Research Article

Diversity Indices of Home Garden Plants in Rural and Urban Areas in Kanyakumari District, Tamil Nadu, India.

R. Neelamegam*, S. Roselin, A. Mary Anishal Priyanka, V. Mathevan Pillai

P.G Department of Botany and Research Center, S.T Hindu College, Nagercoil -629 002, Tamil Nadu, India.

*Corresponding author

Dr. R. Neelamegam

Email: rnmegamsthcngl@gmail.com

Abstract: Various species diversity indices were estimated based on the survey carried out in the home gardens of two villages located one in rural area (Arumanalloor) near Nagercoil and another urban area (Konam) in town municipality of Nagercoil, Kanyakumari District, Tamil Nadu, India. In the study area, 128 home gardens (of which 66 were rural HGs and 62 were urban HGs, categorized into –hutted, tiled, terraced, storied, fenced and non-fenced) were surveyed for enumeration of available plants. The overall HG area surveyed in both rural and urban HGs was 17209.88m^2 (1.72ha.) with an average HG area of 134.45m2 (0.013ha). The number of species recorded in the HGs was 89 species belongs to 45 families comprises 80 genus. The higher indices of HG plants for rural and urban study area were determined as follows: Higher values of Shannon-Weiner's Species Diversity index (H'=4.079), Pielou's Index of Species Evenness (E=0.91), and Margalef Index for Species Richness (R=10.80), were noted in rural HGs than the urban HGs, but the Simpson's dominance index value (λ=0.045) was low. About 88.05% of Sorenson's species similarity index and 11.5% dissimilarity index (Ds) was noted between the rural and urban HGs species. The HG plants were grouped into different categories such as life forms, earthen/potted plants, cultivated/wild pants, useful parts and uses. Among the HG plant categories, the cultivated pants shows more species diversity, species evenness, species richness in overall HGs followed by rural HGs, but the Simpson's dominant index was recorded more in the cultivated plants of urban HGs.

Keywords: Home garden study, Urban & Rural Home gardens, Diversity Indices, Species Evenness, Species Richness, Similarity Index

INTRODUCTION

Home gardens are often comparable in terms of species diversity, with the nearby wet-evergreen and semi-evergreen forests [1]. They are also regarded as the informal experimental stations for transfer, trial and adaptation of domesticated species. According to Ninez [2], home gardens represent a genetic back stop, preserving species and varieties that are not common in field production and are planted in small scale for the reasons of taste preference, traditions or availability of planting material. Several land races, cultivars, rare and endangered species have been preserved in the home gardens [3, 4]. Most of the home gardens around the world have been studied for species diversity and species richness. The frequency count of individual species is the main basis used to understand species diversity in the home gardens. Today, plant species diversity was estimated using various diversity indices from the species inventory [5]. However, Shannon-Weaver Diversity Index (SWI) has also been used in some of the home garden studies for species diversity [6]. SWI is one of the simplest and most basically used diversity indices. It can express the diversity within the community and is generally used to compare the diversity of species. But SWI cannot explain whether

the species are abundant or not. However, the diversity of the particular location will be higher if the species are distributed equally or in abundant.

Simpson index can measure the dominance of the species at a particular community and give the measurement on whether the community is dominated by few species or not. But it lacks the information on which the species is dominant in the community. The equal abundant of the species in HGs can be measured through evenness index [7]. Margalef's index is used to express the species richness of the area. Zaldivar *et al.* [6] have used both SWI and evenness index to measure species diversity in GHs of Costa Rica. According to Sharmila Sunwar [7], the using Simpson's dominance index and evenness index with SWI are extremely important in measuring and explaining the species diversity in GHs. This measurement can help in better planning for both developmental interventions and on-farm conservation strategies at the community level. The present study carried out to record the species diversity level of home garden plant species in rural and urban areas at Nagercoil, Kanyakumari District, Tamil Nadu, India.

METHODOLOGY

Home garden survey was conducted from June 2013 to September, 2013 by field visits in the study area during the study period. The study area is distributed around Nagercoil at Kanyakumari District, Tamil Nadu. The area experiences a warm, humid climate having both southwest monsoons (June to September) and northeast (October to November). The mean minimum temperature ranges from 25°C to 32°C.

Home garden study was carried out in a total of 128 home gardens of rural (66 HGs from Arumanalloor (@8.3246603, 77.4034292) and Veeravanalloor (@8.3242463, 77.4077636) villages comes under Arumanalloor panchayat) and urban (62 HGs from Konam (@8.1567039, 77.3913739) village panchayat comes under Nagercoil municipality) areas. Selection of households was at random based on house type (hutted, tiled, terrace and multistoried). Each type of household was surveyed by the schedule (Questionnaire) methods [8, 9] for information on home gardens. The plant species were identified on the basis of vernacular names, published field inventories, floras, [10, 11], experts in plants and consulting available herbaria of the region.

Shannon-Weaver's Diversity Index values were calculated (Annexure Table-1) for the HG species using the following equation [12]: $H' = -\sum pi\ In\ pi$; where, 'pi' = proportion numbers of ith species i.e., pi = ni/N, i.e., 'ni' is the number of individuals of ith species; 'N' is the total number of individuals in all the species). The term 'pi In pi' is calculated and summed for each species in the community. With this index diversity increases as: species become more evenly distributed in abundance and more species are added to the community. The maximum value that the SWI can reach depends on the number of species in the community (maximum H' = In s).

Pielou's Index $\left(E = \frac{H'}{In\ (s)}\right)$ of Species Evenness [13, 14] was used to describe the diversity in terms of evenness, i.e., how equally abundant the species within the HGs. This standardizes evenness on the scale from '0 to 1'. The Simpson's index $\{\lambda = \sum_{i=1}^{s}(pi)^2\}$ was used to describe the dominance, i.e., the degree that a community is dominated by one or few common species. The index measures dominance on a '0 to 1 scale. If only one species is present in the community 'pi = λ = 1' will be the maximum value [7]. Species Richness Index (R) was estimated as per Margalef [15] was used to describe the species richness in the HGs surveyed by the equation:

$$\{R = \frac{S-1}{In\ (N)}\}$$

where, S = total number of species; N = total number of individuals of all the species.

Further, the Sorenson's Similarity Index [16] was used to record the similarity in species composition between two study areas following the equation:

$$Ss = \frac{No\ of\ common\ species}{Sa + Sb/2}\ x\ 100.$$

The dissimilarity index of rural and urban HG pants was determined by the equation of Ds =100-Ss, where, 'Ss' is the Sorenson similarity index.

