

HOME GARDENS FOR IMPROVED FOOD SECURITY AND
ENHANCED LIVELIHOODS IN NORTHERN SRI LANKA

By

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ABSTRACT

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Food security remains a high priority for the government of Sri Lanka. As a part of the post-conflict rebuilding of Sri Lanka, the government is promoting establishment of home gardens for reducing hunger and malnutrition and improving livelihoods. Since the civil war ended in 2009, the government and non-governmental organizations have established more than 500 home gardens in the Northern region of Sri Lanka. This research was conducted in the Jaffna District of Sri Lanka which was severely affected by the conflict. The objective of this research was to investigate the role of home gardens in enhancing food security. This research study took a three prong approach. First, the past experiences of home gardens in developing countries were analyzed through a rigorous literature review. Second, the current role of home gardens as a supplemental source of food was analyzed using research data obtained through the survey of 167 home gardens. Finally, the findings of the research were used to develop innovative strategies to enhance home gardens.

The global literature supports the positive contributions of home gardens towards enhancing food security in various contexts while pinpointing key constraints. The literature review supports the inclusion and promotion of home gardens as an eco-friendly sustainable agricultural practice to improve food security. The results of the survey of home gardens in Jaffna District indicated that as many as 29 useful plant species were found in home gardens. The home gardens were found to be diverse and were providing supplemental sources of fresh and nutritionally rich food products. The most important constraints identified were weeds, soil

fertility, pests, shortage of capital and labor, and timely access to information and advisory services. The home gardeners strongly stated the need for training in specific areas such as bee keeping, composting, maintaining nurseries of planting materials, pest and soil management.

Based on the needs and constraints identified by the home gardeners, four programs are proposed a collaborative activity between Michigan State University and University of Jaffna (UoJ). First, a model home garden will be established at the UoJ campus to serve as a research, education and outreach site. Second, a Master Home Gardener Program will be developed involving progressive gardeners to serve as trainers for other home gardeners. Third, a user-friendly manual on best practices in home gardening will be developed to enhance educational programs. Lastly, an innovative program will be launched using mobile phones to empower local home gardeners with up-to-date information on home gardening. Overall, the results of this research study indicate that home gardens are contributing to food security, income generation and livelihoods in the Northern region of Sri Lanka. When total value of produce per home garden was extrapolated to a million home gardens as per the long-term goals of the Sri Lankan government, the economic value was estimated to be nearly US \$300 million. Based on these results, it is recommended that the home gardens program should be scaled-up and further expanded in other parts of Sri Lanka.

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LIST OF ABBREVIATIONS

DFE	Dietary Folate Equivalent
FAO	Food and Agriculture Organization
FBG	Family Business Gardens
GDP	Gross Domestic Product
GFS	Gardener Field Schools
ICT	Information and Communication Technology
IHITC	International Horticulture Innovation and Training Center
IRB	Internal Review Board
KFG	Kandyan Forest Gardens
L/N-SA	Low/No-Space Agriculture
LKR	Sri Lankan Rupee
MHGP	Master Home Gardener Program
MMS	Multimedia Message Services
MSU	Michigan State University
NGO	Non-governmental Organization
NSF	National Science Foundation
RAE	Retinol Activity Equivalent
SFS	Student Field School
SWOT	Strengths, Weaknesses, Opportunities, and Threats
ToT	Training of Trainers
UoJ	University of Jaffna
USDA	United States Department of Agriculture

1. INTRODUCTION AND OBJECTIVES

Food security is a global a complex issue (Godfray, et al., 2010) and remains a major challenge for developing countries there (von Grebmer, et al., 2012) Food security¹ is multidimensional and is presumed exists when is adequate and continuous food availability, access, and utilization in a sustainable manner. Agriculture is an important determinant of food security and the various dimensions of food security. However, despite of modern technological innovations in agriculture, the productivity in key food security crops have been in some cases reaching a threshold and in other cases declining around world due to a number of political, social, and environmental factors. As a result, millions of people remain food insecure, undernourished, and impoverished with diminished livelihoods. This calls for a prompt and utilitarian response to address food security and family nutrition as well as reducing poverty and improving standards of living of the poor and marginalized people around the world. The challenges of food security are especially daunting in conflict and post-conflict situations.

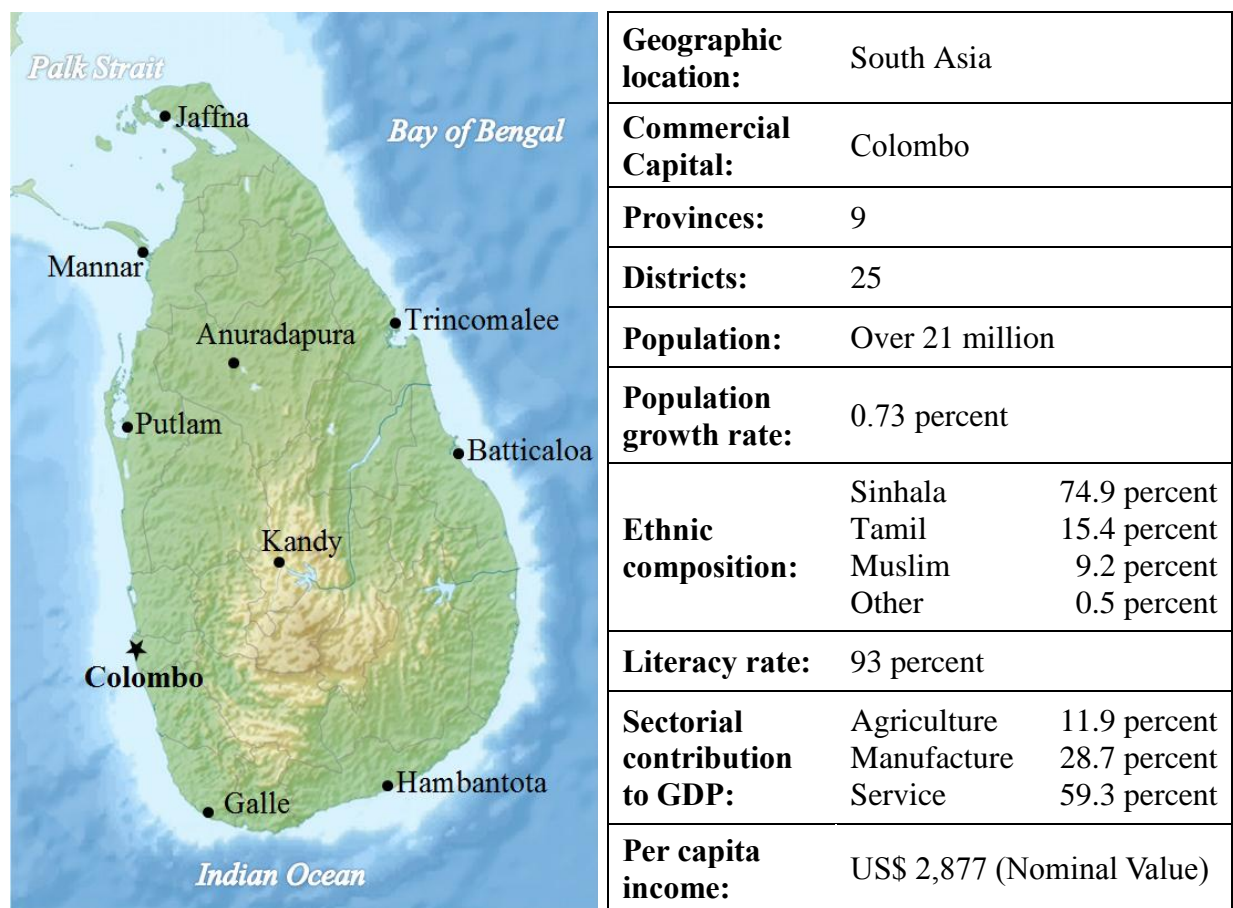
In recent years, governments and other development organizations in both developed and developing countries are emphasizing the importance of building local food production systems as an integrated strategy and a safety net for food security as well as poverty alleviation. Home gardens² are an integral part of the local food production systems and are of vital importance for

¹ Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996).

