Economic Valuation of Home Gardens of Wet Zone Low Country of Sri Lanka

G D S Priyadarshika and U A D P Gunawardena[1]
Department of Forestry and Environmental Science
University of Sri Jayewardenepura
Nugegoda, Sri Lanka
prasanth@sjp.ac.lk

Abstract

Home gardens play an important role in household economy and are important ecosystems in the country. This study sought to estimate economic value of home gardens in the Wet Zone Low Country 3 agro ecological region (WL 3 AER) and intended to identify factors that contribute to the economic value. A structured questionnaire survey was conducted among randomly selected home gardens with varying sizes in Gampaha and Colombo districts. Information on size, crop types, yield and costs of inputs were collected along with respondents' socio economic factors.

Net average value of a home garden is LKR 76, 355 per annum while average value per hectare per annum is LKR 433,855. Values of each size category indicate an optimal size (perch 21-40) for maximum economic gains. Regression analysis indicates that an additional year of stay could increase the value by LKR 1245 and additional perch cultivated increase the value by LKR 500.

The results highlighted the importance of home garden systems in the WL 3 AER for the household economy and the significance of recognizing that value in making decisions regarding home gardens.

Keywords: home gardens, economic value, low country, wet zone

---

[1] Author for correspondence
Telephone: 011 280 4685
E mail: prasanth@sjp.ac.lk

Introduction

Achieving food security is a challenge with rapidly increasing population worldwide. The world demand for crop land is increasing while a considerable amount of crop land is lost each year due to desertification and conversion to other uses. A need for sustainable form of land use is a felt need and agro forestry is recognized as a reasonable solution. Agro-forestry is defined as "A sustainable land management system which increases the overall yield of the land, combines the production of crops and forest plants and /or animals simultaneously or sequentially on the same unit of land and applies management practices that are compatible with the cultural practices of the local population" (King and Chandler, 1982). According to Nair, (1989) agro-forestry systems in addition require significant interaction (positive and negative) between the woody and non woody components of the system, either ecological or economic.

Sri Lankan farmers practice number of agro-forestry systems such as chena, intercropping under coconut, growing tea and coffee under shade trees, wind breaks, shelterbelts and home gardens. Among these systems home gardens play a major role in Sri Lanka. According to FSMP (1995) estimates, home gardens covered about 858,000 ha in extent in 1992. It had been estimated that the amount of home gardens would be increased by one percent annually. However, agricultural census in 2002 indicates total home gardens classified under agricultural small holdings as **293,476** ha (DCS, 2002). National forest policy of 1995 has recognized their important role by stating that 'Trees growing on homesteads, and their agro-forestry, will be promoted as a main strategy to supply wood and other forest products for meeting household and market needs'.

Sri Lanka is geographically divided into wet, intermediate and dry zones which are divided again as low, mid and up country according to the elevation. The country has also been divided into 24 agro-ecological regions. Home gardens are found in any part of the country, but they may differ in their structure and composition due to their agro-ecology.

Kandyan home gardens are traditional systems which have been practiced for several centuries in Sri Lanka. This system has been studied by several scientists for its structural diversity, functions and also for their economy (Perera and Rajapakse, 1991; Gunawardena *et al*, 1994). Less intensively managed home gardens are found in the low country wet zone and dry zone in Sri Lanka. Most the Sri Lankan population is concentrated in the wet zone. The amount of home gardens in the wet zone is 338,820 ha and it is 40% of the total amount of home gardens of the country. This amount is 46% in the dry zone (FSMP, 1995). These home gardens are said to be less profitable and they are operating far below their potential efficiency by providing low income to the residents. This argument however, needs validation with recent data.

In addition, economic aspects of low country home gardens have received only less attention except few occasions (Gunawardena, 2003). Therefore it is important to conduct research on the economics of wet zone home gardens to develop and extend their potentials further. In addition, home gardens in the wet zone are crucial ecosystems due to the increasing scarcity created by the rapid urbanization in the area. Therefore, it is important to study the economics of these wet zone home gardens to understand their value and to develop their potential further. This study was carried out therefore in the wet zone low country -3 agro-ecological region.

The objectives of the study are therefore to determine the economic value of the home gardens in the Wet Zone Low Country 3 (WL3) agro ecological region in Sri Lanka and to determine the relationship between economic values and the socio-economic factors of the home garden owners. The paper is organized as follows: the next section provides an overview of the literature related to home gardens and their economics followed by methodology, results, discussion and conclusions of the study.

