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Research Articles

Species composition, diversity and traditional uses of homegarden in Kumaun Himalaya, India

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ABSTRACT

The aim of present study was to analyse the status, plant diversity and their utilization in homegardens of Kumaun Himalaya. After the recognizance survey, 12 villages were selected in Hill and Bhabhar regions and in each village10 homegardens were selected for detailed study. Out of 120 selected homegardens, 51 were large (>0.004 ha), 42 were medium (0.001-0.004 ha) and 27 were small (<0.001 ha). A total of 70 plant species belonging to 35 families were recorded. Herb density was maximum in large sized homegardens (479 ind./ha) followed by medium (317 ind./ha) and small sized homegardens (249 ind./ha). Tree density was maximum in large (825 ind./ha) as compared to medium (750 ind./ha) and small sized homegardens (317 ind./ha). Similarly, frequency of species occurrence increased with increasing homegarden size. Shannon-Weiner Index for both herbs (H'= 3.65) and trees (H' = 2.51) were maximum in the large sized and minimum in small sized homegardens. Among the usable components, vegetable shared the half (50.78%) of the total plant diversity followed by fruits (22.57%), medicinal plants (18.03%), fodder (12.21%), fuel wood (7.35%) and ornamental species (1.43%) across all the homegardens in both the regions. *Mangifera indica, Artocarpus integrifolia*, *Litchi chinensis*, *Bohermaria olerosa* were the most frequent and dominant trees in all sized homegardens. This study suggested that large homegardens are more efficient than the small and medium sized homegardensand are ecologically, socially and economically diversified.

Key words: Floristic composition, Homegarden size, Plant utilization, Species diversity

Homegarden is a traditional land use practice around a homestead where several plant species are maintained by members of the household and their products are intended primarily for household consumption (Shrestha *et al.*2001, Vibhuti *et al.* 2018, Padalia *et al.* 2018, Bargali *et al.* 2019). The cultivation of fruits, vegetables and ornamentals in the homegardens has a long tradition in North-East India, especially among the hills of Uttarakhand, Assam, Manipur, Nagaland and Meghalaya. Homegardens provide cash income, nutrition, stability, integrity of the household, reflect the cultural and societal status of the owner. The combined effects of social, economic and cultural changes that are affecting the biophysical and socio-economic characteristics of the homegardens pose a threat of extinction of this age-old land use system (Kumar and Nair 2004, Bargali *et al.* 2015, Vibhuti *et al.* 2017, Bargali *et al.* 2018).

Growing number of species together in homegardens not only assure resources availability for food and medicine but also reveal invisible social mechanisms, maintenance of soil fertility and related resilience strategies by avoiding risk and reducing vulnerability as may be noticed generally in single crop cultivation (Buchmann 2009). Despite these contributions, only few studies have been undertaken on the homegarden system in Kumaun Himalyan region. The heterogeneity of crops and other vegetation in this agroforestry system as a whole is not known. Maintaining homegarden is a common practice in Kumaun Himalaya and almost every household in rural area including tribal community has a homegarden (Bargali 2016).

Because of differences in function of homegardens, these systems should also be expected to hold different potential to maintain plant diversity and utilization patterns. We therefore, predicted that plant diversity of homegardens and its uses varies depending on a combination of external and intrinsic factors that are mainly related to agro-ecology (climate, altitude, size of homegarden etc.) and socio-economic condition of the household. This study specially aimed to assess the plant diversity and utilization pattern of homegardens and to determine how altitude and homegarden size affect plant diversity and its uses in Hill and Bhabhar region of Kumaun Himalaya?

MATERIALS AND METHODS

The study sites were selected between 359-2189m amsl (at 29º19'-29º28' N and 79º22'-79º38' E) at Nainital, Kumaun Himalaya (2015-16).The study area falls in sub-

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tropical to temperate climate. The maximum and minimum temperature was 40.2ºC and -5.4ºC, respectively. The average rainfall in the district was 1407 mm.

Vegetation analysis: In Bhabhar and Hill region, 12 villages were randomly selected and in each village 10 homegardens were selected purposively as ultimate sampling unit for data collection. Homegardens were classified into three categories depending upon the size of homegarden holdings: large, medium and small. For the collection of phytosociological data the quadrat method was used. Trees and saplings were sampled in 10×10 m quadrat, shrubs in 5×5 m quadrat and seedlings and herbs in 1×1 m quadrat within each plot (Curtis and McIntosh 1950, Phillips 1959). Circumference at breast height (cbh at 1.37m from the ground) of individual tree and sapling was measured in each quadrat. The phytosociological parameters were calculated following Cottom and Curtis (1956). Species richness (Margalef 1958), Shannon's diversity Index (Shannon and Weiner 1963) and Simpson's Index (Simpson 1949) were also computed based on phytosociological data.

