

# **Kandyan Homegardens in Sri Lanka**

**by**

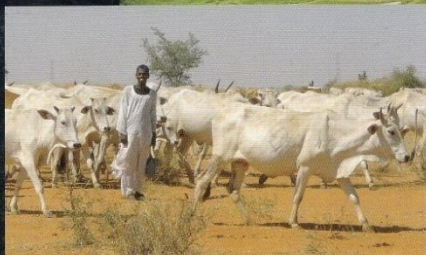
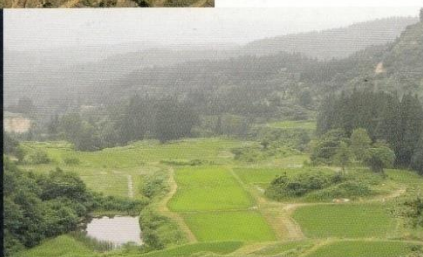
**Gamini Pushpakumara**

**Faculty of Agriculture  
University of Peradeniya  
Peradeniya, Sri Lanka**



# SUSTAINABLE USE OF BIOLOGICAL DIVERSITY IN SOCIO-ECOLOGICAL PRODUCTION LANDSCAPES

Background to the 'Satoyama Initiative for the benefit of biodiversity and human well-being'



## Kandyan homegardens: A promising land management system in Sri Lanka

D. K. N. G. Pushpakumara<sup>1</sup>, A. Wijesekara<sup>2</sup> and D. G. Hunter<sup>3</sup>

<sup>1</sup> Country Liaison Scientist for ICRAF and Senior Lecturer, Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka. Email: ngpkumara@pdn.ac.lk; phone: 0094714933591

<sup>2</sup> Research Officer, Horticulture Crops Research and Development Institute, Peradeniya, Sri Lanka

<sup>3</sup> Scientist, Bioversity International, Rome, Italy

\* Corresponding author

### 1. Introduction

Kandyan homegardens located in the mid-country region of Sri Lanka, predominantly in the district of Kandy but also in Matale, Kegalle, Kurungalle and Rathnapura districts, represent a centuries old sustainable system of production based on a highly diversified portfolio of perennial mixed cropping comprising a variety of tree crops with multiple uses and to a lesser extent livestock (figure 1). This traditional, complex and risk-averse multi-story production system comprising several perennial food crops, fruits, vegetables, roots, tubers, medicinal plants, sugar crops, spice crops and timber crops has continuously provided high levels of nutritional and diet diversity to households while medicinal species, spices and tree species provide substantial additional income. While similar to other homegarden systems in other parts of the world, Kandyan homegardens are unique in the high levels of functional plant diversity they contain. The farmers and households with Kandyan homegardens have also tended to have a better livelihood from a broader range of market and subsistence products compared to those with other homegarden systems. In addition to these important economic and social benefits, the Kandyan homegarden system also provides key ecosystem services and habitats for a range of flora and fauna. Kandyan homegardens provide connectivity and linkages to other agricultural and natural landscapes, and this in itself is important for biodiversity conservation and adaptation, and will become more

important under a changing climate, particularly as the risk of population fragmentation and the need for geneflow and species dispersal and migration increase. Kandyan homegardens may well provide the quality matrix through which such linkage and connectivity may occur. For these reasons, past, present and future, this important system will continue to be important for the contribution it makes to sustainable diets and livelihoods as well as enhanced conservation of globally important biodiversity.

### 2. Background and Landscape

The mid-country wet zone area of Kandy district, Sri Lanka, is typically covered by sloping land and valleys. Kandy district covers 1,906 square kilometres or 2.9 per cent of total land area of the country (IUCN, 2007). The altitude of the area ranges from 400 to 650 metres above sea level and rainfall in the area varies from 2,000-2,500 millimetres/year. Day time temperature in the area varies between 24-26 degrees Celsius and relative humidity changes from 65-80 per cent during the day to 75-90 per cent at night. The Kandy area harbours a relatively high population density in the country with an average of 704 people per square kilometre (IUCN, 2007). Originally, much of the area of the district was covered by natural forests but, due to various reasons, natural forest cover (including sparse forests) of the district is now limited to less than 17 per cent (IUCN, 2007). Much of the natural forest has been cleared and a plantation crop based agroecosystems were established in the highlands during the colonial era. To this day, tea and rubber based agroecosystems are the dominant land use category of the district. Low land valleys have been cultivated with mainly paddy and in some instances vegetable crops. The other main land use category in the area is homegardens. The homegardens in Kandy district are termed Kandyan home (forest) gardens. Thus, it is clear that according to the biophysical limits and socio-economic characteristics of the area, several land use systems have been developed and collectively these represent a unique landscape of ecosystem mosaics covering both wild and cultivated areas. The Kandyan homegardens in many instances represent the bridging or linking land use category throughout this mosaic.