Home garden systems in Sri Lanka
Home garden is a popular farming practice that flourishes under wide variation of climatic, soil, topographic, elevation and socio-economic

conditions. A home garden is defined as "a piece of land around a dwelling with clear boundaries which has functional relationship with its occupants related to biophysical and socio-economic aspects" (Weerakoon, 1989).

The ownership of a home garden is usually closely associated with the ownership of the house located within the premises. A home garden often consists of a mixture of annual and perennial crops, along with some livestock. Home garden is identified as 'multi species, multi storied cropping system' due to its vertical structure with different canopy depths of varying plant species (Weerakoon, 1989).

The structure and management of a home garden could vary from place to place depending upon ecological, socio-economic and cultural background. Trees grown in the home garden could be grouped based on their functional values such as ornamental, vegetable, medicinal, spices, fruits, starch food crops, fodder, timber, fire wood, and shade.

The most intensive home garden systems in Sri Lanka are found in Kandy and Matale districts. These are small units based on a close association of coconut, Kithul, and arecanut, under-planted with cloves, cinnamon, nutmeg, citrus, mango, durian, jak fruit, Rambutan, bread fruit, bananas, pepper vines and a peripheral ground storey of maize, cassava and beans.

Typical dry zone home garden contains a mixture of food and fruit trees such as coconut, mango, banana, soursop, jak fruit, cashew, wood apple, guava, lime, and orange, along with annual crops such as cassava, sweet potato, *Kiriala (Diascorea spp.)*, and winged bean. Farmers deliberately retain or sometimes grow other species of trees or shrubs in their home gardens such as margosa, Halmilla, Mee, teak and satin wood (Weerakoon, 1986).

Modern home gardens have undergone several changes including the introduction of spice crops, providing enhanced cash generation and the division of home gardens into different parcels. The plot size often varied;

but in average, majority is found within the range of 0.1-0.4 ha. Within this small extent, home gardens cover variety of species and enterprises including livestock activities. Crops and trees are not grown in any specific pattern or design except *Gliricidia sepium, Ceiba pentandra* and *Moringa oleifera* which are grown as live fences.

The output of a traditional home garden is meant to sustain most of the daily needs of the owner. The diversity of plant species guarantees maximum use of space and light with minimum risk for the farmer. The main threats of intensive agricultural systems such as crop failure, price fluctuations, pests and diseases, do not endanger the home garden systems leading to long term stability and sustainability. Home gardens are involved with an extensive type of management. Only few improved material inputs are used in the system and the adoption of modern agricultural techniques also is poor. While the seeds and planting materials are the main material inputs used in the system, utilization of inorganic fertilizer and other plant protection chemicals is marginal. The level of the adoption of improved cultivars or agronomic recommendations also is low (Perera and Rajapakse, 1991).

As response to outside market signals, farmers have converted a portion of their home gardens for example to export based spice crops which has led to development of distinct zones within home garden. Home garden have been able to tolerate such shocks by accommodating and absorbing new features while retaining the original multi-objective, diverse structure unaltered (Senaratne *et al*, 1998).

Wood production from non-forest tree resources is highly significant in the Sri Lankan context (Ariyadasa, 2002). Home gardens in Sri Lanka produce 41% of national saw logs and 26% of the bio fuel demand. According to the FSMP (1995) estimates home gardens produce $0.95m^3$ of saw logs and $0.5m^3$ of poles per hectare per year.

The concept of economic value

As explained by Barbier (2001) and Pearce and Turner (1990) economic valuation of any good or service is generally measured in terms of what resource users or society at large are willing to pay for the commodity, minus what it costs to supply it. Where an environmental resource simply exists, and products and services are supplied at no cost, then it is our willingness to pay alone which describes the value of the resource in providing such commodities whether or not payments are actually made.

The concept of total economic value has been used as a framework for identifying and categorizing ecosystem benefits. This comprises use values (direct, indirect and option) and non-use values (Pearce and Turner, 1990). Direct use values are values from direct use or interaction with environmental resource and services. They involve commercial, subsistence, leisure or other activities associated with a resource. Indirect use value relates to the indirect support and protection provided to economic activities by the natural functions of ecosystems. Some of the goods and services provided by home gardens are never traded, are undervalued by market prices and are subject to prices which are highly distorted or have characteristics of public goods which mean that they cannot be accurately priced by the free market. Market prices may be insufficient for valuing home garden services and subsistence level use of natural resources, which are consumed within the household, or are not traded through formal markets.

