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Research Article

Floristic Composition and Diversity Assessment of Home garden Plants in a Rural Village, Swamithoppe, Kanyakumari District, Tamil Nadu, India

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Abstract: The main objective of this study was to assess the status, composition and diversity of plants in a rural village homegardens with the help of socio economic factors of households. The study was carried out in Swamithoppe village, Kanyakumari district, Tamil Nadu, India, in 121 randomly selected homegardens were measured. Complex plant species inventories were carried out to assess the number and abundance of plant species (i.e., all useful plant species) and ornamentals. All gardeners were individually interviewed about homegarden management and plant utilization, among other information. In addition, to plant species information, species diversity, richness, evenness and dominance indices were also calculated. In Swamithoppe village, the homegarden area varied from 20.23m^2 to 627.28m^2 with an average of 73.21m^2 to 519.36m^2. In the HG survey, a total of 119 plant species comes under 108 genus belongs to 58 families with a total number of individual is 3540 were recorded. The number species recorded ranged from2 to 23/HG species with an average of 8.30 to 9.24species/HG. The species density varied from1.65/100m^2 to 64.26/100m^2 with an average of 2.58 to 13.84/100m^2. The number of individuals of plant species noted in the homegarden varied from 7 to 78nos with an average of 24.75 to 66.67nos The overall, plant diversity in homegarden based on number of individuals ranged from9.88 to 143.35/100m^2 with an average of 12.99 to 40.06/100m^2.In plant overall HGs shows a total of 119 species with 3540 individuals in 121 HGs and the plants distributed in HGs ranged from 3 to 22 HGs with an average of 9.39 HG. Out of 58 botanical families recorded Euphorbiaceae is one of the most represented family having 6 genes, 10 species with 245 individuals with an average of 2450 individuals per species and the maximum diversity (H'=0.342) and low Simpson's diversity (λ=0.00052) as compared to other families. Among the top 10 HG species, *Cocos nucifera* shows maximum no of individuals (162) with an average of 7.36/HG and found in 22 HGs. The distribution pattern of HG plants indicate that maximum no of plants found in herbs (36.13%) in life form, earthen plants (77.31%) in habitat, cultivated plants(74.79%)in growth condition, whole plant utilization (39.50%) in useful parts and ornamental use plants (31.93%)in uses category. The diversity indices estimated for over on home garden plants as H'=4.627, (Shannon diversity), species richness (R=14.440), species evenness (E=0.968), and Simpson's diversity (λ=0.0109).
Keywords: Homegardens, Plant structure, Plant composition and distribution, Plant diversity, Swamithoppe village, Kanyakumari.

INTRODUCTION

Homegardens make a vital contribution to meet various household needs, especially for poor families in developing countries. However, the importance of the biodiversity of homegardens is the availability of vareties, which are found siutable to humanbeings under a large variety of social, economic and cultural situations. Research on homegardens gaining interest for their potential as models of economically efficient and ecologically sustainable agroforestry system [1-3], and they emphasize the importance of preservinghomegardens as key elements in the conservation and generation of diversity in agricultural species. Personal prefence, socio-economic status and culture seems to be the main deteminants of the appearance, functions and structure of homegardens[4]. The rural homegardens usually have more layers of plant canopy and thus, are more complex than the urban gardens [5]. Most homegardens research has focused on homegardens as integrated multi-species system, giving greatest attention to the variation of speceis diversity among homegardens [6-9]. Additionally, several studies have paid special attention to the vertical variation of species by comparing the different layers of canopy strata constituting homegardens [2, 10, 11]. Little or no attention has been gives to analysing the horizontal variability wirthin homegardens [12-14]. The aim of present study is to evaluate the floristic composition and diversity of homegarden plants in the Swamithoppe village, Kanyakumari district, Tamilnadu, India.

MATERIALS AND METHODS

Homegardens in the study area, Swamithoppe village, was surveyed from June 2015 to September 2015 to evaluate the status, composition and diversity of plant species. Methods used in this study mainly focussed on detemining certain indicators for the assessment of sustainability with respect to socio-economic condition of households and homegarden plant diversity. The present study was carried out in the Swamithoppe village, Kanyakumari District, Tamilnadu, India.Swamithoppe lies about half-way between the cities of Nagercoil and Kanyakumari on the Nagercoil-Kanyakumari road and located at 8.12°N 77.49°E and elevated as 13m (43ft).

Homegarden survey was conducted in 121 households with homegardens were randomly selected.The selected homegardens were categorized into four types based on their nature –as hutted, tiled, and terraced and storied which are fenced or non-fenced in the study area. Households were identified as sampling units for the survey. Questionnaire was prepared to collect various information from the households (respondents) related to home gardening. For this, the actual respondent of the household was identified as one who involved in most of the decision making in the agriculture (homegarden) related matters. In some case the interview was conducted more than one member as well. Each household was interviewed as basic socio-economic data and homegarden specific data. Finally, the filled questionnaires were checked to confirm the competence and quality of the information collected. The filled questionnaires were thoroughly checked and numerical coding of the filled questionnaires for the data entry and calculation of various parameters was done.Before starting plant inventory, the homegarden type (fenced/non-fenced, hut, tiled, terrace, and multistoried) were noted. The size of HG was measured excluding the area occupied by the houses.

The plant species were identified on the basis of vernacular names, published field inventories, floras [15, 16], experts in plants and consulting available herbaria of the region. In the study the plant species recorded have been arranged alphabetically for each species the binomial name first followed by the local name, family, life-forms, potted/earthern plants, cultivated/wild plants, useful parts of the plants and their utilization are recorded (Annexure table I). From the data collected, various diversity indices like Shannon-Weiner diversity index [17, 18], Simpson's diversity index [19], Pielou's species evenness index [20, 21], Margalef species richnness index [22, 23] were estimated using the standard methods.

RESULTS AND DISCUSSION

Socio-economic conditions of Households

The homegardens of Swamithoppe village are categorized into 4 types such as hutted, tiled, terraced and storied house which are sub categories into fenced and non-fenced house (Table 1). Out of 121 houses surveyed in the study area, terrace house represent more in number (55nos.) which is about 45.45% and it is followed by storied house (51nos. with 42.14%).

