STRUCTURE AND SPECIES DIVERSITY OF TRADITIONAL HOMEGARDENS IN BATTICALOA DISTRICT

S. Krishnal[1], J. Weerahewa[2]

ABSTRACT

A homegarden is part of a household livelihood strategy and has gained prominence as a natural asset through which sustainable use of resources, for the livelihoods of the poor, may be achieved. Despite the benefits, homegardens in the Batticaloa district have not been evaluated in-depth. This study focused on the composition, structure, diversity and different systems of homegardens in the Batticaloa district. The study was conducted in three Divisional Secretariat divisions in the district where 206 samples were collected. Results of the study revealed that average number of trees per household was 6.56. Species richness, varied from 2- 56 with the mean of 12.93. Mean Shannon index was 0.66. Two different types of systems were identified viz., Single layered and Multi layered systems. Single storied system composed only of banana or cashew or coconut trees. Only 23% homegardens were classified as single layered system while the rest were multi layered system.

Keywords: *Homegarden, Diversity, Shannon index, Evenness, Composition*

INTRODUCTION

A homegarden is part of a household livelihood strategy and has gained prominence as a natural asset through which sustainable use of resources, particularly for the livelihoods of the poor, may be achieved. Homestead gardening systems provide an important contribution to sustainable agricultural production because of their potential to meet economic, social, ecological, and institutional conditions for sustainable livelihoods (Nair, 2006).

Tropical homegardens consist of an assemblage of plants, which may include trees, shrubs, vines, and herbaceous plants, growing in or adjacent to a homestead or home compound. The word "homegarden" has been used rather loosely to describe diverse practices. It is used to refer to intimate association of multipurpose trees and shrubs with annual and perennial crops and, invariably livestock within the compounds of individual houses, with the whole crop-tree-animal unit being managed by family labor (Fernandes and Nair, 1986). It is a micro-environment composed of a multi-species (annual to perennial, root crops to climbers etc), multi-storied and multi-purpose garden situated close to the homestead (Quat, 1996; Watson and Eyzaguirre, 2002; Hodgkin, 2002). A home garden also refers to the traditional land use system around a homestead, where several species of plants are grown and maintained by the household members and their products are primarily intended for the family consumption. Several terms have been used to describe these garden production systems, such as "homestead garden, backyard garden, kitchen garden, agro forestry, mixed garden, garden culture, etc" (Helen Keller International, 2001; Mictchell and Hanstad, 2004). Diversity of plant species and the layered canopy of species are the most striking features of homegardens, with all homegardens generally consisting of "a herbaceous layer near the ground, a tree layer at upper levels, and intermediate layers in between" (Nair 1993).

[1] *Department of Agricultural Economics, Faculty of Agriculture, Eastern University, Sri Lanka.*

[2] *Department of Agricultural Economics and Business Administration, Faculty of Agriculture, University of Peradeniya, Sri Lanka.*

Species diversity in tropical home garden is reported to be very high due to species having different life forms, height and canopy structure (Babu *et al.*, 1994; Soemarwoto and Conway,1991). Distribution of species in the home garden creates a forest like multistorey structure (Singh, 1987). Structure of home gardens varies from place to place depending upon the socio-economic and ecological conditions (Soemarwoto, 1987).

Home gardens are perhaps the best-developed agroforestry system in Sri Lanka. This system of perennial cropping has been practiced for centuries. It is essentially mixed cropping with a variety of tree species that provide food, fruits, timber, medicine and spices. The significance of homegardens to rural livelihoods is well appreciated throughout the world (Fernandes and Nair, 1986; Soemarwoto, 1987; Torquebiau, 1992; Jose and Shanmugaratnam, 1993; Nair, 2006). The garden may become the principal source of household food and income during periods of stress, e.g. the preharvest lean season, harvest failure, prolonged unemployment, health or other disabilities suffered by family members or agricultural and economic disruption caused by warty as well.

Despite the above potential benefits of Homegarden, a review of literature clearly showed that there is a lack of research on plant species diversity and different systems of the homegardens in the Batticaloa District. Within this context this study aimed at analyzing the plant species structure and species diversity of homegarden in Batticaloa. Specific objectives were to identify the species composition of homegarden in Batticaloa, to analyse the species richness, diversity and evenness of homegardens, and to investigate the different systems of homegardens in Batticaloa district.