Index of similarity (IS) between homegardens was calculated (Muller–Dombois and Ellenberg 1974) using species richness in different homegardens as:

$$\text{Index of similarity (IS)} = \frac{2C}{A + B} \times 100$$

where; C, common species in comparison sites; A, total number of species in site A and B in site B.

RESULTS AND DISCUSSION

Status of homegardens: Out of 120 studied homegardens 51 were observed as large (>0.004 ha), 42 as medium (0.001-0.004 ha) and 27 as small (<0.001 ha) (Table 1). High and low concentration of dominance was variable in different homegardens due to anthropogenic pressure. Though, no specific planting pattern was observed, it was found that smaller plants were preferred in the front yard, while the boundaries and backyard of consisted of taller, upper storey fruits and other trees. The homegardens in the study area showed four distinct strata. In the Bhabhar region, strata A or canopy (15%) layer was composed of big trees (>3 m height), sub canopy layer or B strata (15%) was composed of middle size trees (2–3 m height), under canopy or C strata (6%) was composed of shrubs and saplings (1–2 m height) and ground vegetation (<1 m height) included herbs (crops+wild herbs), seedlings of both tree and shrub species (64%). In the Hill region, strata A or canopy (18%) layer was composed of big tree, sub canopy layer or B strata (16%) was composed of middle size trees, under canopy or C strata (5%) was composed of shrubs and saplings and ground vegetation included herbs, seedlings of both tree and shrub species (61%). The common tree species in the A strata were: *Mangifera indica, Artocarpus hetrophyllum, Bombex ceiba, Litchi chinensis, Syzygium cumini* and *Mallotus philippensis*. B strata were composed of *Carica papaya, Ficus hispida, Cinnamomum tamala, Citrus limetta, Malus domestica, Prunus dulis, Sarca asoca, Achras sapota. Morus alba, Elaeocarpus ganitrus* and *Punica granatum*. C strata were composed of *Psidium guajava* and *Prunus persica*. The shrub layer was composed of *Murraya koenigii* and the dominated plants in herb layer were *Ageratum conyzoides, Cynodon dactylon, Curcuma longa, Galinsoga parviflora, Stellaria media, Oxalis corniculata, Poa* sp. and *Zingiber officinale*. Tynsong and Tiwari (2010) also reported four distinct strata (canopy layer, sub canopy layer, under canopy layer and ground vegetation) in homegardens of Meghalaya.

Floristic composition and species diversity: A total of 70 plant species (22, trees; 1, shrub; 45, herbs; 1, pteridophyte and 1, gymnosperm) belonging to 35 families were recorded from the set of 120 surveyed homegardens. Brassicaceae, Cucurbitaceae, Fabaceae, Rosaceae and Poaceae were the dominant families with 5 species each. Solanaceae was represented by 4 species followed by Moraceae, Malvaceae and Rutaceae with 3 species each. Four families were represented by 2 species while 21 families were represented by single species only. Majority of species showing high density were vegetable crops and fruit plants and there was a remarkable similarity with respect to species composition among different homegardens. *Mangifera indica* was the most common tree species in the all homegardens. However, a high variability in density of plant species was noticed in different categories of homegardens (Table 2). Herb density was maximum in large homegardens (479 ind./m^2) followed by medium (316 ind./m^2) and small sized (249 ind./m^2). Tree density was maximum in large (825 ind. /ha) followed by medium (750 ind./ha) and small-sized (317 ind./ha). Similarly, frequency of species occurrence increased with increasing homegarden size. On the other hand, basal area of the tree species was maximum in large (24.33 m^2/ha) followed by medium (24.09 m^2/ha) and small sized (6.32 m^2/ha) homegardens (Table 2). Large sized homegardens were species rich (27 spp.) followed by medium (22 spp.) and small sized (13 spp.) (Table 2). Density and frequency of species increased with increasing homegarden size which showed the strong relationship between homegarden size and species diversity. Similar results were also observed by Kabir and Webb (2009),who reported strong relationship between homegarden size and species richness in the homegardens of Bangladesh.

Species diversity of trees (H'=2.51) and herbs (H'=3.65) were maximum in large sized homegardens as compared to medium and small sized. Concentration of dominance of trees (Cd=0.22) and herbs (Cd=0.56) were maximum in large sized homegardens and minimum was reported

Table 1 Homegarden (HG) category (Size range) and total area of sampled homegardens

Homegarden size (ha)	Small HGs (<0.001)	Medium HGs (0.001-0.004)	Large HGs (>0.004)
No. of HGs	27	42	51
Total areas of HGs	0.017	0.09	0.94

