees and grasses decreased with increasing altitude (Figs. 23, 24). Sasaki *et al*. (2005) concluded that the floristic diversity of area is manage under diverse grazing force and changed with the high grazing pressure. Durrani *et al*. (2010) strengthened our view that in the study area no protected zone is present therefore, grazing occurs freely and highly disturbed. In hilly area the highest number of shrubs and grasses were found due to cutting trees for various uses. The herbaceous vegetation harvested as fodder for animals. Most nonplatable species survive and are increases in the area. In plains, people beside grow plants also protect the natural vegetation for fodder and fuel purposes. These factore change the types of communities in different area. Our result agrees with

Malik (2005) and Hussain *et al*. (1992) who reported similar changes in plant life condition during their investigation. They stated that elevation is an important in determining plant life structure. Altitudinal gradient can also change community type and floristic diversity.

When plains and hilly areas were compared among, it was noticed that the total number declined from plain to hilly area. The TIV contributed by trees, herbs and grasses were high where the TIV of shrubs are low in plain area as compared to hilly area (Figs. 25, 26). This could due to the fact that the hilly area is under heavy biotic pressure. Furthermore, it was also noticed that the number of trees and herbs were decreased while the numbers of shrubs and grasses increased from plains to hilly areas. Enright *et al*. (2005) revealed that plant life of cliffs, mountains and canyons showed higher species richness and lower human impacts than did that of riparian and plains habitats. The local of the area fight with each other on natural plant species which are present on common land called shamilat. Thus the area has been now protected for the past two or three decades. In plain area the soil erosion is very high. Therefore, people grow plant species for controlling the soil erosion.

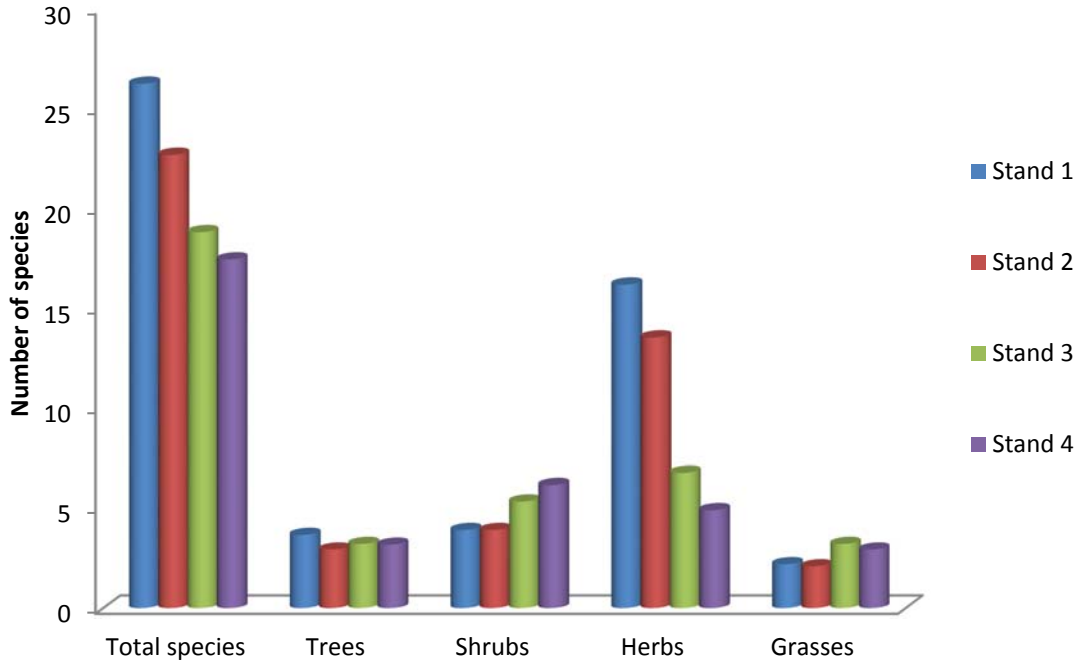


Fig. 23. Comparison of number of plant species among stands during winter, Tehsil Takht-e-Nasrati, Karak.

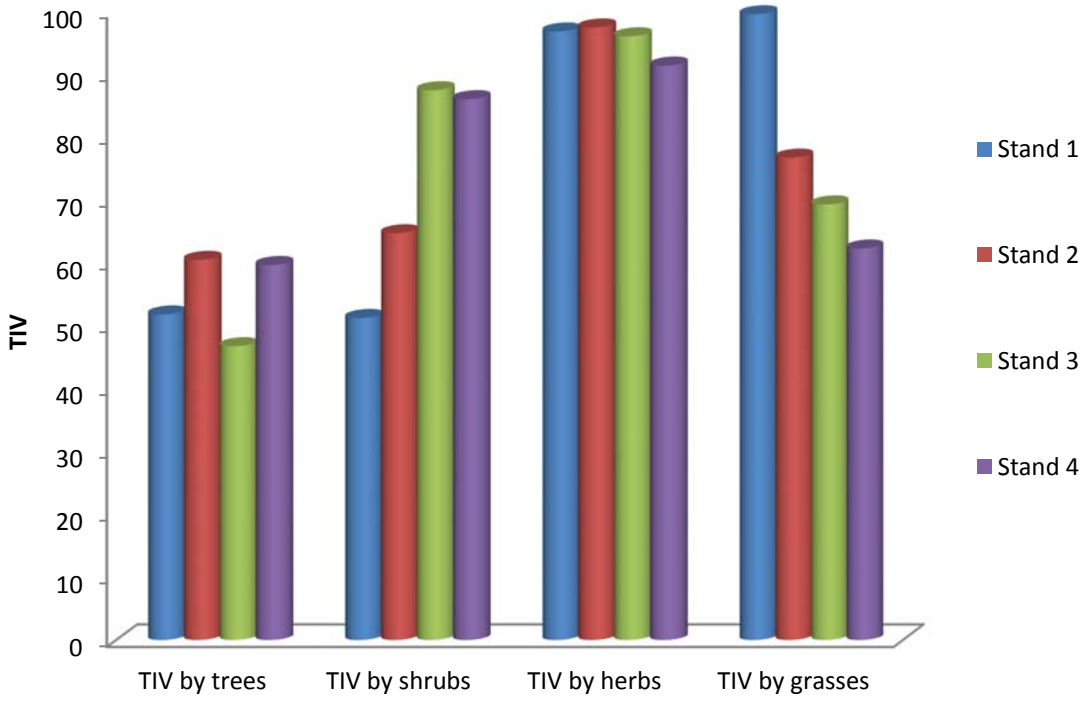


Fig. 24. Comparison of TIV by plant species among stands during winter Tehsil Takht-e-Nasrati, Karak.

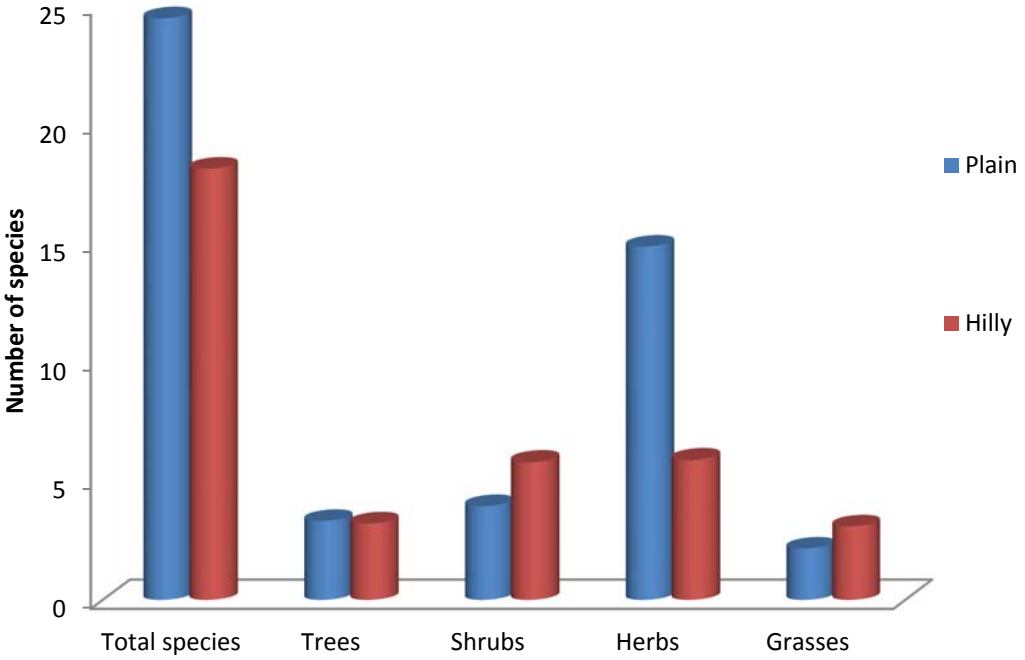


Fig . 25. Comparison of number of plant species between plain and hilly areas during winter Tehsil Takht-e-Nasrati, Karak.

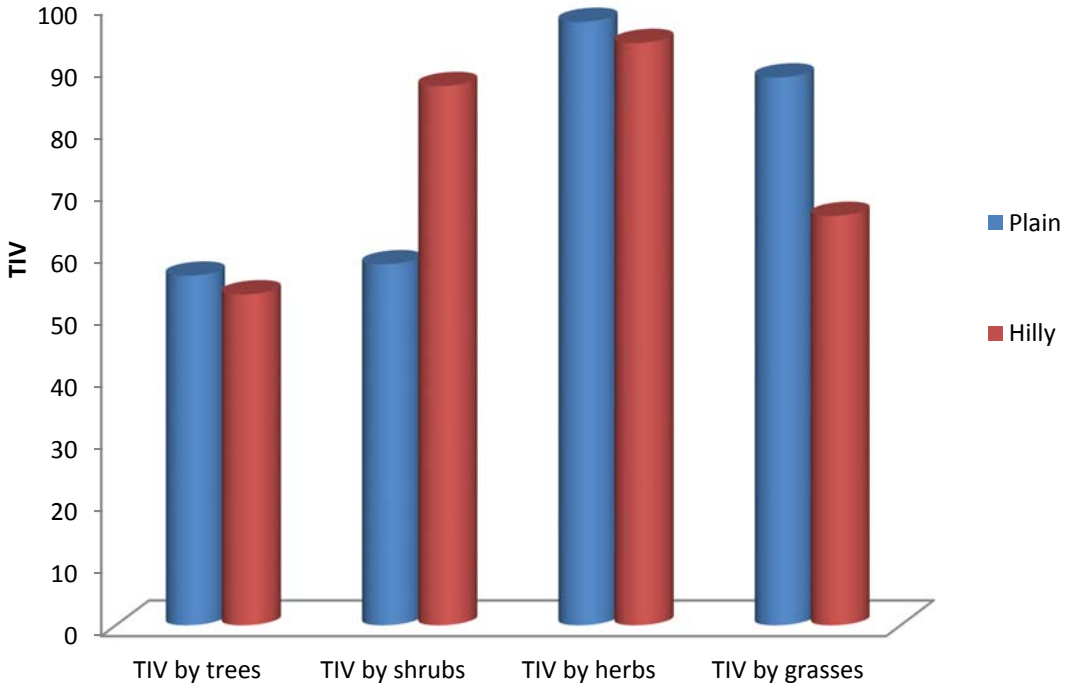


Fig. 26. Comparison of TIV gathered by species among plain and hilly area during winter Tehsil Takht-e-Nasrati, Karak.

Table 52. The number of species and share relative important value of tree, shrubs, herbs and grasses among the different communities during winter of Takht-e- Nasrati, Karak.

Stands	Sites	Communities	Total species	Tree	Shrubs	Herbs	TIV contribution by three dominants species	TIV by remaining species	TIV by trees	TIV by shrubs	TIV by herbs
1	As a whole	CSP	40	6	6	28	132.59	167.41	52.1	51.54	196.34
	Tater Khel	CSP	26	4	4	18	153.54	146.46	55.54	49.98	194.48
	Gardi Banda	CSP	22	3	4	15	193.4	106.6	51.28	60.68	188.04
	Ahmad Abad	CPS	25	4	4	17	92.4	207.6	55.23	44.96	199.79
	Warana	CPP	32	4	4	24	131.37	168.63	46.33	50.53	203.14
2	As a whole	CZS	43	4	5	34	134.42	165.58	60.72	64.92	174.36
	S Bogara	CSZ	30	4	4	22	117.26	182.74	35.81	55.35	208.84
	N Bogara	CSA	21	4	4	13	173.25	126.75	67.45	66.5	166.05
	Gandiri Khattak	ZCS	17	1	3	13	200.63	99.37	93.7	61.87	144.43
	Kiri Dhand	CCZ	22	3	5	14	89.9	210.1	30.52	77.9	191.58
	Jahangiri Banda	CCA	21	3	4	14	178.95	121.05	66.16	90.29	143.55
	Mona Khel	ZCC	22	3	4	15	158.3	141.7	81.76	60.45	157.79
	Jarassi	CZS	26	3	4	19	135.56	164.44	49.68	42.13	208.19
3	As a whole	ARZ	47	6	12	29	67.78	232.22	46.91	87.53	165.56
	Chokara	CRZ	19	4	5	10	159.19	140.81	36.24	76.18	187.58
	Ambiri Kala	AAZ	19	4	6	9	106.65	198.35	30.84	103.35	165.81
	Takht-e- Nasrati	CRZ	18	3	5	10	134.54	165.46	35.9	71.52	192.58
	Siraj Khel	PFC	23	4	6	13	98.93	201.07	59.5	58.58	181.92
	Shahidan Banda	CZF	15	3	4	8	111.25	188.75	56.62	110.77	132.61
	Zarki Nasrati	CAA	23	2	7	14	79.36	220.64	44.42	99.32	156.26
	Shawa	AAC	13	3	5	5	144.86	155.14	64.85	93.01	142.14
4	As a whole	ZCA	36	6	11	19	90.13	209.87	59.91	86.14	153.94
	Kandu Khel	ZCP	18	2	7	9	114.4	185.6	47.26	74.99	177.75
	Shadi Khel	ACA	21	4	7	10	125.84	174.16	72.56	97.73	129.71
	Sarki Lawager	FZS	19	4	7	8	79.48	220.52	52.37	77.58	170.05
	Shnawa	ZAC	12	3	4	5	132.56	167.44	67.47	94.21	138.28

Table 53. Phytosociological attributes of *Cenchrus-Saccharum-Prosopis* community recorded at Tater Khel during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.4	40	0.5	1.85	4.65	0.75	7.25
2	*Phoenix dactylifera* L.	0.8	30	1.3	3.7	3.5	1.96	9.16
3	*Prosopis farcta* (Banks & Soland.) J.F. Macbr.	1.6	100	6.05	7.4	11.6	9.13	28.13
4	*Zizyphus maurtiana* Lam.	0.6	50	1.6	2.78	5.81	2.41	11
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	0.3	30	0.45	1.39	3.5	0.68	5.57
6	*Datura metel* L.	0.3	30	0.18	1.39	3.5	0.27	5.16
7	*Periploca aphylla* Decne.	0.2	20	0.12	0.93	2.33	0.18	3.44
8	*Saccharum bengalense* Retz.	4.7	100	1.6	21.8	11.6	2.41	35.81
Herbaceous layer								
9	*Achyranthus aspera* L.	0.3	30	4.5	1.39	3.5	6.79	11.68
10	*Cenchrus biflorus* Hook. f.	6.1	100	33	28.2	11.6	49.8	89.6
11	*Convolvulus arvensis* L.	0.1	10	0.25	0.46	1.16	0.38	2
12	*Cynodon dactylon* (L.) Pers.	1.9	30	3.25	8.8	3.5	4.9	17.2
13	*Digera muricata* (L). Mart.	0.2	20	0.5	0.93	2.33	0.75	4.01
14	*Echinops echinatus* D.C.	0.2	20	0.5	0.93	2.33	0.75	4.01
15	*Eragrostis poaoides* Beauv.	0.4	40	2.25	1.85	4.65	3.4	9.9
16	*Euphorbia helioscopia* L.	0.2	20	0.5	0.93	2.33	0.75	4.01
17	*Euphorbia prostrata* Ait.	0.5	20	0.5	2.31	2.33	0.75	5.39
18	*Ifloga fontanesii* Cass.	1.6	50	2.5	7.41	5.81	3.77	16.99
19	*Kickxia ramosissima* (Wall.) Janchen.	0.2	20	0.5	0.93	2.33	0.75	4.01
20	*Plantago ciliata* Desf.	0.2	20	0.5	0.93	2.33	0.75	4.01
21	*Plantago ovata* Forssk.	0.2	20	0.5	0.93	2.33	0.75	4.01
22	*Rumex dentatus* L.	0.1	10	0.25	0.46	1.16	0.38	2
23	*Saussurea heteromalla* (D.Don.) Hand.	0.1	10	0.25	0.46	1.16	0.38	2
24	*Solanum nigrum* L.	0.1	10	0.25	0.46	1.16	0.38	2
25	*Tribulus terrestris* L.	0.2	20	3	0.93	2.33	4.52	7.78
26	*Xanthium strumarium* L.	0.1	10	1.5	0.46	1.16	2.26	3.88

Table 54. Phytosociological attributes of *Cenchrus-Saccharum-Phoenix* community recorded at Gardi Banda during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Dalbergia sissoo* Roxb.	0.3	30	0.35	1.47	4.05	0.43	5.96
2	*Phoenix dactylifera* L.	3.1	100	6.71	15.2	13.5	8.27	37
3	*Zizyphus maurtiana* Lam.	0.4	40	0.8	1.96	5.41	0.99	8.35
Shrubby layer								
4	*Calotropis procera* (Wild) R.Br.	0.2	20	0.12	0.98	2.7	0.15	3.83
5	*Periploca aphylla* Decne.	0.2	20	0.12	0.98	2.7	0.15	3.83
6	*Saccharum bengalense* Retz.	5.8	100	2.38	28.4	13.5	2.93	44.9
7	*Saccharum spontaneum* L.	0.8	30	0.18	3.92	4.05	0.22	8.2
Herbaceous layer								
8	*Achyranthus aspera* L.	0.1	20	0.25	0.49	2.7	0.31	3.5
9	*Aerua persica* (Burm.f) Merrill.	0.4	40	6	1.96	5.41	7.39	14.8
10	*Boerhavia diffusa* L.	0.2	20	1.75	0.98	2.7	2.16	5.84
11	*Cenchrus biflorus* Hook. f.	6.3	100	54.5	30.9	13.5	67.2	112
12	*Convolvulus arvensis* L.	0.1	10	0.25	0.49	1.35	0.31	2.15
13	*Digera muricata* (L.). Mart.	0.2	20	0.5	0.98	2.7	0.62	4.3
14	*Eragrostis poaoides* Beauv.	0.4	40	2.25	1.96	5.41	2.77	10.1
15	*Euphorbia helioscopia* L.	0.2	20	0.5	0.98	2.7	0.62	4.3
16	*Erodium malacoides* (L.) L Her. ex Ait.	0.2	20	0.5	0.98	2.7	0.62	4.3
17	*Medicago laciniata* (L.) Mill.	0.7	30	2	3.43	4.05	2.46	9.95
18	*Plantago ciliata* Desf.	0.2	20	0.5	0.98	2.7	0.62	4.3
19	*Plantago ovata* Forssk.	0.2	20	0.5	0.98	2.7	0.62	4.3
20	*Rumex dentatus* L.	0.1	10	0.25	0.49	1.35	0.31	2.15
21	*Saussurea heteromalla* (D.Don.) Hand.	0.2	20	0.5	0.98	2.7	0.62	4.3
22	*Solanum nigrum* L.	0.1	10	0.25	0.49	1.35	0.31	2.15

Table 55. Phytosociological attributes of *Cenchrus-Prosopis-Saccharum* community recorded at Ahmad Abad during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.1	10	0.13	0.62	1.12	0.16	1.9
2	*Dalbergia sissoo* Roxb.	0.2	20	0.26	1.24	2.25	0.32	3.81
3	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	2.6	100	9.9	16.1	11.2	12	39.3
4	*Zizyphus maurtiana* Lam.	0.6	50	0.72	3.73	5.62	0.87	10.22
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	0.6	40	0.71	3.73	4.5	0.86	9.09
6	*Ricinus communis* L.	0.2	20	0.12	1.24	2.25	0.15	3.64
7	*Saccharum bengalense* Retz.	2	100	1.05	12.4	11.2	1.28	24.88
8	*Saccharum spontaneum* L.	0.6	30	0.18	3.73	3.4	0.22	7.35
Herbaceous layer								
9	*Aerua persica* (Burm.f) Merrill.	0.3	30	9	1.86	3.37	10.9	16.13
10	*Cenchrus biflorus* Hook. f.	3	100	38	18.6	11.2	46.2	76
11	*Convolvulus arvensis* L.	0.1	10	0.25	0.62	1.12	0.3	2.04
12	*Corchorus trilocularis* L.	0.3	30	0.75	1.9	3.4	0.91	6.21
13	*Cyperus rotundus* L.	0.9	20	0.5	5.6	2.25	0.61	8.46
14	*Digera muricata* (L). Mart.	0.2	20	0.5	1.24	2.25	0.61	4.1
15	*Eragrostis poaoides* Beauv	0.3	30	0.75	1.86	3.37	0.91	6.14
16	*Euphorbia helioscopia* L.	0.2	20	0.5	1.24	2.25	0.61	4.1
17	*Erodium malacoides* (L.) L Her. ex Ait.	0.2	20	0.5	1.24	2.25	0.61	4.1
18	*Fagonia cretica* L.	0.5	40	6	3.11	4.5	7.29	14.9
19	*Kickxia ramosissima* (Wall.) Janchen.	0.2	20	0.5	1.24	2.25	0.61	4.1
20	*Peganum hermala* L.	1.7	70	8	10.6	7.9	9.72	28.22
21	*Plantago ciliata* Desf.	0.3	30	0.75	1.86	3.37	0.91	6.14
22	*Plantago ovata* Forssk.	0.5	30	0.75	3.11	3.37	0.91	7.39
23	*Rumex dentatus* L.	0.2	20	0.5	1.24	2.25	0.61	4.1
24	*Saussurea heteromalla* (D.Don.) Hand.	0.2	20	0.5	1.24	2.25	0.61	4.1
25	*Tribulus terrestris* L.	0.1	10	1.5	0.62	1.12	1.82	3.56

Table 56. Phytosociological attributes of *Cenchrus- Periploca-Prosopis* community recorded at Warana during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.53	0.9	1.89	0.58	3.37
2	*Prosopis farcta* (Banks & Soland.) J.F. Macbr.	1.6	90	10.6	7.31	8.49	11.6	27.4
3	*Tamarix aphylla* (L.) Karst.	0.2	20	1.9	0.91	1.89	2.07	4.87
4	*Zizyphus maurtiana* Lam.	0.7	70	0.82	3.2	6.6	0.89	10.69
Shrubby layer								
5	*Calotropis procera* (Wild) R.Br.	0.2	20	0.12	0.9	1.89	0.13	2.92
6	*Datura metel* L.	0.3	20	0.07	1.37	1.89	0.08	3.34
7	*Periploca aphylla* Decne.	3.5	100	2.39	16	9.43	2.61	28.04
8	*Saccharum bengalense* Retz.	2	70	0.46	9.13	6.6	0.5	16.23
Herbaceous layer								
9	*Achyranthus aspera* L.	0.3	30	4.5	1.37	2.83	4.91	9.11
10	*Aerua persica* (Burm.f.) Merrill.	0.3	20	7.5	1.37	1.89	8.18	11.44
11	*Boerhavia diffusa* L.	0.2	20	3	0.9	1.89	3.27	6.06
12	*Cenchrus biflorus* Hook. f.	5.6	100	37.5	25.6	9.43	40.9	75.93
13	*Chenopodium album* L.	0.1	10	0.5	0.46	0.94	0.55	1.95
14	*Convolvulus arvensis* L.	0.1	10	0.25	0.46	0.94	0.27	1.67
15	*Cyperus rotundus* L.	0.4	20	1.75	1.83	1.89	1.9	5.62
16	*Digera muricata* (L). Mart.	0.2	20	0.5	0.91	1.89	0.55	3.35
17	*Eragrostis poaoides* Beauv.	0.1	10	0.25	0.46	0.94	0.27	1.67
18	*Euphorbia helioscopia* L.	0.5	40	1	2.28	3.77	1.09	7.14
19	*Erodium malacoides* (L.) L Her. ex Ait.	0.2	20	1.75	0.9	1.89	1.91	4.7
20	*Euphorbia prostrata* Ait.	0.6	20	0.5	2.74	1.89	0.55	5.18
21	*Fagonia cretica* L.	0.8	60	4	3.65	5.66	4.36	13.67
22	*Ifloga fontanesii* Cass.	1.6	50	2.5	7.31	4.72	2.73	14.76
23	*Kickxia ramosissima* (Wall.) Janchen.	0.2	20	0.5	0.91	1.89	0.55	3.35
24	*Malva neglecta* Wallr.	0.1	10	0.25	0.46	0.94	0.27	1.67
25	*Medicago laciniata* (L.) Mill.	0.2	20	0.5	0.9	1.89	0.55	3.34
26	*Plantago ciliata* Desf.	0.4	40	1	1.83	3.77	1.09	6.69
27	*Plantago ovata* Forssk.	0.3	30	0.75	1.37	2.83	0.82	5.02
28	*Rumex dentatus* L.	0.2	20	0.5	0.91	1.89	0.55	3.35
29	*Saussurea heteromalla* (D.Don.) Hand.	0.4	40	1	1.83	3.77	1.09	6.69
30	*Solanum nigrum* L.	0.1	10	0.25	0.46	0.94	0.27	1.67
31	*Tribulus terrestris* L.	0.2	20	3	0.91	1.89	3.27	6.07
32	*Xanthium strumarium* L.	0.1	10	1.5	0.46	0.94	1.64	3.04

Table 57. Phytosociological attributes of *Cenchrus-Saccharum-Zizyphus* community recorded at Bogara during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.2	20	0.37	0.79	1.94	0.31	3.04
2	*Dalbergia sissoo* Roxb.	0.2	20	1.01	0.79	1.94	0.84	3.57
3	*Phoenix dactylifera* L.	1.2	50	2.27	4.74	4.85	1.89	11.48
4	*Zizyphus maurtiana* Lam.	1.4	80	5.29	5.53	7.77	4.41	17.71
Shrubby layer								
5	*Calligonum polygonoides* L.	1.2	60	0.54	4.74	5.83	0.45	11.02
6	*Calotropis procera* (Wild.) R.Br.	0.6	40	0.33	2.37	3.88	0.28	6.53
7	*Periploca aphylla* Decne.	0.4	40	0.24	1.58	3.88	0.2	5.66
8	*Saccharum bengalense* Retz.	5.2	100	2.2	20.6	9.71	1.83	32.14
Herbaceous layer								
9	*Achyranthus aspera* L.	0.3	30	4.5	1.19	2.91	3.75	7.85
10	*Aerua persica* (Burm.f.) Merrill.	0.3	20	12.5	1.19	1.94	10.4	13.53
11	*Boerhavia diffusa* L.	0.3	20	3	1.19	1.94	2.5	5.63
12	*Cenchrus biflorus* Hook. f.	5.8	100	41.75	22.9	9.71	34.8	67.41
13	*Centaurea iberica* Trev.Ex. Spreng	0.2	20	3	0.79	1.94	2.5	5.23
14	*Citrullus colocynthis* L. Schrad.	0.2	20	3	0.79	1.94	2.5	5.23
15	*Cynodon dactylon* (L.) Pers.	0.5	10	1.5	1.98	0.97	1.25	4.2
16	*Cyperus rotundus* L.	0.8	30	3.25	3.16	2.91	2.71	8.78
17	*Cyperus scarlosus* R.Br.	1.6	40	1	6.32	3.88	0.83	11.03
18	*Digera muricata* (L.) Mart.	0.2	20	1.75	0.79	1.94	1.46	4.19
19	*Echinops echinatus* D.C.	0.3	30	0.75	1.19	2.91	0.63	4.73
20	*Eragrostis poaoides* Beauv.	0.4	20	3	1.58	1.94	2.5	6.02
21	*Euphorbia prostrata* Ait.	1.2	40	6	4.74	3.88	5	13.62
22	*Fagonia cretica* L.	0.6	30	4.5	2.37	2.91	3.75	9.03
23	*Ifloga fontanesii* Cass.	0.4	40	1	1.58	3.88	0.83	6.29
24	*Ipomoea hederacea* (L.) Jacq.	0.2	20	3	0.79	1.94	2.5	5.23
25	*Malva parviflora* L.	0.2	20	0.5	0.79	1.94	0.42	3.15
26	*Malva neglecta* Wallr.	0.2	20	0.5	0.79	1.94	0.42	3.15
27	*Medicago laciniata* (L.) Mill.	0.5	50	7.5	1.98	4.85	6.25	13.08
28	*Solanum surattense* Burm .f .	0.1	10	1.5	0.4	0.97	1.25	2.62
29	*Vicia sativa* L.	0.5	20	0.5	1.98	1.94	0.42	4.34
30	*Xanthium strumarium* L.	0.1	10	3.75	0.4	0.97	3.13	4.5

Table 58. Phytosociological attributes of *Cenchrus-Saccharum-Acacia* community recorded at Northern Bogara during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	2.5	70	14.76	10.5	10	19	39.5
2	*Dalbergia sissoo* Roxb.	0.3	30	0.71	1.26	4.29	0.91	6.46
3	*Phoenix dactylifera* L.	0.3	10	0.79	1.26	1.4	1.02	3.68
4	*Zizyphus maurtiana* Lam.	1.1	60	3.61	4.6	8.57	4.64	17.81
Shrubby layer								
5	*Calligonum polygonoides* L.	0.2	20	0.12	0.84	2.86	0.15	3.85
6	*Calotropis procera* (Wild.) R.Br.	0.5	50	0.39	2.09	7.14	0.5	9.73
7	*Periploca aphylla* Decne.	0.3	30	0.18	1.26	4.29	0.23	5.78
8	*Saccharum bengalense* Retz.	7.5	90	2.22	31.4	12.9	2.85	47.15
Herbaceous layer								
9	*Achyranthus aspera* L.	0.6	20	1.75	2.5	2.86	2.25	7.61
10	*Asphodelous tenuifolius* Cavan.	1.2	30	0.75	5	4.29	0.96	10.25
11	*Boerhavia diffusa* L.	0.1	10	1.5	0.4	1.4	1.93	3.73
12	*Cenchrus biflorus* Hook. f.	6.4	90	36.5	26.8	12.9	46.9	86.6
13	*Citrullus colocynthis* (L.) Schrad.	0.1	10	3.75	0.4	1.4	4.82	6.62
14	*Cyperus rotundus* L.	0.3	20	0.5	1.26	2.86	0.64	4.76
15	*Cyperus scarlosus* R.Br.	0.4	20	0.5	1.67	2.86	0.64	5.17
16	*Eragrostis poaoides* Beauv.	0.2	20	0.5	0.84	2.86	0.64	4.34
17	*Erodium malacoides* (L.) L Her. ex Ait.	0.2	20	0.5	0.84	2.86	0.64	4.34
18	*Euphorbia prostrata* Ait.	0.6	30	0.75	2.5	4.29	0.96	7.75
19	*Ifloga fontanesii* Cass.	0.7	30	4.5	2.9	4.29	5.79	12.98
20	*Medicago laciniata* (L.) Mill.	0.2	20	0.5	0.84	2.86	0.64	4.34
21	*Tribulus terrestris* L.	0.2	20	3	0.84	2.86	3.86	7.56

Table 59. Phytosociological attributes of *Zizyphus-Cenchrus-Saccharum* community recorded at Gandiri Khattak during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Zizyphus maurtiana* Lam.	2.4	90	132	11.7	13.8	68.2	93.7
Shrubby Layer								
2	*Calotropis procera* (Wild) R.Br.	0.3	30	0.18	1.46	4.62	0.09	6.17
3	*Periploca aphylla* Decne.	0.3	30	0.18	1.46	4.62	0.09	6.17
4	*Saccharum bengalense* Retz.	6.8	100	1.8	33.2	15.4	0.93	49.53
Herbaceous layer								
5	*Achyranthus aspera* L.	0.3	30	0.75	1.46	4.62	0.39	6.47
6	*Boerhavia diffusa* L.	0.3	30	4.5	1.46	4.62	2.33	8.4
7	*Cenchrus biflorus* Hook. f.	5.1	100	33	24.9	15.4	17.1	57.4
8	*Cynodon dactylon* (L.) Pers.	2	20	3	9.76	3.08	1.55	14.39
9	*Echinops echinatus* D.C.	0.3	30	0.75	1.46	4.62	0.39	6.47
10	*Eragrostis poaoides* Beauv.	0.4	30	3.25	1.95	4.62	1.68	8.25
11	*Erodium malacoides* (L.) L Her. ex Ait.	0.1	10	0.25	0.49	1.54	0.13	2.16
12	*Euphorbia prostrata* Ait.	0.5	30	0.75	2.4	4.62	0.39	7.4
13	*Fagonia cretica* L.	0.2	20	3	0.98	3.08	1.55	5.61
14	*Ifloga fontanesii* Cass.	0.9	40	1	4.39	6.15	0.52	11.06
15	*Medicago laciniata* (L) Mill.	0.3	30	4.5	1.46	4.62	2.33	8.4
16	*Solanum surattense* Burm .f.	0.1	10	1.5	0.49	1.54	0.78	2.81
17	*Tribulus terrestris* L.	0.2	20	3	0.98	3.08	1.55	5.61

Table 60. Phytosociological attributes of *Calligonum-Cenchrus-Zizyphus* community recorded at Kari Dand during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.5	40	0.7	2.15	3.92	1.79	7.86
2	*Dalbergia sissoo* Roxb.	0.3	30	0.4	1.29	2.94	1.02	5.25
3	*Zizyphus maurtiana* Lam.	0.8	80	2.4	3.43	7.84	6.14	17.41
Shrubby layer								
4	*Calligonum polygonoides* L.	6.3	100	2.48	27	9.8	6.35	43.15
5	*Calotropis procera* (Wild) R.Br.	0.4	30	0.13	1.72	2.94	0.33	4.99
6	*Datura metel* L.	0.8	40	0.24	3.43	3.92	0.61	7.96
7	*Periploca aphylla* Decne.	1.1	80	0.48	4.72	7.84	1.23	13.79
8	*Saccharum bengalense* Retz.	0.8	40	0.25	3.43	3.92	0.64	7.99
Herbaceous layer								
9	*Achyranthus aspera* L.	0.2	20	3	0.86	1.96	7.68	10.5
10	*Boerhavia diffusa* L.	0.3	30	4.5	1.29	2.94	11.5	15.73
11	*Cenchrus biflorus* Hook. f.	4.4	100	0.25	18.9	9.8	0.64	29.34
12	*Cymbopogon jwarancusa* (Jones.) Schult.	0.1	10	3.75	0.43	0.98	9.6	11.01
13	*Cyperus rotundus* L.	1.2	50	1.25	5.15	4.9	3.2	13.25
14	*Cyperus scarlosus* R.Br.	0.3	30	0.75	1.29	2.94	1.92	6.15
15	*Digera muricata* (L.). Mart.	0.3	30	0.75	1.29	2.94	1.92	6.15
16	*Echinops echinatus* D.C.	0.6	20	0.5	2.58	1.96	1.28	5.82
17	*Eragrostis poaoides* Beauv.	0.5	50	3.75	2.15	4.9	9.6	16.65
18	*Ifloga fontanesii* Cass.	1	40	1	4.29	3.92	2.56	10.77
19	*Malva parviflora* L.	0.6	50	1.25	2.58	4.9	3.2	10.68
20	*Malva neglecta* Wallr.	1.7	50	1.25	7.3	4.9	3.2	15.4
21	*Medicago laciniata* (L.) Mill.	0.6	50	2.5	2.58	4.9	6.4	13.88
22	*Tribulus terrestris* L.	0.5	50	7.5	2.15	4.9	19.2	26.25

Table 61. Phytosociological attributes of *Cenchrus-Calligonum-Acacia* community recorded at Jahangiri Banda during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	300	0.28	0.95	29.4	0.44	30.79
2	*Dalbergia sissoo* Roxb.	0.8	50	1.63	2.52	4.9	2.56	9.98
3	*Zizyphus maurtiana* Lam.	2.7	80	5.75	8.52	7.84	9.03	25.39
Shrubby layer								
4	Calligonum polygonoides L.	15.2	100	2.2	47.9	9.8	3.46	61.16
5	*Calotropis procera* (Wild.) R.Br.	0.2	20	0.12	0.63	1.96	0.19	2.78
6	*Periploca aphylla* Decne.	0.2	20	0.21	0.63	1.96	0.33	2.92
7	*Saccharum bengalense* Retz.	3.7	100	1.23	11.7	9.8	1.93	23.43
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.1	10	1.5	0.32	0.98	2.36	3.66
9	*Cenchrus biflorus* Hook. f.	5.8	100	37.5	18.3	9.8	58.9	87
10	*Chenopodium album* L	0.1	10	1.5	0.32	0.98	2.36	3.66
11	*Citrullus colocynthis* L. Schrad.	0.1	10	3.75	0.32	0.98	5.89	7.19
12	*Convolvulus arvensis* L.	0.2	20	0.5	0.63	1.96	0.79	3.38
13	*Echinops echinatus* D.C.	0.1	10	0.25	0.32	0.98	0.39	1.69
14	*Euphorbia helioscopia* L.	0.5	40	1	1.58	3.92	1.57	7.07
15	*Erodium malacoides* (L.) L Her. ex Ait.	0.1	10	0.25	0.32	0.98	0.39	1.69
16	*Euphorbia prostrata* Ait.	0.3	30	0.75	0.95	2.94	1.18	5.07
17	*Malva neglecta* Wallr.	0.1	10	1.5	0.32	0.98	2.36	3.66
18	*Plantago ciliata* Desf.	0.4	40	1	1.26	3.92	1.57	6.75
19	*Plantago ovata* Forssk.	0.3	30	0.75	0.95	2.94	1.18	5.07
20	*Rumex dentatus* L.	0.2	20	0.5	0.63	1.96	0.79	3.38
21	*Solanum surattense* Burm .f.	0.3	10	1.5	0.95	0.98	2.36	4.29

Table 62. Phytosociological attributes of *Zizyphus-Cenchrus- Calligonum* community recorded at Mona Khel during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice	0.2	20	0.23	0.9	2.3	0.33	3.5
2	*Dalbergia sissoo* Roxb	0.7	50	1.36	3.14	5.75	1.97	10.86
3	*Zizyphus maurtiana* Lam	4	100	26.2	17.9	11.5	38	67.4
Shrubby layer								
4	*Calligonum polygonoides* L.	3.6	100	1.52	16.1	11.5	2.21	29.8
5	*Calotropis procera* (Wild) R.Br.	0.5	50	0.48	2.24	5.75	0.7	8.69
6	*Datura metel* L.	0.3	30	0.18	1.35	3.45	0.26	5.06
7	*Saccharum bengalense* Retz.	2.6	40	0.42	11.7	4.6	0.61	16.9
Herbaceous layer								
8	*Boerhaavia diffusa* L.	0.3	20	3	1.35	2.3	4.35	8
9	*Cenchrus biflorus* Hook. f.	4.9	100	19	22	11.5	27.6	61.1
10	*Chenopodium album* L.	0.3	30	2	1.35	3.45	2.9	7.7
11	*Citrullus colocynthis* L. Schrad.	0.1	10	1.5	0.45	1.15	2.18	3.78
12	*Convolvulus arvensis* L.	0.2	20	0.5	0.9	2.3	0.73	3.93
13	*Cyperus rotundus* L.	0.5	10	0.25	2.24	1.15	0.36	3.75
14	*Eragrostis poaoides* Beauv.	0.2	20	0.5	0.9	2.3	0.73	3.93
15	*Euphorbia helioscopia* L.	0.1	10	0.25	0.45	1.15	0.36	1.96
16	*Erodium malacoides (L.) L Her. ex Ait.*	0.2	20	0.5	0.9	2.3	0.73	3.93
17	*Euphorbia prostrata* Ait.	0.3	30	0.75	1.35	3.45	1.09	5.89
18	*Fagonia cretica* L.	1	50	6.25	4.48	5.75	9.07	19.3
19	*Ifloga fontanesii* Cass.	1.3	60	1.5	5.83	6.9	2.18	14.9
20	*Plantago ciliata* Desf.	0.2	20	0.5	0.9	2.3	0.73	3.93
21	*Plantago ovata* Forssk.	0.5	50	1.25	2.24	5.75	1.81	9.8
22	*Rumex dentatus* L.	0.3	30	0.75	1.35	3.45	1.09	5.89

Table 63. Phytosociological attributes of *Cenchrus-Zizyphus -Saccharum* community recorded at Jarassi during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.3	30	0.52	1.78	3.03	0.69	5.5
2	*Dalbergia sissoo* Roxb.	0.5	50	5.4	2.96	5.05	7.13	15.14
3	*Zizyphus maurtiana* Lam.	1.7	100	6.7	10.1	10.1	8.84	29.04
Shrubby layer								
4	*Calotropis procera* (Wild.) R.Br.	0.3	30	0.18	1.78	3.03	0.24	5.05
5	*Datura metel* L.	0.4	30	0.27	2.37	3.03	0.36	5.76
6	*Periploca aphylla* Decne.	0.3	30	0.45	1.78	3.03	0.59	5.4
7	*Saccharum bengalense* Retz.	2.4	100	1.23	14.2	10.1	1.62	25.92
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.2	20	1.75	1.18	2.02	2.31	5.51
9	*Boerhaavia diffusa* L.	0.2	20	0.5	1.18	2.02	0.66	3.86
10	*Cenchrus biflorus* Hook. f.	4.5	100	33.25	26.6	10.1	43.9	80.6
11	*Chenopodium album* L.	0.1	10	1.5	0.59	1.01	1.98	3.58
12	*Chenopodium mural* L.	0.6	30	0.75	3.55	3.03	0.99	7.57
13	*Citrullus colocynthis* L. Schrad.	0.3	30	6.75	1.78	3.03	8.91	13.72
14	*Convolvulus arvensis* L.	0.1	10	0.25	0.59	1.01	0.33	1.9
15	*Cynodon dactylon* (L.) Pers.	1.1	30	0.75	6.51	3.03	0.99	10.53
16	*Cyperus rotundus* L.	0.5	50	1.25	2.96	5.05	1.65	9.66
17	*Eragrostis poaoides* Beauv.	0.4	40	1	2.37	4.04	1.32	7.73
18	*Euphorbia helioscopia* L.	0.3	20	0.5	1.78	2.02	0.66	4.46
19	*Euphorbia prostrata* Ait.	0.2	20	0.5	1.18	2.02	0.66	3.86
20	*Fagonia cretica* L	0.6	50	1.25	3.55	5.05	1.65	10.25
21	*Launaea nudicaulis* (L.) Hook. f.	0.3	30	0.75	1.78	3.03	0.99	5.8
22	*Plantago ciliata* Desf.	0.5	50	1.25	2.96	5.05	1.65	9.66
23	*Plantago ovata* Forssk.	0.4	40	1	2.37	4.04	1.32	7.73
24	*Rumex dentatus* L.	0.2	20	0.5	1.18	2.02	0.66	3.86
25	*Solanum surattense* Burm .f.	0.3	30	4.5	1.78	3.03	5.94	10.75
26	*Tribulus terrestris* L.	0.2	20	3	1.18	2.02	3.96	7.16

Table 64. Phytosociological attributes of *Cymbopogon-Rhazya-Zizyphus* community recorded at Chokara during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.8	50	0.7	3.98	6.33	0.81	11.12
2	*Acacia nilotica* (L.) Delice.	0.5	40	0.5	2.5	5.06	0.58	8.14
3	*Dalbergia sissoo* Roxb.	0.3	20	0.26	1.49	2.53	0.3	4.32
4	*Zizyphus maurtiana* Lam.	0.7	50	2.47	3.48	6.33	2.85	12.66
Shrubby layer								
5	*Periploca aphylla* Decne.	0.3	30	0.18	1.49	3.8	0.21	5.5
6	*Rhazya stricta* Decne.	7.4	100	0.96	36.8	12.7	1.13	50.63
7	*Saccharum bengalense* Retz.	0.6	40	0.6	2.99	5.06	0.69	8.74
8	*Saccharum spontaneum* L.	0.1	10	0.15	0.5	1.27	0.17	1.94
9	*Zizyphus nummularia* (Burm.f.) W & A.	0.5	50	0.48	2.49	6.33	0.55	9.37
Herbaceous layer								
10	*Aerua persica* (Burm.f) Merrill.	0.3	30	11.25	1.49	3.8	13	18.29
11	*Boerhavia diffusa* L.	0.4	40	0.1	1.99	5.06	0.12	7.17
12	*Cenchrus ciliaris* L.	0.3	30	0.75	1.49	3.8	0.87	6.16
13	*Convolvulus arvensis* L.	0.2	20	0.5	1	2.53	0.58	4.1
14	*Corchorus trilocularis* L.	0.2	20	0.5	1	2.53	0.58	4.1
15	*Cymbopogon jwarancusa* (Jones) Schult.	3.9	100	55.25	19.4	12.7	63.8	95.9
16	*Cynodon dactylon* (L.) Pers.	1.5	30	4.5	7.46	3.8	5.2	16.46
17	*Desmostachya bipinnata* (L.) Stapf.	0.2	20	0.5	1	2.5	0.58	4.08
18	*Dichanthium annulatum* (Forssk) Staph.	0.4	30	0.75	1.99	3.8	0.87	6.66
19	*Eragrostis poaoides* Beauv.	0.9	40	0.6	4.48	5.06	0.69	10.23
20	*Fagonia cretica* L.	0.3	20	0.3	1.49	2.5	0.35	4.34
21	*Solanum surattense* Burm .f.	0.3	20	5.25	1.49	2.53	6.07	10.09

Table 65. Phytosociological attributes of *Astragalus-Aerua-Zizyphus* community recorded at Ambiri Kala during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.6	40	0.2	3.1	5.56	0.4	9.04
2	*Acacia nilotica* (L.) Delice.	0.1	10	0.05	0.52	1.39	0.1	2.01
3	*Dalbergia sissoo* Roxb.	0.4	30	0.25	2.06	4.17	0.49	6.72
4	*Zizyphus maurtiana* Lam.	0.8	60	0.33	4.12	8.3	0.65	13.07
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	6.6	100	1.33	34	13.9	2.62	50.52
6	*Calotropis procera* (Wild.) R.Br.	0.3	20	0.21	1.55	2.78	0.41	4.74
7	*Capparis decidua* (Forssk.). Edgeworth.	0.4	20	0.12	2.06	2.78	0.24	5.08
8	*Rhazya stricta* Decne.	0.7	40	0.19	3.61	5.56	0.37	9.54
9	*Saccharum bengalense* Retz.	2.8	90	1.28	14.4	12.5	2.52	29.42
10	*Zizyphus nummularia* (Burm.f.) W & A.	0.2	20	0.12	1.03	2.78	0.24	4.05
Herbaceous layer								
11	*Aerua persica* (Burm.f.) Merrill.	0.6	40	17.5	3.1	5.56	34.4	43.06
12	*Boerhavia diffusa* L.	0.4	30	0.75	2.06	4.17	1.48	7.71
13	*Cenchrus ciliaris* L.	0.4	30	0.75	2.1	4.17	1.48	7.75
14	*Cymbopogon jwarancusa* (Jones) Schult.	0.8	40	12.75	4.12	5.56	25.1	34.78
15	*Cynodon dactylon* (L.) Pers.	2.9	50	1.25	14.9	6.94	2.46	24.29
16	*Dichanthium annulatum* (Forssk.) Staph.	0.4	40	6	2.1	5.56	11.8	19.46
17	*Eragrostis poaoides* Beauv.	0.7	30	4.5	3.61	4.17	8.85	16.63
18	*Launaea nudicaulis* (L.) Hook. f.	0.1	10	0.25	0.52	1.39	0.49	2.4
19	*Medicago laciniata* (L.) Mill.	0.2	20	3	1.03	2.78	5.9	9.71

Table 66. Phytosociological attributes of *Cenchrus-Rhazya-Zizyphus* community recorded at Takht-e-Nasrati during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	30	0.23	2.22	3.75	0.24	6.21
2	*Acacia nilotica* (L.) Delice.	0.2	20	0.37	0.89	2.5	0.38	3.77
3	*Zizyphus maurtiana* Lam.	1.6	90	7.35	7.11	11.3	7.53	25.94
Shrubby layer								
4	*Rhazya stricta* Decne.	5.6	90	1.17	24.9	11.3	1.2	37.4
5	*Saccharum bengalense* Retz.	0.9	50	0.48	4	6.2	0.49	10.69
6	*Saccharum spontaneum* L.	0.3	30	0.27	1.33	3.75	0.28	5.36
7	*Withania coagulans* (Stocks) Dunal.	1.5	60	0.4	6.67	7.5	0.41	14.58
8	*Zizyphus nummularia* (Burm.f.) W & A.	0.2	20	0.12	0.89	2.5	0.12	3.51
Herbaceous layer								
9	*Boerhavia diffusa* L.	0.3	30	0.75	1.33	3.75	0.77	5.85
10	*Cenchrus biflorus* Hook. f.	4.5	100	37.75	20	12.5	38.7	71.2
11	*Cenchrus ciliaris* L.	0.3	30	2	1.33	3.75	2.05	7.13
12	*Corchorus trilocularis* L.	0.2	20	0.5	0.89	2.5	0.51	3.9
13	*Cymbopogon jwarancusa* (Jones) Schult.	0.7	30	9	3.11	3.7	9.2	16.01
14	*Cyperus rotundus* L.	2.2	40	2.25	9.78	5	2.3	17.08
15	*Eragrostis poaoides* Beauv	1.4	40	6	6.22	5	6.15	17.37
16	*Fagonia cretica* L.	0.7	50	18.75	3.11	6.25	19.2	28.56
17	*Medicago laciniata* (L.) Mill.	0.2	20	3	0.89	2.5	3.07	6.46
18	*Salvia moorcroftiana* Wallich ex Benth.	1.2	50	7.25	5.33	6.25	7.4	18.98

Table 67. Phytosociological attributes of *Phoenix-Fagonia-Capparis* community recorded at Siraj khel during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.3	20	0.2	1.28	2.5	0.24	4.02
2	*Acacia nilotica* (L.) Delice.	0.5	30	2.1	2.13	3.75	2.47	8.35
3	*Phoenix dactylifera* L.	4.4	90	8.6	18.7	11.3	10.1	40.1
4	*Zizyphus maurtiana* Lam.	0.4	30	1.35	1.7	3.75	1.59	7.04
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	0.5	30	0.03	2.13	3.75	0.04	5.92
6	*Calotropis procera* (Wild) R.Br.	0.9	50	0.75	3.83	6.25	0.88	10.96
7	*Capparis decidua* (Forssk.). Edgeworth.	2.9	50	0.58	12.3	6.25	0.68	19.23
8	*Rhazya stricta* Decne.	1.5	30	0.18	6.38	3.75	0.21	10.34
9	*Withania coagulans* (Stocks) Dunal.	0.9	30	0.18	3.83	3.75	0.21	7.79
10	*Zizyphus nummularia* (Burm.f.) W.&A.	0.4	20	0.12	1.7	2.5	0.14	4.34
Herbaceous layer								
11	*Aerua persica* (Burm.f.) Merrill.	0.7	40	15	2.98	5	17.6	25.58
12	*Boerhavia diffusa* L.	0.2	20	0.5	0.85	2.5	0.59	3.94
13	*Cenchrus biflorus* Hook. f.	1.6	50	9.75	6.81	6.25	11.5	24.56
14	*Cleome viscosa* L.	0.3	30	6.75	1.28	3.75	7.93	12.96
15	*Corchorus trilocularis* L.	0.3	30	0.75	1.28	3.75	0.88	5.91
16	*Cynodon dactylon* (L.) Pers.	1.8	30	3.25	7.66	3.75	3.82	15.23
17	*Cyperus rotundus* L.	1.2	30	4.5	5.11	3.75	5.29	14.15
18	*Digera muricata* (L.). Mart.	0.2	20	3	0.85	2.5	3.53	6.88
19	*Eragrostis poaoides* Beauv.	0.8	40	6	3.4	5	7.05	15.45
20	*Euphorbia prostrata* Ait.	0.7	30	2	2.98	3.75	2.35	9.08
21	*Fagonia cretica* L.	2.4	80	16.5	10.2	10	19.4	39.6
22	*Medicago laciniata* (L.) Mill.	0.5	10	1.5	2.13	1.25	1.76	5.14
23	*Solanum surattense* Burm .f.	0.1	10	1.5	0.43	1.25	1.76	3.44

Table 68. Phytosociological attributes of *Cassia-Zizyphus-Fagonia* community recorded at Shahidan during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	40	0.34	2.92	6.35	2.96	12.23
2	*Gymnosporia royleana* Wall. ex M. A. Lawson.	0.2	20	0.3	1.2	3.17	2.62	6.99
3	*Zizyphus maurtiana* Lam.	1.3	100	1.6	7.6	15.9	13.9	37.4
Shrubby layer								
4	*Cassia angustifolia* Vahl.	4.2	80	0.38	24.6	12.7	3.31	40.61
5	*Rhazya stricta* Decne.	3.7	70	0.32	21.6	11.1	2.8	35.5
6	*Withania coagulans* (Stocks) Dunal.	2.4	60	0.26	14	9.5	2.3	25.8
7	*Zizyphus nummularia* (Burm.f.) W & A.	0.3	30	0.27	1.75	4.76	2.35	8.86
Herbaceous Layer								
8	*Boerhavia diffusa* L.	0.3	30	0.75	1.75	4.76	6.54	13.05
9	*Cenchrus biflorus* Hook. f.	0.3	30	2	1.75	4.76	17.4	23.91
10	*Cynodon dactylon* (L.) Pers.	1.5	30	0.5	8.77	4.76	4.36	17.89
11	*Cyperus scarlosus* R.Br.	0.6	30	0.75	3.51	4.76	6.54	14.81
12	*Eragrostis poaoides* Beauv.	1	40	1	5.85	6.35	8.72	20.92
13	*Euphorbia prostrata* Ait.	0.1	10	0.25	0.6	1.59	2.2	4.39
14	*Fagonia cretica* L.	0.6	50	2.5	3.5	7.94	21.8	33.24
15	*Solanum surattense* Burm .f.	0.1	10	0.25	0.6	1.6	2.2	4.4

Table 69. Phytosociological attributes of *Capparis-Aerua-Acacia community* recorded at Zarki Nasratti during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	1.6	100	0.82	9.1	13.5	2.4	25
2	*Zizyphus maurtiana* Lam.	0.9	60	2.12	5.11	8.11	6.2	19.42
Shrubby layer								
3	*Astragalus psilocentros* Fisch.	1	30	0.18	5.7	4.05	0.53	10.28
4	*Calotropis procera* (Wild) R.Br.	0.3	30	0.18	1.7	4.05	0.53	6.28
5	*Capparis decidua* (Forssk). Edgeworth.	1.7	30	0.27	9.66	4.05	0.79	14.5
6	*Capparis spinosa* L.	3	60	1.3	17	8.11	3.8	28.91
7	*Punica granatum* L.	1.1	50	0.3	6.25	6.8	0.9	13.95
8	*Rhazya stricta* Decne.	1.1	30	0.13	6.25	4.05	0.38	10.68
9	*Saccharum bengalense* Retz.	1.2	50	0.39	6.82	6.76	1.14	14.72
Herbaceous layer								
10	*Achyranthus aspera* L.	0.2	20	0.5	1.14	2.7	1.46	5.3
11	*Aerua persica* (Burm.f) Merrill.	0.3	30	6.75	1.7	4.05	19.7	25.45
12	*Boerhavia diffusa* L.	0.1	10	1.5	0.57	1.35	4.39	6.31
13	*Centaurea iberica* Trev.Ex. Spreng	0.4	10	0.25	2.3	1.35	0.73	4.38
14	*Cynodon dactylon* (L.) Pers.	1	10	1.5	5.68	1.35	4.39	11.42
15	*Cyperus scarlosus* R.Br.	0.4	20	0.5	2.27	2.7	1.46	6.43
16	*Echinops echinatus* D.C.	0.3	30	0.75	1.7	4.05	2.19	7.94
17	*Eragrostis poaoides* Beauv.	0.4	30	2	2.27	4.05	5.85	12.17
18	*Fagonia cretica* L.	0.5	20	3	2.84	2.7	8.77	14.31
19	*Malva neglecta* Wallr.	0.3	20	0.5	1.7	2.7	1.46	5.86
20	*Pupalia lappacea* (L.) Juss.	0.5	30	0.75	2.84	4.05	2.19	9.1
21	*Solanum surattense* Burm .f.	0.2	20	3	1.14	2.7	8.77	12.61
22	*Tribulus terrestris* L.	0.9	30	4.5	5.11	4.05	13.2	22.36
23	*Xanthium strumarium* L.	0.2	20	3	1.14	2.7	8.77	12.61

Table 70. Phytosociological attributes of *Aerua-Acacia-Capparis* community recorded at Shawa during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layers								
1	*Acacia modesta* Wall.	2.8	90	2.22	21.2	12.5	7.8	41.5
2	*Acacia nilotica* (L.) Delice.	0.3	30	0.11	2.27	4.17	0.39	6.83
3	*Zizyphus maurtiana* Lam.	0.9	50	0.8	6.82	6.9	2.8	16.52
Shrubby layer								
4	*Astragalus psilocentros* Fisch.	0.8	40	0.14	6.06	5.56	0.49	12.11
5	*Capparis decidua* (Forssk.). Edgeworth.	1.6	90	0.49	12.1	12.5	1.7	26.3
6	*Capparis spinosa* L.	2.7	100	0.55	20.5	13.9	1.94	36.34
7	*Rhazya stricta* Decne.	0.6	30	0.08	4.55	4.17	0.28	9
8	*Withania coagulans* (Stocks.) Dunal.	0.4	40	0.19	3.03	5.56	0.67	9.26
Herbaceous layers								
9	*Aerua persica* (Burm.f.) Merrill.	0.9	90	13.5	6.82	12.5	47.7	67.02
10	*Boerhavia diffusa* L..	0.4	40	3.5	3.03	5.56	12.4	20.99
11	*Cyperus scarlosus* R.Br.	0.9	40	1	6.8	5.56	3.53	15.89
12	*Malva neglecta* Wallr.	0.5	40	2.25	3.79	5.56	7.9	17.25
13	*Tribulus terrestris* L.	0.4	40	3.5	3.03	5.56	12.4	20.99

Table 71. Phytosociological attributes of *Zizyphus-Capparis-Phragmites* community recorded at Kandu Khel during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia nilotica* (L.) Delice.	0.4	30	0.66	1.67	4.1	1.11	6.88
2	*Zizyphus maurtiana* Lam.	2.3	100	10.17	9.58	13.7	17.1	40.38
Shrubby layer								
3	*Astragalus psilocentros* Fisch.	0.7	40	0.14	2.9	5.48	0.23	8.61
4	*Calotropis procera* (Wild) R.Br.	0.3	30	0.08	1.25	4.11	0.13	5.49
5	*Capparis decidua* (Forssk). Edgeworth.	5.2	100	1.658	21.8	13.7	2.78	38.28
6	*Periploca aphylla* Decne.	0.4	30	0.18	1.67	4.11	0.3	6.08
7	*Rhazya stricta* Decne.	1	30	0.228	4.17	4.1	0.38	8.65
8	*Saccharum bengalense* Retz.	0.3	20	0.12	1.2	2.74	0.2	4.14
9	*Withania coagulans* (Stocks) Dunal.	0.2	20	0.12	0.8	2.74	0.2	3.74
Herbaceous layer								
10	*Boerhavia diffusa* L.	1.3	80	5.75	5.4	11	9.65	26.05
11	*Cenchrus biflorus* Hook. f.	1.6	30	4.5	6.67	4.1	7.55	18.32
12	*Cynodon dactylon* (L.) Pers.	2	20	3	8.3	2.74	5.03	16.07
13	*Cyperus rotundus* L.	2.8	50	3.75	11.7	6.85	6.29	24.84
14	*Dichanthium annulatum* (Forssk.) Staph.	0.4	30	4.5	1.67	4.1	7.55	13.32
15	*Eragrostis poaoides* Beauv.	2.4	50	7.5	10	6.85	12.6	29.45
16	*Fagonia cretica* L.	0.3	20	0.5	1.25	2.74	0.84	4.83
17	*Medicago laciniata* (L) Mill.	0.4	30	2	1.67	4.1	3.36	9.13
18	*Phragmites karka* (Retz) Trin. ex. Steud.	2	20	14.75	8.3	2.74	24.7	35.74

Table 72. Phytosociological attributes of *Aerua-Capparis-Acacia* community recorded at Shadi khel during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	2.6	70	6.42	11.1	9.2	11.3	31.6
2	*Acacia nilotica* (L.) Delice.	0.4	30	0.75	1.71	3.95	1.32	6.98
3	*Dalbergia sissoo* Roxb.	0.4	20	0.51	1.71	2.63	0.9	5.24
4	*Zizyphus maurtiana* Lam.	1.3	50	9.47	5.56	6.58	16.6	28.74
Shrubby layer								
5	*Astragalus psilocentros* Fisch.	0.8	30	0.18	3.42	3.95	0.32	7.69
6	*Calotropis procera* (Wild) R.Br.	0.7	30	0.18	2.99	3.95	0.32	7.26
7	*Capparis decidua* (Forssk). Edgeworth.	6.6	100	2.11	28.2	13.2	3.71	45.1
8	*Punica granatum* L.	1.3	30	0.18	5.56	3.95	0.32	9.83
9	*Rhazya stricta* Decne.	2.3	50	0.3	9.83	6.6	0.53	16.9
10	*Saccharum bengalense* Retz.	0.4	20	0.12	1.71	2.6	0.21	4.55
11	*Zizyphus nummularia* (Burm.f.) W & A.	0.5	30	0.18	2.14	3.95	0.32	6.4
Herbaceous layer								
12	*Aerua persica* (Burm.f.) Merrill.	0.6	50	22.75	2.56	6.6	40	49.14
13	*Asphodelous tenuifolius* Cavan.	1.6	30	0.75	6.84	3.95	1.32	12.11
14	*Boerhavia diffusa* L.	0.2	20	0.5	0.85	2.6	0.88	4.36
15	*Cenchrus biflorus* Hook. f.	0.9	40	1	3.85	5.26	1.76	10.87
16	*Cymbopogon jwarancusa* (Jones) Schult.	0.3	30	4.5	1.28	3.95	7.91	13.14
17	*Cynodon dactylon* (L.) Pers.	1.1	20	0.5	4.7	2.6	0.88	8.2
18	*Cyperus scarlosus* R.Br.	0.5	30	0.75	2.14	3.95	1.32	7.41
19	*Malvastrum coromandelianum* (L.) Gareke.	0.2	20	0.5	0.85	2.63	0.88	4.36
20	*Medicago laciniata* (L.) Mill.	0.4	30	0.75	1.71	3.95	1.32	6.98
21	*Pupalia lappacea* (L.) Juss.	0.3	30	4.5	1.28	3.95	7.91	13.14

Table 73. Phytosociological attributes of *Fagonia-Zizyphus-Saccharum* community recorded at Sarki Lawager during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.6	40	0.52	5.45	5.8	1.97	13.22
2	*Acacia nilotica* (L.) Delice.	0.2	20	0.4	1.82	2.9	1.51	6.23
3	*Monotheca buxifolia* (Falc.) A.D.	0.3	20	0.42	2.73	2.9	1.59	7.22
4	*Zizyphus maurtiana* Lam.	1	90	0.95	9.09	13	3.59	25.7
Shrubby Layer								
5	*Calotropis procera* (Wild) R.Br.	0.5	20	0.12	4.55	2.9	0.45	7.9
6	*Capparis decidua* (Forssk). Edgeworth.	0.7	50	0.2	6.36	7.25	0.76	14.37
7	*Periploca aphylla* Decne.	0.4	40	0.24	3.64	5.8	0.91	10.35
8	*Rhazya stricta* Decne.	0.6	50	0.25	5.45	7.25	0.95	13.65
9	*Saccharum spontaneum* L.	1.1	50	0.3	10	7.25	1.13	18.38
10	*Withania coagulans* (Stocks) Dunal.	0.3	30	0.18	2.73	4.35	0.68	7.76
11	*Zizyphus nummularia* (Burm.f) W & A.	0.2	20	0.12	1.82	2.9	0.45	5.17
Herbaceous layer								
12	*Achyranthus aspera* L.	0.2	20	3	1.82	2.9	11.3	16.02
13	*Boerhavia diffusa* L.	0.3	30	4.5	2.73	4.35	17	24.1
14	*Cenchrus biflorus* Hook. f.	1.1	30	3.25	10	4.35	12.3	26.65
15	*Cymbopogon jwarancusa* (Jones.) Schult.	0.1	10	1.5	0.91	1.45	5.67	8.03
16	*Cynodon dactylon* (L.) Pers.	2	40	1	18.2	5.8	3.78	27.78
17	*Echinops echinatus* D.C.	0.3	30	2	2.73	4.35	7.56	14.64
18	*Fagonia cretica* L.	0.5	50	6.25	4.55	7.25	23.6	35.4
19	*Malva neglecta* Wallr.	0.6	50	1.25	5.45	7.25	4.73	17.43

Table 74. Phytosociological attributes of *Zizyphus-Aerua-Capparis* community recorded at Shnawa during winter, Tehsil Takht-e-Nasrati, Karak.

S. No	Species	Community attributes						
		D	F	C	RD	RF	RC	IV
Tree layer								
1	*Acacia modesta* Wall.	0.5	40	0.13	4.85	6.25	0.92	12.02
2	*Prosopis juliflora* (Sw.) DC.	0.2	20	0.05	1.94	3.13	0.35	5.42
3	*Zizyphus maurtiana* Lam.	2.6	100	1.3	25.2	15.6	9.23	50.03
Shrubby layer								
4	*Capparis decidua* (Forssk). Edgeworth.	0.7	70	0.27	6.8	10.9	1.92	19.62
5	*Capparis spinosa* L.	2.1	90	0.62	20.4	14.1	4.4	38.9
6	*Punica granatum* L.	1	80	0.33	9.71	12.5	2.34	24.55
7	*Rhazya stricta* Decne.	0.4	40	0.14	3.9	6.25	0.99	11.14
Herbaceous layer								
8	*Aerua persica* (Burm.f.) Merrill.	0.6	60	4	5.83	9.4	28.4	43.63
9	*Boerhavia diffusa* L.	0.5	50	2.5	4.85	7.81	17.7	30.4
10	*Cenchrus biflorus* Hook. f.	1.4	60	2.75	13.6	9.4	19.5	42.5
11	*Ipomoea hederacea* (L.) Jacq.	0.2	20	0.5	1.94	3.13	3.55	8.62
12	*Malva neglecta* Wallr.	0.1	10	1.5	0.97	1.56	10.6	13.13

4.5.2. Degree of Similarity

Degree of similarity is exercised in connecting two plant communities that permits them to join into a plant association; but shows the occurrence or lack of species although it does not explain the plant life potential. Degree of similarity is critical and an important mechanism of plant life study and examination of an area structure. Comparison of community succession of different area provides data on occurrence, development, humanity and plant life in the area. Similarity of plant communities normally is the occurrence of present individuals from which all possibility about population dynamics should be important. Similarity of a plant life with respect to species in an area is a necessary prerequisite for determination. Similarity is of importance in communities and plant life analysis. Diversity or the distribution of a particular plant life of a region can easily be determined by degree of similarity. In present investigation, plant life similarity was determined in 3 seasons i.e. spring, summer and winter. In each seasons 22 communities were found in 22 sites and 4 stands on the basis of altitude and position of plant life. The degree of similarity in each season is expressed in percentage as below:

A. Spring

The highest similarity in spring was reported in *Aerua–Saccharum-Zizyphus* community and *Aerua–Rhazya-Acacia* community (69.57%). Based on similarity indices, 15 plant communities showed similarity above 50%. The remaining communities had less than 50 % similarity among themselves (Table 75).