METHODS AND METHODOLOGY

Study site and sampling

Three Divisional Secretariat (D.S.) divisions were selected where comparably higher extent of homegarden were found viz., Eravurpattu, Manmunai South & Eruvilpattu and Korelapattu D. S. divisions. (Department of Census and Statistics, 2002). They rank first, second and third with the extents of 1645.5, 1533.6 and 1426.1 acres respectively. In these three D. S. divisions, eleven Grama Niladhari divisions were selected and from those, seventy, sixty seven and sixty nine samples were collected respectively from each Divisional Secretariat divisions by personal visit and altogether 206 samples were collected. The unit of analysis is household homegardens for tree inventory.

Data on names of crops, DBH, height (m), and growth stages were also obtained through tree inventory data.

Data analysis

Species composition of Homegardens in Batticaloa

Most common homegarden tree species were identified and their frequency of occurrence and the average yield per annum were calculated.

Diversity and systems of homegardens

To determine the species diversity, species richness and species evenness were calculated. By using Shannon diversity index different systems of homegardens in the surveyed area were identified. Shannon Wiener index and Evenness measure (E), which are commonly used tools for these purposes (Pielou, 1969: Magurran, 1988; Huston, 1995) were computed.

Shannon Diversity Index

$H = {}^{s}\sum_{i=1} - (P_i * \ln P_i)$

Where, H = Shannon diversity index

P_i = fraction of the crop area composed of species i.

S = numbers of species encountered

$\sum$ = sum from species 1 to species S

The measure of Evenness (E) is the ratio of observed diversity to maximum diversity and it is calculated as,

E = H/Hmax,

E = H /lnS (Magurran, 1988)

Classification of systems in Homegarden

By using the Shannon – Weiner index for different homegardens, the different systems were identified. The index having the value of 0 and with single canopy was considered as single layered system. The Shannon index of 0.1 and above and having more than one canopy were considered as multi layered systems.

Profile diagram of home garden was constructed according to appearance and height of the plant species.

RESULTS AND DISCUSSION

Species composition of Homegardens in Batticaloa

The most common tree species recorded during this survey were listed in Table 01. They include coconut, cashew, mango and banana. Average number of trees per household was 6.56. An average of 3.02 coconut trees per household was recorded followed by 1.39 banana trees per household. One coconut tree yielded an average of 111.5 nuts in a year. A mean number of 755 fruits per tree were yielded in cashew trees, but a year round production was not observed in cashew plants.

Species richness, diversity and evenness

Species richness, varied from 2- 56 with the mean of 12.93. The abundance of plants in these gardens is generally uneven because some species, particularly coconut are more dominant.

Shannon Index gives a measure of both species numbers and the evenness of their abundance. The results revealed that Shannon index progressed from 0 to 1.79 with the mean and standard deviation of 0.66 and 0.44 respectively. The high diversity in some homegardens could be the result of selection of species by the owners with utility of the specific products as the main criterion. Shannon value of 0 means there is only one species in that homegarden. The index is increased either by having additional unique species, or by having greater species evenness.

An evenness value of 0 was observed in 23% of homegardens where coconut or cashew or banana alone shared 100% of the crop area. A community dominated by one or two species is considered to be less diverse than one in which several different species have a similar abundance. The mean evenness value of 0.615 for the sampled area indicated that evenness in abundance of the species is 61.5% of what would have been under uniform or even distribution.

Results also indicated that there exists a large variation in diversity and evenness among homegardens. Plant species richness and diversity of plants varied considerably in the areas and hence in addition to the integrated multi-storey gardens, patches of less complex and monoculture composing of coconuts or bananas or cashews were also found. This variation is likely to affect the long-term sustainability of the systems because studies indicate that the diversity and complex

structure of homegardens is responsible for positive agroecosystem functions (Jensen, 1993). Okafor and Fernandes (1987) have also reported that replacement of compound homegardens with monocropping in Nigeria has resulted in severe soil degradation and poor yields. It is also argued that intensification could increase production but in many cases it reduces output stability and resource use efficiency and enhances over-exploitation of the resource base (Almekinders *et* al., 1995). But, why there is a variation in the diversity and composition of plants different in these agro ecologically similar areas, or why do farmers alter the diversity and composition of crops in their farms? Transport facilities, soil characters, access to water and market facilities can be considered as some of the reasons.

Some studies also have indicated that access to markets (Wiersum, 1982; Soemarwoto and Conway, 1991), access to road (Kaya *et al*., 2002), altitude (Soemarwoto and Conway, 1991), and farm size (Wiersum, 1982; Jacob and Alles, 1987; Rico Gray *et al*, 1991) affect the diversity and composition of plants in homegardens.

