

STRUCTURAL AND FUNCTIONAL ANALYSIS OF TROPICAL HOMEGARDENS: A CASE STUDY OF AVANOR GRAMA PANCHAYATH, THRISSUR

Prabhisha V.S¹, Jijeesh CM² and Jisha K.C¹*

1. Department of Botany, MES Asmabi College, P. Vemballur, Thrissur, Kerala, India

2. College of Forestry, Kerala Agricultural University

Corresponding author : jishakc123@gmail.com

ABSTRACT

Homestead farming or home gardening is a historical tradition that has evolved in many tropical countries over a long period of time. It is normally regarded as a system for the production of various crops for a family. The present research work was a detailed investigation on the diversity and functional characteristics of home gardens in Avanoor Grama panchayath Thrissur district in Kerala. From the results of the research work, it was found that the diversity of plant species was low in this panchayath compared to other similar studies. Among the three types of home gardens (small, medium and large), the diversity of plant species in small homegardens was found to be high when compared to large home gardens. This is mainly due to the small-scale farmers' dependence exclusively on their home gardens for their day to day need, so there the cultivations of food crops and vegetables are more in small home gardens. In large-scale home gardens, the cultivation of vegetables is low and they give more importance to the economically important cash crops and timber trees.

Keywords: Crops, cultivation, farming, home gardens, timber

INTRODUCTION

Homegardens are worldwide recognised sustainable agroforestry systems. They can be characterised as a land-use system located close

to the house where woody and non-woody species are intimately arranged in several overlapping canopy layers, sometimes in association with domestic animals. The basic objectives for maintaining this agroforestry system is to ensure availability of multiple products such as food, fuel, vegetables, fruits, fodder, medicines besides generating income and employment (Hoogerbrugge and Fresco 1993; Kumar and Nair 2004). The structural diversity of the home garden is a deliberate strategy that should be adopted by farmers to achieve higher efficiency of resource use by efficiently harvesting solar energy and using soil nutrients and moisture. Homegardens in Kerala effectively serve as human ecosystem with their low input demand, staggered supply of output and enhancement of habitat quality. A large population of the Kerala homegardens is being converted into small- scale plantations of coconut and rubber or cropping system consisting of fewer crops due to commercialization and fragmentation of land holding (Kumar and Nair, 2004). In the present research work an attempt is made to characterize the structural and functional attributes of selected homegardens by analysing the species composition from Avanoor Gramapanchayath (10 wards), Thrissur block, Thrissur District, Kerala. The study was also with the objective to study the nature of dynamics of homegardens characteristics and to know the changing trends in cultivation practices in this panchayath.

MATERIALS AND METHODS

Study area

The present study was carried out at the Avanoor Gramapanchayath of Puzhakkal Block in Thrissur District, Kerala. The total geographic area of the panchayath is 18.25km².

Methodology

A field survey was conducted in selected gramapanchayath to explore the structural and functional attribute of the homegardens. The field activity involved a Diagnosis and Design survey using semi structured questionnaire (Raintree, 1987). The selected gramapanchayath areas were subjected to stratified sampling at 50% intensity. Accordingly 10 wards (administrative unit) were randomly selected for the study in the Avanoor Gramapanchayath. Homegardens with holding sizes small (<30 cents), medium (30-50 cents) and large (>30 cents) were selected for each of the selected wards. Thirty homegardens were selected for each of size class from the panchayath.

The plant diversity in the selected homegardens was assessed following total counting. All the vegetation types were separately recorded. The service of experienced taxonomists and flora were used for identifying the plant specimens. The data on the plants were later tabulated into different functional groups. The counts were represented on average basis per homegarden. Also, the number of plants belonging to each functional group were represented on per ha basis for making effective comparisons.

Functional diversity is a tool for predicting the functional consequence of species traits in ecosystem level process (Petchey and Gaston 2006). Diversity index was calculated using Simpson equation.

$$\text{Simpson's diversity index (D)} = 1 - \frac{1}{\sum [n \div N]^2}$$

Where n represents the total number of a particular species and N is the total number of all species.

RESULTS

The results of the study on the structural and functional analysis of the selected homegardens in 10 wards viz. Velappaya, Medical College, Velappaya South, Manithara, Choolissery, Kolangattukare, Ambethkar Gramam, Avanoor, and Karore (ward numbers 1,3,4,5,6,7,10,12,14 and 15 respectively), of Avanoor Gramapanchayath of Thrissur District, Kerala were presented here.