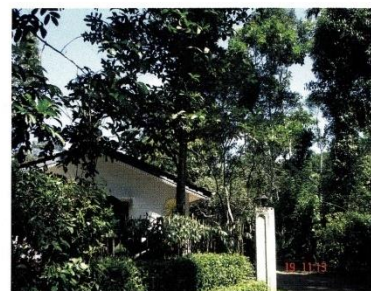


Figure 1. A Typical Kandyan homegarden in Sri Lanka

## 9 Kandyan home gardens

A time-tested good practice from Sri Lanka for conserving tropical fruit tree diversity

*D.K.N.G. Pushpakumara, H.M.S. Heenkenda, B. Marambe, R.H.G. Ranil, B.V.R. Punyawardena, J. Weerahewa, G.L.L.P Silva, Danny Hunter and J. Rizvi*

### Introduction

In Sri Lanka, home gardens (HG) have been identified as an integral part of the landscape and culture for centuries and remain today one of the major and oldest forms of land use in the country (Mahawansa, undated; De Silva, 1981; Jacob and Alles, 1987; FSMP, 1995; MFE, 1999; Pushpakumara *et al.*, 2010). Although the term Kandyan home garden (KHG), as a subset of HGs in Sri Lanka, is commonly used in literature, the term has several definitions (see Jacob and Alles, 1987; Perera and Rajapakshe, 1991). In this study KHG is defined, based on the historical Kandyan Kingdom, to include HGs in Kandy and adjacent districts, such as Badulla, Kegalle, Kurunegala, Matale, Nuwara Eliya and Rathnapura. This area largely falls in the wet zone of Sri Lanka but occasionally in the intermediate zone, where the climate and edaphic environment support luxurious growth of perennial trees. The area consists of deep soil (i.e. reddish brown latosolic, immature brown loam and red yellow podzolic soils). The rainfall is year-round, sufficient to meet the evaporation demand of the atmosphere, with a distinct dry spell of one to two weeks that triggers the flowering of perennial species (personal communication, B.V.R. Punyawardena, Department of Agriculture, Sri Lanka).

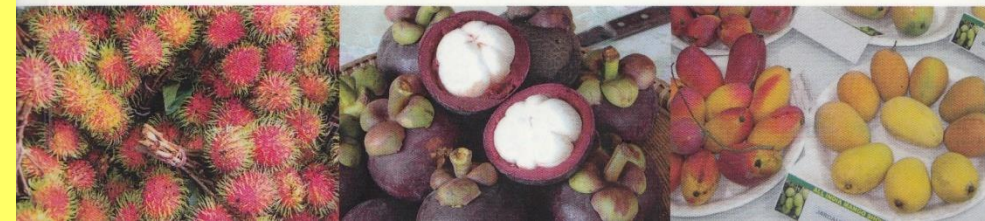
KHGs are considered a result of farmers' conception, investment and long-term planning. Through generations, KHGs in Sri Lanka have evolved to satisfy households' food and other needs while countering the resource constraints resulting from population pressure and shortage of arable lands and capital. The composition and structure of the plant and animal species found in KHGs are a result of a combination of farmers' selection, natural evolution, environmental suitability and occasional recommendations by researchers and extension workers and subsequent co-adaptation. They form a complex to suit

# Tropical Fruit Tree Diversity

GOOD PRACTICES FOR *IN SITU* AND ON-FARM CONSERVATION

EDITED BY

Bhuwon Sthapit, Hugo A. H. Lamers, V. Ramanatha Rao and Arwen Bailey



# Kandyan Homegardens (KHGs)



**KHGs are HGs exist in historical Kandyan kingdom (Kandy and adjacent districts such as Badulla, Kegalle, Kurunegala, Matale, Nuwara Eliya and Rathnapura)**