² Home gardens have been defined “a small scale supplementary food production system by and for household members that mimics the natural multi-layered eco-system” (Hoogerbrugge and Fresco, 1993). Home gardens “can be found in almost all triopical and subtropical ecozones where subsistence land-use systems predominate” (Nair, 1993).

the socio-economic development of subsistent and resource poor communities (Michon, Bompard, Hecketsweiler, and Ducatillion 1983; Soemarwoto, 1987; Mitchell and Hanstad, 2004; Olajide-Taiwo, et al., 2010). Widespread throughout the globe, home gardening is a long standing agricultural practice in countries in Asia, Latin America and Africa is widely promoted to augment and supplement household food needs particularly for resource-poor communities in developing countries.

Figure 1: Map of Sri Lanka and Country Profile



Source: Department of Census and Statistics, Sri Lanka, 2012

For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

Sri Lanka, a small island nation (Figure 1) with a population of 20 million people, is primarily an agrarian economy with a large portion of the population engaged in the agricultural

and allied sectors. The civil conflict that prevailed in the country for nearly three decades caused tremendous devastation to human lives, the social structure, the economy, environment and also the local food production systems. More than a hundred thousand lives were lost over the years and thousands of families have lost their male heads of the household leaving the women and in some cases the children to support the family welfare. In addition, thousands of families have been displaced in the Northern and the Eastern regions which were severely affected by the war and still been resettled.

Since the war ended in 2009, Sri Lanka has been making gradual progress towards social and economic recovery. Addressing food insecurity and poverty are key components of the rebuilding process in Sri Lanka. However, alleviating food insecurity in the country is a complex task and will require great efforts especially since a considerable fraction of the population are still overcoming the negative socio-economic implications of the war.

As a part of the overall strategy for the post-conflict rebuilding of the northern areas of Sri Lanka, the government is taking positive steps to reduce hunger and mal-nutrition, and improve livelihood activities of the war affected people. With this ambition, the government has launched a national home gardens initiative and has given attention to the households in the war affected areas. For example, the regional program sponsored by the government in the Jaffna district has supported the establishment of more than 500 new home gardens in resettled areas.

Effective development of home gardens can significantly contribute to food production in an environmentally friendly manner and make available a variety of fresh and nutritious food products: vegetables, fruits, spices, milk and other livestock products etc. Consumption of fresh food products can add to the family nutrition and health, especially in young children and mothers leading to a better quality of life as well as a more consistent and productive livelihood

engagement. In addition, it also provides a number of sustainable benefits that can help elevate the family's standard of living as well as provide a host of other benefits to the environment and the community.

Focusing on the contribution of home gardens towards improved food security and livelihoods of poverty stricken and war affected families, this research was conducted in collaboration with the University of Jaffna with three main objectives:

- I. Through a rigorous literature review and past experiences, document the role and impacts of home gardens on the various components of sustainable development: social, economic, and environmental dimensions. With emphasis on household food security the past experiences are used to substantiate the hypothesis that - home gardens can make a viable contribution to food availability, access, and utilization and also provide other benefits to the household.
- II. Evaluate the current status of home gardens in the Jaffna District in Northern Sri Lanka through a survey instrument and personal interactions with stakeholders. The survey results will be used to support the hypothesis that - home gardens in the Northern region of Sri Lanka are enhancing household food supplies as well as providing nutritional, economic and social incentives for the households, while providing ecological services.
- III. Propose innovative approaches and potential interventions to enhance research, education, and outreach programs to help improve and scale-up home gardens in the Northern region and other parts of Sri Lanka for increased food and nutrition security and economic growth.

Based on the above three objectives, this dissertation is written as three manuscripts. These include:

- I. Review of Home Gardens in Sri Lanka and other Developing Countries
- II. Role of Home Gardens for Food Security, Nutrition, and Income in Northern Sri Lanka
- III. Innovative Approaches to Enhance Home Gardens for Improved Food Security, Nutrition and Livelihoods in Sri Lanka

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2. HYPOTHESIS

This study is based on the overall hypothesis that home gardens provide a versatile option to improve food, nutritional, and income security, livelihoods, and a better quality of life of households affected by civil conflict in Northern Sri Lanka.

I. Manuscript # 1 Specific Hypothesis:

- i. Home gardens improve food availability and nutrition of households.
- ii. Home gardens help improve the economic status of households.
- iii. Home gardens result in ecological benefits to households.

II. Manuscript # 2 Specific Hypothesis:

- i. Home gardens are contributing to household food supplies in the post-conflict Jaffna District of Sri Lanka while maintaining ecological diversity.
- ii. Home gardens are providing an array of fresh and nutritious food to the households in the post-conflict Jaffna District of Sri Lanka.
- iii. Home gardens are generating a source income in the post-conflict Jaffna District of Sri Lanka.
- iv. Home gardens are leading to a better quality of life of households affected by civil conflict in Northern Sri Lanka.

III. Manuscript # 3 Specific Working Hypothesis:

- i. Research, education, and outreach programs can help enhance productivity and benefits from home gardens.

3. REVIEW OF HOME GARDENS IN SRI LANKA AND OTHER DEVELOPING COUNTRIES

ABSTRACT

Home gardens are an integral part of local food systems and agricultural landscapes of developing countries all over the world. Through a rigorous literature review of more than 100 research papers, reports, and book chapters, this paper provides a global overview of social, economic, and environmental contributions of home gardens. Home gardening has been practiced in Sri Lanka for centuries but only a few publications present information on the topic. A majority of the bibliographic evidence discusses home garden research and experiences of countries in Africa, Asia, and Latin America with a handful of studies from post-conflict countries in these regions. The global literature recognize positive contributions of home gardens towards enhancing food security and nutrition different contexts as well as providing additional benefits including income and livelihood opportunities for resource poor families in developing countries and ecosystem services. While emphasizing these multiple benefits, the literature also identifies several constraints in home garden production systems and makes recommendations for making them viable and sustainable enterprises. Overall, the literature review supports the inclusion and promotion of home gardens as an eco-friendly sustainable agricultural practice to improve food security. More empirical evidence on the value and importance of home gardens in conflict and post-conflict situations needs to be documented. Further research is needed on the economic value of home gardening and models that hold the most promise in different circumstances along with their impacts on nutrition, gender issues, and long-term sustainability.