B. Summer

Similarity of communities was high with in stand while low when it was compared with other stands. High similarity was reported between *Calligonum-Cenchrus-Zizyphus* community and *Eragrostis-Saccharum-Zizyphus* community (77.94%) and total 10 plant communities showed similarity above 65% while others are low than 65% (Table 76).

C. Winter

Eight plant communities showed similarity above 60% In winter. The highest similarity (64.94%) was reported between *Cenchrus-Saccharum-Zizyphus* community and *Cenchrus-Saccharum-Acacia* community while others were below 60%.

All communities has less than 65% similarity which show that the habitat different with respect to soil, nutrients, topography and social interaction during winter. It is also noticed that the hilly area i.e. stand 3 & 4 was under heavy biotic pressure. The grazing rate, cutting of trees and collection of medicinal plant was high in stand 3 and 4 (Table 77). In winter, similarity among communities was also low in hilly area due to the high grazing rate. Because the area was semi arid and water quantity was very low in addition to people totally depends on natural plants.

A similarity index does not show the relative abundance of species. It is most useful when major interest lies in the presence or absence of species. Degree of similarity between two plant communities allows combining them into an association or vegetation types. It reduce the higher number of plant communities into few similar vegetation types. In the investigated area there were 22 plant communities in spring, summer and winter respectively. Based on similarity indices, 2 plant communities in spring, showed similarity above 60% which includes between ASZ & ARA (69.57%), FPC & FWZ (63.33%) while 13 plant communities in spring showed similarity above 50% included PSS and PSS (59.74%), APA & ZAC (58.6%), AAC & ZAC (58 .59%), FWZ & DWZ (57.73%), PSS & PPA (57.36%), ZAC & ZCF (56.38%), EZC & DWZ (56.3%), ZSC & ZCF (56.02%), FPS & PPA (55.8%), CRZ & ASZ (54.67%), ZSC & ZCS (53.29%), FZS & ASC (52.7%) and ASC & CZS (50.54%).

In summer, 10 plant communities showed similarity above 65% which includes ESZ & CCZ (77.94%), TAS & ESZ (69.06%), CCZ & TAS (67.69%), SZC & ZCS (67.43%), ZCS & CCZ (66.64%), ZCS & ZCS (65.71%), BAC & BZC (68.65%), ZCS & TAS (65.39%), CTZ & TAS (65.36%) and SZC & ZCS (65.23%). In winter, 8 plant communities showed similarity above 60% included CSA & CSZ (64.94%), CZS & CCA(64.91%), CPP & CSP (64.82%), CZS & CPS (64.14%), CSP & CSP (62.54%), CCA & CSA (62.11%) and ZCC & CCA (60.46%).

The high similarities between the communities might be due to similarity in altitude, nutrients, proximity of stands to each other, which almost had similar habitat condition in terms of nutrients such as potash, phosphorous and soil textures.

The least similarity among the communities was due to change in altitude, climatic, edaphic and biotic condition, such as erosion, soil differences such as silty loan to sandy loam, pH, EC, nitrates, overgrazing, trampling and deforestation. Such differences cause changes in nutrient status and low relationship of habitat and thus species. Malik (2005) and Peer *et al.* (2007) reported similarities between plant communities illustrated high differences among themselves due to the difference in altitude and biotic factors. The similarity during spring and winter might be due to the presence of perennial evergreen shrubs and herbs. The communities in which dominant plant life consist of therophytes illustrated low similarities. Our findings are similar with those of Malik & Hussain (2006), Shaheen & Qureshi (2011) and Shaheen *et al*. (2011) who reported that plant communities, differs from one another due to topography, exposure, erosion and biotic factors.

Table 75. Comparative indices of similarities between communities in spring of Tehsil Takht-e-Nasrati, Karak.

Stand		1				2							3							Stand 4			
		PSS	PSS	FPS	PPA	FZC	ASC	ZSC	CZS	ZAC	ZCF	ZCS	CRZ	ASZ	SZR	FPC	FWZ	APA	AAC	EZC	ARA	DWZ	ZAC
1	PSS																						
	PSS	59.74																					
	FPS	49.51	41.69																				
	PPA	57.36	43.49	55.8																			
2	FZC	43.05	43.05	44.59	43.3																		
	ASC	39.5	34.87	27.66	29.87	52.7																	
	ZSC	46.52	38.88	32.16	37.49	45.82	44.8																
	CZS	45.76	38.11	25.78	35.02	48.81	50.54	45.63															
	ZAC	41.05	43.19	38.05	38.85	36.1	35.17	32.1	33.22														
	ZCF	37.7	32.49	38.1	49.6	40.05	31.53	56.02	41.37	56.38													
	ZCS	44.25	35.25	30.2	38.17	46.65	40.88	53.29	48.1	36.92	42.74												
3	CRZ	16.63	21.5	31.17	29.61	35.14	19.6	24.87	27.33	22.68	25.57	23.3											
	ASZ	24.17	28.75	24.06	27	34.4	22.78	34.91	23.49	12.67	21.59	29.667	54.67										
	SZR	17.33	13.83	22.89	19.3	29.23	20.12	34.82	25.35	20	29.37	32.333	43.33	37.33									
	FPC	22.97	39.26	34.88	25.29	45.27	19.98	33.43	25.67	26.9	20.8	23.3	43.67	46.33	32.33								
	FWZ	19.06	21.09	34.05	23.14	41.27	15.03	33.74	28.45	27.9	22.99	25.333	47.53	48.07	46.33	63.33							
	APA	22.3	24.98	23.35	23.12	35.67	20.41	23.62	18.97	26.13	14.02	19.567	36.13	49	29.73	45.2	47.53						
	AAC	12.87	17.09	16.03	17.46	22.95	12.6	17.9	24.42	24	13.04	20.667	39.33	40	30.33	44.67	45.4	55.07					
4	EZC	25.14	14.5	26.49	24.75	35.98	22.85	47.5	31.99	21.38	36.01	44.233	44.33	46.4	47.8	53.27	47.5	39.2	42.77				
	ARA	21.43	24.56	19.99	21.24	34.71	21.41	27.17	23.71	18.7	17.21	29.533	52.4	69.57	40.07	52.93	50.63	59.8	47.97	50.8			
	DWZ	15.09	20.25	31.72	29.11	43.5	20.45	40.41	27.67	20	25.47	26.667	43.67	53.33	48	56.67	57.73	47.27	39.33	56.3	48.6		
	ZAC	14.52	21.54	17.05	15.82	26.85	11.78	33.73	24.56	33.89	21.42	31.37	35.35	35.83	37.18	43	48.92	58.6	58.59	52.31	45.4	42.01	

Key: PSS: *Prosopis- Saussurea-Saccharum* community, PSS: *Phoenix -Saussurea -Saccharum* community, FPS: *Fagonia-Prosopis-Saccharum* community, PPA: *Prosopis -Periploca -Aerua* community, FZS : *Fagonia- Zizyphus- Saccharum* community, ASC : *Acacia-Saccharum-Citrullus* community, ZSC : *Zizyphus-Saccharum-Cynodon* community, CZS **:** Calligonum-*Zizyphus-Saussurea* community, ZAC : *Zizyphus-Aerua*-Calligonum community, ZCF : *Zizyphus-Calligonum-Fagonia* community, ZCS : *Zizyphus-Cenchrus-Saccharum* community, CRZ: *Cymbopogon -Rhazya – Zizyphus* community, ASZ : *Aerua-Saccharum-Zizyphus* community, SZR : *Salvia-Zizyphus-Rhazya* community, FPC: *Fagonia-Phoenix-Capparis* community, FWZ : *Fagonia -Withania- Zizyphus* community, APA : *Aerua-Punica-Acacia* community, AAC : *Aerua-Acacia-Capparis* community, EZC: *Eragrostis-Zizyphus-Capparis* community, ARA : *Aerua-Rhazya-Acacia* community, DWZ: *Dichanthium -Withania-Zizyphus* community, ZAC:*Zizyphus-Aerua-Capparis* community,

Table 76. Comparative indices of similarities between communities in summer of Tehsil Takht-e-Nasrati, Karak.

Stand		1				2							3							4			
		ECP	PSC	APS	TPS	ESZ	TAS	ZCS	CTZ	CCZ	ZCS	SZC	CRZ	SCZ	FRZ	CPC	CCZ	CAA	BAC	EZC	AAC	TPZ	BZC
1	ECP																						
	PSC	36.79																					
	APS	42.81	53.59																				
	TPS	44.52	55.53	52.83																			
Stand 2	ESZ	49.47	50	45.48	46.65																		
	TAS	46.83	60.28	42.28	55.27	69.06																	
	ZCS	41.79	38.36	41.52	47.98	55.84	53.87																
	CTZ	42.31	48.14	38.4	57.45	60.53	65.36	41.69															
	CCZ	41.46	46.38	46.34	47.42	77.94	67.69	58.08	63.27														
	ZCS	37.79	44.61	43.36	42.49	64.62	65.39	65.71	48.73	66.64													
	SZC	54.52	44.92	51.01	53.33	62.57	57.86	61.09	48.32	67.43	65.23												
Stand 3	CRZ	23.01	26.35	34.11	26.67	29.22	23.51	24.43	31.12	31.96	22.2	41											
	SCZ	30.56	44.41	35.18	30.94	37.48	35.09	38.43	36.54	34.4	26.87	41.73	52										
	FRZ	21.88	20.31	28.43	30.8	31.86	30	27.93	36.56	33.05	36.35	37.09	51.53	38.53									
	CPC	32.06	31.05	29.18	29.93	38	30.69	32.79	25.04	37.04	29.48	41.8	40.15	31.28	41.2								
	CCZ	35.34	31.39	31.89	30.29	40.07	34.55	41.37	31.7	38.42	37.66	43.98	44.7	30.14	51.71	43.11							
	CAA	22.79	34.15	37.77	34.78	33.83	42.05	36.52	26.95	31.16	20.19	32.9	40.76	54.74	31.49	41.72	34.98						
	BAC	9.95	30.25	23.13	30.91	17.89	29.36	18.87	26.38	18.55	12.13	18.2	22.44	36.27	20.16	28.62	22.17	59.34					
Stand 4	EZC	39.85	32.3	32.16	43.03	42.08	26.34	47.59	47.59	46.12	47.49	57.53	33.48	36.18	39.94	41.72	45.61	30.8	37.3				
	AAC	24.11	32.28	35.61	34.94	32.42	36.44	33.21	34.51	36.6	27.07	43.45	40.35	51.83	33.17	49.53	35.26	61.9	59.68	49.17			
	TPZ	25.52	36.49	41.78	46.03	36.88	22.55	42.13	42.42	35.67	25.91	43.18	45.19	34.05	33.51	43.34	45.23	48.61	35.56	45.42	46.52		
	BZC	15.47	31.33	24.46	31.02	20.2	18.74	28.23	22.57	21.26	27.01	21.93	17.48	25.52	17.56	23.48	29.47	46.24	68.65	41.06	50.96	31.03	

1: *Eragrostis-Calotropis-Prosopis* community (ECP), 2: *Phoenix-Saccharum-Cenchrus* community (PSC), 3: *Aerua-Prosopis-Saccharum* community (APS), 4: *Tribulus-Tamarix -Saccharum* community (TTS),5: *Eragrostis-Saccharum-Zizyphus* community (ESZ), 6: *Tribulus-Acacia-Saccharum* community (TAS), 7: *Zizyphus-Cenchrus-Saccharum* community (ZCS), 8**:** *Calligonum Tribulus-Zizyphus* community (CTZ), 9: *Calligonum-Cenchrus-Zizyphus* community (CCZ), 10: *Zizyphus-Cenchrus-Saccharum* community (ZCS), 11: *Saccharum-Zizyphus-Cynodon* community (SZC), 12: *Cymbopogon-Rhazya-Zizyphus* community (CRZ),13: *Saccharum- Cymbopogon-Zizyphus* community (SCZ),14: *Fagonia-Rhazya-Zizyphus* community (FRZ), 15: *Cleome-Phoenix-Capparis* community (CPC), 16: *Cenchrus-Cassia-Zizyphus* community (CCZ), 17: *Capparis-Aerua-Acacia* community (CAA), 18: *Boerhavia-Acacia-Capparis* community (BAC), 19: *Eragrostis-Zizyphus-Capparis* community (EZC), 20: *Aerua-Acacia-Capparis* community (AAC), 21: *Tribulus-Periploca-Zizyphus* community (TPZ), 22: *Boerhavia-Zizyphus-Capparis* community (BZC)

Table 77. Comparative indices of similarities between communities in winter of Tehsil Takht-e-Nasrati, Karak.

Stand		1				2							3							4			
		CSP	CSP	CPS	CPP	CSZ	CSA	ZCS	CCZ	CCA	ZCC	CZS	CRZ	AAZ	CRZ	PFC	CZF	CAA	AAC	ZCP	ACA	FZS	ZAC
1	CSP																						
	CSP	62.54																					
	CPS	52.08	58.82																				
	CPP	64.82	54.47	59.94																			
2	CSZ	57.8	57.61	52.26	56.69																		
	CSA	63.74	57.67	47.71	53.42	64.94																	
	ZCS	52.44	48.8	38.71	43.17	56.72	55.4																
	CCZ	36.99	33.57	27.94	38.86	50.66	43.58	36.27															
	CCA	52.39	51	50.77	49.92	51.1	62.11	41.06	40.66														
	ZCC	47.08	41.44	52.4	54.85	52.72	50.78	57.82	43.26	60.46													
	CZS	55.4	54.18	64.14	58.17	59.07	59.07	54.27	34.75	64.91	59.61												
3	CRZ	19.6	18.08	22.44	15.81	21.41	14.57	18.9	19.85	16.04	13.81	25.57											
	AAZ	24.76	29.21	25.46	18.12	30.63	19.37	28.66	26.04	17.22	18.36	27.5	47.65										
	CRZ	35.54	39.37	46.7	42.05	44.94	40.23	40.08	37.26	42.3	44.7	47.72	38.31	32.41									
	PFC	29.37	36.89	35.23	28.7	39.73	26.09	28.44	29.48	18.3	26.87	32.33	29.84	35.91	44.06								
	CZF	22.13	16.08	20.24	20.14	28.18	19.78	35.05	25.74	19.33	32.31	31.19	34.52	25.98	53.81	44.38							
	CAA	24.53	20.38	21.01	25.75	36.08	21.64	30.7	31.45	16.74	21.66	31.66	32.52	40.61	26.46	39.61	32.46						
	AAC	8.537	9.653	11.87	13.1	17.63	16.6	10.18	27.2	10.22	9.34	12.85	19.3	33.69	16.87	29.78	24.96	46.78					
4	ZCP	25.08	21.2	14.36	22.35	30.98	25.2	39.56	37.48	20.08	30.78	32.89	24.98	36.39	38.72	44.67	40.99	31.84	27.66				
	ACA	15.72	20.32	21.21	17.18	27.58	25.4	23.76	26.17	19.82	21.51	25.84	34.19	46.92	32.9	39.62	31.7	50.5	52.95	43.43			
	FZS	27.26	20.07	25.45	28.16	31.39	25.24	35.34	40.36	23.28	30.35	29.18	28.38	29.19	35.5	47.04	50.87	38.37	35.11	44.53	39.02		
	ZAC	17.83	23.82	23.58	24.12	29.25	21.35	33.63	25.17	25.07	33.5	26.97	17.72	29.17	30.53	31.57	32.49	45.69	57.05	37.67	46.7	42.34	

1: *Cenchrus-Calotropis-Prosopis* community (CCP), 2: *Cenchrus-Saccharum-Phoenix community* (CSP), 3: *Zizyphus-Peganum-Saccharum* community (ZPS), 4: *Cenchrus-Periploca-Prosopis*-community (CPP), 5: *Cenchrus-Saccharum-Zizyphus* community (CSZ), 6: *Cenchrus-Saccharum-Acacia* community (CSA), 7: *Zizyphus-Cenchrus-Saccharum* community (ZCS), 8: *Saccharum-Cenchrus-Zizyphus* community (SCZ), 9: *Cenchrus-Calligonum-Acacia* community (CCA), 10: *Zizyphus-Cenchrus-Calligonum* community (ZCC), 11: *Cenchrus-Zizyphus-Saccharum* community (CZS), 12: *Cymbopogon-Rhazya-Zizyphus* community (CRZ), 13: *Astragalus-Aerua-Zizyphus* community (AAZ), 14: *Cenchrus-Rhazya-Zizyphus* community (CRZ), 15: *Phoenix-Fagonia-Capparis* community (PFC), 16: *Cassia-Zizyphus-Fagonia* community (CZF), 17: *Capparis-Aerua-Acacia* community (CAA), 18: *Aerua-Acacia-Capparis* community (AAC), 19: *Zizyphus-Capparis-Phragmites* community (ZCP), 20: *Aerua-Capparis-Zizyphus* community (ACZ), 21: *Fagonia-Zizyphus-Saccharum* community (FZS), 22: *Zizyphus-Aerua-Capparis* community (ZAC)

4.5.3. Biodiversity of Plant Species

The assortment and changeability along with existing organisms and the biological difficulties where those happen is called biological diversity. Diversity index, species richness and equitability in different seasons are given below:

A. Spring

In stand 1, the diversity index (2.908), species richness (4.397) and equitability (0.927) were found high in PSS. In stand 2, the diversity index (3.097) and species richness (5.634) was high in FZS while equitability value was high (0.957) in CZS. In stand 3, the diversity index (2.899), species richness (3.917) and equitability (0.952) were high in APA. The diversity index (2.757) and species richness (4.008) was high in ARA while equitability (0.919) was high in DWZ in stand 4 (Table 78).

B. Summer

The highest diversity index (2.63) and species richness (3.11) was found in APS and high equitability value (0.91) was also similar in all communities except ECP (0.89) in stand 1. In ESZ the diversity index (2.79) and species richness (3.85) were high while in SZC, the equitability value was high (0.89) in stand 2. Stand 3 had the higher diversity index (2.8) and species richness (3.73) in CPC whereas equitability value was high (0.91) in BAC. In stand 4, the diversity index (2.72) and species richness (3.55) was found high in AAC and TPZ respectively while the highest equitability (0.92) was found in BZC and TPZ (Table 79).

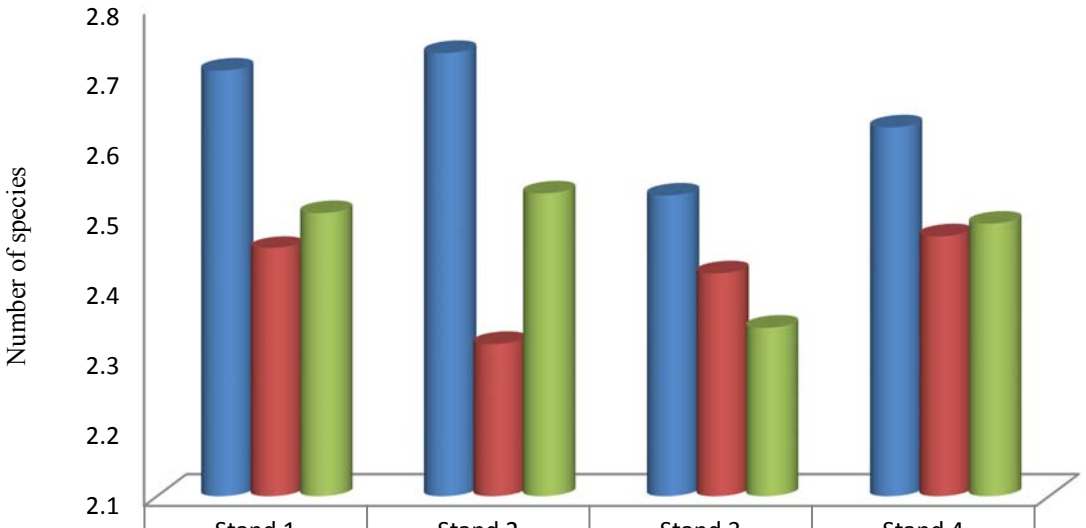
C. Winter

The diversity index (2.689) and species richness (5.752) were high in CPP while equitability value was high (0.831) in CPS in stand 1. In stand 2, the diversity index (2.708) and species richness (5.241) were high in CSZ whereas high equitability (0.822) was originated in CZS. Diversity index, species richness and equitability were high (2.825), (4.255) and (0.901) respectively in CAA within stand 3. In stand 4, the highest diversity index (2.695), species richness (3.829) and equitability (0.915) were found in FZS (Table 80).

Species richness is the total numbers of species present in a given region. Whereas diversity shows the relation how individuals are scattered amongst

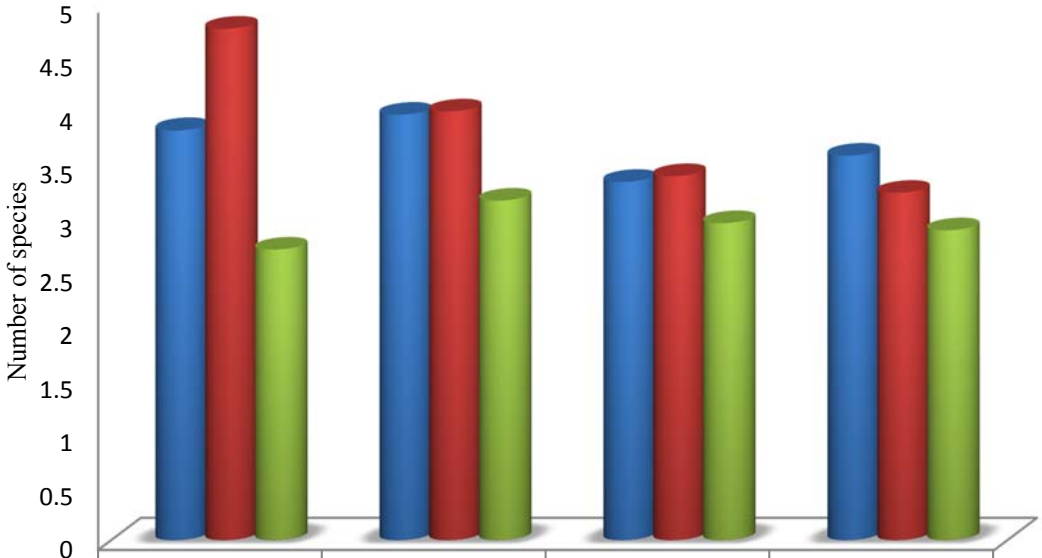
those species. In fact, it turns out that nearly all quantitative measures of diversity are some combination of two components, species richness and evenness, where evenness describes how equally individuals are distributed amongst the species. The present study shows clearly that during spring the species diversity increased in all the stands, it declined in summer in all stands except in stand 3 whiche low species diversity in winter (Fig. 27). The deviation of plants restricted by a particular region submitted to biodiversity. During this study, four stands divided into 22 sites throughout 3 seasons and were assessed for species diversity, species richness and Equitability in investigated area by using quadrat method. The Diversity Index, species richness and equitability is a measure of the biodiversity of a group of organisms in an area. The highest value of species diversity (3.097) was found at *Fagonia-Zizyphus-Saccharum* community in spring and lowest value (1.75) was found in winter at *Cenchrus-Calligonum-Acacia* community. The highest value (5.752) of species richness was found at *Cenchrus-Periploca-Prosopis* community in winter and the lowest value (2.08) in *Tribulus-Periploca-Zizyphus* community in summer (Fig. 28).The highest equitability value (0.957) was found at *Calligonum-Zizyphus-Saussurea* community in spring and lowest value (0.575) was originate in winter at *Fagonia–Zizyphus-Saccharum* community (Fig. 29).

A small number of the majority receptive species are misplaced primary as native plants vanished by invasive species. As the quantity of invasive plants raises the species diversity leaves away. Due to the smaller quantity varieties and figures of native plants the species diversity goes down because the diversity of species is not similar from group to group and from region to region. In other words, the species diversity was increased when some environments are more assorted than others. The most diverse area was southern area of Bogara in spring season due to the high species diversity (3.097). The high diverse habitat is healthiest. The weak habitat is present in Jahangeri Banda during winter due to the lowest species diversity (1.75). The high species diversity in the southern area of Bogara and Jahangeri Banda showed that their vegetation was more stable.



	Stand 1	Stand 2	Stand 3	Stand 4
Spring	2.707	2.732	2.53	2.627
Summer	2.454	2.318	2.418	2.472
Winter	2.505	2.533	2.341	2.49

Fig. 27. Species diversity in different seasons in various stands, Tehsil Takht-e-Nasrati, Karak.



	Stand 1	Stand 2	Stand 3	Stand 4
Spring	3.823	3.966	3.345	3.59
Summer	4.769	3.997	3.399	3.243
Winter	2.713	3.17	2.96	2.893

Fig. 28. Species richness in different seasons in various stands, Tehsil Takht-e-Nasrati, Karak.

For biological diversity, these items are organized at many levels, ranging from complete ecosystems to chemical structures that are the molecular basis of heredity. Thus the term covered species, genes, diverse ecosystems and their virtual plenty (OTA, 1987). One characteristic attribute to multi-species populations is diversity, also probably one of the most misused and incorrectly calculated attributes. Perhaps the commonest misconception is that species richness and diversity are synonymous. The equitability was high in stand 1 and 4, in winter while in stand 2 and 3, the equitability was high in spring. The equitability was diverse at different vicinity due the region physiographic. The equitability was high at lowest and highest zones while it was low at between the lowest and highest zones. The range of diversity measures, species diversity, species richness and evenness available help skillfully in evaluating the biodiversity of the entire habitats. This study pointed out that the climatic environment of region has privileged conscription of area and its correlates in the climax development more than an extensive succession progression and the area administration was supposed to heart on area and its correlates for preserving diversity of this shelter. So, the biological diversity can be defined as the assortment and changeability along with existing organisms and the biological difficulties where they happen.

Diversity of plant species reflects the nature of plant life and its biomass. Index of diversity is the measure of complexity of structure and function with in a community. Shaukat *et al*. (1978) stated that specific dimension of species diversity leads to understanding the processes involved in the developmental alteration and the relationship of communities. Species diversity is a function of the number of species present in a given area of the evenness with which the individual are distributed among species. Willoughby (1996) observed that the species diversity of an area is the reflection of diverse factors i.e. deforestation, overgrazing, environmental stress and tendency of species to those factors, which lowers species diversity. Ohsawa *et al*. (1973) stated that species diversity is restricted not only by habitat condition but also by the interaction of module species. Franklen & Merlin (1992) reported low woody species diversity in Forest of Cook Island. Green & Kauffman (1995) reported that in ungrazed dry meadow communities, species diversity and richness is low as compared to grazed communities. In the most heavily grazed communities, grazing disturbances increased nonpalatable and

competitive poisonous species. Pressure of herbivory on species evenness and diversity differ from one plant community to another. It was observed that in spring there was high species diversity in the lower altitude (stand 1 and 2) due to more species while diversity was low at higher altitude (stand 3 and 4) due to few numbers of species. Similar results were reported by Malik (2005) in Bedori hills (Azsd Kashmir). In spring diversity was positively associated with species maturity and richness as well as negatively associated with equitability, while in summer and winter diversity was positively correlated with species equitability, richness and species maturity.

The investigated area is under harsh grazing stress, deforestation in addition to soil and wind erosion. Low species diversity in Tehsil Takht-e-Nasrati is due to deforestation, overgrazing, soil erosion, elimination of medicinal plants and dry existing environmental conditions. In open plant life, sun loving or tolerant species, which require low moisture, low humidity might do improved. In investigated sites few species can compete and complete their life cycle while, those, which necessitate healthier habitat in term of shade, light, moisture are usually expelled. This reduced the species diversity as number of sciophytes reduced. Our finding agrees with Malik *et al*. (2010). In present study, trampling, overgrazing, temperature, deforestation, rainfall and soil erosion might be some of the factor, which reduced species diversity. Danin (1999) described that species diversity increased with increasing the humidity. A strong altitudinal differentiation with a marked maximum diversity at stand 2 into spring was observed in investigated area.

A visible irregularity of species diversity in plain area i.e. stand 1 & 2 seems to be related to relief climatic factor. In this area phytography exposed ecological changes during the past 40 years. Similarly, the present results show that species diversity and richness was high in plain area while lowest in hilly area (Fig. 30). At plain area diversity changed due to climatic factors i.e. temperature, humidity and rainfall. Zhao *et al*. (2005) stated that altitudinal rise was the primary factor in shaping the spatial pattern of plant species. Saxena *et al*. (1982, 1987) illustrated that with increasing altitude the average tree height decreased. In our result altitude is a main factor changes the species diversity from low to high. The species diversity was low due to less number of species in higher altitude and high species diversity in lower altitude due to high number of species.

Malik *et al*. (2006) reported high species diversity in the upper area while low diversity at lower altitude in Dao Khan. Dastagir *et al*. (1999) stated that index of diversity and its components equitability, species maturity decreased from low altitude to high altitude. In the study area, the conclusion are concentrated in hilly area i.e. stands 3 & 4 except species richness which not agree with the former review. Hussain *et al*. (2000) stated that challenging environmental situation also reduced species diversity. In present study, stand 2 & 4 are characterized by severe climatic condition. In plain area i.e. stands 1 & 2 the species diversity increased while in hilly area i.e. stand 3 & 4 the species diversity decreased. Overgrazing in area has restricted species diversity especially in summer.

The present result agrees with Singh *et al*. (2005) who described that species biomass turn downed with loss of species diversity. Species diversity had close relationship with rainfall and soil nature. Soil depth decreased at the altitude increased (Dolezal & Srutek, 2002). A community having a small number of individuals of many species will have a high diversity as compared to a community having the same number of individual having limited number of species. Malik & Malik (2004) examined that in Kotli hills species diversity was low in the higher elevation and high diversity in the lower elevation due to low precipitation and high temperature. Townsend *et al*. (2000) declared that species richness increases as climatic differences decrease. High biomass is interrelated with a broad range of existing resources, it expresses increase in species richness. The species richness was highest during spring that decreased during summer and winter. In spring, there was plenty of annual plant species due to which species richness increased while in summer most of the annual plant species disappeared that decreased species richness. The higher value of species richness was recorded for communities of stand 1, which had relatively optimum climatic conditions between lower altitudes.

Parthsarathy & Karthikeyan (1997) reported that species richness, diversity and diversity indices constantly declined with increasing size classes of woody species ranging form 30-180 cm belt. In our case species richness and diversity indices from 32 – 280 cm belt constantly decreased with increasing size classes of woody species richness of all vascular plants revealed a relationship with altitude. Henrick *et al*. (2006) stated that pattern in species richness results from declining species limitation and

decreasing concentration of competition with altitude. Hurka & Keinrich (2004) stated that the species richness increased after 15 years and decreased significantly in older plots during sylvigenesis in a tropical dry forest in northwestern Costa Rica. The present study showed that vegetation of dry habitat was irregular and comprehensive in distribution and this might be the reason that low value for species richness occurred. Dolezal & Srutek (2002) described that the horizontal compositional heterogeneity increased in area where tree were aggregated and tree basal area was smaller plant life composition becomes more irregular at open canopy.

Some times there were increase or decrease in species richness i.e. species richness may be high at intermediate levels of biomass. In some cases, it has been possible to relate species richness to the spatial heterogeneity of the abiotic environment. West (1993) stated that the equitability resource is the relative abundance of component taxa and is important to land than richness in vegetation. In our result spring communities showed more equitability value than summer and winter communities. This is due to the reason that annuals were in abundance in spring It showed that equitability value has significant positive connection with maturity index. Shaukat & Khan (1979) observed that a high equitability may result in highly stable position over an extended period of time.

In spring most of the community could not bring animal for grazing due to agriculture. Therefore, the species richness was increased during spring in stand 1 & 2 because these were plain area and the community cultivated habitually gram and wheat in the area (Fig. 31). In stand 3 & 4, the species richness was typically comparable in all seasons since the part was hilly and the majority of the society brings their cattle to the hills. The occupation of the populace in this area was domestic animals trader. For that reason the people use these hills as usual grassland in all seasons (Fig. 32). Jesson (2007) illustrated that ecological traits might influence species richness in Newzaland. He suggested that regional differences in community processes can influence speciation or extinction. Ohlemuller *et al.* (2006) observed that local species richness also varies significantly across a location, suggesting that limited factors may be more significant than those performing at larger scale.

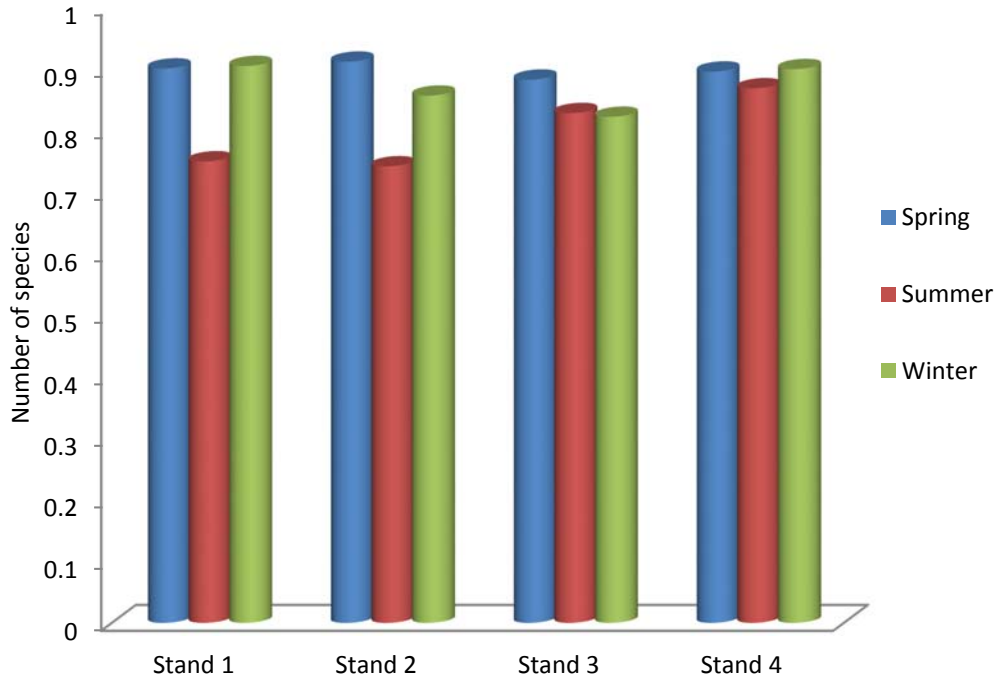


Fig. 29. Equitability of species in different seasons in various stands, Tehsil Takht-e-Nasrati, Karak.

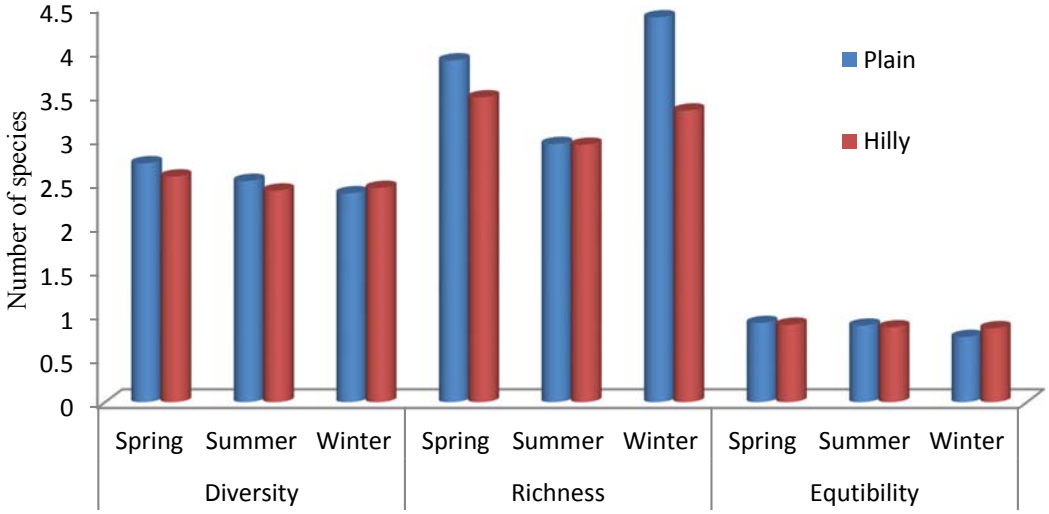


Fig. 30. Mean species diversity, richness and equitability of plant in the plain and hilly areas of Tehsil Takht-e-Nasrati, Karak.



Fig. 31. Cultivation of gram and wheat in the plain area of Tehsil Takht-e-Nasrati, Karak.



Fig. 32. Hills sides serve as grasslands that show increase of non palatable plants like *Calotropis procera* and *Rhazya stricta* due to overgrazing in Tehsil Takht-e-Nasrati, Karak.

Table 78. Diversity parameters of plants during spring in Tehsil Takht-e-Nasrati, District Karak.

Stands	Sites	Communities	S	N	Pi	Species diversity		Species Richness			Equitability	
						lnPi	H	S-1	lnN	(S-1)/lnN	lnS	H/lnS
1	Tater Khel	PSS	23	149	1	-77.35	-2.91	22	5	4.4	3.14	-0.93
	Gardi Banda	PSS	17	139	1	-54.37	-2.45	16	4.93	3.24	2.83	-0.86
	Ahmad Abad	FPS	21	170	1	-69.27	-2.77	20	5.14	3.89	3.04	-0.91
	Warana	PPA	20	149	1	-65.64	-2.7	19	5	3.8	3	-0.9
2	S Bogara	FZS	30	172	1	-111.4	-3.1	29	5.15	5.63	3.4	-0.91
	N Bogara	ASC	24	147	1	-82.77	-2.87	23	4.99	4.61	3.18	-0.9
	Gandiri Khattak	ZSC	17	104	1	-51.65	-2.62	16	4.64	3.45	2.83	-0.92
	Kiri Dhand	CZS	20	112	1	-62.37	-2.87	19	4.72	4.03	3	-0.96
	Jahangiri Banda	ZAC	17	129	1	-52.73	-2.55	16	4.86	3.29	2.83	-0.9
	Mona Khel	ZCF	17	148	1	-54.74	-2.43	16	5	3.2	2.83	-0.86
	Jarassi	ZCS	18	120	1	-55.38	-2.7	17	4.79	3.55	2.89	-0.93
3	Chokara	CRZ	19	135	1	-64.77	-2.43	18	4.91	3.67	2.94	-0.83
	Ambiri Kala	ASZ	19	160	1	-63.32	-2.61	18	5.08	3.55	2.94	-0.89
	Takht-e- Nasrati	SZR	16	136	1	-50.81	-2.37	15	4.91	3.05	2.77	-0.86
	Siraj khel	FPC	20	158	1	-66.52	-2.64	19	5.06	3.75	3	-0.88
	Shahidan Banda	FWZ	15	164	1	-45.38	-2.43	14	5.1	2.75	2.71	-0.9
	Zarki Nasrati	APA	21	165	1	-67.07	-2.9	20	5.11	3.92	3.04	-0.95
	Shawa	AAC	14	116	1	-41.34	-2.33	13	4.75	2.73	2.64	-0.88
4	Kandu Khel	EZC	19	153	1	-62.59	-2.63	18	5.03	3.58	2.94	-0.89
	Shadi Khel	ARA	23	242	1	-81.94	-2.76	22	5.49	4.01	3.14	-0.88
	Sarki Lawager	DWZ	19	126	1	-60.35	-2.71	18	4.84	3.72	2.94	-0.92
	Shnawa	ZAC	15	98	1	-44.88	-2.42	14	4.58	3.05	2.71	-0.89

S = Total species number in community.

N = Total number of Individual in community.

Key:

PSS: *Prosopis- Saussurea-Saccharum* community, PSS: *Phoenix -Saussurea -Saccharum* community,
FPS: *Fagonia-Prosopis-Saccharum* community, PPA: *Prosopis -Periploca -Aerua* community,
FZS : *Fagonia- Zizyphus- Saccharum* community, ASC : *Acacia-Saccharum-Citrullus* community,
ZSC : *Zizyphus-Saccharum-Cynodon* community, CZS : *Calligonum-Zizyphus-Saussurea* community
ZAC : *Zizyphus-Aerua-Calligonum* community, ZCF : *Zizyphus-Calligonum-Fagonia* community,
ZCS : *Zizyphus-Cenchrus-Saccharum* community, CRZ: *Cymbopogon -Rhazya –Zizyphus* community,
ASZ : *Aerua-Saccharum-Zizyphus* community, SZR : *Salvia-Zizyphus-Rhazya* community,
FPC: *Fagonia-Phoenix-Capparis* community, FWZ : *Fagonia -Withania- Zizyphus* community,
APA : *Aerua-Punica-Acacia* community, AAC : *Aerua-Acacia-Capparis* community,
EZC: *Eragrostis-Zizyphus-Capparis* community, ARA : *Aerua-Rhazya-Acacia* community,
DWZ: *Dichanthium -Withania-Zizyphus* community, ZAC: *Zizyphus-Aerua-Capparis* community.

Table 79. Diversity parameters of plants during summer in Tehsil Takht-e-Nasrati, District Karak.

Stand	Sites	Communities	S	N	Species diversity			Species Richness			Equitability	
					pi	lnPi	H	S-1	lnN	(S-1)/lnN	lnS	H/lnS
1	Tater Khel	ECP	15	248	1	-44.6	2.46	14	5.51	2.54	2.71	-0.91
	Gardi Banda	PSC	14	283	1	-41.4	2.36	13	5.65	2.3	2.64	-0.89
	Ahmad Abad	APS	18	235	1	-57.2	2.63	17	5.46	3.11	2.89	-0.91
	Warana	TTS	17	250	1	-53.9	2.57	16	5.52	2.9	2.83	-0.91
2	S Bogara	ESZ	24	394	1	-88.2	2.79	23	5.98	3.85	3.18	-0.88
	N Bogara	TAS	19	524	1	-67.6	2.46	18	6.26	2.87	2.94	-0.84
	Gandiri Khattak	ZCS	17	272	1	-55.3	2.44	16	5.61	2.85	2.83	-0.86
	Kiri Dhand	CTZ	19	295	1	-63.8	2.55	18	5.69	3.17	2.94	-0.87
	Jahangiri Banda	CCZ	21	500	1	-76.8	2.46	20	6.21	3.22	3.04	-0.81
	Mona Khel	ZCS	17	314	1	-58.9	2.4	16	5.75	2.78	2.83	-0.85
	Paki Gudi Khel	SZC	19	185	1	-62.5	2.63	18	5.22	3.45	2.94	-0.89
3	Chokara	CRZ	18	336	1	-66	1.95	17	5.82	2.92	2.89	-0.68
	Ambiri Kala	SCZ	17	307	1	-62.5	2.11	16	5.73	2.79	2.83	-0.74
	Takht-e-Nasrati	FRZ	18	294	1	-63.3	2.34	17	5.68	2.99	2.89	-0.81
	Siraj Khel	CPC	23	367	1	-81	2.8	22	5.91	3.73	3.14	-0.89
	Shahidan	CCZ	15	212	1	-47.7	2.27	14	5.36	2.61	2.71	-0.84
	Zarki Nasrati	CAA	20	236	1	-68.5	2.65	19	5.46	3.48	3	-0.89
	Shawa	BAC	12	150	1	-32.7	2.27	11	5.01	2.2	2.48	-0.91
4	Kandu Khel	EZC	16	249	1	-52.6	2.34	15	5.52	2.72	2.77	-0.85
	Shadi Khel	AAC	20	364	1	-66.4	2.72	19	5.9	3.22	3	-0.91
	Sarki Lawager	TPZ	19	160	1	-61	2.7	18	5.08	3.55	2.94	-0.92
	Shanawa	BZC	11	123	1	-28.9	2.2	10	4.81	2.08	2.4	-0.92

S = Total species number in community.

N = Total number of Individual in community.

Key:

ECP: *Eragrostis-Calotropis-Prosopis* community, PSC: *Phoenix-Saccharum-Cenchrus* community,

APS: *Aerua-Prosopis-Saccharum* community, TTS: *Tribulus-Tamarix -Saccharum* community,

ESZ : *Eragrostis-Saccharum-Zizyphus* community, TAS : *Tribulus-Acacia-Saccharum* community,

ZCS : *Zizyphus-Cenchrus-Saccharum* community, CTZ **:** *Calligonum Tribulus-Zizyphus* community,

CCZ: *Calligonum-Cenchrus-Zizyphus* community, ZCS : *Zizyphus-Cenchrus-Saccharum* community,

SZC : *Saccharum-Zizyphus-Cynodon* community, CRZ : *Cymbopogon-Rhazya-Zizyphus* community,

SCZ : *Saccharum-Cymbopogon-Zizyphus* community, FRZ : *Fagonia-Rhazya-Zizyphus* community,

CPC : *Cleome-Phoenix-Capparis* community, CCZ: *Cenchrus-Cassia-Zizyphus* community,

CAA : *Capparis-Aerua-Acacia* community, BAC : *Boerhavia-Acacia-Capparis* community,

EZC : *Eragrostis-Zizyphus-Capparis* community, AAC : *Aerua-Acacia-Capparis* community,

TPZ: *Tribulus-Periploca-Zizyphus* community, BZC : *Boerhavia-Zizyphus-Capparis* community.

Table 80. Diversity parameters of plants during winter in Tehsil Takht-e-Nasrati, District Karak.

Stands	**Sites**	**Communities**	S	N	**Species diversity**			**Species Richness**			**Equitability**	
					Pi	lnPi	H	S-1	lnN	(S-1)/lnN	lnS	H/lnS
1	Tater Khel	**CSP**	26	216	1	-106.2	2.39	25	5.38	4.65	3.26	0.74
	Gardi Banda	**CSP**	22	204	1	-89.84	2.06	21	5.32	3.95	3.09	0.67
	Ahmad Abad	**CPS**	25	161	1	-93.82	2.68	24	5.08	4.72	3.22	0.83
	Warana	**CPP**	32	219	1	-133.4	2.69	31	5.39	5.75	3.47	0.78
2	S Bogara	**CSZ**	30	253	1	-120.5	2.71	29	5.53	5.24	3.4	0.8
	N Bogara	**CSA**	21	239	1	-82.04	2.15	20	5.48	3.65	3.05	0.71
	Gandiri Khattak	**ZCS**	17	205	1	-63	2.01	16	5.32	3.01	2.83	0.71
	Kiri Dhand	**CCZ**	22	233	1	-79.06	2.53	21	5.45	3.85	3.09	0.82
	Jahangiri Banda	**CCA**	21	317	1	-92.7	1.75	20	5.76	3.47	3.05	0.58
	Mona Khel	**ZCC**	22	223	1	-83.94	2.41	21	5.41	3.88	3.09	0.78
	Jarassi	**CZS**	26	169	1	-97.44	2.68	25	5.13	4.87	3.26	0.82
3	Chokara	**CRZ**	21	201	1	-78.02	2.25	20	5.3	3.77	3.05	0.74
	Ambiri Kala	**AAZ**	19	194	1	-68.15	2.26	18	5.27	3.42	2.94	0.77
	Takht-e- Nasrati	**CRZ**	18	225	1	-62.2	2.36	17	5.42	3.14	2.89	0.82
	Siraj Khel	**PFC**	23	235	1	-81.74	2.74	22	5.46	4.03	3.14	0.88
	Shahidan Banda	**CZF**	15	171	1	-49.84	2.19	14	5.14	2.72	2.71	0.81
	Zarki Nasrati	**CAA**	23	176	1	-79.78	2.83	22	5.17	4.26	3.14	0.9
	Shawa	**AAC**	13	132	1	-36.75	2.3	**12**	4.88	2.46	2.57	0.9
4	Kandu Khel	**ZCP**	18	240	1	-59.94	2.5	**17**	5.48	3.1	2.89	0.87
	Shadi Khel	**ACA**	21	234	1	-73.32	2.55	20	5.46	3.67	3.05	0.84
	Sarki Lawager	**FZS**	19	110	1	-60.82	2.7	18	4.7	3.83	2.94	0.92
	Shnawa	**ZAC**	12	103	1	-34.64	2.14	11	4.64	2.37	2.49	0.86

S = Total species number in community.

N = Total number of Individual in community.

Key:

CCP: *Cenchrus-Calotropis-Prosopis* community, CSP: *Cenchrus-Saccharum-Phoenix community*,

ZPS: *Zizyphus-Peganum-Saccharum* community, CPP: *Cenchrus-Periploca-Prosopis*-community,

CSZ : *Cenchrus-Saccharum-Zizyphus* community, CSA: *Cenchrus-Saccharum-Acacia* community,

ZCS : *Zizyphus-Cenchrus-Saccharum* community, SCZ : *Saccharum-Cenchrus-Zizyphus* community,

CCA: *Cenchrus-Calligonum-Acacia* community, ZCC : *Zizyphus-Cenchrus-Calligonum* community,

CZS: *Cenchrus-Zizyphus-Saccharum* community, CRZ : *Cymbopogon-Rhazya-Zizyphus* community,

AAZ : *Astragalus-Aerua-Zizyphus* community, CRZ : *Cenchrus-Rhazya-Zizyphus* community,

PFC : *Phoenix-Fagonia-Capparis* community, CZF : *Cassia-Zizyphus-Fagonia* community,

CAA: *Capparis-Aerua-Acacia* community, AAC : *Aerua-Acacia-Capparis* community,

ZCP: *Zizyphus-Capparis-Phragmites* community, ACZ : *Aerua-Capparis-Zizyphus* community,

FZS: *Fagonia-Zizyphus-Saccharum* community, ZAC : *Zizyphus-Aerua-Capparis* community.

4.5.4. Maturity Index

The biological assessment is necessary for a sufficient characterization and different parameters of a plant community. These activities could be for store extraction, consumer utilization, progress of preservation or unpleasant of foreigner species etc. The vegetation in the areas does not a sign of a visibly growth species composition but relatively a mixture of dominated by native plants of largely invasive weedy alien plant and mixed native and non native plant. All over the world, natural habitats are being ruined. The conservation of the plant life is very necessary to maintain natural habitat for our pleasure and provide sound way to control pollution. Maturity index is an important indicator for the maturity of the communities in a specific area. High value of the maturity index means that such community can survive in any harsh environmental condition. In the present investigation, the Maturity index of plant life was determined during spring, summer and winter in Tehsil Takht-e-Nasrati. It is discussed below:

Spring

In stand 1, the highest maturity index (44.29) was found in *Prosopis-Periploca-Aerua* community, in stand 2, the maturity index (46.11) was high in *Zizyphus-Cenchrus-Saccharum* community, in stand 3, high maturity index (51.33) was originated in *Fagonia-Withania-Zizyphus* community and in stand 4, the *Dichanthium-Withania-Zizyphus* community had high maturity index (48). The mean maturity index (44.79) was high in stand 3. The highest number of plant species (30) were present in *Fagonia-Zizyphus-Saccharum* community in stand 2 (Table 81).

B. Summer

During summer the highest maturity index in stand 1, were 66.43 in *Phoenix-Saccharum-Cenchrus* community. In stand 2, the highest maturity index (56.84) was presnt in Calligonum-*Tribulus-Zizyphus* community. In stand 3, the *Boerhavia–Acacia-Capparis* community had the highest maturity index (61.67) and in stand 4, the highest maturity index found in *Boerhavia–Zizyphus-Capparis* community was 50.83. The species number (19.43) and total frequency value (971.4) was high in stand 2 while Maturity Index in stand 1. The low species number (16) was found in stand 1 but total frequency (775) and maturity index in stand 4 (Table 82).

C. Winter

The highest maturity index was 35.6 present in *Cenchrus-Prosopis-Saccharum* community in stand 1. *Cenchrus*-Calligonum-*Acacia* community showed the highest maturity index (48.57) in stand 2. In stand 3 and 4, the highest maturity index was found in *Aerua–Acacia-Capparis* community (55.38) and *Zizyphus-Aerua-Capparis* community (53.33) respectively. The mean plants number were high (26.25) in stand 1, frequency (897.143) in stand 2 and maturity index (41.59) in stand 4. The low rate of species number (17.5) and frequency (705) was found in stand 4 while maturity Index (33.86) in stand 1 (Table 83).

Maturity index is quotient of the total of the frequency percentage of all the species in the community. It means that higher the frequency percentage of each species and smaller the number of sporadic species, the community will be more mature (Pichi Sermoli, 1948). It helps us to get better understanding of plant life study and provides a clear image of the vegetation. Plant life communities in investigated area pointed out the maturity index scores less than 50 in spring except in FWZ community, in summer, 11 communities had more than 50 score while in winter, only 2 communities have more than 50 scores that indicates unbalance and immaturity within communities, seasons and stands due to smaller adaptation to the ecological conditions of area. It was noticed that in plain area the grazing pressure is high on ground flora, herbs and seedlings while in hilly area it is high on shrubs and trees that has created a considerable stress (Figs. 33, 34). The high concentration of consumer interference regularly disturbs the natural balance of plant life populations as a result preventing them to reach a climax stand of plant life maturity. Our result was similar with that of Saxena & Singh (1982) and Negi (2009). This phenomenon is clear from the heavy grazing and tree cutting down in studies sites (Figs. 35, 36).

In the present study the maturity Index was high 60.18 and low 33.86 in stand 1 during summer and winter respectively. The total average frequency value was high (971.4) in stand 2 during summer and low (705) in stand 4 during winter (Table 82). The high maturity index in stand 1 shows that shrubs reached to their mature stage in the area. In plain most of area was surrounded by shrubs and trees for area protection and food requirement for the consumer. The area is totally rain depended. Therefore, if rain

occurs the plain area become ready to be cultivated, in the case, the grazing was avoided for a few months in plain area. The grazing rate is very high in hilly area during summer owing to which the plant cannot attain their climax stage. Therefore, the maturity index was seen below 50 in all stands. The pressure on the growing seedlings of plants occurs due to over and illegal grazing and cutting in the area because the limited grazing area and no energy facilities are available to consumers.

The results showed that maturity index was low with increasing altitude both plain and hilly area during spring (Fig. 37). Similarly, the maturity index was decreased with increase of altitude during summer (Fig. 38). During winter the species number were decreased but maturity index increased with increase of altitude (Fig. 39). The maturity index of plant community required for a conservation and biodiversity purposes depends on type of the area but anyway it is the basic requirement for stable plant life measurement. The plants are collected in abundant as a medicinal, fuel and are being utilized by people for different purposes. The plant cutting rate was high in hilly area because plants are the main source of income in these areas. The cutting rate was high during summer because the people used them as a fuel.

During summer the species number and frequency was found high and maturity index was decreased in plain area while these were decreased in hilly area with increase in altitude. In plain area the frequency and maturity Index were decreased and species number was increased while in hilly area the species number and maturity Index were decreased and frequency was increased with the increase of altitude during spring From the result it was noticed that the maturity index was increases with the decreasing of species number and vise versa in spring season. It was also noticed from the present study that the smallest number and higher frequency of plant species increase the maturity of the community.

When seasons were compared summer had high maturity index due to low number of plant species and high frequency as compare to the other seasons (Fig. 40). In winter, the species number are high due to the presences of nonpalatable plants in the area and the availability of cultivated plant in the area. So the consumers selected plant for their food and choice. In summer, the cultivated plant and other natural species are unavailable in the area therefore, the palatability rate was high and only

none palatable species are present in the area which become mature. People of the area are poor so they cut the species at the end of summer for burning purposes in winter. In spring, the rain percentage is more, therefore, the plant number is high but the frequency and maturity index was low. Qadir & Shetvy (1986) described low maturity and homogeneity of community for Libyan plant communities, for the reason that these communities are also different floristically and vary in their stages of growth.

The maturity index is necessary for perfect representation of the quantitative and qualitative characteristics and used as an ideal way to study the plant life. It is used as a perfect way to study and helps skillfully in evaluating the biodiversity and conservation of the intact habitat and plant life in specific area. This study pointed out that climatic environment of region has privileged conscription of area and frequency was changed with the change of seasons and altitude. Plant ecologists have commonly been conscious that vegetation shows a discrepancy over a broad variety of particular scales and area.

Table 81. Maturity Index of communities during spring of Tehsil Takht-e-Nasrati, Karak.

Stand	Sites	Community	Number of Species	Frequency	Maturity Index
1	Tater Khel	PSS	23	950	41.3
	Gardi Banda	PSS	17	730	42.94
	Ahmad Abad	FPS	21	930	44.29
	Warana	PPA	20	880	44
		Mean	**20.25**	**872.5**	**43.1325**
2	S Bogara	FZC	30	1010	33.67
	N Bogara	ASC	24	910	37.92
	Gandiri Khattak	ZSC	17	670	39.41
	Kiri Dhand	CZS	20	860	43
	Jahangiri Banda	ZAC	17	740	43.53
	Mona Khel	ZCF	17	740	43.53
	Jarassi	ZCS	18	830	46.11
		Mean	**20.43**	**822.86**	**41.02**
3	Chokara	CRZ	19	730	38.42
	Ambiri Kala	ASZ	19	740	38.95
	Takht-e- Nasrati	SZR	16	740	46.25
	Siraj khel	FPC	20	810	40.5
	Shahidan Banda	FWZ	15	770	51.33
	Zarki Nasrati	APA	21	980	46.67
	Shawa	AAC	14	690	49.29
		Mean	**17.71**	**780**	**44.49**
4	Kandu Khel	EZC	19	680	35.79
	Shadi Khel	ARA	23	1040	45.22
	Sarki Lawager	DWZ	15	720	48
	Shnawa	ZAC	19	810	42.63
		Mean	**19**	**812.5**	**42.91**

Table 82. Maturity Index of communities during summer of Tehsil Takht-e-Nasrati, Karak.

Stand	Sites	Community	Number of Species	Frequency	Maturity Index
1	Tater Khel	ECP	15	880	58.67
	Gardi Banda	PSC	14	930	66.43
	Ahmad Abad	APS	18	980	54.44
	Warana	TTS	17	1040	61.18
		Mean	**16**	**957.5**	**60.18**
2	S Bogara	ESZ	24	1100	45.83
	N Bogara	TAS	19	910	47.89
	Gandiri Khattak	ZCS	17	780	45.88
	Kiri Dhand	CTZ	19	1080	56.84
	Jahangiri Banda	CCZ	21	1090	51.9
	Mona Khel	ZCS	17	880	51.76
	Paki Gudi Khel	SZC	19	960	50.53
		Mean	**19.43**	**971.42**	**50.09**
3	Chokara	CRZ	18	88	48.89
	Ambiri Kala	SCZ	18	78	43.33
	Takht-e- Nasrati	FRZ	18	82	45.56
	Siraj Khel	CPC	23	92	40
	Shahidan	CCZ	15	83	55.33
	Zarki Nasrati	CAA	20	80	40
	Shawa	BAC	12	74	61.67
		Mean	**17.71**	**82.43**	**47.82**
4	Kandu Khel	EZC	16	770	48.13
	Shadi Khel	AAC	20	820	41
	Sarki Lawager	TPZ	19	900	47.37
	Shanawa	BZC	11	610	50.83
		Mean	**16.5**	**775**	**46.83**

Table 83. Maturity Index of communities during winter of Tehsil Takht-e-Nasrati, Karak.

Stand	Sites	Community	Number of species	Frequency	Maturity Index
1	Tater Khel	CSP	26	860	33.08
	Gardi Banda	CSP	22	740	33.64
	Ahmad Abad	CPS	25	890	35.6
	Warana	CPP	32	1060	33.13
		Mean	**26.25**	**887.5**	**33.86**
2	S Bogara	CSZ	30	1030	34.33
	N Bogara	CSA	21	700	33.33
	Gandiri Khattak	ZCS	17	650	38.24
	Kiri Dhand	CCZ	22	1020	46.36
	Jahangiri Banda	CCA	21	1020	48.57
	Jarassi	CZS	26	990	38.08
	Mona Khel	ZCC	22	870	39.55
		Mean	**22.71**	**897.14**	**39.78**
3	Chokara	CRZ	19	790	41.58
	Ambiri Kala	AAZ	19	720	37.89
	Takht-e- Nasrati	CRZ	18	800	44.44
	Siraj Khel	PFC	23	800	34.78
	Shahidan Banda	CZF	15	630	42
	Zarki Nasrati	CAA	23	740	32.17
	Shawa	AAC	13	720	55.38
		Mean	**18.57**	**742.85**	**41.18**
4	Kandu Khel	ZCP	18	730	40.56
	Shadi Khel	ACA	21	760	36.19
	Sarki Lawager	FZS	19	690	36.32
	Shnawa	ZAC	12	640	53.33
		Mean	**17.5**	**705**	**41.59**



Fig. 33. Herbaceous vegetation grazed by goat, sheep and cow that reduced maturity index.



Fig. 34. Shrubby and woody species being heavily grazed by goat and sheep that is hampering vegetation and maturity index.



Fig. 35. Cutting of trees in Saraj Khel for fuel is a common practice leading to low species diversity and maturity index.



Fig. 36. Pruning of wild *Zizyphus maurtiana* during winter for fodder.

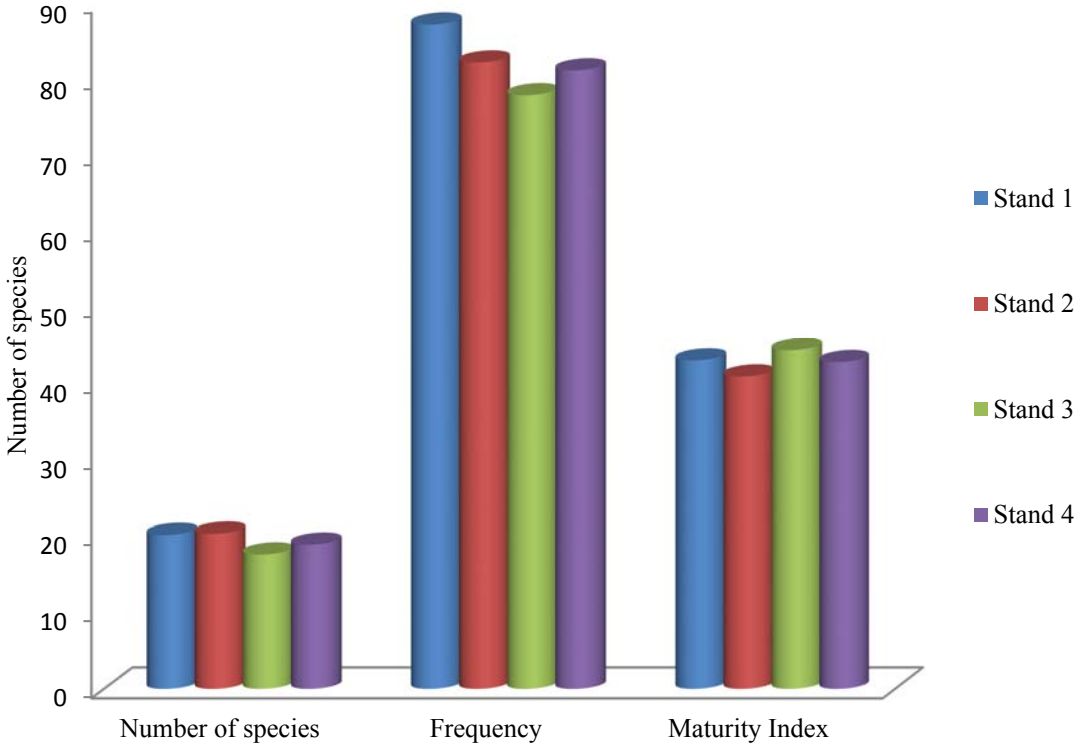


Fig. 37.Effect of increasing altitude maturity index in spring .

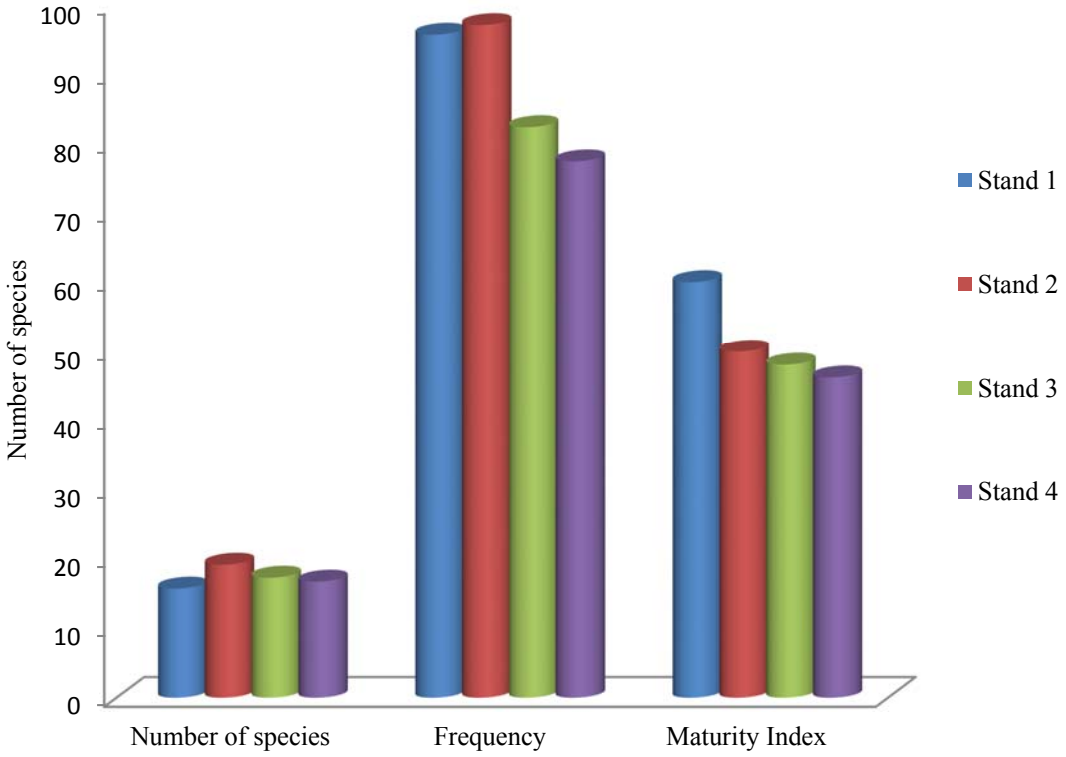


Fig. 38. Maturity Index decreased with increasing altitude in summer.