RESULTS AND DISCUSSION

The total number of species in different categories was presented in the Figure 1. The HG survey indicates that more number of plant species (83sps.) was noted in rural HGs than in urban HGs (76sps). Among HG plant categories, more number of herbs in life forms; earthen plants; cultivated plants; whole plant uses; and ornamental plants were noted in both rural and urban HGs (Figure 1). In rural HGs, tree plants, earthen plants, cultivated plants, whole plant uses were dominated as compared to urban HGs where ornamental plants are more in number. Similar trend also observed in overall HGs also (Figure 1).

The number of individual plants of all species was more in rural HGs (2227no.) as compared to Urban HGs (1228no.). In general, the total number of individuals of all species was noted as 3455no. In rural HGs, more number of trees (782 no.), earthen plants (1788 no.), cultivated plants (1924 no.), whole plant uses (1548 no.), and multipurpose use plants (1548 no.) were noted than in the urban HGs (Figure 2). In general, the overall HGs in the study area exhibited more number of trees (1181no.), earthen plants (2590no.), cultivated plants (3047no.), whole plant utilization (2531no.) and multipurpose used plants (1173no.) as compared to other categories of plants (Figure 2).

Diversity indices estimated for HGs plant in rural and urban areas are presented in Table 1, Table 2 and Annexure Table I. The physiognomy of the HGs may be determined by species diversity of plants present in each HG [17]. The numbers of local plants present in the home gardens provide an obvious starting point in determining the amount of diversity [18]. Eichemberg *et al*. [17] estimated the Shannon-Wiener diversity index value as 1.66 for the older urban HGs in Rio Claro which included 86 species. In agro-forestry, HGs in Aripuana, plants from all the habits, were surveyed and their diversity corresponded to an index of 2.22 which represents high diversity [19]. In this study, it was estimated that the HG in the rural area contained higher species diversity (H'=3.977 with 83 species) as compared to urban HGs (H'=3.633 with 76 species) (Table 1). Tynsong and Tiwari [20] recorded a mean SWI of plant species as 2.37 which was considerably higher as compared to Cuba (1.79) [21] and central Sulawesi, Indonesia (2.32) [22] but comparatively much lesser than the mean SWI of areca nut agro-forestry (3.04) of south Meghalaya [23]. The mean SWI vary

widely in tropical HGs and are reported to range from
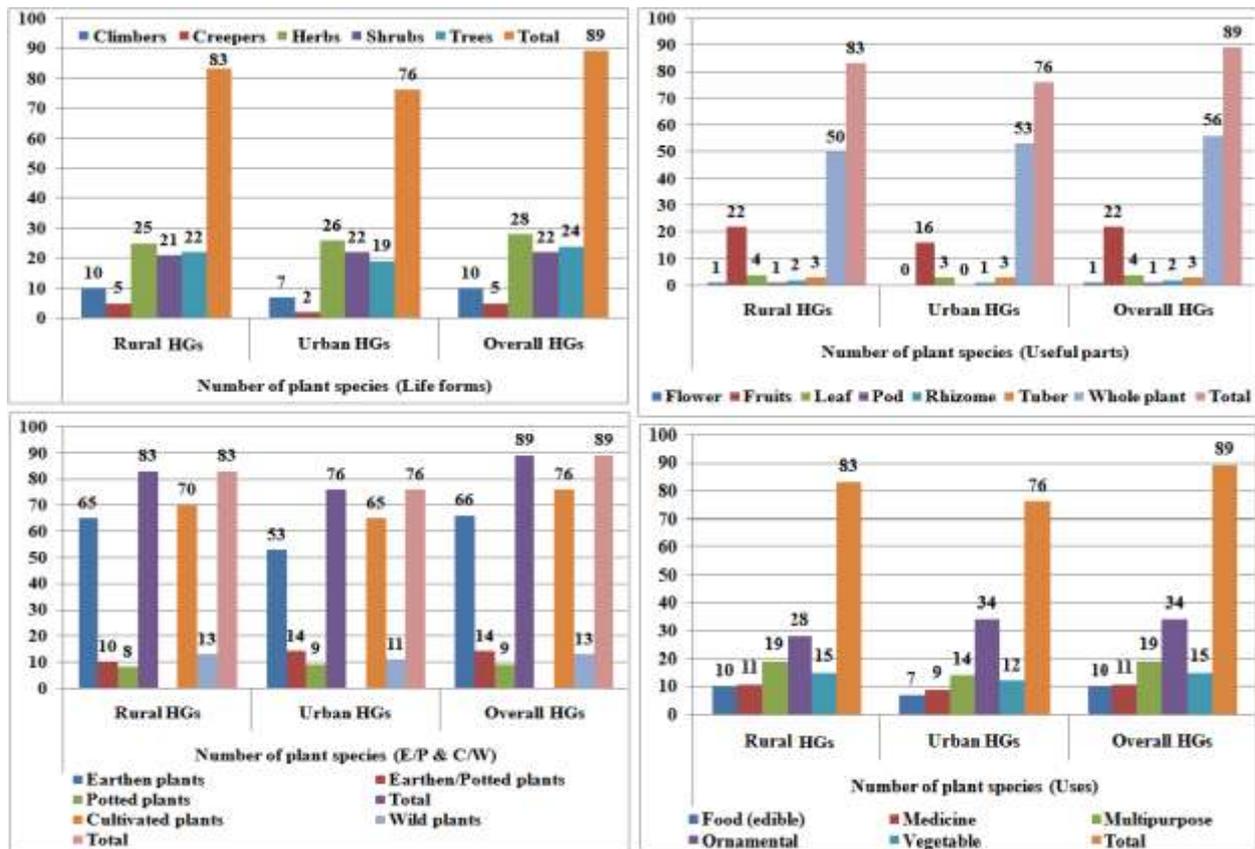0.93 to 3.00 [24] and from 0.69 to 4.01 [20].