HGs=home gardens

Table 2 Community characteristics of homegarden (HG) categories

Parameter	Average	Hill	Bhabhar	Small HGs	Medium HGs	Large HGs
Number of families	9	8	9	13	22	27
Number of genera	14	12	16	12	26	33
Number of species	15	13	16	18	26	35
Herb density (ind./m^2)	348	346	350	249	316	479
Herb diversity (H')	3.15	3.14	3.15	2.73	3.04	3.65
Concentration of dominance of herbs (Cd)	0.30	0.15	0.45	0.18	0.22	0.56
Tree density (ind./ha)	630	661	600	317	750	825
Tree diversity	2.07	2.13	2	1.60	2.08	2.51
Concentration of dominance of trees (Cd)	0.26	0.26	0.25	0.36	0.18	0.22
Basal area of trees (m^2/ha)	19.57	16.4	22.73	6.32	24.09	24.33

by small sized (Table 2). Similarity Indices showed a high degree of similarity among different homegarden categories (Table 3).

Plant utilization patterns: The homegarden provide continuous food supply especially for the people living in the rural areas because of high production and diversity of cultivated edible plants. The majority of homegarden species were useful and utilized for different purposes. Among the usable components vegetable shared the half (50.78%) of the total plant diversity followed by fruit (22.57%), medicinal (18.03%), fodder (12.21%), fuel wood (7.35%) and ornamental (1.43%) purposes in overall homegardens. *Mangifera indica, Artocarpus integrifolia*, *Litchi chinensis*, *Bohermaria olerosa* were the most frequent and dominant trees in both the regions. Plants like *Carica papaya*, *Allium cepa, A. sativum, Artocarpus integrifolia, Coriandrum sativum* and *Musa paradisiaca* were cultivated as vegetable plants and fruit tree in majority of homegardens. Medicinal plants having different curative properties were abundant in all categories of homegardens. Most important were *Oxalis corniculata, Stellaria media, Equisetum* sp., *Cynodon dactylon, Ageratum conyzoides, Zingiber officinale, Curcuma longa* and *Galinsoga parviflora*. A few important fuel wood/fodder trees were *Grewia optiva, Mangifera indica, Ficus palmeta* and *Bombex ceiba*.The presence of fodder trees and grasses has a crucial value, which resulted in increased number of livestock and decrease in the livestock forage cost. A few ornament plants like *Auracaria* sp. and *Duranta* sp. were also maintained by the farmers.

The homegarden system is an intimate mix of diversified crops and multipurpose trees planted and maintained by family members (Bargali 2015, Parihaar *et al.* 2015). In India, there are studies which determine the importance and role of home gardens in the life of local people, especially in terms of livelihood and economic significance (Samati 2004, Das and Das 2005, Srivastava and Heines 2005, Tangjang and Arunachalam 2009, Tynsong and Tiwari 2010, Padalia *et al.* 2015, Pande *et al.* 2016, Vibhuti 2018).

A correlation analysis and PCA were carried out between frequency of variables (herbs, trees, saplings and seedlings) and their sites (Fig 2). The loading values of the first two principal components explain the contribution of each variable (Fig 1). The bold number means the variables load on that component (loadings >0.8). The F1 explains 46.71% and the F2 explain 72.61% of total variance.

Table 3 Similarity Index (%) for different homegarden (HG) categories

	Bhabhar	Hill	Large HGs	Medium HGs	Small HGs
Bhabhar	00.00				
Hill	45.45	00.00			
Large HGs	85.71	90.41	00.00		
Medium HGs	81.48	64.40	44.62	00.00	
Small HGs	60	73.01	30.76	79.06	00.00

This study suggested that large homegardens are more efficient than the small and medium sized homegardens. Species diversity of trees and herbs were maximum in the Bhabhar region as compared to Hill region and they are ecologically, socially and economically diversified. These homegardens could be considered as the potential units for maintaining species diversity and conserving plant

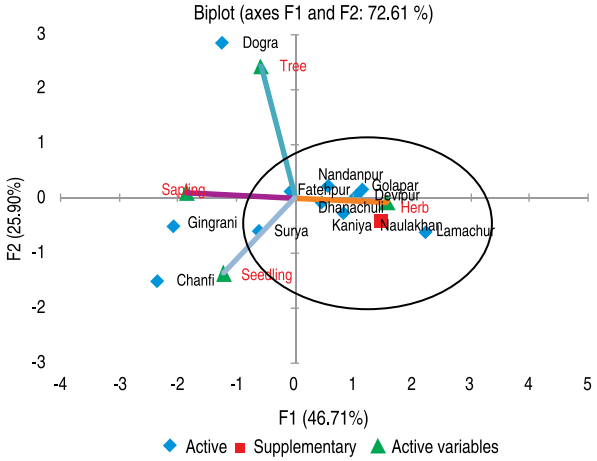

Fig 1 Principal component analysis between frequency of variables (herbs, trees, saplings and seedlings) and sites.

genetic resources and would become very important for food security.

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