Keywords — *Home gardens, Food Security, Nutritional Security, Livelihood, Post-conflict*

INTRODUCTION

The vast majority of hungry and malnourished people live in developing countries under sub-standard living conditions (Food and Agriculture Organization, 2010) and over half a billion of the global population suffer from chronic food insecurity³. With the global population expected to reach over 9 billion by 2050, there will be a continuous need to increase food production and buffer stocks to meet the growing demand and efficiently cope with volatilities in food production and prices. It has been projected that global food production will need to increase by 70 percent in order to meet the average daily caloric requirement⁴ of the world's population in 2050. Moreover, the need for interventions are resonated as the resources available for food production including land, water, seeds, labor and credit are becoming scarce and costly and in the face of climate change and degradation of natural resources.

Multiple strategies are required to address the issue of food production and food security. The choice of feasible approaches hinges on the existing social, political and economic conditions and resources available to design and implement the intervention. Home gardens are a time-tested local strategy widely adopted and practiced in various circumstances by local communities with limited resources and institutional support. It is evident from literature that home gardens are a part of the agriculture and food production systems in many developing

³ Food insecurity and malnutrition occurs in three forms: chronic food security is the most severe category where a person is unable to consume the minimum amount of food needed for healthy life over a long period usually due to poverty or lack of productive recourses to generate income to purchase food (Food and Agriculture Organization, 2008). Other types of include transitional (short-term) which is further subdivide to temporary (limited time period due to shocks) and seasonal or cyclical (trend) food insecurity.

⁴ FAO (2006) reported an average consumption per person of 3130 kcal per day by the year 2050 based on their baseline projections. Alexandratos (2009) estimated a slightly lower average daily caloric availability per person of 3047 kcal per day by the year 2050.

countries and are widely used as a remedy to alleviate hunger and malnutrition in the face of global food crisis (Johnson-Welch, et al., 2000).

Globally, home gardens have been documented as an important supplemental source contributing to food and nutritional security and livelihoods. “Food production on small garden plots adjacent to human settlements is the oldest and most enduring form of cultivation and food production systems” – (Niñez, 1984). For centuries, home gardens have been an integral component of family farming and local food systems.

Home gardening is an ancient and widespread practice all over the world. In literature, home gardens are classified as mixed, kitchen, backyard, farmyard, compound or homestead garden (Terra, 1958; Ruthenberg, 1980; Brownrigg, 1985; Landauer and Brazil, 1990; Soemarwoto and Conway, 1991; Michon and Mary, 1994; Vogl, et al., 2002; Kumar and Nair, 2004; Puri and Nair, 2004; Mitchell and Hanstad, 2004). This paper presents the experiences of home gardens from Sri Lanka and other developing countries from around the world. An extensive literature search was conducted through electronic searches, as well as personal contacts with colleagues and collaborators. The information presented in this paper is based on the review of over 100 publications, reports, and book chapters covering various aspects of home gardens.

DEFINITION AND CHARACTERISTICS OF HOME GARDENS

Home gardens are found in both rural and urban areas in predominantly small-scale subsistence agricultural systems (Nair, 1993). The very beginning of modern agriculture can be dated back to subsistence production systems that began in small garden plots around the household. These gardens have persistently endured the test of time and continued to play an

important role in providing food and income for the family (Marsh, 1998). In the early 1950s, G.J.A. Terra pioneered the literature on Home gardens with his publications on mixed gardens in Java, Indonesia and the analysis of farm systems in Southeast Asia. Since then there has been extensive contribution to the topic by many researchers synthesizing definitions, species inventories, functions, structural characteristics, composition, socio-economic, and cultural relevance (Kumar and Nair, 2004). Home gardens are emphasized in a number of ways based on the context as well as the objectives of the research (Hoogerbrugge and Fresco, 1993). Gupta (1989) pointed out that the background and gender of the researcher or scientist may also bias their perception on home gardens and may not entirely reflect the opinion of the family involved in home gardening activities.

Definition of Home Gardens

On the basis of research and observations of household gardens in developing and developed countries on five continents, Vera Ninez (1987), formulated the following definition of a home garden:

“The household garden is a small-scale production system supplying plant and animal consumption and utilitarian items either not obtainable, affordable, or readily available through retail markets, field cultivation, hunting, gathering, fishing, and wage earning. Household gardens tend to be located close to dwelling for security, convenience, and special care. They occupy land marginal to field production and labor marginal to major household economic activities. Featuring ecologically adapted and complementary species, household gardens are marked by low capital input and simple technology.”

Generally, home gardening is referred to the cultivation of a small portion of land which may be around the household plot or within a walking distance from home (Odebo, 2006). They can be described as a mixed cropping system that encompass vegetables, fruits, plantation crops, spices, herbs, ornamental and medicinal plants as well as livestock that can serve as supplementary source of food and income. Fresco and Westphal (1988) categorized home

gardens as a cropping system composed of soil, crops, weeds, pathogens and insects that converts resource inputs: solar energy, water, nutrients, labor, etc. into food, feed, fuel, fiber and pharmaceuticals. Kumar and Nair (2004), while acknowledging that there is no standard definition for “a home garden” summarized the shared perception by referring to it as “...an intimate, multi-story combinations of various trees and crops, sometimes in association with domestic animals, around homesteads” and adds that home garden cultivation is fully or partially committed for vegetables, fruits, and herbs primarily for domestic consumption.

Adding to this, other scholars have described a home garden as a well-defined, multi-storied and multi-use area near the family dwelling that serves as a small-scale supplementary food production system maintained by the household members and encompasses a diverse array of plant and animal species that mimics the natural eco-system (Hoogerbrugge and Fresco, 1993; Eyzaguirre and Linares, 2004; Sthapit, et al., 2004; Krishna, 2006). It encapsulates a perpetual small scaled subsistence agricultural system established by the household to obtain and supplement the food requirements of the family.

Home gardens are mainly intended to grow and produce food items for family consumption, but they can be diversified to produce outputs that have multiple uses including indigenous medicine and home remedies for certain illnesses, kindling and alternative fuel source, manure, building material, and animal feed. The excess output can also be sold to generate additional income (Niñez, 1985; Torquebiau, 1992; Trinh, et al., 2003; Eyzaguirre and Linares, 2004; Sthapit, et al., 2006; Yiridoe and Anchirinah, 2005).

Characteristics of a Home Garden

Michelle and Hanstad (2004) list five identifying characteristics of home gardens: 1) a home garden is located near the residence; 2) a home garden contains a high diversity of plants;

3) home garden production is supplemental rather than a main source of family consumption and income; 4) home garden occupies a small area (Brownrigg, 1985) and 5) home gardens are a production system that the poor can easily enter at some level (Marsh, 1998).

Figure 2: Characteristics of a Home Garden

- A home garden is located near the residence
- A home garden contains a high diversity of plants
- Home garden production is supplemental rather than a main source of family consumption and income
- A home garden occupies a small area, and
- Home gardens are a production system that the poor can easily enter at some level

Sources: Michelle and Hanstad (2004), Brownrigg (1985), and Marsh (1998)

There is a vast body of literature presenting research and case studies focusing on the role of home gardens as agroforestry or food production systems or a combination of both. Home gardens are ecologically divided into two categories: tropical and temperate (Niñez, 1984). Much of the literature focuses on home gardens in the tropical areas in Central and South America; (Mendez, et al., 2001; Leiva, et al., 2001; Aguilar-Stoen, et al., 2009; Finerman and Sackett, 2008).

