

Traditional Home Gardens in Sri Lanka: A Sustainable Agro-Ecosystem with Integrated Land Management

Introduction

Home gardens form an ideal system of land use, combining agriculture, forestry and livestock. They are traditional systems used since many thousand years and form an intimate bond between householder and his/her garden. A home garden provides a multitude of benefits for the householder, including economic, environmental and social arenas. In the economic perspective, it provides the much needed food, fruits, medicines, fuelwood and small timber. In the environmental perspective, it provides a healthy and comfortable microclimate, conserves oil and water, increases biodiversity, and therefore, increases overall productivity of the garden. It, therefore, makes the householder self sufficient. These agro-forestry systems developed and nurtured by farmers through generations of innovation and experiment are often cited as the epitome of sustainability, yet have been long neglected by the scientific community. Today, however, these age old systems are receiving increasing attention owing to their perceived potential to mitigate environmental problems such as loss of biodiversity and rising levels of atmospheric carbon dioxide while providing significant economic gains as well as food and nutritional security to their owners.

Home gardens generally have five identifying characteristics. First, the garden is located near the residence. Second, the garden contains high diversity of plants. The garden is therefore capable of recycling nutrients in a sustainable manner. The plants are planted densely and the plants are layered to mimic a natural forest. Third, the

garden production is a supplemental rather than a main source of family consumption or income. Fourth, the garden occupies a small area. A fifth distinguishing characteristic of home gardens is that they are production systems that the poor can easily enter with virtually no economic resources, using locally available planting materials, natural manures and indigenous methods of pest control. In this context, the home gardens make sustainable contribution to the family's livelihood objectives.

Benefits of Home gardens

Food and nutrition security —

Home gardens are believed to provide a number of benefits to families, ranging from improving nutrition and providing a source for additional household income, to improving the status of women in the household. Potential environmental benefits of home gardens may be important not only for home gardening households, but for the broader society as well. The species diversity in a home garden is quite high and comprise of food, condiments, fodder, timber, fuelwood, medicines, etc. Sri Lankan home gardens have been reported to produce 60 percent of leaf vegetables and 20 percent of all vegetables consumed by the household (Hoogerbrugge and Fresco, 1993) as cited by Ensing et al. (1985). Others have reported that home gardens typically produce more than 50 percent of vegetables, fruits, medicinal plants and herbs, consumed by the household (Marsh, 1998). Home gardens contribute immensely in the improvement of the family nutrition as they are the best sources of nutritive food. A study in

Prof. Hemanthi Ranasinghe

*Department of Forestry and
Environmental Science,
University of
Sri Jayewardenepura.*

Bangladesh found that children living in households with a home garden were less likely to have eye diseases associated with lack of vitamin A than children living in households without a home garden; specifically, children from households without a home garden were 2.5 times more likely to be nightblind, 2.1 times more likely to have Bitot's spot, 3.4 times more likely to have active corneal lesions and 2.4 times more likely to have corneal scars (Cohen et al. 1985) as cited by Helen Keller International/Asia-Pacific (HKI/AP) (2003).

In home gardens, crops trees are mixed sometimes with livestock. Home gardens in Java have been reported to provide 14 percent of household protein requirements (Hoogerbrugge and Fresco, 1993) as cited by Christanty (1981). A study of home gardens in Ghana found that households could potentially produce substantial amounts of meat and income per year (Asare et al., 1990). In India, it is very common to combine gardening with poultry and livestock on the home garden plot. Typically, the household ties up, fences in or keeps the animals in a shed located on the plot. The household uses manure as fertiliser for the garden and as fuel source.

In Javanese home gardens, animals are not confined and receive only minimal feeding— chicken range freely and eat leftovers from the kitchen and "whatever they can find

in the garden," while buffalo, cows, goats and sheep graze on village common lands and are fed additional food at night from grasses cut from dykes of rice fields and other areas (Soemarwoto, 1985). To date, there is very little written regarding dietary intake and nutritional status of children in households that integrate production of fish, small animals and vegetables (Schipani, 2002). However, a survey in Bangladesh found that, even after accounting for household socio-economic status, young children in households that raised chickens in the home garden had the lowest incidence of night blindness (as vegetables and fruits produce less bio-available beta-carotene than previously assumed, and the amount produced varies widely, which means that consumption of vegetables and fruits is not as likely to improve vitamin A status as previously thought; therefore, programmes that promote consumption of dark green leafy vegetables are likely to have a more modest impact on vitamin A deficiency disorders (HKI/AP, 2003; de Pee et al., 1998).

Environmental benefits

The following quote depicts the functions of the home garden explicitly. "A village with its home gardens is not merely a dwelling-place but also an important agro-ecosystem. It is an integrated unit in which the solar energy is channelled through the plants to animals and man, and matter is cycled and recycled. This cycling and recycling process, together with the layered plant cover, protects the soil of the home garden from exhaustion, leaching, and soil erosion." (Gajaseni and Gajaseni, 1999).

