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HOMEGARDENS: REFUGE TO VALUABLE FLORA OF CENTRAL KASHMIR, J&K, INDIA

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ABSTRACT

Vegetation composition of Homegarden in District Budgam revealed the presence of 14 genera, 17 species of 8 families of cultivated herbage, 20 genera having 21 species belonging to 17 families of wild herbage and 9 genera of 12 species representing 5 families of tree diversity. Seasonal variation in quantitative parameters explicated dominance of Brassica olearacea var. acephala and Brassica rapa during spring, summer and autumn respectively among cultivated herbage. However, Stellaria media amongst wild herbage was found to dominate the system during the three consecutive seasons. Malus domestica achieved highest Importance Value Index of 57.09 amongst other evaluated tree species.

Keywords: Homegarden, Flora, Quantitative attributes, Seasons, Kashmir

I.INTRODUCTION

The assessment of species diversity is crucial, since it represents a fundamental property of ecological communities and provides a tool to compare assemblages in time and space, independently from species identities (Guyassa and Raj, 2013). The floristic composition or plant diversity and community structure are important attributes correlated with prevailing environmental as well as anthropogenic variables (Gairola *et al*., 2008). Species diversity incorporates two important components viz., evenness (distribution of individuals over species/or how equally abundant the species within the land use system) (Neelamegam *et al*., 2015) and richness (number of species per unit area) (Sterling and Wilsey, 2001). These properties are related with micro-environmental conditions created by man, cultural and economic (commercial crops) factors, which interact to determine structure and composition of a land use system suggesting that this variation is basically idiosyncratic, although marginally dependent of environment (Asfaw *et al*. (2015); Pulido *et al*. (2008)). As rates of deforestation, land degradation, losses of biodiversity and ecosystem services continue to rise globally, the international community is faced with the challenge of finding land use interventions that can mitigate or reduce the impact of these environmental issues. In the past, the conservation of biodiversity has been mostly understood in terms of the management of protected areas and natural forests, ignoring the possible role of farm areas and the ways through which rural communities have promoted biodiversity in their subsistence agricultural production systems (Fifanou *et al*., 2011). Considering the

fact, that ecosystems and species are disappearing at an alarming rate, the role of agroforestry as a conservation tool needs to be exploited (Jose, 2011). Multistrata agroforests which may include homegarden, boundary plantation, horti-silviculture system, horti-agricultural system etc. contribute to biodiversity conservation via: (i) the provision of supplementary habitat for species that tolerate a lower level of disturbance; (ii) conservation of remnant native species; (iii) buffering the pressure on natural habitats; (iv) provision of corridors for persistence and movement of species across landscapes (Negash *et al*., 2012). In order to evaluate and summarize the flora in Homegarden agroforestry system, the present investigation was conducted in District Budgam, Kashmir Valley, India.

II.MATERIALS AND METHODS

The research study was conducted in Budgam District of Kashmir Valley, India during the year 2013 and 2014. The experimental site is located between 34°1′12″N latitude and 74°46′48″E longitude at an altitude of 1610 m above mean sea level (msl), roughly 15 km south east of Srinagar city. The topography of the district is mixed with both mountainous and plain areas. The climate is of the temperate type with the upper-reaches receiving heavy snowfall during winter. The average annual precipitation of the district is 585 mm. For present study, three tehsils namely: Budgam, Beerwah and Chadoora were selected to carry out the research problem. Multistage stratified random sampling was used to select the blocks; villages within tehsils and then farmers within villages. A total of 252 farmers were selected and interviewed through pre-tested questionnaire regarding different land use patterns (agriculture, agroforestry, horticulture) and their socio-economic status. The methodology of the experimental study is given in Table-1.