Economic value of home gardens

Total economic value of a home garden is a broad concept since it encompasses a wide range of direct and indirect benefits. Majority of home garden products have a market value since they enter the market. According to Perera and Rajapakse (1991), a home garden can generate cash income in the range of LKR 3600-68700 per year per household. Jacob and Alles (1987) estimated land and labour productivity of the system as LKR 4085 per ha and LKR 1120 per adult male. Their estimation of the land productivity of subsistent output is only LKR 271 per ha. Jacob and Alles

(1987) estimated that average operational cost per unit area of home garden could be as low as LKR 710 per ha of which majority is for hired labour. However, family labour is the major source of labour for home garden operations (Perera and Rajapakse, 1991; Weerakoon *et al*, 1987). Nuberg *et al* (1994) reevaluated the value of home garden output based on McConell and Darmapala (1973), as LKR 20,000 per ha per year.

Variations found among home gardens may be due to personal and other socio economic factors of the owners in addition to other biophysical and natural factors. Homegardens are not pure agricultural systems; instead they represent a multi-objective framework which may extend beyond the horizon of economic objectives.

Any attempt to evaluate systems should consider its multi-dimensional (spatial and temporal), multiuse (forestry and agriculture), and multi-disciplinary (economic, social, environmental) complexities (Mendoza, 1987). For example, significant number of home garden products is non-priced subsistent products and the species have varied life spans, which generate benefits over extended periods of time. In addition, there are various interactions (i.e. complementary, competitive) among different species which influence the overall productivity of systems. Agro forestry presents therefore a formidable challenge to any economic analyst who embarks upon the task of assessing the economic value of the system.

Methodology

Study area
The area selected for the study is WL3 agro ecological region. The region is characterized by an annual rainfall above 1525 mm with a rolling and undulating terrain and red-yellow podzolic soils with soft and hard laterite. Each agro-ecological region would support a particular farming system. Pineapple under coconut finds its best expression on the moderately gravel soils in WL3. Coconut is grown both in pure stand and as a mixed home garden crop and the yield of coconut in this environment is moderate to low

because solar radiation is a limiting factor during the south west monsoon season. Yams and tubers are grown on the less gravelly soils in the mid slopes and lower slopes of the landscape. The productivity of betel vine is high in this environment. Land with a high content of stone and boulder can be used for rubber (Panabokke, 1996).

Within this agro-ecological region, Gampaha and Colombo districts were selected and home gardens for the study were selected from Gampaha, Attanagalle, Mahara, Biyagama, Homagama and Maharagama divisional secretariats. It covered urban, suburban as well as rural areas including all sizes of the home gardens. Table 1 provides details of the sample.

Table 1: Details of the selected home gardens

Size in perch	Size of the land/ha	Number of home gardens
<=20	<0.05	19
21-40	0.05-0.1	25
41-80	0.1-0.2	23
81-160	0.2-0.4	17
161-240	0.40-0.80	4
>240	>0.80	6
Total		94

First, a pilot survey was conducted within the study area to identify the size distribution of the home gardens within the area and major economic uses. It revealed that, size of the lands is on average between 0.4 – 1.3 hectares (1-3 acres) and presence of variety of uses derived from home gardens.

Collection of data
The data for the study was collected both from primary and secondary sources. Primary data were collected through the questionnaire survey conducted among the selected home garden owners and from market surveys.

Questionnaire Survey

The questionnaire has four main sections:

a) Socio economic characteristics of the respondents
b) General information on the garden - land size, area allocated for cultivation and constraints faced
c) Crop types - extents, age, harvest and contribution to the income.
d) Maintenance of the home garden - information on time spent, labour cost and use of inputs

In addition, in depth information was collected on multiple uses of plants in different stages of growth. The survey was carried out in the form of person-to-person interviewing at their households. The information supplied by the home garden owners was verified with field observations. The survey was conducted from November 2006 to end of March in 2007. Average time taken for an interview was one hour and about another one hour was spent on field observations.