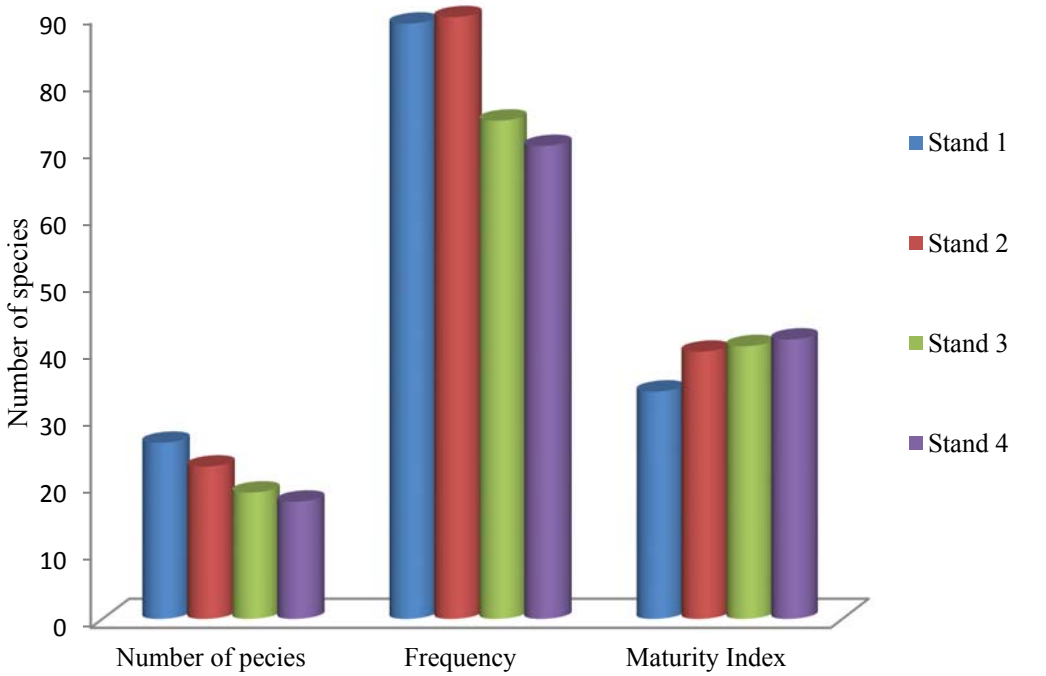


Fig. 39. Maturity Index increased with increasing altitude during winter in Tehsil Takht-e-Nasrati, District Karak.

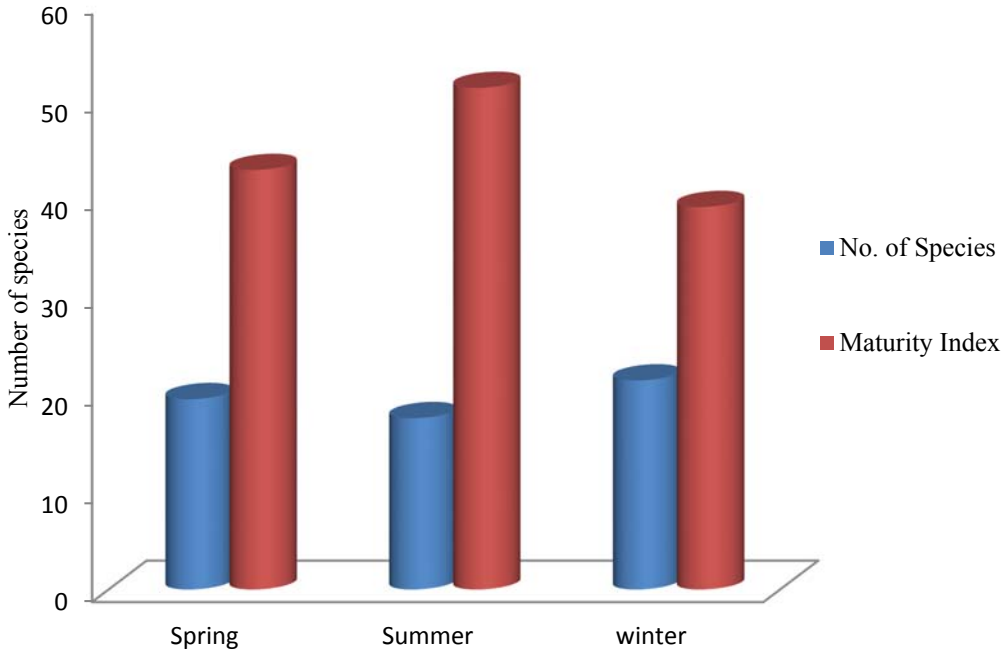


Fig. 40. Over all picture of Maturity Index of plant life in Tehsil Takht-e-Nasrati, District Karak.

4.5.6. Degree of Homogeneity

The homogeneity of community distribution presents precious information regarding development, competition and predation and life history of plant species. It is accepted that human activities and man's way of life have altered the global cycles of plant life resulting in numerous environmental changes. Degree of homogeneity and abundance distribution explains the presence of plant availability in area and different seasons. Raunkiærian (1934) postulated that mature homogeneous plant life could be documented by means of this model. Plants give the pattern on which communities and ecosystems are gathered and on which food webs are arranged. So, considerate the reasons that find out plant division and abundance is central for our perceptive of natural balance at large. Consumers, as key components of mainly ecology and constant representatives of plant spoil, include vast prospective to primarily change plant homogeneity. Consequently, the improved levels of consumer may harm the ecosystem and could affect the plant life of the region. As part of the necessary background to the detailed studies on the frequency classes of plant life in Tehsil Takht-e-Nasrati, District Karak, Pakistan describes and compares the preliminary results on the background homogeneity levels of different community in different stand and seasons. In this study, particular attention was paid to the systematic characteristics of the frequency classes to determined homogeneity of plant life in the area.

Stand 1

In stands1, the value is high of class B and low in E as compare to other classes in spring so the equation of homogeneity will be A < B > C > D > E. In summer class C has high value while it is low in A; A < B < C > D < E. The value of class A is high in winter so equation takes form as A < B < C < D > E. (Table 84; Fig. 41). Our result is similar only in winter with that of Raunkiærian (1934) law of frequency. It means that in winter the plant become mature and grazing and herbivory become low due to farming While in other seasons grazing rate and herbivory is very high. The mean value showed that the area is under biotic pressure i.e. grazing and uprooting of plants species in the area. The area is rain depended and high grazing pressure so plant availability is also affected.

Stand 2

In stand 2, the class B has high value in spring and summer i.e. 9.86, 7.29 respectively while the value of class A is high (8.86) in winter. Therefore, following equations may be derived A > B < C < D < E, A > B < C < D > E and A < B < C < D > E in spring, summer and winter respectively (Table 85; Fig. 42). In stand 2, the winter value is similar with that of Raunkiærian (1934) law of frequency while other values are different. The area is sandy, therefore, the plant grow in the area have lower frequency class in winter due to cultivation and stopping of grazing in the area. People used plant for fuel and food purposes mostly in spring and summer. Therefore, the plant appearance became low as compare to winter.

Stand 3

In stand 3, the class B has high value in all season as compare to other classes so following equations are obtain in spring, summer and winter A > B < C < D < E, A > B < C < D > E and A > B < C < D > E respectively (Table 86; Fig. 43). In this stand all equations are different from Raunkiærian (1934) law of frequency. The area is composed of small hills and people used them as a meadow. Therefore, the frequency class of B is more than A. The consumer feeds plants with roots while in summer they also some time eat a nonpalatable plant due to unavailability of plant. The area is unprotected so people also cut plants for fuel purposes and for economy.

Stand 4

The value of class B is high in all seasons in stand 4. The equation derived for spring, summer and winter are A > B < C < D < E, A > B < C < D < E and A > B < C < D > E respectively (Table 87; Fig. 44). People of the area are very poor. Therefore, most of the people depend on plant species. The equations of the frequency classes are not similar with that of Raunkiærian (1934) law of frequency because the area is also under biotic pressure. On hills the plant are either absent or present with small quantity because hills are composed of sand in addition to wind and water bring upper superficial portion with plants from these hills.

There were 22 plant communities in each season i.e. spring, summer and winter. All plant communities showed heterogeneity. Those communities showing heterogeneity might be due to the presence of large number of therophytes, altitudinal degradation,

climatic and edaphic environment, over grazing, crushing, deforestation and soil erosion in the study area. With increasing altitude heterogeneity occurred in most of the communities. The area is highly disturbed which outcomes in more plant species in the class B. Some of the frequency classes were absent in the investigated area which is due to deforestation and human pressure for fuel purposes. Senecio-Bupleurum community showed homogeneity because of low number of species (Durani, 2000).

Comparison between plain areas i.e. stand 1 & 2 and hilly areas i.e. stands 3 & 4, it was found that the distribution of plant species velocity was high in plain area (Fig. 45). There seems no homogeneity in both areas. The low rate of frequency classes in hilly area means that plant variety was less due to considering them as a meadow and consumer lost variety of palatable plant species in the area. The area is under heavy biotic pressure. The distribution of plant species are also affected with area position. As a whole the class B was high in spring and winter while the summer shows similarity with Raunkiærian law of frequency to some extant (Fig. 46). In plain and hilly area, the highest value was originated of class B i.e. 7.35 and 7.09 respectively. Frequency class's distribution is crucial and an important mechanism of plant life study and analysis of a species population structure. Comparison of community succession of frequency classes provides data on conscription, development, transience and plant life in the area. Frequency distribution of a plant species normally is the size of the present individuals from which all supposition about population dynamics should be consequential. Homogeneity of a plant life with respect to a frequency classes in an area is a necessary prerequisite for reliable determination. Sample homogeneity is of particular importance in communities and plant life analysis. Homogeneity (or the distribution of a particular plant life) of a region can easily be determined by law of frequency classes. The range of homogeneity helps us skillfully in evaluating the biodiversity and conservation of entire habitat and plant life. This study pointed out that the climatic environment of region has privileged conscription of area and the frequency was changed with the change of seasons and altitude. Plant ecologists have commonly been conscious that vegetation had showed a discrepancy over a broad variety of particular scales and area and had build up methods for studying the degree of vegetation deviation.

Table 84. Degree of homogeneity of stand 1 Tehsil Takht-e-Nasrati, Karak.

Season	Communities	Distribution of species in Frequency classes					Homogeneity equation	Remarks	
		A	B	C	D	E		Home	Hetero
Spring	PSS	3	**12**	7	0	1	A < B > C > D < E	-	+
	PSS	2	9	4	1	1	A < B > C > D = E	-	+
	FPS	5	6	6	3	1	A < B = C > D > E	-	+
	PPA	4	9	3	3	1	A < B > C = D > E	-	+
	Mean	**3.5**	**9**	**5**	**1.75**	**1**	**A < B > C > D > E**	**-**	**+**
Summer	ECP	0	6	4	0	3	A < B > C > D < E	-	+
	PSC	0	3	5	1	5	A < B < C > D < E	-	+
	APS	1	5	6	4	2	A < B < C > D > E	-	+
	TTS	3	2	4	3	5	A > B < C > D < E	-	+
	Mean	**1**	**4**	**4.75**	**2**	**3.75**	**A < B < C > D < E**	**-**	**+**
Winter	CCP	14	7	2	0	3	A > B > C > D < E	+	-
	CSP	13	6	0	0	3	A > B > C = D < E	+	-
	ZPS	12	8	1	1	3	A > B > C = D < E	+	-
	CPP	20	5	2	2	3	A > B > C = D < E	+	-
	Mean	**14.8**	**6.5**	**1.25**	**0.75**	**3**	**A > B > C > D < E**	**+**	**-**

Key :

PSS: *Prosopis- Saussurea-Saccharum* community, PSS: *Phoenix -Saussurea -Saccharum* community,

FPS: *Fagonia-Prosopis-Saccharum* community, PPA: *Prosopis -Periploca -Aerua* community,

ECP: *Eragrostis-Calotropis-Prosopis* community, PSC: *Phoenix-Saccharum-Cenchrus* community,

APS: *Aerua-Prosopis-Saccharum* community, TTS: *Tribulus-Tamarix -Saccharum* community,

CCP: *Cenchrus-Calotropis-Prosopis* community, CSP: *Cenchrus-Saccharum-Phoenix community*,

ZPS: *Zizyphus-Peganum-Saccharum* community, CPP: *Cenchrus-Periploca-Prosopis*-community.

Table 85. Degree of homogeneity of stand 2 Tehsil Takht-e-Nasrati, Karak.

Season	Community	Distribution of species in Frequency classes					Homogeneity equation	Remarks	
		A	B	C	D	E		Homo	Hetro
Spring	FZC	12	12	4	2	0	A = B < C > D < E	-	+
	ASC	4	13	6	1	0	A < B > C > D > E	-	+
	ZSC	4	9	2	1	1	A < B > C > D = E	-	+
	CZS	1	10	7	2	0	A < B > C > D > E	-	+
	ZAC	2	8	5	2	0	A < B > C > D > E	-	+
	ZCF	3	7	5	0	2	A < B > C > D < E	-	+
	ZCS	1	10	6	0	1	A < B > C > D < E	-	+
	Mean	**3.86**	**9.86**	**5**	**1.143**	**0.57**	**A < B > C > D > E**	**-**	**+**
Summer	ESZ	8	6	3	4	3	A > B > C < D > E	-	+
	TAS	2	9	3	3	2	A < B > C = D > E	-	+
	ZCS	1	**10**	3	0	3	A < B > C > D > E	-	+
	CTZ	1	6	4	5	3	A < B > C > D > E	-	+
	CCZ	3	8	4	2	4	A < B > C > D < E	-	+
	ZCS	3	6	3	1	4	A < B > C > D < E	-	+
	SZC	4	6	5	0	4	A < B > C > D < E	-	+
	Mean	**3.14**	**7.29**	**3.57**	**2.143**	**3.29**	**A < B > C > D < E**	**-**	**+**
Winter	CSZ	15	9	3	1	2	A > B > C > D < E	+	-
	CSA	11	5	2	1	2	A> B > C > D < E.	+	-
	ZCS	5	8	0	0	3	A< B > C = D < E.	-	+
	CCZ	3	9	6	2	2	A< B > C < D =E.	-	+
	CCA	11	5	1	1	3	A> B > C = D < E.	+	-
	ZCC	8	11	4	0	3	A < B > C > D < E.	-	+
	CZS	9	5	5	0	3	A < B > C > D < E.	-	+
	Mean	**8.86**	**7.43**	**3**	**0.714**	**2.57**	**A > B > C > D< E.**	**+**	**-**

Key :

FZS : *Fagonia- Zizyphus- Saccharum* community, ASC : *Acacia-Saccharum-Citrullus* community,
ZSC : *Zizyphus-Saccharum-Cynodon* community, CZS : *Calligonum-Zizyphus-Saussurea* community
ZAC : *Zizyphus-Aerua-Calligonum* community, ZCF : *Zizyphus-Calligonum-Fagonia* community,
ZCS : *Zizyphus-Cenchrus-Saccharum* community, ESZ : *Eragrostis-Saccharum-Zizyphus* community,
TAS : *Tribulus-Acacia-Saccharum* community, ZCS : *Zizyphus-Cenchrus-Saccharum* community,
CTZ **:** *Calligonum Tribulus-Zizyphus* community, CCZ: *Calligonum-Cenchrus-Zizyphus* community,
ZCS : *Zizyphus-Cenchrus-Saccharum* community, SZC : *Saccharum-Zizyphus-Cynodon* community,
CSZ : *Cenchrus-Saccharum-Zizyphus* community, CSA: *Cenchrus-Saccharum-Acacia* community,
ZCS : *Zizyphus-Cenchrus-Saccharum* community, SCZ : *Saccharum-Cenchrus-Zizyphus* community,
CCA: *Cenchrus-Calligonum-Acacia* community, ZCC : *Zizyphus-Cenchrus-Calligonum* community,
CZS: *Cenchrus-Zizyphus-Saccharum* community.

Table 86. Degree of homogeneity of stand 3 Tehsil Takht-e-Nasrati, Karak.

Season	Community	Distribution of species in Frequency classes					Homogeneity equation	Remarks	
		A	B	C	D	E		Homo	Hetro
Spring	CRZ	7	5	6	0	1	A > B < C > D < E	-	+
	ASZ	3	10	5	1	0	A < B > C > D > E	-	+
	SZR	3	6	3	3	1	A < B > C = D > E	-	+
	FPC	4	9	4	2	1	A < B > C > D > E	-	+
	FWZ	2	5	4	3	1	A < B > C > D > E	-	+
	APA	2	11	5	1	2	A < B > C > D < E	-	+
	AAC	2	5	4	1	2	A < B > C > D < E	-	+
	Mean	**3.29**	**7.29**	**4.43**	**1.571**	**1.14**	**A < B > C > D > E**	**-**	**+**
Summer	CRZ	2	6	8	0	2	A < B < C > D < E	-	+
	SCZ	5	5	3	1	3	A = B > C > D < E	-	+
	FRZ	2	8	4	2	2	A < B > C > D = E	-	+
	CPC	8	7	4	3	1	A > B > C > D > E	-	+
	CCZ	2	6	1	4	2	A < B > C < D > E	-	+
	CAA	6	6	5	2	1	A = B > C > D > E	-	+
	BAC	0	6	1	0	5	A < B > C > D < E	-	+
	Mean	**3.57**	**6.29**	**3.71**	**1.714**	**2.29**	**A < B > C > D < E**	**-**	**+**
Winter	CRZ	7	9	3	0	2	A < B > C > D < E	-	+
	AAZ	6	9	2	0	2	A < B > C > D < E	-	+
	CRZ	4	7	4	0	3	A < B > C > D < E	-	+
	PFC	6	**12**	3	1	1	A < B > C > D = E	-	+
	CZF	3	7	2	2	1	A < B > C = D < E	-	+
	CAA	9	9	4	0	1	A = B > C > D < E	-	+
	AAC	0	8	1	0	4	A < B > C > D < E	-	+
	Mean	**5**	**8.71**	**2.71**	**0.429**	**2**	**A < B > C > D < E**	**-**	**+**

Key :
CRZ: *Cymbopogon -Rhazya –Zizyphus* community, ASZ : *Aerua-Saccharum-Zizyphus* community,
SZR : *Salvia-Zizyphus-Rhazya* community, FPC: *Fagonia-Phoenix-Capparis* community,
FWZ : *Fagonia -Withania- Zizyphus* community, APA : *Aerua-Punica-Acacia* community,
AAC : *Aerua-Acacia-Capparis* community, CRZ : *Cymbopogon-Rhazya-Zizyphus* community,
SCZ : *Saccharum-Cymbopogon-Zizyphus* community,FRZ : *Fagonia-Rhazya-Zizyphus* community,
CPC : *Cleome-Phoenix-Capparis* community, CCZ: *Cenchrus-Cassia-Zizyphus* community,
CAA : *Capparis-Aerua-Acacia* community, BAC : *Boerhavia-Acacia-Capparis* community,
CRZ : *Cymbopogon-Rhazya-Zizyphus* community, AAZ : *Astragalus-Aerua-Zizyphus* community,
CRZ : *Cenchrus-Rhazya-Zizyphus* community, PFC : *Phoenix-Fagonia-Capparis* community,
CZF : *Cassia-Zizyphus-Fagonia* community, CAA: *Capparis-Aerua-Acacia* community,
AAC : *Aerua-Acacia-Capparis* community.

Table 87. Degree of homogeneity of stand 4 Tehsil Takht-e-Nasrati, Karak.

Season	Community	Distribution of species in Frequency classes					Homogeneity equation	Remarks	
		A	B	C	D	E		Home	Hetro
Spring	EZC	5	9	4	1	0	A < B > C > D > E	-	+
	ARA	6	6	7	2	2	A = B < C > D = E	-	+
	DWZ	3	4	6	1	1	A < B < C > D = E	-	+
	ZAC	3	10	3	2	1	A < B > C > D > E	-	+
	Mean	**4.25**	**7.25**	**5**	**1.5**	**1**	**A < B > C > D > E**	**-**	**+**
Summer	EZC	4	5	3	1	3	A < B > C > D < E	-	+
	AAC	5	9	2	4	0	A < B > C < D > E	-	+
	TPZ	4	6	5	2	2	A < B > C > D = E	-	+
	BZC	1	4	2	2	2	A < B > C = D = E	-	+
	Mean	**3.5**	**6**	**3**	**2.25**	**1.75**	**A < B > C > D > E**	**-**	**+**
Winter	ZCP	5	8	2	1	2	A < B > C > D < E	-	+
	ACA	5	11	3	1	1	A < B > C < D = E	-	+
	FZS	6	7	5	0	1	A < B > C > D < E	-	+
	ZAC	3	2	3	2	2	A > B < C > D = E	-	+
	Mean	**4.75**	**7**	**3.25**	**1**	**1.5**	**A < B > C > D < E**	**-**	**+**

Key :

EZC: *Eragrostis-Zizyphus-Capparis* community, ARA : *Aerua-Rhazya-Acacia* community,
DWZ: *Dichanthium -Withania-Zizyphus* community, ZAC: *Zizyphus-Aerua-Capparis* community,
EZC : *Eragrostis-Zizyphus-Capparis* community, AAC : *Aerua-Acacia-Capparis* community,
TPZ: *Tribulus-Periploca-Zizyphus* community, BZC : *Boerhavia-Zizyphus-Capparis* community,
ZCP : *Zizyphus-Capparis-Phragmites* community, ACZ : *Aerua-Capparis-Zizyphus* community,
FZS: *Fagonia-Zizyphus-Saccharum* community, ZAC : *Zizyphus-Aerua-Capparis* community.

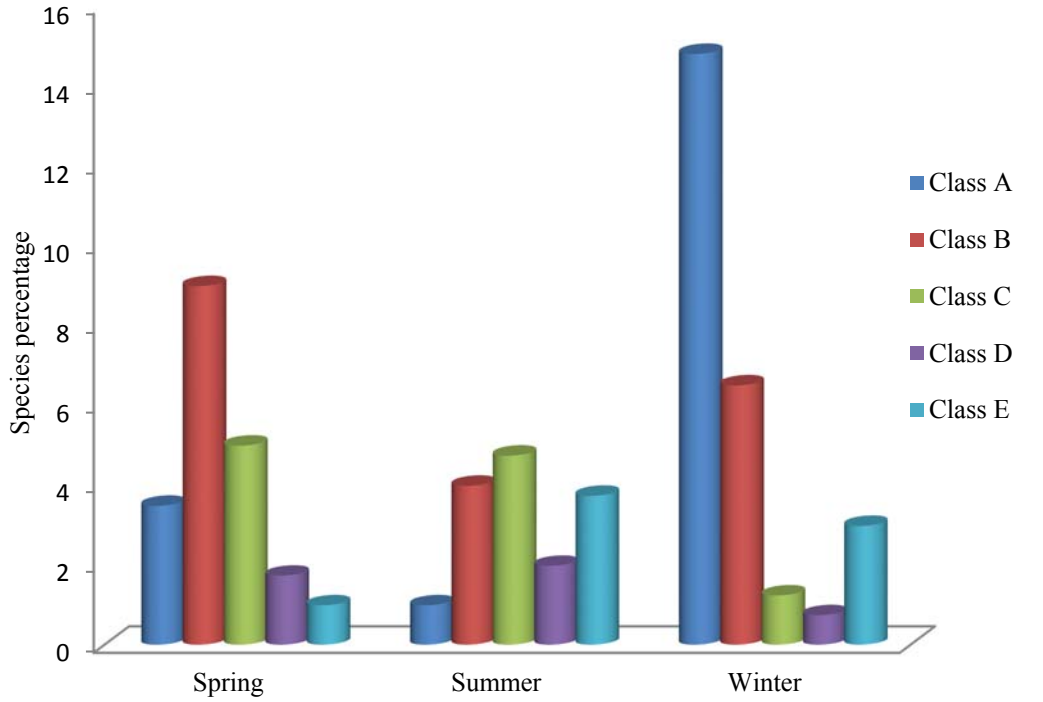


Fig. 41. Frequency classes in stand 1, Tehsil Takht-e-Nasrati, Karak.

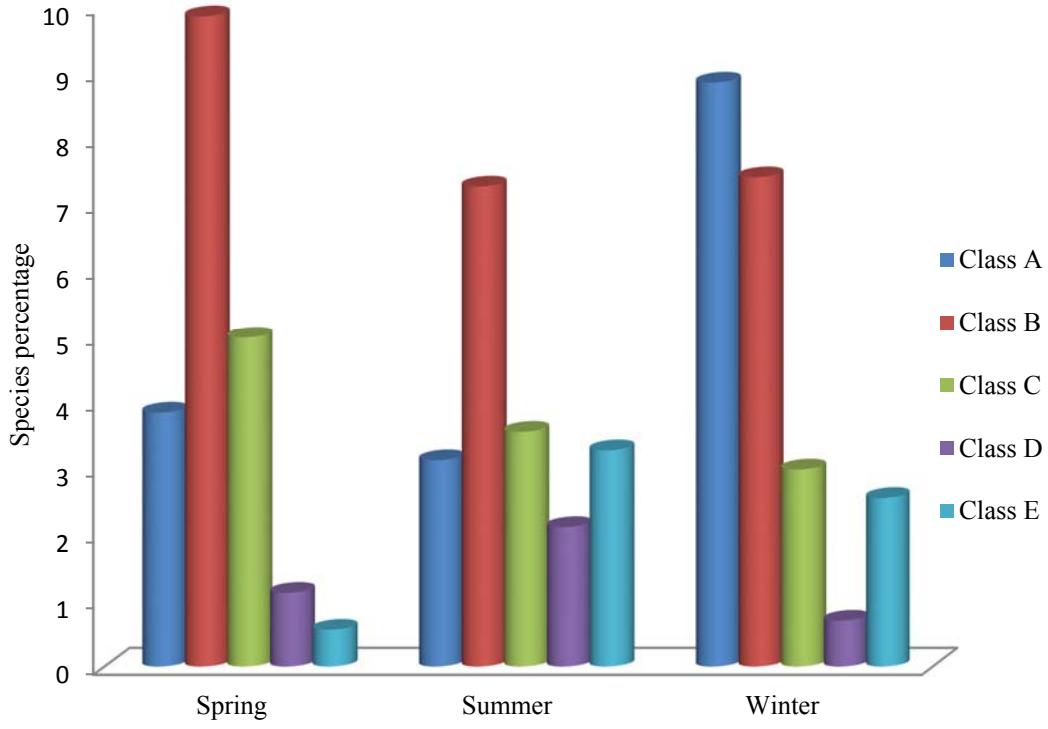


Fig. 42. Frequency classes in stand 2, Tehsil Takht-e-Nasrati, Karak.

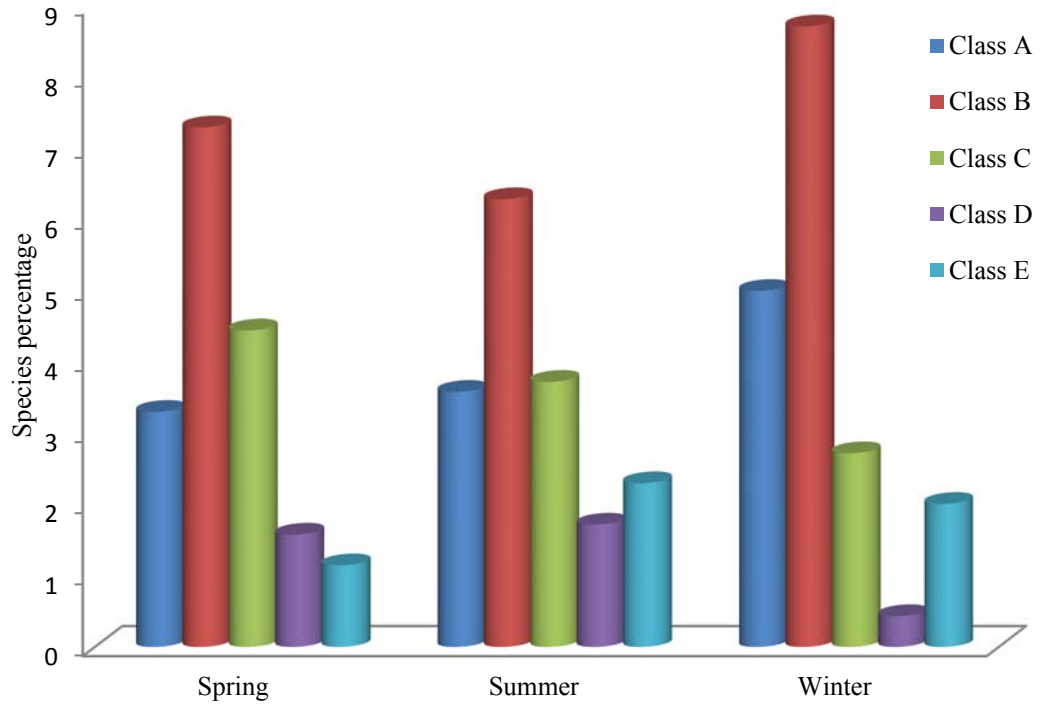


Fig. 43. Frequency classes in stand 3, Tehsil Takht-e-Nasrati, Karak.

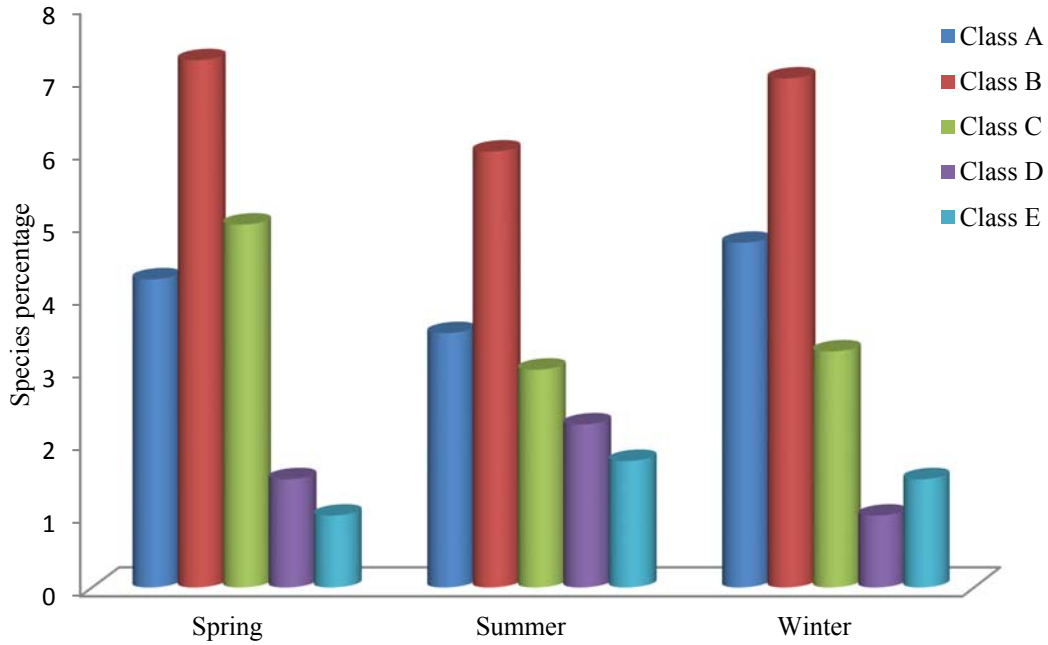


Fig. 44. Frequency classes in stand 4, Tehsil Takht-e-Nasrati, Karak.

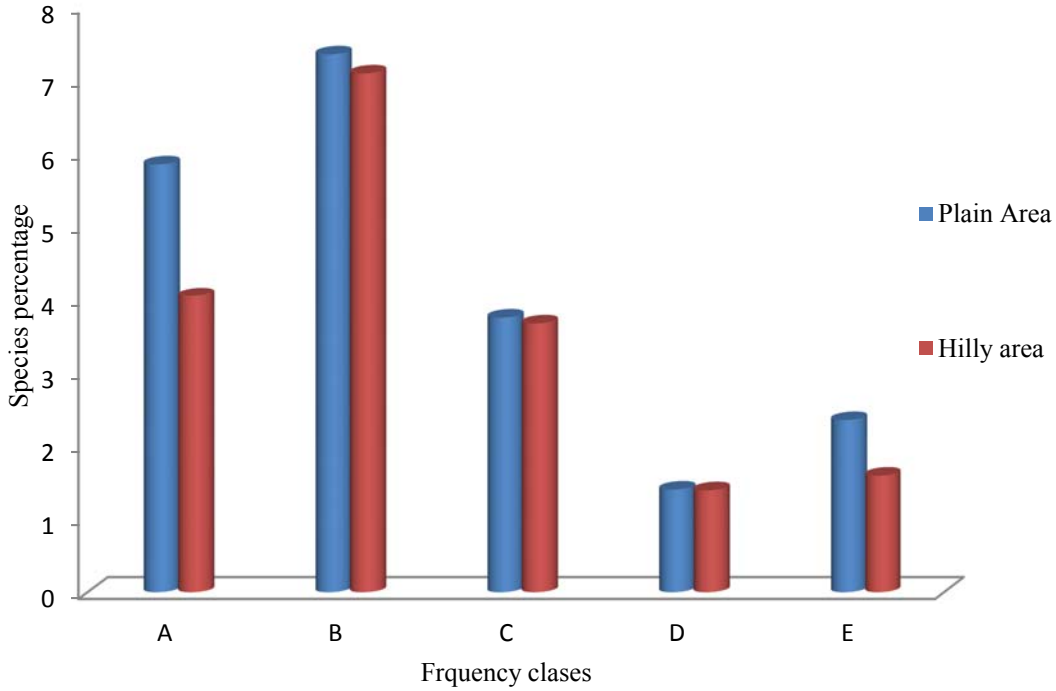


Fig. 45. Comparative homogeneity between plains and hilly area of Tehsil Takht-e-Nasrati, Karak.

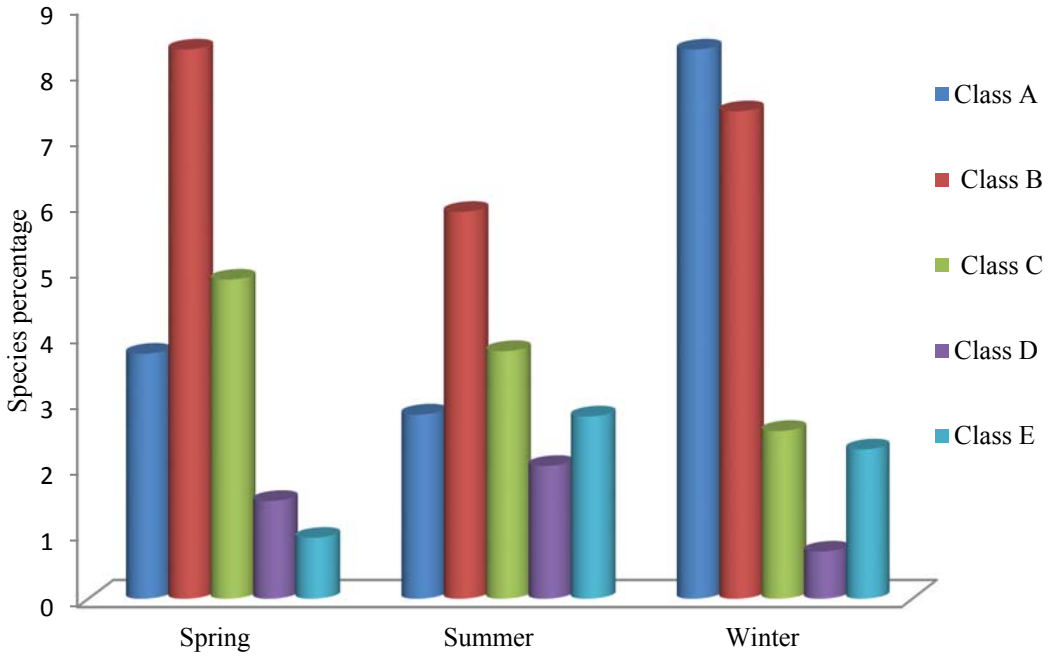


Fig. 46. Seasonal differences in homogeneity of plants of Tehsil Takht-e-Nasrati, Karak.

4.5.7. Classification and Ordination

The arrangement of plant life record is commonly vegetation orientation and main query disquiets the classification and explanation of the vegetation in addition to inconsistency of ecological arrangement. Distinctive multivariate techniques are generally fruitful and commonly used for plant life arrangement position. Though, distinctive multivariate analyses do not directly take into explanation relations in their computation and are not particularly designed to vegetation structures rationalization. The ordination may be defined as the position of communities designed to set apart group types, location, relative position, standing of communities in a season of particular area. In other words, the ordination is the sound or clear arrangement of split communities or species in a season of a particular area. In present work the Ordination methods i.e. Hierarchical Cluster Analysis (HCA) and Detrended Correspondence Analysis (DCA) (Hill, 1979; McCune & Mefford, 1999) were used to summarize biological records and position of communities in groups during spring, summer and winter of the research area. The ordination of communities in each season is given as follows:

1. Spring

1.1. Hierarchical Cluster Analysis

In spring season, 66 species were present in 22 communities in 4 different stands on the basis of altitude. The Hierarchical Cluster Analysis shows that the relationship among 22 communities during spring were inclusion iv into 21 cluster cycling where in cycle 1 it shows the relation of 2 communities at 1.0928E+03 and last i.e. cycle 21, 22 communities were connected with one another at 1.0144E+05 with 3.29 % chaining Further more, on the basis of relationship it marked out distinct 4 groups by different level, cycling and similarity of communities. The depiction of each one group association is as below:

1. *Prosopis-Fagonia-Saccharum* association

In group 1, 32 species comprising 6 trees, 6 shrubs and 20 herbs and grasses were present. The dominant species of association with highest mean important value were *Prosopis farcta* (IV = 28.4), *Fagonia cretica* (IV = 22.6) and *Saccharum bengalense* (IV = 21.9). Furthermore, it comprises 4 communities i.e. *Prosopis-Saussurea-Saccharum* community (PSS), *Prosopis-Periploca-Aerua* community (PPA),

Fagonia-Prosopis-Saccharum community (FPS) and *Phoenix-Saussurea-Saccharum* community (PSS) which raised at 4.2195E+04 in cycles 15 (Table 88; Fig. 47).

2. *Zizyphus-Saccharum-Acacia* association

The group 2 becomes visible at 4.8435E+04 in cycle 16 that contains *Acacia-Saccharum-Citrullus* community (ASC), *Calligonum-Zizyphus-Saussurea* community (CZS), *Zizyphus-Cenchrus-Saccharum* community (ZCS), *Zizyphus-Aerua-Calligonum* community (ZAC), *Zizyphus-Saccharum-Cynodon* community (ZSC) and *Zizyphus-Calligonum-Fagonia* community (ZCF). Moreover, 42 species in which 4 trees, 7 shrubs and 31 herbs were present. Where mean highest important value was represented by *Zizyphus maurtiana* (IV = 54.08), *Saccharum bengalense* (IV = 19.84) and *Acacia nilotica* (IV = 17.26) (Table 88; Fig. 47).

3. *Fagonia-Zizyphus-Eragrostis* association

In cycle 17 at 5.5773E+04, the *Fagonia-Zizyphus-Eragrostis* association was structured that composed of 47 species of 7 trees, 14 shrubs and 26 herbs in which the mean highest important value 34.5, 28.1 and 19.9 presented by *Fagonia cretica*, *Zizyphus maurtiana* and *Aerua persica* respectively. It consists of 6 communities i.e. *Fagonia-Zizyphus-Saccharum* community (FZS), *Fagonia-Phoenix-Capparis* community (FPC), *Fagonia-Withania- Zizyphus* community (FWZ), *Dichanthium-Withania-Zizyphus* community (DWZ), *Eragrostis-Zizyphus-Capparis* community (EZC) and *Salvia-Zizyphus-Rhazya* community (SZR) (Table 88; Fig. 47).

4. *Aerua-Acacia-Cymbopogon* association

In *Aerua-Acacia-Cymbopogon* association, 34 plant species comprising 5 trees, 11 shrubs and 18 herbs and grasses were present. The dominant species on the basis of important value were *Aerua persica* (IV = 49.4), *Acacia modesta* (IV = 21.2) and *Cymbopogon jwarancusa* (IV=20.9). It was structured at 6.3334E+04 in cycle 18 covering *Cymbopogon-Rhazya-Zizyphus* community (CRZ), *Aerua-Saccharum-Zizyphus* community (ASZ), *Aerua-Rhazya-Acacia* community (ARA), *Aerua-Punica-Acacia* community (APA), *Aerua-Acacia-Capparis* community (AAC) and *Zizyphus-Aerua-Capparis* community (ZAC) (Table 88; Fig. 47).

1.2. Detrended Correspondence Analysis (DCA)

Ordination of the communities by DCA explains that the communities with high weight and structured 4 groups. On Axis 1, the groups 4, 3, 2 & 1 were structured with mean DCA weight 241, 138, 34.6 and 23.8 at Eigen values of axes (0.495) respectively. While on Axis 2, the 1, 2, 3 and 4 groups were produced with mean DCA weight as 145, 74, 135 and 69 at EIG (0.206) respectively. Furthermore, the group 1, 2, 3 and 4 were composed of 4, 5, 3 and 5 communities respectively. Other communities that were not present in groups were ASC, CZS, EZC, FPC and FPS with DCA weight 231, 221, 67, 84, 207 at Axis 1 and 220, 190, 116, 88 and zero at Axis 2 respectively. These groups show different vegetation types during spring seasons (Fig. 48).

Table 88. Mean relative importance value of species in different associations during spring distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak.

S. No	Species Name	Groups			
		1	2	3	4
1	*Acacia modesta* Wall.	0	0	7.55	21.2
2	*Acacia nilotica* (L.) Delice.	4.6	17.3	5.56	4.07
3	*Dalbergia sissoo* Roxb.	2.9	12.4	0.79	2.97
4	*Gymnosporia royleana* Wall. ex M. A. Lawson.	0	0	0.78	0
5	*Monotheca buxifolia* (Falc.) A.D.	0	0	1.02	0
6	*Phoenix dactylifera* L.	16.6	0.87	10.7	1.32
7	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	28.4	0	0	0
8	*Prosopis juliflora* (Sw.) DC.	0	0	0	0.86
9	*Tamarix aphylla* (L.) Karst.	2.03	0	0	0
10	*Zizyphus maurtiana* Lam.	14.2	54.1	28.1	19.7
11	*Astragalus psilocentros* Fisch.	0	1.9	2.09	8.88
12	*Calligonum polygonoides* L.	0	15.3	2.3	0
13	*Calotropis procera* (Wild.) R. Br.	9.79	10.3	5.59	2.24
14	*Capparis decidua* (Forssk.) Edge worth.	0	0	7.49	11.9
15	*Capparis spinosa* L.	0	0	0	8.5
16	*Cassia angustifolia* Vahl.	0	0	3.19	0
17	*Datura metel* L.	13	7.99	1.1	0
18	*Periploca aphylla* Decne.	12.7	5.28	3.26	0.73
19	*Punica granatum* L	0	0	0	8.81
20	*Rhazya stricta* Decne.	0	0	15.7	20.2
21	*Ricinus communis* L.	6.5	2.83	0.83	0
22	*Saccharum bengalense* Retz.	21.9	19.8	6.34	9.02
23	*Saccharum spontaneum* L.	1.38	0	3.03	0.75
24	*Withania coagulans* (Stocks) Dunal.	0	0	14.2	2.15

25	*Zizyphus nummularia* (Burm.f.) W. & A.	0	0	4.87	4.93
26	*Aerua persica* (Burm.f.) Merrill.	16.3	5.28	19.9	49.4
27	*Asparagus gracilis* Royle.	0	5.98	4.19	9.25
28	*Asphodelous tenuifolius* Cavan.	0	2.15	2.27	0
29	*Cenchrus biflorus* Hook. f.	4.17	0	0	0
30	*Cenchrus ciliaris* L.	0	12.3	15.9	12.8
31	*Centaurea iberica* Trev.Ex. Spreng	0	0	1.32	1.53
32	*Chenopodium album* L.	2.7	4.76	0	0
33	*Citrullus colocynthis* L. Schrad.	1.7	5.57	1.32	0
34	*Convolvulus arvensis* L.	6.9	2.3	0	0
35	*Convolvulus pluricaulis* Choisy.	0	0	2.82	7.64
36	*Crotalaria medicaginea* Lam.	0	1.22	0	0
37	*Cymbopogon jwarancusa* (Jones) Schult.	0	0	0	20.9
38	*Cynodon dactylon* (L.) Pers.	5.08	3.4	13.1	8
39	*Cyperus rotundus* L.	0	3.65	1.41	0
40	*Dichanthium annulatum* (Forssk) Staph.	0	0	11.5	8.44
41	*Echinops echinatus* D.C.	0	2.18	9.08	7.16
42	*Eragrostis poaoides* Beauv.	12.9	11.9	21.7	19
43	*Erodium malacoides* (L.)L. Her. Ex Ait.	0	0.81	0	0
44	*Euphorbia helioscopia* L.	5.89	6.44	0	0
45	*Euphorbia prostrata* Ait.	2.47	4.37	0	0
46	*Fagonia cretica* L.	22.6	6.68	34.5	8.2
47	*Hypecoum pendulum* L.	0	3.53	0	0
48	*Ifloga fontanesii* Cass.	12.1	10.7	0	0
49	*Ipomoea hederacea* (L.)Jacq.	0	0	1.32	0
50	*Kickxia ramosissima* (Wall) Janchen.	0	1.63	0	3.3
51	*Launaea nudicaulis* (L.) Hook. f.	0	7.7	8.1	4.25
52	*Malcolmia africana* (L.) R.Br.	1.8	2.04	0.66	0.44
53	*Malva parviflora* L.	0	2.75	0.98	0
54	*Malva neglecta* Wallr.	0	4.58	0.98	1.87

55	*Medicago laciniata* (L.) Mill.	0	0	0.49	1.66
56	*Melilotus indicus* (L.) All.	0	3.87	0	0
57	*Peganum hermala* L.	7.6	0	0	0
58	*Plantago ciliata* Desf.	9.9	4.34	0	0
59	*Plantago ovata* Forssk.	11.1	4.3	0	0
60	*Solanum nigrum L.*	4.99	3.3	0.75	0
61	*Salvia moorcroftiana* Wallich ex Benth.	0	0	12.4	0
62	*Saussurea heteromalla* (D.Don) Hand.	20.5	7.61	1.97	0
63	*Silene conoidea* L.	3.01	2.93	0.66	0
64	*Solanum incanum* L.	0	0	2.41	3.63
65	*Solanum surattense* Burm .f.	9.64	4.63	4.17	4.3
66	*Vicia sativa* L.	4.65	9.03	1.61	0

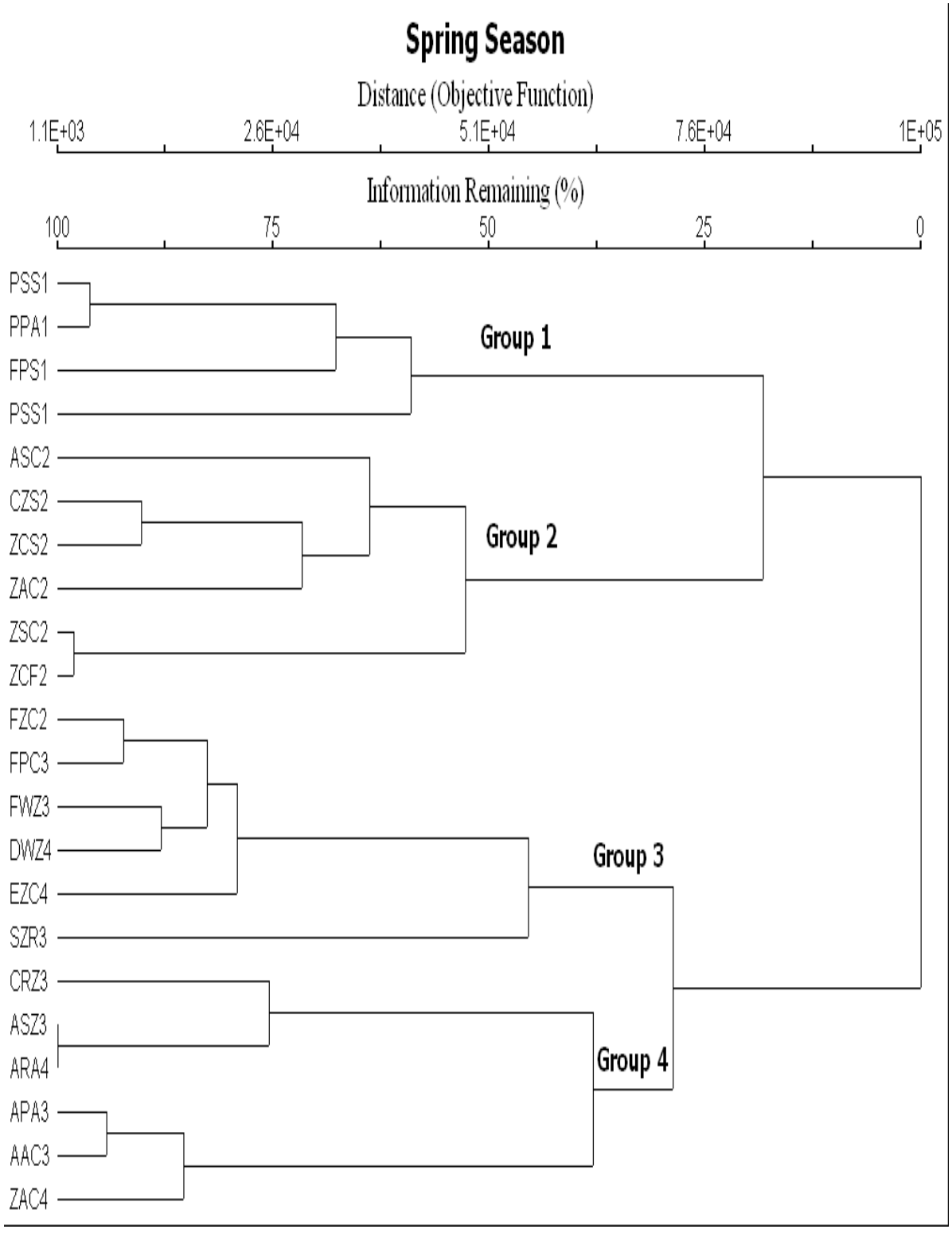


Fig. 47. Two way cluster dendrogram showing grouping of different communities into association during spring, Tehsil Takht-e-Nasrati, Karak.

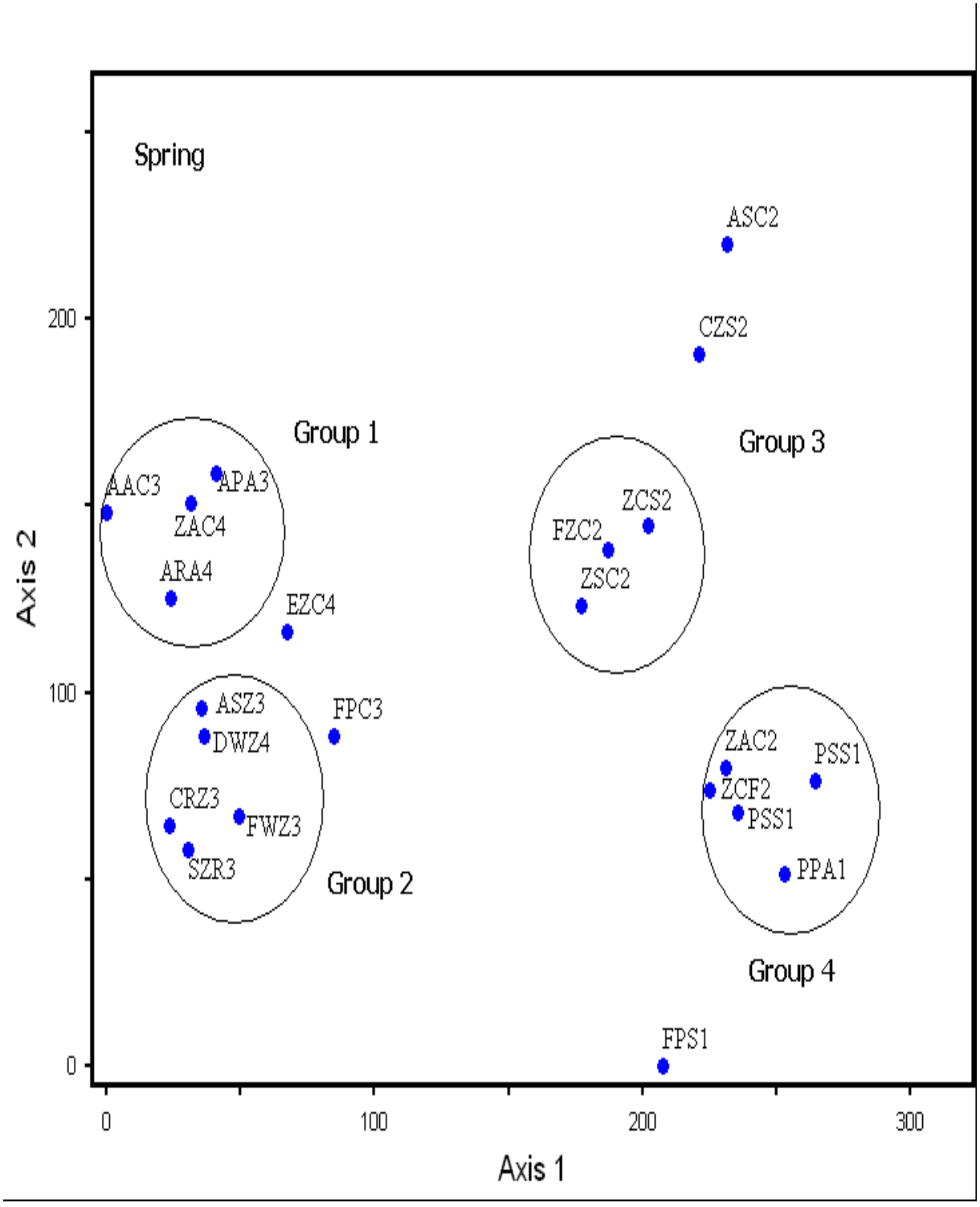


Fig. 48. Detrended Correspondence Analysis (DCA) of communities during spring, Tehsil Takht-e-Nasrati, Karak.

2. Summer Season

2.1. Hierarchical Cluster Analysis

In summer season, 22 communities were analyzed for ordination by Cluster Analysis and DCA. The Hierarchical Cluster Analysis shows that the relationship among 22 communities during summer were inclusive into 21 cluster cycling where in cycle 1 it shows the relationship of 2 communities at 4.6423E-02 and last i.e. cycle 21, 22 communities were connected with one another at 3.9256E+00 as well as 0.66 % chaining. Furthermore, it marked out distinct five groups by different level, cycling and similarity of communities. The picture of each one group is as below:

1. *Cenchrus-Saccharum-Prosopis* association

The Group 1 consists of *Eragrostis-Calotropis-Prosopis* community (ECP), *Phoenix- Saccharum-Cenchrus* community (PSC), *Aerua-Prosopis-Saccharum* community (APS) and *Tribulus-Tamarix-Saccharum* community (TTS) which raised at 1.5117E+00 in cycles 14. It composed of 28 plant species consisted of 6 trees, 6 shrubs and 16 herbs. The dominant plant species on the basis of important value *Cenchrus biflorus* (IV = 29.2), *Saccharum bengalense* (IV = 25.5) and *Prosopis farcta* (IV = 24.3) (Table 89; Fig. 49).

2. *Cenchrus-Eragrostis-Calligonum* association

Group 2 consists of 26 species of 4 tree, 5 shrubs and 17 herbs. *Eragrostis-Saccharum- Zizyphus* community (ESZ), *Calligonum-Cenchrus-Zizyphus* community (CCZ), *Tribulus- Acacia-Saccharum* community (TAS) and *Calligonum-Tribulus*-Zizyphus community (CTZ) made the association at 6.2210E-01 in cycles 8. The mean highest important value was covered by *Cenchrus biflorus* (IV = 29.7), *Eragrostis poaoides* (IV = 26.6), *Calligonum polygonoides* (IV = 26.14) (Table 89; Fig. 49).

3. *Zizyphus-Cenchrus-Eragrostis* association

Zizyphus-Cenchrus-Saccharum community (ZCS), *Saccharum-Zizyphus-Cynodon* community (SZC) and *Eragrostis-Zizyphus-Capparis* community (EZC) formed the 3rd group of association at 8.7080E-01 in cycles 10. . It composed of 27 species included 3 tree, 9 shrub and 15 herb species. The dominant plant of association were

Zizyphus maurtiana (IV = 51.25), *Cenchrus biflorus* (IV = 33.88) and *Eragrostis poaoides* (IV = 32.44) (Table 89; Fig. 49).

4. *Rhazya-Fagonia-Cymbopogon* association

Rhazya Fagonia Cymbopogon association becomes visible in the form of 4rth group at 1.9213E+00 in cycle 16 that consists of 5 communities i.e. *Cymbopogon-Rhazya-Zizyphus* community (CRZ), *Fagonia-Rhazya-Zizyphus* community (FRZ), *Cenchrus-Cassia-Zizyphus* community (CCZ), *Cleome-Phoenix-Capparis* community (CPC) and *Tribulus-Periploca-Zizyphus* community (TPZ). The mean highest IV was attained by *Rhazya stricta* (IV = 32), *Fagonia cretica* (IV = 29.2) and *Cymbopogon jwarancusa* (IV = 25.7). Moreover, 33 plants consisted of 7 tree, 10 shrub and 16 herb species were present (Table 89; Fig. 49).

5. *Aerua-Boerhavia-Zizyphus* association

Saccharum-Cymbopogon-Zizyphus community (SCZ), *Capparis-Aerua-Acacia* community (CAA), *Aerua-Acacia-Capparis* community (AAC), *Boerhavia-Acacia-Capparis* community (BAC) and *Boerhavia-Zizyphus-Capparis* community (BZC) formed the group 5 at 2.1408E+00 during cycle 17. It composed of 26 species contained 5 trees, 9 shrubs and 12 herbs. The mean highest IV represented by *Aerua persica*, *Boerhavia diffusa* and *Zizyphus maurtiana* were 41.8, 26.5 and 21.87 respectively (Table 89; Fig. 49).

2.1. Detrended Correspondence Analysis (DCA)

Ordination of the communities in summer by DCA explains that 5 groups i.e. 1, 2, 3, 4 and 5 on the basis of DCA weight on Axis 1 and 2, with different weight were formed that comprises 5, 3, 2, 5 and 2 communities respectively. On axis 1, Groups 1, 2, 3, 4 and 5 were structured with DCA mean weight 171.2, 136.7, 70, 40.3 and 14.5 at EIG 0.385 respectively. High DCA weight (244) in BAC and low (0) in ECP was present on Axis 1. On axis 2, the mean DCA weight of Groups i.e. 1, 2, 3, 4 and 5 were found as 106.2, 65, 120, 57.67 and 5.5 respectively while the highest DCA weight (168) was found in ECP and low (0) in ZCS at EIG (0.157). The communities that were not present in any groups were BAC, BZC, CRZ, APS and ECP with DCA weight 244, 224, 192, 64 and zero respectively on Axis 1. These groups show different vegetation types during summer seasons (Fig. 50).

Table 89. Mean relative importance value of species in different associations during summer distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak.

S. No	Species Name	Groups				
		1	2	3	4	5
1	*Acacia modesta* Wall.	0	0	0	7.2	21.37
2	*Acacia nilotica* (L.) Delice.	3.92	10.03	4.34	4.38	2.82
3	*Dalbergia sissoo* Roxb.	2.32	5.17	5.91	0.68	2.01
4	*Gymnosporia royleana* Wall. ex M. A. Lawson	0	0	0	0.93	0
5	*Monotheca buxifolia* (Falc.) A.D.	0	0	0	1.09	0
6	*Phoenix dactylifera* L.	12.2	2.99	0	6.19	0
7	*Prosopis juliflora* (Sw.) DC.	0	0	0	0	1.04
8	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	24.3	0	0	0	0
9	*Tamarix aphylla* (L.) Karst.	1.4	0	0	0	0
10	*Zizyphus maurtiana* Lam.	12.3	15.68	51.25	17.6	21.87
11	*Astragalus psilocentros* Fisch.	0	0	2.07	0.73	16.14
12	*Calligonum polygonoides* L.	0	26.14	3.38	0	0
13	*Calotropis procera* (Wild) R.Br.	16.4	6.18	7.76	3.7	2.54
14	*Capparis decidua* (Forssk.) Edge worth.	0	0	9.3	7.2	16.11
15	*Capparis spinosa* L.	0	0	0	0	20.53
16	*Cassia angustifolia* Vahl.	0	0	0	7.14	0
17	*Datura metel* L.	6.22	1.72	4.22	0	0
18	*Periploca aphylla* Decne.	10.1	6.84	4.5	6.9	0
19	*Punica granatum* L.	0	0	0	0	7.74
20	*Rhazya stricta* Decne.	0	0	2.98	32	9.52
21	*Ricinus communis* L.	2.2	0	0	0	0
22	*Saccharum bengalense* Retz.	25.5	18.02	22.66	3.37	11.4
23	*Saccharum spontaneum* L.	12.6	0	0	5.64	0

24	*Withania coagulans* (Stocks) Dunal.	0	0	0.91	10.8	1.79
25	*Zizyphus nummularia* (Burm.f.) W. & A.	0	0	0	6.71	3.89
26	*Aerua persica* (Burm.f.) Merrill.	16	2.48	2.31	4.3	41.8
27	*Boerhavia diffusa* L..	8.81	12.69	16.46	10.8	26.5
28	*Cenchrus biflorus* Hook. f.	29.2	29.7	33.88	15.7	6.7
29	*Chrozophora obliqua* (Vahl.) A. Juss.	6.32	6.54	0	0	0
30	*Citrullus colocynthis* L. Schrad.	0	6.91	9.06	0	0
31	*Cleome viscosa* L.	0	0	0	8.13	0
32	*Cymbopogon jwarancusa* (Jones) Schult.	0	5.12	0	25.7	10.33
33	*Cynodon dactylon* (L.) Pers.	5.6	5.7	13.86	15.1	18.17
34	*Cyperus esculentus* L.	18	8.11	3.1	4.6	16.74
35	*Cyperus rotundus* L.	7.16	14.65	17.66	7.8	4.51
36	*Echinops echinatus* Roxb.	0	5.15	1.48	3.42	2.22
37	*Eragrostis poaoides* Beauv.	22.4	26.6	32.44	17.5	7.84
38	*Euphorbia hirta* L.	7.3	21.49	9.01	0	0
39	*Euphorbia prostrata* Ait.	3.8	15.87	14.38	5.6	0
40	*Fagonia cretica* L.	9.66	7.47	7.96	29.2	4.6
41	*Heliotropium europaeum* L.	8.53	11.61	0	2.69	0
42	*Launaea nudicaulis* (L.) Hook. f.	0	0	3.53	0	0
43	*Peganum hermala* L.	5.52	0	0	0	0
44	*Salvia moorcroftiana* Wallich ex Benth.	0	0	0	4.4	0
45	*Solanum surattense* Burm .f.	3.04	1.63	5.81	11.9	3.52
46	*Tribulus terrestris* L.	19.2	25.51	9.78	10.9	18.3

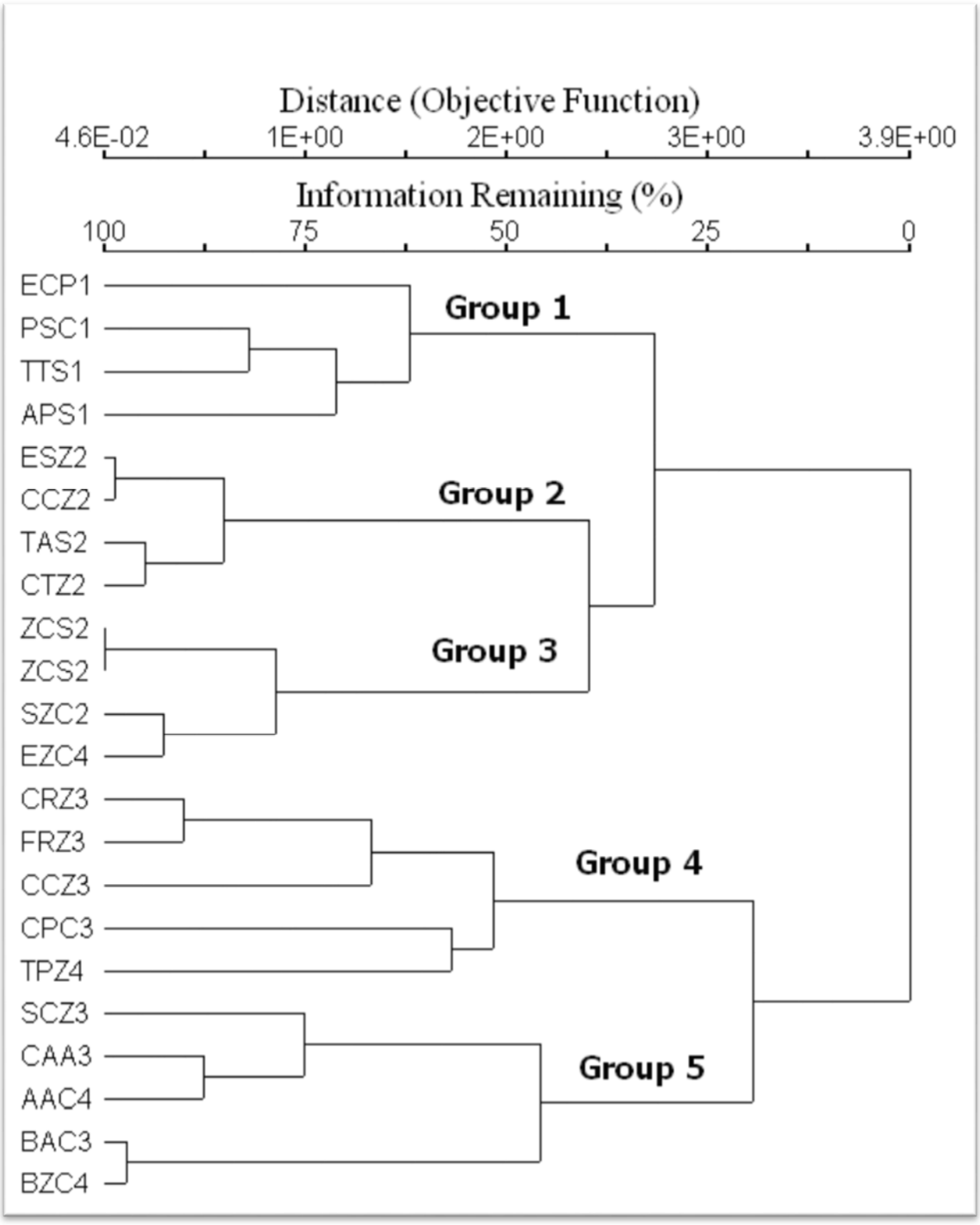


Fig. 49. Two way cluster dendrogram showing grouping of different communities into association during summer, Tehsil Takht-e-Nasrati, Karak.