## Land area, population density, forest cover and homegarden area of districts where KHGs exists in Sri Lanka.

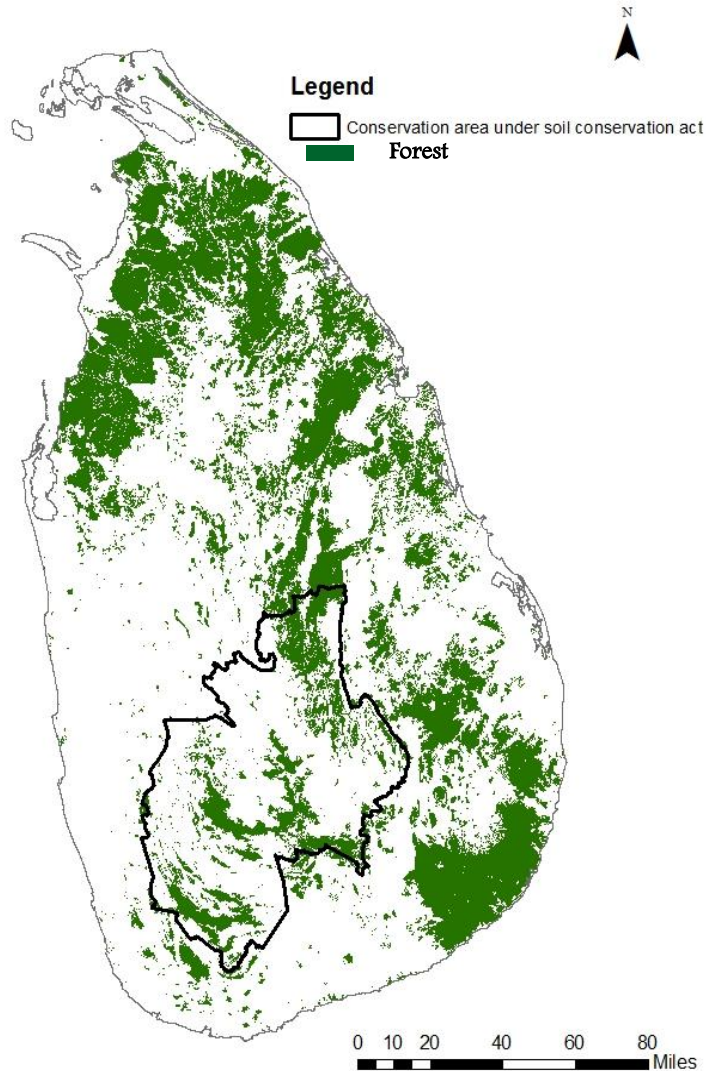
District	Area (km <sup>2</sup> )	Population density (per/km <sup>2</sup> )	Forest cover (%)	HG cover (%)*	Tree canopy cover (%)**
Badulla	2,803	294	19.0	17.7	36.7
Kandy	1,906	704	17.0	30.4	47.4
Kegalle	1,693	468	9.5	23.2	32.7
Kurunegala	4,813	311	5.0	15.1	20.1
Matale	1,993	233	40.5	11.7	52.2
N' Eliya	1,720	423	24.5	5.3	29.8
Rathnapura	3,255	325	20.0	15.8	35.8
<b>All KHGs</b>	<b>18,183</b>	<b>394</b>	<b>19.0</b>	<b>17.0</b>	<b>36.0</b>
Sri Lanka	65,610	314	23.5	13.1	36.6

Sources: IUCN and MENR (2007) and \* based on FSMP (1995). Note: \*\* Tree canopy cover is defined to include forest and HG areas.