Table-1: Detailed methodology for the selection of sample areas

Selected Tehsils	**Beerwah**	**Budgam**	**Chadoora**
Selected Blocks (06)	2	2	2
Selected Villages (06 per Block)	6×2 = 12	6×2 = 12	6×2 = 12
Selected Farmers (7 per Village)	6×2×7 = 84	6×2×7 = 84	6×2×7 = 84
Grand Total	**252**		

2.1 Vegetation analysis

Random quadrats of 10m × 10 m size for trees and within each of these quadrats and two 1m × 1m quadrats for herbs (cultivated & wild) were laid down and replicated three times for each life form respectively. Herbarium specimens (herbaceous plants) were collected for three consecutive seasons viz; spring, summer and autumn (Saikia

et al., 2012) and identified from the Division of Environmental Sciences, SKUAST-Kashmir and Centre for Biodiversity & Taxonomy Department of Botany, University of Kashmir. The data on vegetation were quantitatively analyzed for density, basal area, frequency, Importance Value Index (IVI) separately for three different life forms i.e. trees and herb species as per the methodology of Curtis and Mc Intosh (1950). Species diversity (H), Species evenness following Shannon Weiner's method (1963) and Simpson's diversity measured from Simpson's index (Simpson, 1949) were calculated separately for each life form (herbs and trees) from density data as:

a)Shannon- Weiner Index: $H = -\sum (Ni/N) \times \ln (Ni/N)$

(H = Shannon - Weiner Index, Ni= Density of the species i, N = Total density of all the species)

b)Species Evenness: $E = H/\ln S$ (H = Shannon - Weiner Index, S = Total no. of species)

c)Simpson's Diversity (Simpson, 1949): $D = \sum n (n - 1)/N (N - 1)$

(D = Diversity index; n = Number of individual of a species; N = Number of individual of all the species).

2.2Statistical Analysis

Data was analyzed using descriptive statistics (MS excel work sheet) and by standard procedures given by Gomez and Gomez (1984).

III.RESULTS & DISCUSSION

3.1 Floristic diversity, community structure and composition in Homegarden of District Budgam

Plant diversity and/or floristic composition revealed the presence of 14 genera, 18 species of 8 families of cultivated plants (herbage) and 20 genera having 21 species belonging to 17 families of wild plants (herbage). Tree diversity comprised of 9 genera, 12 species representing 5 families. Floristic composition and community structure are important attributes correlated with prevailing environmental as well as anthropogenic variables (Bisht and Bhat, 2011). Vegetation stratas *viz*., herbage and trees recorded was quite lower than reported by Tynsong and Das (2010) in areca-nut based agroforestry of Meghalaya (88 woody species); 98 cultivated/ edible species by Eichemberg *et al*. (2009) in old urban homegardens in Brazil; 75 wild plants by Shameem and Kangroo (2011) for forest ecosystem in Dachigam National Park, Kashmir; 59 plant species evaluated by Ahmad and Habib (2014) for Dawarian Village, Neelum Valley, Azad Jammu and Kashmir, Pakistan.

Less vegetation diversity may be due to selective approach of landholders to grow plants that are required for their primary needs only. The motives for retaining different woody species depend on the uses or benefits that they render to the household and for income generation to some farmers, management strategy. As far as wild herbaceous species are concerned, about 20 plants were recorded in the system representing much lower than reported by various workers. This less species richness may be due to the more human interferences/disturbances, micro-climate

and edaphic conditions as also reported by Amjad (2015) and Lyaruu (2010).

3.2 Seasonal variation in quantitative attribute (IVI) of cultivated herbage

Importance value index (IVI) of cultivated herbage showed a marked variation from spring, summer to autumn season in the study area. Numeric values of importance value index (Table-2) revealed that the dominant species during spring and summer seasons was *Brassica oleracea var. acephala* with highest value of (42.84) and (44.68) followed by its co-dominants *Allium sativum* (34.71) and *Phaseolus vulgaris* (32.20) during two consecutive seasons respectively. Whereas, in autumn, *Brassica rapa* showed dominance over other species attaining maximum value (103.81) and *Brassica oleracea var. acephala* (73.71) as co-dominant. IVI measures the overall importance of a species and gives an indication of the ecological success of a species in a particular area (Mishra, 1968). Also, high importance value index (IVI) exhibited by any individual species may be due to the available resource being utilized efficiently (better adaptability) of a particular species under prevailing environmental conditions, market value (socio-economic factors), preference of the farmer, management intensity and families (at species level) often retain /or cultivate a large number of individuals for certain species that are commonly utilized by the households (Kabir and Webb, (2009)).