Market survey

A market survey was conducted to collect market prices of the home garden products. Prices of vegetables, green leaves, yams and fruits were obtained from the weekly fairs in the area. Prices of commercial crops, spices, animal products as well as firewood were obtained from retail vendors of the area. Market prices of medicinal plants were collected from government approved Ayurvedic drug sales centers and the prices of other plant species especially ornamental plants were obtained from well-established plant nurseries in the area.

Estimation of economic value

The extracted harvests from different species of the home gardens were categorized under main product types. The economic value was derived based on production outputs of the home gardens. In the case of ornamental plants, monetary value was assigned based on the possession or presence of such plants rather than outputs such as flowers. An annual quantity was derived for each product type considering the seasonality of the crop.

The gross value of outputs from a home garden could be expressed as

$$\sum_{i=0}^{n} (QiPi) \ldots\ldots\ldots\ldots\text{Equation 1}$$

The net value of outputs from a home garden could be expressed as

$$\sum_{i=0}^{n} Qi(Pi - Ci) \ldots\ldots\ldots\ldots\text{Equation 2}$$

The net value of outputs from a home garden could also be expressed as

$$\sum_{i=0}^{n} (Qi \times Pi) - TC \ldots\ldots\ldots\ldots\text{Equation 3}$$

where

Qi - quantity of good *i* harvested (or possessed in the case of ornamental plants)

Pi - price or value of good *i*

Ci - marginal cost of producing good *i*

n - total set of home garden products

TC – total cost of all inputs for the home garden

The present study has adopted Equation 1 in estimating gross value. Equation 3 was used in estimating net value since it has been difficult to derive a marginal cost figure for inputs for each crop in a home garden context.

Factors affecting economic values of home garden

A multiple regression analysis was carried out to determine factors affecting economic value and their degree of contribution to the economic value. Regression analysis was carried out assuming that there are no significant correlations among the selected socio economic variables. Socio economic factors of the respondents such as monthly income from their employment, length of stay and size of the cultivated land are considered as predictors and net economic value of the home garden is used as the response variable.

Results and Discussion

Estimation of economic values

Information from questionnaires was tabulated on homegarden basis for each crop type and for each species for their amounts, age, yield per year and market prices. Other inputs used and their costs were also recorded for each home garden.

Gross economic value of each crop type

Total values of the products of each crop type were estimated for each home garden. The results revealed presence of nine different crop types and different species under each crop type (Table 2). Highest number of species was found among medicinal plants.

Table 2: Average annual value of different crop types

Crop type	Number of species		Average annual value (LKR)
	Average	**Maximum**	
Green leaves	5	13	2,852.92
Vegetables	3	13	4,912.17
Yams	2	6	590.98
Fruit crops	10	22	18,724.83
Spice crops	5	11	3,396.03
Commercial crops	4	6	37,166.77
Ornamental plants	7	15	1,276.86
Medicinal plants	5	29	1,597.19
Animal husbandry	0.24	2	6,775.66
Fire wood	1	1	1475.74

According to table 2, commercial crops give the highest average annual value among different crop types. The species listed included coconut, king coconut, Arecanut and beetle leaves. The second highest value is recorded for fruit crops. Highest average number of species is also found within fruit crop category.

Net value of outputs from home gardens

Net value of the outputs from each home garden was derived using Equation 3. Only the costs of inputs were deducted from the total value. Labour cost, which was mainly family labour were not considered under the cost of production, since it was assumed that gardening during leisure time does not involve an opportunity cost, rather it provides benefits from the physical exercises and mental relaxation. Table 3 provides descriptive statistics of the net economic values, both on home garden basis and per hectare basis.

According to the results obtained, mean net economic value for a home garden is LKR 76,355 per annum. Average net economic value is Rs.433,855 per annum per hectare which is a significant value compared to values of other studies.

Table 3: Descriptive statistics of the net economic values

Parameter	Net economic Value (LKR)	
	Per home garden per year	**Per ha per year**
Mean	76,355	433,855
Minimum	3,283	43,784
Maximum	297,979	2,683,006
Median	37,837	319,954
Standard Deviation	81,834	433,387

However, this figure also does not include the value of timber which might contribute to a large portion of the value. The calculated economic values for each size category of home gardens are given in the Table 4. It shows that the economic value varies with the size of the home garden to reach an optimum (perch 21-40) and then decrease. The results are contradictory to those of Jehanathan (1995) who concludes that the size of the home garden does not have any effect on the home garden income. However, Wiersum (2006), Korale-Gedara *et al* (2013) and Pushpakumara *et al* (2012) indicates

that size is a determinant factor in structure and composition of the home garden.