Species Diversity

In general, there was wide variability in crop composition among the homesteads studied. Timber trees, Medicinal Plants, Fruit trees, and spices are predominant in almost all homestead chosen randomly from the 10 wards (1,3,4,5,6,7,10,12,14,15) of Avanoor Gramapanchayath in Thrissur District.

Presence of timber trees noticed in all the 90 homesteads but the number and kind varied. Coconut, arecanut and banana constituted the most important cash crops. The most popular one was coconut and which was seen in almost all Homegardens. Density of most of the components was higher in small- scale homegardens compared to medium and large homegardens. Functional diversity was shown in the Table 1. The results suggested that the fruit trees, medicinal plants and vegetables in the Small Homegardens were higher in number when compared to medium and large homegardens. The timber species and spices were higher in the medium homegardens.

Table 1: The Functional Diversity of various crop components in Avanoor Grama Panchayath, Thrissur District

SI NO	Components	Number per hectare in different Homegarden types		
		Small	Medium	Large
1	Timber	6	8	7
2	Fruit trees	10	8	6
3	Fodder	1	1	1
4	Medicinal plants	7	6	4
5	Spices	4	6	3
6	Vegetables	12	8	10
7	Rhizome and tuber	2	4	4

Medicinal trees

The density of medicinal trees was higher in small homegardens compared to that of large and medium (Table 2). The major medicinal trees of rural and urban homegardens are *Azadirachta*

indica, *Phyllanthus emblica*, *Myristica fragrans*, *Saraca asoca* and *Strychnos nux vomica*. The major medicinal tree species was nutmeg, and was also included in the cash crop.

Table 2: Occurrence of medicinal trees in homegardens of Avanoor Gramapanchayath, Thrissur District

SI NO	Species	Number of occurrence	Frequency (%)
1	<i>Azadirachta indica</i>	40	44.44
2	<i>Strychnos nux vomica</i>	5	5.55
3	<i>Myristica fragrans</i>	69	76.66
4	<i>Phyllanthus emblica</i>	26	28.88
5	<i>Saraca asoca</i>	3	3.33

Fruit trees and crops

Fruit trees are the major components in the homegardens of rural area. The most dominant fruit plant species are Mango, Jack, *Psidium guajava*, Guava, Annona, *Phyllanthus emblica*, Citrus, Papaya etc (Table 3).

Table 3: Density of fruit tree species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Density (Number of trees per acre)		
		Small	Medium	Large
1	<i>Artocarpus integrifolia</i>	11	7	3
2	<i>Mangifera indica</i>	15	8	7
3	<i>Citrus limon</i>	2	3	0.4
4	<i>Phyllanthus emblica</i>	7	2	3
5	<i>Annona squamosa</i>	5	2	1
6	<i>Psidium guajava</i>	9	8	5
7	<i>Passion fruit</i>	3	1.9	1.5
8	<i>Manikara zapota</i>	4	7	9
9	<i>Syzygium samarangense</i>	9	10	6
10	<i>Carica papaya</i>	8	10	5

Plantation crops

Plantation crops include Coconut, arecanut, rubber, banana and nutmeg. These were the main income crops of the homegardens. The density of the plantation crops was less in small homegardens compared to medium and large homegardens (Table 4).

Table 4: Density of Plantation crop species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Plantation crops	Number of crops per acre		
		Small	Medium	Large
1	<i>Cocos nucifera</i>	30	39	44
2	<i>Areca catechu</i>	15	25	30
3	<i>Hevea brasiliensis</i>	10	15	50
4	<i>Musa spe.</i>	85	66	130
5	<i>Myristica fragrans</i>	6	14	35

Vegetable Crop density

Vegetable cultivation is widespread in medium and small homegardens, while the large farmers prefer commercial crops over vegetable crops (Table 5). Cowpea dominated in the

vegetable crops, and its cultivation was higher in medium homegardens. Murraya is widespread in all the homegardens. The cultivation of vegetables was more in medium homegardens compared to small and large homegardens.

Table 5: Density of Vegetable crop species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Density		
		Small	Medium	Large
1	Cow pea	18	25	11
2	Chilly	23	30	28
3	Tomato	20	19	10
4	Cucurbits	15	16	11
5	Murraya	9	15	7
6	Amaranthus	12	15	9
7	Bittergourd	30	26	18
8	Cauliflower	10	12	18
9	Lady finger	17	22	12
10	Brinjal	14	18	9
11	Yam	22	18	14
12	Ivy gourd	10	8	5
13	Snake gourd	25	28	15
14	Pumpkin	11	15	12

Spices and Condiments

The diversity of spices and condiments was more in large homegardens. Pepper is the most common. Cinnamon is relatively low in the three homegardens (Table 6).