Diversity of plant species and the layered canopy of species are the most striking features of home gardens, with all home gardens generally consisting of "a herbaceous layer near the ground, a tree layer at upper levels, and intermediate layers in between"

(Nair, 1993). Plant diversity seems to decrease with altitude, length of dry season, share of cash crops, population density, labour shortage within the household and distance to urban areas (Hoogerbrugge and Fresco, 1993). Traditional home gardens are reported to contain multiple and sometimes rare varieties of each planted species and represented "in-situ reservoirs for biodiversity at all levels: genetic, species, and ecological," all of which helps prevent pest and weed outbreaks (Gajaseni and Gajaseni, 1999). The high density of home garden plants also provides habitat for wild animals, such as, insects, reptiles, birds and small mammals (Christanty, 1990). They are considered as germplasm banks for many crops and other economic plants. They are also a key site for domestication of wild plants. The multi-tiered arrangement of the species aides to capture both the aboveground and belowground resources optimally and increase the nutrient status of the soil and protect the same of erosion. Small home garden plots provide sustainable livelihoods for the poor. Home gardens may be considered to improve or exacerbate public sanitation, depending upon the care with which household wastes are handled. In West Java, it is common for home gardens to contain fishponds. Fish are fed kitchen waste, and the pond is fertilised by animal and human waste, including waste from toilets built above the fishpond (Soemarwoto, 1985). These households do not use the fishpond water for any household needs. Livestock waste is also used to manure the garden and other fields. Urban home gardens may improve public sanitation at virtually no cost to the larger community by using organic wastes from slaughterhouse manure, treated sewage sludge and wastes from fisheries and breweries (Vasey, 1990). However, mishandling of wastes, particularly human faeces, may compromise sanitation (Vasey, 1990; Soemarwoto, 1987). The potential public sanitation benefits should be considered in any

assessment of the benefits and costs of expanding the public water delivery system to accommodate home gardening.

Another potential impact of home gardening is soil conservation. Terraced home gardens have been recommended to preserve soils on sloping areas (Terra, 1954). Fruit trees, bamboo and other trees can be used to rejuvenate infertile soils. Tree roots that penetrate as deep as 10 metres can bring mineral constituents into the topsoil, while fallen leaves can provide a natural protective mulching cover and bring more humus into the soil, helping to prevent exhaustion of soils (Terra, 1954). However, it is important for home gardening families not to remove ground litter or engage in excessive weeding of the home garden, which can increase the risk of soil erosion (Soemarwoto, 1987).

Distribution of home garden plots may also have beneficial off-site environmental effects. For example, where population pressures and lack of arable land threaten to push families to resettle in forests and wetlands, distribution of home garden plots to landless and land poor families can reduce pressures to migrate. This not only helps to reduce conversion of lands better left as forests and wetland, but also allows families to remain in areas with established social services and markets for surpluses produced on the home garden. In addition, distribution of home gardens may reduce the need for land-poor families to gather fodder and fuelwood from marginal lands, contributing to minimising adverse effects on such lands.

Socio-Economic Benefits

The livelihood benefits of home gardens go well beyond those related to nutrition and subsistence. In many cases, the sale of products produced on home gardens significantly improves the family's financial status. It is

a common misconception that home gardens are exclusively subsistence-oriented; home gardens provide households with cash crops as well as food crops (Hoogerbrugge and Fresco, 1993). In fact, returns to land and labour are often higher for home gardens than for field agriculture (Marsh, 1998). Home gardens can contribute to household income in several ways. The household may sell products produced in the home garden, including fruits, vegetables, animal products and other valuable materials such as bamboo and wood for construction or fuel. The household may use the home garden site to conduct cottage industries to produce crafts or small manufactures that can be sold (Marsh, 1998).

The volume of home garden production actually sold appears to be highly variable, depending on the percentage of produce sold. Urban home gardens in Papua New Guinea are reported to have expanded over a period of several years (in one neighbourhood from a mean area of 125 m² in 1974 to a mean area of 817 m² in 1981), which has enhanced opportunities for households to sell home garden produce in local markets (Vasey, 1985). In the study in Papua New Guinea, 42.1 percent of squatter households sold home garden produce at the market, as compared to a district average of 25.8 percent, indicating that the more impoverished households depended on home gardens more than the average (Vasey, 1985).

Livestock and tree crops produced on home gardens in south-eastern Nigeria accounted for over 60 percent of family cash income in one study (Okigbo, 1990). In a study on the small home garden plots and sustainable livelihoods for the poor urban and rural households in three Russian provinces found that two-thirds of all households obtained some income from agricultural home production, and in rural areas, the market value of home production exceeds household labour income (Seeth et

al., 1998). In the Helen Keller International (HKI) pilot home garden project in Bangladesh, 54 percent of households reported selling home garden products and earning the cash equivalent of 14.8 percent of total average monthly income (HKI/AP, 2003).

In addition to direct earnings from sale of home garden production, production consumed by the household frees up household earnings for other purchases. In the Bangladesh HKI home garden project, the income value of home garden production increased from 14 percent of average monthly income to 25 percent after taking into account purchased fruits and vegetables (Marsh, 1998). In some cases, a portion of the cash income from home gardens is used to purchase additional food for household consumption. A study of urban home gardens in the Philippines revealed that home gardening families spend less on food than non-gardening families, while home gardening families who plant a larger number of varieties of fruits and vegetables spend even less (Miura, 2003). In Cambodia and Nepal, 31-65 percent of income (31 percent in the case of Nepal and 65 percent in the case of Cambodia) derived from sale of poultry raised on home gardens was used to purchase other foods, while other proceeds were used to invest in production, education, savings and other purposes (HKI, 2003). Urban home gardeners in Papua New Guinea sell various fruits at local markets and obtain cash that allows them to purchase rice that produces several times the food energy of the sold fruits (Vasey, 1985). Thus, home gardens provide households with a number of options by which they

can satisfy their livelihood objectives, and each household can determine for itself what combination of consumption, trade and sale of home garden production best fits its livelihood strategy.