Among the 121 homegardens surveyed, 74.38% of the house (90nos.) were fenced and remaining are non-fenced house were recorded in the Swamithoppe village. The number of family members exists in the range between as 1 to7nos. Most of the families (34nos. out of 121) have 4 members in the study area and it was 28.09%. About 55.33% of the households had formal education less than 10^{th} standard while 36.36% had above 10^{th} level formal education and 8.26% of respondents showed illiterate. Most of the households were unskilled workers 35.53% followed by 22.31% skilled workers, 14.87% farmers (Table 1).

Most of the households (38.01%) in the study area were under the annual income ranges from Rs.50,000/- to Rs. 1,00, 000/- (maximum) and most of the households (65nos.) out of 121 (53.71%) spent between Rs. 1000 to Rs. 5000 annually for HG maintenance. It was noted that 34.71% of the households (42nos. out of 121) have experience in homegarden works, while 37.88% households were farm workers (41nos.). Among the households, 34.71% households (42) were used the homegardens as washing area and is followed by 22.31% households utilize the homegarden as children play area. Out of 121 homegardens surveyed, the plants grow well in 47 HGs (38.84%), in 50.41% HGs shown plants with moderately grown and the remaining HGs poorly grown plants. About 84 (69.42%) HGs were categorized into two layered and the remaining 30.58% (30nos.) were three layered (Table 1).

Status and structure of homegarden plant

A complete inventory list of the plant species and the detailed species list is presented in (Annexure Table I) along with common name of the plant species, family name, plant type (habit) growth condition (wild/potted), nature of growth (wild/cultivated), useful part, uses were recorded. A total of 3540 individuals from 119 species under 108 genera belongs to 58 families were recorded and the plant species have been taxonomically verified and identified as distinct species (Table 2).

Table -1: Socio-economic characteristics of households recorded during the survey of homegardens in the Swamithoppe village.

1. House types	**No of homegardens***	**% of homegardens****
i. Hutted house	01	00.83
ii. Tiled house	14	11.57
iii. Terrace house	55	45.45
iv. Storied house	51	42.15
v. Non-fenced house	31	25.62
vi. Fenced house	90	74.38
2. Household members	**No of Households***	**% of households****
i. ≤ 3 members	46	38.02
ii. 4 to 5 members	54	44.63
iii. ≥ 6 members	21	17.35
3. Educational status of Households	**No of households***	**% of households****
i. Non-formal education	10	8.27
ii. Formal education up to 10^{th} level	67	55.37
Iii. Formal education above 10^{th} level	44	36.36
4. Occupation of Households	**No of households***	**% of households****
i. Farmers	18	14.88
ii. Businessman	14	11.57
iii. Professionals	19	15.70
iv. Skilled workers	27	22.31
v. Unskilled workers	43	35.54
5. Annual Income of Households	**No of households***	**% of households****
i. Up to Rs. 50, 000/=	25	20.66
ii. Rs. 50, 000/= to 1, 00, 000/=	46	38.02
iii. Rs. 1, 00, 000/= to 2, 00, 000/=	24	19.83
iv. Rs. 2, 00, 000/- to 5, 00, 000/=	26	21.49
6. Annual Homegarden Expenditure	**No of households***	**% of households****
i. Up to Rs. 1, 000/=	45	37.19
ii. Rs. 1, 000/= to 5, 000/=	65	53.72
iii. Rs. 5, 000/= to 10, 000/=	11	09.09
7. Activity of Household Members	**No of households***	**% of households****
i. Farm workers	41	33.88
ii. Non-farm workers	27	22.31
iii. Experience in homegarden works	42	34.71
iv. No experience in homegarden works	11	09.09
8. Homegardens used for other purposes	No of households*	% of households**
A. Used as social/ living area		
i. Rest or meeting area	10	08.26
ii. Children's play area	27	22.31
iii. Flower garden	21	17.36
B. Used as Physical/ utility area		
i. Storage area	11	09.09
ii. Washing area	42	34.71
iii. Drying area	10	08.26
9. Growth condition of HG plants	**No of homegardens***	**% of homegardens****
i. Well grown	47	38.84
ii. Moderately grown	61	50.41
iii. Poorly grown	13	10.74
10. Layering pattern of HG plants	**No of homegardens***	**% of homegardens****
i. Two layered	84	69.42
ii. Three layered	37	30.58
Total*/**	**121***	**100.00****

Table -2: Most represented botanical families in number of species, number of genus and number of individuals recorded in the homegardens of Swamithoppe village.

Family	Number of Species (%) /Family	Number of Genus (%) /Family	Number of Individuals (%) /Family	Number of Individuals (%) /Genus	Number of Individuals (%) /species
Euphorbiaceae	10 (8.40)	6 (5.56)	245 (6.92)	40.83 (1.15)	24.50 (0.69)
Solanaceae	7 (5.88)	3 (2.78)	170 (4.80)	56.67 (1.60)	24.29 (0.69)
Rubiaceae	5 (4.20)	4 (3.70)	183 (5.17)	45.75 (1.29)	36.60 (1.03)
Leguminaceae	4 (3.36)	4 (3.70)	72 (2.03)	18.00 (0.51)	18.00 (0.51)
Cucurbitaceae	4 (3.36)	4 (3.70)	84 (2.37)	21.00 (0.59)	21.00 (0.59)
Ameranthaceae	4 (3.36)	3 (2.78)	135 (3.81)	45.00 (1.27)	33.75 (0.95)
10-Families with	3 (2.52)	30 (2.78)	1051 (2.97)	35.03 (0.99)	35.03 (0.99)
13-Families with	2 (1.68)	25 (1.78)	783 (1.70)	31.32 (0.88)	30.12 (0.85)
29-Families with	1 (0.84)	29 (0.93)	817 (0.79)	28.17 (0.80)	28.17 (0.80)
Total -58	**119 (100.00)**	**108 (100.00)**	**3540 (100.00)**		

The homegarden survey reveals that out 58 families recorded, 29 families have single species, 13 families have two species, 10 families have 3 species, 3 families have 4 species, Rubiaceae family have 5 species, Solanaceae have 7 species and Euphorbiaceae have 10 species. Among the families, Euphorbiaceae represent 8.40% with 5.56% genus (6), 6.92% individuals (245nos.) with an average of 24.50 individuals per species (Table 2). Among the top 5 families recorded, Euphorbiaceae shows maximum number of species (10sps.), maximum number of individuals (245nos.) and maximum species diversity index (H'=0.342), while *Arecaceae* shows more Simpson's diversity index (λ= 0.00230) as compared to other families. Among the top 5 species, out of 119 species recorded, *Cocos nucifera* have maximum number of individuals (7.36 per homegarden) and in more number of homegardens (22nos.) as compared to other plants (Table 3).