Fig-1: Number of species in HG species distribution categories in rural and urban area HGs studied.
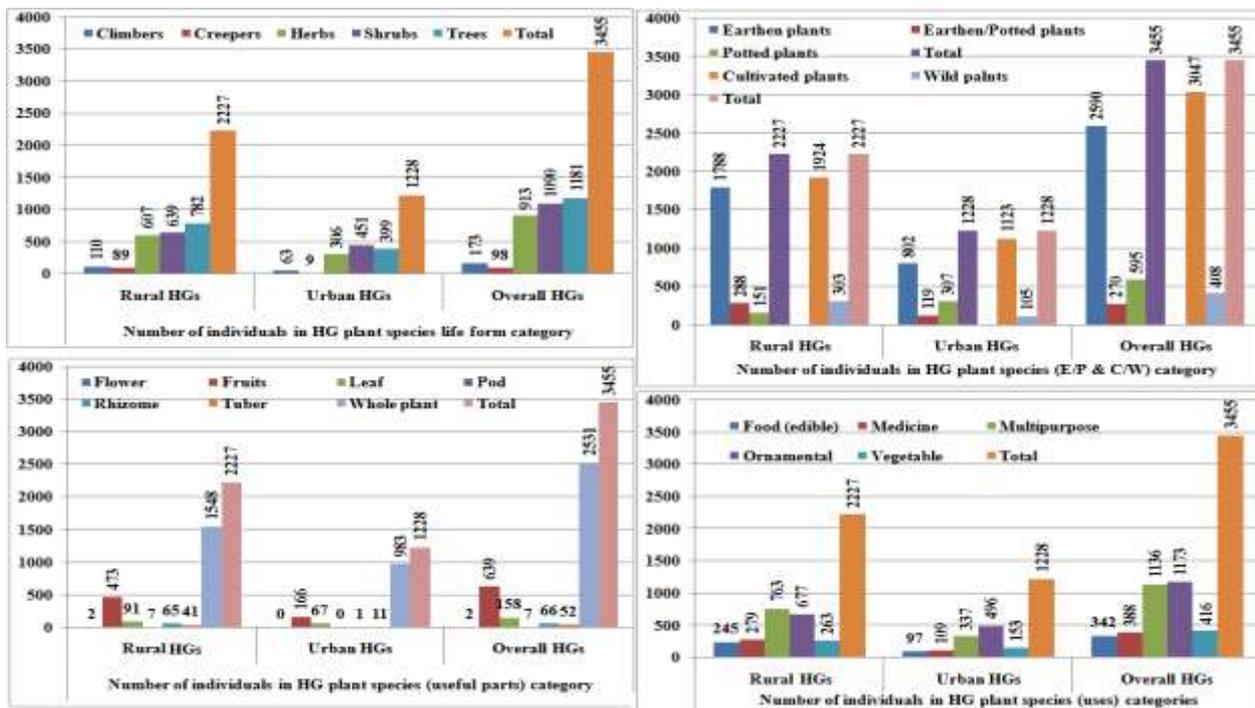

Fig-2: Number of individuals in each HG species distribution categories in rural and urban HGs studied.

Table-1: Diversity indices estimated for home garden in rural and urban areas of Kanyakumari District, Tamil Nadu.

Diversity Indices	Rural HGs	Urban HGs	Overall HGs
H'	3.977	3.633	4.079
E	0.900	0.839	0.909
λ	0.022	0.045	0.025
R	10.637	10.544	10.800
Ss	---	---	88.05%
Ds	---	---	11.95%
Number of species	83	76	89
Number of individuals in all species	2227	1228	3455

H'-Shannon-Weaver Diversity Index; E-Pielou's Index of Species Evenness; λ-Simpson's dominance Index; R-Margalef'sIndex of Species Richness; Ss- Sorenson's Similarity Index;

The species composition in rural HGs is more evenly distributed (E=0.900) as compared to urban HGs (E=0.839). Simpson index values indicate that there are more of few common species that have dominated in the HGs of urban area (λ=0.045 with 2227 individuals of a species) than in the rural HGs (λ=0.022 with 1228 individuals of all species). Similar observations were also made by Sharmila Sunwar [7] and Abiskar Subedi *et al.*, [25]. Thus, the home garden species found in rural village area have more diversity than those of the urban area HGs, due to high values of diversity (H'=3.977), evenness (E=0.900), species richness (R=10.64) and low values of dominance (λ=0.022). This may be due to diverse agro-geographical conditions in rural area creating different micro-environments suitable for diverse species to maintain in conditions and limited options available for the households to grow different HG species as suggested by Abishkar Subedi *et al*. [25]. Tynsong and Tiwari, [20] estimated evenness index and dominance index in five village HGs and evenness was ranged from 0.56 to 1.15 and the dominance was ranged from 0.06 to 0.26.

The Margalef's index of species richness values revealed that the species richness was higher in rural (R=10.64) than in urban (R=10.54) HGs, while it was higher (R=10.80) in overall HGs as compared to both study area. Out of 89 species recorded in the study area, 70 species were noted in both rural and urban HGs with a similarity index (Ss) of 88.05% and the dissimilarity index was 11.95% which comprises 13 species recorded only in rural area and 6 species noted in urban area alone (Table-1).

The HG plant species recorded were grouped into different categories such as life forms, earthen/potted, cultivated/wild, useful parts and uses. The distribution pattern of plants in these categories were analyzed and presented in table -2. Among the life forms, trees showed maximum diversity (H'=1.304), and evenness (E=0.422) values as compared to the urban and overall HGs surveyed, while the Simpson's dominance index was higher in the shrubs of urban area HGs (λ=0.02012) and the species richness were found more in the herbs of overall HGs (R=4.401) and is

followed by the herbs in urban HGs (R=4.368) as compared to other HG areas surveyed.

In habitat category, earthen plants reveals more diversity (H'=3.247), evenness (E=0.778) and richness (R=8.546) and low dominance index (λ=0.01830) in rural HGs as compared to urban and overall HGs. But, potted (or earthen/potted) plants in urban HG shows more species diversity, evenness, dominance and richness indices as compared to rural and overall HGs (Table 2). Higher plant diversity (H'=3.395), species richness R=9.124) and evenness (E=0.799) were noted in cultivated plants of rural area HGs than the urban HGs whereas the values of dominance index (λ=0.01980) are low (Table 2).

Based on useful parts, the maximum species diversity, evenness, richness and dominance index were recorded in the whole plant material used species in urban HGs and are followed by overall and rural HGs (Table 2). In case of uses category, ornamental plants reveals the maximum species diversity, evenness, and richness while the dominance index was more in the multi-purposely used species in urban HGs and are followed by overall and rural HGs (Table 2).

Thus, among the HG plant categories, the cultivated pants shows more species diversity, species evenness, species richness in overall HGs followed by rural HGs, but the Simpson's dominant index was recorded more in the cultivated plants of urban HGs. Kabir and Web [26] reported strong relationship between home garden sizes with species richness in Bangladesh HGs. According to Saikia *et al.* [27] high diversity and low concentration (density) of dominance in different HG categories may be due to variations in anthropogenic pressure in different HGs. They also noted that the average number of species per garden did not differ significantly among the HG categories, but density and frequency of species increased with decreasing HG size. With increase in household size, more varieties in species composition were also reported by Das and Das [28] in Barakvalley, Assam. This suggests that households maintain a diverse group of plants to fulfill their regular needs regardless of the

HG size. Diversity is selected according to the requirements of the families (at species level) and the home garden often contain a large number of individuals for certain species that are commonly utilized by the households. Management activities are carried out with minimal ecological cost, due to the low utilization chemical product. Species found in home gardens from the study area are used for primary and secondary needs of the household.

