

## Evaluation of the Structure and Functions of Home Garden: A case study in Vavuniya District, Sri Lanka

S.Vijitharan<sup>1</sup>

### Abstract

*Home gardens are represented as multi-purpose agroforestry system with ecological and economical sustainability. The objective of the study was to investigate the socioeconomic features of the study population and evaluation of the structure, species diversity and different methods of home garden. Primary data was collected from 30 randomly selected home gardens in urban areas of Vavuniya D.S Division through questionnaire survey and field observations. The collected data were analyzed using Minitab 17. The majority of the farmers were females (60 %) and remaining were males. The respondents of the study population were 21 to 75 years of age and around 50% of younger farmers have been involving in home gardening activities. The size of the home garden ranged from 0.05 to 1.5ha. The diversity indices estimated for home gardens as Shannon index was 2.08 and Species evenness was 0.18. 70% of home gardens have more than 10 different plant species. Positive correlation was found between age of home garden owner – size of home garden and age of home garden owner – plant diversity ( $p < 0.05$ ). In the study area, the raised bed method, pot method and packets methods used by farmers as 47%, 10%, 27% respectively. The various types of home garden patterns observed, among these 43% of them had ornamental plants. This study recommends that creating community based awareness programs among the households about the significance of well-developed home gardens for their consumption of daily basis high-nutrient food items for sustained life.*

**Key Words:** Home garden, Structure, Shannon index, Evenness

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<sup>1</sup> Department of Bio-Science, Faculty of Applied Sciences, Vavuniya Campus, Sri Lanka  
sarani300@gmail.com

## Introduction

Home gardens are conventional agro-forestry systems and characterized by the complexity of their structure and multiple functions. Home gardens have various levels of stratified layer and valuable for medicine, fruits, vegetables and biodiversity conservation (Dissanayake & Hettiarachchi, 2013) and the produces are mostly used for household purpose such as supplementary food (Christanty, 1990) not retailed on local market (Gebauer, 2005). Tropical home gardens consisted a diversity of plants as trees, shrubs and herbaceous plants (Fernandes & Nair, 1986) and it has the herbaceous layer near the ground, tree layer at the upper levels and intermediate layers in between ground and upper level (Nair, 1993). Species diversity in tropical home garden was very high due to the different height of plants, life forms and the canopy structure of plant species (Babu *et al.*, 1994; Soemarwoto & Conway, 1991) therefore, it showed the multistoried structure (Singh, 1987). Home gardens structure can be varied from place to place due to the socio-economic and ecological conditions (Soemarwoto, 1987).

In Sri Lanka, home gardens are the best developed agroforestry system and it was a mixed cropping system with diversity of plant species that can be provided the services and products. Rural livelihoods were appreciated through home gardens in worldwide (Fernandes & Nair, 1986; Jose & Shanmugaratnam, 1993; Nair, 2006; Soemarwoto, 1987; Torquebiau, 1992). The spatial dimension of home garden can be divided as horizontal strata and vertical strata. The vertical strata was consisted only the vegetation component but the horizontal strata was extended to all components as livestock, buildings and vegetation. These strata have the constant change by season and the age of the garden.

Sri Lanka is a developing country and agriculture is the main food production system (Johnson, 2000). People are interested in home gardening activities because they believe that they can get additional benefits through home gardening and it will fulfill their needs. Home gardening is the most effective way to get the organic products and other environmental benefits (Dissanayake & Hettiarachchi, 2013). Particularly in urban areas, most of the household have ornamental plants than rural area and also gardens had multipurpose trees such as medicinal plants, spices, fruits and timber species. Different methods of home gardens are practiced because of the land scarcities such as pot method, packet method and vertical gardening. Vavuniya district is the agricultural based district and people are not aware of the home gardening activities, therefore, this study was designed to investigate the socio-economic features of the study population and evaluation of the structure, functions and different home garden techniques and methods in Vavuniya D.S Division.

## Materials and Methods

### Description of Study Area

This study was carried out in urban area of Vavuniya D.S division. The Vavuniya district situated in the Northern part of Sri Lanka and falls under the dry zone of Sri Lanka. The climatological conditions are suitable for cultivation such as the mean temperature is 28°C and annual rainfall is 1400mm. The study area was targeted the urban area home gardens in Vavuniya D.S division because they have the problem of land scarcity in congested area and around 50 % of underutilized home gardens were found in this division due to various reasons.