There is also a substantial interest for home gardens in Asia (Cai, et al., 2004; Ali, 2005; Abdoellah, et al., 2006; Sunwar, et al., 2006) and Africa (Drescher, et al., 1999; Soini, 2005; Thompson, et al., 2010; Udofia, 2010). Studies on home gardens also encompass some publications from temperate areas (tho Seeth, et al., 1998; Agelet, et al., 2000; Vogl, et al., 2002; Bassullu and Tolunay, 2010; Calvet-Mir, et al., 2011; Reyes-García, et al., 2012) and from developed countries (Cleveland, et al., 1985; Faber, et al., 2002; Vogl and Vogl-Lukasser, 2003; Faber and Wenhold, 2007; Bleasdale, et al.,; Winter 2010–2011; Reynolds, 2011).

Hoogerbrugge and Fresco (1993) note that home gardens are established on lands that are generally not suitable for field crops or forage cultivation because of their size, topography, or location. The specific size of a home garden varies from household to household and normally, their average size is less than that of the arable land owned by the household. However, this may not hold true for those families that do not own agricultural land and for the landless. New innovations and techniques have made home gardening possible even for the families that have very little land or no land at all (Ranasinghe, 2009). The home gardens may be delimited by physical demarcations such as live fence or hedges, fences, ditches or boundaries established through mutual understanding. Application of kitchen waste, animal manure and other organic residues has been a practice amongst home gardeners and this exercise has helped to considerably increase the productivity and fertility of these gardens (Hoogerbrugge and Fresco, 1993; Galhena, et al., 2012).

While some similarities exist across the board, each home garden is unique in structure, functionality, and composition (Fernandes and Nair, 1986; Nair, 1989; Soemarwoto and Conway, 1991; Torquebiau, 1992) as they depend on the available family resources, skills and preferences (Christanty, et al., 1986; Asfaw, 2002; Galhena, et al., 2012). Ninez (1987) listed general tendencies with respect to home garden food production systems based on 15 type-specific characteristics adopted from Ruthenberg (1971). These characteristics are represented in Table 1.

The natural ecology of the location along with the enthusiasm and preference of the family members often controls the structure and appearance of the household gardens (Niñez 1984). Home garden cultivation tends to be quite dynamic (Eyzaguirre and Linares, 2004; Sthapit, et al., 2004). The decisions related the selection of crops, procuring inputs, harvesting,

management and so forth are primarily driven by the consumption and income generation needs of the household (Ali, 2005; Galhena, et al., 2012). Moreno-Black et al. (1996) further identified that personal preferences and limitations resulting from factors such as opportunities for off-farm employment, size and composition of the family as well as local customs influence the development and composition of the gardens.

Table 1: The Key Characteristics of a Typical Home Gardens

Characteristic	General Practice
Species density	High
Species type	Staples, vegetables, fruits, medicinal plants
Production objective	Home consumption
Labor source	Family (women, elderly, children)
Labor requirements	Part-time
Harvest frequency	Daily, seasonal
Space utilization	Horizontal and vertical
Location	Near dwelling
Cropping pattern	Irregular and row
Technology	Simple hand tools
Input-cost	Low
Distribution	Rural and urban areas
Skills	Gardening and horticultural skills
Assistance	None or minor
Skills	Gardening and horticultural skills
Assistance	None or minor

Source: Ninez 1987

A study from Indonesia observed that the structure, composition, intensity of cultivation, and diversity of home gardens can be subjected to the socioeconomic status of the household (Wiersum, 2006). For instance, as the families became economically stable their cultivation shifted from staples to horticultural crops and some families began to raise livestock. Based on the economics of the household, Niñez (1984) differentiated two types of home gardens: 1. subsistence gardens and 2. budget gardens. Access to planting material and social capital has also been important attributes to species diversity (Perrault-Archambault and Coomes, 2008). Collectively, the ecological potential, economic status, and social element influence the presence

of food and non-food crops and animals in the garden.

The home garden often uses family labor (Sthapit, et al., 2004). Women, children, and elders are of particular importance in their management (Fernandes and Nair, 1986; Jose and Shanmugaratnam, 1993; Landauer and Brazil, 1990; Torquebiau, 1992; Wojtkowski, 1993). But depending on the economic capacity and affordability, households may hire wage laborers to cultivate and maintain the home garden and directly affect the composition and intensity of home garden activities (Jacob and Alles, 1987; Maroyi, 2009; Mendez, et al., 2001).

Like any other food production system, home gardens may be vulnerable to harsh environmental conditions such as drought and floods (Turner, et al., 1977; Meertens, et al., 1996). Despite the fact that home gardening activities demand a lesser amount of horticultural and agronomic know-how, negative implications and crop losses can be reduced when the household members are empowered with better skills and knowledge (Turner and Brush, 1987).

EXPERIENCES OF HOME GARDENS FROM THE DEVELOPING WORLD

Home gardens have been an integral part of local food systems in developing countries around the world. Many studies provide descriptive evidence and analysis of home gardens in Asia, Africa, and Latin America contributing to social, economic, and environmental benefits as presented in the following section.

Home gardens provide multiple benefits. A paper by Ninez (1994) synthesizing research and case studies from four continents exemplifies a number of benefits from home gardens. Subsequent studies recognized and reconfirmed these findings. Chris Landon-Lane (2004) provides an excellent overview of the benefits of home gardens and the influence of gardening from ancient to recent times. Further, exploration of past and more recent compositions on home

gardens from world over, not only affirms the Landon-Lane's insight but also recognize additional advantages. In this paper, the benefits of home gardens are broadly categorized into three components: (1) social, (2) Economic, and (3) environmental benefits. These benefits are elaborated and exemplified through global experiences on home gardens.

Figure 3: Key Benefits of Home Gardens

- Improved food security
- Increased availability of food and better nutrition through food diversity
- Income and enhanced rural employment through additional or off-season production
- Decreased risk through diversification;
- Environmental benefits from recycling water and waste nutrients, controlling shade, dust and erosion, and maintaining or increasing local biodiversity

Source: (Landon-Lane, 2011)

Social Benefits

Enhancing Food and Nutritional Security. Review of studies from various countries reveals that the degree and combination socio-cultural impacts on societies engaged in home gardening vary across the board. Multiple social benefits of home gardens include enhancing food and nutritional security in many socio-economic and political situations, improving family health and human capacity, empowering women, promoting social justice and equity, and preserving indigenous knowledge and culture (Mitchell and Hanstad, 2004).

The most fundamental social benefit of home gardens stems from its direct contributions to household food security by increasing availability, accessibility and utilization of food products. Home gardens are maintained for easy access to fresh plant and animal food sources in both rural and urban locales. Food items from home gardens add substantially to the family energy and nutritive requirements on a continuous basis. A pioneering research study on home

gardens was conducted by Ochse and Terra in the early 1930s. They state that home gardens led to 18 percent of the caloric and 14 percent of the protein consumption by households in Kutowinangun, Indonesia. A subsequent study notes that a household nutritional status is directly linked to the development of home gardens (Ochse, 1937). Danoesastro (1980) observed an increase in household food consumption with intensive home garden food production. The numerous publications on Javanese home gardens in the 1980s illustrating their potential to increase food production and alleviate malnutrition in the tropics heightened global attention to home gardens (Niñez, 1984; Brownrigg, 1985).