Wage Security and Household Status

Ownership of the home garden plot can make important contributions to improved and sustainable livelihoods in ways that often overlooked, including improved leverage in labour markets, enhanced social status and greater political participation. By being an owner of a home garden plot, the owner's economic and social status gets elevated. They can spend their labour in their own gardens, and even if they want to sell their labour, they have a bargaining power. Further, due to the produce from the garden, their self sufficiency is improved and the earnings from excess can be used to purchase other items than daily food needs. Home gardens are thus seen to contribute to a cohesive social environment, another core objective of the livelihoods approach.

Home gardens in Sri Lanka

Home gardens are a traditional forms of agro-forestry in Sri Lanka and had been in existence for many thousand of years. They are located in almost all the districts in the country, but the ones in the Central Region called 'Kandyan

Table 1: Projected wood production from home gardens and other non-forest tree resources ('000 m³)

Source/year	2000	2005	2010	2015	2020
Peeler logs (rubber)	7.9	8.3	8.4	8.2	8.2
Saw logs					
Home gardens	582.7	631.3	681.4	731.7	769.2
Rubber	256.3	269.9	270.0	263.3	265.8
Coconut and Palmyra	202.4	220.0	210.9	166.4	154.3
Trees on tea lands	75.9	75.9	75.9	75.9	75.9
Other perennials	68.6	71.7	74.9	78.3	81.9
Roadside planting	4.8	5.0	5.1	5.2	5.2
Poles					
Home gardens	831.4	853.7	873.4	889.5	910.8
Other perennials	47.7	49.9	52.1	54.5	57.0

Source: FSMP (1995).

home gardens' are more famous. They are located mostly in Kandy, Matale and also in Kurunegala districts. Apart from the traditional gardens, cultivated gardens are also common. Traditional home gardens often show complicated structures, diverse floristic compositions, multiple functions, low input (including labour and money), and ecological and socio-economic sustainability. The characteristics and functions of traditional home gardens are closely related to many factors, such as their geographic location and the cultural backgrounds and socioeconomic conditions of their owners. They are ideal forms of land use which combines agriculture, forestry and livestock. Trees are grown in a multi-tiered arrangement, terraced where necessary and planted according to local topography and soil conditions. It is a traditional practice of mixed cropping of trees yielding timber, small wood, fuelwood, fodder, fruits, spices, nuts, medicines and other cash crops. The entire system provides an ideal healthy microclimate for both man and animals. According to the Forest Sector Master Plan (Ministry of Land, 1995), home gardens covered about 858, 000 ha in 1992. They are most prevalent in Gampaha, Kandy, Galle, Matara, Kalutara, Kegalle and Puttalam Districts. Their extent is increasing by about one percent annually.

The benefits from the Sri Lanka home gardens are also the same as mentioned in the previous sections for home gardens in general. With regard to wood, it has been noted that they produce 41 percent of national saw logs and 26 percent of the biofuel demand (Ministry of Land, 1995). The National Forest Policy of 1995 has recognised their important role by stating that "Trees growing on homesteads, and other agro-forestry, will be promoted as a main strategy to supply wood and other forest products for meeting household and market needs". According to the FSMP estimates, home gardens produce 0.95 m³ of saw logs and 0.5 m³ of poles per hectare per year. Table 1 shows the projected wood

production from home gardens and other non-forest tree resources in Sri Lanka.

Kandyan Home gardens

Kandyan Home gardens are world famous as many articles have been written based on these by the foreigners as well as locals. They are located in the Central Region and cover about 80000 ha. Trees are grown in multi-tiered arrangement, terraced where necessary and adjusted to local topography. It provides maximum utilisation of space and other resources, both vertically and horizontally. The holdings are small, on average about 1 ha and they are mostly privately owned. The gardens are generally owner cultivated and the bigger the farm the less the density of plants. The sittings of the plants are rather haphazard and dependent on the owner's practical experience. Operating costs are lower than monoculture. Economically, the practice is quite profitable and with better management, it has the potential for continuous higher levels of production and high returns. Among the many crops grown in these home gardens are jackfruit, durian, rambuttan, papaya, citrus, avocado, plantain, pineapple, passion fruit, mango, breadfruit, coffee, cacao, tea, black pepper, kitul, spices, yams and fodder grasses. In addition to these benefits, due to the significant biomass lodged in these gardens, it stocks large amount of carbon, and therefore, helps to keep it away from the atmosphere. From a recent research study, it was stipulated that 7 Gt of carbon is stored within the above ground components of the Kandyan Home gardens in the country and 27 Gt of carbon dioxide is prevented from emitting to the atmosphere which is a significant mitigation to the climate change phenomenon (Dissanayake and Ranasinghe, 2009). The same study stipulated that the annual litterfall rate of these gardens is 8.77 t/ha which provides organic matter to the soil and keeps it fertile.

Other Homestead Gardens

Less intensively-managed home gardens are found in most other

districts of Sri Lanka, especially, in the low country wet zone, in the western and southern coastal belts and in the low country dry zone. Except for cacao, most of the Kandyan home garden species are grown in the low country wet zone less intensively. In addition, fruit-bearing species like rambuttan and mangosteen can be found here. Homestead gardens usually have fences of *Gliricidia septum* and in the intermediate and dry zone fences of kapok (*Bombax malabaricum*) are found. The canopy cover in these less intensively managed home gardens is not dense and ranges from about 25 to 75%. Cattle, goats and poultry are reared in these systems, especially, goats in the dry zone. *Leucaena leucocephala* is now grown profusely in home gardens in this zone increasing soil fertility and providing food and fodder.