Table-2: Diversity indices estimated for home garden species based on their distribution in rural and urban areas of Kanyakumari District, Tamil Nadu.

Plant distribution categories	Diversity indices											
	H'			E			λ			R		
	Rural HGs	Urban HGs	Overall HGs	Rural HGs	Urban HGs	Overall HGs	Rural HGs	Urban HGs	Overall HGs	Rural HGs	Urban HGs	Overall HGs
I. Life forms												
i. Climbers	**0.243**	**0.242**	**0.248**	0.106	0.124	0.108	**0.00036**	**0.00057**	**0.00035**	1.915	1.448	1.746
ii. Creepers	**0.178**	**0.039**	**0.132**	0.111	0.056	0.082	**0.00053**	**0.00003**	**0.00024**	0.891	0.455	0.872
iii. Herbs	**1.070**	**1.048**	**1.176**	0.332	0.322	0.353	**0.00396**	**0.00459**	**0.00379**	3.745	4.368	4.401
iv. Shrubs	**1.183**	**1.275**	**1.270**	0.389	0.412	0.411	**0.00487**	**0.02012**	**0.00709**	3.096	3.436	3.003
v. Trees	**1.304**	**1.029**	**1.253**	0.422	0.349	0.394	**0.01195**	**0.02011**	**0.01391**	3.152	3.006	3.251
II. Habitat												
i. Earthen	**3.247**	**2.471**	**3.064**	0.778	0.622	0.731	**0.01830**	**0.02534**	**0.01912**	8.546	7.776	8.270
ii. Earthen/Potted	**0.544**	**0.791**	**0.679**	0.236	0.300	0.257	**0.00212**	**0.01771**	**0.00468**	1.589	1.674	1.429
iii. Potted	**0.185**	**0.371**	**0.336**	0.089	0.169	0.153	**0.00126**	**0.00237**	**0.00158**	1.395	2.270	2.034
III. Nature of Growth												
i. Cultivated	**3.395**	**3.232**	**3.543**	0.799	0.774	0.818	**0.01980**	**0.04452**	**0.02400**	9.124	9.112	9.349
ii. Wild	**0.582**	**0.401**	**0.536**	0.277	0.167	0.209	**0.00188**	**0.00089**	**0.00138**	2.100	2.149	1.996
IV. Useful part												
i. Flower	**0.007**	**---**	**0.007**	0.007	---	0.007	**0.00000**	**---**	**0.00000**	0.000	---	0.000
ii. Fruit	**0.934**	**0.593**	**0.854**	0.302	0.214	0.276	**0.00246**	**0.00215**	**0.00201**	3.410	2.934	3.251
iii. Leaf	**0.181**	**0.214**	**0.195**	0.131	0.195	0.141	**0.00014**	**0.00121**	**0.00072**	0.665	0.476	0.593
iv. Pod	**0.017**	**---**	**0.012**	0.017	---	0.012	**0.00001**	**---**	**0.00001**	0.000	---	0.000
v. Rhizome	**0.122**	**0.007**	**0.088**	0.176	0.007	0.127	**0.00042**	**0.00000**	**0.00018**	0.240	0.000	0.239
vi. Tuber	**0.091**	**0.051**	**0.071**	0.083	0.046	0.065	**0.00017**	**0.00003**	**0.00010**	0.539	0.834	0.509
vii. Whole plant	**2.625**	**2.767**	**2.851**	0.671	0.697	0.708	**0.01808**	**0.04202**	**0.02238**	6.671	7.547	7.019
V. Uses												
i. Food/Edible	**0.482**	**0.329**	**0.441**	0.209	0.169	0.192	**0.00136**	**0.00160**	**0.00126**	1.636	1.312	1.542
ii. Medicine	**0.542**	**0.392**	**0.503**	0.226	0.178	0.210	**0.00172**	**0.00121**	**0.00138**	1.776	1.705	1.678
iii. Multipurpose	**1.237**	**0.929**	**1.179**	0.420	0.352	0.400	**0.01213**	**0.01995**	**0.01394**	2.712	2.195	2.559
iv. Ornamental	**1.295**	**1.477**	**1.438**	0.389	0.419	0.408	**0.00473**	**0.01961**	**0.00679**	4.143	5.317	4.669
v. Vegetable	**0.420**	**0.505**	**0.518**	0.155	0.203	0.191	**0.00174**	**0.00304**	**0.00201**	2.512	2.187	2.321

H'-Shannon-Weaver Diversity Index; E-Pielou's Index of Species Evenness; λ-Simpson's dominance Index; R-Margalef's Index of Species Richness;

REFERENCES

1. Chandrashekara UM; Ecological and economic benefits of tree components in homestead forming systems of Kerala. In: P.P. Pillai & R.P. Nair (eds.) Understanding Ecologically Sustainable Economic Development. Institute of Planning and Applied Economic Research, Dr. John Mathai Centre, Thrissur, Kerala, 1995; 104-108.
2. Ninez VK; Household gardens: theoretical considerations on an old survival strategy. Agricultural Systems, 1987; 23: 167-186.
3. Watson JW, Eyzaguirre PB; (editors) Home gardens and in situ conservation of plant genetic resources in farming systems.

Proceedings of the second International Home Gardens Workshop, Witzen Hausen, Federal Republic of Germany, 2002.

4. Kumar BM, Nair PKR; The enigma of tropical home gardens. Agroforetry Systems, Kluwer Academic Publisher. 2004; 61: 135-152.

5. Powers EL, McSorley R; Ecological principles of Agriculture. In: Library of Congress Cateloging in Publication Data, 2000; 243-248.

6. Zaldivar ME, Roche OJ, Castro E, Barrantes R; Species diversity of edible plants grown in home gardens if Chibchan Amerindians from Costa Rica. In: Human Ecology, 2002; 30: 3.

7. Sunwar S; Does Shannon-Weaver Index explain the species diversity in home gardens? In: Home Gardens in Nepal: Proceeding of a workshop (eds.) 2006, Hautam R, Sthapit BR, Shrestha, PK, 6-7 August 2004; Pokhara, Nepal, 2004; 324: 66-71.