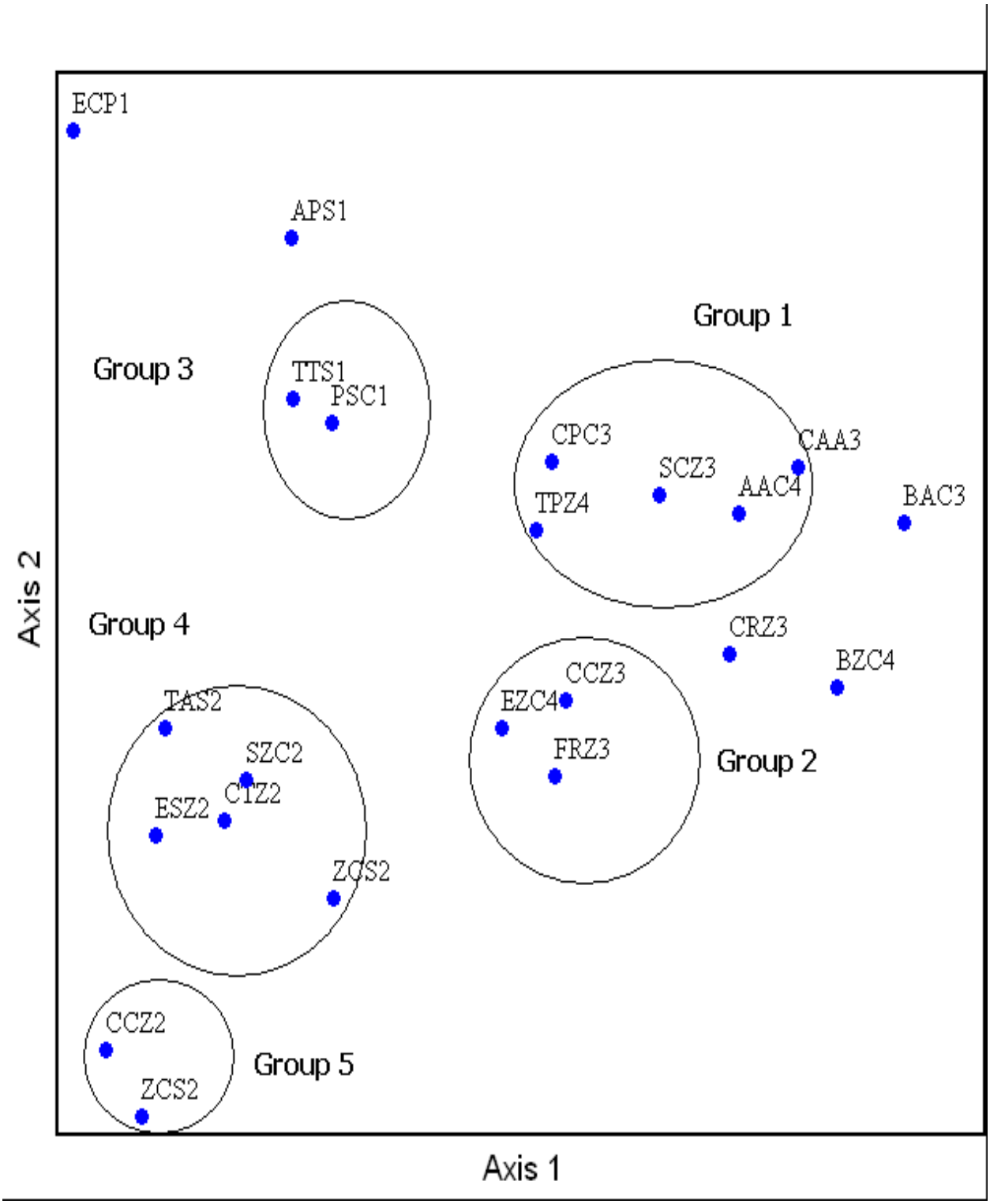


Fig. 50. Detrended Correspondence Analysis (DCA) of communities during summer, Tehsil Takht-e-Nasrati, Karak.

3. Winter season

3.1. Hierarchical Cluster Analysis

The Hierarchical Cluster Analysis shows that the relationship among 22 communities during winter were completed into 21 cluster's cycling wherever in 1st cycle, it pointed up the relationship of 2 communities at 1.0792E-01 and in end cycle, 22 communities were related with one another at 6.5113E+00 by way of 2.63 % chaining. In addition on the basis of relationship, it distinct out 4 diverse groups comprising at various level, cycling and similarity of communities. The description of each one group is as under:

1. *Cenchrus-Saccharum-Prosopis* association

Group 1 comprises *Cenchrus-Calotropis-Prosopis* community (CCP), *Cenchrus-Periploca-Prosopis* community (CPP), *Cenchrus-Saccharum-Phoenix* community (CSP) and *Zizyphus-Peganum-Saccharum* community (ZPS) and was arranged in cycle 10 at 1.7502E+00. It composed of 41 species with 7 tree, 6 shrubs and 28 herbs. The dominant plant species on the basis of important value were *Cenchrus biflorus* (IV = 88.3), *Saccharum bengalense* (IV = 30.4) and *Prosopis farcta* (IV = 13.9) (Table 90; Fig. 51).

2. *Cenchrus-Zizyphus-Saccharum* association

Cenchrus-Calligonum-Acacia community (CCA), *Cenchrus-Zizyphus-Saccharum* community (CZS), *Cenchrus-Saccharum-Acacia* community (CSA), *Cenchrus-Saccharum-Zizyphus* community (CSZ), *Zizyphus-Cenchrus-Calligonum* community (ZCC) and *Zizyphus-Cenchrus-Saccharum* community (ZCS) formed the association in the form of group 2 in cycle 14 at 2.7128E+00. It arranged 43 species having 4 trees, 5 shrubs and 34 herbs. Furthermore, the mean highest important value was presented by *Cenchrus biflorus* (IV = 73.4), *Zizyphus maurtiana* (IV = 41.8) and *Saccharum bengalense* (IV = 32.5) (Table 90; Fig. 51).

3. *Cenchrus-Zizyphus-Cymbopogon* association

The group 3 was originated in cycle 19 at 4.4519E+00 that linked the *Saccharum-Cenchrus-Zizyphus* community (SCZ), *Cymbopogon-Rhazya-Zizyphus* community (CRZ), *Cassia-Zizyphus-Fagonia* community (CZF), *Phoenix-Fagonia-Capparis* community (PFC), *Fagonia-Zizyphus-Saccharum* community (FZS), *Zizyphus-Capparis-Phragmites* community (ZCP), *Astragalus-Aerua-Zizyphus* community (AAZ)

and *Cenchrus-Rhazya-Zizyphus* community (CRZ) together. This association composed of 48 species included 7 tree, 12 shrub and 29 herb species in which the mean highest important value was offered by *Cenchrus biflorus* (IV = 24.2), *Zizyphus maurtiana* (IV = 22.40) and *Cymbopogon jwarancusa* (IV = 20.72) (Table 90; Fig. 51).

4. *Aerua-Zizyphus-Acacia* association

Aerua-Acacia-Capparis community (AAC), *Zizyphus-Aerua-Capparis* community (ZAC), *Capparis-Aerua-Acacia* community (CAA) and *Aerua-Capparis-Zizyphus* community (ACZ) were arranged in cycle 12 at 2.2257E+00 and shaped group 4. It composed of 34 plant species covered 5 trees, 9 shrubs and 20 herbs in which the highest mean important value 46.3, 28.7 and 27.5 were represented by *Aerua persica, Zizyphus maurtiana* and *Acacia modesta* respectively (Table 90; Fig. 51).

3.2. Detrended Correspondence Analysis (DCA)

Ordination of the communities by DCA highlight 4 groups i.e. 1, 2, 3 and 4 which composed of 8, 3, 3 and 2 communities respectively. The community AAC with high weight (259) as low weight (0) of CCA was present on DCA Axis 1 and summarizes the group 1, 2, 3 and 4 with mean weight 27.75, 75, 161 and 229 at EIG (0.495) respectively. On DCA Axis 2, the high weight (235) was found in CRZ and low (0) in AAC and give shape to groups 1, 2, 3 and 4 with the mean weight as 120.62, 103.33, 107.67 and 56.5 at EIG (0.206) respectively. Other communities that did not appear in groups were CRZ, AAZ, CRZ, CZF, ZAC and AAC with DCA weight 247, 232, 143, 187, 215 and 259 on DCA Axis 1 respectively. These Groups show different vegetation types during winter seasons (Fig. 52).

Cluster analysis segregates the communities of similar character into major groups of plant life. In spring and winter, 4 groups were structured while in summer 5 group. The chaining percentage between communities association was high 3.29 in spring while low 0.66 in summer. From this it was noticed that the chaining percentage would be high with high quantity and presence of species in an area. In spring, species were mostly found in all sites in less or high quantity while in summer, species presence is restricted to specific area due to diverse factors. Most factors that occur during summer in under investigated area were high grazing, cutting, non availability of water, soil erosion and uprooting of plant species.

Ahmed & Yasmin (2011) analyzed natural vegetation of two zones along Hanna Lake, Baluchistan using DECORANA and classify the vegetation into plant communities.

Major group is the objective to give structure to plant life. However, cluster analysis is a helpful preliminary position for competent judgment and adjoining neighbors of vegetation. Greater the homogeneity within communities and greater will be the similarity in the clustering. The cluster analysis was used to give clear picture of the plant life in an area in the form of tree - shape. In hierarchical clustering the principle is to structure a hierarchical chain of communities' groups sorting from groups of community position at the bottom to a comprehensive group at the top. The graphically diagram which represents the hierarchy in the structure of upturned tree expresses a dendogram that clarifies the arrangement in which position were united (bottom-up outlook) or group were divide (top-down outlook).

Detrended Correspondence Analysis (DCA) was used to give the shape to the communities on the basis of weight. This method is also used to give cleared picture of plant life in specific area in different seasons. The present results conclud that the plant species composition was different in different seasons in the same area. On axis 1, in spring, communities DCA weight was high in plain area and low in hilly area while in summer and winter, the DCA weight was low in plain area. In spring, plant species are available in every site of investigated area while in summer and winter, plants are restricted to specific sites due to environmental condition. However, DCA has limitations, making it best to remove extreme outliers and discontinuities prior to analysis. DCA consistently gives the most interpretable ordination results, but as always the interpretation of results remains a matter of ecological insight and is improved by field experience and by integration of supplementary environmental data for the plant life sample sites. Ali & Malik (2010) applied the Detrended Correspondence Analysis (DCA) to identify environmental gradients to define vegetation distribution in green belts, gardens and parks of Islamabad city and classified the flora into 4 major association groups.

Four association from spring and winter and five associations from summer were focused by the present study. El-Ghanim *et al*. (2010) studied the vegetation at

Hail region north of central Saudi Arabia where multivariate techniques results showed 7 vegetation groups. Ahmad *et al*. (2010b) analyzed the vegetation along motorway (M-2), Pakistan by using multivariate techniques. In the investigated area, the fore mentioned facts noticeably indicate that slope, edaphic factor, harsh erosion, crushing of herbs and supply of rain water were the key source of plant life discrepancy. These geomorphologic aspects restrict the limitations and composition of plant communities. Distant from the reality that the site changeable are definitely significant for explaining the major plant life nature the association between the results of cluster analysis and DCA planes allow a direct analysis of scores of position data in DCA plane in relation to area up-and-down. The DCA technique provided interpretable and dynamic results than other ordination techniques and the length of first axis was greater than 3.0 and in terms of communities or species turnover. Jongman *et al*. (1995) recommended that if plants species or communities turnover is larger than 1.9 standard deviation then DCA techniqe is advanced option of ordination. Detrended Correspondence Analysis (DCA) was carried out to express compositional ascents in the plant life. DCA was presented using a default value for rescaling and detrending. Rare species and divergent communities were downweighted in DCA ordination.

The different association produced by cluster analyses in different seasons are designed a first two axes as a sprinkled diagram. The DCA ordination axes may signify in same way the main substrate weight that affect the community in these records and have been used by the community and area characteristic of the relationship to argue the dominant characteristics of the location and plant life association. Cluster and DCA analysis are very helpful in communities' and species classification in addition to give structure to plant life. Such type of study was also carried out by Saima *et al*. (2009) who stated that tree density, pH and soil texture were the major determinant of vegetation pattern. There was thin vegetation in the invistigated area and species was present in patches. The ecologists have tried to quantify the division of species beside the ecological gradients. There is an association between plant life sample and resources available (Ahmad *et al*., 2009b and Jabeen & Ahmad, 2009).

The ordination by means of cluster analysis and DCA help us skillfully in evaluating the classification of plants and structure of entire habitat of plant life. Malik & Hussain (2008) conducted a study to work out the relationship between remote sensing data and vegetation communities of ecological importance using multivariate techniques and stated that the ordination methods proved effective in summarizing basic, general structure of the plant community types and to some extent indicated correspondence with their spectral signatures. This study pointed out that the climatic environment of region has restricted enlistment of area and the plant life was changed with the change of seasons and altitude. Our result agrees with Dasti & Malik (1998) who stated that altitude is an environmental factore which affecting plants association. Plant ecologists have commonly been aware that plant life shows an inconsistency over a wide range of particular scales and area that have built up methods for studying the classification of vegetation. The area show less rainfall than 200 mm and consist of thorny trees like *Zizyphus spp, A. nilotica*, *A. modesta*. Trees are sprinkled, roots longs, leaves thick and small in most plant species therefore, the investigated area fall into tropical thorn forests. The value of altitude as an ecological factor affecting plant species association is not considering, surprising its close correlation with precipitation and interruption of rain (Danin *et al.*, 1975; Evenari *et al.*,1982).

Table 90. Mean relative importance value of species in different associations during winter distinguished through cluster analysis of Tehsil Takht-e-Nasrati, Karak.

S. No	Species Name	Groups			
		1	2	3	4
1	*Acacia modesta* Wall.	0.48	0	6.98	27.5
2	*Acacia nilotica* (L.) Delice.	3.61	13.7	5.41	3.45
3	*Dalbergia sissoo* Roxb.	11.3	7.67	2.04	1.31
4	*Gymnosporia royleana* Wall. ex M. A. Lawson.	0	0	0.90	0
5	*Monotheca buxifolia* (Falc.) A.D.	0	0	0.90	0
6	*Phoenix dactylifera* L.	11.5	2.53	5.01	0
7	*Prosopis farcta* (Banks & Soland.) J.F. Macbr.	13.9	0	0	0
8	*Prosopis juliflora* (Sw.) DC.	0	0	0	1.36
9	*Tamarix aphylla* (L.) Karst.	1.22	0	0	0
10	*Zizyphus maurtiana* Lam.	10.1	41.8	22.40	28.7
11	*Astragalus psilocentros* Fisch.	0	0	8.13	7.52
12	*Calligonum polygonoides* L.	0	17.6	5.40	0
13	*Calotropis procera* (Wild.) R.Br.	5.35	6.5	4.26	3.4
14	*Capparis decidua* (Forssk.). Edge worth.	0	0	9.62	26.4
15	*Capparis spinosa* L.	0	0	0	26
16	*Cassia angustifolia* Vahl.	0	0	5.10	0
17	*Datura metel* L.	2.13	1.81	1	0
18	*Periploca aphylla* Decne.	8.83	4.32	4.50	0
19	*Punica granatum* L.	0	0	0	12.1
20	*Rhazya stricta* Decne.	0	0	20.70	11.9
21	*Saccharum bengalense* Retz.	30.4	32.5	7.63	4.82
22	*Saccharum spontaneum* L.	3.89	0	3.21	0
23	*Withania coagulans* (Stocks) Dunal.	0	0	7.46	2.32
24	*Zizyphus nummularia* (Burm.f.) W & A.	0.91	0	4.41	1.6

25	*Achyranthus aspera* L.	6.08	3.66	3.32	1.33
26	*Aerua persica* (Burm.f.) Merrill.	10.6	3.78	10.9	46.3
27	*Aristida caerulescens* Desf.	0	0	0.9	0
28	*Asphodelous tenuifolius* Cavan.	0	1.71	0	3.03
29	*Boerhavia diffusa* L..	2.98	4.94	12.1	15.5
30	*Cenchrus biflorus* Hook. f.	88.3	73.4	24.2	13.3
31	*Cenchrus ciliaris* L.	0	0	2.63	0
32	*Centaurea iberica* Trev.Ex. Spreng	0	0.87	0	1.1
33	*Chenopodium album* L.	0.49	2.5	0	0
34	*Chenopodium mural* L.	0	1.26	0	0
35	*Citrullus colocynthis* L. Schrad.	0	6.09	0	0
36	*Cleome viscosa* L.	0	0	1.62	0
37	*Convolvulus arvensis* L.	1.97	1.54	0.51	0
38	*Corchorus trilocularis* L.	1.55	0	1.74	0
39	*Cymbopogon jwarancusa* (Jones) Schult.	0	0	20.72	3.3
40	*Cynodon dactylon* (L.) Pers.	4.3	4.85	14.7	4.91
41	*Cyperus rotundus* L.	3.52	4.49	8.67	0
42	*Cyperus scarlosus* R.Br.	0	2.7	2.62	7.43
43	*Desmostachya bipinnata* (L.) Stapf.	0	0	0.51	0
44	*Dichanthium annulatum* (Forssk) Staph.	0	0	4.93	0
45	*Digera muricata* (L.). Mart.	3.94	0.7	1.63	0
46	*Echinops echinatus* D. C.	1	2.15	2.56	1.99
47	*Eragrostis poaoides* Beauv.	6.96	5.05	15.8	3.04
48	*Erodium malacoides* (L.) L Her. ex Ait.	0	0.72	0	0
49	*Euphorbia helioscopia* L.	8.17	3.55	0	0
50	*Euphorbia prostrata* Ait.	2.64	7.27	1.68	0
51	*Fagonia cretica* L.	7.14	7.37	18.2	3.58
52	*Ifloga fontanesii* Cass.	7.94	7.54	1.35	0
53	*Ipomoea hederacea* (L.)Jacq.	0	0.87	0	2.2
54	*Kickxia ramosissima* (Wall.) Janchen.	2.87	0	0	0

55	*Launaea nudicaulis* (L.) Hook. f.	0	0.97	0.3	0
56	*Malva parviflora* L.	0	0.53	1.34	0
57	*Malva neglecta* Wallr.	0.42	1.14	4.1	9.05
58	*Malvastrum coromandelianum* (L.) Gareke.	0	0	0	1.1
59	*Medicago laciniata* (L.) Mill.	3.2	4.3	5.54	1.75
60	*Peganum hermala* L.	7.06	0	0	0
61	*Phragmites karka* (Retz) Trin. ex. Steud.	0	0	4.47	0
62	*Plantago ciliata* Desf.	5.29	3.39	0	0
63	*Plantago ovata* Forssk.	5.18	3.77	0	0
64	*Pupalia lappacea* (L.) Juss.	0	0	0	5.6
65	*Rumex dentatus* L.	2.9	2.19	0	0
66	*Salvia moorcroftiana* Wallich ex Benth.	0	0	2.38	0
67	*Saussurea heteromalla* (D.Don.) Hand.	4.3	0	0	0
68	*Solanum miniatum* Beruh. ex Willd.	1.5	0	0	0
69	*Solanum surattense* Burm .f.	0	3.41	2.24	3.15
70	*Tribulus terrestris* L.	4.35	3.39	3.3	10.8
71	*Vicia sativa* L.	0	0.72	0	0
72	*Xanthium strumarium* L.	1.73	0.75	0	3.15

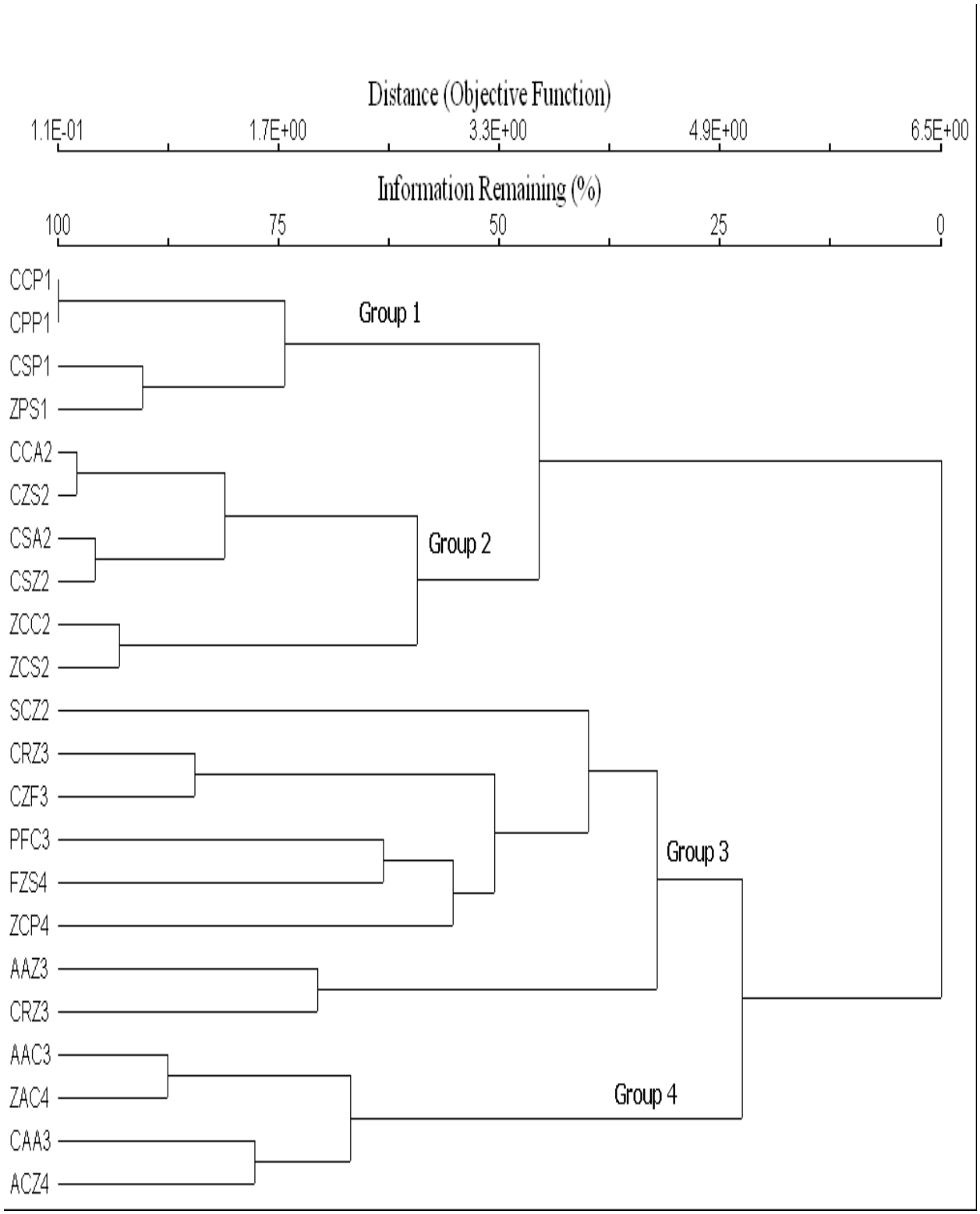


Fig. 51. Dendrogram showing grouping of different communities into association during winter, Tehsil Takht-e-Nasrati, Karak.

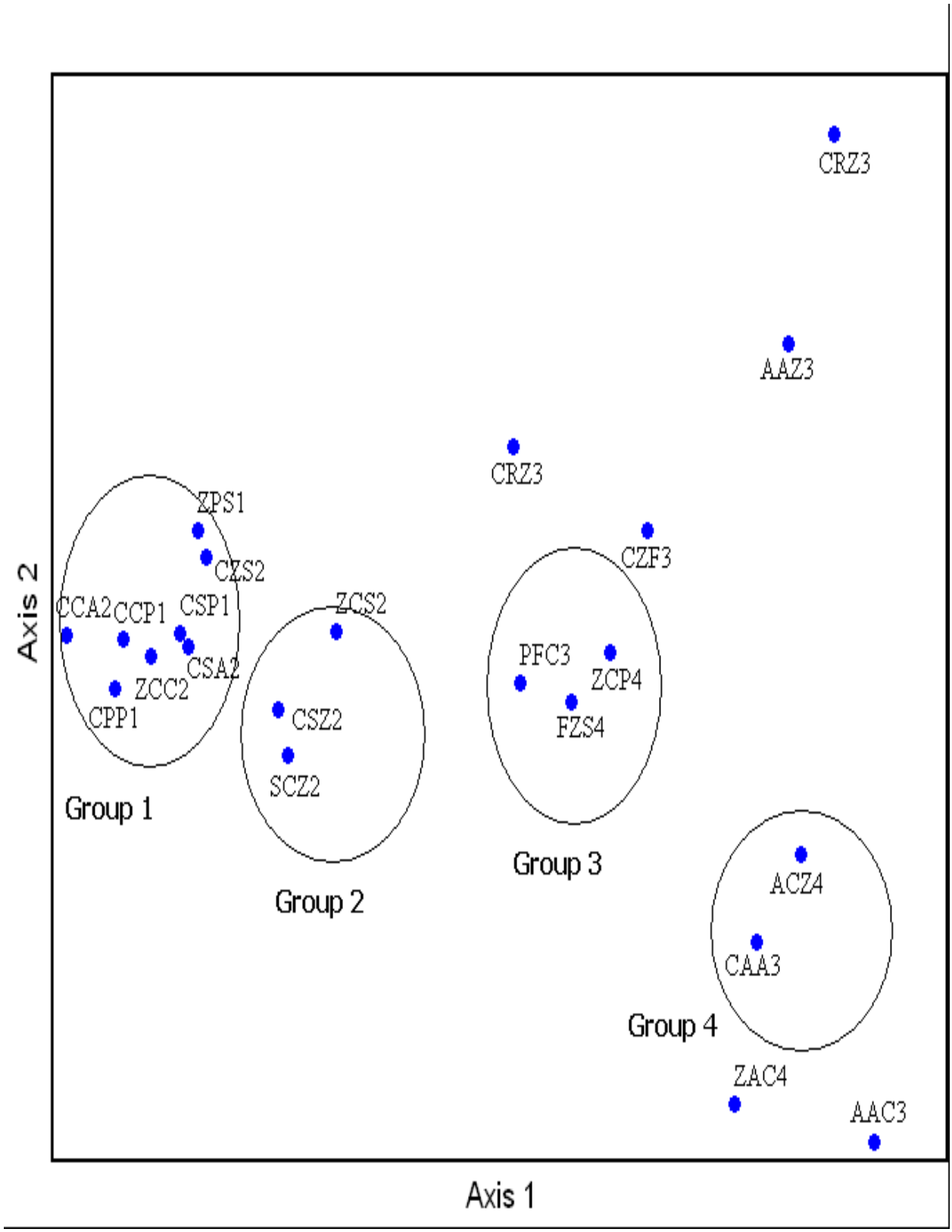


Fig. 52. Detrended Correspondence Analysis (DCA) of communities during winter, Tehsil Takht-e-Nasrati, Karak.

4.5.8. Rangeland Productivity

4.5.8.1. Herbaceous Biomass

The above ground fresh biomass of herbs and grasses in different altitudes i.e. between 340 -399 m (stand 1), 400-499 m (stand 2), 500-599 m (stand 3) and 600-700 m (stand 4) in Tehsil Takht-e-Nasrati, district Karak in three seasons i.e., spring, summer and winter is discussed separately below.

Stand 1

The fresh herb biomass between 340-399 m was high (962 Kg hec^{-1}) during spring and remained less (232 Kg hec^{-1}) in summer at Tater Khel. The fresh grass biomass was high (146 Kg hec^{-1}) at Gardi Banda in spring and less (68 Kg hec^{-1}) in winter at Warana. Among seasons the fresh biomass was high (426.5 Kg hec^{-1}) in spring and less (156 Kg hec^{-1}) in winter. The highest average herbaceous biomass among sites was in Tater Khel (298.7 Kg hec^{-1}) followed by Gardi Banda (288.7 Kg hec^{-1}), Ahmad Abad (269.33 Kg hec^{-1}) and Warana (194 Kg hec^{-1}) (Table 91; Fig. 53).

In summer the grazing intensity was very high so the biomass was less during summer. At the end of summer and early winter the rains started which the new plants grew. At that time the agricultural process becomes in progress so the farmer cut off herbs and grasses for their cattle which loss the fresh biomass. The plants also lost their biomass owing to chilly environment in winter's mid. During winter, unavailability of cultivated plants in the area people chooses the natural herbs and grasses for their live stocks which also less the biomass of herbs and grassed. Joshi *et al*. (2012) stated that the ground production was maximum in winter season and minimum in summer season in herb layer of banj oak-chir pine mixed forest in Kumaun, central Himalaya, India. Hussain & Durrani (2007) observe that the biomass contributed by grasses and herbs generally increased from April through August and thereafter it progressively decreased till October. The water level of the area is mostly low as compare to other area of the research area. In some places the water level is very high that increased the biomass of herbs and grasses. Joshi & Rawat (2011) analyzed the productivity of herbaceous vegetation and stated that the maximum above-ground production occurred during rainy season and minimum during winter season. Even though it is usually known that a good association is presents between rainfall and

biomass production (Rozenzwieg, 1968; Strickland & Haydock, 1978; Carton *et al*., 1988; Smuts, 1989). It should, however, be stressed that the production ability of ecotypes can be affected by rainfall factors. It appeared that loss of biomass due to weathering during the winter could, in some situations, be compensated for by harvesting near ground level to include the basal, which would usually be expected to be the heaviest internodes (Boe *et al*., 2000).

Stand 2

The fresh herbs biomass between 400-499 m was high (562 Kg hec^{-1}) at Kiri Khand during spring and less (110 Kg hec^{-1}) in summer at Northern Bogara. The fresh grass biomass was high (328 Kg hec^{-1}) at Kiri Dhand in summer and less (66 Kg hec^{-1}) in winter at Gandiri Khattak. Among seasons the biomass was high (258.89 Kg hec^{-1}) in spring and less (155.14 Kg hec^{-1}) in winter. The average herbaceous biomass among sites was high in Kiri Dhand (268 Kg hec^{-1}) followed by Mona Khel (246 Kg hec^{-1}), Jarassi (213.67 Kg hec^{-1}), Southern Bogara (212.68 Kg hec^{-1}), Jahangiri Banda (171.33 Kg hec^{-1}), Nouthern Bogara (164.85 Kg hec^{-1}) and Gandiri Khattak (161.98 Kg hec^{-1}) (Table 92; Fig. 54).

In stand 2, the biomass was high in spring and low in winter. The biomass was low as of stand 1 for the reason that rainwater which move toward stand 2 through rain stream are directly go away while stored in the ordinary reservoir in stand 1. As a result increases the dynamism and biomass of the plant life as will as raises the water level of the area. Arshadullah *et al*. (2009) investigated the response of various warm season forage grass species under semi-arid conditions of hills, Kharian range. In this area, people obtained fuel and livestock's food from xerophytes like *Zizyphus maurtiana* and *Acacia modesta* because the area is mostly desert like so herbs produce in the area turned into deceased owing the water deficiency. Arshadullah *et al*. (2011) recorded biomass of grasses; they found that the forage yield was higher in monsoon than in spring season due to prolonged growing period and more rainfall. The natives and biomass of herbs and grasses were counted on rain if in the summer's ending, rain happen, it takes the green revolution in the area beside the summer is very warm. The rainfall is very scanty in the area, which decreases the numbers and biomass of species. Therefore, the famous idiom in the area is "Khattak deprive of single drizzle".

Stand 3

At stand 3 (500-599 m), the fresh herbs biomass was high (716 Kg hec^{-1}) during spring at Shahidan Banda and less (190 Kg hec^{-1}) at Siraj Khel in summer. The fresh grass biomass was high (404 Kg hec^{-1}) at Chokara in summer and less (50 Kg hec^{-1}) in spring at Siraj Khel. Among seasons the grand total biomass was high (240.86 Kg hec^{-1}) in spring and less (185.29 Kg hec^{-1}) in winter. The highest average herbaceous biomass among sites was present in Chokara (275 Kg hec^{-1}) followed by Shahidan Banda (232.35 Kg hec^{-1}), Ambiri Kala (231.35 Kg hec^{-1}), Zarki Nasrati (207.99 Kg hec^{-1}), Takht-e-Nasrati (190 Kg hec^{-1}), Siraj Khel (154 Kg hec^{-1}) and Shawa (150.5 Kg hec^{-1}) (Table 93; Fig. 55).

Area between 500-599 m was consisting of small hills. The area is semi arid and the rain water is not stored in any part of the area. The biomass of herbs was also high in spring. The biomass of grasses was high during summer and low in spring The areas were often used as a natural meadow and grazing animal preferred the young grasses which cause declining of species biomass. In summer, the biomass of grasses was high in Chokara due to the presence of plant species in floral condition. Our results were agree with Ahmad *et al*. (2009c). He stated that the *Cymbopogon jwarancusa* biomass was low in April and high in June. Arshadullah *et al*. (2011) also stated that grasses biomass was higher in summer than in spring. In winter the herbs and grasses growth is to be less and are in mature stage which decrease the biomass. People cut both herbs and grasses for burning purposes and livestock's food. People spent their life hand to mouth that is why they cut the grasses like *Cymbopogon jwarancusa* during winter and carried to local bazaar to overcome their economic crisis. For this progression mainly effort was done by female (Fig. 56). Due to the cutting of plant species decreased the biomass of the communities in the area.

Though, the most critical month differed amongst locations and genotype groups differed in their response to moisture availability. Similarly, Muir *et al*. (2001) reported that switch-grass biomass yield was absolutely associated with precipitation during the growing season in Texas. Smart *et al*. (2005) also pointed out that it was commonly recognized to the amount of April through June precipitation was highly unpredictable and was a strong indicator of the current year's forage production in the

northern mixed-grass prairie. The result showed that the average biomass was high in spring and low in winter. Our result is also agreed with Joshi & Rawat (2011). They observed that maximum biomass occurred during rainy season (132.5 g m^{-2}) and low during winter (2.8 g m^{-2}).

Stand 4

At Shadi Khel the fresh herbs biomass was high (868 Kg hec^{-1}) during spring and low (158 Kg hec^{-1}) at Kandu Khel during winter. The fresh grass biomass was high (222 Kg hec^{-1}) at Kandu Khel during summer and less (54 Kg hec^{-1}) during winter at Sarki Lawager. Among seasons the grand total biomass was high (348.75 Kg hec^{-1}) in spring and less (144.25 Kg hec^{-1}) in winter. Comparison among sites the highest average fresh herbaceous biomass was initiated in Shadi Khel (248.65 Kg hec^{-1}) followed Kandu Khel (209 Kg hec^{-1}), Sarki Lawager (208.01 Kg hec^{-1}) and Shnawa (194.01 Kg hec^{-1}) (Table 94; Fig. 57).

Stand 4 was the highest region between 600-700m where biomass was high in spring and low throughout winter as compared to other stands except stand 1. The hills were generally composed of sand and clay so the water accessibility was missing in the hills which decrease the herbaceous biomass**.** Lamsal *et al*. (2012) determined the biomass of the Big Sur forest, California. They stated that the geo statistical analyses revealed that biomass distribution is spatially structured. The grasses are palatable in nature and essential for cattle nourishing and the height of the grasses found in the rangelands of stand 4 reached around 20-40 cm. In all the stands, maximum carrying capacity was recorded in summer. Similar findings have been reported by researchers in the world (Lemma, 2001; Amaslu & Baars, 2002; Alemayehu, 2004; Yvan & Tessema, 2005).

Herbaceous biomass is the total mass of herbs and grasses within a given unit. In bio-based wealth, herbaceous biomass such as herbs and perennial grasses will turn out to be important cellulosic supply for conversion to bio fuel, chemical constituents, energy and heat in the modern time. Due to environmental condition and grazing the biomass of plants is highly variable (Olson & Richard, 1989). There was an increasing trend of biomass up to the spring to winter in present investigation area. However, the collective biomass amount of both herbs and grasses were higher 426.5 Kg hec^{-1}

during spring at stand 1 as compared to other seasons and stands. The average grasses and herbs biomass was decreasing with increasing altitude. The herb biomass was high 730 Kg hec^{-1} during spring at stand 1 (340 – 399 m) and less during summer (194 Kg hec^{-1}) at stand 4 (600 -700 m). The grass biomass was high 173 Kg hec^{-1} during summer at stand 3 (400-499 m) and low 74 Kg hec^{-1} during winter at stand 1 (500-599 m). The total herbs mean biomass was high during spring (536.30 Kg hec^{-1}) while the grasses had (129.9 Kg hec^{-1}) during summer. The total average biomass was high at stand 1 (262.58 Kg hec^{-1}) and total mean and average biomass of the research area was 223.23 Kg hec^{-1} (Tables 91-94).

Means for fresh biomass (Kg hec^{-1}) of herb at different seasons showed differences for season to season at different altitude in investigated area (Fig. 58). It illustrated that throughout summer the grasses biomass was high at all stands but stand 1 where biomass was high in spring (Fig. 59). The means of herbaceous biomass at different seasons showed differences from season to season at different altitude in research area. The herb productivity was high in spring and low in winter at all the altitude. It reduced in summer due to high grazing intensity (Fig. 60). As a result of the agriculture approach as well as low grazing rate. Cassida *et al*. (2005) accomplished that water accessibility from April to July was critical for grass biomass production. Angassa (2005) studied the ecological impact of woody encroachment and the responses of herbage yield to encroachment. The assessment was based on the yield and floristic composition of the herbaceous layer. The quantity and quality of herbaceous biomass depend plant form, plant portion, growing season, growing region, harvesting time and harvesting methods. These factors can be handled to a definite amount to decrease entire herbaceous biomass. A crucial progress to herb biomass organization for conversion systems is needed that will help to develop strategies to decrease the problem of the area in plant adaptation. Tough work should be prepared to put together the approach with valuable exercises of herbaceous biomass including the potential for production of herbs and grasses to the ground. Difference of biomass production at different stands might be due to divergence in climatic conditions, rainfall and soil conditions. Rutherford (1980) stated that the association between climatic conditions subsist of which rainfall is regarded as the most essential.

Table 91. The herbaceous biomass (Kg hec^{-1}) producing during different seasons at stand 1,Tehsil Takht-e-Nasrati, Karak.

Sites	Species Stratum	Season			Average
		Spring	Summer	Winter	
Tater Khel	Herbs	962	282	228	490.7
	Grasses	126	112	82	106.7
	Total	**544**	**197**	**155**	**298.7**
Gardi Banda	Herbs	732	390	248	456.7
	Grasses	146	138	78	120.7
	Total	**439**	**264**	**163**	**288.7**
Ahmad Abad	Herbs	788	310	234	444
	Grasses	122	92	70	94.67
	Total	**455**	**201**	**152**	**269.33**
Warana	Herbs	438	232	242	304
	Grasses	98	86	68	84
	Total	**268**	**159**	**155**	**194**
Grand Total		**426.5**	**205.25**	**156**	**262.6**

Table 92. The herbaceous biomass (Kg hec^{-1}) producing during different seasons at stand 2, Tehsil Takht-e-Nasrati, Karak.

Sites	Species Stratum	Season			Average
		Spring	Summer	Winter	
S Bogara	Herbs	356	338	322	338.7
	Grasses	108	80	72	86.67
	Total	**232**	**209**	**197**	**212.68**
N Bogara	Herbs	384	110	150	214.7
	Grasses	92	159	94	115
	Total	**238**	**134.5**	**122**	**164.85**
Gandiri Khattak	Herbs	374	198	158	243.3
	Grasses	96	80	66	80.67
	Total	**235**	**139**	**112**	**161.98**
Kiri Dhand	Herbs	562	266	226	351.3
	Grasses	102	328	124	184.7
	Total	**332**	**297**	**175**	**268**
Jahangiri Banda	Herbs	392	272	218	294
	Grasses	0	78	68	48.67
	Total	**196**	**175**	**143**	**171.33**
Mona Khel	Herbs	468	422	258	382.7
	Grasses	126	120	82	109.3
	Total	**297**	**271**	**170**	**246**
Jarassi	Herbs	452	322	228	334
	Grasses	104	70	106	93.33
	Total	**278**	**194**	**167**	**213.67**
Grand total		**258.289**	**202.98**	**155.14**	**205.4**

Table 93. The herbaceous biomass (Kg hec^{-1}) producing during different seasons at stand 3, Tehsil Takht-e-Nasrati, Karak.

Sites	Species strata	Season			Average
		Spring	Summer	Winter	
Chokara	Herbs	364	260	288	304
	Grasses	94	404	240	246
	Total	**229**	**332**	**264**	**275**
Ambiri Kala	Herbs	280	210	310	266.7
	Grasses	96	298	194	196
	Total	**188**	**254**	**252**	**231.35**
Takht-e- Nasrati	Herbs	302	250	276	276
	Grasses	68	116	128	104
	Total	**185**	**183**	**202**	**190**
Siraj khel	Herbs	190	244	298	244
	Grasses	50	68	74	64
	Total	**120**	**156**	**186**	**154**
Shahidan Banda	Herbs	716	224	226	388.7
	Grasses	86	70	72	76
	Total	**401**	**147**	**149**	**232.35**
Zarki Nasrati	Herbs	540	238	240	339.3
	Grasses	94	80	56	76.67
	Total	**317**	**159**	**148**	**207.99**
Shawa	Herbs	386	216	192	264.7
	Grasses	106	0	0	35.33
	Total	**248**	**108**	**96**	**150.01**
Grand Total		**240.86**	**191.29**	**185.29**	**205.8**

Table 94. The herbaceous biomass (Kg hec^{-1}) producing during different seasons at stand 4, Tehsil Takht-e-Nasrati, Karak.

Sited	Species	Season			Average
		Spring	Summer	Winter	
Kandu Khel	Herbs	450	172	158	260
	Grasses	96	222	156	158
	Total	**273**	**197**	**157**	**209**
Shadi Khel	Herbs	868	180	162	403.3
	Grasses	164	60	58	94
	Total	**516**	**120**	**110**	**248.65**
Sarki Lawager	Herbs	612	200	240	350.7
	Grasses	68	74	54	65.33
	Total	**340**	**137**	**147**	**208.01**
Shnawa	Herbs	436	224	254	304.7
	Grasses	96	82	72	83.33
	Total	**266**	**153**	**163**	**194.01**
Grand Total		**348.75**	**151.75**	**144.25**	**214.9**

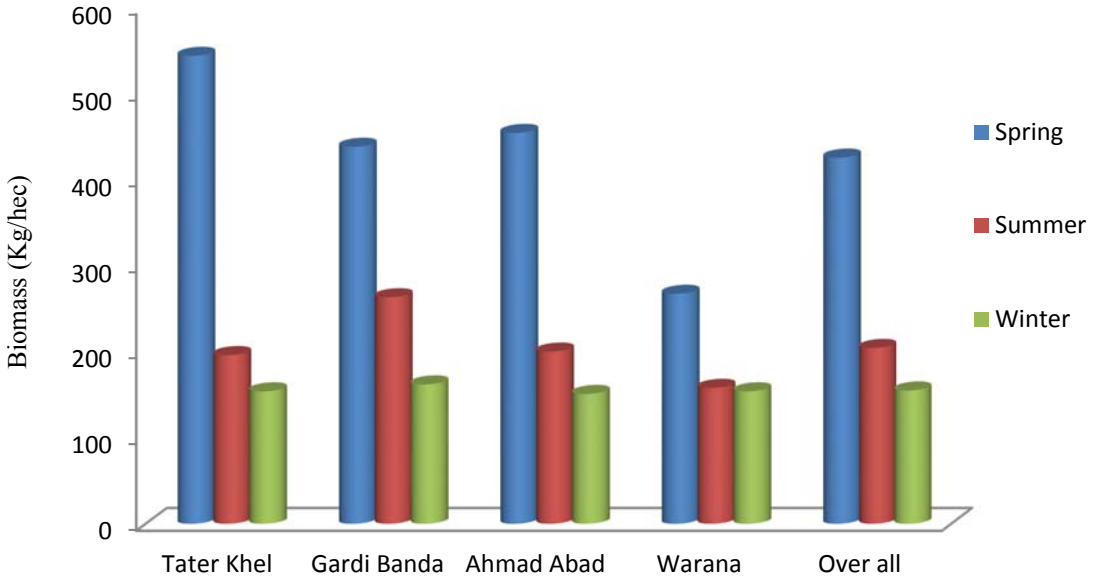


Fig. 53. Fresh biomass in stand 1show seasonal variation.

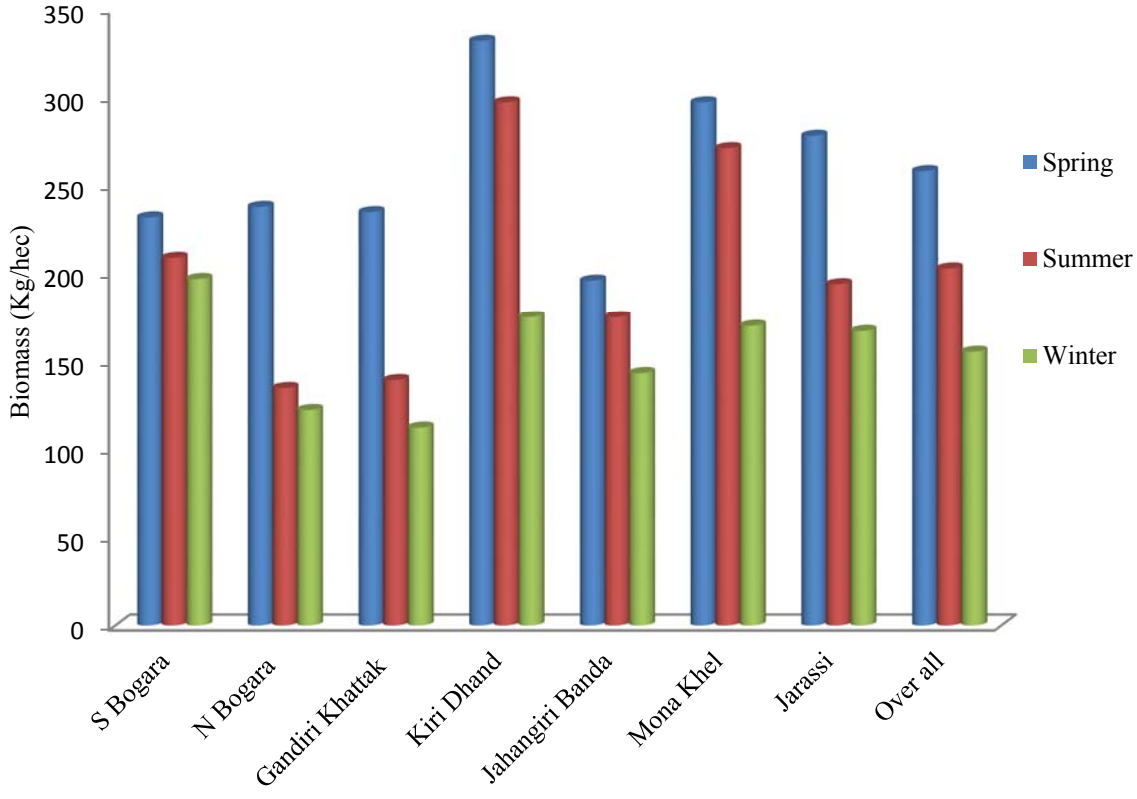


Fig. 54. Fresh biomass in stand 2 show seasonal variation.

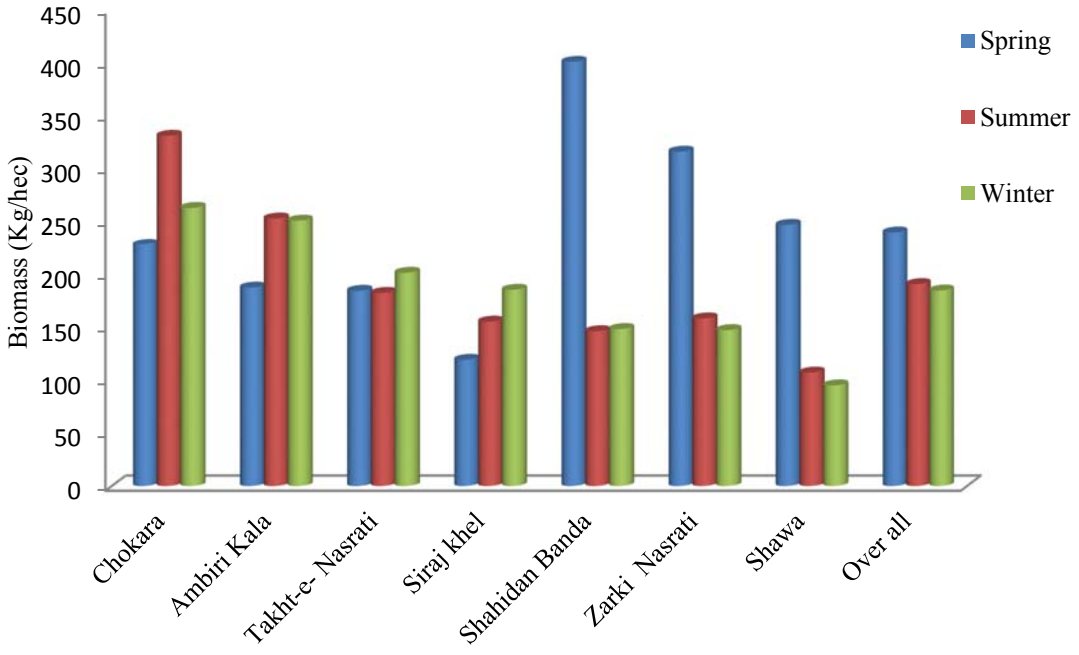


Fig. 55. Fresh biomass in stand 3, show seasonal variation.



Fig. 56. Female folk generally collect fodder and transport.

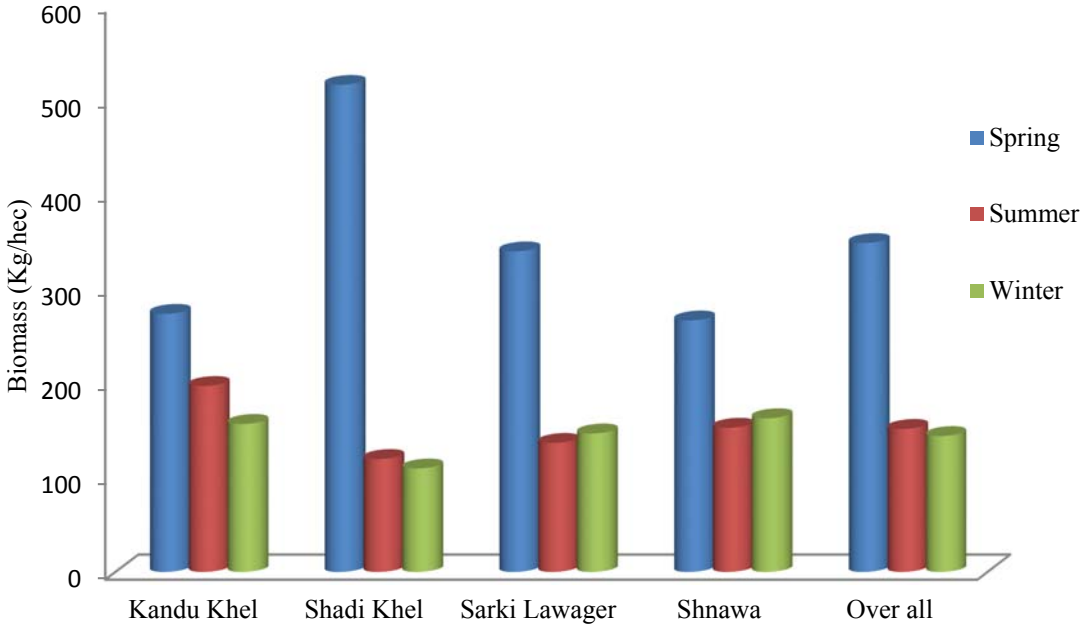


Fig. 57. Fresh biomass in stand 4, show seasonal variation.

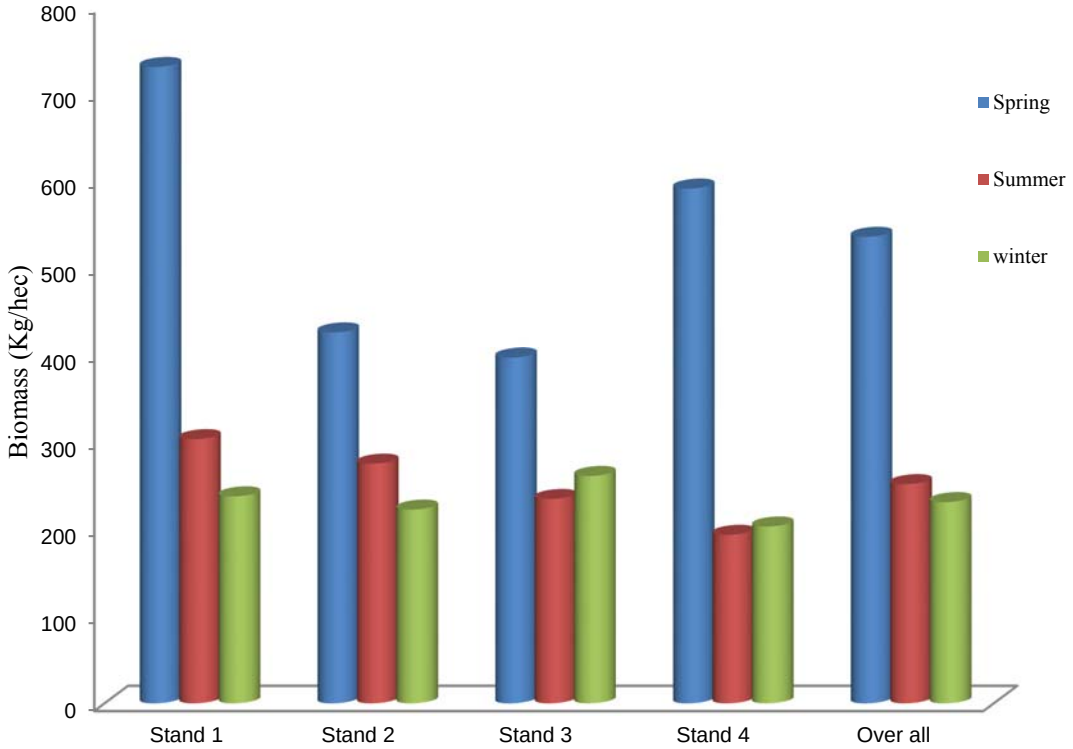


Fig. 58. Fresh altitudinal biomass of herbs in different seasons.

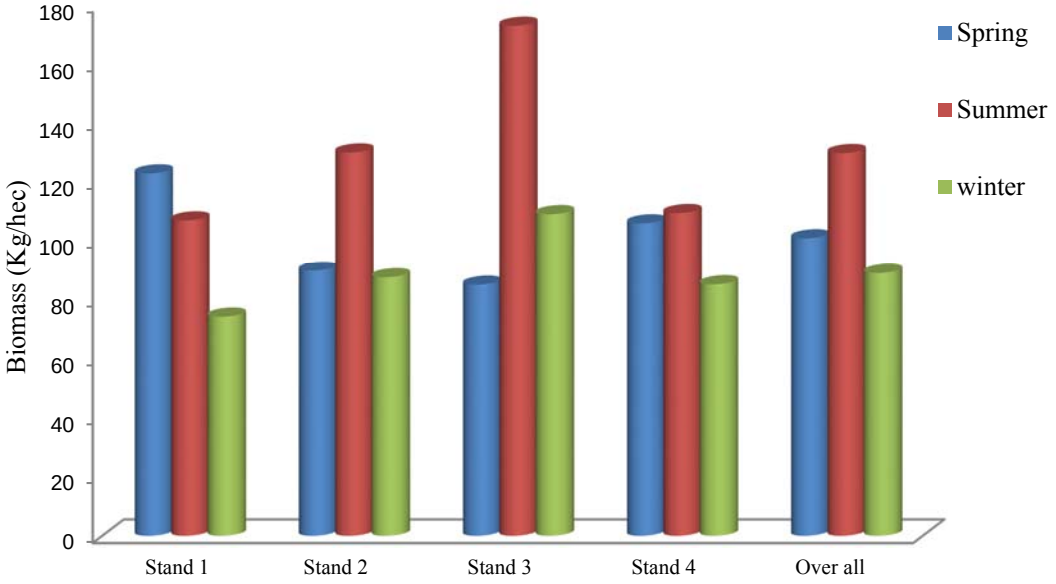


Fig. 59. Fresh altitudinal biomass of grasses in different seasons.

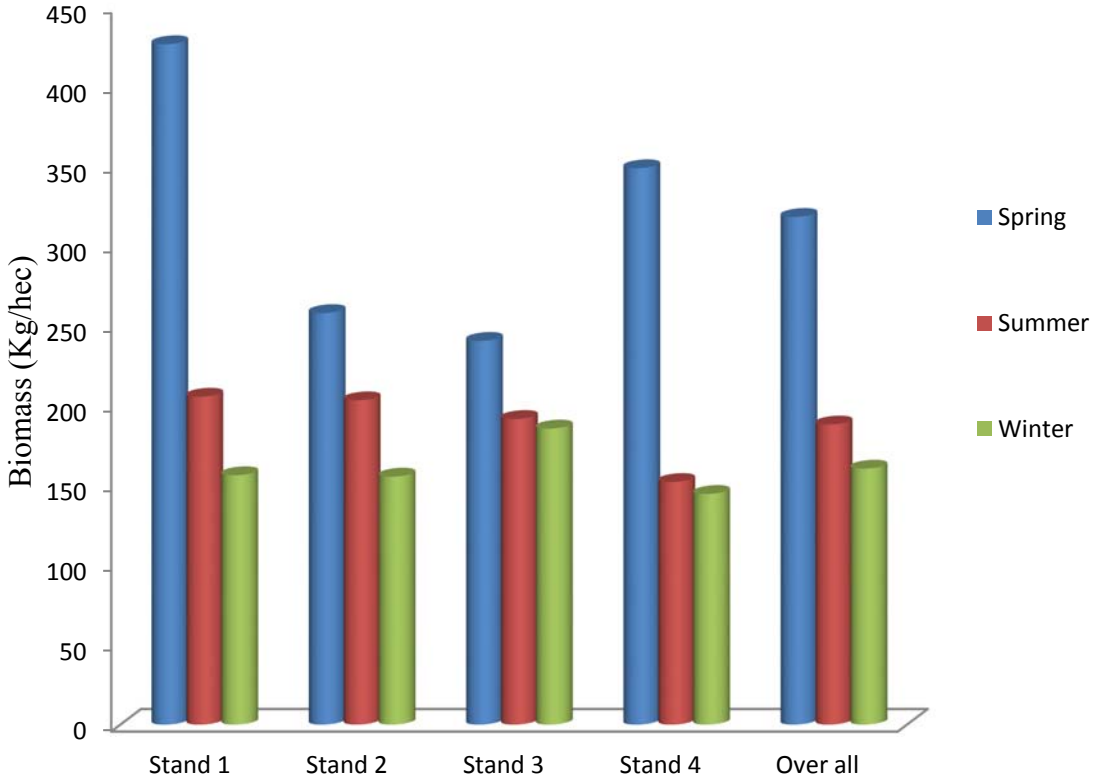


Fig. 60. Fresh average altitudinal biomass of herbs and grasses in different seasons.

4.5.8.2. Productivity of Shrub Biomass

The productivity of shrub biomass was determined in three seasons in different altitude i.e. between 340 -399 m (stand 1), 400-499 m (stand 2), 500-599 m (stand 3) and 600-700 m (stand 4) in Tehsil Takht-e-Nasrati, district Karak is discussed below:

Between altitude 340-399 m (stand 1), the biomass of *Saccharum bengalense* (5020.38 Kg hec^{-1}) was high, followed by *Periploca aphylla* (1638.85 Kg hec^{-1}) and *Calotropis procera* (1500.91 Kg hec^{-1}). Between 400-499 m (stand 2), the fresh biomass of *Saccharum bengalense* (4331.58 Kg hec^{-1}) was high followed by *Calligonum polygonoides* (2025.18 Kg hec^{-1}) and *Calotropis procera* (921.33 Kg hec^{-1}). Between 500-599 m (stand 3), the biomass value of *Zizyphus nummularia* 1125.1 $Kghec^{-1}$ was high followed by *Saccharum bengalense* (925.87 Kg hec^{-1}) and *Rhazya stricta* (699.46 Kg hec^{-1}). Between 600 – 700 m (stand 4), *Capparis decidua* have a high biomass value of 437.79 (Kg hec^{-1}) followed by *Rhazya stricta* (332.7 Kg hec^{-1}) and *Astragalus psilocentros* (329.14 Kg hec^{-1}) (Table 95). Among shrubs average biomass of *Saccharum bengalense* (2665.12 Kg hec^{-1}) was greater followed by *Calotropis procera* (677.73 Kg hec^{-1}), *Periploca aphylla* (533.67 Kg hec^{-1}), *Calligonum polygonoides* (506.29 Kg hec^{-1}), *Zizyphus nummularia* (355.83 Kg hec^{-1}), *Rhazya stricta* (258.04 $Kghec^{-1}$), *Datura metel* (242.37 Kg hec^{-1}), *Capparis decidua* (213.25 Kg hec^{-1}), *Astragalus psilocentros* (201.81 Kg hec^{-1}), *Withania coagulans* (175.13 Kg hec^{-1}), *Ricinus communis* (160.62 Kg hec^{-1}), *Saccharum spontaneum* (144.14Kg hec^{-1}), *Punica granatum* (62.18 Kg hec^{-1}), *Capparis spinosa* (38.67 Kg hec^{-1}) and *Cassia angustifolia* (13.47 Kg hec^{-1}) (Table 95). Among seasons variation the biomass of *Saccharum bengalense* (13800 Kg hec^{-1}) was greater during winter at stand 1 and *Periploca aphylla* (12.35 Kg hec^{-1}) biomass was lower in spring at stand 4 (Table 96)

The result of measuring productivity showed that the biomass of shrubs varied at different altitudes in plains and hilly area. It was found that the average shrub biomass decreased with increasing altitude. The productivity analyses were undertaken to investigate the relationships between altitude and biomass. In stand 1 and 2, 6 species were present with overall mean biomass of 656.52 $Kghec^{-1}$ and 533.86 $Kghec^{-1}$ respectively. In stand 3, 12 species were found through biomass of 308.82 $Kghec^{-1}$.

In stand 4, 11 species were found with overall mean biomass of 167.51 Kg hec^{-1}. It showed that the species number were increased and biomass were decreased with increasing altitude. Kharkwal & Rawat (2010) stated that dynamics and biomass production were decreased significantly with increasing altitudes in central Himalaya, India.

This study explains the relationships of shrubs fresh biomass with area condition such as altitude and environmental effect. The local used shrubs for fuel purposes because most of the shrubs were non palatable or less palatable. Malubekova (1996) described that plant life degradation and low forage production might also be due to severe deforestation, over grazing and soil erosion. Similarly some species such as *Saccharum bengalense*, *Capparis decidua, Saccharum spontaneum* and *Calligonum polygonoides* were used as fuel that resulted in hammering of forage availability and production. The local used these important species for diverse utilities, which reason the degradation of shrubs with vulnerable regeneration. Tree position in the area is very trouncing so people used shrubs as fuel. Shrubs biomass determines the probable quantity of heat but the type and nature of shrub change their combustibility. The habitat environment got adapted with the tremendous and uncontrolled consumption and removal of flora cover. It resulted in low organic substances in soil so finally falling soil moisture and further retarded the species growth. The habitat has declined with improved degradation. Many research workers have explained similar degraded plant life and reduced biomass production in their works. This study finding is in agreement with those (Hussain & Chaughtai, 1984; Malubekova, 1996; Sakya & Bania, 1998; Hajara & Rao, 1990; Malik, 2005).

In comparison among season, the fresh biomass was high during winter due to the dormant stage of shrubs in stand 1 while it was low during summer in stand 4 (Fig. 61). In winter the grazing process was stop due to cultivation while in hilly area grazing was high and low percentage of rain fall. Available shrubs were very important for livestock fodder, burning and fire intensity. In good dynamism forage shrubs wiped out by fire more readily than ordinary ones. The moisture contents of fuel influenced completeness of combustion. Therefore the fodder shrub biomass was low due to cutting for fuel. Our result is similar with Bilgili & Saglam (2003) and Gambiza *et al*. (2005).

It was noticed that in the plains locals put off those shrubs which are non functional for burning proposes like *Calotropis procera* (Fig. 62). The high quantity of moisture in young plant shoots is due to the dominance of fuels from species and plant life fractions with greater moisture contents. A decrease in water content with age had also been found in the shrubs (Pook & Gill, 1993). The biomass increases with the age and seasons. At the end of winter, people cut shrubs for fuel because biomass was high due to its maturity as compared to other season.

Comparatively high fresh forage production was recorded in spring as compared to summer and winter. Yousaf *et al*. (1996) stated that the forage production was high due to soil moisture, moderate temperatures and rain. Our result agree with those of Akbar *et al*. (1994) who stated that in Mastung and Tomagh rangeland high biomass production in spring were due to rain. An increasing tendency of forage production from winter to spring and from summer to winter was noted in all the four stands. It was also seen that the biomass was high in plains and low in hilly area. Some shrubs are specific to the plains like *Calligonum polygonoides* and some in hilly area like *Withania coagulans* and *Cassia angustifolia* (Figs. 63, 64). Our result is similar with Saleem (1993). According to locals, plants have short time in burning when it was cut in spring and summer while in winter the duration was more due the dormant condition of plant life (Fig. 65).

The overall average total shrub biomass was 741.58 Kg hec^{-1}. The total biomass in different area was diverse from 13.47 Kg hec^{-1} to 2665.12 Kg hec^{-1} (Table 96). As a whole the biomass was high in winter while low in summer (Fig. 66). The present result agrees with that De Luis *et al*. (2004) and Dimitrakopoulos (2002). Numerous studies have established the relation between vegetation structure and shrub biomass. The present exploration showed that all biomass were related with area composition highly significant for all components of shrubs (Table 96). Saleem *et al*. (2009) estimated shrub biomass of a maquis formation in western Turkey and stated that the plant species are used for different purposes such as non-timber products and fuel. The people used hills as a meadow. Estimates of fresh shrub biomass were required for much purposes like fodder estimation, bionetwork, bio energy and biomass exploration. However, the use of destructive sampling to provide these estimates is time consuming and expensive.

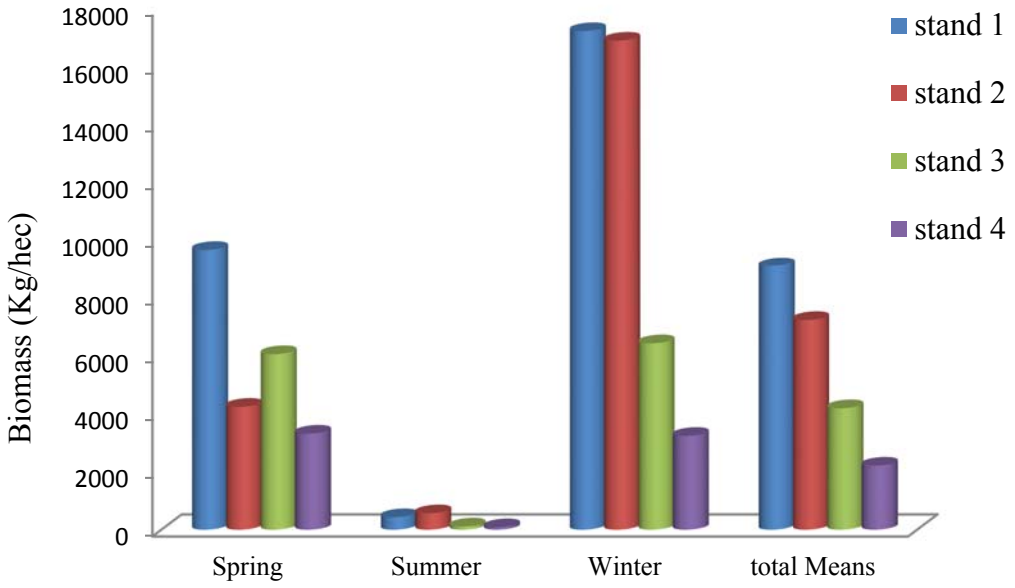


Fig. 61. The shrubs biomass (Kg hec-1) productivity during different seasons and stands in Tehsil Takht-e-Nasrati, Karak.