Table 4: Average net economic value for each size category

Size of homegarden (perch)	Average Economic Value (LKR) per year	Economic value (LKR) per year/ha
<=20	21,317.58	443,664.78
21-40	52,067.14	613,402.26
41-80	45,416.30	294,269.65
81-120	120,768.17	473,761.30
121-160	165,406.44	431,525.87
161-240	208,780.88	347,968.13
>240	174,472.49	211,382.72

Comparison of the values of the present study with past studies is presented in the Table 5. For the comparison, all values are converted to 2016 values using GDP deflator figures. The comparison shows that the values of the present study are much higher.

Table 5: Comparison of values of present study with past studies

Study	Value of home garden (LKR)	Value in LKR 2016	Unit
Jacob and Alles (1987)	271	3,520	Subsistent output per ha
Perera and Rajapakse (1991)	3,600 - 68,700	30,530-582,615	Per year per household
Nuberg *et al* (1994) reevaluation of value of home garden output	20,000	122,663	per ha per year

based on McConell and Darmapala (1973)			
Jehanathan (1995)[1]	<3,500	<19,741	Per farmer
Present study (survey done in year 2007)	433,855	889,534	Per ha per year

[1]

income from home gardens in both Kandyan villages and dry zone villages; study indicates that only 3%-10% of the farmers received more than LKR 3,500 per year.

There are several reasons for the higher estimate of the present study. Many previous studies have focused on the single values and marketed outputs alone, but the present study had in depth investigations into multiple uses of the same plant and the uses of a particular plant throughout different stages of the plant. In addition, the present study investigated all the subsistence outputs from the home gardens and ornamental plants based on the potential market value. However, direct comparisons are quite difficult since most of the available studies were based on Kandyan home garden system but not for the home gardens in other climatic zones.

Socio economic characteristics and other information on home gardens
Table 6 presents socio-economic characteristics of the home gardeners and other characteristics of the homegardens. On average people have stayed for 33 years in their gardens with a maximum stay of 74 years. On average, respondents have a mean income of LKR 20,000 and they have cultivated nearly 77% of their land.

Table 6: Summary of the socioeconomic and other characteristics of the sample

Parameter	Average Value
Length of stay	33 years
Monthly income from other employment	LKR 20,147
Number of family members	4
Years of education	10
Land size	84 perch
Amount of land cultivated	65 perch
Cost of inputs (annual)	LKR 1631

Regression analysis

Results of multiple regression analysis revealed factors affecting economic value and their degree of contribution to the economic value. Among them, amount of land cultivated and length of stay were significantly contributing towards the net economic value of the home garden (Table 7).

The regression equation is
Net value = - 8377 + 1245 Length of stay (Yr) + 0.602 Monthly income from employment+ 500 Amount of land cultivated (perch)

According to the analysis of variance, overall equation is significant (at 0.0001 significance level). Adjusted R-square is 42% indicating the proportion of variation in Y variable explained by all the dependent variables. Examination of residual plots indicated the presence of outliers. (Removal of one such outlier has resulted in adjusted R square of 48%.)

Table 7: Coefficients and their significance

Predictor	Coefficient	SE Coefficient	T	P
Constant	8377	15471	0.5	0.590
Length of stay	1244.8	387.0	3.22	0.002

Monthly income from employment	0.6017	0.4566	1.32	0.191
Amount of land cultivated	500.12	89.35	5.60	0.000

S = 62250.4   R-Sq = 44.0%   R-Sq (adj) = 42.1%

It is obvious that the size of the garden and the length of stay are directly related to the economic value of the garden. The size determines both the number of crop types and number of species that can be included into the garden (Wiersum, 2006) whereas longer stay implies possibility of having higher number of perennial plants mostly commercial crops. However, there were other land specific characteristics especially topography that could have been contributed to the observed variations of productivity.

Methodological limitations

On estimation of economic values
Main assumptions made in the economic value estimation were; (1) the outputs of short rotation crops are uniformly distributed throughout the year and (2) all useful components of the home gardens have a value, though they actually do not exchange in the market.

WL3 region is not usually affected by a severe dry period or long rainy periods within a year (Chithranayana and Punyawardena, 2008). Therefore, if there is an adequate attention on crops it would not be much difficult to maintain the home garden since the area is small. Little effort is needed for watering the crops if water is adequately available. According to the discussions made during survey, 95% of the selected home gardens do not face significant water scarcity issues even within the driest periods of the year.