Table -3: Top 5 families having maximum Simpson's diversity index (λ) and Shannon-Weiner's species diversity index (H') of homegarden species surveyed in the study area.

Sl. No.	Name of the Family	Species diversity Index (H')	Sl. No.	Name of the Family	Simpson's Diversity Index (λ)
1	Arecaceae	0.00230	1	Euphorbiaceae	0.342
2	Rubiaceae	0.00055	2	Rubiaceae	0.236
3	Euphorbiaceae	0.00052	3	Arecaceae	0.233
4	Malvaceae	0.00040	4	Solanaceae	0.192
5	Amaranthaceae	0.00039	5	Amaranthaceae	0.176

Table -4: Top 5 HG plants showing more number of individuals and found in more number of homegardens of Swamithoppe village.

Sl. No.	Name of the species	No of In/Sp	Name of the species	Av No of In/Sp/ HG	Name of the species	Max No of HG
1	*Cocos nucifera*	162	*Cocos nucifera*	7.36	*Cocos nucifera*	22
2	*Abelmoschus esculentus*	61	*Ocimum sanctum*	6.67	*Bambusa arundinacea*	19
3	*Ocimum sanctum*	60	*Nerium indicum*	5.43	*Abelmoschus esculentus*	18
4	*Zingiber officinale*	57	*Stachytarpheta jamaicensis*	5.25	*Zingiber officinale*	17
5	*Amorphophallu spaenoiifolus*	51	*Polyalthia longifolia*	4.64	*Dracaena sps.*	16

No –Number; In –Individuals; Sp –Species; HG –Homegarden; Max –Maximum; Av –Average;

Out of 119 species recorded the top 5 species having maximum number of individuals noted in the homegardens are *C. nucifera, A. esculentus, O. sanctum, Z. officinale, A. paenoiifolus*. Among these plants, *C. nucifera* have maximum number of individuals (162) found in 22 homegardens with an average of 7.36 individuals per homegarden (Table 4).

The homegarden surveyed in the Swamithoppe village were categorized into three types such as small (<200m^2), medium (200 to 400m^2) at large (>400m^2) based on homegarden area and the data collected were compared in different parameters like number of plant species, species family number of individual plants of their (plant) family and homegarden of area (Table 5).

Out of 121 homegardens, 102 HGs (84.30%) comes under small HGs, while 13 HGs (10.74%) under medium HGs and 6 HGs (4.96%) under large HGs. The overall area surveyed was ranged from 20.23% to 627.28m^2 with an average area of 116.06m^2/HGs. About 53.17% of HG area comes under small HGs while it was 24.64% area under medium HGs and 22.19% area comes under large HGs. Maximum average HGs was noted in large HGs (519.36m^2/HGs) and it is followed by medium HGs (266.17 m^2/HG) and it was low in small HGs (73.21 m$^{2/}$ HG) (Table 5).

Table -5: Comparison of minimum, maximum and average of homegarden plants based on number of species, number of individuals and density in the study area.

Parameters	Minimum	Maximum	Average	Total Number & %
Homegarden area (m^2)				
Small HGs (102 HGs.)	20.23	182.11	73.21	7467.25 (53.17)
Medium HGs (13 HGs.)	202.35	343.99	266.17	3468.16 (24.64)
Large HGs ((6 HGs.)	445.17	627.28	519.36	3 16.18(22.19)
Overall (121 HGs)	20.23	627.28	116.06	14043.59 (100.00)
Number of Species in HGs				
Small HGs (102 HGs.)	2	23	8.39	856 (76.57)
Medium HGs (13 HGs.)	6	21	14.08	183 (16.37)
Large HGs ((6 HGs.)	8	17	13.17	79 (7.06)
Overall (121 HGs)	2	23	9.24	1118 (100.00)
Species Density/100m^2				
Small HGs (102 HGs.)	4.12	64.26	13.84	1412.11 (94.25)
Medium HGs (13 HGs.)	2.28	9.39	5.44	70.72 (4.72)
Large HGs ((6 HGs.)	1.65	3.82	2.58	15 .46(1.03)
Overall (121 HGs)	1.65	64.26	12.38	1498.29 (100.00)
Number of individuals in HGs				
Small HGs (102 HGs.)	7	47	24.75	2524 (71.30)
Medium HGs (13 HGs.)	37	65	47.38	616 (17.40)
Large HGs ((6 HGs.)	48	78	66.67	400 (11.30)
Overall (121 HGs)	7	78	29.26	3540 (100.00)
Plant Density/100m^2				
Small HGs (102 HGs.)	11.53	143.35	40.06	4086.31 (92.86)
Medium HGs (13 HGs.)	13.66	26.69	18.16	236.02 (5.36)
Large HGs ((6 HGs.)	9.88	16.17	12.99	77.95 (1.77)
Overall (121 HGs)	9.88	143.35	36.37	4400.29 (100.00)

Small HGs: <200m^2; Medium HGs: 200 to 400m^2; Large HGs: >400m^2;

The range of plant species in small HGs was 2 to 23 with area average of 8.39 species while in medium HGs it was ranged from 6 to 21 with an average of 14.08 species and 8 to 17species in large HGs with an average of 13.17species. Thus, the average number of species per HGs is higher in medium HGs and large HGs as compared to small HGs. However, the total number of species found in small HGs was higher (76.57%) when compared to medium HGs (16.37%) and large HGs (7.06%).The species density is small HGs was ranged from 4.12 to 64.26/ 100m^2 with an average species density of 13.84/m^2. In medium HGs, it was ranged from 2.28/100m^2 with an average species determination of 5.44/100m^2 are in large HGs it was ranged from 1.65 to 3.82/100m^2 with average species density 2.58/100m^2. The species density/100m^2 was higher (94.25%) in small HGs density compared to medium HGs and large GH. Among the HGs, maximum species density (94.25%) was noted in small HGs as compared to medium 4.72% in large HGs (1.03%) (Table 5).