8. Chambers R, Pacey A, Thrupp LA; Farmer First: Formar Innovation and Agricultural Research, Intermediate Technology Publications, London, U.K., 1989.

9. Vogl CR, Vogl-Lukasser B, Puri RK; Tools and methods for data collection in ethnobotanical studies of home gardens. Field Methods, 2004; 16: 285-306.

10. Gamble JS; Flora of the Presidency of Madras. 3 volumes. Adlered & Son Limited, London, 1928.

11. Gamble JS, Fischer CEC; Flora of Presidency of Madras. Vol I-III (Repr.ed.) Botanical survey of India Culcutta, 1957.

12. Shannon CF, Wiener W; the Mathematical Theory of Communication. University of Illnois Press, Urbana, 1963; 117.

13. Pielou EC; Species diversity and pattern diversity in the study of ecological succession. J Theo Biol, 1966; 10: 370-383.

14. Nilima S, Sadika S, Vidyanand N; Diversity of soil fungi in a tropical deciduous forest in Mudumalai, Southern India. Curr Sci, 2007; 93: 67-669.

15. Margalef T; Temporal succession and spatial heterogeneity in phytoplankton. In: Buzatti-Traverso (Ed.) Perspective in Marine Biology. University of California Press, Berkeley, 1958; 323-347.

16. Sorenson T; A method of establishing groups of equal amplitude in a plant society based on similarity of species content. K. Danske Vidensk, 1948; 5:1-34.

17. Eichemberg MT, Maria Christina de Meo Amorozo, e Leila Cunha de Moura; Species composition and plant use in old urban home gardens in Ris Claro, southeast of Brazil. Acta bot Bras, 2009; 23(4): 1057-1075.

18. Hodgkin T; Home gardens and maintenance of genetic diversity. In: Watson JW, Eyzaguirre

PB, (eds.) Proceedings of the Second International Home Gardens Workshops: Contribution of home gardens to Insitu Conservation of plant genetic resources, Witzenhausen, Federal Republic of Germany, International Plant Genetic Resources, Rome, 2002.

19. Brito MA; In. Eichemberg MT, Maria Christina de Meo Amorozo, e Leila Cunha de Moura; Species composition and plant use in old urban home gardens in Ris Claro, southeast of Brazil. Acta bot Bras, 2009; 23(4): 1057-1075.

20. Tynsong H, Tiwari BK; Pant diversity in the homegardens and their significance in the livelihoods of War Khasi community of Meghalaya, Northeast India. Journal of Biodiversity, 2010; 1(1): 1-11.

21. Wezel A, Bender S; Plant species diversity of homegardens of Cuba and its significance for household food supply. Agroforestry Systems, 2003; 57: 39-49.

22. Kehlenbeck K, Maass BL; Crop diversity and classification of homegardens in central Sulawesi, Indonesia. Agroforestry Systems, 2004; 63: 53-62.

23. Tynsong H; Plant diversity and NTEF management on community forests of War area, Meghalaya. Ph.D., Thesis, Unpublished, Shillong, North-eastern Hill University, 2009.

24. Karyono; Homegardens in Java: their structure and functions. In: Landauer K, Brazil M; (eds.): Tropical Homegardens. Tokyo, Jappan, United Nations University Press, 1990; 138-146.

25. Abishkar Subedi, Rojee Suwa, Resham Gautam, Sharmila Sunwar, Pratap Shrestha; Status and composition of plant genetic diversity in Nepalese Home Gardens. In: Home Gardens in Nepal:Proceeding of a workshop (eds.) 2006, Hautam R, Sthapit BR, Shrestha, PK, Pokhara, Nepal, 2004.

26. Kabir ME, Web EL; Household and homegarden characteristics in South Western Bangladesh. Agroforestry Systems, 2009; 75: 129-145.

27. Saikia P, Choudhury BI, Khan M; Foristic composition and plant utilization pattern in home gardens of Upper Assam, India. Tropical Ecology, 2012; 53(1): 105-118.

28. Das T, Das AK; inventorying plant biodiversity in home gardens: A case study in Barak Valley, Assam, North East India. Curr Sci., 2005; 89: 155-163.

ANNEXURE
Table I: Diversity Indices of Home garden species recorded in the study area.