Table 6: Density of Spices and Condiments species in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Density		
		Small	Medium	Large
1	Pepper	15	18	25
2	Ginger	10	14	19
3	Cinnamon	2	1	2.9
4	Turmeric	12	18	17
5	Nutmeg	5	11	23

Rhizome and Tubers

The major tuber crops like tapioca, elephant yam, ginger, turmeric and colocassia. The tapioca, elephant yam and colocasia in higher in small homegardens. Turmeric and ginger density low in the small homegarden. Colocassia is very low in the large homegarden (Table 7).

Table 7: Density of Rhizome and Tubers species in different homegardens of Avanoor gramapanchayath Thrissur District

SI NO	Species	Density		
		Small	Medium	Large
1	Turmeric	12	18	17
2	Elephant yam	22	18	14
3	Ginger	10	14	19
4	Tapioca	37	35	30
5	Colocassia	30	14	8

Timber species

Results indicated that *Mangifera indica* was the most common timber tree species in all homegardens. *Artocarpus heterophyllus*, *Tectona grandis*, *Garcinia gummi-gutta* are the

other commonly cultivated trees. *Tamarindus indica*, *Swietenia magagoni* and *Ailanthus excelsa* were recorded from only a few homegardens (Table 8).

Table 8: The Functional diversity of the timber species in different homegardens of Avanoor Grama Panchayath, Thrissur District

SI NO	TIMBER	Number per hectare in different homegarden types		
		Small	Medium	Large
1	<i>Mangifera indica</i>	1.8	2.7	3.36
2	<i>Artocarpus heterophyllum</i>	0.73	0.63	1.4
3	<i>Tectona grandis</i>	0.37	0.83	0.57
4	<i>Tamarindus indica</i>	0	0.2	0.26
5	<i>Garcinia gummi-gutta</i>	0.1	0.07	0.07
6	<i>Swietenia mahagoni</i>	0	0.07	0
7	<i>Ailanthus excels</i>	0	0	0.07
8	<i>Anacardium occidentale</i>	0.07	0.07	0
9	<i>Ficus callosa</i>	0.07	0.23	0.07

Livestock

Livestock population is higher in large homegarden. The poultry density is higher in the

three categories of the homegardens. In small homegarden the cow density is low compared to medium and large homegardens (Table 9).

Table 9: Density of Livestock in different homegardens of Avanoor gramapanchayath, Thrissur District

SI NO	Species	Small	Medium	Large
1	Cow	10	15	12
2	Goat	12	10	11
3	Poultry	25	28	33

DIVERSITY INDEX

The plant diversity index was calculated by Simpson index formula. The Simpson index was 0.625, 0.631, and 0.593 for small, medium and

large homegardens, respectively. The diversity index was high in medium homegardens compared to small and large homegardens (Table 10-12).

Table 10: The Diversity Index of small scale Homegardens

SI NO	Species	Number of individual (n)	(n/96) ²
1.	<i>Mangifera indica</i>	53	0.3047
2.	<i>Artocarpus heterophyllum</i>	22	0.0525
3.	<i>Tectona grandis</i>	11	0.0131
4.	<i>Garcinia gummi-gutta</i>	3	0.0009
5.	<i>Anacardium occidentale</i>	2	0.0004
6.	<i>Ficus callosa</i>	5	0.0027
	Total	N =96	0.3743
		$D = 1 - (\sum(n/N)^2) = 0.625$	

Table 11: The Diversity Index of medium scale Homegardens

SI NO	Species	Number of individuals (n)	(n/144) ²
1.	<i>Mangifera indica</i>	81	0.3164
2.	<i>Artocarpus heterophyllum</i>	19	0.0174
3.	<i>Tectona grandis</i>	25	0.0301
4.	<i>Tamarindus indica</i>	6	0.0017
5.	<i>Garcinia gummi-gutta</i>	2	0.0001
6.	<i>Swietenia mahagoni</i>	2	0.0001
7.	<i>Anacardium occidentale</i>	2	0.0001
8.	<i>Ficus callosa</i>	7	0.0023
	Total	N = 144	0.3682
		$D = 1 - (\sum(n/N)^2) = 0.631$	

Table 12: The Diversity Index of large scale Homegardens

SI NO	Species	Number of individuals (n)	$(n/174)^2$
1.	<i>Mangifera indica</i>	101	0.3369
2.	<i>Artocarpus heterophyllum</i>	42	0.0582
3.	<i>Tectona grandis</i>	17	0.0095
4.	<i>Tamarindus indica</i>	8	0.0021
5.	<i>Garcinia gummi-gutta</i>	2	0.0001
6.	<i>Ailanthus excels</i>	2	0.0001
7.	<i>Ficus callosa</i>	2	0.0001
	Total	N = 174	0.407
		$D = 1 - (\sum (n/N)^2) = 0.593$	

The diversity index of the timber species was high in the medium homegardens and was lower in the large homegardens. The Diversity Index of the

species in the small homegardens was found to be in between the large and medium home gardens (Table 13).