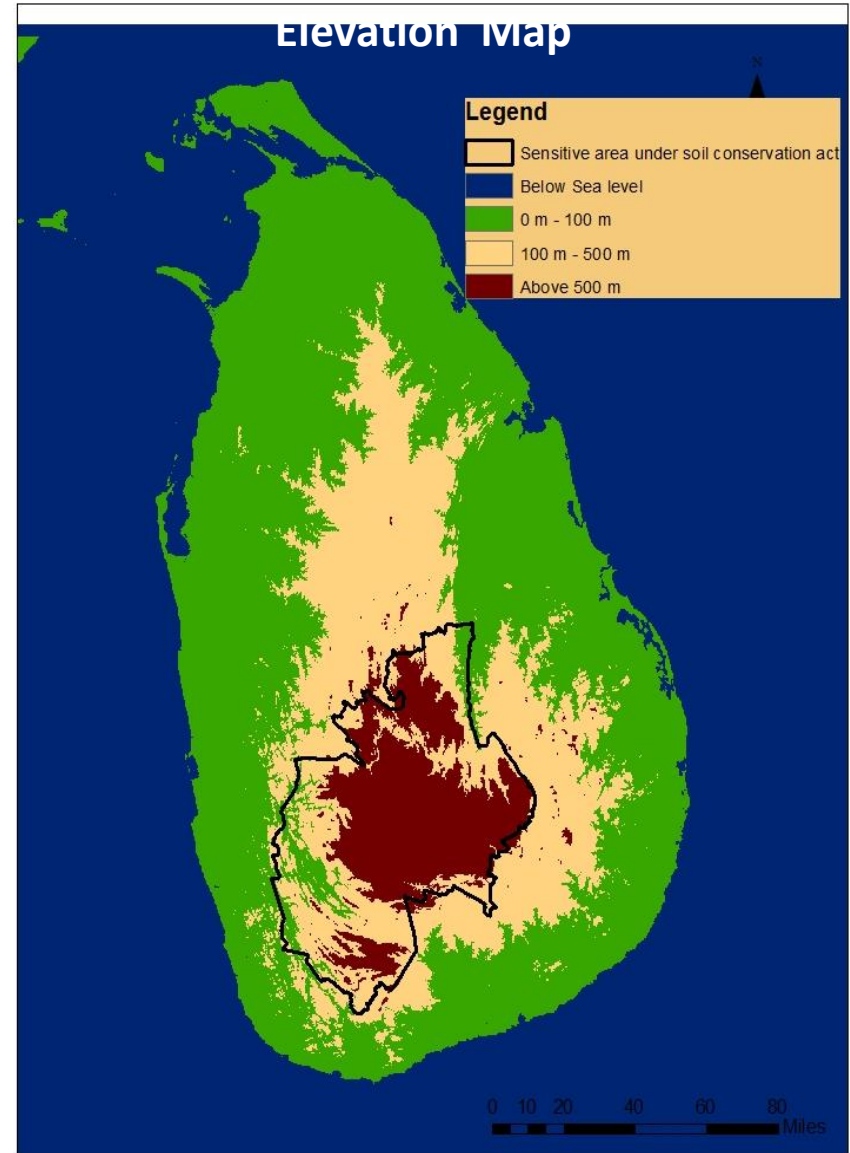
<b>Characteristics</b>	<b>Range</b>
Size of homegardens (ha)	0.05-2.5 (mean = 0.4 ha)
Altitude (m amsl)	400-1050
Rainfall (mm)	2000-2500
Temperature (°C)	24-26
Relative humidity (percent)	65-80 (day) and 75-90 (night)
Population density (Per square km)	500-699
Family size (numbers)	2-9
Number of vertical canopy strata	3-5
Canopy coverage (percent)	45-98
Ground coverage (percent)	50-90
Dominant soil type	Reddish brown latosolic to immature brown loam
Slope of land (percent)	10-40
Number of Species per homegardens	37-143
Number of woody taxa per homegardens	11-39
Tree species density per ha (over 5 cm dbh)	92-3736
Plant species density per ha (including annuals)	654-5663
Dominant natural vegetation of the area	Tropical wet evergreen forests
Land tenure	Mainly privately owned

# Forest Cover and Area Declared under Soil Conservation Act

## Forest Cover Map - 2010



## Elevation Map





**Forests**

**Chena**

**Homegardens**

**Rice based  
system**



# Sustainable Agricultural Intensification

Multifunctionality and the pillars of sustainable development



**Sustainability of Kandyan homegardens is mainly due to the system structure, its ecological functions, and its continued ability to fulfil the socio-economic needs of people.**