Fig. 62. Biomass of *Calotropis procera* was high due to useless in fuel through out the area.



Fig. 63. Dormant condition of *Calligonum polygonoides* in plains during winter.



Fig. 64. *Cassia angustifolia* restricted to small hillocks through out the area.



Fig. 65. Shrubby life form of *Capparis decidua* due to grazing throughout the area.

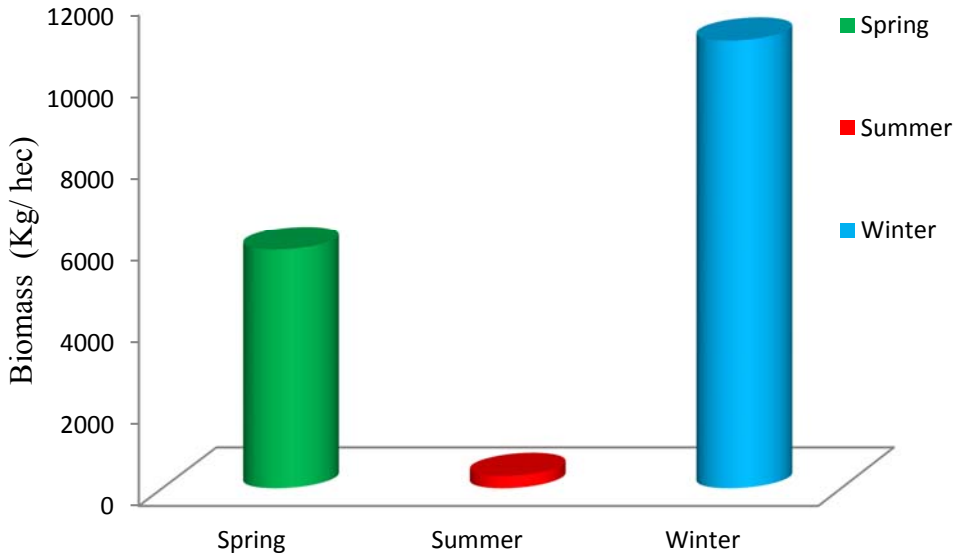


Fig. 66. The shrubs biomass (Kg hec^{-1}) productivity during different seasons inTehsil Takht-e-Nasrati, Karak.

Table 95. Altitudinal variation in the average biomass productivity of shrubs (Kg hec^{-1}) of Tehsil Takht-e-Nasrati, District Karak.

S. No	Species	Altitude				Overall Mean
		340 – 399	400 – 499	500 – 599	600 – 700	
1	*Astragalus psilocentros* Fisch.	-	-	478.1	329.14	201.81
2	*Calligonum polygonoides* L.	-	2025.18	-	-	506.29
3	*Calotropis procera* (Wild.) R.Br.	1500.91	921.33	138.63	150.04	677.73
4	*Capparis decidua* (Forssk.). Edge worth.	-	-	415.21	437.79	213.25
5	*Capparis spinosa* L.	-	-	116.72	37.97	38.67
6	*Cassia angustifolia* Vahl.	-	-	53.88	-	13.47
7	*Datura metel* L.	721.45	248.04	-	-	242.37
8	*Periploca aphylla* Decne.	1638.85	389.01	21.3	85.51	533.67
9	*Punica granatum* .L	-	-	116.22	132.52	62.18
10	*Rhazya stricta* Decne.	-	-	699.46	332.7	258.04
11	*Ricinus communis* L.	549.77	92.72	-	-	160.62
12	*Saccharum bengalense* Retz.	5020.38	4331.58	925.87	382.64	2665.12
13	*Saccharum spontaneum* L.	416.55	-	24.08	135.95	144.14
14	*Withania coagulans* (Stocks) Dunal.	-	-	510.29	190.24	175.13
15	*Zizyphus nummularia* (Burm.f.) W. & A.		-	1125.1	298.23	355.83
	Average	**656.52**	**533.86**	**308.32**	**167.51**	**416.56**

Table 96. The seasonal and altitudinal variation in the biomass productivity of shrubs (Kg hec^{-1}) of Tehsil Takht-e-Nasrati, District Karak.

S. No	Species	Seasons	Altitude											
			340 – 399			400 – 499			500 – 599			600 – 700		
			Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1	*Astragalus psilocentros* Fisch.	Summer	-	-	-	-	-	-	80.94	116.24	194.24	77.74	109.6	201.36
		Winter	-	-	-	-	-	-	369.23	203.2	1266.72	61.02	111.84	132.24
		Spring	-	-	-	-	-	-	984.13	206.4	5333.36	848.66	1601.5	1793.1
		Average	**-**	**-**	**-**	**-**	**-**	**-**	**478.1**	**175.28**	**2264.77**	**329.14**	**607.65**	**708.91**
2	*Calligonum polygonoides* L.	Summer	-	-	-	955.94	636.8	2220	-	-	-	-	-	-
		Winter	-	-	-	3097.51	1430.32	7556.72	-	-	-	-	-	-
		Spring	-	-	-	2022.1	447.36	5805.44	-	-	-	-	-	-
		Average	**-**	**-**	**-**	**2025.18**	**838.16**	**5194.05**	**-**	**-**	**-**	**-**	**-**	**-**
3	*Calotropis procera* (Wild.) R.Br.	Summer	901.02	342.88	3604.08	880.84	624.4	1642.8	54.01	62.72	160.96	113.7	104.6	205.52
		Winter	743.06	284.8	1244.24	963.95	353.44	1973.12	147.33	126.48	474.32	118.66	96.16	239.52
		Spring	2858.64	586.16	7826.16	919.2	424.16	1449.6	214.55	78.96	1256.32	217.76	212.64	366.08
		Average	**1500.91**	**404.61**	**4224.82**	**921.33**	**467.33**	**1688.51**	**138.63**	**89.38**	**630.53**	**150.04**	**137.8**	**270.37**
4	*Capparis decidua* (Forssk.). Edge worth.	Summer	-	-	-	-	-	-	155.84	103.76	537.2	210.7	113	346.48
		Winter	-	-	-	-	-	-	702.9	881.12	1566	563.68	209.28	1183
		Spring	-	-	-	-	-	-	386.89	216.32	1814.64	539	158.4	1007.2
		Average	**-**	**-**	**-**	**-**	**-**	**-**	**415.21**	**400.4**	**1305.95**	**437.79**	**160.23**	**845.55**
5	*Capparis spinosa* L.	Summer	-	-	-	-	-	-	92.68	152.8	496	29.58	118.3	118.3
		Winter	-	-	-	-	-	-	112.17	159.28	625.92	43.84	175.36	175.36
		Spring	-	-	-	-	-	-	145.33	437.04	580.24	40.5	162	162
		Average	**-**	**-**	**-**	**-**	**-**	**-**	**116.72**	**249.71**	**567.38**	**37.97**	**151.89**	**151.89**

6	*Cassia angustifolia* Vahl.	Summer	-	-	-	-	-	-	34.72	243.04	243.04	-	-	-
		Winter	-	-	-	-	-	-	78.36	548.56	548.56	-	-	-
		Spring	-	-	-	-	-	-	48.57	340	340	-	-	-
		Average	-	-	-	-	-	-	**53.88**	**377.2**	**377.2**	-	-	-
7	*Datura metel* L.	Summer	256.04	160.88	607.6	120.67	127.28	366.88	-	-	-	-	-	-
		Winter	231.84	140	787.36	226.47	397.28	782.8	-	-	-	-	-	-
		Spring	1676.46	815.12	2838.8	396.99	250.16	898.88	-	-	-	-	-	-
		Average	**721.45**	**372**	**1411.25**	**248.04**	**258.24**	**682.85**	-	-	-	-	-	-

8	*Periploca aphylla* Decne.	Summer	588.74	136.88	2354.96	233.13	106.4	551.6	26.58	186.1	186.1	84.86	80.72	258.72
		Winter	1414.42	166.88	5100.08	702.05	353.36	1523.36	24.98	174.88	174.88	56.3	75.44	149.76
		Spring	2913.4	228.4	9828.16	231.84	230.72	624	12.35	86.48	86.48	115.38	117.6	343.92
		Average	**1638.85**	**177.38**	**5761.06**	**389.01**	**230.16**	**899.65**	**21.3**	**149.15**	**149.15**	**85.51**	**91.25**	**250.8**
9	*Punica granatum* L.	Summer	-	-	-	-	-	-	7.29	51.04	51.04	56.66	86.96	139.68
		Winter	-	-	-	-	-	-	33.99	237.92	237.92	219.3	148.72	728.48
		Spring	-	-	-	-	-	-	307.39	2151.76	2151.76	121.62	231.68	254.8
		Average	-	-	-	-	-	-	**116.22**	**813.57**	**813.58**	**132.52**	**155.79**	**374.32**
10	*Rhazya stricta* Decne.	Summer	-	-	-	-	-	-	327.26	179.2	463.6	126.4	78	234.88
		Winter	-	-	-	-	-	-	531.43	93.84	1211.04	398.34	103.68	1010.7
		Spring	-	-	-	-	-	-	1239.7	249.12	3511.52	473.36	146.24	747.92
		Average	-	-	-	-	-	-	**699.46**	**174.05**	**1728.72**	**332.7**	**109.31**	**664.51**
11	*Ricinus communis* L.	Summer	187.1	748.4	748.4	-	-	-	-	-	-	-	-	-
		Winter	209.56	838.24	838.24	-	-	-	-	-	-	-	-	-
		Spring	1252.66	557.2	2395.6	278.16	320.32	1163.76	-	-	-	-	-	-
		Average	**549.77**	**714.61**	**1327.41**	**92.72**	**106.77**	**387.92**	-	-	-	-	-	-
12	*Saccharum bengalense* Retz.	Summer	574.4	424.4	766	661.71	496.8	1046.8	167.05	225.44	392.64	27.2	47.36	61.44
		Winter	13800	13040	15520	11918.98	3297.68	19360	2436.27	4539.2	6992.32	1046.5	1692.5	2493.6
		Spring	686.74	496.88	844.16	414.06	229.92	559.28	174.29	236.24	383.52	74.2	71.84	224.96
		Average	**5020.38**	**4653.76**	**5710.05**	**4331.58**	**1341.46**	**6988.69**	**925.87**	**1666.96**	**2589.49**	**382.64**	**603.89**	**926.67**
13	*Saccharum spontaneum* L.	Summer	101.86	190.96	216.48	-	-	-	31.68	101.68	120.08	77.22	308.88	308.88
		Winter	840	1280	2080	-	-	-	-	-	-	301.68	1206.72	1206.72
		Spring	307.8	1231.2	1231.2	-	-	-	40.571	95.12	188.88	28.96	115.84	115.84
		Average	**416.55**	**900.72**	**1175.89**	-	-	-	**24.08**	**65.6**	**102.98**	**135.95**	**543.81**	**543.81**
14	*Withania coagulans* (Stocks) Dunal.	Summer	-	-	-	-	-	-	225.87	169.76	850.4	62.68	49.52	201.2
		Winter	-	-	-	-	-	-	368.54	100.16	1355.04	260.7	310.32	732.48
		Spring	-	-	-	-	-	-	936.46	199.52	3520.8	247.34	449.04	540.32
		Average	-	-	-	-	-	-	**510.29**	**156.48**	**1908.75**	**190.24**	**269.63**	**491.33**
15	*Zizyphus nummularia* (Burm.f.) W. & A.	Summer	-	-	-	-	-	-	149.92	50.56	322.96	73.34	123.5	169.84
		Winter	-	-	-	-	-	-	1958.34	312	7350.56	215.54	340.32	521.84
		Spring	-	-	-	-	-	-	1267.1	571.04	3327.12	605.82	717.28	1706
		Average		-	-	-	-	-	**1125.12**	**311.2**	**3666.88**	**298.23**	**393.7**	**799.23**

4.6. Palatability

Palatability is a plant characteristic that refers to enjoy with which plants or its parts or feed is inspired as stimulated by the sensory impulses of grazing animal (Heath *et al*., 1985). In animal diets the fruits and flowers were required seasonally (Pfister & Malechek, 1986). Sheep feed generally consist of more than 50% grasses during all the seasons while shrub components tends to increase during dry seasons in Africa (Migongo-Bake & Hansen, 1987). Palatability is affected through different animal factors such as differential preference for forage species, period, phase of pregnancy, general health and hunger of animal. Palatability is also affected through different plant factors such as seasonal availability of plant, degree of maturity, growth stage, phenology, morphological and chemical nature (Hussain & Durrani, 2009). Comparative wealth of related plant species, animal accessibility to plants/sites and environment also affect palatability (Grunwaldt *et al*., 1994; Nyamangara & Ndlovu, 1995). Many studies concluded that in excess in grazing decreases palatable species in the range (Malubekova, 1996; Hussain & Chaghtai, 1984; Hussain & Durrani, 2007, 2008, 2009b; Badshah & Hussain, (2011). The present study showed that 161 plant species including 22 (13.4%) trees, 23 (14%) shrubs and 116 (72.6%) herbs were grazed among 5 animals i.e. goat, camel, cow, sheep and donkey in the area in different seasons.

Of the 161 recorded species, 29 species (18.01 %) were non palatable, 32 Spp. (19.88 %) highly palatable, 43 Spp. (26.71 %) mostly palatable, 34 Spp. (21.12 %) less palatable and 23 Spp. (14.29 %) were rarely palatable (Table 97; Fig. 67). Of the 22 recorded tree species, all species were palatable in which 8 Spp. (36.36%) highly palatable, 6 Spp. (27.27 %) mostly palatable, 5 Spp. (22.73 %) less palatable and 3 Spp. (13.64 %) were rarely palatable. Of the 23 recorded shrub species, 11 species (47.83%) were non palatable, 2 Spp. (8.69 %) highly palatable, single specie (4.35 %) mostly palatable, 6 Spp. (26.09 %) less palatable and 3 Spp. (13.04 %) were rarely palatable. Among herbs species, 18 species (15.52 %) were non palatable while other were palatable in which 22 Spp. (18.97 %) highly palatable, 36 Spp. (31.03 %) mostly palatable, 23 Spp. (19.83 %) less palatable and 17 Spp. (14.66 %) were rarely palatable. Comparison among percentage of palatable species, the percentage of non palatable shrubs was 47.83 % and those of

herbs were 15.52 %. All the recorded trees were palatable. Among high palatable species of tree the percentage was high i.e. 36.4 % than herbs which was 19%. The shrubs had low value of 8.7 %. In medium palatable species the herbs dominated i.e. 31.03 % compared to tree species (27.27 %) and shrub (4.35%). Among shrubs the low palatable was high (26.09%) than tree (22.73 %) and herbs (19.83%). The percentage of rare palatable plants was high in herbs and grasses (14.66%) compared to tree (13.64 %) and shrubs (13.04%) (Table 97; Fig. 68).

Differential palatability of plant parts

The animal preference differed for various parts of the plants. It seen that 88 (66.67 %) plants were grazed as a whole, in 40 (30.3 %) leaves were used, inflorences and fruits were utilized 2 (1.52 %) each. 10 (41.67 %) plants as a whole and leaves each and 2 (8.33%) each inflorences and fruits of tree was preferred by animals. Among shrubs, 4 (36.36 %) whole plant and 8 (72.73 %) leaves were preferred by livestock. In herbs 74 (77.08 %) whole plants and 22 (22.92 %) leaves were preferred by grazing animals (Table 97; Fig. 69). Hussain & Durrani (2009b) observed that 99 species were used as whole, in 30 species leaves and in 29 species floral parts were utilized.

Herbivory increases plant diversity qualitatively in two diverse ways i.e. global frequency abundance (amount of herbivory related species) and spatial variability (herbivory levels can form temporary neighboring refuges for herbivory for each species). Both these mechanisms function only if there is no negative association between plant palatability and its aggressive capacity. If there is no connection then plant diversity is increasing task of herbivores level of monophagy (Pacala & Crawley, 1992). Adequate feed quantity is essential to provide necessary nutrient herbivores. Appropriate grazing is important to sustain sufficient forage environment. Younger tissues were more drought tough than older tissues. Younger tissues also grew longer with succeeding wilting as water moved from old to young tissues. Anderson (1994) stated that wilted tissues had increased sugar contents and are highly palatable due to conversion of starch to sugar. Plant vigor is maintained only half the plant is grazed. Clark *et al*. (1998) recommended that on entire year of break restores the losses of plant dynamism.

Plant condition preferred by animals

The animals prefer plants in both fresh or in dry conditions. The animals over all preferred 83 plant species (62.88 %) in a fresh form, single specie (0.76 %) in dry form and 48 species (36.4 %) in both forms. In trees 15 species (68.18 %) were preferred in fresh, single specie (4.54 %) in dry and 6 species (27.3 %) in both conditions. In shrubs 10 species (83.33 %) fresh and 2 species (16.7 %) in both condition were preferred. In herbs 58 species (59.18 %) plants were preferred in fresh while 40 species (40.8%) in both condition (Table 97; Fig. 70.). The study animals usually decision for live fresh tissues. Grazing is significant that it decreases the fraction of deceased parts and increases the chances of accessibility and availability of live tissues of species. The existing of fresh plant materials increases ungulate grazing animal efficiency.

Hussain & Durrani (2009b) stated that seasonal availability of fodder species depend on phenological stages and climate. This is similar to our observation that if the climate is suitable, extra fresh fodder plants will be obtainable to livestock. In drought and winter season dried species and trees become the only supply of fodder to the livestock. In 2009-2010, low precipitation occurred in the study area which noticeably turned down the livestock population like goat, sheep and cow etc. It produced deficiency of dairy products and meat in the area. Hussain & Mustafa (1995) stated that in Nsairabad valley the livestock used mostly fresh forage species. Marqueus *et al*. (2004) stated that in absence of annuals, the shrubs provide fresh fodder. It is obvious that most of the forage species present in March to April and fodder availability is high in this time.

Animal preference for plant

The preference of goat, camel, cow, sheep and donkey for the palatability was observed. The goat preferred the most plant (118 spp., 33.52 %), camel (79 spp., 22.4 %), cow (61 spp., 17.33 %), sheep (51 spp., 14.5 %) and donkey (43 spp., 12.22 %). Goat preferred the herbs (89 spp., 75.4 %), shrubs (9 spp., 7.63 %) and tree (20 spp., 16.9 %). Camel preferred herbs (52 spp., 65.82 %), tree (19 spp., 24.05 %) while shrubs (8 spp., 10.12 %). The cow also preferred herbs (44 spp., 72.13), tree (13 spp., 21.31 %) and shrubs (4 spp., 6.56 %). Sheep preferred herbs (40 spp., 78.43 %), tree (6 spp., 11.76 %) and shrubs (5 spp., 9.8 %). Donkey also

preferred herbs (38 spp., 88.37), tree (4 spp., 9.3 %) and shrubs (single sp., 2.32 %) (Table 97; Fig. 71).

In the current study it was observed personally that in summer the palatability were reached at high stage due to the unavailability of herbs so the animals for a moment grazes unpalatable plants which indicate that the palatability depends on the existing of plant species (Fig. 72). It was perceived that in winter the *Zizyphus maurtiana* was become a high palatable species in the plain area while in spring they become low palatable or rare palatable which substantiated that the palatability depends on seasonal discrepancy. It was noted that the *Dalbergia sissoo* was grazed by cow and camel only (Fig. 73). Hickman *et al*. (2004) described that livestock diversity was a main changeable controlling diversity of plant species and its plant life composition changes are also studied in fairly and lightly grazing area. Papachristou *et al*. (2003) stated that goats like all livestock, express nutritional freedom since they choose plant species of high nutrient in meadow. The free grazing rangeland plants including *Cymbopogon jwarancusa, Dichanthiurn annulatum. Cymbopogon jwarancusa* were commonly available at lower hilly area in Chokara and Ambiri Kala. The *Dichanthiun annulatum* was available through out the study area. In the current study it was observed that the people of the area mostly use the *Zizyphus maurtiana* and *Acacia modesta* during winter and spring, respectively as fodder for goat. Hussain & Durrani (2009b) observed the seasonal availability of forage, palatability and preferences of goats and sheep varied in their botanical composition throughout the growing season. Sheep generally preferred grasses and goat shrubs in the investigated area. Our result agrees with other workers (Farooq, 2003; Gillen & Sims, 2004; Melinda *et al*., 2002; Solomon *et al*., 2007).

From the present investigation, it was noticed that the plant palatability varied significantly throughout the year at different altitude by different animals and reached it's tremendous in summer. The palatability depends on the plant availability. The area where vegetation were plenty, animal choice plant for their requirement but it was also observed that in summer the animal also had eaten non palatable species. The goats walking up a sharp slope may necessitate up to 10 times more vigor as walking on the plain to reach tender preferred shrubby twigs (Fig. 74) our judgment had the same opinion with Grunwaldt *et al.* (1994) who stated that at low elevation,

salt marsh species are less palatable than high elevation.

Some species including *Euphorbia helioscopia* were non palatable probably due to occurrence of phenolics, alkaloids, saponins and further toxic materials (Kayani *et al*., 2007). The *Euphorbia prostrata, Cynodon dactylon and Cenchrus ciliaris* were high palatable in the area. According to Hussain & Durrani (2007), Sultan *et al*. (2008a) and Inam-ur-Rahim *et al*. (2008) that *Cenchrus ciliaris* was the most common grass along field boundaries and margins of the heaps. Palkova & Leps (2008) stated that the incensement of plant attractiveness for herbivores is due to the presence of nitrogen content in plant species. It becomes difficult to critically differentiate between lethal and nonpoisonous plants as animals obtain detestation to food as a consequence of offensive approach of physical awkwardness happening whichever by existence of poison, or glut of nutrients, or by insufficient nutrient foodstuff. This is noticeable when grazing animals no longer acquire attention still for favorite food or when offered substitutes (Provenza, 1995). Most plants were toxic just while eat in huge quantity at particular stage that might give nutritive forage when consumed in minute quantity or mix up with other forage. Various herds were found freely in the area because the professions of the most people are agriculture and livestock.

In tree species the *Zizyphus maurtiana* leaves and shoots become highly preferred by goat under compulsion during early spring and late winter while in summer, the *Acacia modesta* is highly preferred in hilly area. However in plains, during summer the animals graze every plant which had come in their front because due to low availability of plant species in the area (Fig. 75). Omer *et al*. (2006) observed that production of food is higher in spring in dry temperate forests in Northern area of Pakistan. Hussain & Durrani (2009b) working on Harboi Range land, Pakistan. They described that goat consumed more species of herbs, shrubs, grasses and tree than other animals. Our results are similar with these previous statements. The camel preferred the *Tamarix aphylla*, *Heliotropium europaeum* in summer and *Fagonia cretica* in spring The cow preferred the *Dalbergia sissoo* in summer while in spring and winter it preferred *Saccharum bengalense* due to unavailability of plants (Fig. 76). It was obvious that the cow and donkey did not prefer spiny or prickly while camels preferred such plants. Due to the access and availability of species, grasses were preferred in spring and trees

were preferred in winter while in summer the herbs and shrubs were preferred by animals in the area. It was observed that goat preferred trees and shrubby species as compare to other animals while during comparison among plant strata the shrubs were preferred by cow (Fig. 77). Our outcome is turn out with that of Nyamanagara & Ndlovu (1995). Rasool *et al*. (2005) stated that grazing system of Baluchistan involved 74 % nomads, 21 % transhumaniant and 5 % inactive type. *Acacia nilotica* was preferred mostly at flowering stage in the plains. Palatable and non palatable species and animal preference were also studied by Hussain & Mustafa (1995) and Gyamtosho *et al.* (1996). Kayani *et al*. (2007) reported that phenolics, alkaloids and saponins chemicals in plants were regarded as anti-nutritional feature which decreased the palatability. These animals might have adapted to digest these plants because of nutritional habit of eating a particular feed during early life. It was suggested that saliva might possibly conjugate with the volatile oils and tannins to render them non-toxic (Nymangara & Ndlovu, 1995). *Cymbopogon jawarancusa* was low palatable. Presence of phenolics and alkaloids gave negative factors in palatability for animals in *Cymbopogon jawarancusa* (Kayani *et al.,* 2007). In plains the grazing seasons starts from April and ceases in October. The present study showed that the palatability depends on plant species, animal type and season. It was suggested that plant palatability should be conformed on the basis of animal food requirement in support of improving physical condition and output of domestic animals in region.

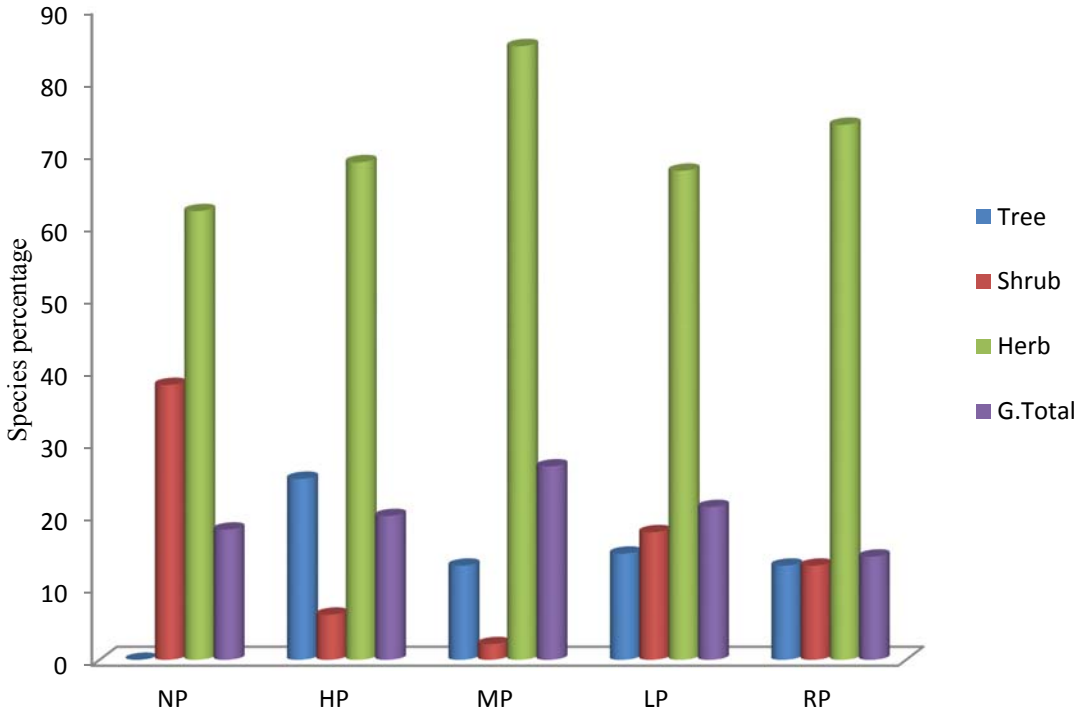


Fig. 67. Differential palatability of plant species in Tehsil Takht-e-Nasrati, Karak.

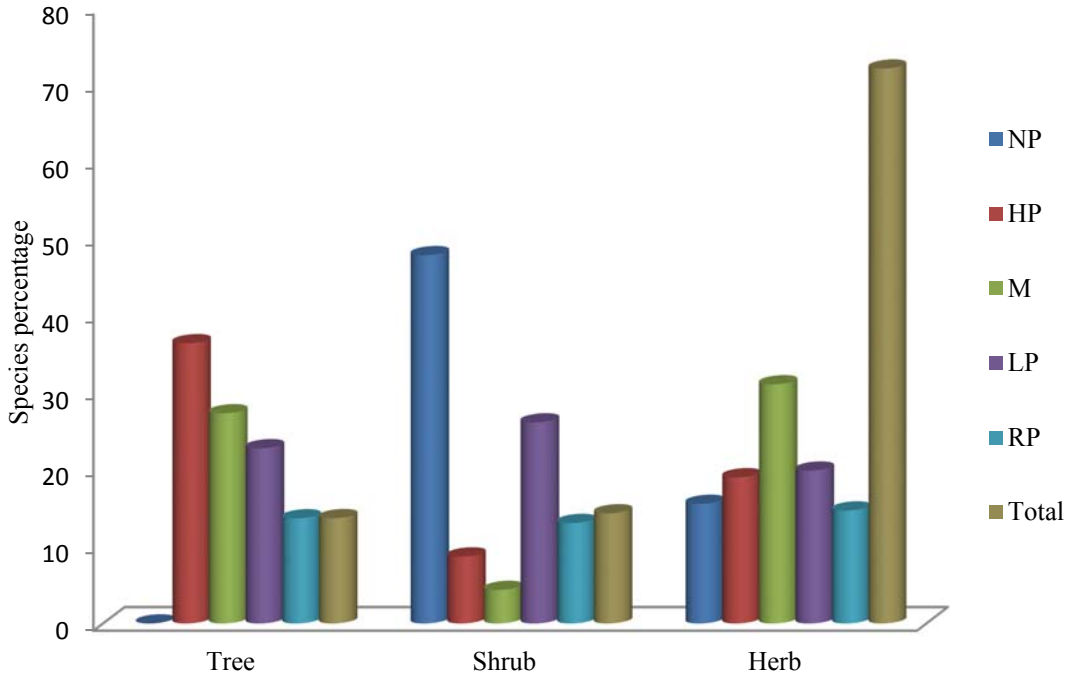


Fig. 68. Differential palatability percentage in each stratum of plant species in Tehsil Takht-e-Nasrati, Karak.

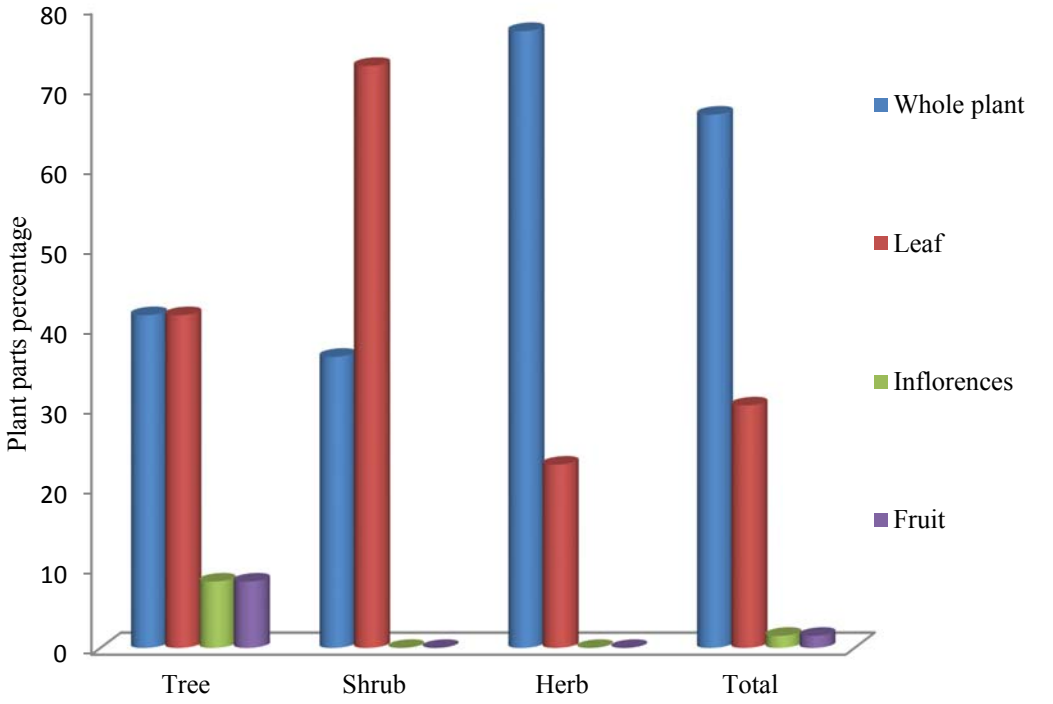


Fig. 69. Plant parts preferred by animals in Tehsil Takht-e-Nasrati, Karak.

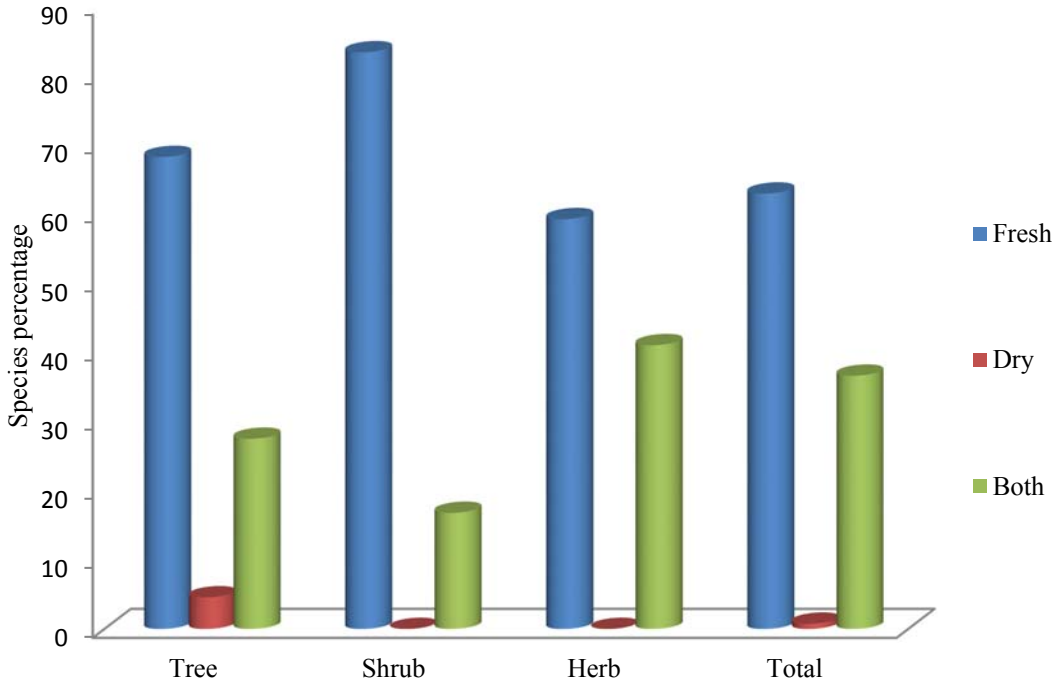


Fig. 70. The preference by lives stock for fodder in fresh and dry condition of Tehsil Takht-e-Nasrati, Karak.

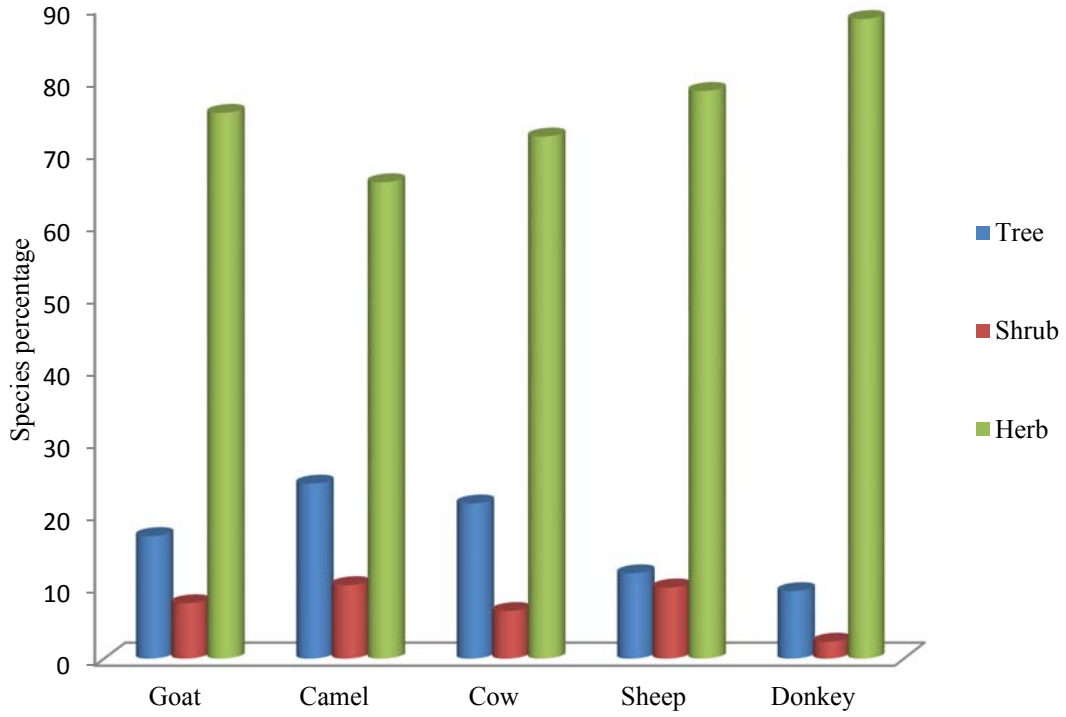


Fig. 71. Animal preference for plant species in Tehsil Takht-e-Nasrati, Karak.



Fig. 72. Sheep graze upon nonpalatable plants under compulsion.



Fig. 73. *Dalbargia sissoo* is being grazed by cow due to their preference.



Fig. 74. The goats reach to inaccessible area due to non available of forage.



Fig. 75. Goat try to reach high shoots due to non availability of forage in the area.



Fig. 76. *Saccharum bengalanse* grazed as a preference by cow during spring and winter due to unavailability of other forage plants.



Fig. 77. Goat preferred *Acacia modesta* in summer.

Table 97. Differential palatability plant species, Plant parts, various parts, preference by livestock.

S. No	Species	Habit	Palatability Classes					Plant parts				Plant Condition			Grazing animals				
			NP	HP	MP	LP	RP	Whole	Leaf	Inf	Fruit	Fresh	Dry	Both	Cow	Goat	Sheep	Camel	Donkey
1	*Acacia modesta* Wall.	T	-	+	-	-	-	+	-	-	-	-	-	+	-	+	-	+	-
2	*Acacia nilotica* (L.) Delice.	T	-	+	-	-	-	+	-	-	-	-	-	+	-	+	-	+	-
3	*Albizia lebbeck* (L.) Benth.	T	-	-	-	-	+	-	-	+	+	-	+	-	+	+	-	+	-
4	*Capparis decidua* (Forssk). Edge worth.	T	-	-	+	-	-	-	-	+	+	+	-	-	-	+	-	+	-
5	*Dalbergia sissoo* Roxb.	T	-	-	+	-	-	-	+	-	-	+	-	-	+	+	-	+	-
6	*Eucalyptus globules* L.	T	-	-	-	+	-	+	-	-	-	+	-	-	-	+	-	-	-
7	*Eucalyptus lanceolatus* L.	T	-	-	-	-	+	+	-	-	-	+	-	-	+	+	-	-	-
8	*Gymnosporia royleana* Wall. ex M. A. Lawson.	T	-	-	-	+	-	+	-	-	-	+	-	-	-	+	-	+	-
9	*Melia azedarach* L.	T	-	-	+	-	-	-	+	-	-	+	-	-	+	+	-	+	-
10	*Monotheca buxifolia* (falk.) A.DC.	T	-	+	-	-	-	-	+	-	-	+	-	-	-	+	-	+	-
11	*Morus alba* L.	T	-	-	-	+	-	-	+	-	-	+	-	-	+	+	+	+	-
12	*Morus nigra* L.	T	-	-	-	+	-	-	+	-	-	+	-	-	+	+	+	+	-
13	*Parkinsonia aculeata* L.	T	-	-	-	-	+	-	+	-	-	+	-	-	-	+	-	+	-
14	*Phoenix dactylifera* L.	T	-	-	-	+	-	-	+	-	-	+	-	-	-	+	-	-	-
15	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.	T	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
16	*Prosopis juliflora* (Sw.) DC.	T	-	+	-	-	-	+	-	-	-	+	-	-	-	+	-	+	-
17	*Punica granatum* L.	T	-	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+
18	*Salvadora oleoides* Decne.	T	-	+	-	-	-	-	+	-	-	+	-	-	+	+	-	+	-
19	*Tamarix aphylla* (L.) Karst.	T	-	-	+	-	-	-	+	-	-	+	-	-	+	-	-	+	-
20	*Tamarix decidva* Roxb.	T	-	-	+	-	-	-	+	-	-	+	-	-	+	-	-	+	-
21	*Zizyphus maurtiana* Lam.	T	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
22	*Zizyphus oxyphylla* Edgew.	T	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
Total			**0**	**8**	**6**	**5**	**3**	**10**	**10**	**2**	**2**	**5**	**+**	**6**	**3**	**20**	**6**	**9**	**4**
23	*Alhagi maurorum* Medic.	S	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	+	-
24	*Astragalus psilocentros* Fisch.	S	-	-	-	+	-	+	-	-	-	+	-	-	-	+	-	+	-
25	*Calligonum polygonoides* L.	S	-	+	-	-	-	+	-	-	-	+	-	-	-	+	+	+	-
26	*Calotropis procera* (Wild) R.Br.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	*Capparis spinosa* L.	S	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	+	-
28	*Cassia angustifolia* Vahl.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	*Datura metel* L.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	*Dodonaea viscosa* L.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	*Ocimum basilicum* L.	S	-	-	-	+	-	-	+	-	-	+	-	-	-	+	-	-	-
32	*Opuntia ficus indica* (L.) Mill.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	*Otostegia Limbata* (Benth) Boiss.	S	-	-	-	+	-	-	+	-	-	+	-	-	-	+	-	+	-
34	*Periploca aphylla* Decne.	S	-	-	-	-	+	-	+	-	-	+	-	-	+	+	+	+	-
35	*Rhazya stricta* Decne.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	*Ricinus communis* L.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

37	*Rosa indica* L.	S	-	-	-	+	-	-	+	-	-	-	-	+	-	+	-	-	-
38	*Saccharum bengalense* Retz.	S	-	-	-	+	-	-	+	-	-	+	-	-	+	-	-	-	-
39	*Saccharum spontaneum* L.	S	-	-	-	+	-	-	+	-	-	+	-	-	+	-	-	-	-
40	*Vites vinifera* L.	S	-	-	-	-	+	-	+	-	-	+	-	-	-	+	-	+	-
41	*Vitex trifolia* L.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	*Vitex negundo* L.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	*Withania coagulans* (Stocks) Dunal.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44	*Withania somnifera* (L) Dunal.	S	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	*Zizyphus nummularia* (Burm.f) W.&A.	S	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
Total			**11**	**2**	**1**	**6**	**3**	**4**	**8**	**0**	**0**	**0**	**0**	**2**	**4**	**9**	**3**	**8**	**1**
46	*Abelmoschus esculentus* (L.) Moench.	H	-	-	-	+	-	-	-	-	-	+	-	-	+	+	-	-	-
47	*Achyranthus aspera* L.	H	-	-	-	+	-	+	-	-	-	-	-	+	-	+	+	+	-
48	*Aerua persica* (Burm.f.) Merrill.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	+	-
49	*Ajuga bracteosa* Wall.ex Benth.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	*Allium cepa* L.	H	-	-	-	+	-	-	-	-	-	+	-	-	-	+	-	-	-
51	*Allium sativum* L.	H	-	-	-	+	-	-	-	-	-	+	-	-	-	+	-	-	-
52	*Aloe barbadensis* Mill.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
53	*Alternanthra pungens* Kunth.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	+	+	+
54	*Amaranthus viridis* L.	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	+	+	+
55	*Anagalis arvensis* L.	H	-	-	-	-	+	+	-	-	-	+	-	-	+	-	-	-	-
56	*Arachis hypogaea* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
57	*Asparagus gracilis* Royle.	H	-	-	-	+	-	+	-	-	-	+	-	+	-	-	-	-	-
58	*Asphodelous tenuifolius* Cavan.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59	*Avena sativa* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
60	*Boerhavia diffusa*L.	H	-	-	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+
61	*Brassica rapa* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
62	*Calendula arvenis* L.	H	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	*Capsicum annum* L.	H	-	-	-	+	-	+	-	-	-	-	-	+	-	+	-	-	-
64	*Carthamus oxycantha* Bieb	H	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
65	*Celosia argentea* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	*Cenchrus biflorus* Hook. f.	H	-	-	+	-	-	-	+	-	-	+	-	-	+	+	+	+	+
67	*Cenchrus ciliaris* L.	H	-	+	-	-	-	-	+	-	-	+	-	-	+	+	+	+	+
68	*Centaurea iberica* Trev.Ex. Spreng	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	+	+	+
69	*Chenopodium album* L.	H	-	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+
70	*Chenopodium murale* L.	H	-	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+
71	*Chrozophora obliqua* (Vahl) A. Juss.	H	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	+	-
72	*Cicer arietinum* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
73	*Cistanche tubulosa* (Schenk) Wight.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	*Citrullus colocynthis* L. Schrad.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	*Cleome viscosa* L.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
76	*Cocculus pendulus* (Forst) Diels.	H	-	-	+	-	-	+	-	-	-	+	-	+	-	+	-	-	-
77	*Convolvulus arvensis* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+

78	*Convolvulus pluricaulis* Choisy.	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	+	+	+
79	*Corchorus trilocularis* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	*Coriandrum sativum* L.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
81	*Coronopus didymus* (L.) Smith.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
82	*Crotalaria medicaginea* Lam.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
83	*Cucurbita maxima* Duchesne.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
84	*Cucurbita pepo* L.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
85	*Cuscuta reflexa* Roxb.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
86	*Cymbopogon jwarancusa* (Jones) Schult.	H	-	-	-	+	-	-	+	-	-	+	-	-	+	+	-	-	-
87	*Cynodon dactylon* (L.) Pers.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
88	*Cyperus rotundus* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
89	*Cyperus scarlosus* R.Br.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
90	*Daucus carrota* L.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
91	*Descurainia Sophia* (L.) Webb.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92	*Desmostachya bipinnata* (L.) Stapf.	H	-	-	-	+	-	-	+	-	-	+	-	-	-	+	-	-	-
93	*Dichanthium annulatum* (Forssk) Staph.	H	-	-	-	+	-	+	-	-	-	+	-	-	-	+	-	-	-
94	*Digera muricata* (L.). Mart.	H	-	-	-	-	+	+	-	-	-	-	-	+	+	+	+	+	+
95	*Echinochloa colonum* (L.) Link.	H	-	-	+	-	-	-	+	-	-	-	-	+	+	+	+	+	+
96	*Echinops echinatus* D.C.	H	-	-	-	+	-	-	+	-	-	+	-	-	-	+	-	+	-
97	*Eragrostis poaoides*Beauv.	H	-	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+
98	*Erodium malacoides* (L.) Her. Ex Ait.	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	+	-
99	*Eruca sativa* Millel.	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	-	+	+
100	*Euphorbia helioscopia* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
101	*Euphorbia prostrata* Ait.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
102	*Evolvulus alsinoides* L.	H	-	-	-	+	-	+	-	-	-	+	-	-	-	+	+	-	-
103	*Fagonia cretica* L.	H	-	+	-	-	-	+	-	-	-	+	-	-	-	-	-	+	-
104	*Fumaria indica* (Haussk.) Pugsley.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
105	*Helianthus annus* L.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	+	-	-
106	*Heliotropium europaeum* L.	H	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	+	-
107	*Heliotropium strigosum* Willd.	H	-	-	-	+	-	+	-	-	-	+	-	-	-	-	-	+	-
108	*Hordeum vulgare* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
109	*Hypericum pendulum* L.	H	-	-	+	-	-	+	-	-	-	-	-	+	+	-	-	-	-
110	*Ifloga fontanesii* Cass.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-
111	*Indigofera linifolia* (L.f.) Retz.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
112	*Ipomoea hederacea* (L.) Jacq.	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	+	-	-
113	*Kickxia ramosissima* (Wall) Janchen.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
114	*Lactuca sativa* L.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-

115	*Lactuca serriola* L.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-
116	*Launaea nudicaulis* (L.) Hook. f.	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	+	+	+
117	*Lens culinaris* Medic.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
118	*Lippia nodiflora* (L.) L.C. Rich.ex. Michaux.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-
119	*Lithospermum arvense* L.	H	-	-	-	+	-	+	-	-	-	+	-	-	-	+	-	-	-
120	*Luffa acutangula* Roxb.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
121	*Luffa aegyptiaca* (L.) M. J. Rocm.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
122	*Lycopersicom esculentum* Mill.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
123	*Malcolmia africana* (L.) R.Br.	H	-	-	-	-	+	+	-	-	-	+	-	-	-	+	-	-	-
124	*Malva parviflora* L.	H	-	-	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+
125	*Malva neglecta* Wallr.	H	-	-	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+
126	*Malvastrum coromandelianum* (L.) Gareke.	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-	-
127	*Medicago laciniata* (L.) Mill.	H	-	-	+	-	-	-	+	-	-	+	-	-	+	+	+	+	+
128	*Melilotus indicus* (L.) All.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-
129	*Mentha arvensis* L.	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-	-
130	*Micromeria biflora* (Buchi. Ham exD. Don Benth).	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-	-
131	*Momordica charantia* L.	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-	-
132	*Orobanche ramose* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
133	*Oxalis corniculata* L.	H	-	-	-	-	+	-	+	-	-	+	-	-	-	+	-	-	-
134	*Peganum hermala* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
135	*Pennisetum typhoideum* (Burm.) Stapf.	H	-	+	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-
136	*Phragmites karka* (Retz.) Trin. Ex. Steud.	H	-	-	-	-	+	-	+	-	-	+	-	-	-	+	-	-	-
137	*Plantago ciliata* Desf.	H	-	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+
138	*Plantago ovata* Forssk.	H	-	-	+	-	-	+	-	-	-	+	-	-	+	+	+	+	+
139	*Pupalia lappacea* (L.) Juss.	H	-	-	+	-	-	-	+	-	-	-	-	+	-	+	-	+	-
140	*Ranunculus muricatus* L.	H	-	-	-	+	-	-	+	-	-	-	-	+	-	+	-	-	-
141	*Raphanus sativus* L.	H	-	-	-	+	-	-	+	-	-	-	-	+	-	+	-	-	-
142	*Rumex dentatus* L.	H	-	-	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+
143	*Salvia moorcroftiana* Wallich ex Benth.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
144	*Saussurea heteromalla* (D.Don.) Hand.	H	-	-	-	-	+	-	+	-	-	+	-	-	-	+	-	+	-
145	*Sesamum indicum* L.	H	-	+	-	-	-	-	+	-	-	-	-	+	-	+	-	-	-
146	*Silene conoidea* L.	H	-	-	-	+	-	-	+	-	-	-	-	+	+	+	-	-	-

147	*Sissymbrium irrio* L.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	+	-
148	*Solanum incanum* L.	H	-	-	-	+	-	+	-	-	-	-	-	+	-	+	-	+	-
149	*Solanum nigrum* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	*Solanum surattense* Burm .f.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151	*Sonchus asper* (L.) Hill.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-
152	*Sorghum vulgare* (L.) Pers.	H	-	+	-	-	-	+	-	-	-	+	-	-	-	+	-	+	-
153	*Spinacia oleraceae* L.	H	-	-	+	-	-	+	-	-	-	+	-	-	-	+	-	-	-
154	*Taraxacum officinale* Weber.	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-	-
155	*Trianthema portulacastrum* L.	H	-	-	+	-	-	-	+	-	-	+	-	-	-	+	-	-	-
156	*Tribulus terrestris* L.	H	-	-	+	-	-	+	-	-	-	-	-	+	+	+	+	+	+
157	*Trifolium alexandrianum* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
158	*Triticum aestivum* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
159	*Vicia sativa* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
160	*Xanthium strumarium* L.	H	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
161	*Zea mays* L.	H	-	+	-	-	-	+	-	-	-	-	-	+	+	+	+	+	+
Total		**-**	**8**	**22**	**36**	**23**	**7**	**74**	**22**	**0**	**0**	**58**	**0**	**40**	**44**	**89**	**42**	**52**	**38**
Grand total		**-**	**29**	**32**	**43**	**34**	**23**	**88**	**40**	**2**	**2**	**83**	**1**	**48**	**61**	**118**	**51**	**79**	**43**

4.7. Chemical Evaluation

4.7.1. Phytochemical Screening

Alkalid and carbohydrate was present in all test species in all the phenological stages. Gurbuz *et al*. (2005) reported mucilage from the infloresence of some *Verbascum* species. Anthraquinone was present in *Albizia lebbeck* and *Tamarix aphylla* in all the phenological stages while it was detected at post reproductive stage only in *Cymbopogon jwarancusa*, *Eragrostis poaoides, Withania somnifera, Datura metel* and *Chrozophora obliqua*. It was absent in *Boerhaavia diffusa,Vitex trifolia* and *Rhazya stricta* (Table 98). Shingare *et al*. (2003) reported anthraquinone glycosides from *Cassia pumila*. Zhu *et al*. (2006) reported anthraquinone derivatives in *Rumex dentatus*. Anke *et al*. (2006) reported new proanthocyanidins from *Rumex acetosa*. Flavonoid was present in *Cymbopogon jwarancusa, Eragrostis poaoides, Rhazya stricta, Withania somnifera*, *Tamarix aphylla* and *Albizia lebbeck* in all the phenological stages while it was detected at post reproductive stage only in *Chrozophora obliqua.* It was absent in *Boerhaavia diffusa, Datura metel* and *Vitex trifolia* (Table 98). Naseem *et al*. (2006) reported that alkaloids, flavonoids and unbounded anthraquinones were absent from *Crotalaria burhia*.

Saponins was present in *Boerhaavia diffusa*, *Chrozophora obliqua, Rhazya stricta, Vitex trifolia, Withania somnifera, Albizia lebbeck* and *Tamarix aphylla* in all the phenological stages while it was detected at post reproductive stage only in *Datura metel.* It was absent in *Cymbopogon jwarancusa* and *Eragrostis poaoides.* Khan *et al*. (2011e) reported saponins from *Amaranthus viridis.* Ansari *et al*. (2007) reported saponins from *Balanites aegyptiaca*. Steroids was present in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia diffusa*, *Chrozophora obliqua, Datura metel, Rhazya stricta, Vitex trifolia, Albizia lebbeck* and *Tamarix aphylla* in all the phenological stages while it was detected at post reproductive stage only in *Withania somnifera.* Yadav *et al*. (2007) reported flavonoids, saponins, steroids, alkaloids, carbohydrates and proteins in *Chenopodium album* root. Tannins was present in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia diffusa*, *Datura metel, Vitex trifolia,*

Withania somnifera, *Albizia lebbeck* and *Tamarix aphylla* in all the phenological stages while it was absent in *Chrozophora obliqua* and *Rhazya stricta* (Table 98). Badami *et al.* (2007) reported alkaloids, carbohydrates, steroids, saponins and tannins in *Caesalpinia sappan*.

Table 98. Phytochemical screening of different forage plant species of Takht-e-Nasrati, District Karak.

Species	Alkaloids			Anthraquinone			Carbohydrates			Flavonoid			Saponins			Steroids			Tannins		
	Vegetative	Reproductive	P. Reproductive	Vegetative	Reproductive	P. Reproductive	Vegetative	Reproductive	P. Reproductive	Vegetative	Reproductive	P. Reproductive	Vegetative	Reproductive	P. Reproductive	Vegetative	Reproductive	P. Reproductive	Vegetative	Reproductive	P. Reproductive
Cymbopogon jwarancusa (Jones) Schult	+	+	+	-	-	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+
Eragrostis poaoides Beauv.	+	+	+	-	-	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+
Boerhaavia diffusa L..	+	+	+	-	-	-	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+
Chrozophora obliqua (Vahl) A. Juss.	+	+	+	-	-	+	+	+	+	-	-	+	+	+	+	+	+	+	-	-	-
Datura metel L.	+	+	+	-	-	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+
Rhazya stricta Decne	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-
Vitex trifolia L.	+	+	+	-	-	-	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+
Withania somnifera (L) Dunal.	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+
Albizia lebbeck (L.) Benth.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Tamarix aphylla (L.) Karst.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

4.7.2. Mineral composition

In present study, 10 plant species consisting of 2 grasses, 2 herbs, 4 shrubs and 2 trees at three phenological stages were analyzed for their mineral composition. This included 3 macro mineral such as sodium (Na), potassium (K) and calcium (Ca) and 7 micro mineral like Zinc (Zn), copper (Cu), manganese (Mn), chromium (Cr), nickel (Ni), cadmium (Cd) and lead (Pb). The data obtained was subjected to two way analysis of variance, randomized complete block design (RCBD) and the mean values were separated at $P < 0.05$ applying least significant difference test (LSD).

Sodium

It was observed that sodium contents increased with advancing phenological stages in all test species. Overall average indicated that post reproductive stage had the maximum (2.1 g Kg^{-1}) and vegetative then minimum (1.22 g Kg^{-1}) sodium contents. Among the plants the maximum sodium content were recorded for *Tamarix aphylla* (3.17 g Kg^{-1}) followed by *Rhazya stricta* (2.78 g Kg^{-1}) and *Withania somnifera* (2.46 g Kg^{-1}). The least sodium content was found in *Albizia lebbeck* (0.54 g Kg^{-1}). Statistical analysis of ANOVA showed that within groups i.e. among the growth stages, plants species and between groups the significant differences of sodium were found at LSD 0.03269, 0.05968 and 0.1039 respectively. The Na was significantly high at post reproductive stage ($F = 1421.7805$) and in *Tamarix aphylla* ($F = 1778.0359$) while between the groups it was significantly high in *Tamarix aphylla* at post reproductive stage ($F = 82.8847$) (Tables 99, 100; Fig. 78).

The present result showed that Na content was found low in all test species. The maximum content was present in *Tamarix aphylla.* It controls acid base balance in the body fluid. Gbolahan (2001) stated that Na is a main electrolyte of human blood and assist in hydration. Its ingestion is correlated with hypertension in human being James *et al*. (2010) find out the highest level of Na in *Saba florida*. Hussain *et al*. (2010) determined the highest level of Na in *Dalbergia sisso*. In *Bupleurum falcatum* the low level of Na was determined by Adnan *et al*. (2010). They also pointed out that Na content was high in *Otostegia lambata*. Ahmad *et al.* (2008b) stated that Na contents in pods were higher than those found in the leaves and leaflets. According to Hanif *et al.* (2006) that maximum amount of Na was present in reddish while low content

in bottle gourd. The current study showed that low content of Na was due to the soil physiochemical properties and climate conditions. Cheema *et al*. (2011) stated that the Na contents were high in *Ziziphus jujube*. In our result the Na contents were also high in tree specie i.e. *Tamarix aphylla* than all other test species. Our result is also agree with Hussain *et al*. (2011) who stated that Na content were low in *Datura alba* is compare to other test species.

Potassium

It was observed that potassium contents decreased with advancing phenological stages in *Chrozophora obliqua* and *Datura metel* while increased in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia diffusa, Rhazya stricta, Withania somnifera, Vitex trifolia, Albizia lebbeck* and *Tamarix aphylla.* Overall average indicated that post reproductive stage had the maximum (45.86 g Kg^{-1}) and vegetative then minimum (33.74 g Kg^{-1}) potassium contents. Among the plants the maximum sodium content were recorded for *Rhazya stricta* (63.86 g Kg^{-1}) followed by *Withania somnifera* (56.32 g Kg^{-1}) and *Boerhaavia diffusa* (52.96 g Kg^{-1}). The least sodium content was found in *Tamarix aphylla* (12.74 g Kg^{-1}). ANOVA showed that with in group the potassium quantity were significantly high at post reproductive stage and in *Rhazya stricta* with F = 287.9101 and F = 695.3157 respectively while between the groups it was found high in *Rhazya stricta* at post reproductive stage (F = 105.8730). The significant differences of K was found in stages, plant species at LSD 1.012 and 1.847 respectively while between the groups with LSD 3.199 (Tables 99, 100; Fig. 79).

The result showed that potassium content were low in *Tamarix aphylla* at two phenological stages i.e. reproductive and post reproductive while at vegetative stage it was low in *Eragrostis poaoides.* The highest content was found in *Rhazya stricta* at two phenological stages. According to Hameed *et al*. (2008) the potassium content was not present in the *Rumex hastatus*'s flowers. They also stated that in the members of Polygonaceae family, potassium varied from 1.04 – 6.57 ppm. Their work supports our judgment. Our result also supported by Saidu & Jideobi (2009) and Zafar *et al*. (2010). According to Sultan *et al*. (2008a) the potassium content was higher in free grazing lands at premature stage than at ripeness. But they stated that potassium increases with maturity

which is agree with our results. Our result agrees with Minson (1990) who stated that in herbs potassium content is higher than grasses. According to Hussain & Durrani (2007), Khan *et al*. (2007), Sultan *et al*. (2007) and Sultan *et al*. (2008a) that potassium affect the development of plant, their growth and structure because it is essential to activate growth enzymes. Khan *et al.* (2009) stated that potassium was high in summer than winter. Our result also agrees with the above statement. In our case, the potassium contents were increased with advancing phenological stages in test species.

Calcium

It was observed that calcium (Ca) contents decreased with advancing phenological stages in *Albizia lebbeck* while increased in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia diffusa, Chrozophora obliqua, Datura metel, Rhazya stricta, Withania somnifera, Vitex trifolia* and *Tamarix aphylla.* Overall average indicated that post reproductive stage had the maximum (25.74 g Kg^{-1}) and vegetative then minimum (16.06 g Kg^{-1}) calcium contents. Among the plants the maximum calcium content were recorded for *Chrozophora obliqua* (29.17 g Kg^{-1}) followed by *Tamarix aphylla* (28.93 g Kg^{-1}) and *Cymbopogon jwarancusa* (28.09 g Kg^{-1}). The least calcium content was found in *Rhazya stricta* (2.204 g Kg^{-1}). ANOVA showed that calcium was significantly high at post reproductive stage (F = 469.9962) and in *Chrozophora obliqua* (F = 422.1825) while between the groups it was found high (F = 56.5285) in *Boerhaavia diffusa* at post reproductive stage. The significant differences of calcium was found at all stages (LSD = 0.6378), among plant species (LSD = 1.165) and between the groups (LSD = 2.017) (Tables 99, 100; Fig. 80).

It is noted form the data that herb had the higher content of calcium followed by tree and than grasses. The least calcium contents were present in shrub i.e. *Rhazya stricta.* WHO proposed the daily intake of calcium 450-1200 mg. According to Zafar *et al*. (2008) that in plants, the calcium concentration was present persistently. Bano *et al*. (2009) described calcium in *Cymbopogon jwarancusa*. James *et al*. (2010) stated that higher calcium contents were present in *Saba florida*. In plants, seasonal effect on calcium was reported by Khan *et al*. (2009). According to Hussain *et al.* (2010) that the plants give 25% of calcium in foodstuff. In present study the calcium contents were high in herbs followed by tree. Cheema *et al*. (2011) reported that calcium concentration

was high in tree i.e. *Acacia nilotica.*

Zinc

It was observed that Zinc contents decreased with advancing phenological stages in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia difusa, Chrozophora obliqua* and *Datura metel* while increased in *Rhazya stricta, Withania somnifera, Vitex trifolia, Albizia lebbeck* and *Tamarix aphylla.* Overall average indicated that post reproductive stage had the maximum (22.34 mg Kg^{-1}) and vegetative then minimum (19.11 mg Kg^{-1}) Zinc contents. Among the plants the maximum Zinc content were recorded for *Rhazya stricta* (52.37 mg Kg^{-1}) followed by *Chrozophora obliqua* (30.77 mg Kg^{-1}) and *Vitex trifolia* (19.11 mg Kg^{-1}). The least sodium content was found in *Tamarix aphylla* (9.19 mg Kg^{-1}). ANOVA showed that among the growth stages Zn was significantly high at post reproductive stage (F= 19.0524). While among the plant species it was high in *Rhazya stricta* (F = 290.2262) and between the groups it was highly significant in *Rhazya stricta* at post reproductive stage (F = 57.3217). The significant differences with in groups i.e. stages, plant species and between the groups are found with LSD 1.40, 2.081 and 3.605 respectively (Tables 101, 102; Fig. 81).

Zinc is an essential element for male fertility and nerve function. Zn is necessary for the plant growth in high quantity because the plant could not grow and mature in the absence of Zn. The high quantity of Zn in herbs and grasses was due the presence of such element on the surface of earth while the shrubs and tree collected the mineral from the low surface of the earth where the Zn quantity was low. Zn is necessary for RBC in consumers consequently the consumer preferred herbs and grasses as compare to shrubs and trees. Cladde & Paule (1979) reported that zinc element increased formation of RBC, WBC and vitamin activity. Our results was agrees with Sultan *et al*. (2008a) who reported that zinc was low in grasses than herbs. Khan *et al*. (2006) stated that grazing land forage had slightly low content of zinc than mean contents of required for livestock. Rehman & Iqbal (2008) reported the high zinc concentration in leaves collected from industrial area. Hussain *at al*. (2009) stated that zinc content were high in herb like *Mentha sylvestris* while in our case the zinc content were high in shrub i.e. *Rhazya stricta*. Hussain *et al*. (2009) declared that zinc deficiency is an important

health problem in 3rd world countries.

Malik *et al*. (2010) also described the presences of Zn in plant species. Zn deficiency might supply to detained sexual maturation, growth retardation and enzymes interruption. Zn reduced the harmful effect of Cu in primary consumers. Zafar *et al*. (2010) described that zinc was an essential element for livestock. Zn and Mn increased the milk production in cow (Griffiths *et al*. 2007). Thus cow preferred shrubs and trees as compare to grasses. Cow eats shrubs and trees to accomplish its requirement for increasing milk production. Malik *et al.* (2010) stated that in industrial area the Zn contents were higher in plant as compare to other metal. They collected the Zn content varied from 61.9-172.6 mg/kg in different plant species. In our case, no industrial zone is present so, the Zn content was low in grasses as compare to the above statement. Zinc was present mostly in upper layer of the soil therefore it was easily collected by herbs and grasses than shrubs and trees. It was noted from the present data that in herbs and grasses the zinc was decreases at advancing phenological stages while in shrubs and tree it will increased at advancing phenological stages. Asaolu & Asaolu (2010) stated that zinc was the most abundant metal with averages of 2.82, 1.97 and 2.08 (mg/g) in roots, stem and leaf of the vegetables.

Copper

It was observed that copper contents decreased with advancing phenological stages in *Chrozophora obliqua* and *Withania somnifera* while increased in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia difusa, Datura metel, Rhazya stricta, Vitex trifolia, Albizia lebbeck* and *Tamarix aphylla.* Overall average indicated that post reproductive stage had the maximum (11.01 mg Kg^{-1}) and vegetative then minimum (6.9 mg Kg^{-1}) copper contents. Among the plants the maximum copper content were recorded for *Cymbopogon jwarancusa* (30.13 mg Kg^{-1}) followed by *Eragrostis poaoides* (19.8 mg Kg^{-1})) and *Chrozophora obliqua* (8.63 mg Kg^{-1}). The least sodium content was found in *Albizia lebbeck* (1.73 mg Kg^{-1}) followed by *Datura metel* (2.31 mg Kg^{-1}). ANOVA showed that in stages and among plant species the presence of copper was significantly high at post reproductive stage (F = 109.2303) and in *Cymbopogon jwarancusa* (F= 634.6047). The comparison between the stages and

plant species, copper was found significantly high in *Cymbopogon jwarancusa* at post reproductive stage (F= 16.1486). Among the stages and plant species, significant differences were present at LSD 0.5564 and 1.016 respectively. The significant differences between the groups were at LSD 1.76 (Tables 101, 102; Fig. 82).