The products from home gardens vary from staples to horticultural crops to animal products as well as firewood, herbs, and fodder for the animals (Albuquerque, 2005; Angel-Pérez and Mendoza, 2004; Kehlenbeck and Maass, 2004; Kumar and Nair, 2004; Michon and Mary, 1994; Peyre, et al., 2006). Thaman (1990) documented that Pacific Islanders obtained their main staple foods from home gardens. Similar contributions were made from home gardens in Nepal (Krishna, 2006), Yucatan Peninsula (de la Cerda and Mukul, 2008), Indonesia (Kehlenbeck, et al., 2007), Peru (Coomes and Ban, 2004), Ghana (Bennett-Lartey, et al., 2002), and Zimbabwe (Maroyi, 2009). Resource poor families often depended more on home gardens for their food staples and secondary staples than those endowed with a fair amount of resources such as land and capital (Wiersum, 2006). Also, home gardens provide the main source of staple food for people in heavily degraded and densely populated areas with limited croplands (Soemarwoto and Conway, 1991; Abebe, et al., 2006).

As stated by Marsh, home gardens provide day-to-day access to diversity of nutrient-rich fresh food that can be easily obtained and prepared to feed the family. According to Marsh, in Bangladesh households with home gardens obtained more than 50 percent of the household

supply of vegetables, fruits, tubers, and yams. When they integrated livestock activities, home gardens provided the main and in many times the only source of animal protein for the family. Kumar and Nair (2004) also support this premise through their study of Javanese home gardens in Indonesia and add that output from home gardens supplement the staple-based diet by adding nutrient-rich food items that contain proteins, vitamins, and minerals as well condiments and spices (Wiersum, 2006; Soemarwoto, 1987; Hoogerbrugge and Fresco, 1993; Abdoellah, et al., 2001) resulting in important dietary complements especially for growing children (Alvarez-Buylla Rocas, et al., 1989).

In an attempt to assess the dynamics of home garden evolution in Java and Sulawesi in Indonesia, Wiersum (2006) records that home gardens make available a small but continuous flow of subsistence food products for the household. The type of food products cultivated or extracted is often influenced by various socioeconomic and environmental factors (Peyre, et al., 2006; Abdoellah, et al., 2006).

Evidence from around the world suggests that home gardens can be a versatile option to address food insecurity in various challenging situations, thus they have attracted sponsorship by numerous government and non-governmental organizations. Home gardens can ensure food to very poor and resources-poor households as they can be established and maintained within a small patch of land or with no land using a few inputs. A study of home gardens in Cuba reveals that they were used as a strategy to increase resilience and ensure food security in the face of economic crisis and political isolation (Buchmann, 2009). To mitigate recurring food shortages and malnutrition, Cuban households obtained basic staple foods (rice and beans) through rations, but the households relied on their home gardens to obtain additional produce to diversify family diet (Wezel and Bender 2003). Consequently, home garden production has significantly

increased in the country and has been instrumental in reducing ‘hidden hunger’ and diseases caused by micronutrient deficiency.

A study conducted by William Rowe (2009) in 2009 in Tajikistan found that as much as one third of the food that was sold in the market came from kitchen gardens. Tajikistan became independent from the Soviet Union in 1991. Home gardens have allowed families facing civil war, drought, and de-modernization to meet their food needs and earn additional income. The Tajikistan experience shows that home gardens play an important role in household food security and sustenance.

Home gardens, while assuring a reliable and convenient source of food, fiber, and fuel for the family is a robust system in situations where population pressures and numerous resource limitations persist (Salam, et al., 1994; Holden, et al., 1996). In the Peruvian capital of Lima, home gardening has led to nutritional benefits to families living in slum areas by increasing the availability of carbohydrates as well as nutrient-rich vegetables and fruits that are not economically accessible for poor slum dwellers (Ninez 1984). Home gardens based on Enset and coffee is an integrated farming system that not only provide subsistence and complementary food products for Ethiopian families but also provide the primary means of employment for the household (Abebe, et al., 2006). The existence of these home gardens is especially important during famines.

Faber et. al. (2002) conducted a study in a rural village in Kwa Zulu-Natal in South Africa and found that production of yellow and dark green leafy vegetable in home gardens significantly improved Vitamin A status of children between the ages of two to five years. This project showed that home gardens can play a significant role in improving the dietary intake of food items rich in Vitamin A. The findings of this study support the integration of home

gardening programs with primary health care. The national home gardening program in Bangladesh was successful in increasing the availability and consumption of vitamin A-rich food items (Talukder, et al., 2000). For poor and marginalized families who are unable to afford expensive animal products to fulfill their family's nutritional needs, home gardens offer a cheap source of nutritious food (Bloem, et al., 1998).

Improving Health. Plants are an important source of medicine for humans and livestock and are used as biological pesticides to protect crop from diseases and pest infestations. Herbs and medicinal plants are grown in home gardens all over the world. People use herbal and medicinal plant to treat various illnesses, diseases and also to improve their health conditions. A study by Agelet et. al., (2000) in Catalina, Italy reports that around 250 medicinal plant species were found in home gardens representing more than 50 percent of the medicinal plant species grown in the region.

Perera and Rajapaksa (1991) in their assessment of Kandyan gardens in Sri Lanka state that, out of the 125 plant species found about 30 percent were exclusively used for medicinal uses and about 12 percent for medical and other purposes. Medicinal plants were recognized as the second most important plant group next only to cash value species in Sri Lanka (Perera and Rajapakse, 1991) and in Bangladesh (Millat-e-Mustafa, et al., 2002). In Bukoba district of Tanzania, home gardens contained plant species grown entirely for medicine (Rugalema, et al., 1994). In Quitana Roo, Mexico, of the 77 useful plants found in 80 Mayan home gardens, nine species were exclusive used for medicinal purposes and 26 species had mixed uses as medicines, food, spices, and ornamentals (De Clerck and Negreros-Castillo, 2000). Almost 70 percent of 301 plant species in the Yucatan forest and home gardens had medicinal value (Rico-Gray, et al., 1991).

Food insecurity and economic hardships impel people to consume food that is low in essential. Adverse health effects due to inadequate intake of basic macronutrients are further compounded by deficiencies of micronutrients such as vitamins and minerals. Vitamin A deficiency is a major health issues in many developing nations (World Health Organization, 2009). It is a serious problem particularly for pregnant women and growing children in low income countries. Reports indicate more than 7 million women suffering from complications due to vitamin A insufficiency (West and Darnton-Hill, 2008) and causing deaths in 6-8 percent of the children under the age of five in Africa and Asia. Homestead food production program was launched in Bangladesh and Nepal to assist the year-round production of vegetables and fruits mainly to address vitamin A deficiency and to improve the quality of diet (Iannotti, et al., 2009; Bloem, et al., 1996).

The incidence of anemia worldwide is primary attributed to iron deficiency. Iron deficiency elevates the risk of mortality during pregnancy by 20 percent (Stoltzfus, et al., 2004). Moreover, estimates suggest that nearly one-third of the global population live in countries with aggravate zinc deficiency (de Benoist, et al., 2007). Micronutrient deficiency can raise the vulnerability to infectious diseases and the risks of mortality due to illnesses such as diarrhea, pneumonia, malaria, and measles (Black, et al., 2008). It may also lead to multiple health issues as well as poor physical and cognitive development in young children. Several studies have documented that fresh vegetables and fruits produced through home gardens provide an array of nutrients including vitamins and minerals essential for better health (Faber, et al., 2002; Talukder, et al., 2006; Faber and Wenhold, 2007).