3.3 Seasonal variation in quantitative attributes of wild herbage

Perusal of the data in Table-3,4,5 and 6 revealed that density (individuals/ m^2) & basal area (cm^2/m^2) of wild herbage species increased gradually from spring to summer and declined in autumn season, while importance value index (IVI) showed an irregular increasing and decreasing pattern in subsequent seasons. With respect to species, *Stellaria media* exhibited highest value for density/m^2 as 9.17 (spring), 36.33 (summer) to 8.83 (autumn); basal area of 1.02 (spring), 1.16 (summer) and 0.77 (autumn) and IVI as 33.22 (spring), 27.60 (summer) and 60.46 (autumn). However, *Galinsoga parviflora* was observed to achieve lowest values for density, basal area and IVI. The marked variation among seasons may be attributed to the conducive growth and development conditions, availability of soil moisture for optimum nutrient flow in soil-plant system and other environmental factors i.e. humidity and solar radiation from spring onwards which later on decline with the commencement of autumn. During autumn season, the rate of sprouting of root/seed stock is diminished and species number declined owing to adverse climatic conditions (Abdullah *et al*., 2009). Dominance in terms of density, basal area and IVI of certain species in a particular season show better adaptation of that species to prevailing environmental conditions i.e. suitable edaphic and climatic conditions that favors growth and survival of species in a particular system (Nogues-Bravo *et al.*, 2008). The pattern of distribution depends both on physico-chemical natures of the environment as well as on the biological peculiarities of the organisms themselves and vegetative reproduction by certain species in addition to their sexuality (Ilorkar and Khatri, 2003). Other factors affecting the vegetation distribution include biotic such as dispersal limitation, competition, and predation (Wright, 2002). A close observation of IVI in Table-5 of different species showed that there was irregular increase and decrease of this parameter in subsequent seasons with highest

IVI values during autumn. It may be due to the reason that most of the available resources are being utilized by that species (having high IVI) and left over are being trapped by another species as the competitors and the associates i.e. their inter-relationships with ambient environment and associate species, light availability etc. IVI values can also be used to prioritize species for conservation, and species with high IVI value need less conservation efforts, whereas those having low IVI value need high conservation efforts (Molla and Kewessa, 2015).

3.4 Quantitative attributes of Trees

Detailed analysis of the data revealed that *Malus domestica* in the system explicated maximum density (66.67 ha^{-1}), basal area (0.57m^2 ha^{-1}), frequency (83.33%) and IVI (57.09), while as, lowest values were demonstrated by *Juglans regia* 6.66 ha^{-1}, 0.03 m^2 ha^{-1}, 8.34%, 7.22 for density, basal area, frequency and IVI respectively. Higher values for quantitative or phytosociological attributes of few trees may be due to ecological/environmental adaptability, farmers' preference for their subsistence requirement fulfillment and variety of multipurpose uses such as fuelwood, easy propagation and management, as cash crop (Rawat *et al*., 2010). As per the results summarized in Table-7, *Malus domestica* was found to explicate high IVI value because this fruit tree species have greater economic value i.e. it provides huge monetary benefits to farmers in addition to agricultural crops, good market value i.e. its great demand locally and country wide, long shelf life than other fruit tree species evaluated.