Age of the crop is very important factor in the estimation of the economic value. Different products can be obtained at different stages of the plant, for example margosa (*Kohomba*) produce seeds after about 10 years of the

16

planting and before that age it provides medicinal products from leaves and bark. Seeds are used as pesticides also. Leaves of manioc is used as a food.

Some crops give several food types for example, kohila (*Lasia spinosa*) stem is used as a vegetable and leaf is used as a green leaf type. Winged bean provides vegetables as well as green leaves. In those situations, both products are included in the estimation of the economic value under different crop types. Jak provides fruits ('Wela' and 'Waraka') and raw jak fruit is consumed as a vegetable. 'Polos' is the immature fruit which is used as a curry. For the present study, jak fruit is considered as a vegetable that is the mature form of the fruit.

Some crops provide several products which have a number of values. Most home garden crops have additional medicinal values. However, such additional values have not been included in this analysis since their evaluation has been difficult. In addition, home garden products are produced using non-chemical farming and the output is always organic. There has to be a price premium added to the home garden products to represent such values.

Only the most prevalent values are included into the estimation and value added products are excluded. For example several food items can be made by preserving jak fruit and seeds and Kitul and coconut palms can also yield various value added products which are not considered in the present study. In addition, timber value of the homegadens have been excluded from the present study due to practical issues in volume measurements.

Being very important eco systems home gardens provide many services at various levels (Mohri *et al*, 2013). Among the environmental services provided by the home garden systems soil conservation, prevention of water loss by evaporation, improvement of environmental quality, mitigating global warming through carbon sequestration, improving scenic beauty and fertilization of the ground by litter layer decomposition could be

highlighted. Estimation of these services needs additional information based on scientific studies.

In addition, home gardens are not static but they are dynamic systems. Therefore, interactions between the biological organisms and also between the biotic and abiotic environment are prevalent. Some eco systems exist under such environments i.e. *Gliricidia sepium* fix nitrogen from the environment and provide them to other plants in the home garden system. In addition, mixtures of woody and non woody plants interact to a high degree and the interactions in such situations are highly site dependant. Those interactions are not evaluated here. Indirect and option use values as well as non-use values are not considered at any level for this study. Therefore, the total economic value of this home garden system would be a much higher figure if all such values are taken into consideration.

Conclusions and policy implications

The study intended to estimate the economic value of home gardens of the WL3 Agro ecological region. The study concludes that homegardens have high economic values compared to the existing estimates. It is also shown that amount of land cultivated and length of stay of home gardeners are positively and significantly contributing to the economic value of the home garden. Average values estimated for each size category indicates an optimal size range (perch 21-40) for maximum economic gains.

Although the low country home gardens have many important roles in the household economy, it has not attracted the attention of the agriculturists, economists as well as policy makers. The results emphasize that the potential of wet zone home garden system is very high. In the drive towards sustainable development the home garden systems should be given a high priority and attention by the governments due to their economic value and the unaccounted multiple benefits. Especially, governments could provide necessary economic incentives such as conservation easements in preventing conversion to other uses and towards maintaining the multiple benefits of this diverse system. This study justifies such implications.

References

a) *Ariyadasa, K.P. (2002) Assessment of tree resources in the homegardens of Sri Lanka.FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.*

b) *Barbier, E.B., (2001) Deforestation, Land Degradation, and Rural Poverty in Latin America: Examining the Evidence, in R. Seroa da Motta, (ed.), Environmental Economics and Policy Making in Developing Countries: Current Issues, Edward Elgar, Cheltenham, UK, pp. 118-139.*

c) *Chithranayana, R.D. and B.V.R. Punyawardena, 2008 Identification of drought prone agro-ecological regions in Sri Lanka, Journal of the National Science Foundation of Sri Lanka, 36 (2), 117-123*

d) *FSMP. (1995). Sri Lanka forestry sector master plan. Forestry Planning Unit, Forest Department, Ministry of Agriculture, Lands and Forestry, Colombo, Sri Lanka.*