In some homestead gardens in the dry zone, the planting of useful tree species is widespread. The drumstick tree (*Moringa oleifera*) is grown in fences or hedges as its crown is very light and the pods are a popular and very nutritive dish. Production starts within one year of planting and the bark of the tree is of medicinal value.

In some other systems, *Sesbania grandiflora* is planted. It is a short-lived tree of medium height, mostly planted in the intermediate, dry and semi arid zones. Local people use the tender leaves and flowers as vegetables. Production in this case is also within one year of planting. It is important producer of green manure and fodder, especially in the dry season.

Home gardens vary in their species composition depending on the location. In a study conducted by Sennanayake et al. (2009) on home gardens in Meegahakiula region in Sri Lanka (located between Mahiyangana and Badulla), five major perennial species categories and six important annual species were identified in these home gardens. There was a greater distribution of annuals in

Table 2: Most common home garden species in order of frequency of occurrence

Species name	Botanical	Origin	Category	Total number of trees
Local				
Coconut	<i>Cocos nucifera</i>	Planted	Timber & food	38, 616, 649
Rubber	<i>Hevea brasiliensis</i>	Planted	Timber	17, 101, 488
Jak	<i>Artocarpus heterophyllus</i>	Planted	Timber & food	10, 437, 142
Arecanut	<i>Areca catechu</i>	Planted	Food	9, 697, 944
Mahogany	<i>Swietenia macrophylla</i>	Planted	Timber	6, 410, 248
Alstonia	<i>Alstonia macrophylla</i>	Planted	Timber	5, 968, 286
Mango	<i>Mangifera indica</i>	Planted	Timber & food	5, 607, 688
Albizzia_1	<i>Albizzia molucana</i>	Planted	Timber	5, 607, 581
Eucalyptus	<i>Eucalyptus</i> spp.	Planted	Timber	4, 061, 191
Teak	<i>Tectona grandis</i>	Planted	Timber	3, 293, 609
Margosa	<i>Azadirachta indica</i>	Naturally grown/planted	Timber	3, 044, 932
Cashew	<i>Anacardium occidentale</i>	Planted	Timber & food	3, 001, 240
Lime	<i>Citrus aurantifolia</i>	Planted	Food	2, 484, 387
Lunumidella	<i>Melia dubia</i>	Naturally grown/planted	Timber	2, 349, 245
Weera	<i>Drypetes sepiaria</i>	Naturally grown	Timber	2, 073, 390
Guava	<i>Psidium guajva</i>	Planted	Food	1, 790, 026
Kitul	<i>Caryota urens</i>	Naturally grown/planted	Timber & food	1, 751, 016
Satin	<i>Chloroxylon swietenia</i>	Naturally grown	Timber	1, 489, 903
Orange	<i>Citrus cinensis</i>	Planted	Food	1, 468, 383
Sabukku	<i>Grevillea robusta</i>	Planted	Timber	1, 460, 721
Bamboo	<i>Bambusa vulgaris</i>	Planted	Timber	1, 333, 073
Gliricidia	<i>Gliricidia sepium</i> L.	Naturally grown/planted	Timber	1, 252, 885
Halmilla	<i>Berrya cordifolia</i>	Naturally grown/planted	Timber	1, 185, 466
Rambutan	<i>Nephelium lappaceum</i>	Planted	Timber & food	1,177, 920
Toona	<i>Toona sinensis</i>	Planted	Timber	1, 023, 771
Daminiya	<i>Grewia damine</i>	Naturally grown	Timber	1, 001, 625
Butter fruit	<i>Persea americana</i>	Planted	Food	986, 161
Wood apple	<i>Limonia acidissima</i>	Naturally grown/planted	Timber & food	948, 752
Del	<i>Artocarpus altitlis</i>	Planted	Timber & food	910, 473
Hora	<i>Dipterocarpus zeylanicus</i>	Naturally grown/planted	Timber	865, 437
Milla	<i>Vitex altissima</i>	Naturally grown	Timber	774, 419
Ketakela	<i>Bridelia retusa</i>	Naturally grown	Timber	760, 242
Tamarind	<i>Tamarindus indica</i>	Naturally grown/planted	Timber & food	689, 922
Kumbuk	<i>Terminalia arjuna</i>	Naturally grown/planted	Timber	686, 953
Kon	<i>Schleichera oleosa</i>	Naturally grown	Timber	664, 536
Damba	<i>Syzygium assimile</i>	Naturally grown	Timber	627, 121
Murunga	<i>Moringa oleifera</i>	Planted	Food	621, 284
Helamba	<i>Mitragyna parvifolia</i>	Naturally grown	Timber	602, 453
Palu	<i>Manilkara hexandra</i>	Naturally grown	Timber	599, 898
Welang	<i>Pterospermum suberifolium</i>	Naturally grown	Timber	564, 431
Kolon	<i>Adina cordifolia</i>	Naturally grown	Timber	548, 464
Suriyamara	<i>Albizzia odoratissima</i>	Naturally grown	Timber	509, 591
Nedun	<i>Pericopsis mooniana</i>	Naturally grown/planted	Timber	473, 408
Jambu	<i>Syzygium malaccensis</i>	Planted	Food	463, 685
Aralu	<i>Terminalia chebula</i>	Naturally grown/planted	Timber & food	436, 299
Gini sapu	<i>Michelia champaca</i>	Naturally grown/planted	Timber	415, 273
Kaduru	<i>Thevetia peruviana</i>	Naturally grown	Timber	382, 514
Ipil ipil	<i>Leucaena leucocephala</i>	Planted	Timber	373, 421
Gammalu	<i>Pterocarpus marsupium</i>	Naturally grown	Timber	350, 441
Anoda	<i>Anona cherimolia</i>	Planted	Food	325, 895
Mee	<i>Madhuca longifolia</i>	Naturally grown/planted	Timber	298, 387
Cocoa	<i>Theobroma cacao</i>	Planted	Food	259, 498
Mora	<i>Dim ocarpus longana</i>	Naturally grown	Timber & food	252, 611
Kenda	<i>Macaranga peltata</i>	Naturally grown	Timber	244, 020
Veralu	<i>Elaeocarpus serratus</i>	Naturally grown	Food	234, 654
Gansuriya	<i>Thespesia populnea</i>	Naturally grown	Timber	202, 853
Delum	<i>Punica granatum</i>	Planted	Food	197, 941
Kottamba	<i>Terminalia catappa</i>	Naturally grown/planted	Timber	186, 665
Pihimbiya	<i>Filicium decipiens</i>	Naturally grown/planted	Timber	184, 958
Bulu	<i>Terminalia bellirica</i>	Naturally grown/planted	Timber	180, 690
Ebony	<i>Diospyros ebenum</i>	Naturally grown/planted	Timber	174, 005
Godapara	<i>Dillenia retusa</i>	Naturally grown	Timber	171, 937
Domba	<i>Calophyllum inophyllum</i>	Naturally grown	Timber	167, 747
Beli	<i>Aegle marmelos</i>	Naturally grown/planted	Food	165, 718
Kahata	<i>Careya arborea</i>	Naturally grown	Timber	165, 294
Wewarana	<i>Alseodaphne semicarpifolia</i>	Naturally grown	Timber	162, 881
Hik	<i>Lannea coromandelica</i>	Naturally grown	Timber	149, 077
Ehela	<i>Cassia fistula</i>	Naturally grown	Timber	140, 965
Hulanhik	<i>Chukrasia tabularis</i>	Naturally grown	Timber	131, 500
Palmainrah	<i>Borrassus flabellifer</i>	Naturally grown/planted	Timber & food	127, 340
Nelli	<i>Phyllanthus emblica</i>	Naturally grown/planted	Food	116, 728
Ambarella	<i>Spondias dulcis</i>	Planted	Food	86, 200
Albizzia_2	<i>Albizzia lebbek</i>	Naturally grown	Timber	70, 110
Gal siyambala	<i>Dialium ovoideum</i>	Naturally grown	Timber & food	57, 304
Etamba	<i>Mangifera zeylanica</i>	Naturally grown	Timber & food	52, 103
Coffee	<i>Coffea arabica</i>	Planted	Food	40, 936