V.CONCLUSION

Homegarden in District Budgam currently serves as a repository of plant diversity and is comprised of comprehensive rich ecological niches as they preserve some of the valuable bioresources/medicinal plants like *Mentha arvensis*, *Rumex nepalensis*, *Taraxacum officinale*, which are in great demand in market for various therapeutic and commercial exploitation are listed as endangered/vulnerable in IUCN Red Data Book. Thus, this agroforestry system is gene pool of medicinal plants (lifesaving drugs) and also in real sense buffer for forests and protected areas. Creating awareness among farmers and local inhabitants about the importance of invaluable genetic diversity and sustainable use of resources can definitely lead to a secure future of these reservoirs.

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Table-2: Importance Value Index (IVI) of cultivated herbage in Homegarden of the study area (District Budgam)

S. No.	Plant species	Importance Value Index					
		Spring		Summer		Autumn	
		Mean	±S.E	Mean	±S.E	Mean	±S.E
1.	*Allium sativum* L.	34.71	1.69	-	-	-	-
2.	*Brassica oleracea var. gonglyonoides* L.	18.12	1.20	21.65	0.81	-	-
3.	*Brassica oleracea* var. *acephala* L.	42.84	1.49	44.68	1.51	73.71	7.51
4.	*Brassica rapa* L.	-	-	-	-	103.81	2.02
5.	*Capsicum annum* L.	23.11	1.64	21.90	1.43	-	-
6.	*Cucumis sativus* L.	19.85	2.75	20.25	0.20	-	-
7.	*Daucus carota* subsp. *sativus* Hoffm.	-	-	-	-	67.81	8.05
8.	*Lagenaria vulgaris* Standl.(Molina)	17.94	3.16	20.17	0.72	-	-
9.	*Phaseolus vulgaris* L.	27.98	2.55	32.20	1.55	-	-
10.	*Phaseolus* spp. (String/French beans) L.	-	-	27.31	1.23	-	-
11.	*Pisum sativum* L.	33.35	0.92	-	-	-	-
12.	*Raphanus sativus* L.	-	-	-	-	54.66	6.35
13.	*Solanum lycopersicon* L.	-	-	18.31	0.90	-	-
14.	*Solanum melongena* L.	-	-	13.60	0.30	-	-
15.	*Solanum tuberosum* L.	22.72	1.06	23.61	1.48	-	-
16.	*Spinacia oleracea* L.	-	-	7.28	0.22	-	-
17.	*Trigonella foenumgraecum* L.	20.75	1.08	-	-	-	-
18.	*Vicia faba* L.	24.64	0.37	31.16	1.91	-	-
19.	*Zea mays* L.	14.00	1.22	17.81	1.41	-	-
Total		**300.00**	-	**300.00**	-	**300.00**	-

Table-3: Density of wild herbage in Homegarden of the study area (District Budgam)

S. No.	Plant species	Density/m^2					
		Spring		Summer		Autumn	
		Mean	±S.E	Mean	±S.E	Mean	±S.E
1.	*Amaranthus caudatus* L.	4.67	0.64	21.67	4.32	3.00	0.87
2.	*Avena fatua* L.	3.00	0.50	14.83	2.19	2.33	0.04
3.	*Capsella bursa-pastoris* L.	3.00	0.73	16.33	3.17	2.33	0.41
4.	*Chenopodium album* L.	2.17	0.03	12.00	2.52	1.83	0.07
5.	*Conyza Canadensis* L. Cronquist	1.83	0.73	10.50	3.00	0.83	0.03
6.	*Galinsoga parviflora* Cav.	0.83	0.02	4.83	0.17	0.33	0.01
7.	*Galium aparine* L.	2.67	0.04	15.00	2.25	2.33	0.20
8.	*Kochia scoparia* L.	3.17	0.59	15.50	2.52	-	-