The number of individuals of HGs plant species recorded was ranged from 7 to 78nos. with an average of 29.26 individuals per HGs in general. This range was higher in large HGs (48 to 78nos. with are average of 66.67nos) as medium HGs (37 to 65nos. with an average of 24.75nos.). Among the HGs, maximum number of individuals (71.30%) was recorded in small HGs while it was only 17.40% in medium HGs at 11.30% in large HGs. The plant (vegetation) density/100m^2 in general was ranged from 9.88/100m^2 to 143.35/100m^2 with an average of 36.37/100m^2 HGs. About 92.86% plant density was noted in small HGs as it ranged from 11.53/100m2 to 143.35/100m^2 HGs while it was lower in medium large HGs (Table 5).

Distribution pattern of HG plants

The plant distribution pattern of HG species and their number of individuals, the range and average number of HGs in which the plants present were categorised based on the life forms (climbers, creepers, herbs, shurbs and trees), habitat (earthern/potted), nature of growth (cultivated/wild), usefull parts (flower,

fruit, leaf, seed, stem, wood and wholeplant) and uses (edible, fuel, medicine, multipurpose, ornamental, and vegetable). Based on life form category, maximum number of species (43nos.) in herbs (36.13%) and the number of individuals noted as 1235 (34.89%). The HGs, inwhich the species present was ranged from 5 to 18 HGs with an average of 9 to 16/HG. But, the range and average number of HGs inwhich the species present was more in case of tree species which found in 6 to 22 HGs with an average of 10.32 HGs (Table 6).

In the Habitat (Earthen/Potted plants) category, most of the HG plants (77.31%) were earthern plants (92 species) while the potted plants were only 16 species (21.85%) and both earthern and potted plants have only 1 species (0.84%). The number of individuals found more (77.94%), i.e., earthern plants (2759nos.) and it was 756nos. (21.36%) noted in potted plants. The minimum and maximum number of HGs in which the species present in case of earthern plants was 3 to 22 HGs with an average of 9.35 HGs, while to potted plants found in 6 to 18 HGs with an average of 9.65 HGs,and the earthern and potted plants found only in 7 HGs (Table 6).

Based on Growth Conditions (cultivated/wild), cultivated plants represented 74.79% (89 species), then the wild plants (2 species; 68%) in HG's surveyed, whereas both cultivated and wild plants noted as 23.53% (28 species). The total number of individuals of HG plants shows 78.28% (2 771 nos.) in cultivated category and it was 66nos. (1.86%) only in wild category, while both represented as 19.86% (703 nos.). The number of HGs inwhich the cultivated species present ranged from 3 to 22 HGs with an average of 9.64 HGs and it was 7 to 9 HGs with an average of 8 HGs for wild plants. The presence of both cultivated and wild were ranged from 5 to 16 HGs with an average of 8.71 HGs (Table 6).

Table -6: Distribution categories of homegarden species and their individuals in the study area surveyed.

Plant distribution categories	No. sp. (%)	No of Indi. (%)	No of HGs in which the species present	
			Range of HGs	Average No of HGs
I. Life forms				
i. Climbers	13(10.92)	276(07.80)	3 to 10	7.38
ii. Creepers	3(02.52)	86(02.43)	6-13	9.00
iii. Herbs	43(36.13)	1235(34.89)	5-18	9.16
iv. Shrubs	26(21.85)	796(22.49)	5-17	9.61
v. Trees	34(28.57)	1147(32.40)	6-22	10.32
II. Habitat				
i. Earthen plants	92(77.31)	2759(77.94)	3-22	9.35
ii. Potted plants	26(21.85)	756(21.36)	6-18	9.65
iii. Earthen/Potted plants	1(00.84)	25(00.71)	7	7.00
III. Nature of Growth				
i. Cultivated	89(74.79)	2771(78.28)	3-22	9.64
ii. Wild	2(01.68)	66(01.86)	7-9	8.00
iii. Cultivated/Wild	28(23.53)	703(19.86)	5-16	8.71
IV. Useful part				
i. Flower	29(24.37)	795(22.46)	3-15	8.86
ii. Fruit	25(21.00)	674(19.04)	5-18	8.96
iii. Leaf	14(11.76)	394(11.13)	5-16	9.29
iv. Seed	2(01.68)	41(01.16)	7-10	8.50
v. Stem	1(00.84)	45(01.27)	14	14.00
vi. Wood	1(00.84)	39(01.10)	16	16.00
vii. Whole plant	47(39.50)	1552(43.84)	6-22	9.79
V. Uses				
i. Edible	16(13.45)	419(11.84)	5-14	8.50
ii. Fuel	2(01.68)	67(01.89)	7-16	11.50
ii. Medicine	15(12.61)	414(11.69)	6-13	8.80
iii. Multipurpose	30(25.21)	1057(29.86)	6-22	10.23
iv. Ornamental	38(31.93)	1067(30.14)	3-16	9.00
v. Vegetable	18(15.13)	516(14.58)	5-18	9.89
Total	**119(100.00)**	**3540(100.00)**	**3-22**	**9.39**

In case of useful parts of plants, whole plant utilization category contain 47 species (39.50%) and is followed by flowers (29 species; 24.37%), fruits (25 species; 21%) and leaf (14 species; 11.76%). The total number of individuals of HG plants higher (1552nos; 43.84%) in whole plant use category as compared to others. The number of HGs inwhich the whole plant used species present was ranged from 6 to 22 HGs with

an average of 9.79 HGs. Next to this, the leaf part used plants present in HGs range from 5 to 16 HGs with an average of 9.29 HGs; the flower used plant found in HGs ranges from 3 to 15 (average 8.86) HGs; the fruit used plant in HGs ranges from 5 to 18 (average 8.96) HGs; and the seed used plant present in HG ranges from 7 to 10 (average 8.5) HGs. But, the stem and woody part used plants found only 14 and 16 HGs, respectively (Table 6).