Source: Ariyadasa, 2002

home gardens in the flat land category while the home gardens with moderate and steep land category had a distribution of perennial species.

The traditional home garden are sometimes associated with rice field agro-ecosystems. The home gardens are usually located in slopes while the rice fields are located in valleys. While the multi-storied vegetation in the homegardens consists of trees, shrubs, vines and herbs, the irrigated rice fields being temporary aquatic habitats with a generally predictable dry phase can be scientifically defined as an agronomically-managed temporary wetland ecosystem. Although being a monoculture agro-ecosystem, a rice field undergo three major ecological phases, namely, aquatic, semi-aquatic and a terrestrial, during a single irrigated and rain-fed paddy cycle. The rich nutrients generated in the home gardens benefit the adjoining rice fields, through runoff. As a whole, the traditional home garden-rice field integrated agro-ecosystem comprises of a rich mosaic of ecotones, harbouring a rice biological diversity. Bambaradeniya (1999) recorded a total of 250 species of fauna which represents about 40% of the total inland native vertebrates in Sri Lanka from home garden-rice field ecosystems. Among the vertebrate species recorded, 29 (12%) were endemic while 40 (16%) are nationally threatened. In addition to 133 species of native birds observed, 30 species of winter migratory birds that visit Sri Lanka from other countries were also documented. The above shows that the traditional home gardens are highly integrated and managed, contributing to sustain a rich biodiversity including unique as well as threatened species while enhancing the biodiversity in urban and sub-urban areas.

In a study carried out in 242 Divisional Secretary areas covering 12,267 GN (*Grama Niladhari*) divisions, which represent 87

percent coverage of the country, more than 400 woody species were found in home gardens. Some species were planted while the balance regenerated naturally in home gardens. Almost all the species in the categories of food (F) and timber and food (TF) were planted while some of the timber (T) species, especially in the dry zone, regenerated naturally. Table 2 shows the origin and category for 76 species considered in the analysis conducted by Ariyadasa in 2002 in order of frequency of occurrence.

Apart from the three general uses of the species given in Table 2, some species are used widely in traditional medicine. Table 3 lists species used in traditional medicine, which were selected from a list of 142 species found in home gardens. The highest number of species as well as the highest species density are found in the wet zone districts followed by the intermediate and dry zones. Species richness in the wet and intermediate zones can be attributed to favourable climatic

conditions and the limited availability of land resources in these areas.

The majority of tree species found in home gardens are indigenous or endemic with multi-purpose uses. However, recently, more exotic species have been introduced, especially commercial timber species. Five of the top 10 species grown in home gardens are exotic timber species. These species, namely, teak, mahogany, *Albizia molucana*, *Alstonia macrophylla* and eucalyptus, account for 15 percent of the total number of trees recorded in this assessment.