9.	*Malva neglecta* Wallr.	3.67	0.86	17.33	5.17	1.67	0.83
10.	*Mentha arvensis* L.	3.67	0.55	17.33	5.46	0.50	0.003
11.	*Oenothera rosea* L'Her.ex. Aiton	3.33	1.67	16.83	4.23	2.50	0.32
12.	*Plantago major* L.	6.50	2.02	30.17	0.83	2.33	0.33
13.	*Poa aungustifolia* L.	8.67	2.40	32.00	4.16	6.33	0.60
14.	*Poa bulbosa* L.	1.67	0.72	9.83	0.44	1.50	0.01
15.	*Portulaca oleracea* L.	2.00	1.04	11.83	1.48	-	-
16.	*Ranunculus muricatus* L.	1.83	0.93	10.33	0.60	0.83	0.03
17.	*Rumex nepalensis* Mill.	4.50	2.47	10.67	2.73	-	-
18.	*Stellaria media* L.(Vill.)	9.17	1.88	36.33	1.92	8.83	0.42
19.	*Taraxacum officinale* Weber	4.83	1.13	14.33	1.69	2.00	0.01
20.	*Veronica persica* L.	1.50	0.76	6.00	1.00	-	-
21.	*Viola oderata* L.	6.67	1.96	24.00	6.64	-	-
Total		**79.35**	-	**347.64**	-	**39.47**	-

Table-4: Basal area of wild herbage in Homegarden of the study area (District Budgam)

S. No.	**Plant species**	**Basal area(cm^2/m^2)**					
		Spring		**Summer**		**Autumn**	
		Mean	**±S.E**	**Mean**	**±S.E**	**Mean**	**±S.E**
1.	*Amaranthus caudatus* L.	0.35	0.02	0.41	0.04	0.14	0.04
2.	*Avena fatua* L.	0.34	0.07	0.39	0.01	0.13	0.010
3.	*Capsella bursa-pastoris* L.	0.27	0.08	0.31	0.12	0.12	0.09
4.	*Chenopodium album* L.	0.17	0.07	0.34	0.17	0.10	0.07
5.	*Conyza Canadensis* L. Cronquist	0.19	0.01	0.23	0.14	0.02	0.001
6.	*Galinsoga parviflora* Cav.	0.05	0.002	0.10	0.005	0.02	0.004
7.	*Galium aparine* L.	0.22	0.07	0.32	0.33	0.06	0.003
8.	*Kochia scoparia* L.	0.27	0.03	0.33	0.31	-	-
9.	*Malva neglecta* Wallr.	0.33	0.63	0.40	0.07	0.03	0.004
10.	*Mentha arvensis* L.	0.31	0.07	0.39	0.06	0.02	0.004
11.	*Oenothera rosea* L'Her.ex. Aiton	0.69	0.62	0.81	0.05	0.23	0.12
12.	*Plantago major* L.	0.73	0.04	0.89	0.09	0.20	0.04
13.	*Poa aungustifolia* L.	1.01	0.27	1.12	0.07	0.72	0.06
14.	*Poa bulbosa* L.	0.08	0.03	0.21	0.30	0.03	0.001
15.	*Portulaca oleracea* L.	0.23	0.002	0.39	0.17	-	-
16.	*Ranunculus muricatus* L.	0.18	0.02	0.21	0.006	0.03	0.002
17.	*Rumex nepalensis* Mill.	0.73	0.04	0.90	0.19	-	-
18.	*Stellaria media* L.(Vill.)	1.02	0.06	1.16	0.10	0.77	0.12
19.	*Taraxacum officinale* Weber	0.41	0.20	0.43	0.003	0.04	0.001

20.	*Veronica persica* L.	0.15	0.008	0.31	0.16	-	-
21.	*Viola oderata* L.	0.66	0.11	0.73	0.05	-	-
Total		**8.12**	-	**10.38**	-	**2.66**	-

Table-5: Importance Value Index (IVI) of wild herbage in Homegarden of the study area (District Budgam)