### Data Collection and Analysis

Thirty home gardens (40 %) were randomly selected in urban area of Vavuniya D.S division and required data (socio-economic data, home gardening methods, household waste management and structure of home garden) was collected through questionnaire survey and field visits. Each household was surveyed using questionnaire for socio-economic factors, plant species, and extent of garden, methods of pest control, vertical canopy zonation and different methods of home garden techniques. Species diversity indices were calculated using Shannon index (H) and species evenness index (E<sub>H</sub>). The collected data were analyzed using Minitab 17.

#### Shannon – Wiener Index (H)

Shannon index is a measure of species abundance and richness to quantify diversity (Shannon and Weaver, 1949).

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

Where:

H = Shannon diversity index

P<sub>i</sub> = Fraction of the entire population made up of species i

S = Numbers of species encountered

∑ = Sum from species 1 to species S

#### Species Evenness Index (E<sub>H</sub>)

Evenness is used to measure the ratio of the actual diversity value to the maximum possible diversity by using following equation:

$$E_H = H/H_{max} \text{ (Magurran, 1998).}$$

## Results and Discussion

### Population Dynamics of Study Area

The majority of the farmers were females (60%) and remaining were males. The respondents of the study population ranged from 21 to 75 years of age and around 50 % of younger farmers have been practicing the home gardens. Around 74% of the farmers had knowledge in medium level of education.

### Home Gardening Activities in the Study Area

Research finding revealed that, home gardeners grown different types of plant species such as vegetables, fruits, ornamental plants, medicinal plants and multipurpose trees. These different varieties of plants were increased the environmental and economical benefits. Structure of the home garden was varied from place to place and it was depended on the ecological, environmental, socio-economical and cultural characteristics (Kryono, 1985; Kumar & Nair, 2004). The size of the home garden ranged from 0.05 to 1.5ha and size of the small household's home gardens were less than 1ha. In this study area, people were interested on home gardening activities due to the usage of organic agricultural products and to increase the supplementary income from the gardening activities. Furthermore, around 60 % of females were engaged in home gardening to fulfill their daily needs and make the aesthetically pleasant environment. And the various organic methods were used to increase the crop yield. Householders said that, around 50% of the fruits, some kind of vegetables and flower were obtained from their garden. According to the correlation analysis, plant density was increased with increasing size of home garden but there was no any significant relationship between plant diversity and size of home garden ( $p < 0.051$ ). Positive correlation was found between the age of home garden owner – size of home garden and age of home garden owner – plant diversity ( $p < 0.05$ ).

Table 1. Organic pest control methods followed by farmers

Organic pest control methods	% of respondent
Organic productions	10.0
Repellent crops	13.0
Manual clearing	43.0
Crop rotation	34.0

Table 1 showed that, different organic pest control methods were used by farmers such as 10% of them used organic productions, 13 % repellent crops, 43% manual clearing and 34% of them used crop rotation to control the pest. Around 34% of farmers followed crop rotation to control the pest because crop rotation was an effective method to reduce pest and disease problems and farmers grown enemy plants such as *Helianthus annuus* and *Chrysanthemum* in their field and manual clearing was carried out by destruction of crop residues by ploughing and shredding. Therefore, organic pest control methods were practiced in home gardens and it was an effective pest control method to small scale gardens.

Seventy percentage (70%) of home gardens have more than 10 different plant species (Table 2). In case of home garden pattern; vegetable, medicinal, edible ornamental and multipurpose uses were recorded from the home garden respondents with an overall 40% of them had ornamental plants. Home gardens showed the complex structure in vertically and horizontally. The vertical structure of the home gardens has different height level of strata as herb (<1 m), shrub (1 to 5 m), understory layer (5 to 10 m) and canopy layer (>10 m) and this result was supported by Fernandes and Nair, 1986. In this study area, 3 to 4 layers of vertical strata's were observed but commonly 3 layers were recorded. The upper most layer has the perennial trees. The commonly found species were *Mangifera indica*, *Areca catechu*, *Azadirachta indica*, *Musa* species and *Cocous nucifera*. Below this layer, both perennial and annual plants were recorded such as *Citrus limon*, *Hibiscus rosa-sinensis* and *Rosa* species.

The Shannon index showed a moderate diversity of plant species in the study area with 2.08 while the value of Shannon index usually falls between 1.5 and 3.5. The Shannon index is used to compare the diversity between various habitats (Ajmal, 2016). This study area home gardens are categorized as multilayered system because this system has consisted with more than 2 canopy layers. The species evenness were calculated as 0.18 and it was usually ranged from 0 to 1. The evenness index showed that plant species in home gardens were not equally abundant due to the householder's preference and their needs.