Name of the species	Lf	E/P	C/W	UsPa	Uses	Rura HGs					Urban HGs					Overall HGs				
						Nin/S	Pi=ni/N	P_i^2	In Pi	Pi In Pi	Nin/S	Pi=ni/N	P_i^2	In Pi	Pi In Pi	Nin/S	Pi=ni/N	P_i^2	In Pi	Pi In Pi
Acalypa hispida Burm.	H	E	C	Wp	Or	0	0.000	0.00000	0.000	0.000	2	0.002	0.00000	-6.420	-0.013	2	0.001	0.00000	-7.454	-0.007
Acalypa indica Linn.	H	E	W	L	Me	17	0.008	0.00006	-4.875	-0.039	8	0.007	0.00004	-5.034	-0.035	25	0.007	0.00005	-4.929	-0.035
Achras zapota (L.) P. Royan	T	E	C	Fr	Fo	17	0.008	0.00006	-4.875	-0.039	3	0.002	0.00001	-6.015	-0.012	20	0.006	0.00003	-5.152	-0.031
Adenium obesum (Forssk) Roem & Schult.	H	P	C	Wp	Or	14	0.006	0.00004	-5.069	-0.030	4	0.003	0.00001	-5.727	-0.002	18	0.005	0.00003	-5.257	-0.026
Allamanda cathartica L.	Cl	E	C	Wp	Or	7	0.003	0.00001	-5.763	-0.017	4	0.003	0.00001	-5.727	-0.017	11	0.003	0.00001	-5.750	-0.017
Aloe vera (L.) Burm.F.	H	E/P	C	Wp	Me	31	0.014	0.00019	-4.274	-0.060	26	0.021	0.00045	-3.855	-0.081	57	0.016	0.00027	-4.105	-0.066
Amaranthus gangetics L.	H	P	C	Wp	Ve	70	0.031	0.00096	-3.460	-0.011	53	0.043	0.00185	-3.143	-0.135	123	0.036	0.00127	-3.335	-0.120
Amaranthus viridis Linn.	H	E	W	Wp	Ve	14	0.006	0.00004	-5.069	-0.030	8	0.007	0.00004	-5.034	-0.035	22	0.006	0.00004	-5.057	-0.030
Ananas comosus (L.) Merr.	T	E	C	Fr	Fo	30	0.013	0.00017	-4.307	-0.056	0	0.000	0.00000	0.000	0.000	30	0.009	0.00008	-4.746	-0.043
Annona squamosa L.	S	E	C	Fr	Fo	40	0.018	0.00032	-4.020	-0.072	12	0.010	0.00010	-4.628	-0.046	52	0.015	0.00023	-4.196	-0.063
Anthurium andreanum Schott.	H	P	C	Wp	Or	18	0.008	0.00007	-4.818	-0.039	17	0.014	0.00019	-4.280	-0.060	35	0.010	0.00010	-4.592	-0.046
Areca catechu L.	T	E	C	Wp	Mp	52	0.023	0.00054	-3.757	-0.086	0	0.000	0.00000	0.000	0.000	52	0.015	0.00023	-4.196	-0.063
Argyreia nervosa (Burm.f.) Bojer.	Cr	E	C	Tu	Ve	13	0.006	0.00003	-5.143	-0.031	6	0.005	0.00002	-5.321	-0.027	19	0.005	0.00003	-5.203	-0.026
Artobotrys hexapetalus (L.f.) Bhandari.	Cl	E	W	Fl	Me	2	0.001	0.00000	-7.015	-0.007	0	0.000	0.00000	0.000	0.000	2	0.001	0.00000	-7.454	-0.007
Artocarpus communis Frost.	T	E	C	Fr	Fo	12	0.005	0.00003	-5.224	-0.026	0	0.000	0.00000	0.000	0.000	12	0.003	0.00001	-5.663	-0.017
Artocarpus heterophyllus Lam.	T	E	C	Fr	Fo	27	0.012	0.00014	-4.413	-0.053	7	0.006	0.00003	-5.167	-0.031	34	0.010	0.00010	-4.621	-0.046
Artocarpus hirsutus Lam.	T	E	C	Fr	Fo	15	0.007	0.00004	-5.000	-0.035	0	0.000	0.00000	0.000	0.000	15	0.004	0.00002	-5.440	-0.022
Auracaria columnaris Jus.	T	E/P	C	Wp	Or	0	0.000	0.00000	0.000	0.000	5	0.004	0.00002	-0.504	-0.022	5	0.001	0.00000	-6.538	-0.007
Azadirachta indica A. Juss.	T	E	W	Wp	Mp	43	0.019	0.00037	-3.947	-0.075	11	0.009	0.00008	-4.715	-0.042	54	0.016	0.00024	-4.158	-0.067
Bambusa arundinaceae (Retz.) Roxb.	T	E	C	Wp	Mp	11	0.005	0.00002	-5.311	-0.027	6	0.005	0.00002	-5.321	-0.027	17	0.005	0.00002	-5.314	-0.027
Basella alba L.	Cl	E	C	Wp	Ve	12	0.005	0.00003	-5.224	-0.026	7	0.006	0.00003	-5.167	-0.031	19	0.005	0.00003	-5.203	-0.026
Bougainvillaea spectabilis (Wild)	S	E	C	Wp	Or	12	0.005	0.00003	-5.224	-0.026	5	0.004	0.00002	-0.504	-0.022	17	0.005	0.00002	-5.314	-0.027

Table I: Diversity Indices of Home garden species recorded in the study area. (Cont….)

Species																				
Caladium bicolour Vent.	H	P	C	WP	Or	1	0.000	0.00000	-7.708	0.000	9	0.007	0.00005	-4.916	-0.034	10	0.003	0.00001	-5.845	-0.018
Caladium sps. Vent.	H	P	C	Wp	Or	0	0.000	0.00000	0.000	0.000	3	0.002	0.00001	-6.015	-0.012	3	0.001	0.00000	-7.049	-0.007
Callicarpa tomentosa (L.) Muss.	Cl	E	C	Le	Mp	7	0.003	0.00001	-5.763	-0.017	0	0.000	0.00000	0.000	0.000	7	0.002	0.00000	-6.202	-0.012
Canavalia gladiata (Jacq.) DC.	Cl	E	C	Fr	Ve	6	0.003	0.00001	-5.917	-0.018	2	0.002	0.00000	-6.420	-0.013	8	0.002	0.00000	-6.068	-0.012
Capsicum frutescens L.	H	E	C	Fr	Ve	40	0.018	0.00032	-4.020	-0.072	5	0.004	0.00002	-0.504	-0.022	45	0.013	0.00017	-4.341	-0.056
Carica papaya L.	S	E	C	Fr	Fo	30	0.013	0.00017	-4.307	-0.056	37	0.030	0.00091	-3.502	-0.105	67	0.019	0.00036	-3.943	-0.075
Celosia argentea L.	H	E	C	Wp	Or	33	0.015	0.00022	-4.212	-0.063	3	0.002	0.00001	-6.015	-0.012	36	0.010	0.00011	-4.564	-0.046
Centella asiatica L. Urban.	Cr	E	W	Wp	Me	45	0.020	0.00041	-3.902	-0.078	0	0.000	0.00000	0.000	0.000	45	0.013	0.00017	-4.341	-0.056
Chrysanthemum coronarium L.	H	E	C	Wp	Or	22	0.010	0.00010	-4.617	-0.046	19	0.015	0.00024	-4.169	-0.063	41	0.012	0.00014	-4.434	-0.053
Citrus aurantium L.	T	E	C	Fr	Mp	30	0.013	0.00017	-4.307	-0.056	3	0.002	0.00001	-6.015	-0.012	33	0.010	0.00009	-4.651	-0.047
Citrus limon L.Burm.f.	S	E	C	Fr	Mp	21	0.009	0.00009	-4.664	-0.042	5	0.004	0.00002	-0.504	-0.022	26	0.008	0.00006	-4.889	-0.039
Cocous nucifera L.	T	E	C	Wp	Mp	186	0.084	0.00697	-2.483	-0.209	126	0.103	0.01053	-2.277	-0.235	312	0.090	0.00815	-2.405	-0.216
Codiaeum variegatum (L.) A. Juss.	S	E	C	Wp	Or	20	0.009	0.00008	-4.713	-0.042	9	0.007	0.00005	-4.916	-0.034	29	0.008	0.00006	-4.780	-0.038
Coleus amboinicus (Lour) Spreng.	H	P	C	Wp	Me	19	0.009	0.00007	-4.764	-0.043	15	0.012	0.00014	-4.405	-0.053	34	0.010	0.00010	-4.624	-0.046
Crossandra infundibuliformis (L.) Nees.	H	E/P	C	Wp	Or	27	0.012	0.00014	-4.413	-0.053	6	0.005	0.00002	-5.321	-0.027	33	0.010	0.00009	-4.651	-0.047
Cucurbita moschata Duchesne ex Peir.	Cr	E	C	Fr	Ve	11	0.005	0.00002	-5.311	-0.024	0	0.000	0.00000	0.000	0.000	11	0.003	0.00001	-5.750	-0.017
Cupressus lusitanica (L.)	T	E/P	C	Wp	Or	0	0.000	0.00000	0.000	0.000	2	0.002	0.00000	-6.420	-0.013	2	0.001	0.00000	-7.454	-0.007
Curcuma longa L.	H	E	C	Rh	Mp	30	0.013	0.00017	-4.307	-0.056	1	0.001	0.00000	-7.113	-0.007	31	0.009	0.00008	-4.714	-0.042
Dieffenbachieae bowmannii	S	E	C	Wp	Or	16	0.007	0.00005	-4.936	-0.035	9	0.007	0.00005	-4.916	-0.034	25	0.007	0.00005	-4.929	-0.035
Dioscorea esculenta (L.)	Cr	E	C	Tu	Ve	2	0.001	0.00000	-7.015	-0.007	3	0.002	0.00001	-6.015	-0.012	5	0.001	0.00000	-6.538	-0.007
Dracaena sps. Vand. Ex L.	S	E/P	C	Wp	Or	0	0.000	0.00000	0.000	0.000	17	0.014	0.00019	-4.280	-0.060	17	0.005	0.00002	-5.314	-0.027
Epipremnum auream (L.) Engl.	Cl	E	C	Wp	Or	22	0.010	0.00010	-4.617	-0.046	17	0.014	0.00019	-4.280	-0.060	39	0.011	0.00013	-4.484	-0.049
Ervatamia coronaria	S	E	W	Wp	Or	7	0.003	0.00001	-5.763	-0.017	6	0.005	0.00002	-5.321	-0.027	13	0.004	0.00001	-5.583	-0.022
Euphorbia milii Des Moul.	H	P	C	Wp	Or	2	0.001	0.00000	-7.015	-0.007	13	0.011	0.00011	-4.548	-0.050	15	0.004	0.00002	-5.440	-0.022
Ficus religiosa Linn.	T	E	W	Wp	Mp	3	0.001	0.00000	-6.610	-0.007	1	0.001	0.00000	-7.113	-0.007	4	0.001	0.00000	-6.761	-0.007