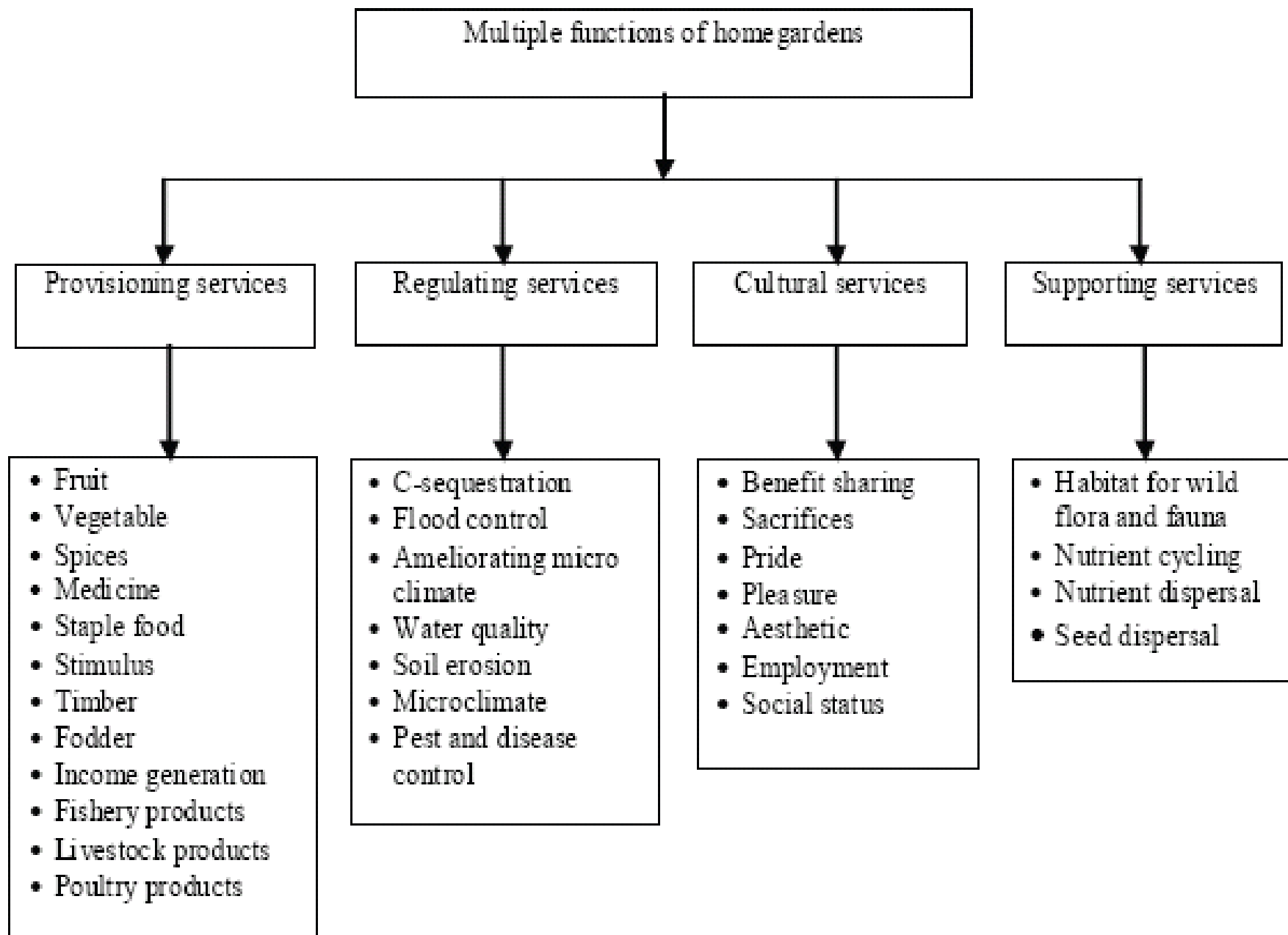


Figure 2. Ecosystem services provided by the agroforestry homegardens

# Provisioning Services

## Products obtained from the ecosystems

Food (fruit, vegetable, spices, livestock, poultry products)