S. No.	**Plant species**	**Importance Value Index**					
		Spring		**Summer**		**Autumn**	
		Mean	**±S.E**	**Mean**	**±S.E**	**Mean**	**±S.E**
1.	*Amaranthus caudatus* L.	15.68	2.54	15.08	1.73	19.01	3.01
2.	*Avena fatua* L.	13.03	2.14	13.23	1.16	20.79	4.38
3.	*Capsella bursa-pastoris* L.	9.52	3.95	11.82	0.94	13.58	6.37
4.	*Chenopodium album* L.	9.24	4.31	12.20	1.38	15.57	3.76
5.	*Conyza Canadensis* L. Cronquist	9.96	0.21	9.60	1.00	7.27	0.61
6.	*Galinsoga parviflora* Cav.	3.15	0.33	4.02	0.13	2.34	2.03
7.	*Galium aparine* L.	10.19	2.59	11.60	1.23	14.70	2.83
8.	*Kochia scoparia* L.	9.74	1.08	12.93	1.16	-	-
9.	*Malva neglecta* Wallr.	10.95	4.51	14.10	1.66	13.40	2.82
10.	*Mentha arvensis* L.	14.49	2.31	13.15	3.56	6.46	0.32
11.	*Oenothera rosea* L'Her.ex. Aiton	14.48	5.73	17.87	1.31	19.80	9.41
12.	*Plantago major* L.	23.72	1.98	22.52	0.28	24.23	0.78
13.	*Poa aungustifolia* L.	30.17	1.86	25.77	1.06	50.06	3.98
14.	*Poa bulbosa* L.	4.62	0.74	10.09	1.04	9.14	0.28
15.	*Portulaca oleracea* L.	9.79	1.62	12.36	0.45	-	-
16.	*Ranunculus muricatus* L.	8.41	1.21	9.14	0.45	7.52	0.84
17.	*Rumex nepalensis* Mill.	19.26	6.38	15.86	2.44	-	-
18.	*Stellaria media* L.(Vill.)	33.22	1.23	27.60	0.44	60.46	11.64
19.	*Taraxacum officinale* Weber	18.47	2.41	13.54	0.47	15.60	5.98
20.	*Veronica persica* L.	7.87	1.13	9.94	0.93	-	-
21.	*Viola oderata* L.	23.93	4.57	17.50	2.53	-	-
Total		**300.00**	-	**300.00**	-	**300.00**	-

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Table-6: Quantitative attributes of Trees in Homegarden of the study area (District Budgam)

Quantitative attributes → / Tree species↓	Density (plants ha^{-1})		Basal area (m^2 ha^{-1})		Frequency (%)		Importance value index (IVI)	
	Mean	**±S.E**	**Mean**	**±S.E**	**Mean**	**±S.E**	**Mean**	**±S.E**
Cydonia oblonga Mill.	13.34	2.33	0.09	0.001	13.34	1.71	18.08	0.25
Juglans regia L.	6.66	0.60	0.03	0.01	8.34	1.90	7.22	4.55
Malus domestica Borkh.	66.67	1.61	0.57	0.03	83.33	0.34	57.09	6.41
Populus deltoides L.	26.66	1.32	0.50	0.01	60.00	0.67	44.50	1.24
Populus nigra L.	36.66	0.98	0.52	0.21	66.70	11.02	47.81	3.33
Prunus dulcis L.	10.00	0.21	0.11	0.03	46.70	3.65	16.33	4.56
Prunus persica L.	13.33	1.11	0.11	0.03	33.40	7.00	18.14	2.34
Punica granatum L.	26.66	1.22	0.08	0.005	33.40	11.12	22.71	11.98
Pyrus communis L.	13.33	0.45	0.12	0.02	33.40	0.45	13.02	0.34
Salix alba L.	13.33	0.15	0.19	0.009	58.33	2.34	33.73	10.10
Salix fragilis L.	10.00	0.15	0.13	0.01	33.40	0.94	12.15	0.45
Ulmus wallichiana L.	7.34	0.27	0.05	0.08	10.00	1.21	9.15	0.11
Total	**244.01**		**2.50**		**480.31**		**300**	