Copper is necessary for appropriate growth and utility in plants but a deficient or an excess of the element could destroys plants because the element deficiency reduced the development of roots. Copper intensity of 150 mg Kg-1 or high in plant produced plant toxicity. From the result it was noticed that Cu value increase with increased of plant growth. Shah *et al*. (1986) investigated that increase in copper concentration in plant species endorses maturity. Hussain & Durrani (2008) stated that Cu contents were higher in shrubs than grasses while in our case, the Cu contents were higher in grasses than shrubs. Cu is necessary for seed development and low growth of plants is the general symptom of Cu deficiency. The test species of shrubs are nonpalatable and the copper contents were low in all shrub species. Copper is toxic for animals but it is reduced with the presence of some micro mineral. Cu is required in red cell growth and bone formation in consumers in moderate quantity. Gonzalez-V *et al*. (2006) and Sobukola *et al*. (2010) also worked on copper intensity in some plants. The result showed that the highest copper content was found in grasses as compare to herbs, shrubs and trees. Our result agrees with Sultan *et al*. (2008) who stated that copper contents increased with plant growth in rangeland grasses. It is obvious that copper concentration increased from vegetative stage to reproductive stage and then post reproductive stage. The investigated area is semi arid and temperature is high. Sultan *et al*. (2008) reported that copper contents were increased in species with increasing soil temperature. Malik *et al.* (2010) reported that accumulation of copper was highest in shoots followed by Zn, Cr, Pb, Co and Ni.

Manganese

It was observed that manganese contents increased with advancing phenological stages in *Boerhaavia diffusa, Rhazya stricta, Withania somnifera, Datura metel, Vitex trifolia* and *Tamarix aphylla* while decreased in *Cymbopogon jwarancusa, Eragrostis poaoides, Chrozophora obliqua* and *Albizia lebbeck.* Overall average indicated that post reproductive stage had

the maximum (38.45 mg Kg^{-1}) and vegetative then minimum (33.4 mg Kg^{-1}) manganese contents. Among the plants the maximum manganese content were recorded for *Rhazya stricta* (65.68 mg Kg^{-1}) followed by *Chrozophora obliqua* (62.9 mg Kg^{-1}) and *Tamarix aphylla* (48.1 mg Kg^{-1}). The least manganese content was found in *Eragrostis poaoides* (7.21 mg Kg^{-1}). ANOVA showed that with in groups the presence of manganese was significantly high at post reproductive stage (F = 96.3419) and in *Rhazya stricta* (F = 1554.2594) while comparison between the groups it was significantly high in *Rhazya stricta* at post reproductive stage (F = 122.1608). The significant differences of manganese was present at phonological stages (LSD = 0.7708), test species (LSD = 1.407) and between the groups (LSD = 2.43) (Tables 101, 102; Fig. 83).

Manganese is necessary for chloroplast development. Deficiency of manganese in plants leads to the leaves' discoloration. Manganese intensity in plant, differ among test species and among growths stages. Mn is necessary for the bone strength, formation and necessary for activation of enzymes in livestock therefore they preferred the herbs in early stage besides shrubs and trees. Manganese quantity was decreased in grasses and herbs while increased in shrubs and trees with the increase of plant growth. Khan *et al*. (2007) also described the presences of manganese in plants species. Manganese is an important micronutrient and essential for many vital functions in species. It joined with enzymes required for chlorophyll development. Ducic & Polle (2005) stated that manganese acts as a cofactor and assist in synthesis of ascorbic acid, riboflavin and carotene. Hussain & Durrani (2008) analyzed that Mn contents were higher in grasses than shrubs while in our case, the Mn contents were higher in shrubs than grasses. The result showed that the shrubs have high contents of manganese followed by herbs and then trees. Hussain *et al*. (2010) reported high concentration of manganese in *Dalbergia sisso*. The manganese contents increases with advanced phenological stages. Our result agree with those of Hussain *et al*. (2010), Sultan *et al*. (2008) and Zafar *et al*. (2010) stated that manganese concentration in plant species were sufficient to meet up the grazing animals supplies.

Nickel

It was observed that nickel contents decreased with advancing phenological stages in *Datura metel* and *Tamarix aphylla* while increased in *Cymbopogon jwarancusa,*

Eragrostis poaoides, Boerhaavia diffusa, Chrozophora obliqua, Rhazya stricta, Withania somnifera, Vitex trifolia and *Albizia lebbeck.* Overall average indicated that post reproductive stage had the maximum (12.97 mg Kg^{-1}) and vegetative then minimum (4.28 mg Kg^{-1}) nickel contents. Among the plants the maximum nickel content were recorded for *Vitex trifolia* (57.4 mg Kg^{-1}) followed by *Rhazya stricta* (24.3 mg Kg^{-1}) and *Withania somnifera* (7.7 mg Kg^{-1}). The least nickel content was found in *Chrozophora obliqua* (0.45 mg Kg^{-1}) followed by *Boerhaavia diffusa* (0.46 mg Kg^{-1}). ANOVA showed the significant differences of Ni with in the groups i.e. growth stages and plant species at LSD 0.4757 and 0.8684 respectively while between the groups at LSD (1.504). Within the groups, Ni was found significantly high at post reproductive stage (F = 717.0494) and in *Vitex trifolia* (F = 3640.0361) while between the groups it was found high (F = 310.0047) at post reproductive stage in *Vitex trifolia* (Tables 101, 102; Fig. 84).

Ni is the part of RNA, therefore, it was found in high concentration in all plant species. It is also essential for urease activity in rumen microbes. Ahmad *et al*. (2009) and Sobukola *et al*. (2010) also illustrated the presence of Ni in plant species in high quantity. Results of the current investigation explain the significant differences within group and between the groups. From the result it's noticed that the significant differences were present among the phenological stages. In shrubs and trees the mineral value was high at stage of maturation while low in seedling stage. The differences of mineral value in different species were also due the requirement of that specie and unavailability of mineral as sap solution, soil texture and chemistry as well as environmental conditions. Naser *et al.* (2009) stated that nickel, lead and cadmium content were higher in those plant species which are present in polluted area and low or absent in those plant species which present in non-polluted area. Our result agrees with the above statement. Sobukola *et al.* (2010) determined the nickel levels in sixteen different fruits and leafy vegetables ranged from 0.070±0.07 to 0.137±0.05 mg/kg and 0.05±0.04 to 0.24±0.01 mg/kg for fruit and leafy vegetable respectively.

Chromium

It was observed that chromium contents increased with advancing phenological stages in *Cymbopogon jwarancusa, Eragrostis poaoides, Boerhaavia diffusa, Rhazya stricta, Withania somnifera, Datura metel, Vitex trifolia, Albizia lebbeck* and *Tamarix aphylla* while decreased only in *Chrozophora obliqua.* Overall average indicated that post reproductive stage had the maximum (4.39 mg Kg-1) and vegetative then minimum (2.68 mg Kg^{-1}) chromium contents. Among the plants the maximum chromium content were recorded for *Rhazya stricta* (9.42 mg Kg^{-1}) followed by *Chrozophora obliqua* (5.46 mg Kg^{-1}) and *Withania somnifera* (5.45 mg Kg^{-1}). The least chromium content was found in *Tamarix aphylla* (0.2 mg Kg^{-1}) followed *Datura metel* (0.23 mg Kg^{-1}). ANOVA showed that among the growth stages at post reproductive stage the chromium was significantly high (F = 4.6537) while among plant species it was significantly high in *Rhazya stricta* (F = 950.8827). Between the groups, chromium was significantly high (F 120.0930) in *Rhazya stricta* at post reproductive stage. The significant differences between the groups were found by LSD (0.4506) however with in the groups i.e. growth stages and plant species were present on LSD 0.1425 and 0.2606 respectively (Tables 101, 102; Fig. 85).

Chromium is toxic essential element for plants and microorganisms. It participate a vital role in the production and metabolism of different biological conjugated molecules like carbohydrates, proteins and Fat. In the current study Cr value vary from 0.12 to 8.49 mg Kg^{-1} in the test species which is tremendously low from lethal point. Hashmi *et al.* (2007) determined the highest concentrations of chromium level (1.2 μg/g) in coriander. In our result the chromium content were high only in vegetative stage of *Chrozophora obliqua.* Farooq *et al.* (2008) stated that the chromium contents were high (0.546 mg kg^{-1}) in leaves of cauliflower as compare to other parts. According to Ahmad *et al*., (2009) in salt ranges of Pakistan the grazing was very dangerous for consumers and caused different problems due the presences of higher concentration of chromium. Zafer *et al*. (2010) reported chromium in some medicinal plant species. Sharma *et al*. (2006) and Rahim *et al*. (2008) also studied Cr in different plant species. Our result showed that shrubs have high content of chromium followed by herbs while the least content were found in tree species. Malik *et al.* (2010) stated that the chromium

was high in root as compare to other parts of the plants.

Cadmium and Lead

Cadmium (Cd) and lead (Pb) were absent in all the test species. No industrial unit is present in the investigated area. Naser *et al.* (2009) stated that lead and cadmium content were higher in those plant species which are present in polluted area and low or absent in those plant species which present in non-polluted area.

Minerals are essential for the normal growth and development of plants that ultimately effect the growth, maintenance and productivity of range animals at secondary level. Various environmental factors including edaphic, climatic, geographic and biotic stresses influence the mineral composition of plants including forage species. Mineral compositions of plants are used to diagnose probable deficiencies in food and forage and nutritional status of plants. Comparison among at vegetative stage of test species and macro nutrients showed that the highest amount (74.08 g Kg^{-1}) of potassium was found in *Datura metel* while in micro nutrients the amount of manganese was found high (64.4 mg Kg^{-1})in *Chrozophora obliqua*. The least amount (0.27 g Kg^{-1}) of sodium among macro nutrients was found in *Albizia lebbeck* while in micro nutrients the chromium was low (0.12 mg Kg^{-1}) in *Tamarix aphylla* (Fig. 86). Comparison among at reproductive stage of test species and macro nutrients pointed out that the highest amount (72.07 g Kg^{-1}) of potassium was found in *Rhazya stricta* while in micro nutrients the amount of nickel was found high (67.24 mg Kg^{-1}) in *Vitex trifolia*. The least amount (0.58 g Kg^{-1}) of sodium among macro elements was found in *Vitex trifolia* while in micro nutrients the chromium was low (0.29 mg Kg^{-1}) in *Tamarix aphylla* (Fig. 87).Comparison among at post reproductive stage of test species and macro nutrients showed that the highest amount (75.46 g Kg^{-1}) of potassium was found in *Rhazya stricta* while in micro nutrients the highest amount (80.4 mg Kg^{-1}) was found in *Vitex trifolia* of nickel. The least amount (0.5 g Kg^{-1}) of sodium among macro nutrients was found in *Vitex trifolia* while in micro nutrients the chromium was low (0.18 mg Kg^{-1}) in *Tamarix aphylla* (Fig. 88). Comparison among the means value of macro and micro nutrients of test species showed that the highest amount (63.86 g Kg^{-1}) of potassium was found in *Rhazya stricta* while in micro nutrients the amount of manganese was also high (65.68 mg Kg^{-1})in *Rhazya stricta*. The least amount

(0.54 g Kg^{-1}) of sodium among macro nutrients was found in *Albizia lebbeck* while in micro nutrients the chromium was low (0.2 mg Kg^{-1}) in *Tamarix aphylla* (Fig. 89)

The producers require minute amount of micro and macro elements for their growth although their importance could not be judged the minimum amount in the growth and development of livestock. Some of the micro minerals upset affects of macro elements in different condition. The main sources of these elements were water, soil temperature, moisture and soil types leading on which the plant species produce (McDowell, 2003). Elements deficiencies could reduce herbage digestibility and ingestion and eventually decline animal's productivity (Khan *et al.*, 2005). The elements glut also originated harsh physiological disorder. Heavy metals influenced the nutritional value of farming yield and also caused harmful effect on livestock. According to the Sobukola *et al*. (2008) that the heavy metals should be in safe and sound limits in food. Domestic animals nurture was a common practice in the research area because the people solve their economical problem. Minerals are required for soil fertility. In plants, as herbs and grasses fully developed, some minerals were transferred to the fruit. Also, the minerals content of the plant was inclined clearly by the accessibility of mineral in the soil. As a result of this, low-quality fields without legumes and range plants lean to be naturally low in minerals, as the forage full-fledged and the seeds fall; naturally, the range soil was also deficient in minerals. Some sufficient mineral availability stimulates premature development and speed up plant's maturity. Thus, it was an essential that the time of sampling, stage of growth and character of growth prior to sampling be known and considered when taking a plant analysis result.

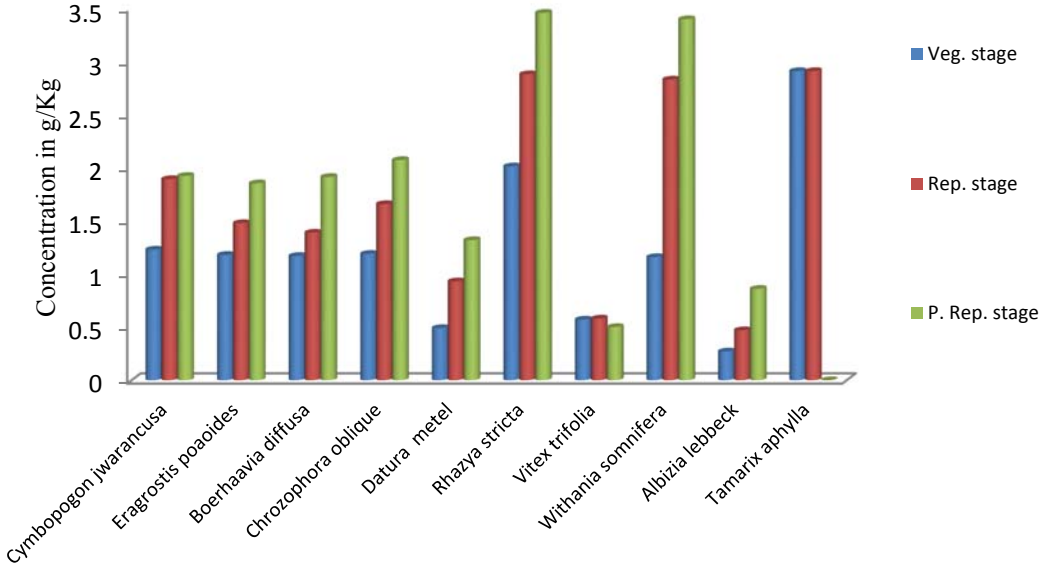


Fig. 78. Sodium contents (g Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

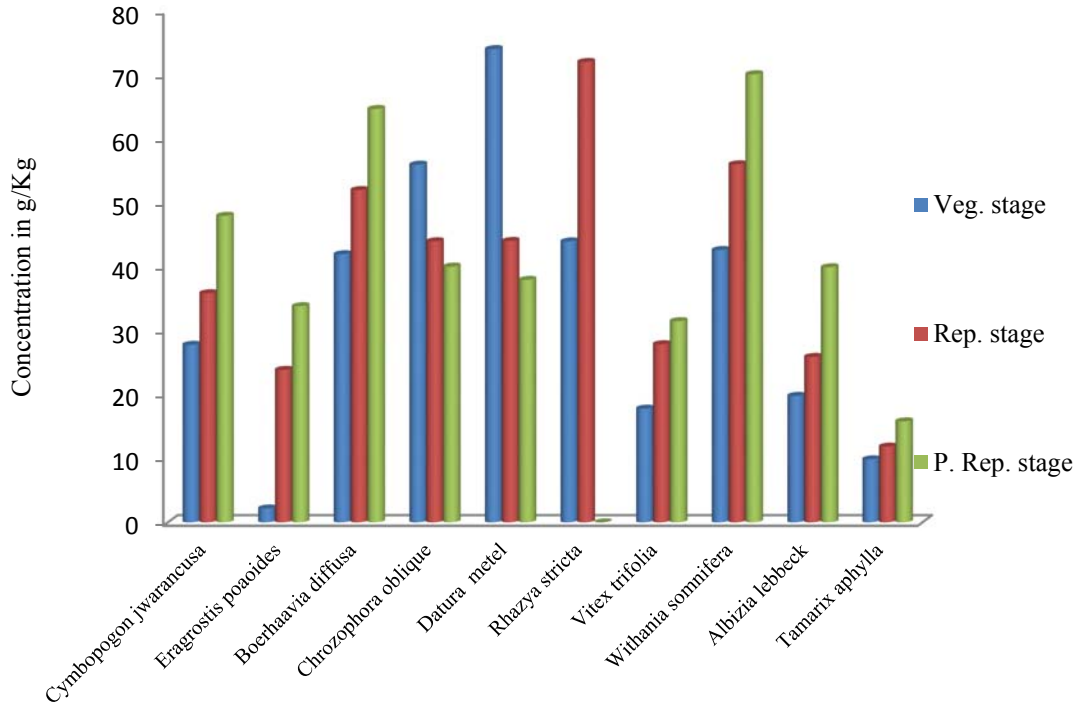


Fig. 79.Potassium contents (g Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages

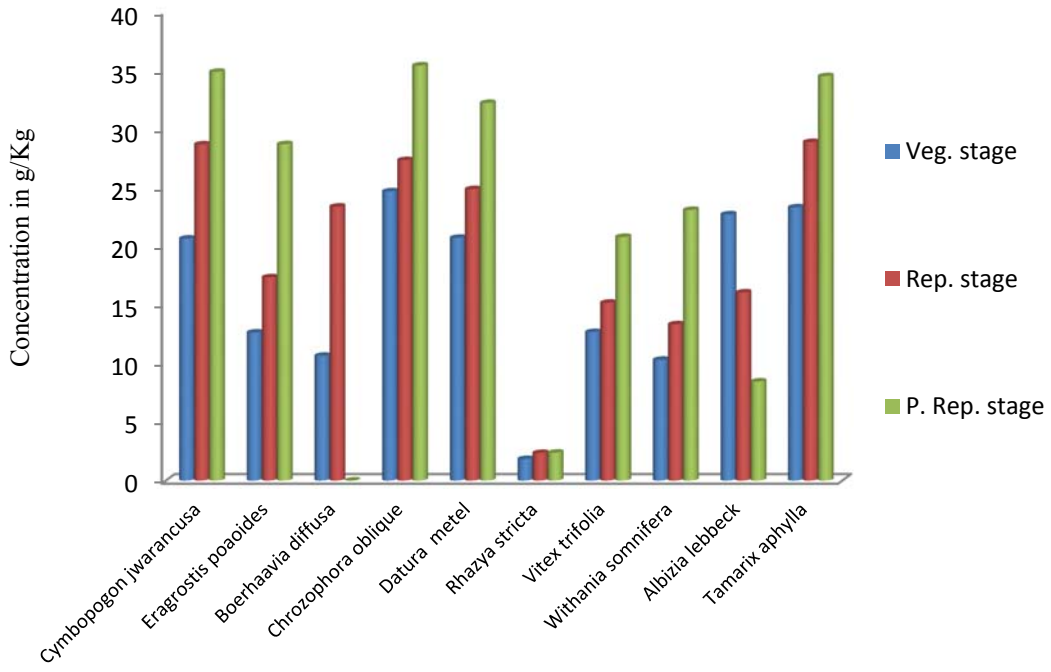


Fig. 80. Calcium contents (g Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

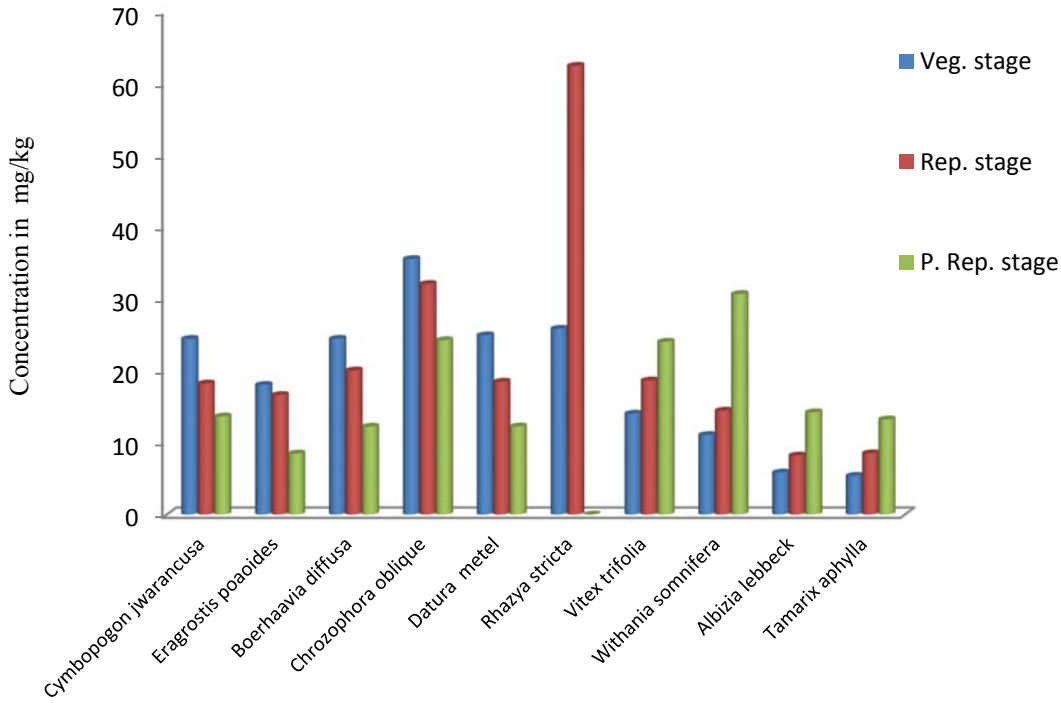


Fig. 81. Zinc contents (mg Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

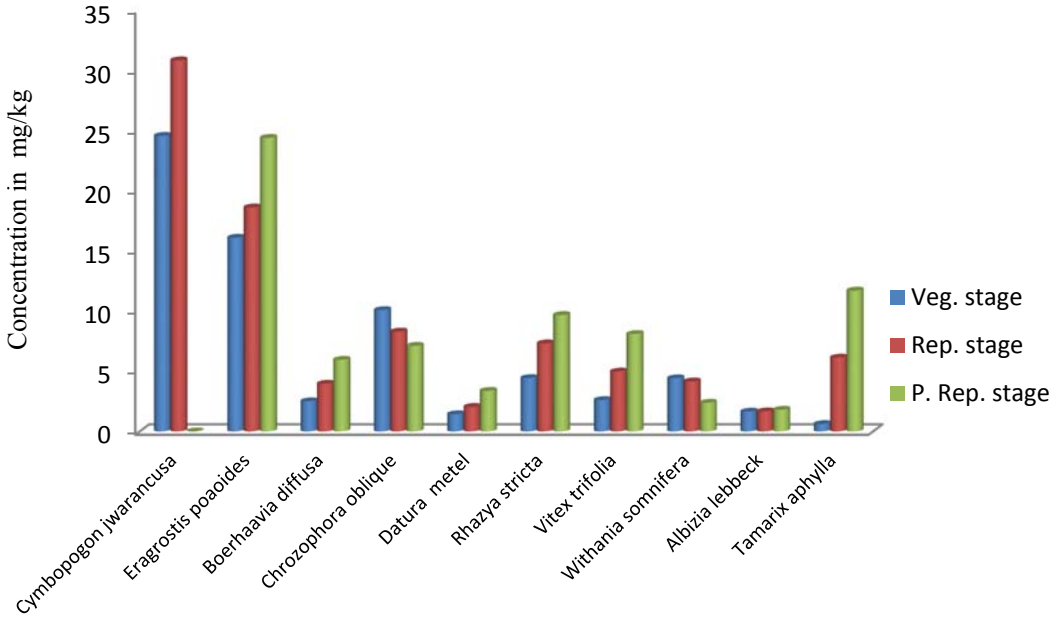


Fig. 82. Copper contents (mg Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

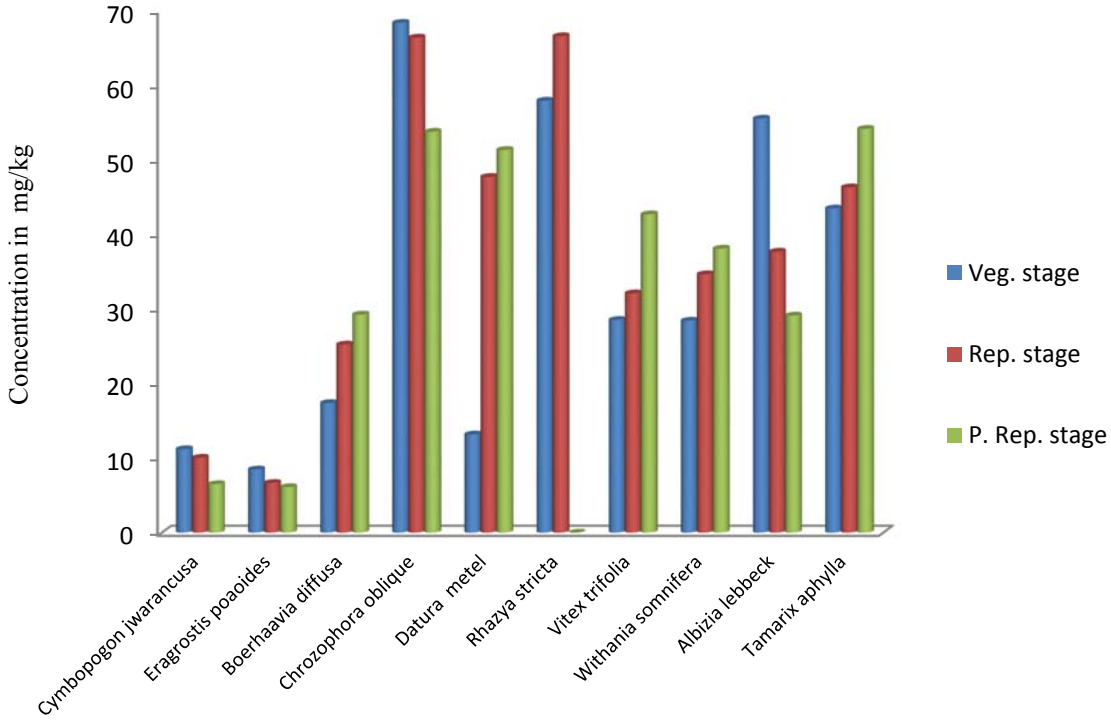


Fig. 83. Manganese contents (mg Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

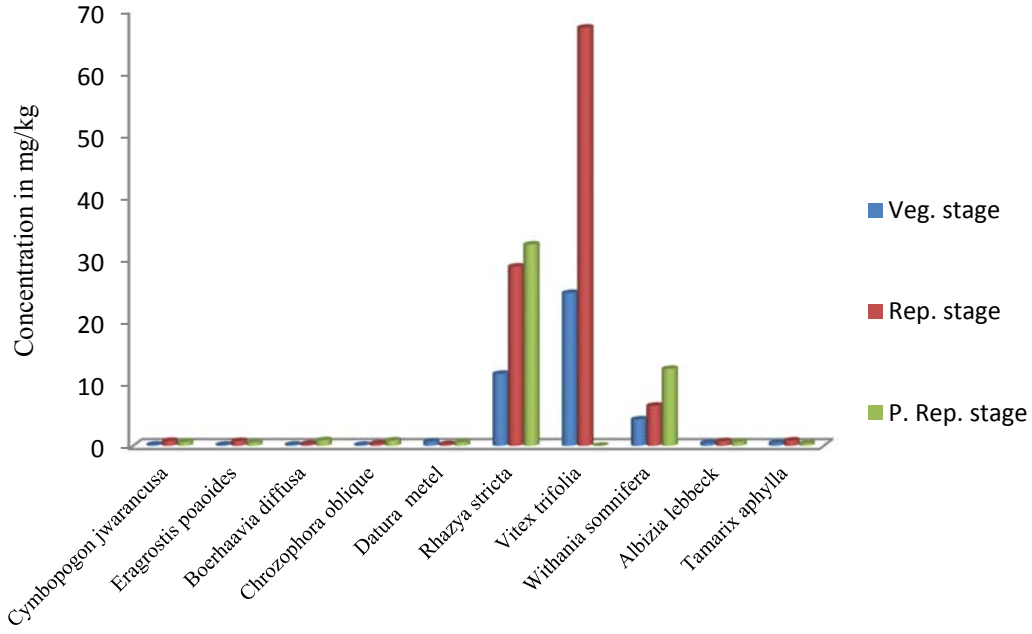


Fig. 84. Nickel contents (mg Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

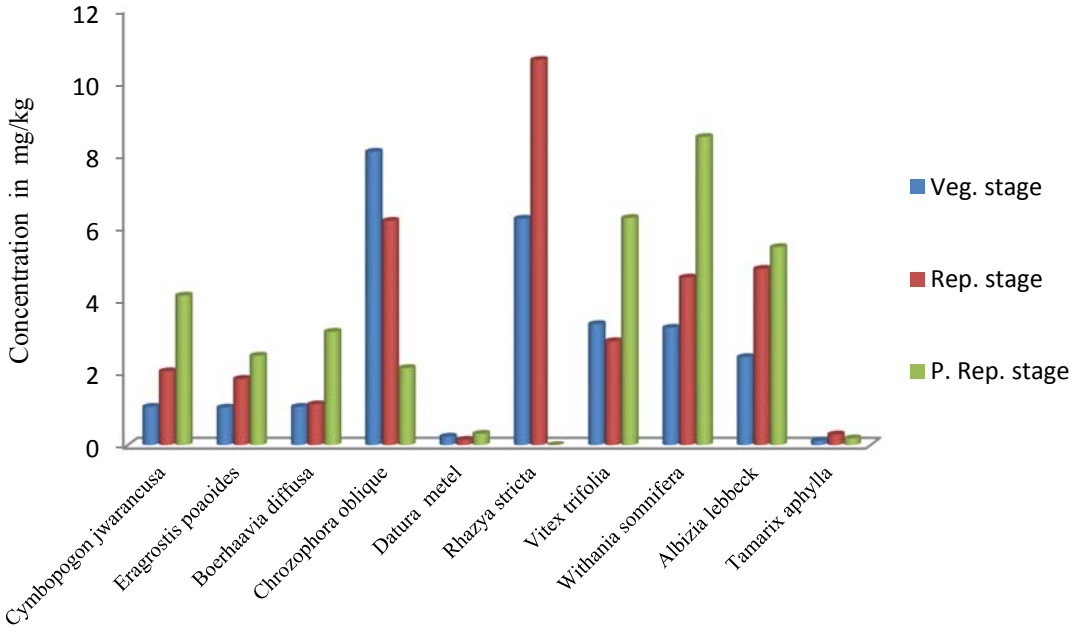


Fig. 85. Chromium contents (mg Kg^{-1}) of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

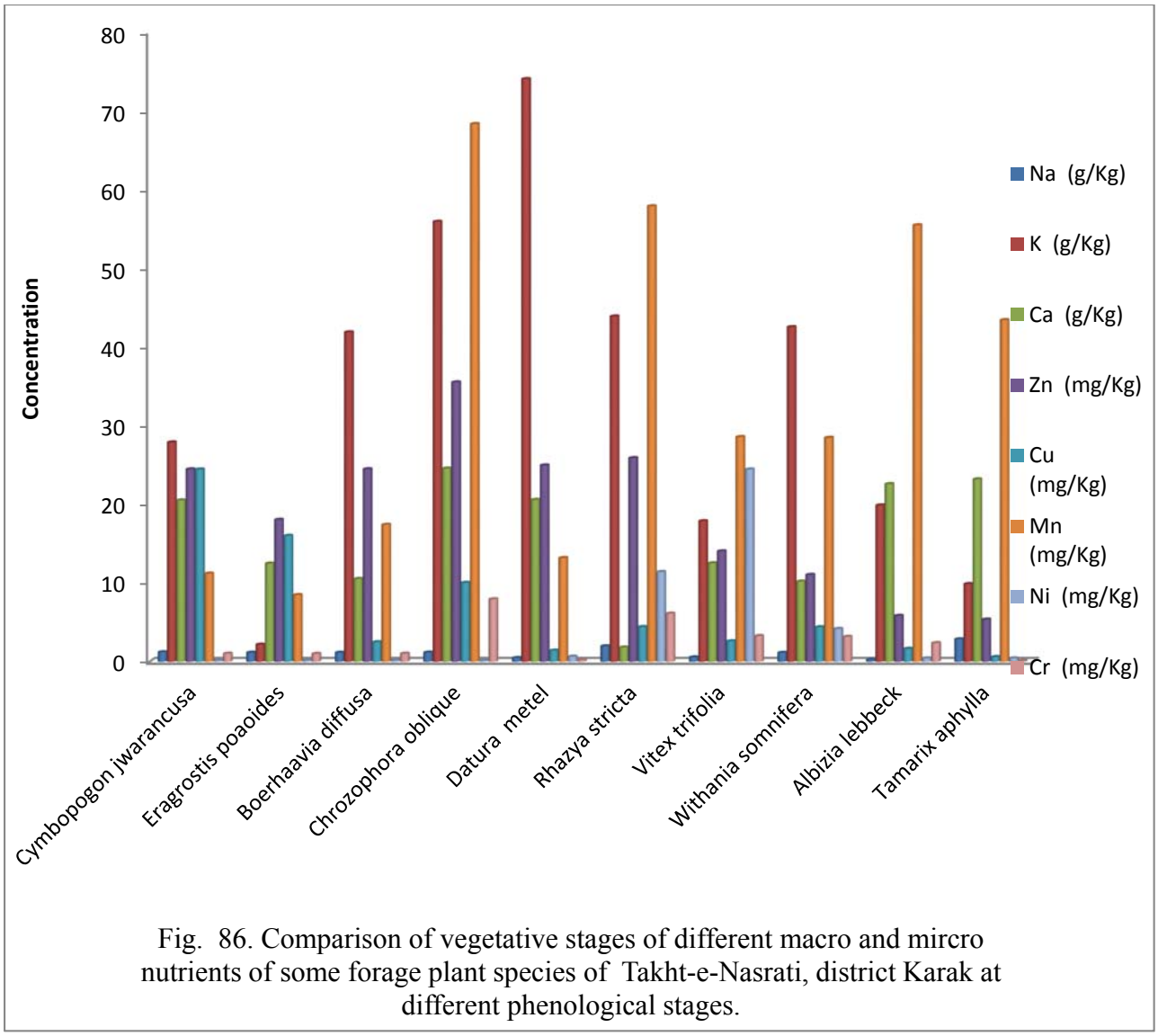


Fig. 86. Comparison of vegetative stages of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

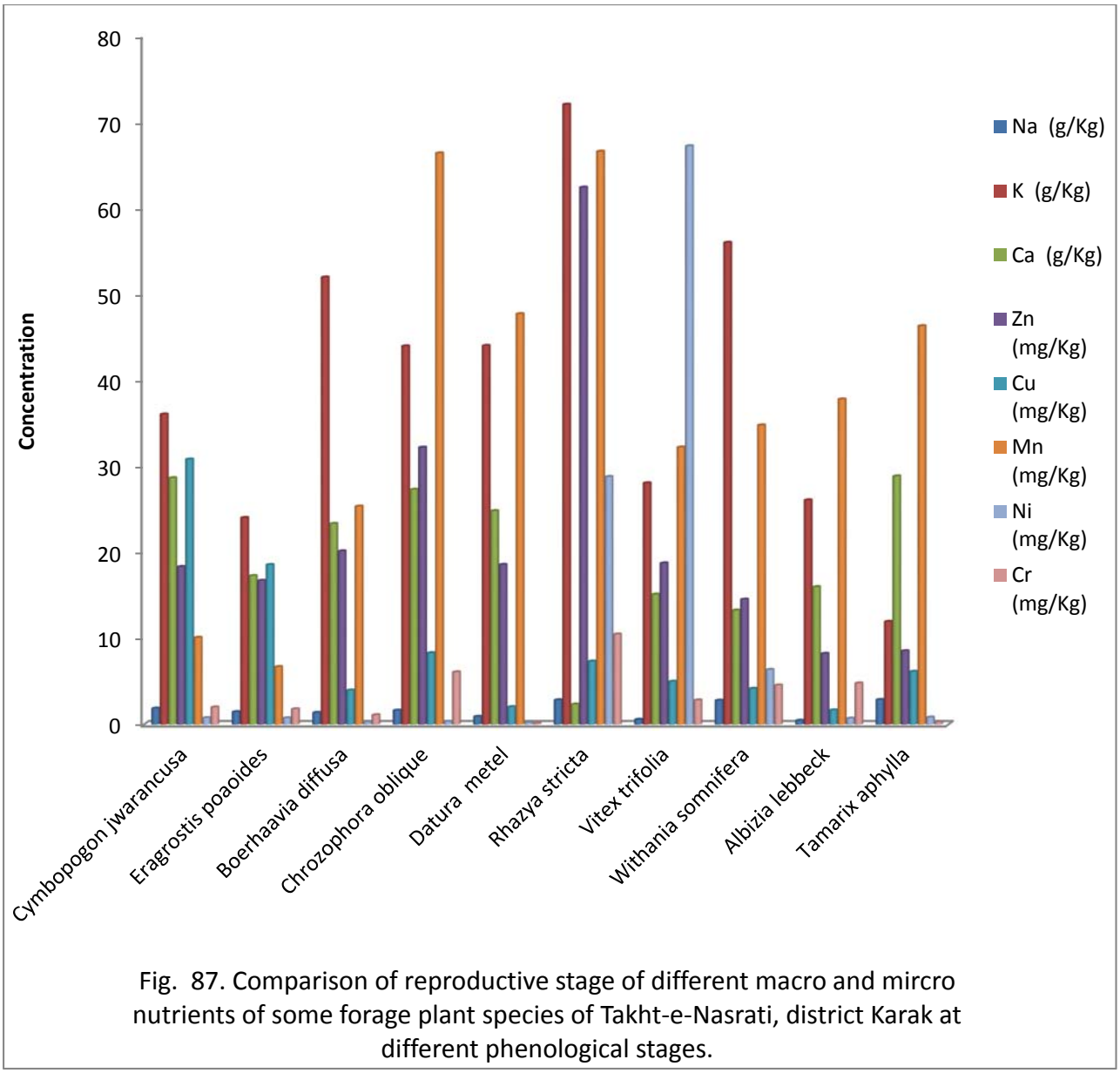


Fig. 87. Comparison of reproductive stage of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

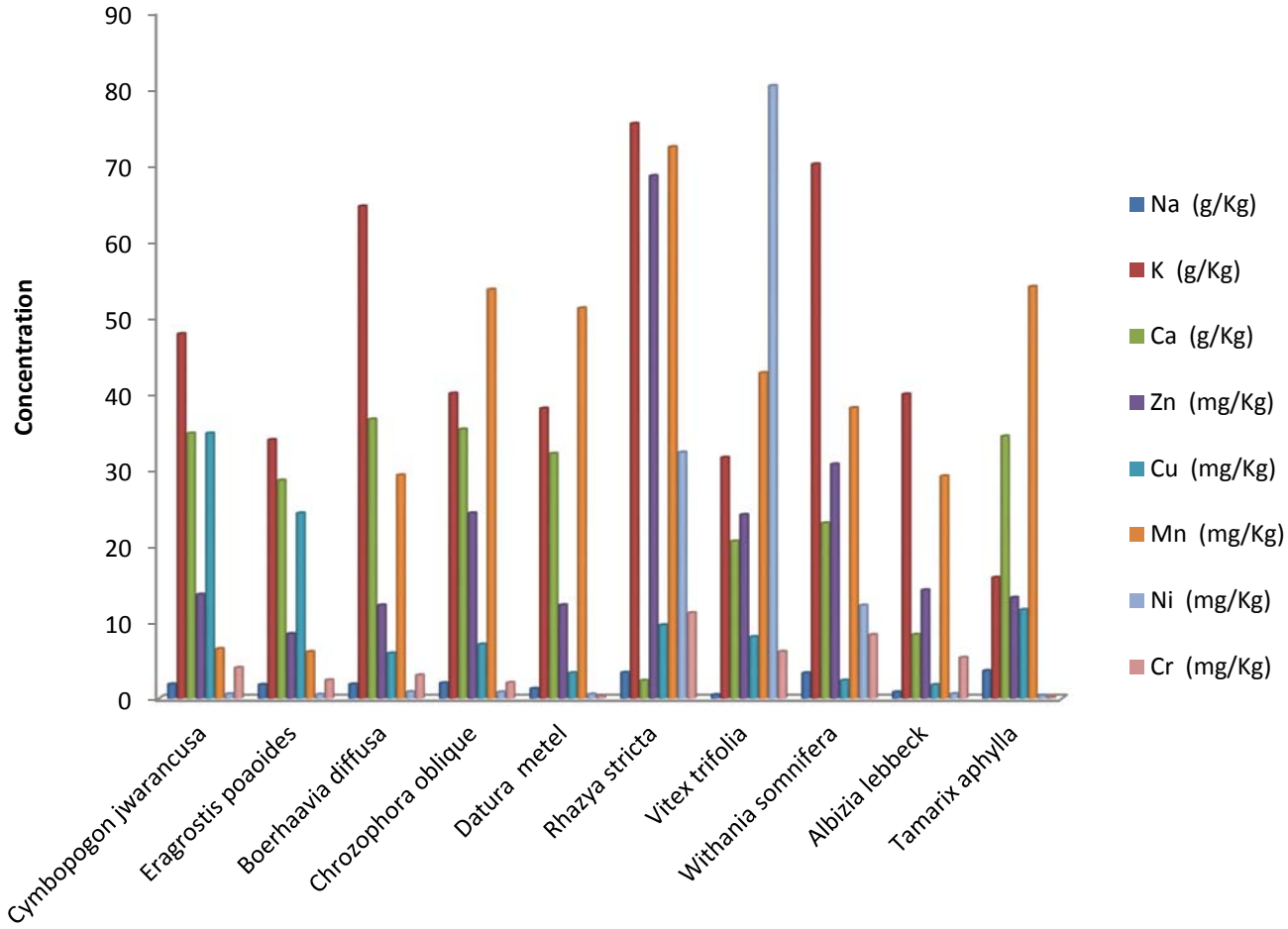


Fig. 88. Comparison of post reproductive stages of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

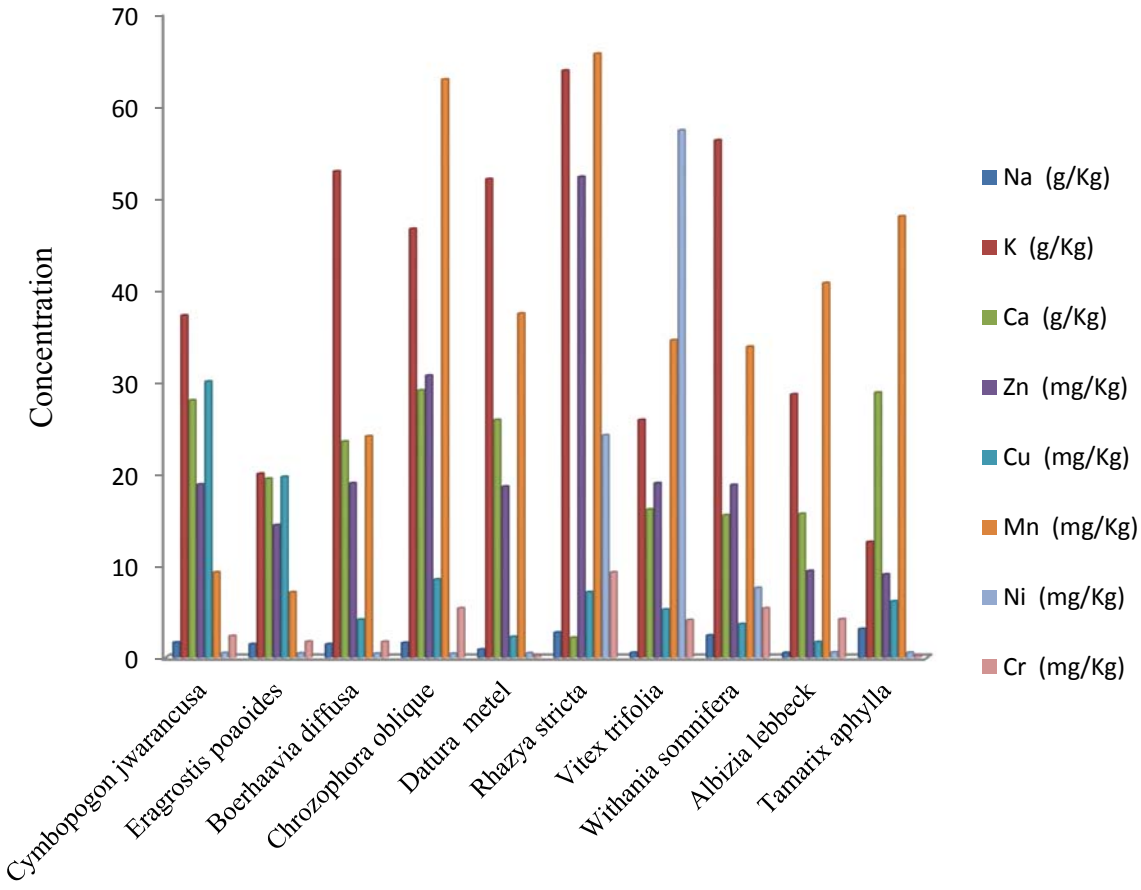


Fig. 89. Comparison of mean value of different macro and mircro nutrients of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

Table 99. concentration gradient of macro elements i.e. Na, K and Ca of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

Species	Na				K				Ca			
	Vegetative	Reproductive	Post Reproductive	Mean	Vegetative	Reproductive	Post Reproductive	Mean	Vegetative	Reproductive	Post Reproductive	Mean
Cymbopogon jwarancusa (Jones) Schult	1.23	1.89	1.92	1.68	28.02	36.08	48.06	37.39	20.69	28.71	34.89	28.09
Eragrostis poaoides Beauv.	1.18	1.48	1.85	1.5	2.22	24.11	34.05	20.13	12.69	17.39	28.73	19.6
Boerhaavia diffusa L..	1.17	1.39	1.91	1.49	42.06	52.07	64.74	52.96	10.71	23.41	36.74*	23.62
Chrozophora obliqua (Vahl) A. Juss	1.19	1.66	2.07	1.64	56.04	44.08	40.13	46.75	24.71	27.37	35.43	29.17*
Datura metel L.	0.49	0.93	1.32	0.91	74.08	44.13	38.16	52.13	20.75	24.9	32.24	25.96
Rhazya stricta Decne.	2.01	2.88	3.46	2.78	44.06	72.07	75.46^{+}	63.86*	1.85	2.37	2.393	2.204
Vitex trifolia L.	0.57	0.58	0.5	0.55	18.06	28.12	31.72	25.96	12.73	15.23	20.83	16.26
Withania somnifera (L) Dunal.	1.16	2.83	3.4	2.46	42.72	56.1	70.16	56.32	10.37	13.39	23.13	15.63
Albizia lebbeck (L.) Benth.	0.27	0.47	0.86	0.54	20.05	26.14	40.03	28.74	22.75	16.1	8.513	15.79
Tamarix aphylla (L.) Karst	2.91	2.91	3.69^{+}	3.17*	10.05	12.08	16.08	12.74	23.35	28.91	34.52	28.93
Means	**1.22**	**1.7**	**2.1***	**1.67**	**33.736**	**39.498**	**45.86***	**39.69**	**16.06**	**19.78**	**25.74***	**20.52**

Table 100. Analysis of variance of Na, K and Ca contents of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

	K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
Sodium	1	Replication	2	0.045	0.022	5.4452	0.0068
	2	Factor A	2	11.679	5.839	1421.7805	0
	4	Factor B	9	65.722	7.302	1778.0359	0
	6	AB	18	6.127	0.34	82.8847	0
	-7	Error	58	0.238	0.004		
		Total	89	83.811			
Potassium	1	Replication	2	10.407	5.204	1.358	0.2652
	2	Factor A	2	2206.42	1103.21	287.9101	0
	4	Factor B	9	23978.715	2664.302	695.3157	0
	6	AB	18	7302.291	405.683	105.873	0
	-7	Error	58	222.244	3.832		
		Total	89	33720.077			
Calcium	1	Replication	2	6.518	3.259	2.1402	0.1268
	2	Factor A	2	1431.28	715.64	469.9962	0
	4	Factor B	9	5785.526	642.836	422.1825	0
	6	AB	18	1549.316	86.073	56.5285	0
	-7	Error	58	88.314	1.523		
		Total	89	8860.953			

Table 101. Concentration gradient of micro elements i.e. Zn, Cu, Mn, Ni and Cr of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

Species	Zn				Cu				Mn				Ni				Cr			
	Vegetative	Reproductive	Post Reproductive	Mean	Vegetative	Reproductive	Post Reproductive	Mean	Vegetative	Reproductive	Post Reproductive	Mean	Vegetative	Reproductive	Post Reproductive	Mean	Vegetative	Reproductive	Post Reproductive	Mean
Cymbopogon jwarancusa (Jones) Schult.	24.62	18.43	13.85	18.97	24.6	30.86	34.90+	30.13*	11.4	10.23	6.62	9.42	0.18	0.78	0.61	0.52	1.05	2.03	4.12	2.4
Eragrostis poaoides Beauv.	18.23	16.83	8.62	14.56	16.2	18.66	24.43	19.8	8.63	6.787	6.227	7.21	0.17	0.76	0.54	0.49	1.03	1.82	2.46	1.77
Boerhaavia diffusa L..	24.63	20.24	12.43	19.1	2.54	4.02	6.04	4.2	17.6	25.42	29.42	24.2	0.18	0.3	0.89	0.46	1.05	1.12	3.12	1.76
Chrozophora obliqua (Vahl) A. Juss.	35.62	32.24	24.44	30.77	10.2	8.42	7.22	8.63	68.4	66.42	53.85	62.9	0.15	0.35	0.85	0.45	8.08	6.17	2.12	5.46
Datura metel L.	25.11	18.68	12.45	18.74	1.45	2.07	3.42	2.31	13.4	47.82	51.42	37.6	0.67	0.25	0.57	0.5	0.23	0.143	0.31	0.23
Rhazya stricta Decne.	26.03	62.44	68.63+	52.37*	4.5	7.43	9.79	7.24	58	66.61	72.41+	65.68*	11.6	28.85	32.4	24.3	6.23	10.62	11.4*	9.42*
Vitex trifolia L.	14.24	18.85	24.23	19.11	2.65	5.05	8.22	5.31	28.7	32.26	42.82	34.6	24.6	67.24	80.4+	57.4*	3.33	2.86	6.25	4.15
Withania somnifera (L) Dunal.	11.24	14.66	30.85	18.92	4.48	4.22	2.42	3.71	28.6	34.81	38.23	33.9	4.25	6.45	12.4	7.7	3.23	4.62	8.49	5.45
Albizia lebbeck (L.) Benth.	5.94	8.34	14.43	9.57	1.67	1.69	1.83	1.73	55.6	37.82	29.29	40.9	0.44	0.72	0.62	0.59	2.42	4.86	5.46	4.25
Tamarix aphylla (L.) Karst.	5.47	8.66	13.44	9.19	0.62	6.23	11.82	6.22	43.6	46.42	54.23	48.1	0.45	0.84	0.38	0.56	0.12	0.29	0.18	0.2
Means	**19.11**	**21.94**	**22.34**	**21.13**	**6.89**	**8.87**	**11.01**	**8.93**	**33.39**	**37.46**	**38.45**	**36.450**	**4.27**	**10.65**	**12.97**	**9.29**	**2.68**	**3.45**	**4.39**	**3.51**

Table 102. Analysis of variance of Zinc, copper, Manganese, Nickle and Chromium contents of some forage plant species of Takht-e-Nasrati, district Karak at different phenological stages.

	K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
Zinc	1	Replication	2	0.231	0.115	0.0237	
	2	Factor A	2	185.324	92.662	19.0524	0
	4	Factor B	9	12703.745	1411.527	290.2262	0
	6	AB	18	5018.153	278.786	57.3217	0
	-7	Error	58	282.085	4.864		
		Total	89	18189.538			
Copper	1	Replication	2	1.404	0.702	0.6053	
	2	Factor A	2	253.258	126.629	109.2303	0
	4	Factor B	9	6621.176	735.686	634.6047	0
	6	AB	18	336.974	18.721	16.1486	0
	-7	Error	58	67.238	1.159		
		Total	89	7280.05			
Manganese	1	Replication	2	3.721	1.861	0.8366	
	2	Factor A	2	428.548	214.274	96.3419	0
	4	Factor B	9	31111.441	3456.827	1554.2594	0
	6	AB	18	4890.561	271.698	122.1608	0
	-7	Error	58	128.998	2.224		
		Total	89	36563.269			
Nickle	1	Replication	2	0.374	0.187	0.221	
	2	Factor A	2	1214.882	607.441	717.0494	0
	4	Factor B	9	27752.569	3083.619	3640.0361	0
	6	AB	18	4727.11	262.617	310.0047	0
	-7	Error	58	49.134	0.847		
		Total	89	33744.069			
Chromium	1	Replication	2	0.71	0.355	4.6537	0.0134
	2	Factor A	2	44.361	22.18	290.8428	0
	4	Factor B	9	652.647	72.516	950.8827	0
	6	AB	18	164.854	9.159	120.093	0
	-7	Error	58	4.423	0.076		
		Total	89	866.994			

4.7.3. Proximate Composition

Proximate analysis plays an important role in assessing the suitability of plants species for different ruminant's requirement in different phases and subsidiary communities. Livestock nurture is a common observe in the area by the locals to build their livelihood. Low productivity due to deprived health of livestock was chief deliberation in the study area. To explain various proximate parameters like ash, carbohydrate, protein, fiber, fat, moisture and energy of selected forage plant species of Tehsil Takht-e-Nasrati, District Karak in three phenological stages were assessed. The nutritional demands of livestock vary with age and physiological functions of the grazing animal such as development safeguarding, growth, stuffing and lactation etc. Range animal efficiency depends upon the quantity and nutritive value of plant species available to primary consumers.

Moisture content (%)

The moisture content in the test species varied from 2.11 - 14.12 % in vegetative stage, 1.85 – 11.51 in reproductive stage and 1.12 – 11.51 % in post reproductive stage. The overall average ranged from 1.69 – 10.58 % among the plants at three phenological stages. The overall percentage of moisture composition was maximum in *Datura metel* (14.12%) in vegetative stage as well as in reproductive stage (11.51 %) and in post reproductive stage (6.12 %). The least moisture percentage was recorded in *Eragrostis poaoides* (2.11 %) in vegetative stage, (1.85 %) in reproductive and (1.12 %) in post reproductive. However, the lowest average was shown by *Eragrostis poaoides*(1.69 %) and highest average by *Datura metel* (10.58 %). It was observed that the lowest percentage of moisture was found at post reproductive stage in all test species (Table 103; Fig. 90).

The result showed that moisture contents not only varied among the species but also between the different phenological states of the plants. The result showed that moisture contant was high in all test species at vegetative stage. Our result agrees with Hanif *et al*. (2006) who stated that the green leafy vegetables had higher moisture content. The highest percentage of moisture in leaves was also reported by `Saidu & Jideobi (2009). The moisture contents of species are also depending upon on water availability. The moisture contents of the irrigated species are more than that of

non irrigated species. In present case the area is semi arid. High moisture content in *Allium sativum* (67.66 %) was reported by Hussain *et al*. (2009) while the moisture contents are much less in our results. Adnan *et al*. (2010) agree with our results. They described the ranged of moisture in *Otostegia limbata* and stated that the moisture contents decreased with age. Onwordi *et al*. (2009) reported the mean moisture contents of leaves for *Amaranthus cruentus, Celusia argenta* and *Corchorus olitorius* is 23.57, 15.58 and 30.90% respectively. In our result the moisture content was low in post reproductive stage in all test species. Sowemimo *et al*. (2011) reported that the seeds of *Detarium senegalense* contain 5.89 % moisture. Ingale & Shrivastava (2011) reported the moisture contents (5.529%) in seed of *Arachis hypogaea*.

Ash content (%)

In the test species, the ash contents varied from 3.08 – 17.16 % in vegetative stage, 5.09 – 18.12% in reproductive stage and 6.13 – 19.09 % in post reproductive stage. Among the plants at three phenological stages, the overall average ranged from 4.81 – 18.12 %. The overall percentage of ash composition was maximum in *Vitex trifolia* (17.16 %) in vegetative stage as well as in reproductive stage (18.12 %) and in post reproductive stage (19.09 %). The least ash percentage in vegetative stage was (3.03%), in reproductive stage (5.09 %) and 6.13 % in post reproductive was found in *Withania somnifera*. However, the lowest average was shown by *Withania somnifera* (4.81 %) and highest average by *Vitex trifolia* (18.12 %). It was noticed that the highest percentage of ash was present at post reproductive stage in all test species (Table 103; Fig. 91).

The result shows that the ash contents of test species increased progressively with advancing phenological stages. Hussain & Durrani (2008) stated that ash contents increase with age. Hussain *et al*. (2010) reported ash % in *Melia azadarichta, Withania cogulans* and *Fagonia indica* which ranged from 10.6 % - 16 %. Ash content percentage of the herbs and grasses are smaller than shrubs and trees. Cheema *et al*. (2011) explored the nutrational value of *Morus alba, Acacia nilotica, Syzygium cumuni* and *Ziziphus jujuba* leaves and stated that ash content (10%) were higher in *Z. jujuba* and *M. Alba*, respectively. Sowemimo *et al*. (2011) reported that the seeds of *Detarium senegalense* contain 1.93% ash. Our result is also similar with that of

Hussain *et al*. (2011) who stated that the ash contents were high in shrubs than herbs.

Fibre contents (%)

The fibre contents in test species, varied from 2.14 – 11.09 % in vegetative stage, 2.43 – 12.31% in reproductive stage and 2.78 – 13.01 % in post reproductive stage. Among the plants at three phenological stages, the overall average ranged from 2.45 – 12.13 %. The overall percentage of fibres composition was maximum in *Albizia lebbeck* (17.16 %) in vegetative stage as well as in reproductive stage (12.31 %) and in post reproductive stage (13.01 %). The least fibres percentage in vegetative stage was (2.14%), in reproductive stage (2.43 %) and 2.78 % was in post reproductive recorded in *Chrozophora obliqua*. However, the lowest average of fiber was shown by *Chrozophora obliqua* (2.45 %) and highest average by *Albizia lebbeck* (12.13 %). It was noticed that the highest percentage of fiber was present at post reproductive stage in all test species (Table 103; Fig. 92).

Fiber kept the digestive system healthy and functioning correctly in ruminants. In grazing animals, fiber parts that give energy are significant because celluloses and hemicelluloses are easily digested. Fiber aids and speeds up the excretion of toxins and waste product from the body. According to Belewu & Babalola (2009) the fibers can be used for useful purposes if treated with microorganisms. It is noticed from the result that the fibre contents percentage increased with advancing phenological stages. Hussain *et al*. (2010) reported the highest percentage (12.12 %) of fibers in selected medicinal plants. Our range of percentage was similar with their value. In investigated area the *Albizia lebbeck* was used for digestion problem in grazing animal specially to cow. Hussain *et al.* (2010) described that the high level of fiber increase the digestibility but high contents in diet can cause intestinal irritation. Hussain *et al*. (2011) reported the highest fibre contents (40.150%) in *Nepeta suavis*. The fibres contents in the case are much less than that of the cited results. Plant material is dividable into fibrous and nonfibrous portions.

Carbohydrate contents (%)

In the test species, the carbohydrate contents in vegetative stage varied from 54 – 85.1 %, in reproductive stage (50 – 84.1) and 47.1 – 81.1 % in post reproductive stage. Among the plants at three phenological stages, the overall average ranged from

50.4 – 83.4 %. The overall percentage of carbohydrate composition was maximum in *Eragrostis poaoides* (85.1 %) in vegetative stage as well as in reproductive stage (84.1 %) and in post reproductive stage (81.1%). The least carbohydrate percentage in vegetative stage was (54 %), in reproductive stage (50 %) and 47.1 % was in post reproductive recorded in *Vitex trifolia*. However, the lowest average was shown by *Vitex trifolia* (50.4 %) and highest average by *Eragrostis poaoides* (83.4 %). It was noticed that the highest percentage of carbohydrate was present at vegetative stage in all test species (Table 104; Fig. 93).

The result showed that the carbohydrate contents decrease with advancing phenological stages. Taiga *et al*. (2008) carried out the proximate chemical analyses of dry vegetables and reported that Carbohydrate content of *P. guineese* and *V. subteranea* (77.17 and 89.42% respectively) was higher than that of *T. occidendalis* (63.64%). Our result is agreed with the above statement on basis of carbohydrate contents percentage. The carbohydrates contents were high in grasses is compare to other plant layers. In investigated area the grazing animals preferred the grasses as compare to other plant. Our result is similar with that of Hussain & Durrani (2009) who stated that sheep generally preferred grasses and concluded that grasses generally had more carbohydrates than shrubs. Our result agrees with Hussain *et al.* (2010) who investigated the carbohydrates ranged between 18.3 -64.3 %.

Fat contents (%)

In the test species, the fat contents in vegetative stage varied from 1.06 – 5.46 %, 1.09 - 5.98% in reproductive stage and 1.56 – 6.57 % in post reproductive stage. Among the plants at three phenological stages, the overall average ranged from 1.23 - 6 %. The overall percentage of fat composition was maximum in *Chrozophora obliqua* (5.46 %) in vegetative stage as well as in reproductive stage (5.98 %) and in post reproductive stage (6.57 %). The least fat percentage in vegetative stage was (1.06%), in reproductive stage (1.09 %) and 1.56 % was in post reproductive recorded in *Rhazya stricta*. However, the lowest average was shown by *Rhazya stricta 1.23*1 %) and highest average by *Chrozophora obliqua* (6 %). It was noticed that the highest percentage of fat was present at post reproductive stage in all test species (Table 104; Fig. 94).

Fats play a vital role in maintaining healthy skin and hair, insulating body organs

against shock, maintaining body temperature, and promoting healthy cell function in ruminants. The result showed that the percentage of fat were increase with advancing phenological stages. The test plant species were collected from semi arid area. Adnan *et al*. (2010) stated that the sub-humid region's species had higher nutritional value than humid region's species. Ali *et al*. (2010) studied the nuts of six different walnut cultivars grown in Pakistan and reported the highest fats contents (63.54-69.92%). Hussain *et al*. (2011) carried out the nutritional value of 4 medicinal plants and stated that the highest percentage of fats (12.595%) was present in *Nepeta suavis*. The fat contents in our case are less than that of the cited results. Bangash *et al*. (2011) analyzed 10 vegetables in which the highest (0.40 %) and lowest (0.08 %) of fat was determined.

Protein contents (%)

In the test species, the protein contents in vegetative stage varied from 2.11 – 12.41 %, 3.14 – 15.87 % in reproductive stage and 4.12 – 18.54 % in post reproductive stage. Among the plants at three phenological stages, the overall average ranged from 3.46 -15.6 %. The overall percentage of protein composition was maximum in *Vitex trifolia* (12.41 %) in vegetative stage as well as in reproductive stage (15.87 %) and in post reproductive stage (18.54 %). The least protein percentage in vegetative stage was (2.11%), in reproductive stage (3.14 %) and 4.12 % was in post reproductive recorded in *Datura metel*. However, the lowest average was shown by *Datura metel* (3.46 %) and highest average by *Vitex trifolia* (15.6 %). It was noticed that the highest percentage of protein was present at post reproductive stage in all test species (Table 104; Fig. 95).

Protein is used as defense against germs. Yao *et al.* (2000) reported that *Morus alba* is a best source of protein for ruminants. Hanif *et al*. (2006) estimated protein (0.9 – 2.1%) in the selected plants. The plant growing in higher altitudes experiences quite different climate and had higher content of protein than plants of plains. In the investigated area the *Rhazya stricta* and *Cymbopogon jwarancusa* were present through out in the hilly area. Bukhsh *et al.* (2007) stated that the protein contents are much in cultivated plants species as compare to wild plants. They reported that proteins were significantly higher in leaves of *Eruca sativa* as compared to *Carthamus oxyacantha* and *Plantago ovata.* The protein contents in our case are less than that of Taiga *et al*. (2008)

who reported the higher protein contents in *M. esculentum* (29.30 %) and *C. odorata* (32.40%) the cited results. Shah *et al.* (2009) described that the highest protein contents varied from 23 % - 33 % in plant species. In the present result the protein contents varied at advancing phenological stages. Our result agrees with that of Hussain & Durrani (2009) who state that protein contents changed with advancing phenological stages. Our result is also agrees with James *et al.* (2010) who stated that in plants the protein contents different from part to part. Cheema *et al.* (2011) reported high concentration of protein in leaves of *Morus alba* and stated that it is a best source of protein in ruminant feeding They also stated that different level of protein is due to differences of protein accumulation. Our results suggested that the investigated plants had sufficient level of protein which is the best source of supplement for grazing animals. Chinedu & Nwinyi (2012) reported the protein contents percentage of two traditional grain legumes and stated that *Voadzeia subterranean* contain 32.40±0.02% protein and 37.21±0.02% proteins in *Sphenostylis stenocarpa*.

Energy Value (KCal/100g)

The energy value in the test species varied from 305.12 – 394.23 KCal/100g at vegetative stage, 314.21 – 423.13 KCal/100g at reproductive stage and 321.23 – 434.26 KCal/100g at post reproductive stage. The overall average ranged from 313.52 – 417.2 KCal/100g among the plants at three phenological stages. The overall highest energy value was found in *Tamarix aphylla;* (394.23 KCal/100g) at vegetative stage, 423.13 KCal/100g at reproductive stage and 434.26 KCal/100g at post reproductive stage. The least energy value was recorded in *Eragrostis poaoides;* (305.12 KCal/100g) at vegetative stage, (314.21 KCal/100g) at reproductive and (321.23 KCal/100g) at post reproductive stage. However, the lowest average was shown by *Eragrostis poaoides* (313.52 KCal/100g) and highest average by *Tamarix aphylla* (417.2 KCal/100g). It was observed that the highest percentage of energy level was found at post reproductive stage in all test species (Table 104; Fig. 96).

From the result it was found that the energy value was high in tree species and least in grasses. The energy value was increased with advancing phenological stages. Hussain & Durrani (2009) stated that the proximate composition of plant species was changed with advancing phenological stages. Ali *et al*. (2010) studied the nuts of

six different walnut cultivars grown in Pakistan. They found the highest energy value of the kernels in the range of 698.10-732.44 Kcal/100 g, and stated that energy value were high in fruits. In our case the energy value was high in post reproductive stage. Adnan *et al*. (2010) concluded that sub-humid region's species had higher nutritional value than humid region's species. Hussain *et al*. (2011) carried out the nutritional value of 4 medicinal plants of the Northwest Pakistan. They reported the energy value of herbaceous plant i.e. *Aerva javanica* (398.496 Kcal/100g). In our case the energy value of herbaceous layer was similar with the above sited. Henry-Unaeze (2011) reported the highest energy value (468.3 kcal) in acha porridge used in complementary food of Igbo mother. Ingale & Shrivastava (2011) determined proximate composition and nutritional value of seeds of new variety of *Arachis hypogaea* and stated that groundnut seed contained the highest energy value (601.856%).