Under use category, plants used ornamentally showed a maximum of 38 species (31.93%) and is followed by multipurposly used plants (30 species; 25.21%), vegetable plants (18 species; 15.13%), edible plants (16 species; 13.45%), medicinal plants (15 species; 12.61%) and the fuel plant (1 species;1.68%). A maximum number of 1067(30.14%) individuals was noted in ornamental category and is followed by 1057 (29.86%) number of plants in multipurpose use of plants. Fuel purpose plants found in 7 to 16 HGs with an average of 11.50 HGs and is followed by multipurposly used plants noted in 6-22 HGs with an average of 10.23 HGs (Table 6).

Table -7: Diversity indices estimated for homegarden species based on homegarden species distribution in Swamithoppe village of Kanyakumari District, Tamil Nadu.

Plant distribution categories	Diversity indices			
	H'	**E**	**λ**	**R**
I. Life forms				
i. Climbers	0.393	0.153	0.00053	2.135
ii. Creepers	0.116	0.106	0.00021	0.449
iii. Herbs	1.606	0.427	0.00332	5.900
iv. Shrubs	1.054	0.324	0.00218	3.743
v. Trees	1.457	0.413	0.00466	4.684
II. Habitat				
i. Earthen	3.582	0.792	0.00884	11.486
ii. Earthen/Potted	1.010	0.310	0.00201	3.772
iii. Potted	0.035	0.035	0.00005	0.000
III. Cultivated/Wild				
i. Cultivated	3.616	0.806	0.00911	11.101
ii. Cultivated/Wild	0.087	0.126	0.00018	0.239
iii. Wild	0.924	0.277	0.00161	4.119
IV. Useful part				
i. Flower	1.029	0.306	0.00200	4.193
ii. Fruit	0.910	0.283	0.00177	3.685
iii. Leaf	0.534	0.202	0.00094	2.175
iv. Seed	0.059	0.085	0.00008	0.269
v. Stem	0.055	0.055	0.00016	0.000
vi. Wood	0.050	0.050	0.00012	0.000
vii. Whole plant	1.990	0.517	0.00583	6.261
V. Uses				
i. Edible	0.573	0.207	0.00100	2.484
ii. Fuel	0.088	0.127	0.00018	0.238
iii. Medicine	0.564	0.208	0.00097	2.323
iv. Multipurpose	1.326	0.390	0.00454	4.165
v. Ornamental	1.391	0.382	0.00273	5.306
vi. Vegetable	0.685	0.237	0.00148	2.722
Total	**4.627**	**0.968**	**0.01090**	**14.440**

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

Diversity assessment of HG plants

Diversity indices estimated for HG plants surveyed in the study area, Swamithoppe village based on various distriibution categories (such as lifeforms, habitat, growth condition, useful part and uses). In life form categories, herbs shows higher Shannon diversity index (H' =1.606), species evenness index (E =0.427), species richness index (R =5.8), while trees were more Simpson's diversity (λ= 0.00466), than other life forms. Earthen plants shows maximum diversity (H' =3.582), species evenness (E =0.792), species richnes (R =11.486) and more Simpson's diversity idex (λ = 0.00884) as compared to potted and earthern/potted category. In Cultivated/Wild plants category, cultivated plants recorded maximum diversity (H' =3.616), species evenness (E =0.806), species richhness (R =11.01) and Simpson's diversity index (λ=0.00911) as

compared to cultivated/wild and wild plants categories (Table 7).

Among the plant parts used category, wholeplant utilized category shows maximum diversity (H' =1.99), species evenness (E =0.517), species richness (R =6.261) while the Simpson's diversity index (λ =0.0058) was higher that indicate less dominance as compared to other categories. Based on uses category of HG plants, ornamental plants show maximum diversity (H' =1.391) and species richness (R =5.306) while multipurposly used plants show maximum species evenness (E =0.390) and Simpson's diversity index (λ =0.00454) as compared to other plant categories (Table 7).

In the present work, it was observed in the study area that the HGs were generally maintained by house wives and not the household heads. It was also noted that the different responsibilities of male and female household members revealed different works. Females mostly maintain vegetables, spices, medicinal plants and ornamentals, whereas, males were responsible for shrubs and tree species. Thus, in HGs dominated by herbal plants females did most of the works, but in trees and shrubs dominated HGs women contributed only little works. Similar reports were also made by many workers [24-26]. In addition, the females did most of the HG works like hoeing, planting, weeding, fertilizing, and harvesting, whereas males carry out works like watering, pruning, land preparation, etc., as reported in several studies [27-29]. In some regions, HGs are managed mainly by females, i.e., in Thailand [30]; in Nepal [31]; and in Bangladesh [32-34].

In India, Dash and Mishra [35] reported that male dominating in HG works. In general, in the HGs of the study area, Swamithoppe village, are socio-economically sustainable with regards to labour input. The work input in HGs as compared to agricultural work is rather small, not very heavy, and having no heavy labour requirements. Instead, home gardening was done continuously year-round and in flexible manner as reported in other studies [36-38].

The HGs of Swamithoppe village have high species richness, with 119 species recorded from 121 HGs of 14043.59m^2 total areas with 108 genus belongs to 58 families containing 3540 individuals. Earlier reports indicated that in Arumanalloor rural village 83species was recorded from 66 HGs of 12,080.30m^2 total areas with 76 genera belongs to 43 families containing 2227 individuals [39]. The number of species can be related to the size of the HGs surveyed. It may be influenced by a number of factors such as socio-economic status of households, market integration, landholding size, etc., [40]. Homegarden exhibits complex structure, both vertically and horizontally. Vertical stratification is a common structure among homegardens throughout the tropics [41, 42]. The vertical structure composed of 3 to 4 layers based on the height and plant types [1]. In this survey, it was noted that the HGs were mostly consisting two layered (69.42%), either with herbs and shrubs or shrubs and trees or herbs and tress. But, it was noted in the previous report that the rural HGs of Arumanallor village shows three to four layered [43] or more layered structure [1, 44]. The wide range of species found in HGs adds their ecological efficiency in terms of use of physical and chemical resources [45, 46]. In this study, the pattern of species distribution in HGs was showed in table 11 & 12. In the study area, the herbs were dominant (36.13%) over other life forms with 77.31% of earthen plant, 74.79% of cultivated plants, 39.50% whole plant utilization species and 31.93% of ornamental plants. Similar observation was also made in Arumanalloor HGs studies by Neelamegam *et al.* [39]. It was also noted that there is no specific pattern of planting in the HGs of study area.