The production from home gardens is dependent on the garden size. As against the traditional gardens, in developed gardens using the scientific principles, the production is greater.

Table 4 shows the estimated annual returns from one hectare from a more organised mixed cropping model of a Kandayn home garden.

Table 3: Home garden species widely used in traditional medicine

Species name		Category	Origin
Local	Botanical		
Ahu	<i>Morinda citrifolia</i>	Timber	Naturally grown/planted
Ambarella	<i>Spondias dulcis</i>	Food	Planted
Aralu	<i>Terminalia chebula</i>	Timber & food	Naturally grown/planted
Attikka	<i>Ficus racemosa</i>	Timber	Planted
Bakini	<i>Nauclea orientalis</i>	Timber & food	Planted
Beli	<i>Aegle marmelos</i>	Food	Planted
Bulu	<i>Terminalia bellirica</i>	Timber	Naturally grown/planted
Delum	<i>Punica granatum</i>	Food	Planted
Domba	<i>Calophyllum inophyllum</i>	Timber	Naturally grown/planted
Ehela	<i>Cassia fistula</i>	Timber	Naturally grown/planted
Gammalu	<i>Pterocarpus marsupium</i>	Timber	Naturally grown/planted
Ingini	<i>Strychnos potatorum</i>	Timber	Naturally grown/planted
Kaduru	<i>Thevetia peruviana</i>	Timber	Naturally grown/planted
Kahata	<i>Careya arborea</i>	Timber	Naturally grown
Karapincha	<i>Murraya koenigii</i>	Food	Planted
Keena	<i>Calophyllum walkeri</i>	Timber	Naturally grown
Ketakela	<i>Bridelia retusa</i>	Timber	Naturally grown
Kirikon	<i>Walsura piscidia</i>	Timber	Naturally grown
Kitul	<i>Caryota urens</i>	Timber & food	Planted
Kolon	<i>Adina cordifolia</i>	Timber	Naturally grown
Kumbuk	<i>Terminalia arjuna</i>	Timber	Naturally grown/planted
Lime	<i>Citrus aurantifolia</i>	Food	Planted
Margosa	<i>Azadirachta indica</i>	Timber	Naturally grown/planted
Mee	<i>Madhuca longifolia</i>	Timber	Naturally grown/planted
Murunga	<i>Moringa oleifera</i>	Food	Planted
Nelli	<i>Phyllanthus emblica</i>	Food	Planted
Sadikka	<i>Myristica fragrans</i>	Food	Planted
Tamarind	<i>Tamarindus indica</i>	Timber & food	Planted
Wara	<i>Calotropis gigantea</i>	Timber	Naturally grown

Source: Ariyadasa, 2002

With the urbanisation, the land parcels available for homes and gardens decrease rapidly. Most of the urban dwellings are having a bare space to put up the house and thus the practice of home gardening is getting rapidly lost. The new knowledge is not infused usually to the existing home garden practice, and therefore, the yields are not improved. The fluctuation of the markets and the dearth of labour adds to the challenges. The new generation is not interested in this practice as they are searching for white collar occupations. Due to these many challenges, home gardens are rapidly decreasing from the Sri Lanka landscape.

In an effort to infuse this traditional practice to the country's development process, Sri Lanka Ministry of Agriculture has provided policy guidance to improve this practice. National Agriculture Policy in the statement 29 of 2003 mentions the need to implement special urban agriculture promotion programs designed to ensure supply of home consumption needs and environmental protection. In the Statement 17 of 2007, it states the need to promote urban agriculture to enhance household nutrition and income and also promote women's participation in home gardening. Through the Government Initiative 'Let us cultivate to uplift the nation' many types of home gardens have been promoted; rural and urban home gardens, school gardens, home gardens of schoolchildren, gardens and model farms in office premises, gardens in security forces camps, private home gardens of state officials, gardens in office premises of the private institutions and home gardens of public representatives.

A model urban home garden was developed by Horticultural Research and Development Institute (HORDI) located in Gannoruwa, Kandy with a view to

Table 4: Estimated annual returns from one hectare from a more organised mixed cropping model of a Kandyan homegarden

Crops	No. of plants	Total yield	Unit price	Total value Rs.
Pepper (kg)	1,296	1,296	500	6,48,000
Coffee R (kg)	220	165	200	33,000
Coffee S (kg)	1,914	957	200	1,91,400
Nutmeg (No)	12	6,000	6	36,000
Vasavasi	12	6,000	10	60,000
Cloves (kg)	12	18	475	8,550
Coconut (No.)	36	1,810	20	36,200
Mango (No.)	3	150	20	3,000
Breadfruit (No.)	3	150	80	12,000
Jak fruit (No.)	3	45	30	1,350
Avacado (No.)	3	150	20	3,000
Arecanut (No.)	24	2,400	3	7,200
Banana (No. of bunches)	24	24	750	18,000
Lime (No.)	44	4,400	5	22,000
Total				1,079,700

Source: Ranasinghe, D.M.S.H.K. 1991

help families to establish and maintain high-output home gardens. The 900 m² model garden features many of the vegetables, fruits, spices, herbs and tubers which are grown in Sri Lanka. During 2006, over 63,000 people from all over the country viewed HORDI's model home garden, including large numbers of schoolchildren.