The goat and sheep preferred the grasses *Eragrostis poaoides* as compared to shrubs and trees while trees are preferred by camel. It means that these animals preferred those plant which have more content of carbohydrate. Some plants have relatively a good source of carbohydrate up to 80% while some can yield carbohydrates up to a low amount of 15.51% (Saputera *et al*., 2006 and Shah *et al*., 2009). *Chrozophora obliqua* was preferred by camel. From the above result we may concluded that the plants which have more fat content were preferred by the camels. On average the increasing order of these nutrients among the plant samples of the area were carbohydrate (85.06 %) > ash (19.09 %) > protein (18.54 %) > moisture (14.12 %) > fiber (13.01 %) > fat (6.57 %) (Fig. 97). In summer season the area were free of grasses and herbs. From the result it was observed that the amount of carbohydrate and moisture were decreased with the plant intensification and vise versa while the amount of ash, fat, fiber, protein and energy value were increased with the advancing phenological stages (Fig. 98). It was also noticed that the different parameter were also depended on the plant habit. In trees species the energy value and fiber content were increased while in shrubs, the amount of ash, moisture and protein were found in high quantity. High quantity of fat was found in herbs while the high amount of carbohydrate was found in grasses (Tables 103, 104).

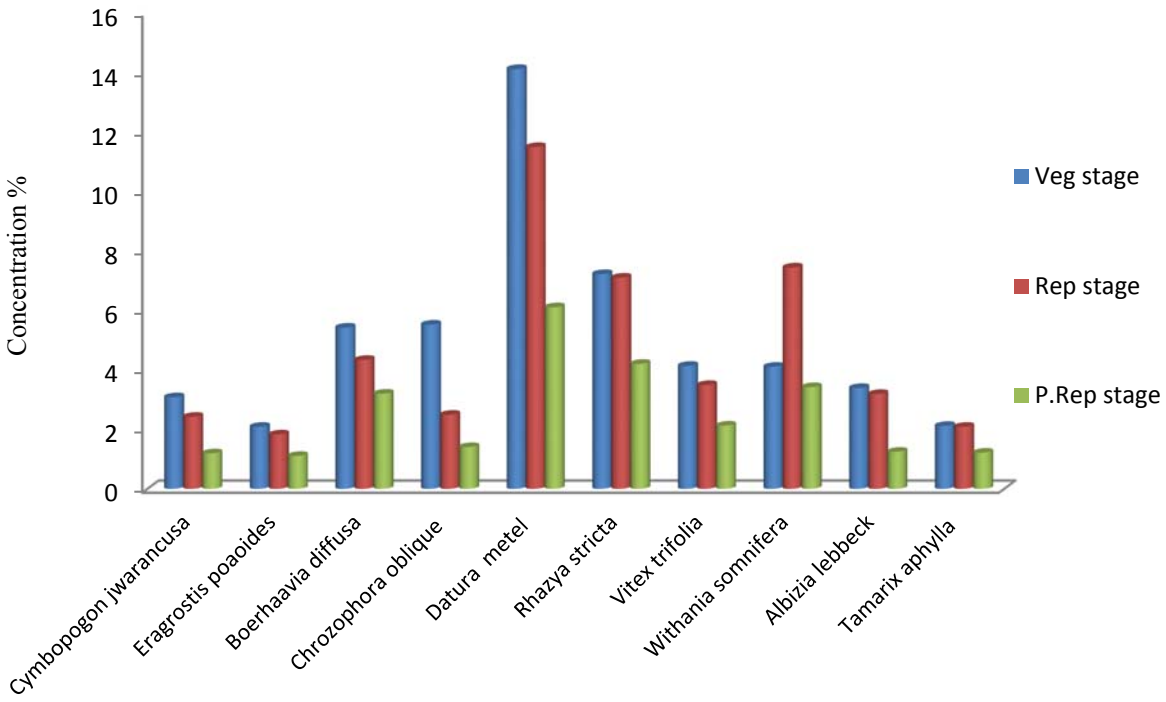


Fig. 90. Moisture contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

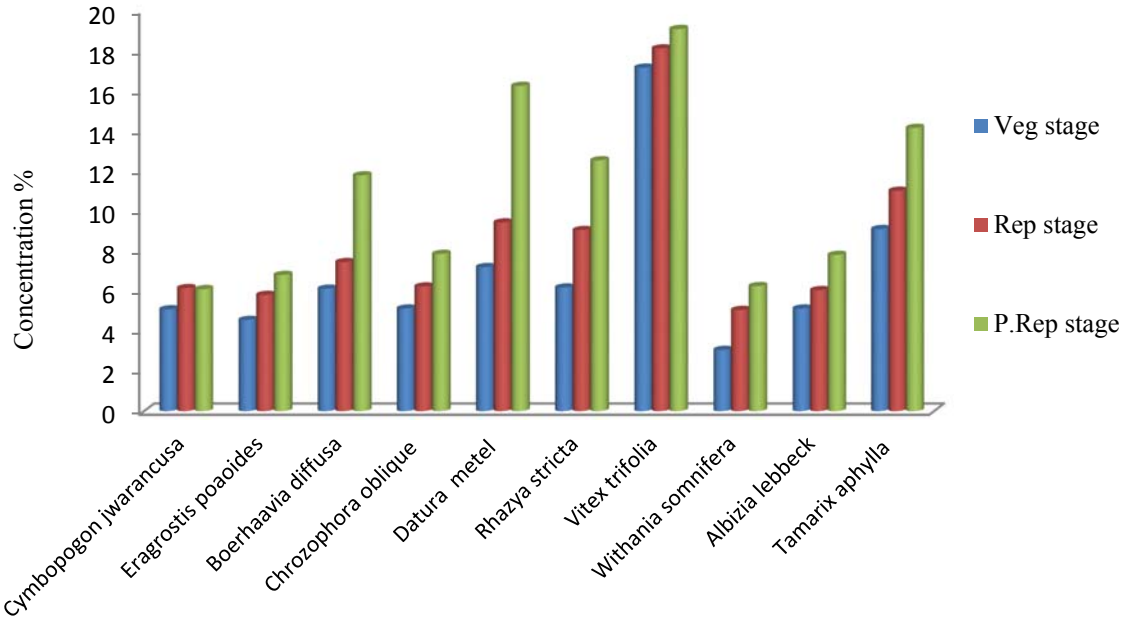


Fig. 91. Ash contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

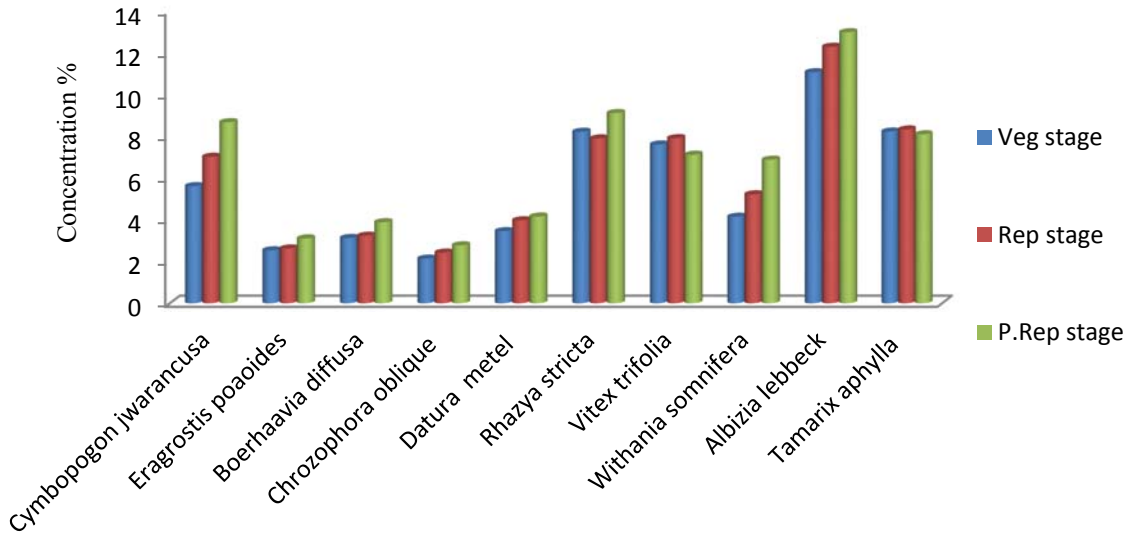


Fig. 92. Fibre contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

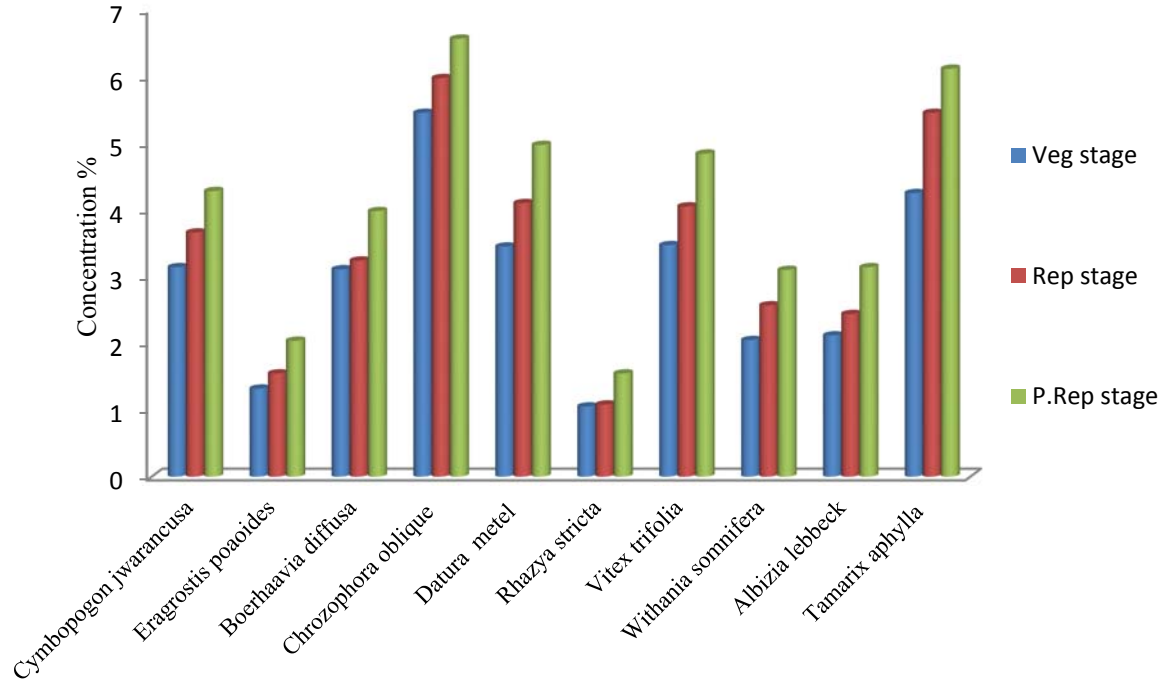


Fig. 93. Fat contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

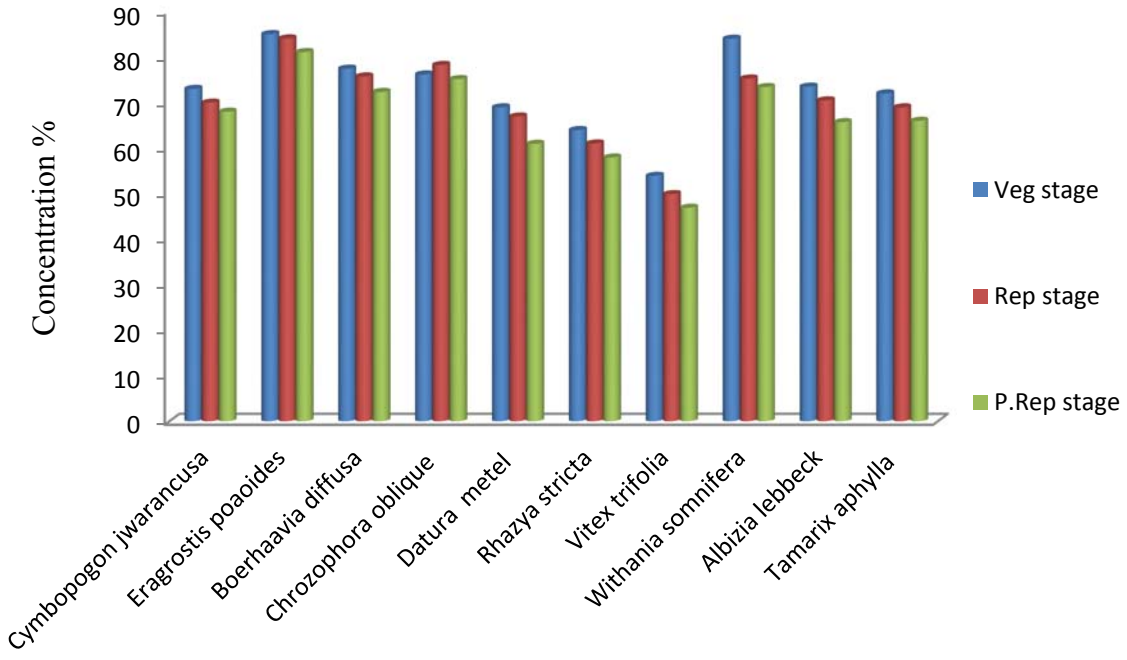


Fig. 94. Carbohydrate contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

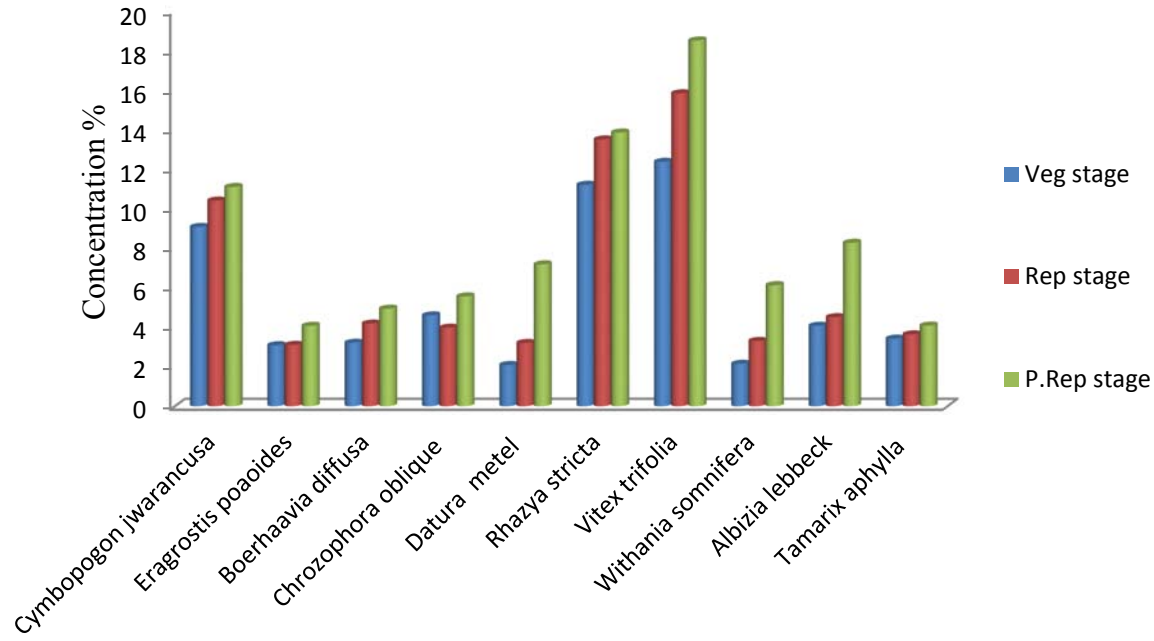


Fig. 95. Protein contents (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

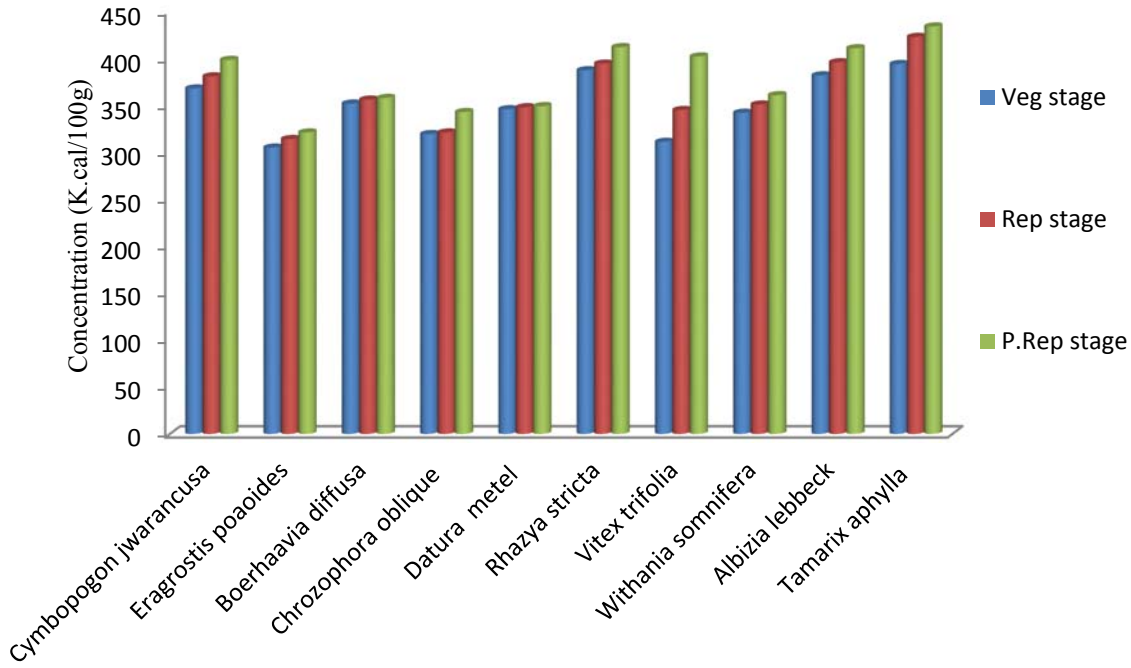


Fig. 96. Energy value (K Cal/100g) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

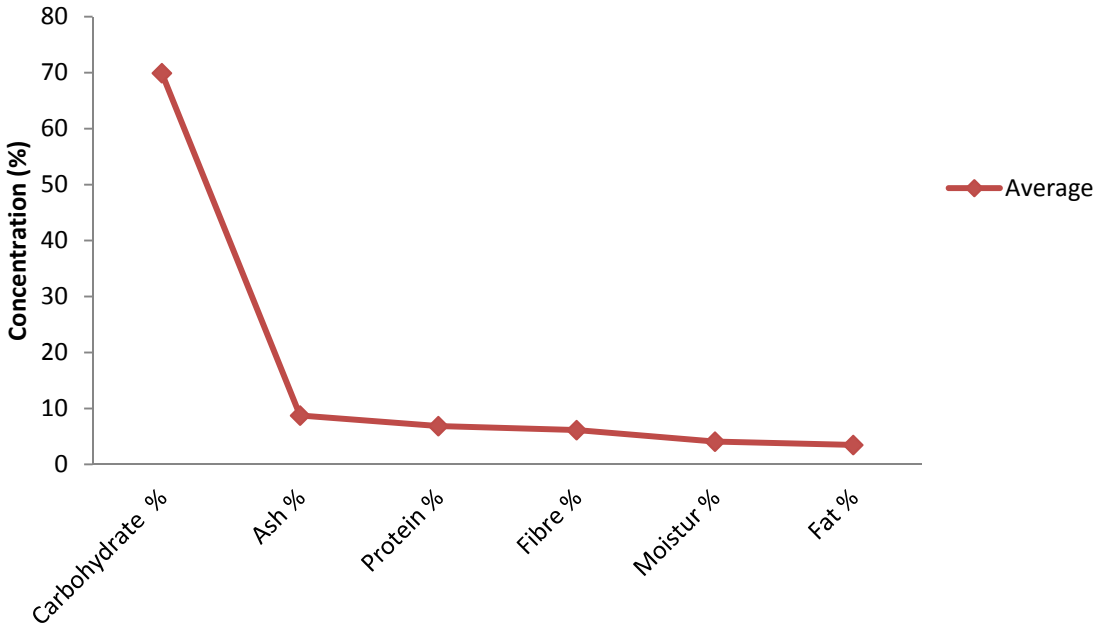


Fig. 97. Mean nutrien value (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak.

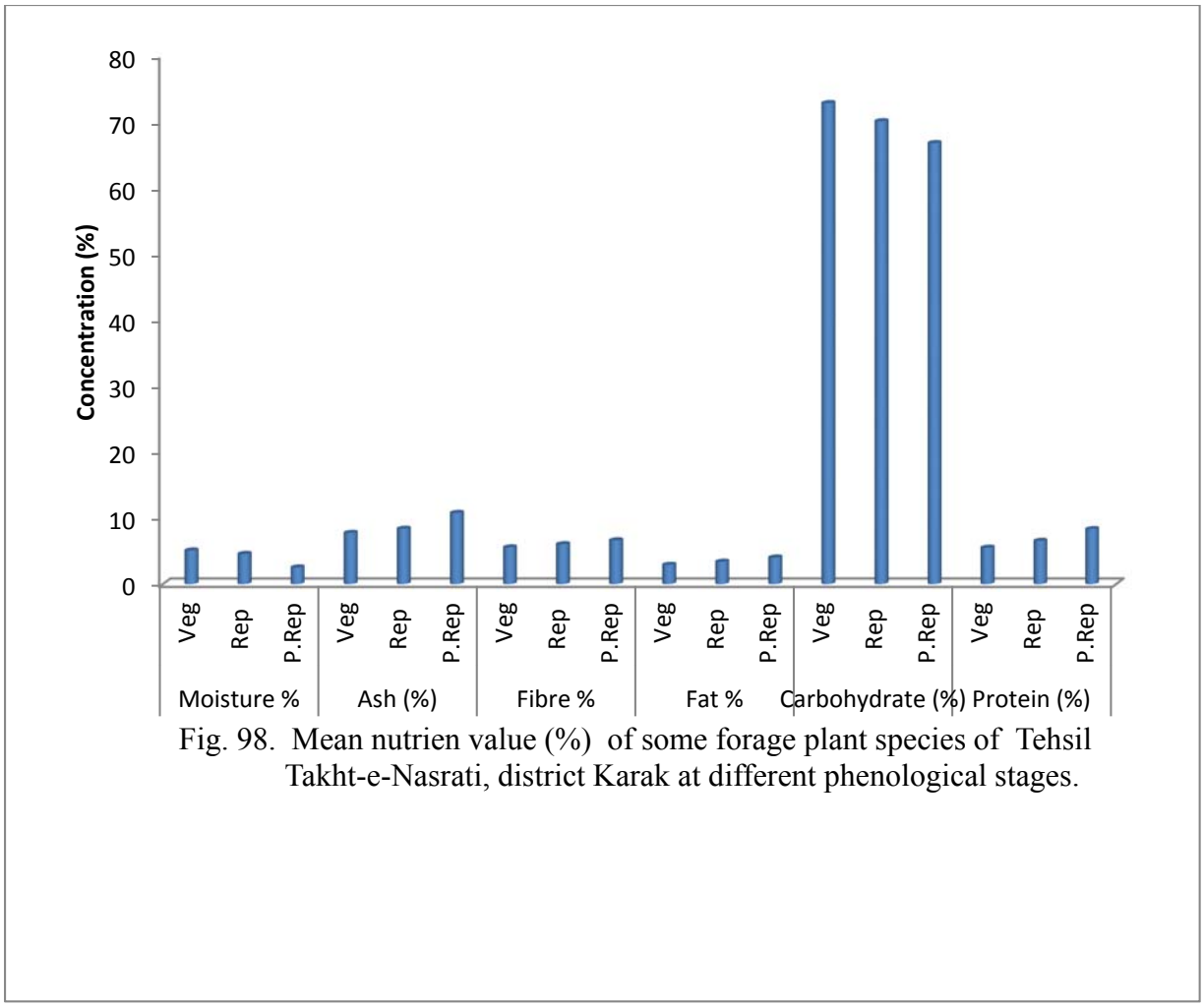


Fig. 98. Mean nutrien value (%) of some forage plant species of Tehsil Takht-e-Nasrati, district Karak at different phenological stages.

Table 103. Proximate composition (moister, Ash and Fiber) of selected forage species of Tehsil Takht-e-Nasrati, District Karak.

Species	Moister %				Ash %				Fibre %			
	Vegetative	Reproductive	P. Reproductive	Average	Vegetative	Reproductive	P. Reproductive	Average	Vegetative	Reproductive	P. Reproductive	Average
Cymbopogon jwarancusa (Jones) Schult.	3.11	2.45	1.21	2.25	5.12	6.18	6.13	5.81	5.62	7.03	8.69	7.11
Eragrostis poaoides Beauv.	2.11	1.85	1.12	1.69	4.59	5.84	6.84	5.75	2.54	2.63	3.11	2.76
Boerhaavia diffusa L..	5.44	4.36	3.23	4.34	6.15	7.48	11.78	8.47	3.13	3.24	3.89	3.42
Chrozophora obliqua (Vahl) A. Juss.	5.54	2.52	1.42	3.16	5.16	6.26	7.89	6.44	2.14	2.43	2.78	2.45
Datura metel L.	14.12	11.51	6.12	10.58	7.23	9.46	16.25	10.98	3.46	3.98	4.16	3.86
Rhazya stricta Decne.	7.23	7.11	4.23	6.19	6.21	9.08	12.53	9.27	8.23	7.91	9.13	8.42
Vitex trifolia L.	4.16	3.52	2.15	3.27	17.16	18.12	19.09	18.12	7.62	7.92	7.13	7.55
Withania somnifera (L) Dunal.	4.13	7.45	3.45	5.01	3.08	5.09	6.28	4.81	4.15	5.23	6.89	5.42
Albizia lebbeck (L.) Benth.	3.42	3.22	1.26	2.63	5.16	6.08	7.84	6.36	11.09	12.31	13.01	12.13
Tamarix aphylla (L.) Karst.	2.14	2.11	1.23	1.82	9.13	11.01	14.15	11.43	8.24	8.34	8.11	8.23
Maximum	**14.12**	**11.51**	**6.12**	**10.58**	**17.16**	**18.12**	**19.09**	**18.12**	**11.09**	**12.31**	**13.01**	**12.13**
Minimum	**2.11**	**1.85**	**1.12**	**1.69**	**3.08**	**5.09**	**6.13**	**4.81**	**2.14**	**2.43**	**2.78**	**2.45**
Average	**5.14**	**4.61**	**2.54**	**4.09**	**7.83**	**8.46**	**10.88**	**8.74**	**5.62**	**6.1**	**6.69**	**6.13**

Table 104. Proximate composition (Carbohydrate, Fat, Protein and energy value) of selected forage species of Tehsil Takht-e-Nasrati, District Karak.

Species	Fat %				Carbohydrate %				Protein %				EV (KCal/100g)			
	Vegetative	Reproductive	P. Reproductive	Average	Vegetative	Reproductive	P. Reproductive	Average	Vegetative	Reproductive	P. Reproductive	Average	Vegetative	Reproductive	P. Reproductive	Average
Cymbopogon jwarancusa (Jones) Schult.	3.15	3.67	4.29	3.7	73.1	70.1	68.1	70.4	9.12	10.45	11.14	10.23	368.12	381.03	398.62	382.59
Eragrostis poaoides Beauv.	1.33	1.56	2.05	1.64	85.1	84.1	81.1	83.4	3.12	3.14	4.12	3.46	305.12	314.21	321.23	313.52
Boerhaavia diffusa L..	3.12	3.25	3.99	3.45	77.5	75.8	72.4	75.2	3.25	4.23	4.99	4.15	352.05	356.28	358.06	355.46
Chrozophora obliqua (Vahl) A. Juss.	5.46	5.98	6.57	6	76.2	78.3	75.2	76.6	4.65	4.02	5.61	4.76	319.46	321.23	343.03	327.9
Datura metel L.	3.46	4.11	4.98	4.18	69	67	61	65.7	2.11	3.24	7.23	4.19	346.03	348.13	349.26	347.81
Rhazya stricta Decne.	1.06	1.09	1.56	1.23	64.1	61.1	58.1	61.1	11.25	13.54	13.89	12.89	387.56	394.62	412.23	398.13
Vitex trifolia L.	3.48	4.06	4.85	4.13	54	50	47.1	50.4	12.41	15.87	18.54	15.6	311.25	345.13	402.23	352.87
Withania somnifera (L) Dunal.	2.06	2.58	3.11	2.58	84.1	75.3	73.5	77.6	2.17	3.34	6.18	3.89	342.26	351.03	361.02	351.43
Albizia lebbeck (L.) Benth.	2.13	2.45	3.15	2.57	73.6	70.6	65.8	70	4.12	4.56	8.32	5.66	382.12	396.08	411.03	396.41
Tamarix aphylla (L.) Karst.	4.26	5.46	6.12	5.28	72.1	69	66.1	69.1	3.46	3.68	4.13	3.75	394.23	423.13	434.26	417.2
Maximum	**5.46**	**5.98**	**6.57**	**6**	**85.1**	**84.1**	**81.1**	**83.4**	**12.41**	**15.87**	**18.54**	**15.6**	**394.23**	**423.13**	**434.26**	**417.2**
Minimum	**1.06**	**1.09**	**1.56**	**1.23**	**54**	**50**	**47.1**	**50.4**	**2.11**	**3.14**	**4.12**	**3.46**	**305.12**	**314.21**	**321.23**	**313.52**
Mean	**2.95**	**3.42**	**4.07**	**3.48**	**72.9**	**70.1**	**66.8**	**69.9**	**5.57**	**6.61**	**8.41**	**6.86**	**350.82**	**363.09**	**379.09**	**364.33**

4.8. Conservation status of plants

Tehsil Takht-e-Nasrati is unfamiliar in all features of plant life and no effort has been done concerning taxa restoration and conservation. It is populated and composed of numbers of settlement. It is one of exploited area of Khyber Pakhtun Khawa. People depend on plant life for their individual provisions. Tree and shrubs species are also a source of their livelihood. Locals harshly cut off the plants and use it a source of their income. In the present study, the conservation status of 45 species belonging to 26 families of 22 trees and 23 shrubs were determined on the basis of IUCN conservation criteria. There are 20 (44.44 %) vulnerable, 16 (35.56 %) rare, 7 (15.56 %) endangered and 2 (4.44 %) were infrequent (Table 105; Fig. 99).

The vulnerable species of the area included *Saccharum bengalense, Saccharum spontaneum, Periploca aphylla, Rhazya stricta, Vitex negundo*, *Zizyphus nummularia, Monotheca buxifolia, Tamarix aphylla, Tamarix decidua*, *Capparis decidua, Dalbergia sissoo* and *Melia azedarach.* Hamayun *et al*. (2006) reported the conservation status of taxa and described that 49 % of medicinal plants are threatened in the area due to unsustainable cropping and increased mistreatment of plant life. In the same way, Ahmad *et al.* (2006) and Shaheen *et al.* (2011) observed that the Himalayan forests which is exceptional property for researcher use changes driven by increasing anthropogenic activities and fast population growth of human being It is recognized that locals regularly used wood as fuel of the forest and this is the major reason of plant life removal. The severe grazing and land used for agriculture also provide the shocking picture of the area. In the investigated area, need of plant for fuel wood causing severe deforestation. Hamayun *et al.* (2006) reported that in Gabral and Uttr valley 17.61 % are threatened species in which 5.67 % species are vulnerable, endangered (4.5 %), rare (4.5 %) and 2.8 % are near threatened.

The rare plant species of the investigated area including *Acacia modesta, Acacia nilotica, Albizia lebbeck, Prosopis juliflora, Zizyphus maurtiana, Zizyphus oxyphylla, Capparis spinosa, Cassia angustifolia, Opuntia ficus indica*, *Withania coagulans, Withania somnifera, Otostegia Limbata*, *Punica granatum, Ricinus communis, Calotropis procera* and *Alhagi maurorum.* Bocuk *et al.* (2009) reported 77 endemic species in Turkey in which the least concern composed of

56 species, near threatened (9 spp.) and vulnerable risk categories (4 spp). Land use and ruthless grazing are usually regarded to be the inexpensive way of developing plant life. On the basis of IUCN 2001, Red data list criteria, the *Cadaba heterotricha* was classified as endangered species by Abbas *et al.* (2010). In Battagram the conservation status of critically endangered species was also determined by Haq (2011).

The endangered species included *Morus nigra, Prosopis farcta, Salvadora oleoides, Gymnosporia royleana, Morus alba, Calligonum polygonoides* and *Dodonaea viscosa.* Plants are important source and have vast impact on environment and have a vital role in socio economic conditions of the people. The locals used the plant species for different purposes like medicinal, fuel, agriculture etc. So it is not easy to identify that how many taxa are threatened in the area. According to IUCN threatened plant data base, about thirty two thousand taxa are threatened with extermination. This number represents 13 % of estimated 250,000 of plants. Hamayoun (2005) reported 92 threatened plant species in which 28 species are endangered; vulnerable (40 Spp.) and 24 species are rare. In present study, the hilly areas are under severe biotic pressure. The conservation status show that mostly trees are under harsh biotic situation. No regeneration is observable about the shrubs and trees due to the high grazing pressure and important fruiting has been recorded and regeneration looks to be entirely missing. Ghazanfar & Osborne (2010) studied the conservation status of plant species and reported that area consist of usually a few shrubs and trees that have tolerated pressure of grazing animals and those that are inedible to goats and camel. Ubom (2010) identified 339 species in the Niger Delta, Nigeria in which 32 were endemic and 23 were endangered. Al-Quran (2011) studies the threatened status of medicinal plants of Ajloun, Jordan in which 31 species were non endangered species, vulnerable (5), endangered (5) i.e. *Alchemilla vulgaris*, *Crocus hyemalis*, *Pistacia palaestina*, *Rubia tinctorum* and *Salvia triloba* while 4 were critically endangered i.e. *Eryngium creticum, Majorana syriaca, Mandragora autumnalis* and *Matricaria aurea*. Ali *et al.* (2012) declared the *Delphinium nordhagenii* is an endemic species in District Chitral, Pakistan.

The infrequent species comprised of *Datura metel* and *Astragalus psilocentros.* In the investigated area, overgrazing, deforestation, unplanned collection, erosion, effects of introduced species, attack of pathogens and loss of habitat were the main threats to the

plant life. 37 plant species comprising 14 critically endangered and endangered (23spp.) were reported by Haq (2011). According to IUCN Red list categories and criteria conservation status of 19 species were given by Alam & Ali (2009). Hilton-Taylor (2000) and Akeroyd (2002) stated that rate of plant loss has reached to one species per day as a result of anthropogenic activities and this is judged 100-10,000 times quicker than would occur naturally. Akeroyd (2002) and Bramwell (2002) stated that in the near future, 60,000 and 100,000 taxa may withdraw if the inclinations remain constant. According to IUCN Red List categories and criteria 2001, *Gaillonia chitralensis* is considered endemic species to Chitral district by Ali & Qaiser (2009).

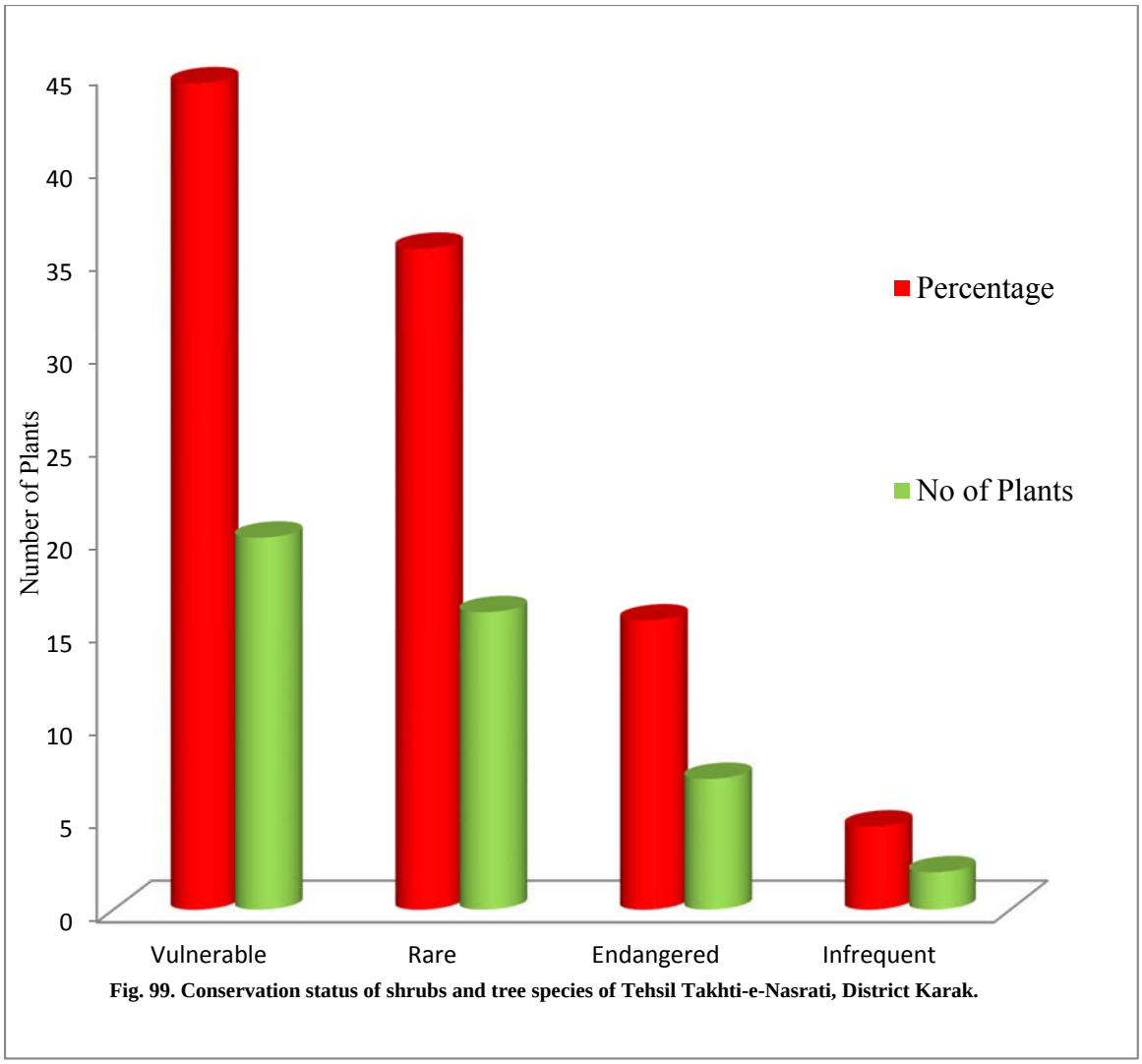


Fig. 99. Conservation status of shrubs and tree species of Tehsil Takhti-e-Nasrati, District Karak.

Table 105. Floristic list and conservation status of shrubs and tree species of Tehsil Takht-e-Nasrati, District Karak.

S. No	Species	Availability				Collection				Growth					Plant used					Total score	Status
		0	1	2	3	0	1	2	3	0	1	2	3	4	0	1	2	3	4		
1	*Acacia modesta* Wall.	-	-	2	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	9	Rare
2	*Acacia nilotica* (L.) Delice.	-	-	2	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	9	Rare
3	*Albizia lebbeck* (L.) Benth.	-	-	2	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	9	Rare
4	*Alhagi maurorum* Medic.	-	1	-	-	-	-	-	3	-	-	-	3	-	-	-	-	-	4	11	Rare
5	*Astragalus psilocentros* Fisch.	-	-	2	-	-	-	-	3	-	-	-	-	4	-	-	-	-	4	13	Infrequent
6	*Calligonum polygonoides* L.	-	-	2	-	0	-	-	-	-	-	2	-	-	0	-	-	-	-	4	Endangered
7	*Calotropis procera* (Wild) R.Br.	-	-	-	3	-	-	-	3	-	1	-	-	-	-	-	-	-	4	11	Rare
8	*Capparis decidua* (Forssk). Edgeworth.	-	1	-	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	8	Vulnerable
9	*Capparis spinosa* L.	-	1	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	4	9	Rare
10	*Cassia angustifolia* Vahl.	-	1	-	-	-	-	-	3	-	-	-	3	-	-	-	2	-	-	9	Rare
11	*Dalbergia sissoo* Roxb.	-	1	-	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	8	Vulnerable
12	*Datura metel* L.	-	-	-	3	-	-	-	3	-	-	-	-	4	-	-	-	3	-	13	Infrequent
13	*Dodonaea viscosa* L.	-	1	-	-	-	1	-	-	-	-	2	-	-	0	-	-	-	-	4	Endangered
14	*Eucalyptus globules* L.	-	1	-	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	8	Vulnerable
15	*Eucalyptus lanceolatus* L	-	1	-	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	8	Vulnerable
16	*Gymnosporia royleana* Wall.	-	1	-	-	0	-	-	-	-	-	-	3	-	0	-	-	-	-	4	Endangered
17	*Melia azedarach* L.	-	1	-	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	8	Vulnerable
18	*Monotheca buxifolia* (Falk) A.DC.	-	1	-	-	-	1	-	-	-	-	-	3	-	0	-	-	-	-	5	Vulnerable
19	*Morus alba* L.	-	1	-	-	0	-	-	-	-	-	-	3	-	0	-	-	-	-	4	Endangered
20	*Morus nigra* L.	-	1	-	-	0	-	-	-	-	-	-	3	-	0	-	-	-	-	4	Endangered
21	*Ocimum basilicum* L.		1			0								4	0					5	Vulnerable
22	*Opuntia ficus indica* (L.) Mill.	-	1	-	-	-	-	-	3	-	-	-	3	-	-	-	2	-	-	9	Rare
23	*Otostegia Limbata* (Benth) Boiss.	-	1	-	-	-	-	-	3	-	-	2	-	-	-	-	-	-	4	10	Rare
24	*Parkinsonia aculeate* L.	-	1	-	-	-	1	-	-	-	-	-	3	-	0	-	-	-	-	5	Vulnerable
25	*Periploca aphylla* Decne.	-	-	2	-	-	-	2	-	-	-	-	3	-	-	1	-	-	-	8	Vulnerable
26	*Phoenix dactylifera* L.	-	1	-	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	8	Vulnerable
27	*Prosopis farcta* (Banks & Sol.) J.F. Macbr.		1			0							3		0					4	Endangered
28	*Prosopis juliflora* (Sw.) DC.	-	-	2	-	0	-	-	-	-	-	-	3	-	-	-	-	-	4	9	Rare

29	*Punica granatum* L.	-	-	2	-	-	1	-	-	-	-	-	3	-	-	-	-	-	4	10	Rare
30	*Rhazya stricta* Decne.	-	-	2	-	-	1	-	-	-	1	-	-	-	-	-	-	-	4	8	Vulnerable
31	*Ricinus communis* L.	-	-	2	-	-	-	2	-	-	-	-	-	4	-	-	2	-	-	10	Rare
32	*Rosa indica* L.	0	-	-	-	-	-	-	3	-	-	-	3	-	-	-	2	-	-	8	Vulnerable
33	*Saccharum bengalense* Retz.	-	-	-	3	-	-	-	3	0	-	-	-	-	0	-	-	-	-	6	Vulnerable
34	*Saccharum spontaneum* L.	-	-	2	-	-	-	-	3	-	1	-	-	-	0	-	-	-	-	6	Vulnerable
35	*Salvadora oleoides* Decne.	-	-	2	-	0	-	-	-	-	-	2	-	-	0	-	-	-	-	4	Endangered
36	*Tamarix aphylla* (L.) Karst.	-	-	2	-	0	-	-	-	-	-	-	3	-	-	-	2	-	-	7	Vulnerable
37	*Tamarix decidua* Roxb.	-	-	2	-	0	-	-	-	-	-	-	3	-	-	-	2	-	-	7	Vulnerable
38	*Vites vinifera* L.	0	-	-	-	-	-	-	3	-	-	-	3	-	-	-	2	-	-	8	Vulnerable
39	*Vitex trifolia* L.	-	-	2	-	-	-	-	3	-	1	-	-	-	-	-	2	-	-	8	Vulnerable
40	*Vitex negundo* L.	-	-	2	-	-	-	-	3	-	1	-	-	-	-	-	2	-	-	8	Vulnerable
41	*Withania coagulans* (Stocks) Dunal.	-	-	2	-	-	-	-	3	-	-	2	-	-	-	-	2	-	-	9	Rare
42	*Withania somnifera* (L) Dunal.	-	1	-	-	-	-	-	3	-	-	-	3	-	-	-	2	-	-	9	Rare
43	*Zizyphus maurtiana* Lam.	-	-	-	3	0	-	-	-	-	-	-	3	-	-	-	-	-	4	10	Rare
44	*Zizyphus nummularia* (Burm.f) W.&A.	-	-	2	-	-	1	-	-	-	1	-	-	-	-	-	2	-	-	5	Vulnerable
45	*Zizyphus oxyphylla* Edge.	-	-	2	-	-	1	-	-	-	-	-	3	-	-	-	-	-	4	10	Rare

5.1. Conclusion

The study revealed that Tehsil Takht-e-Nasrati had 161 plant species belonging to 136 genera and 57 families. There are 7 families of monocotyledons having 21 genera and 25 species. Dicotyledons had 50 families, 115 genera and 136 species. Phenological data showed that 94 plants were found in flowering condition in spring, 28 plants in summer and 27 plants in winter while 12 plants were found through out the year. The biological spectrum revealed that therophytes was dominated by 47.83% plants species followed by hemicryptophytes (18.63%), megaphanerophytes (10.6%), nanophanerophytes (9.94%), chamaephytes (6.83%), microphanerophytes (2.48 %), parasite (1.86%) and geophytes (1.86%). The leaf size spectrum dominated by microphylls (52.8%) followed by nanophylls (19.9%), mesophylls (10.6 %), leptophylls (9.32%) and megaphylls (7.45%). Ethnobotanical profile showed that that the locals used 73.3% species as folk medicinal plants, 70.8 % fodder species, 26.7 % fuel species, 9.94% timber woods, 14.3 % vegetable species, 31.06 % veterinary use plants, 55.9 % honey bee species. The 20.5 % fruit plants species and 10.6 % species were used for making agricultural tools, 11.8 % species were used for fencing field borders and 11.18% were used for making furniture. Quantitative and qualitative description of diverse plant communities at different altitude had provided some basic information about phytodiversity, plant life structure and climatic combination. In each season 22 plant communities were established at various sites on the basis of important value from each plant strata. All plant communities showed heterogeneity in all seasons. The highest value of species diversity (3.097) and equitability value (0.957) was found in spring while the highest value of species richness (5.752) was found in winter. Communities had high percentage of maturity index value in summer. In summer and winter total 12 plant communities showed similarity above 65% while winter show no similarity above 65% between communities. Hierarchical Cluster Analysis marked out distinct 4 groups association in spring, 5 in summer and 4 in winter by different level, cycling and similarity of communities. The total average herbaceous biomass was high between altitudes 340-399 m (262.58 $Kghec^{-1}$). The total shrub biomass in different area was diverse from 13.47 $Kg\ hec^{-1}$ to 2665.12 $Kg\ hec^{-1}$. Palatability of 161 recorded species was studied on the basis of differential palatability of plant parts, animal preference for plant and plant condition preferred by animals. 10 plant species were studied for phytochemical screening, mineral composition and proximate analysis. The conservation status of 22 tree and 23 shrub species were determined on the basis of IUCN criteria.

5.2. Recommendations and suggestions

Tehsil Takht-e-Nasrati district Karak has been remained out of view of ecologists so far. The government and public sectors should give consideration to solve the problems and give facilities to ecologist and geologist who escape some time for research in this area. The following general recommendations are given to improve the plant life in the area.

1. Government and private sectors should issue variety of different xerophytic tree species each year among the locals for plantation. Because the regeneration capacity of woody tree species very poor in the investigated area.
2. Government and private sectors should provide facilities to locald regarding horticulture and forestry training
3. Government and private sectors should have to set up nurseries on large scale in the area to perform the propagation of valued tree species like *Zizyphus oxyphylla*.
4. Government and private sectors should provide facilities to locals for cultivation of medicinal plants and it should be a source of income.
5. Government and private sectors should provide the facilities of education in hilly area.
6. Government and private sectors should provide education and facilities to school teachers and masque teacher who run awareness campaign among the locals to grow the medicinal plant.
7. Practices should carry on sericulture practices.
8. The media should present positive role to save the natural plant life and their importance.
9. To decline the pressure on plant life in the area, the government and private sectors should provide small scale schemes for the assistance of the locals through which they improve their life.
10. Government and private sectors should provide the employment schemes in the area.
11. Government and private sectors should provide priority to those medicinal plants whose regeneration capacity is poor in the area like *Salvadora oleoides*.

References

Abbas, F. I., T. Akhtar and A. Mian. 2009. Phytosociological analysis within the range of Grey Goral in Pakistan and Azad Kashmir. *Pak. J. Bot*., 41(2):667-682.

Abbas, H., M. Qaiser and J. Alam. 2010. Conservation status of *Cadaba heterotricha* stocks (Capparaceae): an endangered species in Pakistan. *Pak. J. Bot*., 42(1): 35-46.

Abbasi, A. M., M. A. Khan, M. Ahmad, R. Qureshi, M. Arshad, S. Jahan, M. Zafar and S. Sultana. 2010. Ethnobotanical study of wound healing herbs among the tribal communities in Northern Himalaya Ranges District Abbottabad, Pakistan. *Pak. J. Bot*., 42(6): 3747-3753.

Abd El-Ghani, M.M. and K. N. Abdel-Khalik. 2006. Floristic diversity and phytogeography of the Gebel Elba National Park, South-East Egypt. *Turkish Journal of Botany,* 30: 121–136.

Abdullahi, M. B., S.S. Sanusi, S. D. Abdul and F. B. J. Sawa. 2009. An Assessment of the Herbaceous Species Vegetation of Yankari Game Reserve, Bauchi, Nigeria. *American-Eurasian J. Agric. & Environ. Sci*., 6 (1): 20-25.

Adam, J. H. and Z. Mamat. 2005. Floristic composition and structural composition of lime stone forests at three different elevations in Bau, Kuching and Saravak, Malaysia. *J. Biol. Sci*., 5(4): 478-485.

Adebisi, I. M. and S. O. Bello. 2011. An ethnobotanical survey of herbal male contraceptives used in south-west Nigeria. *African J. Pharm. & Pharmacology*, 5(2): 289-291.

Adnan, M., J. Hussain, M. T. Shah, Z. K. Shinwari, F. Ullah, A. Bahader, N. Khan, A. L. Khan and T. Watanabe. 2010. Proximate and nutrient composition of medicinal plants of humid and sub-humid regions in North-west Pakistan. *Journal of Medicinal Plants Research*, 4(4): 339-345.

Agha, Q., S. Ahmad, M. Islam, A. Gill, and M. Athar. 2011. Growth and production potential of three exotic herbs in highlands of Balochistan, Pakistan. *Journal of Medicinal Plants Research,* 5(4): 543-548.

Agrawal, A. K. 1989. Floristic composition and phenology of temperate grasslands of Western Himalaya as affected by scraping, fire and heavy grazing. *Vegetatio*, 88: 177-187.

Ahmad, I., M. S. A. Ahmad, M. Hussain and M. Ashraf. 2011. Spatiotemporal variations in soil characteristics and nutrient availability in open scrub type semi-arid rangelands of typical sub-mountainous Himalayan tract. *Pak. J. Bot*., 43(1): 565-571.

Ahmad, I., M. S. A. Ahmad, M. Hussain, M. Ashraf, M. Y. Ashraf and M. Hameed. 2010a. Spatiotemporal aspects of plant community structure in open scrub rangelands of submountainous Himalayan plateaus. *Pak. J. Bot*., 42(5): 3431-3440.

Ahmad, K., M. Ashraf, Z. I. Khan and E. E. Valeem. 2008b. Evaluation of macro-mineral concentrations of forages in relation to ruminants requirements: a case study in Soone valley, Punjab, Pakistan. *Pak. J. Bot*., 40(1): 295-299.

Ahmad, K., M. Hussain, M. Ashraf, M. Luqman, M.Y. Ashraf and Z.I. Khan. 2007. Indigenous vegetation of Soon Valley: At the risk of extinction. *Pak. J. Bot*., 39(3): 679-690.

Ahmad, K., Z. I. Khan, M. Ashraf, E. E. Valeem, Z. A. Shah and L. R. Mcdowell. 2009a. Determination of forage concentrations of lead, nickel and chromium in relation to the requirements of grazing ruminants in the salt range, Pakistan. *Pak. J. Bot*., 41(1): 61-65.

Ahmad, K., Z. I. Khan, M. Ashraf, M. Hussain, M. Ibrahim and E. E. Valeem. 2008b. Status of plant diversity at Kufri (Soone valley) Punjab, Pakistan and prevailing threats therein. *Pak. J. Bot*., 40(3): 993-997.

Ahmad, K., Z. I. Khan, M. Y. Ashraf, M. Ashraf and E. E. Valeem. 2008a. Forage evaluation for some trace elements: a case study in the Soone valley, Pakistan. *Pak. J. Bot*., 40(3): 999-1004.

Ahmad, M., M. A. Khan, Arshad and M. Zafar. 2004. Ethnophytotherapical a[[roaches for the treatment of diabetes by the local inhabitants of District Attock (Pakistan). *Ethnobotanical leaflets*.

Ahmad, M., M. A. Khan, M. Zafar and S. Sultana. 2006. Ethnomedicinal demography and ecological diversification of some important weeds from District Attock-Pakistan. *Pak J. Weed Sci. Res.*, 12 (1-2): 37-46.

Ahmad, S. S. and T. Yasmin. 2011. Vegetation classification along Hanna lake, Baluchistan using ordination techniques. *Pak. J. Bot*., 43(2): 863-872.

Ahmad, S. S., A. Wahid and K. F. Akbar. 2010b. Multivariate classification and data analysis of vegetation along motorway (M-2), Pakistan. *Pak. J. Bot*., 42(2): 1173-1185.

Ahmad, S. S., S. Fazal., E. E Valeem and I. Zafar. 2009b. Evaluation of ecological aspects of road side vegetation around Havalian city using multivariate techniques. *Pak. J. Bot.*, 41(1): 461-466.

Ahmad, S., M. Islam, G. Bano, S. Aslam and S. Koukab. 2009c. Seasonal variation in current season and dead Biomass of *chrysopogon aucheri* (boiss) stapf. and *cymbopogon jwarancusa* (Jones) Schult. in highland Balochistan, Pakistan. *Pak. J. Bot.*, 41(2): 519-527.

Ahmed, M., K. N. Muhammad, F. Siddiqui, M. Wahab, N. Khan, M. U. Khan and S. S. Hussain. 2010. Community description of Deodar forests from Himalayan range of Pakistan. *Pak. J. Bot*., 42(5): 3091-3102.

Ahmed, M., N. Khan, M, Wahab, S, Hamza, M.F. Siddiqui, K. Nazim and M.U. Khan. 2009a. Description and structure of *Olea ferruginea* Royle forests of Dir Lower District of Pakistan. *Pak. J. Bot*., 41(6): 2683-2695.

Ahmed, M., T. Hussain, A. K. Sheikh, S. S. Hussain and M. F. Siddiqui. 2006. Phytosociology and structure of Himalayan forests from different climatic zones of Pakistan. *Pak. J. Bot*., 38(2): 361-383.

Ajaib, M., Z.D. Khan, N. Khan and M. Wahab. 2010. Ethnobotanical studies on useful shrubs of District Kotli, Azad Jammu & Kashmir, Pakistan. *Pak. J. Bot*., 42(3): 1407-1415.

Akbar, G., S. Rafique and M. Asghar. 1994. Evaluation of different exotic grass species in upland Balochistan. *Pak. J. For*., 1:1-8.

Akeroyd, J. 2002. A rational look at extinction. *Plant Talk*., 28:35-37.

Alam, J. and S. L. Ali. 2009. Conservation status of *Astraglus gilgitensis* Ali (Fabaceae): a critically endangered species in Gilgit district, Pakistan. *Phyton (Horn, Austria),* 48(2): 211-223.

Alemayehu, M. 2004. Rangeland biodiversity: Concepts, approaches and the way forward. Addis Abad, Ethiopia. pp. 87-106.

Ali, H. and M. Qaiser. 2009. The ethnobotany of Chitral valley, Pakistan with particular reference to medicinal plants. *Pak. J. Bot*., 41(4): 2009-2041.

Ali, H., M. Qaiser and K.B. Marwat. 2012. Contribution to the red list of Pakistan: a case study of *Delphinium nordhagenii* (Ranunculaceae). *Pak. J. Bot*., 44(1): 27-31.

Ali, J. and A. B. Tor. 2004. Fuel wood, timber and deforestation in the Himalayas: the case of Basho valley, Baltistan region, Pakistan. *Mountain Research and Development*, 24(4): 312-318.

Ali, J., P. Fontenot and V. G. Allen. 2009. Palatability and dry matter intake by sheep fed corn stover treated with different nitrogen sources. *Pakistan Vet. J*., 29(4): 199-201.

Ali, M., A. Ullah, H. Ullah, F. Khan, S. M. Ibrahim, L. Ali and S. Ahmad. 2010. Fruit Properties and Nutritional Composition of Some Walnut Cultivars Grown in Pakistan. *Pakistan Journal of Nutrition*, 9 (3): 240-244.

Ali, S. I. and M. Qaiser. 1995-2011. Flora of Pakistan. Department of Botany, Universitt of Karachi, Pakistan.

Ali, S. M. and R. N. Malik. 2010. Spatial patterns of vegetation with underlying soil properties prevailing along drain side areas in Islamabad city. *Pak. J. Bot*., 42(4): 2397-2410.

Ali, S. M. and R. N. Malik. 2010. Vegetation communities of urban open spaces: green belts and parks in Islamabad city. *Pak. J. Bot*., 42(2): 1031-1039.

Al-Quran, S. 2011. Conservation of medicinal plants in Ajlun woodland / Jordan. *Journal of Medicinal Plants Research*, 5(24): 5857-5862.

Al-Yemeni, M. and H. Sher. 2010. Biological spectrum with some other ecological attributes of the flora and vegetation of the Asir Mountain of South West, Saudi Arabia. *African Journal of Biotechnology*, 9 (34): 5550-5559.

Amigo, J., I. Pulgar and J. Izco. 2009.Evidence of riverside ash tree forests in southern Galicia (northwestern Spain). *Lazaroa,* 30: 181-189.

Amiri, M. S., P. Jabbarzadeh and M. Akhondi. 2012. An ethnobotanical survey of medicinal plants used by indigenous people in Zangelanlo district, Northeast Iran. *Journal of Medicinal Plants Research*, 6(5): 749-753.

Amsalu, S. and R. M.T. Barrs. 2002. Grass composition and rangeland condition of the major grazing areas of the mid rift vally, Ethiopia. *Afr. J. Range Forage Sci.,* 19:161.166.

Anderson, R. C. (1994). Height of white flowered trillium (*Trillium grandiflorum*) as an index of deer browsing intensity. *Ecol. Appl.,* 4, 104 109.

Angassa, A. 2005. The ecological impact of bush encroachment on the yield of grasses in Borana rangeland ecosystem. *African Journal of Ecology*, 43(1):14–20.

Anjorin, T.S., P. Ikokoh and S. Okolo, 2010. Mineral composition of *Moringa oleifera* leaves, pods and seeds from two regions in Abuja, Nigeria. *Int. J. Agric. Biol.*, 12: 431–434.

Anke, J., F. Petereit and A. Hansel. 2006. Proanthocyanidins and phenolglycosides from *Rumex acetosa* L. *Planta Medica*., 72: 109 – 115.

Anonymous. 2008. Balochistan fisheries development studies: Options for Balochistan coastal fisheries and aquaculture. In: Competitiveness support fund. p. 17

Ansaari, M. M., J. Ahmad and S. H. Ansari. 2007. Pharmacognostical evaluation of the stem bark of *Balanites aegyptiaca* Delile "*Hingot*". *Hamdard Medicus*., 50(1): 82 – 94.

Arshad, M., A. Hussan, M. Y. Ashraf, S. Noureen and M. Moazzam. 2008. Edaphic factors and distribution of vegetation in the Cholistan Desert, Pakistan. *Pak. J. Bot.,* 40(5): 1923-1931.

Arshadullah, M., M. A. Malik, M. Rasheed, G. Jilani, F. Zahoor and S. Kaleem, 2011. Seasonal and genotypic variations influence the biomass and nutritional ingredients of *Cenchrus ciliaris* grass forage. *Int. J. Agric. Biol*., 13: 120–124.

Arshadullah, M., M. Anwar and A. Azim. 2009. Evaluation of various exotic grasses in semi-arid conditions of Pabbi hills, Kharian range. *The Journal of Animal & Plant Sciences*, 19(2): 85-89.

Asaolu, S.S. and M.F. Asaolu. 2010. Trace Metal Distribution in Nigerian Leafy Vegetables. *Pakistan Journal of Nutrition*, 9 (1): 91-92, 2010.

Asri, Y., 2003. Plant diversity in Touran biosphere reservoir. Publishing Research Institute of Forests and Rangelands-Tehran. Pp:306.

Badami, S., S. R. Rai, S. Moorkoth, S. Rajan and B. Suresh. 2007. Pharmacognostic evaluate on of *Caesalpinia sappan. Hamdard Medicus.* 50(1): 103 – 108.

Badshah, L. and F. Hussain. 2011. Farmers preferences and use of local fodder flora in Tank District, Pakistan. *African Journal of Biotechnology*, 10(32): 6062-6071.

Bangash, J. A., M. Arif, F. Khan, F. Khan, A. Rahman and I. Hussain. 2011. Proximate composition, minerals and vitamins content of selected vegetables grown in Peshawar. *J.Chem.Soc.Pak*., 33 (1): 118-122.

Bano, A., A. Rehman and M. Winiger. 2009. Altitudinal variation in the content of protein, proline, sugar and abscisic acid (ABA) in the alpine herbs from Hunza valley, Pakistan. *Pak. J. Bot*., 41(4): 1593-1602.

Barkatullah, M. Ibrar and F. Hussain. 2009. Ethnobotanical studies of Charkotli Hills, Batkhela District, Malakand, Pakistan. *Front. Biol. China*, 4(4): 539-548.

Belewu, M. A. and F. T. Babalola. 2009. Nutrient enrichment of waste agricultural resifues after solid state fermentation using *Rhizopus oligosporus. J. Applied Biosci*., 13: 695- 699.

Berg, V. D., Eduardo and T. A. Oliveira-filho. 2000. Floristic composition and phytosociological structure of a riparian forest in Itutinga, State of Minas Gerais, Brazil and comparisons with other areas. *Rev. Bras. Bot*., 23(3): 231-253.

Bilgili, E. and B. Saglam. 2003. Fire behavior in maquis in Turkey. *Forest Ecol. Manag*., 184: 201-207.

Bocuk, H., C. Ture and O. Ketenoglu. 2009. Plant diversity and conservation of the Northeast Phrygia Region under the impact of land degradation and desertification (Central Anatolia, Turkey). *Pak. J. Bot*., 41(5): 2305-2321.

Boe, A., R. Bortnem and K. D. Kephart. 2000. Quantitative description of the phytomers of big bluestem. *Crop Sci.,* 40: 737-741.

Bonet, M. A. and J. Valles. 2007. Ethnobotany of Montseny biosphere reserve (Catalonia, Iberian Peninsula): Plants used in veterinary medicine. *Journal of Ethnopharmacology*, 110:130-147.

Bouyoucos, G. J. 1962. Hydrometer method improved for making particle-size analysis of soils. *Agron. J.,* 53: 464-465.

Bramwell, D. 2002. How many plant species are there? *Plant Talk*., 28:32-34.

Braun-Blanquet, J. 1951. Les Groupements Végétaux de la France Méditerranéenne. Centre National de la Recherche Scient Que, Montpellier.

Brinkmann, K., A. Patzelt, U. Dickhoefer, E. Schlecht and A. Buerkert. 2009. Vegetation patterns and diversity along an altitudinal and a grazing gradient in the Jabal al Akhdar Mountain range of northern Oman. *Journal of Arid Environments*, 73: 1035–1045.

Brown, L. R. and G. J. Bredenkamp. 2004. The use of structural species size classes in the description of the woody vegetation of a nature reserve. *African Journal of Ecology*, 42(4): 252–269.

Bukhsh, E., S. A. Malik and S. S. Ahmad. 2007. Estimation of nutritional value and trace elements content of *Carthamus oxyacantha*, *Eruca sativa* and *Plantago ovate. Pak. J. Bot*., 39(4): 1181-1187.

Buckman, H. O. and N. C. Brady. 1967. The nature and properties of soils. Eurasia Publishing House (Pvt) Ltd. New Delhi.

Cain, S. A. and G. M. De O. Castro. 1959. Manual of Vegetation Analysis. Harper & Brothers, New York.

Campanella, M. V. and A. J. Bisigato. 2010. What causes changes in plant litter quality and quantity as consequence of grazing in the Patagonian Monte: Plant cover reduction or changes in species composition? *Austral Ecology,* 35(7): 787–793.

Carton, O. T, A. J. Brereton, W. F. OKeeffe and G. P. Keane. 1988. Effects of autumn closing date and grazing severity in a rotationally grazed sward during winter and spring. I. Dry matter production. *lrish J. Agric. Res*., 27: 141-150.

Cassida, K. A., J. P. Muir, M. A. Hussey, J. C. Read, B. C. Venuto and W. R. Occumpaugh. 2005. Biomass yield and stand characteristics of switchgrass in south central U.S. environments. *Crop Sci.,* 45: 673-681.

Cayuela, L., J. M. R. Benayas, F. T. Maestre and A. Escudero. 2008. Early environments drive diversity and floristic composition in Mediterranean old fields: Insights from a long term experiment. *Acta Oecologia*, 34:311-321.

Champion, H. G, S. K. Seth and G. M. Khattak. 1965. Forest Types of Pakistan. Pakistan Forest Institute, Peshawar.

Changwe, K. and K. Balkwill. 2003. Floristics of the Dunbar Valley serpentinite site, Songimvelo Game Reserve, South Africa. *Botanical Journal of the Linnean Society*, 143 (3): 271–285.

Cheema, U. B. J. I. Sultan, A. Javaid, P. Akhtar and M. Shahid. 2011. Chemical composition, mineral profile and in situdigestion kinetics of fodder leaves of four native trees. *Pak. J. Bot*., 43(1): 397-404.

Chinedu, S. N. and C. O. Nwinyi. 2012. Proximate analysis of *Sphenostylis stenocarpa* and *Voadzeia subterranean* consumed in South-Eastern Nigeria. *Journal of Agricultural Biotechnology and Sustainable Development,* 4(1): 1-6.

Chmielewski, F. M. and T. Rotzer. 2001. Response of tree phenology to climate change across Europe. *Agric. for Meteorol*, 108:101-112.

Clark, P. E., W. C. Krueger, L. D. Bryant and D. R. Thomas. 1998. Spring defoliation effects on bluebunch wheatgrass: II Basal area. *J. Range Manage*., 51: 526-530.

Claude, B. and S. Paule. 1979. The manual of Natural living. 1 Ed. Biddles Ltd, Guildford, Surrey, pp: 98-101.

Costaa, R. C., F. S. Araujob and L. W. Lima-Verdeb. 2007. Flora and life-formspectrum in an area of deciduous thorn woodland (caatinga) in northeastern, Brazil. *Journal of Arid Environments*, 68 (2): 237–247.