The structure of the homegardens may be determined by the species diversity of the plants present in each HG [47]. The numbers of local plants present in the homegardens provide an obvious starting point in determining the amount of diversity [48]. Eichemberg *et al*. [47] estimated the Shannon-Weiner diversity index value as 1.66 for the older urban HGs in Rio Claro which included 86 species; Brito*et al.* [49] reported a high diversity index of 2.22 in Aripuana; Neelamegam *et al*. [43] noted a diversity index of 3.977 in rural homegardens of Arumanalloor village with 83 species; and the mean SWI vary widely in tropical HGs and are reported to ranges from 0.93 to 3.00 [41] and from 0.69 to 4.01 [50]. In the present study, the overall Shannon-Weiner Index of plant diversity was estimated as H' =4.627, the species evenness as E =0.968, the species richness as R=14.44 and the Simpson's Simpson's diversity index as λ=0.0109. Neelamegam *et al*. [43] also reported species evenness as E=0.9, species richness as R =10.637, and Simpson's dominance as λ =0.022 in the HGs of rural Arumanalloor village. Similar observations were also made by Sunwar [51] and Abiskar Subedi *et al*. [52]. 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 Abishar Subedi *et al*. [52]. Tynsong and Tiwari [50] estimated evenness index and dominance index in five village HGs, and the evenness index ranged from 0.56 to 1.15 and the dominance index was ranged from 0.06 to 1.15. Kabir and Web [53] reported strong relationship between homegarden sizes with species richness in Bangladesh HGs.

According to Saikia *et al*. [54] high diversity and low concentration of dominance in different HG categories may be due to variations in anthropogenic pressure in different HGs. With increase in household size, more varieties in species composition were also

reported by Das and Das [40] in Barak valley, Assam. This suggests that the 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 and the homegarden often contain a large number of individuals for certain species that are commonly utilized by the households. Species found in homegardens from the study area are used for primary and secondary needs of the household.

CONCLUSION

Homegarden are generally regarded as a very complex species rich agro-ecosystem managed in a sustainable manner over decade or even countries. The major purposes of homegardens are sustainable production, proper utilization and income generation, if possible, particularly in rural areas, in addition to fulfill the important ecological, social and cultural function. Plant diversity is considered as a basic for homegarden productivity and sustainability, which is dynamic with time. Both species composition and plant diversity are largely influenced by a combination of various socio-economic and ecological factors. In this study, socio-economic condition of the households, structure and composition, distribution pattern and diversity indices of Swamithoppe village homegarden plants have been presented and assessed. Based on the result, it can be concluded that the homegarden surveyed were managed by mostly family members with low labour investment; the homegarden suitable for *in situ* conservation of genetic resources, but plant diversity may highly dynamic over time and in future, may be threatened by modernization and commercialization; the homegarden surveyed having a high plant diversity, evenness and richness with low dominance; the species composition in homegardens mainly influenced by garden size and various households socio-economic factors; and the urban vegetation also has significance in removing atmospheric pollution.

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Annexure Table

Table -I: List of species recorded in the homegardens of Swamithoppe village, Kanyakumari District, Tamil Nadu, India.