Social Equity and Gender Balance. In many cultures, women play an important role in food production and are active participants in home gardening activities (Talukder et. al 2000).

While women's contribution to household food production is immense, it is incorrect to conclude that home gardening is a predominantly a female activity (Hoogerbrugge and Fresco, 1993). Studies show that women's participation in home gardening varies across cultures ranging from land preparation, planting, weeding, harvesting, and marketing (Moreno-Black, et al., 1996; Keys, 1999; Pandey, et al., 2007).

Home gardens have played an important part in social change. Based on a study evaluating the food and nutritional impact of home gardens in Senegal, Brun et al. (1989) found that although the home gardens did not make a major contribution to food consumption and nutrition, they were instrumental in improving the women's income and social status as well as their awareness of various food habits in urban areas. Amongst the Achuar Indian community in the Upper Amazon, women's ability to maintain a lush home garden not only demonstrates her agronomic competency but also her status in society (Descola, 1994).

Other studies have shown that in situations where women are leading home gardens, there has been improvement to household nutrition especially child nutrition (Kumar, 1978; Talukder et. al 2000). Moreno-Black, et al. (1996) conducted a study of 49 women's home gardens in Northeastern Thailand. They found that these gardens were rich and diverse. The village women studied consistently indicated that they were the key decision makers and carried out most of the activities of the home gardens.

Howard (2006) conducted an analysis of literature on home gardens in Latin America. This analysis of 13 case studies dealing with gardens revealed that women are the main managers of home gardens across the region. Home gardening activities are vital and fit well with their day-to-day household activities and employment patterns along with their cultural and aesthetic values. Through home gardening women have developed proficiency related to the

plants and environment that helps them become better home and environment managers. Home gardens provide a mechanism for women to contribute to family subsistence, status, and identity in a respectable manner and hold the greater socio-cultural and spiritual importance for women. Home gardeners in Peru indicated that women gardeners tend to produce food for family consumption while men gardeners typically focus on high value crops for marketing (Niñez, 1985).

In Tajikistan, where many of the men were killed during the civil war or have migrated to Russia and other countries, the women, elders and children have been providing invaluable family labor and resources to local food and economic systems. Kitchen gardens, as they are referred by Rowe (2009) are contributing to women-headed families to fulfill their food needs and to generate additional income.

Preserving Indigenous Knowledge and Building Integrated Societies. Home gardens consist of a variety of species that represent social and cultural aspects of the different societies. There is a rich indigenous knowledge base in communities around the world that is valuable and expressed in home gardens through the selection of plants and animal species as well as in farming practices used by the local community. Home gardens can serve as a repository for preserving and transferring indigenous crop and livestock production knowledge and the skills from generation to generations, (Vasey, 1985; Brierley, 1985; (Moreno-Black, et al., 1996; Kimber, 2004).

Interactions in and around the home garden create and reinforce social status and ties between the household and the community. Home gardener often exchange or gift planting materials, vegetables, fruits, leaves, herbals and medicinal plants for social, cultural, and religious purposes (Blanckaert, et al., 2004; Soemarwoto, 1984). Such interactions are essential

for social integration and building social capital.

Economic Benefits

The economic and livelihood benefits of home gardens go beyond food and nutritional security and other social and cultural benefits, especially for resource poor families.

Bibliographic evidence suggests that home gardens contribute to income generation, improved livelihoods, and household economic welfare as well as promoting entrepreneurship and rural development (Trinh, et al., 2003; Calvet-Mir, et al., 2012).

Studies from Nepal, Cambodia, and Papua New Guinea report that the income generated from the sale of home gardens fruits, vegetables, and livestock products allowed households to use the proceeds to purchase additional food items as well as for savings, education, and other services (Vasey, 1985; Iannotti, et al., 2009).

Home gardens are widely promoted in many countries as a mechanism to avert poverty and as a source of income for subsistence families in developing countries. A number of ethnobotanical studies have focused on the evaluating the potential or real economic contribution to household and local economy as well as social development (Kehlenbeck, et al., 2007). A study from Southeastern Nigeria (Okigbo, 1990) reported that tree crops and livestock produced in home gardens accounted for more than 60 percent of household income.

In many cases the sale of produce from home gardens improves the financial status of the family providing additional income. The return per unit of land was higher for home gardens compared field agriculture (Marsh 1998). In many developing countries, both crops and livestock add to the household revenue, while contributing social and cultural enrichment (Wilson, 1995). In very small gardens where land resources are limited, livestock housed in home gardens provide a cash buffer and asset to the household (Devendra and Thomas, 2002).

Mitchell and Hanstad (2004) describes that home gardens can contribute to household economic wellbeing in several ways. Home gardens products may be sold to earn additional income. Gardening activities can be developed into a small cottage industry. Furthermore, the direct earnings from the sale of home garden products and the savings from consuming home-grown food products can lead to more disposal income that can be used for other domestic purposes. Families in mountain areas of Vietnam were able to generate more than 22 percent of their cash income through home gardening activities (Trinh, et al., 2003). Although home gardens are viewed as subsistence low production systems, they can be structured to be more efficient commercial enterprises by growing high-value crops and integrating livestock.

Environmental Benefits

Home gardens provide multiple environmental and ecological benefits. They serve as the primary unit that initiates and utilizes ecologically friendly approaches for food production while conserving biodiversity and natural resources. Home gardens are usually diverse and contain a rich composition of plant and animal species. Hence they make interesting cases for ethno-botanical studies (Blanckaert, et al., 2004; Albuquerque, 2005)

Gardens are complex and may be considered sustainable production systems that contribute to biodiversity conservation. Rich diversity and composition of species and varieties are among the most striking features of home gardens (Mitchell and Hanstad, 2004).

Kehlenbeck and Maass (2004) assessed 30 home garden in Sulawesi, Indonesia and identified 149 plant species that included vegetables, fruits, medical plants and spices. The traditional Thai home gardens are reported to contain a wide spectrum of plant species and at times uncommon varieties of different plant species. This leads to in-situ conservation of biodiversity and genetic material (Gajaseneni and Gajaseneni, 1999). Trinh et. al. (2003) through a three year study in four

districts in Vietnamese conclude that home gardens make ideal sites for in situ conservation withing ecozones due to their richness and stability.

Home gardens also provide a number of ecosystem services such as habitats for wildlife and beneficial organisms, nutrient recycling, reduced soil erosion, and enhanced pollination. The high density of plants within the home garden provide ideal habitats and refugia for wildlife species such as birds, small mammals, reptiles, and insects (Christanty, 1990).

Calvet-Mir et. al. (2012) highlights a number of ecosystems services provided by home gardens such as production of quality food, maintenance of land races, cultural services, pest control, and pollination. They conclude that the most important ecosystems services provided by home gardens differ from large scale and commercial agriculture.

Nutrient cycling is another ecological benefit of home gardens (Gajaseni and Gajaseni, 1999; Kumar and Nair, 2004; Seneviratne, et al., 2010). The abundance of plant and animal litter and continuous recycling of soil organic matter contributes to a highly efficient nutrient cycling system. Another potential benefit of home gardens is the reduction of soil erosion and land conservation (Terra, 1954; Soemarwoto, 1987). Inclusion of honey bees provides added benefits of improved pollination on certain plant species and inclusion of animals such as cattle, poultry, and other livestock provide an additional source of manure reducing the need for chemical fertilizer.