Fodder

Fuelwood

Freshwater

Medicinal plants

Genetic resources

Ornamental resources



**Homegardens are good nutritional gardens. Thus, helping food and nutritional security.**



22 15:23

<b>Products</b>	<b>Examples</b>
Staple and other food items	Breadfruit, cassava, coconut, jakfruit, maize, sweet potato, taro, yam
Fruits	Avocado, banana, carambola, cashew, citrus, cocoa, custard apple, durian, guava, jackfruit, mango, mangosteen, orange, passonfruit, papaya, pineapple, pomegranate, rumbutan, rose apple, sapodilla, sour soup.
Ornamentals	Anthurium, cacti, crotons, begonias, orchids, palms, roses, ferns
Timber trees	<i>Alastonia, Alibizia, Berrya, Coconut, Gmelina, jakfruit, mahogany, Melia, Michelia, Pterocarpus, teak</i>
Medicinal plants	Most herbs and trees in homegardens are medicinally used
Vegetables	<i>Amaranthus</i> , brinjal, cabbage, leafy vegetables, okra, pumpkin, spinach <i>Sesbania</i> , water spinach, wing bean
Spices	Cardamom, chillies, cinnamon, cloves, coriander, curry leaf, ginger, lemon grass, nutmeg, pepper, rampe, turmeric
Cash crops	Anthurium, Avocado, Cacao, Cloves, coconut, coffee, mahogany, mangosteen, Michelia, nutmeg, pepper, teak.
Animal products	Local breeds of chicken, eggs, goat and cow milk.

<b>Nutrient</b>	<b>Examples</b>
Energy	Avocado, banana, breadfruit, cashew nut, cassava, coconut, groundnut, jackfruit, maize, sugar cane, sweet potato, yam
Protein	Cashewnut, cowpea, eggs, ground nut, beans, <i>sesbania grandifolia</i> , wing bean
Fat	Avocado, cashew nut, coconut, ground nut, milk and milk products
Vitamin A	Amaranth, banana, bitter gourd, cassava and drumstick, mango, papaya, sweet potato, water spinach
Vitamin C	Anona, banana, carambola, cashew nut, citrus (many kind), custard apple, guava, mango, mangos teen, nelli, orange, passion fruit, papaya, pineapple, pomegranate, rambutan, rose apple, sapodilla, sour soup.
Minerals	Most green vegetables and fruits
Fibre	Most green vegetables and fruits



**Coconut based agroforestry with pepper and cocoa in the wet zone of Sri Lanka**  
**Pushpakumara 2006**

**27 14:35**



# Jackfruit



13 15:30

01231



# Regulating Services

## Benefits obtained from regulating ecosystem processes

Air quality maintenance

Climate regulation

Water regulation

Water Purification

Regulation of human diseases

Strom protection

Biological Control

Pollination

**Soil erosion control**



Landscape of terresed paddy based agroforestry in the up and mid country wet zone

Pushpakumara 2007

19 11:48

# Soil loss in different land use systems in Sri Lanka

AER	Location	Land Use	Soil Loss (t/ha/y)
MCWZ	Peradeniya	Seedling tea no conservation	40
		Well managed tea- in contour	0.24
		Mixed home gardens	0.05
		Natural Forest	<0.02
UCWZ	Talawakele	Clean weeded VP tea	52.6
		VP tea with mulch	0.07
MCIZ	Hanguranketha	Tobacco no conservation	70.0
		Capsicum no conservation	38.0
		Carrots no conservation	18.0

# C Content in Different TROF systems

<b>TROF system</b>	<b>Extent</b>	<b>Weight at 20% M.C</b>	<b>Carbon content (kg)</b>
<b>Homegarden</b>	<b>27,440</b>	<b>1,655,528,757</b>	<b>711,875,713</b>
<b>Tea based TROF system</b>	<b>79,182</b>	<b>989,007,345</b>	<b>441,097,275</b>
<b>Urban agricultural based TROF system</b>	<b>3,885</b>	<b>77,924,882</b>	<b>34,754,497</b>
<b>Grassland</b>	<b>4,289</b>	<b>41,101,104</b>	<b>18,331,092</b>
<b>Annual crop based TROF system</b>	<b>13,154</b>	<b>4,383,012</b>	<b>1,954,823</b>
<b>Total</b>	<b>127950</b>	<b>2,767,945,100</b>	<b>1,208,013,402</b>

# Supporting Services

**Services Necessary for production of all other ecosystem services**

Biodiversity Conservation

Habitats for flora and fauna

Soil formation

Nutrient recycling

Primary production

Species	Number of trees recorded only from homegardens
Coconut	38,616,649
Jakfruit	10,437,142
Mahogany	6,410,248
Mango	5,607,688
Teak	3,293,609
Rambutan	1,177,920
Avacardo	986,161
Woodapple	948,752
Del	910,473
Delum	197,941
Ebony	174 005
Beli	165,718
Palmyrah	127,340
Nelli	116,728
Mango	52,103