Cotton, C.M.1996. Ethnobotany: Principles and Applications. Chichester: John Wiley and Sons.

Dar, G. H., R. C. Bhagat and M. A. Khan. 2001. Biodiversity of Kashmir Himalaya. Valley Book House, Srinagar, J & K, India. Pp. 120-176.

Danin, A. 1999. Desert rocks as plant refugia in the near east. *The Botanical Review*, 65: 93-170.

Danin, A., G. Orshan and M. Zohary. 1975. The vegetation of the northern Negev and the Judean Desert of Israel. *Israel J. Bot.,* 24: 118-172.

Dastagir, G., I. Haq, Z. H. Malik. 1999. Phytosociology of Mai Dhani hill near Muzaffarabad, Azad Kashmir. *Pak. J. Pl. Sci*., 4: 73-84.

Dasti, A. A. and S. A. Malik. 1998. A transect of vegetation and soils on the Indus valley scarp slope, Pakistan. *Pak J. Plant Sci.,* 4(2): 73-84.

Daubenmire, R. and J.B. Daubenmire. 1968. Forest vegetation of east- ern Washington and northern Idaho. Wash. Agric. Exp. Stn. Tech. Bull. 60.

Daur, I., H. Sepetoğlu, K. B. Marwat, G. Hassan and I. A. Khan. 2008. Effect of different levels of nitrogen on dry matter and grain yield of faba bean (*Vicia faba* l.). *Pak. J. Bot*., 40(6): 2453-2459.

Davidar, P., D. Mohandass and S. L. Vijayan. 2007. Floristic inventory of woody plants in a tropical montane (shola) forest in the Palni hills of the Western Ghats, India. *Tropical Ecology*, 48(1): 15-25.

De Lange, P. J., D. A. Norton, S. P. Courtney, P. B. Heenan, J. W. Barkla, E. K. Cameron, R. Hitchmough, A. J. Townsend. 2009. Threatened and uncommon plants of New Zealand (2008 revision). *New Zealand Journal of Botany*, 477: 61–96.

De Luis, M., M. J. Baeza, J. Raventos and J. C. G. Hidalgo. 2004. Fuel characteristics and fire behavior in mature Mediterranean gorse shrublands. *Int. J. Wildland Fire,* 13: 79-87.

Deka, D., P. Saikia and D. Konwer. 2007. Ranking of fuel wood species by Fuel Value Index. Energy Sources, part A. *Recovery, Utilization, and Environmental Effects*, 29 (16), 1499–1506.

Demirezen, D. and A. Aksoy. 2006. Heavy metal levels in vegetables in Turkey are within safe limits for Cu, Zn, Ni and exceeded for Cd and Pb. *Journal of Food Quality*, 29(3): 252–265

DeWalt, S.J. and J. Chave. 2004. Structure and Biomass of Four Lowland Neotropical Forests. *Biotropica*, 36 (1): 7-19.

Dilshad, S. M. R., N. U. Rehman, N. Ahmad, A. Iqbal. 2010. Documentation of ethnoveterinary practices for mastitis in dairy animals in Pakistan. *Pak. Vet. J*., 30(3): 167-171.

Dimitrakopoulos, A. P. 2002. Mediterranean fuel models and potential fire behavior in Greece. *Int. J. Wildland Fire*, 11: 127-130.

Dolezal, J. and M. Srutek. 2002. Altitudinal changes in composition and structure of mountain-temperate vegetation; case study from the western Carpathians. *Plant Ecology*, 158(2): 201-221.

Ducic, T. and A. Polle. 2005. Transport and detoxification of manganese and copper in plants. Braz. *J. Plant Physiol*., 17: 103-112.

Durrani, M. J. 2000. Ecological evaluation of some rangeland plants of Harboi Hills, Kalat, Balochistan. Ph.D. Thesis University of Peshawar.

Durrani, M. J. and F. Hussain. 2005. Ethnoecological profile of plants of Harboi rangeland, Balochistan. *Int. J. Biol. & Biotech*., 2: 15-22.

Durrani, M. J., A. Razaq, S. G. Muhammad and F. Hussain. 2010. Floristic diversity, ecological, characteristics and ethnobotonical profile of plants of Aghberg rangelands, Balochistan, Pakistan. *Pak. J. Pl. Sci*., 16 (1): 29-36.

Durrani, M. J., F. Hussain and S. Rehman. 2005. Ecological characteristics of plants of Harboi rangeland, Kalat, Balochistan. *J. Trop. Subtrop. Bot*., 13: 130-138.

Durrani, M. J., M. Manzoor and S. Irfan. 2009. Folk uses of some plants of Quetta, Pakistan. *Pak. J. Pl. Sci*., 15(1): 1-9.

Ekblom, A. and L. Gillson. 2010. Hierarchy and scale: testing the long term role of water, grazing and nitrogen in the savanna landscape of Limpopo National Park (Mozambique). *Landscape Ecol*., 25(10): 1529-1546.

El-Deen, H.M.E. 2005. Population Ecology of *Rhazya stricta* Decne. in Western Saudi Arabia. *Int. J. Agri. Biol*., (7) 6: 932–938.

El-Ghani, M.M.A. and W. M. Amer. 2003. Soil–vegetation relationships in a coastal desert plain of southern Sinai, Egypt. *Journal of Arid Environments*, 55 (4): 607–628.

El-Ghanim, W. M., L. M. Hassan., T. M. Galal and A. Badr. 2010. Floristic composition and vegetation analysis in Hail region north of central Saudi Arabia. *Saudi Journal of Biological Sciences*, 17: 119-128.

Enright, N. J., B. P. Miller and R. Akhter. 2005. Desert vegetation and vegetation-environment relationships in Kirthar National Park, Sindh, Pakistan. *J. Arid Environments*, 61: 397-418.

Evenari, M., L. Shanan and N. Tadmore. 1982. *The Negev: the challenge of a desert*. Harvard Univ. Press, Cambridge, M.A.

Faridah-hanum, L. Philip and A.G. A. Noor. 2008. Sampling species diversity in a Malaysian rain forest: the case of a logged-over forest. *Pak. J. Bot.,* 40(4): 1729-1733.

Farooq, M. U. 2003. Some suitable and sustainable strategies for improving rangeland productivity in Pakistan. *Pak. J. Forest*., 53: 193-199

Farooq, M., F. Anwar and U. Rashid. 2008. Appraisal of heavy metal contents in different vegetables grown in the vicinity of an industrial area. *Pak. J. Bot*., 40(5): 2099-2106.

Farooq, S., A. Z. Khan, M. Yousaf and H. Fazal. 2010. Phytosociological study of Push Ziarat area (Shawal) in the South Waziristan, Pakistan. *Pak. J. Weed Sci.,* 16(1): 47-55.

Franklen, J. and M. Merlin. 1992. Species environmental patterns of forest vegetation on the uplifted reef limestone of Atiu, Mongaia, Mauke and Mitiaro, Cook island, West central Pacific Ocean. *J. Veg. Sci*., 3(1): 3-14.

Gambiza, J., B. M. Campell, S. R. Moe and P. G. H. Frost. 2005. Fire behaviour in semi-arid Baikiaea plurijuga savanna woodland on Kalahari sands in western Zimbabwe. *S. Afr. J. Sci.,* 101: 239- 244.

Gbolahan, D. 2001. Lesson Note on medical importance of trace elements. Centre for Natural Health Studies.

Ghazanfar, S. and J. Osborne. 2010. Conservation through restoration: study of a degraded gravel plain in South Eastern Arabia. *Pak. J. Bot*., 42:193-204.

Gillen, R. L. and P. L. Sims. 2004. Stocking rate, precipitation and herbal production on sand sagebrush grassland. *Jour. Range Managmt.,* 57: 148-152.

Gimenez, E., M. Melendo, F. Valle, F. Gomez-Mercado and E. Cano. 2004. Endemic flora biodiversity in the south of the Iberian Peninsula: altitudinal distribution, life forms and dispersal modes. *Biodiversity and Conservation*, 13 (14): 2641-2660.

Gonzalez-V, E. A., M. A. Hussey and J. A. Ortega-S. 2006. Nutritive value of desmanthus associated with Kleingrass during the establishment year. *Rangeland Ecol. Manag*., 58(3): 308-314.

Green, D. M. and J. B. Kaufman. 1995. Succession and livestock grazing in a Northeastern Oregon riparian Ecosystem. *J. Range. Manage*, 48(4): 307-313.

Griffiths, L. M., S. H. Loeffler, M. T. Socha, D. J. Tomlinson and A. B. Johnson. 2007. Effects of supplementing complexed zinc, manganese, copper and cobalt on lactation and reproductive performance of intensively grazed lactating dairy cattle on the South Island of New Zealand. *Anim. Feed Sci. Technol*., 137:69–83.

Grunwaldt, E. G., A. R. Pedrani and A. I. Vich. 1994. Goat grazing in arid piedmont of Argentina. *Small Ruminant Research*, 13: 211-216.

Guo, Q. S., X. F. Wang, G. Bar, Y. Kang, M. Hong, S. X. Pei and F. J. Zhang. 2009. Life form spectra, leaf character and hierarchical-synusia structure of vascular plants in *Thuja sutchuehensis* community. *Ying Yong Sheng Tai Xue Bao*, 20(9): 2057-2062.

Gurbuz, I., A. M. ozkan, E. Yesilada and O. Kutsal. 2005. Anti – ulcerogenic activity of some plants used in folk medicine of Pinarbasi (Kayseri, Turkey). *Journal of Ethnopharmacology*., 101(1-3): 313 – 318.

Gyamtosho, P., J. Noeberger and M. Menzi. 1996. Existing status and potential for sustainable improvement of high altitude rangelands of Bhutan. In: *Proc. Rangelands*. In a sustainable biosphere. (Ed.): N.E. West. 5th International Congress. 1995. Salt Lake City, Utah. pp. 195- 196.

Hajara, P. K and R. P. Rao. 1990. Distribution of vegetation types in N. W. *Himalayas plant schems*, 100: 263-277.

Hamayun, M., A. Khan and M. A. Khan. 2005. Common medicinal folk recipes of District Buner, NWFP, Pakistan. *Ethnobotanical leaflets*.

Hamayun, M. 2005. Studies on Ethnobotany, Conservation and Plant Diversity of Utror and Garbal Valleys District Swat, Pakistan. Ph.D. thesis Department of Plant Sciences, Quaid-IAzam University, Islamabad, Pakistan

Hamayun, M., S. A. Khan, E.Y. Sohn and I. J. Lee. 2006. Conservation assessment of Hindu Kush Mountainous region of Pakistan. A case study of Utror and Gabral valley, district Swat, Pakistan. *Asian J. Pl. Sci*., 5(4): 725-732.

Hameed, I., G. Dastagir and F. Hussain. 2008. Nutritional and elemental analyses of some selected medicinal plants of the family polygonaceae. *Pak. J. Bot*., 40(6): 2493-2502.

Hanif, R., Z. Iqbal, M. Iqbal, S. Hanif and M. Rasheed. 2006. Use of vegetables as nutritional food: ole in human health. *Journal of Agricultural and Biological Science*, 1(1): 18-22.

Haq, F. 2011. Conservation status of the critically endangered and endangered species in the Nandiar Khuwar catchment District Battagram, Pakistan. *International Journal of Biodiversity and Conservation*, 3(2): 27-35.

Hashmi, D. R., S. Ismail and G.H. Shaikh. 2007. Assessment of the level of trace metals in commonly edible vegetables locally available in the markets of Karachi city. *Pak. J. Bot.,* 39(3): 747-751.

Hazrat, A., M. Nisar, J. Shah and S. Ahmad. 2011. Ethnobotanical study of some elite plants belonging to Dir, Kohistan Valley, Khyber Pukhtunkhwa, Pakistan. *Pak. J. Bot*., 43(2): 787-795.

Hazrat. A., J. Shah, S. Ahmad, M. Nisar, A. K. Jan and Sikandar. 2010. Medicinal plants of Usherai Valley, Dir, NWFP, Pakistan. *Pak. J. Bot*., 42(1): 31-34.

Heath, M. E., R. F. Barnes and D. S. Metcalfe. 1985. Forages: The Science of Grassland Agriculture. Iowa State University, Iowa, Aimes.

Heennan, P. B., P. J. D. Lange, E. K. Cameron and B. S. Parris. 2008. Checklist of dicotyledons, gymnosperms and pteridophytes naturalized or casual in New Zealand: additional records 2004-2006. *New Zealand Journal of Botany*, 46: 257-283.

Henrik, B. H., M. Jon, V. Risto, G. J. Arvid, O. Lauri and A. Anders. 2006. Effect of altitude and topography on species rechness of vascular plants, bryophytes and lichen in alpine communities. *J. Veg. Sci*., 17:37-46.

Henry-Unaeze, H. N. 2011. A Comparative Study of Micronutrients Content of Complementary Foods Used by Igbo and Hausa Mothers in Umuahia, Abia State, Nigeria. *Pakistan Journal of Nutrition*, 10 (4): 322-324

Hernandez-Stefanoni and J. M. Dupuy. 2007. Mapping species density of trees, shrubs and vines in a tropical forest, using field measurements, satellite multiespectral imagery and spatial interpolation. *Biodivers Conserv.*, 16:3817–3833.

Hickman, K. R. D. C. Hartnett, R. C. Cochran and C. E. Owensby. 2004. Grazing management effects on plant species diversity in tallgrass prairie. *J. Range Manage*., 57: 58-65.

Hill, M.O. 1979. DECORANA - A FORTRAN program for detrended correspondence analysis and reciprocal averaging. Ecology and Systematics, Cornell University, Ithaca, New York 14850, 52 pp.

Hilton-Taylor, C. 2000. IUCN Red List of threatened species. IUCN, Gland, Switzerland and Cambridge, UK.

Hirata, M., N. Koga, H. Shinjo, H. Fujita, G. Gintzburger, J. Ishida and A. Miyazaki. 2005. Measurement of above-ground plant biomass, forage availability and grazing impact by combining satellite image processing and field survey in a dry area of north-eastern Syria. *Grass and Forage Science*, 60, 25–33.

Hurka, H. and A. Heinrik. 2004. Species richness and composition during sylvigensis in a topical dry forest in northwestern Costa Rica. Trop. Ecol., 45(1): 43-57.

Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology. University Grants Commission, Islamabad.

Hussain, F. and G. Mustafa. 1995. Ecological studies on some pasture plants in relation to animal use found in Nasirabad Valley, Hunza, Pakistan. *Pak. J. Pl. Sci*., 1: 255-262.

Hussain, F. and M. J. Durrani. 2007. Forage productivity of arid temperate Harboi Rangeland, Kalat, Pakistan. *Pak. J. Bot*., 39(5): 1455-1470.

Hussain, F. and M. J. Durrani. 2008. Mineral composition of some range grasses and shrubs from Harboi rangeland Kalat, Pakistan. *Pak. J. Bot*., 40(6): 2513-2523.

Hussain, F. and M. J. Durrani. 2009b. Seasonal availability, palatability and animal Preferences of forage plants in Harboi arid Range land, Kalat, Pakistan. *Pak. J. Bot*., 41(2): 539-554.

Hussain, F. and M. J. Durrani. 2009a. Nutritional evaluation of some forage plants from Harboi Rangeland, Kalat, Pakistan. *Pak. J. Bot*., 41(3): 1137-1154

Hussain, F., A. Khaliq and M. J. Durrani. 1995. Ethnobotanical studies of some plants of Dabargai Hills, Swat. *Proceeding s of First Training Workshop on Ethnobotany and its application to Conservation.* National Herbarium/PASA/PARC. Islamabad, Pakistan, pp. 207-215.

Hussain, F., H. Sher and M. Ibrar. 2004. Ethnobotanical Profile of some plants of District Swat, Pakistan. *Pak. J. Pl. Sci*., 10: 85-104.

Hussain, F., H. Sher, M. Ibrar and M. J. Durrani. 2005. Ethnobotanical uses of some plants of District Swat, Pakistan. *Pak. J. Pl. Sci*., 11(2): 137-158.

Hussain, F., I. Iqbal and M.J. Durrani. 2000. Vegetation studies on Ghalegay Hills, District Swat, Pakistan. *Pak. J. Pl. Sci*., 6(1-2): 1-10

Hussain, F., I. Iqbal and P. Akhtar. 2005. Floristic and vegetation studies of Ghalegay Hills, district Swat, Pakistan. *International Journal of Biology and Biotechnology,* 2(4): 847-852.

Hussain, F., L. Badshah and G. Dastigar. 2006. Folk medicinal uses of some plants of South Waziristan, Pakistan. *Pak. J. Pl. Sci*., 12: 27-40.

Hussain, F., S. M. Shah and H. Sher. 2007. Traditional resource evaluation of some plants of Mastuj, district Chitral, Pakistan. *Pak. J. Bot*., 39(2): 339-354.

Hussain, F. and S. R. Ghughtai. 1984. The effect of overgrazing on the development of herbaceous vegetation of Zangilora, Quetta, Balochistan. Pakistan. *Pak. J. Bot.*, 9: 29-38.

Hussain, J. , F. Khan, R. Ullah, Z. Muhammad, N. Rehman, Z. K. Shinwari, I. Khan, M. Zohaib, I. Din and S. M. Hussain. 2011. Nutrient evaluation and elemental analysis of four selected medicinal plants of Khyber Pakhtoon Khwa, Pakistan. *Pak. J. Bot*., 43(1): 427-434.

Hussain, J., R. Ullah, N. Rehman, A. L. Khan, Z. Muhammad, F. U. Khan, S. T. Hussain and S. Anwar. 2010. Endogenous transitional metal and proximate analysis of selected medicinal plants from Pakistan. *Journal of Medicinal Plants Research*, 4(3): 267-270.

Hussain, J., R. Ullah, N. Rehman, Abdul Latif Khan, Z. Muhammad, F. Khan, S. T. Hussain and S. Anwar. 2010. Endogenous transitional metal and proximate analysis of selected medicinal plants from Pakistan. *Journal of Medicinal Plants Research*, 4(3): 267-270.

Hussain, K., A. Shahazad and S. Z. Hussain. 2008. An Ethnobotanical Survey of Important Wild Medicinal Plants of Hattar District Haripur, Pakistan. *Ethnobotanical Leaflets,* 12: 29-35.

Hussain, J., A. L. Khan, N. Rehman, Zainullah, S. T. Hussain, F. Khan and Z. K. Shinwari. 2009. Proximate and nutrient analysis of selected medicinal plant species of Pakistan. *Pakistan J. Nut*., 8 (1): 620 -624.

Hussain, M. I. and A. Perveen. 2009. Plant biodiversity and phytosociological attributes of Tiko baran (Khirthar Range). *Pak. J. Bot*., 41(2): 581-586.

Hussain, F. A. R. Saljoqi, A. Shah and I. Ilahi. 1992. Phytosociology of vanishing subtropical vegetation of Swat with special reference to Docut Hills. I: Spring aspect. *Sarhad J. Aric*., 8: 185-191.

Ibrar, M., F. Hussain and A. Sultan. 2007. Ethnobotanical studies on plant resources of Ranyal Hills, District Shangla, Pakistan. *Pak. J. Bot*., 39(2): 329-337.

Inam-ur-Rahim, I., J. I. Sultan, M. Yaqoob, H. Nawaz, I. Javed and M. Hameed. 2008. Mineral Profile, palatability and digestibility of marginal land grasses of trans-himalayan grasslands of Pakistan. *Pak. J. Bot*., 40(1): 237-248.

Ingale, S. and S. K. Shrivastava. 2011. Nutritional study of new variety of groundnut (*Arachis hypogaea* L.) JL-24 seeds. *African Journal of Food Science*, 5(8): 490 – 498.

Iqbal, I. and M. Hamayun. 2003. Studies on the traditional uses of plants of Malam Jabba valley, District Swat, Pakistan. Botany Department, Swat Public School and College, Swat, Pakistan.

IUCN. 2001. IUCN Red List Categories and Criteria: Version 3.1.IUCN Species Survival Commission. IUCN. Gland. Switzerland and Cambridge, UK. 2: 30.

Jabeen, T. and S.S. Ahmad. 2009. Multivariate analysis of environmental and vegetation data of Ayub National Park, Rawalpindi. *Soil and Environment*, 28(2): 106-112.

Jackson, M. A. 1992. Soil Chemical Analysis. Constable and Co, Ltd., London.

Jafari, S. M. and H. Akhani. 2008. Plants of Jahan Nama protected area, Gulestan Province, N. Iran. *Pak. J. Bot*., 40(4): 1533-1554.

James, O. and E. T. Friday. 2010. Proximate and nutrient composition of *Euphorbia hetrophylla*: A medicinal plant from Anyigba, Nigeria. *Journal of Medicinal Plants Research*, 4(14): 1428-1431.

James, O., A. A. Rotimi and B. O. J. Bamaiyi. 2010. Phytoconstituents, proximate and nutrient investigations of Saba florida (Benth.) from Ibaji forest. *International Journal of Nutrition and Metabolism*, 2(5): 88-92.

Jan, G., M. A. Khan and F. Gul. 2009. Ethnomedicinal Plants Used Against Jaundice in Dir Kohistan Valleys (NWFP), Pakistan. *Ethnobotanical Leaflets,* 13: 1029-41.

Jan, G., M. A. Khan, F. Gul, M. Ahmad, M. Jan and M. Zafar. 2010. Ethnobotanical study of common weeds of Dir Kohistan valley, Khyber Pakhtoonkhwa, Pakistan. *Pak. J. Weed Sci. Res.* 16(1): 81-88.

Jesson, L. K. 2007. Ecological correlates of diversification in New Zealand angiosperm lineages. *New Zealand J. Botany*, 45:35-51.

Jongman, R. H. G., C. J. F. ter Braak and O. F. R. van Tonggren. 1995. Data Analysis in Community and Landscape Ecology. Purdoc, Wageningen, Netherlands.

Joshi, M. and Y. Rawat. 2011. Net primary productivity and species diversity of herbaceous vegetation in banj-oak (*Quercus leucotrichophora* A. Camus) forest in Kumaun Himalaya, India. *Journal of Mountain Science*, 8(6): 787-793.

Joshi, M., Y. S. Rawat and J. Ram. 2012. Seasonal variations in species diversity, dry matter and net primary productivity of herb layer of *Quercus leucotrichophora*-Pinus roxburghii mixed forest in Kumaun Himalaya, India. *Journal of Forestry Research*, 23 (2): 223-228.

Kamatenesi-Mugisha, M., H. Oryem-Origa, Olwa-Odyek and D. Makawiti. 2006. Ethno-pharmacological screening of *Vernonia amygdalina* and *Cleome gynandra*

traditionally used in Childbirth in Western Uganda. *The 11th symposium of the natural product research network for eastern and central Africa (Napreca*).

Kambhar, S. V. and K. Kotresha. 2011. A study on alien flora of Gadag District, Karnataka, India. *Phytotaxa,* 16: 52–62.

Kayani, S. A., A. Masood, A. K. K. Achakzai and S. Anbreen. 2007. Distribution of secondary metabolites in plants of Quetta-Balochistan. *Pak. J. Bot*., 39: 1179-1179.

Kennenni, L. and E. van der Maarel 1990. Population ecology of *Acacia tortilis* in the semi-arid region of the Sudan. *J. Veg. Sci.*, 1:419-24.

Khalil, S. K., A. Wahab, A. Rehman, F. Muhammad, S. Wahab, A. Z. Khan, M. Zubair, M. K. Shah, I. H. Khalil and R. Amin. 2010. Density and planting date influence phenological development assimilate partitioning and dry matter production of Faba bean. *Pak. J. Bot*., 42(6): 3831-3838.

Khan, M. 2004. A fraction of Angiosperm of Tehsil Banda Daud Shah, NWFP, Pakistan. MSc. Thesis. Gomal University D.I.Khan. Khyber Pakhton Khawa, Pakistan.

Khan, M. 2007. Ethnobotany of Tehsil Karak NWFP Pakistan. M.Phil Thesis. Kohat University of Science and Technology, Kohat, Khyber Pakhtunkhwa, Pakistan.

Khan, M. I., G. Hassan, I. Khan, K. B. Marwat, N. U. Khan and R. GUL. 2011. Tolerance of chickpea (*Cicer arietinum* l.) cultivars to the major chickpea herbicides. *Pak. J. Bot*., 43(5): 2497-2501.

Khan, M., A. Rehman and S. Musharaf. 2011a. A fraction of angiosperms of Tehsil Banda Daud Shah, District Karak Pakistan. *J. Bio. & Env. Sci.*, 1(6): 128-154.

Khan, M., F. Hussain, S. Musharaf and Imdadullah. 2011b. Floristic composition, life form and leaf size spectra of the coal mine area vegetation of Darra Adam Khel, Khyber Pakhtun Khwa, Pakistan. *J. Bio. & Env. Sci*., 1(3): 1-6.

Khan, M., S. Musharaf and Z. K. Shinwari. 2011c. Ethnobotanical importance of halophytes of Noshphosalt mine, District Karak, Pakistan. *Research In Pharmaceutical Biotechnology*, 3(4): 46-52.

Khan, M., S. Musharaf, M. Ibrar and F. Hussain. 2011e. Pharmacognostic evaluation of the *Amaranthus viridis* L. *Research In Pharmaceutical Biotechnology*, 3(1): 11-16

Khan, M., Z. K. Shinwari and S. Musharaf. 2011d. Conservation and ecological characteristic of Trees in Tehsil Karak Pakistan. *J. Bio. & Env. Sci.,* 1(6): 155-164.

Khan, N., M. Ahmed, A. Ahmed, S.S. Shaukat, M. Wahab, M. Ajaib, M.F. Siddiqui and M. Nasir. 2011. Important medicinal plants of Chitral Gol National Park (Cgnp) Pakistan. *Pak. J. Bot*., 43(2): 797-809.

Khan, N., M. Ahmed, M. Wahab and M. Ajaib. 2010. Phytosociology, structure and physiochemical analysis of soil in *Quercus baloot* Griff. Forest District Chitral, Pakistan. *Pak. J. Bot*., 42(4): 2429-2441.

Khan, Z. I., M. Ashraf and E.E. Valeem. 2006. Forage mineral status evaluation: the influence of pastures. *Pak. J. Bot*., 38(4): 1043-1054.

Khan, Z. I., M. Ashraf, A. Hussain. H. W. Koyro and B. Huchzermeyer. 2005. Seasonal variation in the status of selenium in goats grazing native and improved pastures in a semiarid region of Pakistan. *Deutsche Tierarztliche Worchenschrift,* 112: 460-465.

Khan, Z. I., M. Ashraf, K. Ahmad, E. E. Valeem and L. R. Mcdowell. 2009b. Mineral status of forage and its relationship with that of plasma of farm animals in southern Punjab, Pakistan. *Pak. J. Bot*., 41(1): 67-72.

Khan, Z. I., M. Ashraf, K. Ahmad, I. Mustafa and M. Danish. 2007. Evaluation of micro minerals composition of different grasses in relation to livestock requirements. *Pak. J. Bot*., 39(3): 719-728.

Khan, Z. I., M. Ashraf, K. Ahmad, N. Ahmad, M. Danish and E. E. Valeem. 2009. Evaluation of mineral composition of forages for grazing ruminants in Pakistan. *Pak. J. Bot*., 41(5): 2465-2476.

Kharkwal, G. and Y.S. Rawat. 2010. Structure and composition of vegetation in subtropical forests of Kumaun Himalaya. *Afr. J. Plant Sci*., 4(4): 112-121.

Kharkwal, G., P. Mehrotra and Y. Rawat. 2010. Biomass production of herb species in broad leaf forests in Kumaun Himalaya, India. *Journal of Forestry Research*, 21(3): 355-360.

Khattak, G. S. S., I. Saeed and R. Zamir. 2007. Breeding high yielding desi chickpea (*Cicer arietinum* l.) genotypes for the agro-climatic conditions of NWFP. *Pak. J. Bot.*, 39(7): 2399-2405.

Kirnse, R. D. and B.E. Noston. 1985. Comparison of the reference unit method and dimension analysis methods for two large shrubby species in the Caatinga Woodlands. *J. Range Manage*., 38: 425- 428.

Kwiatkowski, P. 2008. Current State, Separateness and Dynamics of vascular Flora of the Góry Kaczawskie (Kaczawa Mountains) and Pogórze Kaczawskie (Kaczawa Plateau). II. Phytogeographical Aanalysis. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

Lamsal, **S.,** D. M. Rizzo, and R. K. Meentemeyer. 2012. Spatial variation and prediction of forest biomass in a heterogeneous landscape. *Journal of Forestry Research,* 23(1): 13-22.

Langenberger, G., K. Martin and J. Sauerborn. 2006. Vascular plant species inventory of Philippine lowland rain forest and its conservation value. *Biodiversity & Conservation*, 15(5): 1271-1301.

Lehnebach, C.A. 2003. Preliminary checklist of the orchids of Chile. *Botanical Journal of the Linnean Society*, 143 (4): 449–451

Lemma, Z. 2001. Revegetation of degraded rangelands in middle Awash of Afar region with *Cenchrus ciliaris* and *Chloris gayana*. M.Sc. thesis, Alemaya University, Alemaya, Ethiopia. pp.134-145.

Lindsey, K. L., M. Budesinsky, L. Kohout, and J. Van Staden. 2006. Antibacterial activity of meteoric acid isolated from the root-bark of *Maytenus senegalensis*. *South African Journal of Botany*, 72:473-477.

Linkie, M., R. J. Smith and N. L. Williams. 2004. Mapping and predicting deforestation patterns in the lowlands of Sumatra. *Biodiversity & Conservation*, 13 (10): 1809-1818.

Loeser, M. R. R., T. D. Sisk and T. E. Crews. 2007. Impact of Grazing Intensity during Drought in an Arizona Grassland. *Conservation Biology*, 21(1): 87–97

Lubna, H. 2001. Analyzing Institutional Set-up of Forest Management in Pakistan, Jour. Pakistan Institute of Development Economics. Research Report No. 182, p-21-22.

Madsen, J. E. and I. B. Ilgaard. 2008. Floristic composition, structure and dynamics of an upper montane rain forest in Southern Ecuador. *Nordic J. Bot*., 14(4): 403-423.

Magurran, A. E. 1988. Ecological Diversity and its Measurements. Princeton University Press, New Jersey, pp. 1-192.

Mahmood, A., A. Mahmood and M. Mahmood. 2012. Indigenous wild medicinal plants used by local people of Dudial area, District Mirpur, Azad Jammu and Kashmir, Pakistan. *Journal of Medicinal Plants Research*, 6(13): 2686-2690.

Malik N. Z. and Z. H. Malik. 2004. Present status of subtropical Chirpine vegetation of Kotli Hills, Azad Jammu and Kashmir. *J. Res. Sci*., 15(1): 85-90.

Malik R. N. and S. Z. Hussain. 2006. Spatial distribution of ecological communities using remotely sensed data. *Pak. J. Bot*., 38 (3): 571-582.

Malik, N. Z., M. Arshad and S. N. Mirza. 2007. Phytosociological Attributes of Different Plant Communities of Pir Chinasi Hills of Azad Jammu and Kashmir. *Int. J. Agri. Biol*., 9(4): 569–574.

Malik, R. N. and S. Z. Husain. 2006. Classification and ordination of vegetation communities of the Lohibehr reserve forest and its surrounding areas, Rawalpindi. *Pak. J. Bot.,* 38(3): 543-558.

Malik, M. A., F. Zahoor, S. H. Abbas and M. Ansar. 2006. Comparative study of different herbicides for control of weeds in rainfed maize (*Zea mays* L.). WSSP Absts. Weed Sci. Soc. Pak., 62p

Malik, R. N. and S. Z. Husain. 2008. Linking remote sensing and ecological vegetation communities: a multivariate approach. *Pak. J. Bot*., 40(1): 337-349.

Malik, R. N., S. Z. Husain and I. Nazir. 2010. Heavy metal contamination and accumulation in soil and wild plant species from industrial area of Islamabad, Pakistan. *Pak. J. Bot.,* 42(1): 291-301.

Malik, Z. H. 2005. Comparative study on the vegetation of Ganga Chotti and Bedori hills District Bagh, Azad Jammu and Kashmir with special reference to Range conditions. PhD Thesis, University of Peshawar.

Malubekova, G. B. 1996. The ecological evaluation of the present condition of rangeland vegetation of Kazakhistan deserts. In: Proc. Rangelands. In a sustainable biosphere. (Ed.): N.E. West. 5th International Congress 1995, Salt Lake City Utah. pp. 338-339.

Manhas, R. K., M. K. Gautam and D. Kumari. 2009. Plant diversity of a fresh water swamp of Doon valley, India. *Journal of American Sci.*, 5(1): 1-7.

Margalef, R. 1958. La teoria ded la information on ecologia Mem. Real. Acad. *Cunciary Astes de Barcilona*, 32: 373-449.

Mark, A. F., P. Michel, K. J. M. Dickinson and B. McLen-nan. 2009. The conservation (protected area) status of New Zealand's indigenous grasslands: An up-date. *New Zealand Journal of Botany*, 47:53-60.

Marqueus, M. C. M., J. J. Roper and A.P. B. Salvalaggio. 2004. Phenological patterns among plants life-form in a subtropical forest in Southern Brazil. *J. Plt. Ecol*., 173(2):203-312.

Marwat, S. K., M. A. Khan, M. A. Khan, F. Rehman, M. Ahmad, M. Zafar and S. Sultana. 2009. *Salvadora persica, Tamarix aphylla* and *Zizyphus mauritiana*-Three Woody Plant Species Mentioned in Holy Quran and Ahadith and Their Ethnobotanical Uses in North Western Part (D.I. Khan) of Pakistan. *Pakistan Journal of Nutrition*, 8 (5): 542-547.

McCune, B. and M. J. Mefford. 1999. Multivariate analysis of ecological data. Version 4.16. MJM software, Oregon, USA.

McDowell, L. R. 2003. Minerals in animals and human nutrition. 2nd ed.Elsevier Science BV Amsterdam, Netherlands, p. 144.

Melinda, A. W., M. J. Trlica, G. W. Frasier and J. D. Reeder. 2002. Seasonal grazing affects soil physical properties of a *Montane riparian* community. *Jour. Range Managmt.,* 55: 49-56.

Menzel, A. (2003) Plant phenological anomalies in Germany and their relation to air temperature and NAO. *Climatic Change* 57:243-263.

Messias, M. C. T. B., M. G. P. Leite, J. A. A. Meira-Neto and A. R. Kozovits. 2011. Life-form spectra of quartzite and itabirite rocky outcrop sites, Minas Gerais, Brazil. *Biota Neotrop*., 11(2): 255-268.

Migongo-Bake, W. and R. M. Hensen. 1987. Seasonal diets of camels, cattle, sheep and goats in a common range in Eastern *Africa. J. Range Mange*., 40: 76-79.

Milewski, A. V. and D. Madden. 2006. Interactions between large African browsers and thorny Acacia on a wildlife ranch in Kenya. *African Journal of Ecology*, 4: 515-522.

Milosevic, T., N. Milosevic, I. Glisic and G. Paunovic. 2009. Leaf nutritional status and macronutrient dynamics in european hazelnut (Corylus avellana l.) under western Serbian conditions. Pak. J. Bot., 41(6): 3169-3178.

Minson, D. J. 1990. The chemical composition and nutritive value of tropical grasses. In: Tropical grasses FAO Plant Production and Protection Series, No: 23. (Eds.): P.J. Skerman and F. Riveros. FAO Rome.

Mood, S. G. 2008. A contribution to some ethnobotanical aspects of Birjand flora (Iran). *Pak. J. Bot*., 40(4): 1783-1791.

Moradi, G., M. R. M. Mohadjer, G. Z. Amiri, A. Shirvany and N. Zargham. 2010. Life form and geographical distribution of plants in Posthband region, Khonj, Fars Province, Iran. *Journal of Forestry Research*, 21(2): 201−206.

Morrison, D. A., G.J. Gray, S. M. Pengelly, D.G. Ross, B. J. Mullins, C. R. Thomas, T. S. Anderson and T. Anderson. 2006. Effects of fire frequency on plant species composition of sandstone communities in the Sydney region: Inter-fire interval and time-since-fire. *Austral J. Ecology*, 20(2): 239-247.

Muir, J. P and A. Alage. 2001. Seasonal herbage production from two range types in southern Mozambique. 2001. *African J. of Range and Forage Sci*., 18(1):37-41.

Muller-Dumbois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. John Wiley and Sons, N. Yark. pp. 547.

Muoghalu, J. I. and O. O. Okeesan. (2005). Climber species composition, abundance and relationship with trees in a Nigerian secondary forest. *African Journal of Ecology*, 43 (3): 258–266.

Muthuramkumar, S., N. Ayyappan, N. Parthasarathy, D. Mudappa, T. R. S. Raman, M. A. Selwyn and L. A. Pragasan. 2006. Plant Community Structure in Tropical Rain Forest Fragments of the Western Ghats, India. *Biotropica*, 38 (2): 143–160.

Nadaf, M. and S. M. Mortazavi. 2011. Investigation flora and life form of plants in protected region Sarigol (North Khorasan Province, Iran). *Pak. J. Biol. Sci.*, 14(1):78-81.

Naseem, R., K. Mahmud and M. Arshad. 2006. Chemical composition and antibacterial activity of *Crotalaria burhia*, from Cholistan Desert, Pakistan. *Hamdard Medicus*, 69(4): 45 – 52.

Naser, H. M., N. C. Shil, N. U. Mahmud, M. H. Rashid and K. M. Hossain. 2009. Lead, Cadmium and Nickel contents of vegetables grown in industrially polluted and non-polluted areas of Bangladesh. *Bangladesh J. Agril. Res.*, 34(4): 545-554.

Nasir, E. and S. I. Ali. (1970-1994). Flora of Pakistan. Fascicles. Karachi. Pakistan.

Naughton-Treves, L., M. B. Holland and K. Brandon. 2008. The role of protected areas in conserving biodiversity and sustaining local livelihoods. *Annual Review of Environment & Resources*, 30(1): 219-252.

Naz, N., M. Hameed, M. Ashraf, M. Arshad, M. Sajid and A. Ahmad. 2010. Impact of salinity on species association and phytosociology of halophytic plant communities in the Cholistan desert, Pakistan. *Pak. J. Bot*., 42(4): 2359-2367.

Nazir, A. and Z. H. Malik. 2006. Life form and index of similarity of plant communities recorded at Sarsawa hills district Kotli. *J. Res. Sci*., 17(1): 27-33.

Negi, S. P. 2009. Forest Cover in Indian Himalayan states, An Overview. *Indian Journal of Forestry*, 32(1):1-5.

Noroozi, J., H. Pauli, G. Grabherr and S. Breckle. 2011. The subnival–nival vascular plant species of Iran: a unique high-mountain flora and its threat from climate warming. *Biodiversity and Conservation*, 20(6), 1319-1338.

Nwalo, N. F. 2010. Rate of water absorption and proximate analysis of different varieties of maize cultivated in Ikwo Local Government Area of Ebonyi State, Nigeria. *African Journal of Biotechnology*, 9 (52): 8913-8917.

Nyamangara, M. E. and L. R. Ndlovu. 1995. Feeding behaviour, feed intake, chemicals and botanical composition of the diet of indigenous goats raised on natural vegetation in a semiarid region of Zimbabwe. *J. Agri. Sci*., 124: 455-461.

Ohlemuller. R., S. Walker and J. B. Wilson. 2006. Local vs regional factors as determinants of the invisibility of indigenous forest fragments by alien plant species. *Oikos*, 112: 493-501.

Ohsawa, M., R. Tezuka and M. Numata. 1973. Altitudinal distribution of forest vegetation of Mt. Poroshiri, the Hidaka range, Kokkaido, Japan.*Mem Aatl. Sci. Mus (Tokyo*), 6:183-200.

Olson, B. E. and J. H. Richards. 1989. Crested wheatgrass growth and replacement following fertilization, thinning, and neighbor plant removal. *J. of Range Mang*., 42(2): 93-97.

Omer, R. M., A. J. Hester, I. J. Gordon, M. D. Swaine and S. M. Raffique. 2006. Seasonal changes in pasture biomass, production and off take under transhumance system in Northern Pakistan. *Jour. Arid Environments*, 67: 641-660.

Onwordi, C. T., A. M. Ogungbade and A. D. Wusu. 2009. The proximate and mineral composition of three leafyvegetables commonly consumed in Lagos, Nigeria. *African Journal of Pure and Applied Chemistry*, 3 (6): 102-107.

Oosting, H. J. 1956. The Study of Plant Communities, 2nd edition, 69–78. W.H. Freeman and Co., Sanfrancisco.

Osem, Y., A. Perevolotsky and J. Kigel. 2004. Site productivity and plant size explain the response of annual species to grazing exclusion in a Mediterranean semi-arid rangeland. *Journal of Ecology*, 92: 297–309.

Osuga, I. M., C. C. Wambui, S. A. Abdulrazak, T. Ichinohe and T. Fujihara. 2008. Evaluation of nutritive value and palatability by goats and sheep of selected browse foliages from semiarid area of Kenya. *Animal Science Journal,* 79: 582–589.

OTA (Office of Technology Assessment, U.S.Congress). 1987. Technologies to Maintain Biological Diversity. OTA-F-330. U.S. Government Printing Office, Washington, DC.

Ozturk, M., I. Uysal, S. Gücel, T. Mert, E. Akcicek and S. Celik. 2008. Ethnoecology of poisonous plants of Turkey and Northern Cyprus. *Pak. J. Bot*., 40(4): 1359-1386.

Pacala, S. W. and M. J. Crawley. 1992. Herbivores and plant diversity. *Am.Nat*., 140(2):243-260.

Palkova, K. and J. Leps. 2008. Positive relationship between plant palatability and litter decomposition in meadow plants. *Community Ecology*, 9(1): 17-27.

Panhwar, A. Q. and H. Abro. 2007. Ethnobotanical studies of Mahal Kohistan (Khirthar National Park). *Pak. J. Bot*., 39(7): 2301-2315.

Papachristou, T. G., A. S. Nastis, R. Mathur and M. R. Hutchings. 2003. Effect of physical and chemical plant defenses on herbivory: implications for Mediterranean shrubland management. *Basic Appl. Ecol*., 4(5):395-403.

Parthasarathy, N. and R. Karthikeyan. 1997. Biodiversity and population density of woody species in a tropical evergreen forest in Courtallun reserve forest, Western Ghats. Ind. *Trop. Ecol*., 38(2): 297-306.

Parveen, A. and M. I. Hussain. 2007. Plant biodiversity and phytosociological attributes of Gorakh Hill (Khirthar Range). *Pak. J. Bot*., 39(3): 691-698.

Parveen, A., G. R. Sarwar and I. Hussain. 2008. Plant biodiversity and phytosociological attributes of Dureji (Khirthar range). *Pak. J. Bot*., 40(1): 17-24

Peer, T., J. P. Gruber, A. Millingard and F. Hussain. 2007. Phytosociology, structure and diversity of the steppes vegetation in the mountains of Northern Pakistan. *Phytocoenologia*, 37: 1-65.

Peet, R. K. 1974. The measurement of species diversity. A. Rev. *Ecol. Syst*., 5: 258- 307.

Pichi-Sermolli, R. 1948. An index for establishing the degree of maturity in plant communities. *J. Ecol*., 36: 5 – 90.

Pielou, E. C. 1966. The measurement of diversity in different types of biological collections. *J. Theoret. Biol*., 13: 131-144.

Pielou, E. C. 1975. Ecological diversity. Wiley, New York.

Pfister, J. A. and J. C. Malechek. 1986. Dietary selection by goats and sheep in a deciduous woodland of North Eastern Brazil. *J. Range Mange*., 39: 24-28.

Pook, E. W. and A. M. Gill. 1993. Variation of Live and Dead Fine Fuel Moisture in *Pinus radiata* Plantations of the Australian-Capital-Territory. *International Journal of Wildland Fire,* 3(3) 155 – 168.

Provenza, F. D. 1995. Post ingestive feed back as an elemental determinant of food reference and intake in ruminants. *J. Range Manage*., 48: 2-17.

Putten, W. H. V., M. Mace and M. E. Visser. 2010. Predicting species distribution and abundance responsed to climate change: why it is essential to include biotic interactions across trophic levels. *Phil. Trans. R. Soc. B*., 365(15): 2025-2034.

Qadir, S. A. and O. A. Shetvy. 1986. Life form and leaf size spectra and phytosociology of some Libyan plant communities. *Pak. J. Bot*., 18(2): 271-286.

Qureshi R., M. Maqsood, M. Arshad and A. K. Chaudhry. 2011. Ethnomedicinal uses of plants by the people of Kadhi Areas of Khushab, Punjab, Pakistan. *Pak. J. Bot*., 43(1): 121-133.

Qureshi, R. 2008a. Preliminary floristic list of chotiari wetland complex, Nawab Shah, Sindh, Pakistan. *Pak. J. Bot*., 40(6): 2281-2288.

Qureshi, R. 2008b. Vegetation assessment of Sawan wari of Nara desert, Pakistan. *Pak. J. Bot*., 40(5): 1885-1895.

Qureshi, R. and G. R. Bhatti. 2008. Diversity of micro-habitats and their plant resources in Nara Desert, Pakistan. *Pak. J. Bot*., 40(3): 979-992.

Qureshi, R. and G. R. Bhatti. 2010. Floristic Inventory of Pai Forest, Nawab Shah, Sindh, Pakistan. *Pak. J. Bot*., 42 (4): 2215-2224.

Qureshi, R. and M. Ahmad. 2010. Some notes on the vegetation of Achhro thar (white desert) of Nara region, Sindh, Pakistan. *Pak. J. Bot*., 42(5): 2985-2994

Qureshi, R., W. A. Khan and B. Khan. 2009. Study of vegetation and smooth coated otter in Chotiari wetlands complex, Sanghar, Sindh, Pakistan. *Pak. J. Bot*., 41(5): 2507-2516.

Rafiq, M. K., J. Afzal, A. W. Jasra, I. Ahmad, T. N. Khan and M. U. Farooq. 2010. Foraging preferences of free-ranging sheep and goats on the native vegetation of Rangelands of Pubbi Hills in Pakistan. *Int. J. Agric. Biol*., 12: 944–946.

Ragunathan, M. and S. M. Abey. 2009. Ethnomedicinal survey of folk drugs used in Bahirdar Zuria district, Northwestern Ethiopia. *Indian Journal of Traditional Knowledge*, 8(2): 281-284.

Rahbek, C. 2005. The role of spatial scale and the perception of large-scale species richness patterns. *Ecology Letters*, 8: 224–239.

Rahim, I. U., J. I. Sultan, M. Yaqoob, H. Nawaz, I. Javed and M. Hameed. 2008. Mineral profile, palatability and digestibility of marginal land grassesof trans-Himalayan Grasslands of Pakistan. *Pak. J. Bot*., 40(1): 237-248.

Ram, J. and P. Arya. 1991. Plants forms and vegetational analysis of an alpine meadow of Central Himalaya, India. *Proceeding of Indian National Science Academy,* 57: 311-318.

Rasool, E., A. Rehman and Ihsanullah (2005). Livestock feed resources: A case study in Asghra-Wazulum Valley, Balochistan. On line Document. http://cnrit.edu/conf/isnh/post- online/post 0110. dated 24-6-2005.

Raunkiaer, C. 1934. The life forms of plants and statistical plants Geography. Clarendon Press Oxford. pp. 623.

Razaq, A., A. Rashid, H. Ali, H. Ahmad and M. Islam. 2010. Ethnomedicinal potential of plants of Changa Vally district Shangla, Pakistan. *Pak. J. Bot*., 42(5): 3463-3475.

Reddy, C. S. and C. Pattanaik. 2009. An assessment of floristic diversity of Gandhamardan Hill Range, Orissa, India. *Bangladesh J. Plant Taxon*, 16(1): 29-36.

Reddy, S. R., A. M. Reddy, N. S. Philomina and N. Yasodamma. 2011. Ethnobotanical survey of Sheshachala hill range of Kadapa district, Andhra Pradesh, India. Indian *Journal of Fundamental and Applied Life Sciences*, 1(4): 324-329.

Rehman, A. and M. Z. Iqbal. 2008. Level of heavy metals in the foliage of naturally growing plants collected from Korangi and Landhi Industrial Areas of Karachi city, Pakistan. *Pak. J. Bot*., 40(2): 785-789.

Rehman, W. 1997. Bee flora at Peshawar. *Pak. J. For*., 47: 53-58.

Rethy, P., P. Sing, R. Kagyung and P. R. Gajurel. 2010. Ethnobotanical studies of Dehang-Debang Biosphere Reserve of Arunachal Prad esh with special reference to Memba tribe. *Indian Journal of Traditional Knowledge,* 9(1): 61-67.

Rozenzwieg, M. L. 1968. Net primary production of terrestrial communities: prediction from climatological data. *Amer. Nat*., 102: 67- 74.

Rutherford, M. C. 1980. Annual plant production, precipitation relations in arid and semi-arid regions. *S. Afr. J. Sci*. 76: 53-56.

Saidu, A. N. and N. G. Jideobi. 2009. The proximate and elemental analysis of some leafy vegetables grown in Minna and Environs. *Journal of Applied Science & Environmental Management*, 13(4): 21-22.

Saima, S., A. A. Dasti, F. Hussain, S. M. Wazir and S. A. Malik. 2009. Floristic compositions along an 18 – Km long transect in Ayubia National Park district Abbottabad, Pakistan. *Pak. J. Bot*., 41(5): 2115-2127.

Sakya, S. R. and A. M. S. Bania. 1998. Natural vegetation of Chandragiri region. *Ecoprint.*, 5(1):41-56.

Saleem, A., S. N. Mirza, I. A. Khan and J. Franklin. 2009. Effect of diverse ecological conditions on biomassproduction of Themeda triandra (Kangaroo grass) at various growth stages, *African Journal of Biotechnology*, 8 (7): 1233-1237.

Saleem, M. 1993. Ecology of *Chrysopogon aucheri* and *Cymbopogon jwarancusa* Morphology and defoliation response. *Pak. J. For*., 43:106-118.

Santos, J. P., E. L. Araujob and U. P. Albuquerque. 2008. Richness and distribution of useful woody plants in the semi-arid region of north eastern Brazil. *Journal of Arid Environments,* 72 (5): 652–663.

Saputera, M., R. Djumali, K. Sapta, B. S. Leonardus, D. Iswantini. 2006. Gas chromatography and gas chromatography-mass spectrometry analysis of Indonesian Croton tiglium seeds. *J. App. Sci*., 6(7): 1576-1580.

Sardar, A. A. and Z. Khan. 2009. Ethnomedicinal studies on plant resources of Tehsil Shakargarh, District Narowal, Pakistan. *Pak. J. Bot*., 41(1):11-18.

Sasaki, T., T. Okayasu, K. Takeuchi, U. Jamsran and S. Jadamba. 2005. Patterns of floristic composition under different grazing intensities in Bulgan, South Gobi, Mongolia. *J. Grassland Sci*., 51(3): 235-242.

Saxena, A. K., P. Pandey and J. S. Singh. 1982. Biological Spectrum and other structural functional attributes of the vegetation of Kumaun Himalaya, *Vegetatio,* 49 (1): 111-119.

Saxena, A. K., P. Pandey and J. S. Singh. 1987. Altitudinal variation in the vegetation of Kaumaun Himalaya. *Perspective in Env. Bot*., 44-66.

Saxena, A. .K. and J. S. Sing.1982. A phytosociological analysis of woody plant species in forest communities of a part of Kumaun Himalaya. *Vegetatio*, 50: 3-22.

Saxena, S., P. K. Maulik, P. Sharan, I. Levav and B. Saraceno. 2004. Mental Health Research on Low- and Middle-Income Countries in Indexed Journals: a Preliminary Assessment. *J Ment Health Policy Econ*. 7: 127-131.

Scurlock, J. M. 0. and D. O. Hall. 1990. The Contribution of Biomass to Global Energy Use (1987). *Biomass*, 21: 75-81.

Shah, G. M., M. A. Khan, .M. Ahmad, M. Z. and A. A. Khan. 2009. Observations on antifertility and abortifacient herbal drugs. *African Journal of Biotechnology*, 8 (9): 1959-1964.

Shah, S. M. and F. Hussain. 2008. Ecology of wetlands of Akbarpura, District Nowshera. *Pak. J. Pl. Sci*., 14 (1): 47-57.

Shah, S. M., W. Mohammed and M. M. Iqbal. 1986. Micro-nutrient status of the soils of the Frontier Regions. *Pak. J. Sci. Ind. Res*., 29(4): 288-90.

Shaheen, H. and R. A. Qureshi. 2011. Vegetation types of Sheosar lake and surrounding landscape in Deosai plains of North Pakistan, Western Himalayas. *Journal of Medicinal Plants Research*, 5(4): 599-603.

Shaheen, H., R. A. Qureshi and Z. K. Shinwari. 2011. Structural diversity, vegetation dynamics and anthropogenic impact on lesser himalayan subtropical forests of Bagh District, Kashmir. *Pak. J. Bot*., 43(4): 1861-1866.

Shameem, S. A., N. I. Kangroo and G. A. Bha. 2 011. Comparative assessment of edaphic features and herbaceous diversity in lower Dachigam national park, Kashmir, Himalaya. *Journal of Ecology and the Natural Environment*, 3(6): 196–204.

Shannon, C. E. and W. Wiener. 1949. The mathematical theory of communication. Urbana, University of Illinois Press, 177 p.

Sharma, K. P. and B.P. Upadhyaya. 2002. Phytosociology, primary production and nutrient retention in herbaceous vegetation of the forestry arboretum on the Aravalli hills at Jaipur. *Tropical Ecology*, 43(2): 325-335.

Sharma, R. K., M. Agrawal and F. Marshall. 2006. Heavy metals contamination in vegetables grown in wastewater irrigated areas of Varanasi, India. *B. Environ. Contam. Tox*., 77: 312-318.

Shaukat, S. S. and D. Khan. 1979. A comparative study of the statistical behavior of diversity and equitability indices with reference to desert vegetation. *Pak. J. Bot*., 11:155-165.

Shaukat, S. S. M. A. Kheri and M. A. Khan. 1978. The relationships amongst dominance, diversity and community maturity in desert vegetation. *Pak. J. Bot*., 10(2): 183-196.

Sher, H. and F. Hussain. 2009. Ethnobotanical evaluation of some plant resources in Northern part of Pakistan. *African Journal of Biotechnology*, 8 (17): 4066-4076.

Sher, H., F. Hussain and H. Sher. 2010. Ex-situ Management Study of Some High Value Medicinal Plant Species in Swat, Pakistan. *Ethnobotany Research & Applications*, 8:017-024.

Sher, Z. and Z. Khan. 2007. Floristic Composition, Life Form and Leaf Spectra of the vegetation of Chagharzai Valley, District Buner. *Pak. J. Pl. Sci*., 13 (1): 57-66.

Sher H. and M. Alyemeni 2011. Economically and Ecologically Important Plant Communities in High Altitude Coniferous Forest of Malam Jabba, Swat, Pakistan. *Saudi J. Biol. Sci*., 18(1): 53-61.

Sher, Z., Z. D. Khan and F. Hussain. 2011. Ethnobotanical studies of some plants of Chagharzai valley, District Buner, Pakistan. *Pak. J. Bot*., 43(3): 1445-1452.

Shimwell, D. W. 1971. The Description and Classification of Vegetation Sedgwick and Jackson, p: 322. London.

Shingare, M. S., M. Khan and R. Zafar. 2003. Quantitative estimation of free and combined form of aloe emodin, chrysophanol, emodin and rhein in *Cassia pumila* Lamk by TLC caloricmetric method. *Hamdard Medicus*, 66(3): 49 – 52.

Shinwari, Z. K. 2010. Medicinal plants research in Pakistan. *Journal of Medicinal Plants Research,* 4(3): 161-176.

Shinwari, Z. K., T. Watanabe, M. Rehman and T. Youshikawa. 2006. A Pictorial Guide to medicinal plants of Pakistan.

Siddiqui, K. M. and M. Ayaz, 1997. Properties of Pakistani timber, Pakistan Forest Institute Peshawar.

Siddiqui, M.F., M. Ahmed, M. Wahab and N. Khan. 2009. Phytosociology of *Pinus roxburghii* Sargent (Chir Pine) in lesser Himalayan and Hindu Kush range of Pakistan. *Pak. J. Bot.,* 41(5): 2357-2369.

Singh, V. and R. P. Pandey. 1998. Ethnobotany of Rajasthan, India, (Scientific Publishers, Jodhpur).

Singh, A. 2011. Natural vascular floristic composition of Banaras Hindu University, India:An overview. *International Journal of Peace and Development Studies*, 2(1): 13–25.

Singh, S. P., P. Sah, V. Tyagi and B. S. Jina. 2005. Species diversity contributes to productivity. Evidence from natural grassland communities of the Himalaya. *Curr. Sci*., 89: 548-552.

Smart, A. J., B. Dunn and R. Gates. 2005. Historical weather patterns: A guide for drought planning. *Rangelands*, 27: 10-12.

Smit, C., J. D. Ouden and H. M. Schärer. 2006. Unpalatable plants facilitate tree sapling survival in wooded pastures. *Journal of Applied Ecology*, 43(2): 305–312.

Smuts, T. J. 1989. Production curves for the six most important grass species in the western part of the grassland biome. Potchefstroom: PU vir CHO, pp. 1-4.

Sobukola, O. P., O. M. Adeniran, A. A. Odedairo and O. E. Kajihausa. 2010. Heavy metal levels of some fruits and leafy vegetables from selected markets in Lagos, Nigeria. *Afr. J. Food Sci*., 4(2): 389-393.

Sobukola, O. P., S. O. Awonorin, M. A. Idowu and F. O. Bamiro. 2008. Chemical and physical hazard profile of 'robo' processing – A street vended melon snack. *Int. J. Food Sci. Technol*., 43(2): 237-242.

Solomon, T., H. A. Snyman and G. N. Smit. 2007**.** Rangeland dynamics in southern Ethiopia: (1) Botanical composition of grasses and soil characteristics in relation to land-use and distance from water in semi-arid Borana rangelands. *J. Env. Manage*., 85(2):429-442.

Sorenson, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species conent. *Det Kong Danske. Vidensk Selsk Boil. Skr. (Copenhagen)*, 5(4): 1- 34.

Sowemimo, A. A. C. Pendota, B. Okoh, T. Omotosho, N. Idika, A. A. Adekunle and A. J. Afolayan. 2011. Chemical composition, antimicrobial activity, proximate analysis and mineral content of the seed of *Detarium senegalense* J F Gmelin. *African Journal of Biotechnology*, 10(48): 9875-9879.

Spano, D., C. Cesaraccio, P. Duce, R. L. Snyder. 1999. Phenological stages of natural species and their use as climate indicators. *Int. J. Biometeorol*, 42: 124-133.

Sparks, T. H., E. P. Jeffree and C. E. Jeffree. 2000. An examination of relationship between flowering times and temperture at the national scale using long-term phonological record from the UK. *Int. J. Biometeorol*, 44: 82-87.

Ssegawa, P. and D. N. Nkuutu. Diversity of vascular plants on Ssese islands in Lake Victoria, central Uganda. *African Journal of Ecology*, 44(1): 22–29.

Starks, P. J., D. Zhao, W. A. Phillips and S. W. Coleman. 2006. Herbage mass, nutritive value and canopy spectral reflectance of bermudagrass pastures. *Grass and Forage Science*, 61(2): 101–111.

Stewart, R. R. 1972. An annotated catalogue of the vascular plants of West Pakistan and Kashmir. In Nasir, E. & S. I. Ali (eds.), Flora of West Pakistan 1028 pp. Fakhri Press, Karachi.

Stewart, R. R. 1982. History and exploration of plants in Pakistan and adjoining Areas (Nasir, E. and S.I. Ali, eds.) Pan Graphics, Islamabad, Pakistan.

Strickland, R. W. and K. P. Haydock. 1978. A comparison of twenty Digitaria accessions at four sites in south-east Queensland. *Aust. J. Experimental Agric. and Ani. Husbandry*, 18: 817-824.

Sultan J. I., I. Rahim, M. Yaqoob, H. Nawaz and M. Hameed. 2008b. Nutritive value of free rangeland grasses of Northern grasslands of Pakistan. *Pak. J. Bot.,* 40(1): 249-258.

Sultan, J. I., I. Rahim, H. Nawaz and M. Yaqoob. 2007. Nutritive value of marginal land grasses of northern grasslands of Pakistan. *Pak. J. Bot*., 39(4), 1071-1082.

Sultan, J. I., I. Rahim, H. Nawaz, M. Yaqoob and I. Javed. 2008a. Mineral composition, palatability and digestibility of free rangeland grasses of Northern Grasslands of Pakistan. *Pak. J. Bot.,* 40(5): 2059-2070.

Tabuti, J. R., S. S. Dhillion and K. A. Lye. 2003. Ethnoveterinary medicine for cattle (Bosindicus) in Buiamogicounty. Uganda: Plant species and mode of use. *Journal of Ethnopharmacoloy*, 88. 279-286.

Taiga, A., M. N. Suleiman, D. O. Aina, W. F. Sule and G. O. Alege. 2008. Proximate analysis of some dry season vegetables in Anyigba, Kogi State, Nigeria. *African Journal of Biotechnology*, 7 (10): 1588-1590.

Taj, S., S. M. Wazir, M. Subhan, M. Hassan, S. U. Khan and M. Kamal. 2009. Some of the ethnobotanically important plants of Godi Khel & its outskirts hilly areas, District Karak, Pakistan. *Pak. J. Pl. Sci.,* 15 (1): 39-43.

Toledo, G. and J. Salick. 2005. Secondary succession and indigenous management in semi deciduous forest fallow of the Amazon Basin. *Biotropica*, 38 (2): 161-170.

Toledo, G. M. 1996. Ethnobotanical study of the Chiquitanos from Lomerio, Santa Cruz, Bolvia, *Ecologia-En Bolivia*, 27: 31-47.

Townsend, C. R., J. L. Harper and M. Begon. 2000. Essential of Ecology. Blackwell Sci., Inc USA, pp. 354-387.

Turner, W. R., T. Nakamura, M. Dinetti. 2004. Global urbanization and separation of humans from nature. *Bio. Sci*., 54: 585-590.

Ubom, R. M. 2010. Ethnobotany and Biodiversity Conservation in the Niger Delta, Nigeria. *International Journal of Botany*, 6(3):310-322.

Ukoima, H. N., L. Ogbonnaya, G. E. Arikpo and G. A. Pepple. 2009. Nutritional, Organoleptic and Palatability Studies of Selected Edible Mushrooms in Nigeria. *World Applied Sciences Journal*, 7 (4): 479-484.

Ullah, R., Z. Hussain, Z. Iqbal, J. Hussain, F. Khan, N. Khan, Z. Muhammad, S. Ayaz, S. Ahmad, N. Rehman and I. Hussain. 2010. Traditional uses of medicinal plants in Darra Adam Khel NWFP Pakistan. *Journal of Medicinal Plants Research*, 4(17): 1815-1821.

Vissor, M. E. and C. Both. 2005. Shifts in phenology due to global climate change: the need for a yardstick. *Animal Ecology*, 272(15): 2561-2569.

Wahab, M., M. Ahmed and N. Khan. 2008. Phytosociology and dynamics of some pine forests of Afghanistan. *Pak. J. Bot*., 40(3): 1071-1079.

Wazir, S. M., A. A. Dasti, S. Saima, J. Shah and F. Hussain. 2008. Multivariate analysis of vegetation of Chapursan valley: an alpine meadow in Pakistan. *Pak. J. Bot*., 40(2): 615-626.

Wergerand, M. J. A. and G. A. Ellenbrock. 2004. Leaf size and leaf consistence of a reverine forest formation along a climatic gradient. *Oecologia*, 34(3): 297-308.

West, N. E. 1993. Biodiversity of Rangelands. *J. Range Manage*., 46:2-13.

Willoughby, M.G. 1996. Species diversity and how it is affected by livestock grazing on Alberta's Eastern Slopes. In West, N. E. (ed). Proc. Rangelands. In a sustainable biosphere, 5th International Congress 1995, Salt Lake City Utah. Pp. 610-611.

Winter, S., G. Chirici, R. E. Mcroberts, E. Hauk and E. Tomppo. 2008. Possibilities for harmonizing national foest inventorty data for use in forest biodiversity assessments. *Forestry*, 81(1):33-44.

Yadav, A. S. and S. K. Gupta. 2007. Effect of micro-environment and human disturbance on the diversity of herbaceous species in Sariska Tiger Project. *Tropical Ecology*, 48(1): 125-128.

Yadav, N., N. Vasudeva, S. K. Sharma and S. Singh. 2007. Pharmacognostic and phytochemical studies on *Chenopodium album* Linn., root. *Hamdard Medicus,* 50(1): 95 – 102.

Yao, J., B. Yan, X.Q. Wang and J.X. Liu. 2000. Nutritional evaluation of mulberry leaves tas feeds for ruminants. Livest. *Res. Rural Develop.,* 12: 9-16.

Yavari, A. and S. M. Shahgolzari. 2010. Floristic study of Khan-Gormaz protected area in Hamadan Province, Iran. *Int. J. Agric. Biol*., 12: 271–275.

Yousaf, M., M. A. Bellarbi and O. Berkat. 1996. Rangeland production and degree of utilization along an altitudinal gradient within the middle Atlas Morocco. In: West, N. (ed). Proc. Rangelands. In a sustainable biosphere. 5th International Cogress 1995, Salt Lake City, Utah. pp. 620-621.

Yousifzai, S. A., N. Khan, A. Iqbal, M. Wahab and M. F. Siddiqui. 2010. Ethnoveterinary studies of the medicinal plants of Marghazar valley Swat. *International Journal of Biology and Biotechnology*, 7(3): 273-279.

Yvan, O. and Z. Tessema. 2005. An assessment of grazing lands potentialities in Ordola surroundings (Erer districts) of Shinile zone. Handicap International, Dire Dawa, Ethiopia. pp.75.

Zabihullah, Q., A. Rashid and N. Akhtar. 2006. Ethnobotanical survey of Kot Manzary Baba valley, Malakand Agency, Pakistan. *Pak. J. Pl. Sci*., 12: 115-122.

Zafar, M., M. A Khan, M. Ahmad, S. Sultana, R. Qureshi and R. B. Tareen. 2010. Authentication of misidentified crude herbal drugs marketed in Pakistan. *J. Med. Plants Res*., 4(15): 1584-1593.

Zahoor, M., S. M. Wazir, A. Muhammad and S. F. Muhammad. 2009. Ethnobotany of some plants from Darra'e Pezo, District Lakki Marwat, Pakisan. *Pak. J. Pl. Sci.,* 15 (1): 75-80.

Zhao, C. M., W. L. Cheng, Z. Q. Tian and Z. Q. Xie. 2005. Altitudinal pattern of plant species diversity in Shennongjia Mountains. Central China. *J. Integrative. Plant Bio*., 47(12): 1431.

Zheng, Z., Z. Feng, M. Cao, Z. Li and J. Zhang. 2006. Forest Structure and Biomass of a Tropical Seasonal Rain Forest in Xishuangbanna, Southwest China. *Biotropica*, 38(3): 318–327

Zhu, J. J., C. F. Zhang, M. Zhang and Z. T. Wang. 2006. Studies on chemical constituents in roots of *Rumex dentatus. Zhongguo Zhong Yao Za Zhi*., 31(20): 1691 – 3.