Sl. No.	Name of the species	Common name	Family	LF	C/W	E/P	UsPa	Uses
1	*Abelmoschus esculentus* (L) Moench	Vendai	Malvaceae	H	C	E/P	Fr	Veg
2	*Acalypha hispida* Linn.	Fox tail	Euphorbiaceae	H	C	E	Le	Med
3	*Acalypha indica* L.	Kuppai meni	Euphorbiaceae	H	W	E	Le	Med
4	*Achras sapota* (L) P.Royan	Sapota	Sapotaceae	T	C	E	Fr	Edi
5	*Allium cepa* L.	Ullie	Liliaceae	H	C	E/P	WP	Veg
6	*Aloe vera* (L) Burm F.	Kathazhi	Liliaceae	H	W	E	WP	MP
7	*Adenanthera ficoidea* Linn.	Ani Kundamani	Adenanthereae	H	W	E	Le	Med
8	*Amaranthus blitum* Linn.	Thandu keerai	Amaranthaceae	H	C	E	WP	Veg
9	*Amaranthus tricolor* L.	Spinach	Amaranthaceae	T	C	E	Le	Veg
10	*Amorphophallus paenoiifolus* Bl.	Karu-naik-kishangu	Araceae	H	C	E	WP	MP
11	*Anacardium occidentale* Linn.	Kollammaram	Anacardiaceae	S	W	E	WP	MP
12	*Ananas cosmosus* (L) Merr.	Annachi	Bromeliaceae	H	C	E	Fr	Edi
13	*Annana squmosa* Linn.	Sethapazhlam	Annonaceae	T	C	E	Fr	Edi
14	*Arachis hypogaea* L.	Verkadalai	Papilionaceae	H	C	E	Se	MP
15	*Areca catechu* L.	Pakkumaram	Arecaceae	T	C	E	Se	MP
16	*Artocarpus heterophyllus* (L.f.) Bhandari	Palamaram	Moraceae	T	C	E	WP	MP
17	*Auracaria sps.*.	Monkey tail	Auracareace	T	C	E/P	WP	Orn
18	*Averrhoa bilimbi* Linn.	Pulichankai	Geraniaceae	T	C	E	Fr	Edi
19	*Azadirachta indica* A.Juss.	Veppamaram	Meliaceae	T	C	E	WP	MP
20	*Bambusa arundinacea* (Retz.) Roxb.	Moongil	Gramineae	T	C	E	WP	MP
21	*Bauhinia acuminata* Linn.	Anthimantharai	Leguminosae	H	C	E	Fl	Orn
22	*Bougainvillea spectabilis* L.	Nyctaginaceae	Bignoniaceae	S	C	E	Fl	Orn
23	*Borassus flabellifer* Linn.	Panaimaram	Palmaceae	T	W	E	WP	MP
24	*Calophyllum inophyllum* Linn.	Punnaimaram	Guttiferae	T	W	E	WP	MP
25	*Cassia auriculata* L.	Avaram	Caesalpinaceae	Cl	C	E	WP	Orn
26	*Canna indica* L.	Kalvazhlai	Musaceae	T	C	E	WP	MP
27	*Calotropis gigantea* Linn.	Erukku	Asclepiadaceae	S	W	E	WP	Med
28	*Carica papaya* L.	Pappali	Caricaceae	T	C	E	WP	MP
29	*Catharanthus roseus* (L) G. Don.	Nithiya kalyani	Apocynaceae	S	C/W	E	Fl	Orn
30	*Celosia argentea var. cristata*	Kozhlivada	Amaranthaceae	H	C	P	Fl	Orn
31	*Centella asiatica* Linn.	Vallarai	Umbelliferae	Cr	C	E	WP	MP
32	*Chamabaina cuspidata* Wt.	Insulin plant	Urticaceae	H	C	E	WP	MP
33	*Cissus quadrangularis*	Pirandai	Vitaceae	H	C/W	E	Fl	Orn
34	*Citrus aurantium* Linn.	Naarthai(Sour)	Rutaceae	T	C	E	Fr	Edi
35	*Clitoria ternatea* Linn.	Chankkupoospam	Leguminosae	Cl	W	E	Fl	Orn
36	*Cocos nucifera* Linn.	Thennaimaram	Arecaceae	T	C	E	WP	MP
37	*Crossandra infundibuliformis* (L) Ness.	Kanagamaram	Acanthaceae	S	C	E/P	Fl	Orn
38	*Crotalaria verrucosa* Linn.	Kilukiluppai	Leguminosae	H	W	E	Fl	Orn
39	*Croton sparsiflorus* Linn.	Mannanaiveratti	Euphorbiaceae	H	W	E	Fl	Orn
40	*Cucumis sativa* L.	Vellarikai	Cucurbitaceae	Cl	C	E	Fr	Edi
41	*Cucurbita pepo* (L) Dumort.	Poosani	Cucurbitaceae	Cl	C	E	Fr	Edi
42	*Curcuma longa* L.	Manjal	Zingiberaceae	H	C	E/P	WP	MP
43	*Cyamopsis tetragonoloba* Taub.	Kothavarai	Leguminosae	Cl	C	E	WP	Veg
44	*Daemia extensa* Linn.	Veliparuthi	Asclepiadaceae	Cr	W	E	WP	MP
45	*Datura metal* Linn.	Oomatthai	Solanaceae	H	W	E	Fl	Orn
46	*Dolichos lablab* L.	Avarakai	Papilionaceae	Cl	C	E	Fr	Veg
47	*Dracaena sps.*	Happy plant/ Dragan tree	Asparagaceae	S	C	E/P	Le	Orn
48	*Duranta pluemeri* Jacq.	Goldan-dew-drop	Verbenaceae	S	C	E	Fl	Orn
49	*Eclipta alba* L.	Karisalankanni	Asteraceae	S	C	E	Fl	Orn
50	*Epipremnum aureum* (L) Engl.	Money plant	Araceae	Cl	C	E/P	Le	Orn
51	*Euphorbia heterophylla* L.	Ellaimelraja	Euphorbiaceae	S	C	E	WP	Med
52	*Euphorbia hirta* L.	Ammanpacharisi	Euphorbiaceae	H	W	E	WP	Med
53	*Euphorbia nilli* Linn.	Crown of thorns	Euphorbiaceae	H	C	E/P	WP	Med
54	*Ficus religiosa* Linn.	Arasamaram	Moraceae	T	C	E	WP	MP
55	*Furcraea gigantea* Vent.	Giant aloe	Dioscoreaceae	S	C	E/P	Fl	Orn
56	*Gomphrena decumbens* L.	Vadamalli	Amaranthaceae	H	W	E/P	Fl	Orn
57	*Hemidesmus indicus* L.	Nannari	Asclepiadaceae	H	C	E/P	Le	Med
58	*Hibiscus rosa sinensis* Linn.	Chembaruthi	Malvaceae	S	C	E	WP	MP
59	*Impatiens balsamina* L.	Balsam	Geraniaceae	H	C	E/P	Fl	Orn
60	*Ipomoea quamodit* L.	Mayilmanikam	Convolvulaceae	Cl	C	E/P	WP	Orn