Table 13: The Diversity Index of the Timber species of various Homegardens

DIVERSITY	SH	MH	LH
	0.625	0.631	0.593

DISCUSSION

Homegardens in Kerala represent a subsistence land -use system typical of tropical south Indian, where interaction and intimate association of different production components (crop-tree-animal mix combine) *in situ* are intensively facilitated and managed by family labour so as not only to meet the food production but also to generate additional income through the sale of farm surplus. The structural diversity of the home garden is a deliberate strategy that should be adopted by farmers to achieve higher efficiency of

resource use by efficiently harvesting solar energy and using soil nutrients and moisture. The functional diversity of the system helps to meet the many demands of food, fodder, fuel, timber, organic mulch and medicinal plants.

The study carried out in the homegardens of 10 wards of Avanoor Grama Panchayath revealed the presence of the various plant species comprise of 9 Timber trees, 12 Vegetable species, 8 Medicinal plant, 8 Fruit species, 6 spices species and 4 Rhizome and Tuber crops. Kumar et al.

(1994) encountered 127 woody species from 17 selected taluks of Kerala state. Nair and Sreedharan (1986) had reported 30 arboreal taxa from the homegardens of Kerala. Babu et al. (1982) however observed a total of 36 species of woody perennials from the homestead of Southern districts of Kerala. However, the major species reported in the present research work include cash crops like coconut, arecanut, nutmeg dominated in most of the homegardens. The dominant timber trees include Teak, Jack, Mango tree, Mahogany etc. While the dominant fruit trees include Mango, Jack fruit Guava, Garcinia etc.

Coconut based systems were predominant in all the categories of homegardens. Other annual and perennial components were distributed in time and space around coconut. Arecanut based system had only subsidiary importance compared to coconut - based system. Monoculture of rice was predominant among large and medium farmers taking advantage of the kole lands. Monoculture of rubber was also observed though not coming under the purview of homestead cultivation. Regeena (2007) surveyed the homestead farms of the South zone of Kerala comprising of the three districts of Thiruvananthapuram, Kollam and Pathanamthitta and the data revealed that the homegardens, though under threat from monocultures of commercial crops like *Hevea brasiliensis*, were repositories of plant biodiversity and warranted to be documented and conserved. Animals provide nutrient - rich food products, draught power, dung as organic manure and domestic fuel, hides and skin, and are a regular source of cash income for rural households. Teak, mahogany ailanthus etc. was raised along the boundary in double hedge rows of 3m x 3m spacing. *Gliricidia* was planted mostly at a closer spacing 1x1 m mainly to accommodate more number of plants more biomass. It is also used as pepper standard in some medium and larger

homegardens. Studies of Kerala homedardens have traditionally emphasized species inventories (Nair and Sreedharan, 1986).

CONCLUSION

Homestead farming or home gardening is a historical tradition that has evolved in many tropical countries over a long period of time. It is generally understood to be a system for the production of subsistence crops for the cultivator and his/her family. The present study was a detailed investigation on the diversity and functional characteristics of home gardens in Avanoor Grama panchayath Thrissur district in Kerala. The diversity of plant species was low in this panchayath compared to other similar studies. The diversity of plant species in small homegardens was high compared to large home gardens. This is because the small-scale farmers depend exclusively on their home gardens for their day to day need, so there are large cultivations of food crops and vegetables are seen. In large-scale home gardens the cultivation of vegetables is low and they give more importance to the economically important cash crops and timber trees. Future strategies to improve homestead farming should aim at watershed-based development with focus on a whole-farm or systems approach; restructuring and refining existing home gardens, and developing sustainable models through a farmer-participatory approach for each agro-ecological zone; forming homestead clusters; creating germplasm registers; bridging the yield gap by improving crop productivity; developing post-harvest technology of home garden products; generating non-farm employment opportunities; promoting and improving rural financial networks; providing essential rural infrastructure; creating coalitions to address policy concerns at all levels; and broadening consumer perspectives.

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