On the face of a depleting natural forest cover, home gardens which are repositories of biodiversity providing economic, ecological and social benefits to man and environment are to be propagated widely to enhance sustainability of the country's eco-system. This is a fine example of mainstreaming indigenous knowledge to the development process and making it more suitable to the present day context in the arena of species selection, optimal planting to produce multiple benefits and also accrue environmental benefits. They can largely contribute to the climate change by acting as store houses of atmospheric carbon dioxide thus reducing the adverse effect of climate change.

References:

- Ariyadasa, K.P. (2002). Assessment of tree resources in home gardens of Sri Lanka, FAO.
- Asare, E.O., Opong, S.K. and Twum-Ampofo, K. (1990). Home Gardens in the Humid Tropics of Ghana. In Landauer, K., and Brazil, M. (eds.) (1990). Tropical Home Gardens. United Nations University Press, Tokyo, Japan, pp. 80 - 93.
- Bambaradeniya, C.N.B. (2007). Traditional Home Garden and Rice Agro-Ecosystems

in Sri Lanka: An integrated managed landscape that sustains a rich biodiversity, IUCN.

Barth Eide, W. (1990). Household Food Security: A "Nutritional Safety Net". IFAD Discussion Paper, mimeo.

Chandler, W.U. (1984). Improving World Health: a Least Cost Strategy. *Worldwatch Paper No. 59*, Worldwatch Institute, 1984.

Christanty, L. (1990). Home Gardens in Tropical Asia, with Special Reference to Indonesia. In Landauer, K., and Brazil, M. (eds.) (1990). Tropical Home Gardens. United Nations University Press, Tokyo, Japan, pp. 9 - 20.

Cohen, N., Jalil, M.A., Rahman, H. and others (1985). Landholding, Wealth and Risk of Blinding Malnutrition in Rural Bangladeshi Households. 21(11) *Social Science Medicine* 1269 - 1272.

de Pee, S., Bloem, M., Satoto, Yip, R., Sukaton, A., Tjong, R., Muhilal and Kodyat, B. (1998). Impact of a Social Marketing Campaign in Promoting Dark-green Leafy Vegetables and Eggs in Central Java, Indonesia. 68 *International Journal for Vitamin and Nutrition Research* 389 - 398.

Dissanayake, A and Ranasinghe, H. (2009). Estimation of carbon stock of Kandyan Home gardens in Sri Lanka with special reference to Kandy and Matale Districts, Proceedings of the 14th International Forestry and Environment Symposium, Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Proceedings of the 50th Anniversary Academic Conference, University of Sri Jayewardenepura.

FAO (1987). *The Fifth World Food Survey*, Food and Agriculture Organisation, Rome. Fassil, H, Guarino, S, Sharrock, S, Hodgkin, T. and Iwanga, M. (2000). Diversity for food security: Improving human nutrition through better evaluation, management and use of plant genetic resources, Food and Nutrition Bulletin, 21 (4).

Gajaseni, J. and Gajaseni, N. (1999). Ecological rationalities of the traditional home garden system in the Chao Phraya Basin, Thailand, 46(1) *Agroforestry Systems* 3 - 23.

Helen Keller International/Asia-Pacific (2003). Integration of Animal Husbandry into Home Gardening Programmes to Increase Vitamin A Intake from Foods: Bangladesh, Cambodia and Nepal. Available at http://hkiasiapacific.org/_downloads/APO_percent20Special_percent20issue_percent20Jan_percent202003.pdf

Helvetas (2001). Sustainable farming systems through traditional plant genetic resources and indigenous knowledge based practices.

HORDI (2007). Nourishing inspiration in Sri Lanka's model home garden, New Agriculturist. Hoogerbrugge, I. and Fresco, L.O. (1993). Home garden Systems: Agricultural Characteristics and Challenges. International Institute for Environment and Development, Gatekeeper Series No. 39.

Kumar, B. (2006). Tropical Home gardens: A time tested example of sustainable agroforestry, *Advances of Agroforestry*, Vol. 3.

Jacob, V.J and Alles, W.S. (1987). Kandyan gardens of Sri Lanka, *Agroforestry Systems*, 5, ICRAF.

Lakshman, U. and Ranasinghe, D.M.S.H.K. (2002). Formulation of sustainable agroforestry models for North Central Dry Zone of Sri Lanka, Proceedings of the 8th Annual Forestry and Environment Symposium on 'Sustainable Environmental Management Towards a Better Quality of Life', 12-13th December, Hikkaduwa, Sri Lanka.

Mahindapala, R. (2004). Medicinal Plants: Conservation and Sustainable Use in Sri Lanka, IK Notes, No. 66, Knowledge and Learning Centre, Africa Region, World Bank.

Marsh, R. (1998). Building on Traditional Gardening to Improve Household Food Security. Food, Nutrition and Agriculture No. 22, Food and Agriculture Organization.

Ministry of Lands (1995). Forestry Sector Master Plan

Mitchell, R. and Hanstad, T. (2004). Small home garden plots and sustainable livelihoods for the poor, FAO.

Publications/leaflets of the Minor Export Crops Demonstration Farm in Delpitiya, Organised mixed cropping models for yield maximization

Miura, S., Osamu, K. and Susumu, W. (2003). Home Gardening in Urban Poor Communities of the Philippines. 54(1) *International Journal of Food Sciences and Nutrition*.

Miura, S., Osamu, K. and Susumu, W. (2003). Home Gardening in Urban Poor

Communities of the Philippines. 54(1) *International Journal of Food Sciences and Nutrition*.