61	*Ixora coccinea* L.	Thitti	Rubiaceae	S	C	E	WP	Orn
62	*Ixora sps.* L.	Idlipoo	Rubiaceae	S	C	E/P	WP	Orn
63	*Jasminum auriculatum* Vahl.	Malligai	Oleceae	H	C	E	Fl	Orn
64	*Jasminum multiflorum sps.*	Kattumalligai	Oleceae	H	W	E	Fl	Orn
65	*Jatropha* Linn.	Kattamanakku	Euphorbiaceae	S	W	E	WP	Fue
66	*Lawsonia innermis* L.	Maruthani	Lythraceae	T	C	E	Le	Med
67	*Leucas aspera* Spreng.	Thumbai	Lamiaceae	H	W	E	WP	Med
68	*Lycopersicum esculentum* Mill.	Thakkali	Solanaceae	S	C	E	Fr	Veg
69	*Mangifera indica* L.	Mamaram	Anacardiaceae	T	W	E	Fr	Edi
70	*Mentha piperita* L.	Pudina	Lamiaceae	S	C	E	Le	Veg
71	*Mirabilas jalapa* Linn.	Anthimantharai	Nyctaginaceae	H	W	E/P	Fl	Orn
72	*Momordica charantia* L.	Pagarkai	Cucurbitaceae	Cl	C	E	Fr	Veg
73	*Morinda tinctoria* Roxb.	Manjanathi	Rubiaceae	T	W	E	Wo	Fue
74	*Moringa oleifera* Lamk.	Murungaimaram	Moringaceae	T	C	E	WP	MP
75	*Murraya koengii* (L) Spreng.	Karuveppilai	Rutaceae	T	C	E/P	Le	Veg
76	*Musa paradisiaca* Linn.	Vazhlaimaram	Musaceae	T	C	E	WP	MP
77	*Mussanda erythrophylla* Hutch.	Queen sirikit	Rubiaceae	S	C	E	Fl	Orn
78	*Nerium indicum* Mill.	Arali	Apocynaceae	S	C	E	Fl	Orn
79	*Ocimum sanctum* L.	Tulasi	Lamiaceae	H	C	E	WP	MP
80	*Oldenlandia umbellata* Linn.	Indian madar	Rubiaceae	H	C	E/P	Fl	Orn
81	*Pandanus amaryllfolium* Roxb.	Rambai	Pandanaceae	H	C	E/P	Le	Veg
82	*Phaseolus vulgaris* Linn.	Beans	Fabaceae	Cl	C	E	Fr	Veg
83	*Phoenix sylvestris* Roxb.	Perichchamaram	Arecaceae	T	W	E	Fr	Edi
84	*Phyllanthus emblica* L.	Nellikamaram	Euphorbiaceae	T	W	E	WP	MP
85	*Phyllanthus niruri* Linn.	Kezhlanelli	Euphorbiaceae	H	C	E	Le	Med
86	*Piper nigrum* L.	Kaduku	Piperaceae	Cl	C	E	Fr	MP
87	*Pithecellobium dulce* (Roxb) Benth.	Kodukapuli	Mimosaceae	T	W	E	Fr	Edi
88	*Plectranthus amboinicus* (L) He'r	Karpuravalli	Labiatae	H	C	E/P	Le	Med
89	*Plumpago zeylanica* Linn.	Sky flower	Plumbaginaceae	H	C	E	WP	MP
90	*Polyalthia longifolia* (Sonner.) Thw.	Nettulingam	Annonaceae	T	C	E	WP	Orn
91	*Prunus avium* (L) L.	Cherry	Rosaceae	T	C	E	Fruit	Edi
92	*Psidium guajava* (L). Bot.	Koiyamaram	Myrtaceae	T	C	E	Fr	Edi
93	*Punica granatum* Linn.	Mathulai	Punicaceae	S	C	E	Fr	Edi
94	*Rhoeo spathacea sps.*	Boat lilly	Commenlinaceae	H	C	E/P	Fl	Orn
95	*Ricinus communis* Linn.	Ammanakku	Euphorbiaceae	S	W	E	WP	Med
96	*Rosa sps.*	Roja	Rosaceae	H	C	E/P	Fl	Orn
97	*Saccharum officinarum* Linn.	Karumpu	Gramineae	S	C	E/P	St	Edi
98	*Santalum album* L.	Santanamaram	Santalaceae	T	C	E	WP	MP
99	*Solanum capsicum* Linn.	Patchamilagai	Solanaceae	H	C	E/P	Fr	Veg
100	*Solanum melongena* Linn.	Kathirikai	Solanaceae	H	C	E	Fr	Veg
101	*Solanum torvum Swarta.*	Sundakai	Solanaceae	H	C	E	WP	Veg
102	*Solanum trilobatum* L.	Thuthuvalai	Solnaceae	Cl	C	E	Le	Veg
103	*Solanum nigrum* Linn.	Manathakalli	Solanaceae	H	C	E/P	Fr	Veg
104	*Stachytarpheta jamaicensis* Vahl.	Kattunaiurivi	Verbenaceae	H	W	E	WP	Med
105	*Syzygium cumini* (L) Skeels.	Navalmaram	Myrtaceae	T	W	E	WP	MP
106	*Tabernaemontana divaricata* R. Br. Ex. Roem. & Schult.	Nanthiya vattai	Apocynaceae	S	C	E	Fl	Orn
107	*Talinum portulacifolium* (Forssk.) Asch. Ex. Schweinf.	Galaghati	Portulacaceae	H	C	E/P	Fl	Orn
108	*Tamarandus indica Linn.*	Puliyamaram	Ceasalpinaceae	T	C	E	WP	MP
109	*Tecoma stans*	Manjapoo	Bignoniaceae	S	C	E	Fl	Orn
110	*Tecomaria capansis*	Cape honey Suckle	Bignoniaceae	S	C	E	Fl	Orn
111	*Tectona grandis* Linn.	Thekkumaram	Verbenaceae	T	C	E	WP	MP
112	*Tephrosia purpurea* (L)Pers.	Kollukainelai	Papilionaceae	H	W	E	Fl	Orn
113	*Terminalia catappa* Linn.	Badam	Combretaceae	S	C	E/P	Fr	Edi
114	*Thespesia populnea* L. Soland.	Poovarsamaram	Malvaceae	T	C	E	WP	MP
115	*Thuja occidentalis* L.	Arbor vitae/ White ceder	Cupressaceae	T	C	E	WP	Orn
116	*Trichosanthes anguina* L.	Pudalankai	Cucurbitaceae	Cl	C	E	Fr	Edi
117	*Vernonia cinerea* Linn.	Punarva	Asteraceae	H	W	E	Fl	Orn
118	*Wedalia trilobata* Jacq.	Pottralaikaiyyan	Asteraceae	Cr	C	E	WP	Med
119	*Zingiber officinale* Roscoe	Inji	Zingiberaceae	S	C	E	Fr	Veg

LF-Life forms;T-Tree; H-Herb; S-Shrub; Cl-Climbers; Cr-Creepers; C-Cultivated; W-Wild; WP-Whole Plant; E-Earthern; P-Potted; Veg-Vegetable; Orn-Ornamental; MP-Multipurpose; Le-Leaf; Fr-Fruits; Fl-Flower; Med-Medicinal; Edi-Edible; Se-Seeds; St-Stem;