Table I: Diversity Indices of Home garden species recorded in the study area (Cont….).

Species																					
Helianthus annuus L.	H	P	C	Wp	Mp	3	0.001	0.00000	-6.610	-0.007	3	0.002	0.00001	-6.015	-0.012	6	0.002	0.00000	-6.356	-0.013
Hibiscus rosa-sinensis Lin.	S	E	C	Wp	Or	61	0.027	0.00073	-3.598	-0.097	7	0.006	0.00003	-5.167	-0.031	68	0.020	0.00038	-3.928	-0.079
Ixora coccinea L.	S	E	C	Wp	Or	58	0.026	0.00068	-3.648	-0.095	20	0.016	0.00027	-4.117	-0.066	78	0.023	0.00051	-3.791	-0.087
Jasminum grandiflorum L.	S	E/P	C	Wp	Or	52	0.023	0.00054	-3.757	-0.086	15	0.012	0.00015	-4.405	-0.053	67	0.019	0.00036	-3.943	-0.075
Jasminum sambac Linn.	S	E/P	C	Wp	Or	48	0.022	0.00046	-3.837	-0.084	14	0.011	0.00012	-4.474	-0.049	62	0.018	0.00032	-4.020	-0.072
Lagenaria siceraria (Molina.) Standl.	Cr	E	C	Fr	Ve	18	0.008	0.00006	-4.818	-0.039	0	0.000	0.00000	0.000	0.000	18	0.005	0.00003	-5.257	-0.026
Lucas aspera Spreng.	H	E	W	Wp	Me	24	0.011	0.00012	-4.530	-0.050	10	0.008	0.00006	-4.811	-0.038	34	0.010	0.00010	-4.624	-0.046
Luffa cylindrica M.Roam.	Cl	E	C	Fr	Ve	10	0.004	0.00002	-5.406	-0.022	2	0.002	0.00000	-6.420	-0.013	12	0.003	0.00001	-5.663	-0.017
Mangifera indica L.	T	E	C	Wp	Mp	60	0.027	0.00072	-3.614	-0.098	26	0.021	0.00045	-3.855	-0.081	86	0.025	0.00062	-3.693	-0.092
Manihot esculenta Crantz.	S	E	C	Tu	Fo	26	0.012	0.00013	-4.450	-0.053	2	0.002	0.00000	-6.420	-0.013	28	0.008	0.00006	-4.815	-0.039
Michelia champaca Linn.	S	E	C	Wp	Or	27	0.012	0.00014	-4.413	-0.053	27	0.022	0.00048	-3.817	-0.084	54	0.016	0.00024	-4.158	-0.067
Mirabilis jalapa L.	S	E	C	Wp	Or	34	0.015	0.00023	-4.182	-0.063	35	0.029	0.00081	-3.558	-0.103	69	0.020	0.00040	-3.913	-0.078
Momordica charantia L.	Cl	E	C	Fr	Ve	9	0.004	0.00002	-5.511	-0.022	20	0.016	0.00026	-4.117	-0.066	29	0.008	0.00007	-4.780	-0.038
Moringa oleifera Lam.	T	E	C	Wp	Mp	37	0.017	0.00028	-4.097	-0.070	33	0.027	0.00072	-3.617	-0.098	70	0.020	0.00040	-3.899	-0.078
Murraya koenigii (L.) Spreng.	S	E	C	Le	Mp	42	0.019	0.00035	-3.971	-0.075	26	0.021	0.00045	-3.855	-0.081	68	0.020	0.00038	-3.928	-0.079
Musa paradisiaca L.	T	E	C	Wp	Mp	87	0.039	0.00153	-3.243	-0.126	106	0.086	0.00745	-2.450	-0.211	193	0.056	0.00311	-2.885	-0.162
Mussaenda forndosa Linn.	T	E/P	C	Wp	Or	11	0.005	0.00002	-5.311	-0.027	4	0.003	0.00001	-5.727	-0.002	15	0.004	0.00002	-5.440	-0.022
Nerium oleander Linn.	S	E	W	Wp	Or	31	0.014	0.00019	-4.274	-0.060	6	0.005	0.00002	-5.321	-0.027	37	0.011	0.00011	-4.537	-0.050
Ocimum tenuiflorum L.	H	E/P	C	Wp	Me	40	0.018	0.00032	-4.020	-0.072	7	0.006	0.00003	-5.167	-0.031	47	0.014	0.00018	-4.297	-0.060
Phyllanthus niruri Linn.	H	E	W	Wp	Me	34	0.015	0.00023	-4.182	-0.063	15	0.012	0.00014	-4.405	-0.053	49	0.014	0.00020	-4.256	-0.060
Phyllanthus officinalis Linn.	T	E	C	Fr	Me	23	0.010	0.00010	-4.573	-0.046	5	0.004	0.00002	-0.504	-0.022	28	0.008	0.00006	-4.815	-0.039
Piper nigrum L.	Cl	E	C	Fr	Mp	30	0.013	0.00017	-4.307	-0.056	0	0.000	0.00000	0.000	0.000	30	0.009	0.00008	-4.746	-0.043
Podocarpus sps Persoon..	T	E/P	C	Wp	Or	4	0.002	0.00000	-6.322	-0.013	6	0.005	0.00002	-5.321	-0.027	10	0.003	0.00001	-5.845	-0.018
Polianthus tuberosa L.	H	E	C	Wp	Or	32	0.014	0.00020	-4.243	-0.059	5	0.004	0.00002	-0.504	-0.022	37	0.011	0.00011	-4.537	-0.050
Portulaca oleracea L.	H	E/P	C	Le	Ve	25	0.011	0.00012	-4.490	-0.049	33	0.027	0.00072	-3.617	-0.098	58	0.017	0.00028	-4.087	-0.069
Psidium guajava L.	T	E	C	Fr	Fo	36	0.016	0.00026	-4.125	-0.066	28	0.023	0.00052	-3.781	-0.087	64	0.019	0.00034	-3.989	-0.076
Punica granatum Linn.	S	E	C	Fr	Fo	12	0.005	0.00003	-5.224	-0.026	8	0.007	0.00004	-5.034	-0.035	20	0.006	0.00003	-5.152	-0.031