Table 2. Identified trees in the study area

Common Name	Scientific Name
Mango	<i>Mangifera indica</i>
Coconut	<i>Cocos nucifera</i>
Arecanut	<i>Areca catechu</i>
Neem	<i>Azadirachta indica</i>
Palmyra	<i>Borassus flabellifer</i>
Curry leaf	<i>Murraya koenigii</i>
Jack	<i>Artocarpus heterophylla</i>
Lime	<i>Citrus aurantifolia</i>
Banana	<i>Musa paradisiaca</i>
Teak	<i>Tectona grandis</i>
Guava	<i>Psidium guajava</i>
Rose apple	<i>Syzygium jambos</i>

Table 3. Reasons for following home garden

Reasons for doing home garden	% of respondent
Vegetables are high price in market	6.0
Prevent from non-communicable diseases	47.0
Market vegetables are contaminated by pesticide	37.0
For hobby	3.0

Table 3 shows that, around 47% of them considered non communicable diseases and another 37% of farmers considered the pesticide contamination. Altogether, around 91% of farmers have given the priority to their health and pesticide contamination than price of vegetables in market. Therefore, they followed the home gardens and farmers believed that organic pest control methods were used to protect the human health and prevent from health risks. Based on the statistical test, there was a positive correlation found between the education level and awareness of home gardening ( $p < 0.05$ ).

#### Different methods of home garden

Farmers practiced different methods of home gardens such as raised bed method, pot method (Figure 3), bottle method, Polybag method and vertical method (Figure 2). In this study area, around 47% of them raised bed method, 10% pot method, 27% packets method, 10% bottle method and 6% vertical

method (Figure 1). Vertical Gardens provide the economic and ecologic benefits as well as aesthetic value. These different gardening methods (pot method, bottle method, packets method and vertical method) were cost effective and reduce the wastes (pots, unwanted bottles and packets) from households and reuse these wastes as crop containers. Home gardeners used their kitchen wastes and back yard wastes for home gardening activities. Around 67% of them buried their back yard waste and kitchen wastes to crops and 33% of them prepared compost by using their home wastes. Therefore, home gardeners have clear knowledge on the waste management.

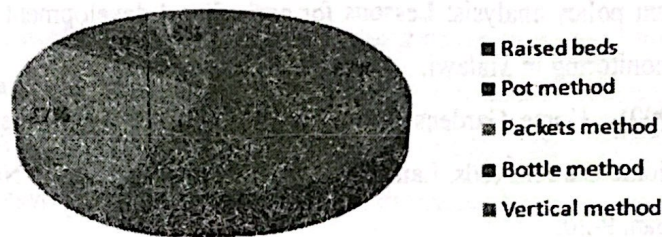


Figure 1. Different methods of home garden

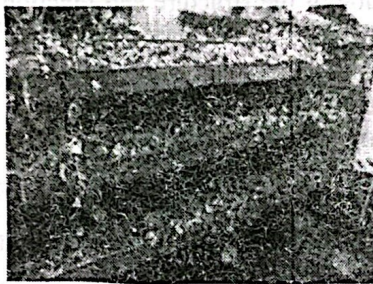


Figure 2. Vertical gardening

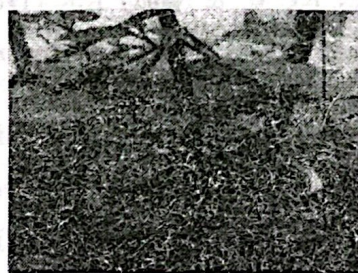


Figure 3. Pot gardening

### Conclusion

This study showed that householders were interested in home gardening and home gardeners mainly provided the food and nutritional support to low income families. The respondents of the study population were 21 to 75 years of age and around 50 % of younger farmers have been involving in home gardening activities. The size of the home garden ranged from 0.05 to 1.5ha. Farmers practiced different organic methods to control the pests. Ten percentage of the farmers apply organic productions, 13% use enemy plants, 43% use manual clearing and 34% of them use crop rotation to control the pest. 91% of the farmers have given the priority to their health and pesticide contamination than price of vegetables in market and farmers believed that organic pest control

methods helped to protect the human health and prevent us from chronic health hazards. Home gardens consisted of more than 2 canopy layers and plant species were not equally abundant due to the householder's needs and their preference. People are encouraged to follow different types of gardening techniques and they have realized the land scarcity. Furthermore, government / relevant authorities should provide various level of community based awareness programs to encourage the people to do the home garden in urban areas to fulfil their daily needs.