## More trees outside forests

### Major source of

1. Fruit production
2. Fuelwood
3. Timber
4. *Circa situm* conservation

Sources: Ariyadasa (2002);  
Pushpakumara et al. (2012)



## Species diversity of fruit crops in Sri Lanka and their endemic, indigenous and exotic status and occurrence in KHGs.

Category	In Sri Lanka		In KHGs		
	Number	% <sup>a</sup>	Number	% <sup>b</sup>	% <sup>c</sup>
Fruit species recorded	196		98	50	-
Plant families of fruit species	46		36	78	-
Wild relatives of fruits	54	29	11	20	-
Endemic fruit species	35	18	6	17	6
Indigenous fruit species	81	41	33	41	34
Exotic fruit species	80	41	59	74	60

*Note: <sup>a</sup>=percentage out of total fruit species; <sup>b</sup>=percentage of species recorded in KHGs out of total fruit species in each category; <sup>c</sup>=percentage out of total fruit species recorded in KHGs.*

# Cultural Services

**Non material Benefits obtained from  
ecosystems**

Recreation

Tourism

Aesthetic

Education



**Spice Gardens in Sri Lanka, another agroforestry with commercial potential.**

# Agro-eco tourism



# What is matter is landscape not individual homegardens

An aerial photograph of a lush, green landscape. The foreground and middle ground are dominated by dense, vibrant green vegetation, including numerous palm trees and other tropical plants. In the center-right, there is a large, bright green, rectangular field, possibly a sports field or a large garden. The background shows rolling hills and mountains, also covered in dense forest, under a clear sky. The overall scene is a mix of natural forest and human-managed green spaces.

**Agroforestry make tree cover to over 50% in this landscape where natural forest cover is less than 10%.**

**Photo: Pushpakumara**

**25 9:26**

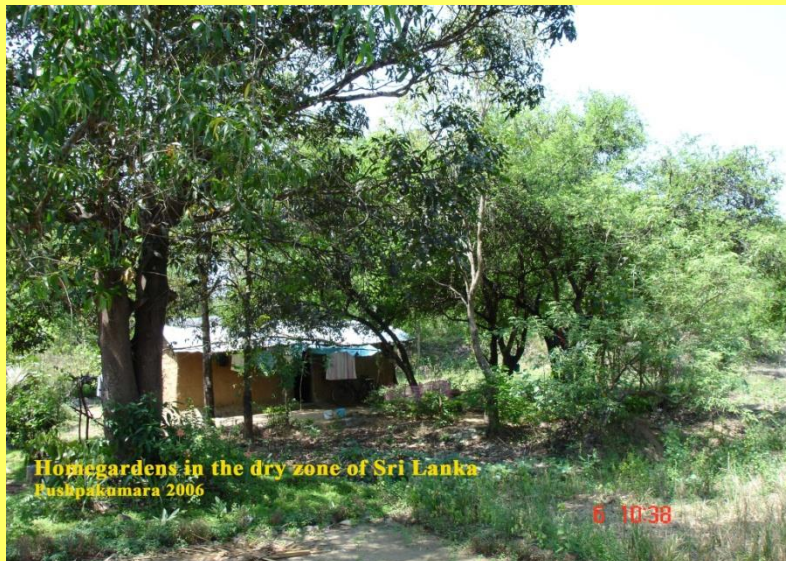
**Strengthening and enhancing the Kandyan homegarden system in the coming years so that it continues to provide quality ecological habitats and other social and economic functions, and connects wild and other cultivated habitats will be important for the future adaptation of this globally important landscape.**

**Synergy with other benefits.**

# Main Issues Related to HGs

- Conversion of HGs into other land uses.
- Fragmentation of HGs.
- Wild animal conflict.
- Changing species composition and structure from multi-tree species rich HGs, hence quality of the sensitive area is reduced.

# Homegardens





**Homegardening is one of the  
eco-friendly options for living...**




# Model Homegarden



## Reverse Phenology....



Maize farming in an agroforest of *Faidherbia albida*, Tanzania



**Thank you for your  
attention.....**

19 11:13