Livestock and poultry manure can add a significant amount of nitrogen, potassium, and phosphorus into the soil. The integration of livestock activities into home gardening can have significant contribution to the nutrient cycling in ecosystem (Thorne and Tanner, 2002). For instance, a study conducted by Biajaikya and Piters (1998) in the Bukoba district in Tanzania presents that nutrient balances were negative for home gardens without cattle.

Benefits of Home Gardens in Post-Conflict and Post-Disaster Situations

Even though there are only a few documented cases, home gardens have been proposed as an option for food and nutritional security in disaster, conflict, and post-conflict situations (Marsh, 1998; Iannotti, Cunningham, and Ruel, 2009; Gebauer, 2005, Rowe, 2009, and Galhena, et al., 2012). The Global Hunger Index specified that the lack of political stability has escalated hunger and poverty in countries affected by conflicts. Also, it can be inferred from the report that several countries transitioning towards peace or better governance has managed to reduce the prevalence and severity of hunger (von Grebmer, et al., 2011).

Bandarin, Jyoti, and Albernaz (2011) point out that in a post conflict setting, assistance and reconciliation mechanisms work best and result in environmental, social and economic benefits when there is a cultural linkage between the target population and the intervention. Hence home garden projects offer a realistic solution as in most countries home gardening is a regular day to day activity amongst the household especially for women.

Additionally, home gardens may serve as mechanism to address food insecurity and malnutrition problems that prevail due to conflicts and post-disaster circumstances where infrastructure is damaged or badly depleted, natural resources are sparse, and production inputs are limited, they provide a four-in-one solution to food and nutrition problem by increasing household food availability, enabling greater physical, economic and social access, providing an array of nutrients, and protecting and buffering the household against food shortages.

HOME GARDENS IN SRI LANKA

Agriculture in Sri Lanka

The economy of Sri Lanka is founded on agriculture. More than 35 percent of the 20

million people of Sri Lanka are engaged both directly and indirectly in the agrarian sectors. Throughout history, strengthening and boosting the agriculture sector has been central to the administrative structure in Sri Lanka. According to old scriptures, there was a tradition among Sri Lankan rulers to construct marvel irrigation systems to support agriculture since the 12th century. During the Colonial and immediate years after independence in 1948 the country's economy was heavily based on subsistence farming and plantations agriculture that began under the British rule. Since then the agricultural sector has vastly diversified.

Rice is the key staple crop. In addition, tea, rubber, coconut, and spices are mainly produced for the export market. Although agriculture is the cornerstone of the country's economy employing nearly 35 percent of the population, its contribution to the country's economy is only 12 percent of the total Gross Domestic Product (GDP) (Central Bank of Sri Lanka, 2011). The agricultural sector is composed of home gardens, small holder subsistence, commercial agriculture, and large scale estates.

The agriculture sector also includes livestock and fisheries activities. The livestock sector in Sri Lanka is less than vibrant and mainly consists of dairy and the poultry operations. There is much scope for expansion and growth in this sector as currently only 25 percent of the total milk requirement is met through local production. The vast coastline of Sri Lanka is abundant with fisheries resources and in addition there are extensive inland fresh water sources suitable for aquaculture that is underutilized.

Home Gardens in Sri Lanka in Sri Lanka

Home gardening is a longstanding practice among the rural and urban households in Sri Lanka for centuries (Jacob and Alles, 1987). The publications discussing home gardens in Sri Lanka almost exclusively focus on Kandyan Gardens, also known as Kandyan Forest Gardens

(KFG). KFG are a common traditional agroforestry systems found in the wet central hills in Sri Lanka. They encompass a mixed cropping system which includes a diverse collection of economically valuable perennial and semi-perennial crops situated around the household (McConnell and Dharmapala, 1973) along with animal species that were raised to suit the necessities of the family, the environment, and the recommendations by scientists and extension workers (Pushpakumara, 2000).

One of the earliest studies on KFG of Sri Lanka was published by McConnell and Dharmapala (1973). From a survey of 30 KFGs established through the use of a farming systems approach, they conclude that although in the short-run KFG were not as productive and profitable as the commercial farming systems but they lead to multiple benefits overtime. Jacob and Alles (1987) differentiate KFGs from other mixed forest-gardening systems found in South Asia and South-east Asia with respect to the diversity of plants grown. They also stated that these garden systems improved the well-being of people who nurtured them through the provision of various food products and timber, livelihood opportunities, and sustainability of the production system. Further, they emphasized the need to inspect existing agronomic practices and to design feasible models that can improve the productivity per unit of land.

Perera and Rajapaksa (1991) characterized various components of KFGs based on ownership, structure, species composition, livestock composition, and management practices. Their baseline survey of 50 randomly selected gardens in the Kandy District showed that the various species in the KFG had numerous uses including food, cash, timber, fuel wood, construction material, green manure, fodder, medicines, shade, and beautification. KFG also have significant implications to the region in terms of in-situ germ-plasm conservation (Perera, 1988), watershed management (Perera and Rajapaksa 1991), preservation of habitat and other

ecological contributions (Senanayake, 1987).

A book by Hochegger (1998), offers a comprehensive overview of the ecological, economic, and cultural relevance of KFG in Sri Lanka investigating six locations in the central hills. The Green Movement in Sri Lanka pioneered by (Kumarathunga, 2008) has published a guide on environmentally friendly agriculture with key emphasis on home gardens. This publication has been initially written in the Sinhala language and is in the process of been translated to the Tamil language. The guide provides step-by-step instructions to home gardeners and farmers on environmentally friendly cultivation and management practices and strategies to boost the efficiency of small agricultural production system.

Figure 4: Key Constraints to Home Gardening

- Lack of adequate land and water resources
- Limited access to high quality agricultural inputs
- Lack of information and timely advisory services
- Lack of credit
- Limited access to markets and market information

Sources: Hoogerbrugge and Fresco (1994); Mitchell and Hanstad, 2004

Ranasinghe (2009) has developed a detailed manual drawing on the ideas of Family Business Gardens (FBG) and Low/No-Space Agriculture (L/N-SA). This manual was shaped primarily to attract urban households to develop their home crop production into a small agribusiness. In addition this publication attempted to reach a wider audience that includes professionals, non-professionals, entrepreneurs, as well as policy makers concerned with issues related to food and nutritional security in the face of limited resources such as land. The manual of L/N-SA cum FBA also highlights that through improved management, home garden cultivations can be transformed into agricultural ventures through the systematic adoption of

economical and eco-friendly technologies and interventions.

CONSTRAINTS AND OPPORTUNITIES

While there are multiple benefits of home gardening for developing countries, the literature also reveals the key constraints to the productivity and sustainability of home gardens and makes recommendations for improving the home gardens and making them a viable and sustainable enterprise.