## References

- Babu, S.C.D.N., Ng'ong'ola, & Mthindi, G.B. (1994). Developing decentralized capacity for development policy analysis: Lessons for agricultural development from food security and nutrition monitoring in Malawi.
- Christanty, I. (1990). Home Gardens in Tropical Asia with special reference to Indonesia. In: Tropical Home Gardens (eds. Landauer, K. and Brazil, M.) United Nations University Press, Tokyo, Japan, 9-20.
- Dissanayake, D.M.A.J., & Hettiarachchi, P. L. (2013). Floristic Composition of Home-garden Systems in Dumbara(Knuckles) Conservation Area with an emphasis on Endemic Species. *Journal of Tropical Forestry and Environment*, 3(01), 24-36.
- Fernandes, E.C.M., & Nair, P.K.R. (1986). An evaluation of the structure and function of tropical homegardens. *Agricultural Systems* 21, 279-310.
- Gebauer, J. (2005). Plant species diversity of home gardens in El Obeid, Central Sudan. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 106(2), 97-103.
- Haque, M.A. (1992). Homestead agroforestry in Bangladesh. Proceedings of the Symposium on Horticulture in National Development. Bangladesh Horticultural Society. Bangladesh Agricultural University, Mymensingh, 182-90.
- Helen Keller International/Asia-Pacific. (2001). Homestead Food Production - A Strategy to Combat Malnutrition and Poverty. Helen Keller International: Jakarta, Indonesia.
- Johnson-Welch, C., Alemu, B., Msaki, T.P., Sengendo, M., Kigutha, H., & Wolff, A. (2000). Improving Household Food Security: Institutions, Gender and Integrated Approaches. Davis CA, USA: Paper prepared for the Broadening Access and Strengthening Input Market Systems (BASIS) Collaborative Research Support Project (CRSP).
- Jose, D., & Shanmugaratnam, N. (1993). Traditional homegardens of Kerala: a sustainable human ecosystem. *Agroforestry Systems* 24, 203-213.

- Kent, M., & Cocke, P. (1992). Vegetation description and analysis: a practical approach. *Belhaven Press, London*, 363 pp.
- Kryono. (1985). Home Gardens in Java –their structure and function. Paper presented in International Workshop on Tropical Home Garden, held at the Institute of Ecology, Padjadjaran University, Bandung-Indonesia, 2-9.
- Kumar, B.M., & Nair, P.K.R. (2004). The enigma of tropical home gardens. *Agroforestry Systems*, 61, 135-152.
- Leuschner, W.A., & Khaleque, K. (1987). Homestead agroforestry in Bangladesh. *Agroforestry Systems*, 5, 139-151.
- Magurran, A. E. (1988). Ecological diversity and its measurement. *Princeton University Press*.
- Nair, P. K. R. (1993). An introduction to agroforestry. Kluwer academic publishers.
- Nair, P. K. R. (2006). An Introduction to Agroforestry, KLUWER Academic Publishers, University of Florida, Gainesville, Florida University Press, Princeton, NJ.
- Shannon, C.E. & Weaver, W. (1949). The Mathematical Theory Communication. *University of Illinois Press*.
- Singh, G.B. (1987) Agroforestry in the Indian sub- continent: past, present and future. pp. 117- 140. In: H.A. Stepler & P.K.R. Nair (eds.) *Agroforestry: A Decade of Development*. ICRAF, Nairobi, Kenya.
- Soemarwoto, O. (1987). Homegardens: A traditional agroforestry system with a promising future. In: Stepler, H.A. and Nair, P.K.R. (eds.), *Agroforestry: A Decade of Development*, 157-170, ICRAF, Nairobi, Kenya.
- Soemarwoto, O., & Conway, G.R. (1991). The Javanese homegarden. *Journal of Farming Systems Research-Extension* 2(3), 95-117.
- Torquebiau, E. (1992). Are tropical agroforestry home gardens sustainable? *Agric Ecosyst Environ* 41, 189-20.
- Vorgelegt Von. (2007). Rural Homegardens in Central Sulawesi, Indonesia: An Example for a Sustainable Agro-Ecosystem? Ph.D Dissertation, Georg-August-University. Gottingen.