Mohan, S. (2004). An assessment of the ecological and socio economic benefits provided by home gardens: a case study of Kerala, India, Ph.D. Theses, University of Florida

Nair, P.K.R. (1993). An Introduction to Agroforestry. Kluwer Academic Publishers, London.

O'rigbo, B. (1990). "Home Gardens in Tropical Africa." In Landauer, K., and Brazil, M. (eds.) (1990). *Tropical Home Gardens*. United Nations University Press, Tokyo, Japan, pp. 21 - 40.

Orr, E. (1972). The Use of Protein-Rich Foods for the Relief of Malnutrition - An Analysis of Experience, *Tropical Products Institute Report* (also *FAO Food and Nutrition* 1977).

Ranasinghe, D.M.S.H.K. (1991). Agroforestry and Community forestry in Sri Lanka. The Sri Lanka Forester, Vol. XX Nos. 1 & 2, January - December: 43-47.

Rajapakse, U. Household food security, the Role of Traditional Food Plants in Sri Lanka, Movement for National Lands and Agriculture Reform, Colombo, Sri Lanka.

Ranasinghe, D.M.S.H.K. and Newman, S.M. (1993). Agroforestry Research and Practice in Sri Lanka, *Agroforestry Systems*, 22.

Ranasinghe, D.M.S.H.K. (1994). Traditional Tree-Crop Practices in Sri Lanka, In: Indigenous Knowledge for sustainable development, Proceedings of the Workshop on Indigenous Knowledge, Colombo, Sri Lanka on 19 20 April 1994, Sri Lanka Resource Centre for Indigenous Knowledge, University of Sri Jayewardenepura.

Ranasinghe, D.M.S.H.K. (1995). Traditional tree-crop practices in Sri Lanka, Indigenous Knowledge and Development Monitor, Vol. 3, Issue 3: 7-9.

Ranasinghe, D.M.S.H.K. (2005). Potential of agroforestry in sustainable development in Sri Lanka, Proceedings of the 10th Annual Forestry and Environment Symposium on 'Forestry and Environmental Science for Sustainable Development' 2-3 December, 2005.

Ranasinghe, Hemanthi (2008). Overview of Indigenous Knowledge in Sustainable Development in Sri Lanka, Proceedings of the 28th Annual Sessions of the institute of Biology on the theme 'Grassroot innovation and traditional knowledge for national development' September 2008.

Ranasinghe, D.M.S.H.K. (1996). Agroforestry : An Overview. In: *Agroforestry for Sustainable Development in Sri Lanka*, Proceedings of the Three Day Training

Workshop on Agroforestry held in Colombo in September 1994 (eds. Ranasinghe, D.M.S.H.K. and Huxley, P), University of Wales, Bangor, UK.

Ranasinghe, T. (2009) Sri Lanka - National Policy for Urban Agriculture after 'Family business Garden' Initiative, *City Farmer News*. Reutlinger, S. (1987). The Nutritional Impact of Agricultural Projects, 153-65. In: Price-Gittinger *et al.* (op. cit.).

Schipani, S., van der Haar, F., Sinawat, S. and Maleevong, K. (2002). Dietary Intake and Nutritional Status of Young Children in Families Practicing Mixed Home Gardening in Northeast Thailand. 23(2) *Food and Nutrition Bulletin* 175 - 180. Sennayake, R.I., Sangakkara, U.R., Pushpakumara, D.K. N.G. and Stamp, P. (2009). Vegetation composition and ecological benefits of home gardens in the Meegahakiula Region of Sri Lanka, *Tropical Agricultural Research* Vol 2 (1).

Soemarwoto, O., Soemarwoto, I., Karyono and others (1985). The Javanese Home Garden as an Integrated Agro-Ecosystem. 7(3) *Food and Nutrition Bulletin*. Terra, G.J.A. (1954). Mixed-Garden Horticulture on Java. 3 *The Malayan Journal of Tropical Geography*.

tho Seeth, H., Chachnov, S. and Surinov, A. (1998). Russian Poverty: Muddling Through Economic Transition with Garden Plots. 26(9) *World Development* 1611-1623.

Vaheesan, S. (2002). Role of Sri Lanka's diversity in traditional paddy and other field crop farming systems for promoting sustainable practices in agriculture, In 1st RDA/ARNOA International Conference on 'Developments of Basic Standard for Organic Rice Cultivation' 12-15 November, 2002, RDA and Dankook University, Korea.

Watson, A. (2009). Home gardens - Maintaining a traditional solution to food, economic and ecological security, <http://www.socialmedia.com>

World Bank (1986) *Poverty and Hunger: Issues and Options for Food Security in the Developing Countries*, Washington DC.

WHO (1990). *Diet, Nutrition and the Prevention of Chronic Diseases*, Report of a WHO Study Group, Technical Report Series No. 797, World Health Organization, Geneva.

West, K.P. and Sommer, A. (1987) *Delivery of Oral Doses of Vitamin A Deficiency and Nutritional Blindness*, ACC/SCN State-of-the-Art Series, Nutrition Policy Discussion Paper No. 2.

Wickramanayake, T.W. (1996). Food and Nutrition, Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo.

The Environmental message delivered by Arahat Mahinda to King Devanampiyathissa

"O' great King! The birds of the air and the beasts on the earth have an equal right to live and move about in any part of this land as thou.

The land belongs to the people and all other beings and thou are only the guardian of it."

(<http://www.sinhalaya.com/network/index.php/topic,4342.0html>)