Table I: Diversity Indices of Home garden species recorded in the study area (Cont….).

Species	Lf					ni					ni					N				
Rosa sps. Linn.	S	E/P	C	Wp	Or	37	0.017	0.00028	-4.097	-0.070	155	0.126	0.01588	-2.070	-0.261	192	0.056	0.00308	-2.890	-0.162
Russelia equisetifolia Schlecht & Champ.	H	P	C	Wp	Or	24	0.011	0.00012	-4.530	-0.050	2	0.002	0.00000	-6.420	-0.013	26	0.008	0.00006	-4.889	-0.039
Sansevieria hyacinthoides (L) Druce.	H	E/P	C	Wp	Or	13	0.006	0.00003	-5.143	-0.031	8	0.007	0.00004	-5.034	-0.035	21	0.006	0.00004	-5.103	-0.031
Solanum torvum Swarta.	S	E	W	Fr	Ve	21	0.009	0.00009	-4.664	-0.042	3	0.002	0.00001	-6.015	-0.012	24	0.007	0.00005	-4.970	-0.035
Tabernaemontana divaricata (Linn.) R.Br. ex. Roems.	S	E	C	Wp	Or	8	0.004	0.00001	-5.629	-0.023	6	0.005	0.00002	-5.321	-0.027	14	0.004	0.00002	-5.509	-0.022
Tamarindus indica Linn.	T	E	W	Fr	Mp	30	0.013	0.00017	-4.307	-0.056	15	0.012	0.00015	-4.405	-0.053	45	0.013	0.00017	-4.341	-0.056
Tecoma stans (L.) Kunth.	S	E	C	Wp	Or	36	0.016	0.00026	-4.125	-0.066	27	0.022	0.00048	-3.817	-0.084	63	0.018	0.00032	-4.004	-0.072
Tectona grandis Linn.	T	E	C	Wp	Mp	29	0.013	0.00017	-4.341	-0.056	11	0.009	0.00008	-4.715	-0.042	40	0.012	0.00013	-4.459	-0.054
Thespesia populnea (L.) Soland	T	E	C	Wp	Mp	27	0.012	0.00014	-4.413	-0.053	0	0.000	0.00000	0.000	0.000	27	0.008	0.00006	-4.852	-0.039
Trichosanthus anguina L.	Cl	E	C	Fr	Ve	5	0.002	0.00000	-6.099	-0.012	11	0.009	0.00008	-4.715	-0.042	16	0.005	0.00002	-0.375	-0.027
Vigna unguiculata (Linn.) Walp.	H	E	C	Po	Ve	7	0.003	0.00001	-5.763	-0.017	0	0.000	0.00000	0.000	0.000	7	0.002	0.00000	-6.202	-0.012
Vinca rosea (L.) G. Don.	H	E	W	Wp	Me	32	0.014	0.00020	-4.243	-0.059	22	0.018	0.00032	-4.022	-0.072	54	0.016	0.00024	-4.159	-0.067
Vitex negundo L.	T	E	C	Wp	Me	12	0.005	0.00003	-5.224	-0.026	1	0.001	0.00000	-7.113	-0.007	13	0.004	0.00001	-5.583	-0.022
Zingiber officinale Roscoe.	H	E	C	Rh	Mp	35	0.016	0.00025	-4.153	-0.066	0	0.000	0.00000	0.000	0.000	35	0.010	0.00010	-4.592	-0.046
Zinnia peruviana (L.) L.	H	E/P	C	Wp	Or	0	0.000	0.00000	0.000	0.000	9	0.007	0.00005	-4.916	-0.034	9	0.003	0.00001	-5.950	-0.018
						2227			-3.977		1228			-3.633		3455			-4.079	
								$\lambda = 0.02168$	H'=3.977			$\lambda = 0.04542$	H'=3.633			$\lambda = 0.02538$	H'=4.079		

C-Cultivated; **Cl**-Climber; **Cr**-Creeper; **E**-Earthen pants; **Fl**-Flower; **Fo**-Food (edible); **Fr**-Fruits; **H**-Herb;
H'-Shannon-Wiener Diversity Index; **Le**-Leaf; **Lf**-Life forms; **Me**-Medicinal; **Mp**-Multipurpose use; **N**-Total number of individuals in all species;
ni-number of individuals in each species; **Nin/S**-Number of individuals per species; **Or**-Ornamental; **P**-Potted plants; **Po**-Pods; **Rh**-Rhizome; **Tu**-Tuber;
S-Shrub; **T**-Tree; **UsPa**-Useful parts; **Ve**-Vegetable; **Wp**-Whole plant; **W**-Wild; **λ**-Simpson's Dominance Index; **HGs**-Home Gardens;