e) *Gunawardena, E.R.N., P.T.W. Rosie and H.G. Bastable (1994) Water use of Kandyan forest gardens, grass and fast growing tree species in mid elevations in Sri Lanka. In: H.P.M. Gunasena (Eds) Multipurpose Tree Species in Sri Lanka MPTS for Natural Resources Management. pp. 38-48. Proceedings of the 5th Regional Workshop on Multipurpose Trees, April 1-3, 1994. Kandy, Sri Lanka.*

f) *Gunawardena, U. A. D. P. (2003) Economic Evaluation of Domestic Biodiversity in selected lowland regions of Sri Lanka. Unpublished Report Submitted to the National Science Foundation of Sri Lanka*

g) *Jacob, V.J. and Alles, W.S. (1987) Kandyan gardens of Sri Lanka, Agro forestry systems, 5:123-137*

h) *Jehanathan, M. (1995) A biophysical and socio economic study of the Kandyan home garden system of Sri Lanka, Unpublished thesis, University of Sri Jayewardenapura, Sri Lanka, pp.1-86*

i) *King, K.F.S and Chandler, M.T (1982) Agro forestry systems, vol.1, No.1, pp.7-12*

j) *Korale-Gedara P., Weerahewa J., Pushpakumara G., and. Kodithuwakku S.S., Commercial Orientation and its Effects on Plant*

Diversity in Homegardens: An Empirical Investigation of Rural Households in Sri Lanka, Sri Lankan Journal of Agricultural Economics. Vol. 14/15(1): 17-42.

k) *Mendoza, G.A., (1987). A mathematical model for generating land-use allocation alternatives for agroforesty systems, Agroforestry Systems 5, 443–453.*

l) *Mohri H., Lahoti S., Saito O., Mahalingam A., Gunatilleke N., Irham I., Van Hoang T., Hitinayake G., Takeuchi K., Herath S. (2013) Assessment of ecosystem services in homegarden systems in Indonesia, Sri Lanka, and Vietnam. Ecosystem Services 5:124–136*

m) *McConnell, D.A.G and Dharmapala, K.A.B (1973) The economic structure of Kandyan forest farms, The management report 7, UNDP/FAO, Agricultural Diversification project, Peradeniya, Sri Lanka*

n) *Nair, N.A.R. (1989) Agro forestry systems in the tropics, Kluwer Academic publishers, London, pp. 13-18; 181-194*

o) *Nuberg, I.K., Evans, D.G. and Senanayaka, R. (1994) "Future of Forest Gardens in Uvan Uplands of Sri Lanka.", Environmental Management, 18:797-814.*

p) *Panabokke, C.R. (1996) Soils and Agro ecological environments of Sri Lanka, Natural resources, Energy and Science Authority of Sri Lanka., pp.125-188*

q) *Pearce, D.W. and Turner, K. (1990) Economics of Natural Resource and Environment, London*

r) *Perera, A.H. and Rajapakse, R.M.N. (1991) "A baseline study of Kandyan forest gardens of Sri Lanka: Structure composition and utilization", Forest Ecology and Management, 45:269-280*

s) *Pushpakumara, D.K.N.G., Marambe, B., Silva, G.L.L.P., Weerahewa, J., Punyawardena, V.R., 2012. A review research on homegardens in Sri Lanka: the status, importance and future perspective. Tropical Agriculturist, 160, 55-125pp*

t) *Senaratne, D.M.A.H., Batagalla, N.K. and Kotagama (1998) Economic viability and Environmental sustainability of agro forestry systems in*

Sri Lanka, Unit for Environmental Economics, Gothenburg University, Sweden

u) *Weerakoon, W.L. (1986) Multi storey cropping in the dry zone of Sri Lanka, Survey of home garden, Paper presented at the seminar on Agriculture and Animal Husbandry, NARESA, Colombo,22nd Aug.1986*

v) *Weerakoon, W.L. (1989) Aspects of conservation farming, Agricultural Research station, Mahailluppallama, Department of Agriculture, Sri Lanka*

w) *Weerakoon, W.L., Seneviratne, A.M. and Gunawardena, G.G (1987) Survey of Home Garden Agro forestry in the North Central province of Sri Lanka, Conservation farming project, Mahailluppallama Agricultural Research station, Department of Agriculture, Sri Lanka*

x) *Wiersum, K.F. 2006. Diversity and change in homegarden cultivation in Indonesia. In: Tropical Homegardens: A Time Tested Example of Sustainable Agroforestry. Eds. B.M. Kumar and P.K.R. Nair. pp. 13-24. Springer, the Netherlands*