Classification of systems in Homegarden

On the basis of Shannon- Weiner index and number of canopies, two different systems were identified viz., Single layered and multi layered cropping systems (Table 02)

Table 01: Most common homegarden tree species in Batticaloa and their frequency of occurrence

Trees (Generic name)	Scientific name	Average number of trees per HG	Avg. yield of tree/ annum
Coconut	*Cocos nucifera*	3.02	111.5 nuts
Banana	*Musa paradisiaca*	1.39	1 bunch
Cashew	*Anacardium occidentale*	0.89	755 fruits
Mango	*Mangifera indica*	0.51	325 fruits
Moringa	*Moringa oleifera*	0.15	86.5 fruits
Palmyrah	*Borassus flabellifer*	0.14	135
Jack	*Artocarpus heterophylla*	0.14	8 fruits
Pomegranate	*Punica granatum*	0.07	9 fruits
Orange	*Citrus sinensis*	0.06	23 fruits
Arecanut	*Areca catechu*	0.05	201 nuts
Guava	*Psidium guajava*	0.03	15 fruits
Neem	*Azadirachta indica*	0.02	-
Lime	*Citrus aurantifolia*	0.02	16 fruits
Anona	*Annona muricata*	0.01	9 fruits
Karapincha	*Murraya koenigii*	0.01	-
Lemon	*Citrus limon*	0.01	12 fruits

Table 02: Mean Shannon and Evenness values

Systems	Mean Shannon index	Mean Evenness value
Single layered	0	0
Multi layered	0.86	0.79

Single storied system composed of banana or cashew or coconut trees with the mean height of 4m, 8.04m and 9.09m respectively. In the study only one stratum could be seen. Only 23% homegardens were classified as single layered system (Figure 01). In the multi system the lower layer dominated by different vegetable crops such as *Solanum melongina*, *Capsicum annum*, *Vigna unguiculata*, *Abelmoschus esculentus*, *Momordica Charantia*, *Manihot esculenta* and so on (less than 1m height), the second layer composed of fruit trees such as *Annona muricata*, *Citrus aurantifolia*, *Citrus limon*, *Musa paradisiaca*, *Citrus sinensis* , *Punica granatum* and trees such as *Murraya koenigii* and *Moringa oleifera* (2- 6m in height). Mangifera indiaca, *Anacardium occidentale*, *Psidium guajava*, *Carica papaya* and *Azadirachta indica* (8- 10m in height) constitute the third layer. The fourth storey made up of *Areca catechu*, *Artocarpus heterophylla* and *Borassus flabellifer* (10-15m in height). *Cocos nucifera* (15-20m) constitutes the top most layers. But all the homegardens do not consist of all these layers. It may vary from 2- 5. Michon (1983) reported, from an analysis of the structure of the *Pekarangan* in the Citarum watershed in West Java, a five-layered canopy structure. The multi-layered, forest-like vegetation structure of homegardens contributes substantially to the ecological sustainability of the village ecosystems (Kehlenbeck and Maass 2004).

Based on these a schematic presentation was developed showing the vertical canopy zonation of multi storied system in Batticaloa and is presented in Figure 02.

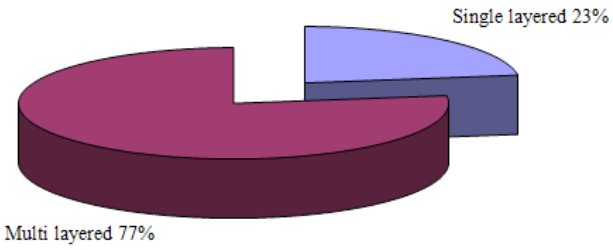

Figure 1: Frequency of different systems in study area

Figure 2: Schematic presentation of the vertical canopy zonation of multi storied system in Batticaloa Homegarden

CONCLUSIONS

This study set out to investigate the composition, structure, diversity of plant species and different systems of homegardens in Batticaloa district. The study was carried out in three Divisional Secretariat divisions. The study revealed that the most common tree species recorded during this survey were coconut, cashew, mango and banana. It was found that there were two different systems of homegardens on the basis Shannon value and number of canopies. Shannon value of 0 yielded the single layered system which comprised only banana or cashew or coconut. 77% of the homegardens were Multi storied system composed of different tree combinations, but tree species were not homogenous among homegardens.

Mean species richness was 12.93 for the sample. Shannon index ranged between 0 to 1.79 showing a high variation among home gardens from mono cropping to multi cropping. The mean evenness value of 0.615 for the sampled area indicated that evenness in abundance of the species is 61.5% of what would have been under uniform or even distribution.

The study brings to fore the biodiversity value of the home gardens. A well-developed home garden with different annuals and perennials can play a crucial role in providing household of high-nutrient food items, in low input costs, through producing diversity of food items that is consumed on a daily basis. Therefore a multistoried system with annual and perennial species in systems would be considered as an essential component for rural poor.

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