Table 2: Selected Publications Presenting Constraints to Home Gardening

Constraint	References
Limited access to agricultural inputs such as seeds, planting material, tools, and capital	Brownrigg, 1985; Niñez, 1985; Talukder, et al., 2000; Fernandes and Nair, 1986
Shortage of land and lack of land tenure security	Hoogerbrugge and Fresco, 1993; Fernandes and Nair, 1986; Jose and Shanmugaratnam, 1993; Howard, 2006
Inadequate access to water	Thaman, 1977; Niñez, 1985; tho Seeth, et al., 1998
Damage due to insect pests, diseases, animals, and theft	Thaman, 1977; Brownrigg, 1985; Niñez, 1985; Pandey, et al., 2007
Poor environmental conditions	Howard, 2006, Marsh, 1998
Lack of knowledge, information, and advisory services	Thaman, 1977; Hoogerbrugge and Fresco, 1993
Shortage of family or hired labor	Howard, 2006; Fernandes and Nair, 1986
Poor soil fertility and soil erosion	Howard, 2006; Thaman, 1977
Limited access to quality livestock breeds	Brownrigg, 1985; Mitchell and Hanstad, 2004
Limited marketing opportunities	Howard, 2006
Excessive post-harvest losses	Okafor and Fernandes, 1987
Inadequate R&D on home gardens	Evers, et al., 1985
Social and Cultural Barriers	Marsh 1998; Ninez 1985; Miura, et al., 2003, Talukder, et al., 2000
Lack of information on nutritional benefits of home gardening	Miura, et al., 2003; Talukder, et al., 2000

Hoogerbrugge and Fresco (1994) and Michelle and Hanstad (2004) provide a review of key constraints to home gardening. Among the constraints, they identified the access to suitable and sufficient land to establish a home garden and to which family has ownership or ownership-like rights as the most important limiting factor. The other constraints include access to capital or credit, access to water, seeds and planting materials, weak extension and advisory services, access to labor, and access to markets. The cultural acceptance of home gardening is also an important constraint. The most common constraints to home gardening identified in literature are summarized in Table 2.

SUMMARY AND CONCLUSIONS

Overall, the literature review supports the inclusion and promotion of home gardens as an eco-friendly sustainable agricultural practice to improve food security and enhance economic growth. The structure, functions, and contributions of home gardens vary in geographic regions. The literature concludes that home gardens fulfill social, economic, cultural need, while providing a number of ecosystems services.

In the wake of global food crisis and the soaring food prizes, there has been increase emphasis on enhancing and building local food systems. In this context, there is renewed attention to food production and livelihood enhancement through home gardens. However, more empirical evidence on the value and importance of home gardens in conflict and post-conflict situations needs to be researched and documented. There is also a need for research on the cost-benefit analysis of home gardening to determine the economic value and describe viable models that hold the most promise in various contexts. The areas of nutrition, access to new technologies, extension/advisory services, economic and non-economic benefits, women

empowerment, and long-term sustainability of home gardens specifically in post-conflict situations need further research.

Recognizing the value and potential of home gardens for enhancing food security and livelihoods, numerous initiatives have been launched by governmental, non-governmental, and international organizations in many developing countries that are providing support and building local capacity to enhance the productivity and also for scaling up home garden activities. In this light, a number of resource materials, manuals, and guides have been developed through various home garden related projects that can be used to improve and promote home gardening programs to enhance food security (Ranasinghe, 2009; Landon-Lane, 2011; (Helen Keller International - Cambodia, 2003).

APPENDIX

APPENDIX: About Sri Lanka and Importance of Agriculture and Food Security

Sri Lanka is an island nation located in South Asia. Sri Lanka has a population of 21 million. The Sri Lankan population is multi ethnic and is composed of Sinhalese, Tamils, Muslims, and Burghers. The agriculture sector primarily includes the production of rice, tea, rubber, coconut, and spices and accounts for about 12 percent of the total Gross Domestic Product (GDP). Although the contribution of the agriculture sector to the country's economy is fairly small, this sector has been employing nearly one third of the local population for over a decade. Sri Lanka has a high literacy level of 92.5 compared to other developing countries.

Sri Lanka is recovering from a long civil war that disrupted the country's social, agricultural, environmental, and economic well-being for nearly three decades. Although the undesirable consequences of the conflict were felt throughout the country, the implications were more intense for the Northern and Eastern Provinces in Sri Lanka. The thirty years of conflict displaced thousands of families and greatly impacted the livelihoods of millions of people in the post-conflict areas in the Northern and Eastern parts of Sri Lanka. After the war ended in 2009, the country was left with the challenging endeavor of rebuilding the war affected areas. The process of rebuilding has been particularly difficult for the Northern Province, which was the epicenter of the civil conflict. Achieving food security is an immediate necessity and a major challenge for the country. Food security is multidimensional and requires the improvement of food availability, food accessibility, and food utilization in a sustainable manner. The problems of hunger and malnutrition continue to burden the wellbeing of the Sri Lankan population, especially that of marginalized groups and those living and newly settled in the post-conflict areas in the North and East.

With the population growing at an annual rate 0.9 percent and hundreds of thousands of people internally displaced, feeding the population is a major challenge for the country. The International Food Policy Research Institute (IFPRI) annually issues the Global Hunger Index (GHI) that provides a snapshot of the hunger levels throughout the world⁵. According to the latest edition of the GHI, close to 14 percent of the Sri Lankan population remain in hunger.

The United Nations Children's Fund's (UNICEF) Sri Lanka office reported that nearly 29 percent of the children under the age of 5 years are suffering from malnutrition and around 14 percent in the same age group suffer from acute malnutrition or wasting. In addition, around 58 percent of the infants between 6 to 11 months and 38 percent of the children between 12 to 23 months were found to be anemic. The world food program (2009) estimated that 40 percent of children are underweight, 31 percent are stunted, and 28 percent suffer from acute malnutrition. The multiple displacement due to conflict has left food production systems completely or partially dilapidated.

Food security plays a critical role in alleviating hunger and elevating the nutritional status of the people in Sri Lanka. Prior to 2009, food security in some parts of the country was constrained by the adversities of decades of civil war. After 2009 people in the post conflict areas, particularly in the North, who were displaced due to the final stages of the war could not pursue their farming or off-farm livelihood that enabled them to obtain the food they need to sustain themselves. There has been a high reliance on food aid that has been rationalized among the large number of recipients. In addition, agricultural activities in these areas were disrupted and in some cases had to be abandoned as families and sometimes villages were relocated

⁵ Global Hunger index is an aggregation of three equally weighted hunger indicators – the number of undernourished as a percentage of the population, the proportion of children suffering from weight loss, and mortality rate of children under five.

elsewhere for safety due to the presence of land mines. Furthermore, years of isolation from markets, resources, and dilapidated infrastructure have also deteriorated the progress of the agricultural sector in these areas.

With so many people's livelihoods dependant on agriculture and a critical need to improve food security, there is a need to restore and revive local food systems. The restoration process must be focused on the dual purpose of expanding food production and at the same time stimulating natural resources management. The northern is region is home to thousands of resource poor farmers who are barely able to manage their livelihood. It is estimated that 14.5 percent of the population in Sri Lanka remains in hunger and undernourished and the numbers in the post-conflict region are much higher than the country average. In addition, hundreds of thousands of resource poor people in these areas depend on agriculture for food and livelihood. Their food security will depend on the availability and ability to produce food in a sustainable manner with minimal stress on the natural resources and environment.

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4. ROLE OF HOME GARDENS FOR FOOD SECURITY, INCOME GENERATION, AND LIVILIHOOHS IN NORTHERN SRI LANKA

ABSTRACT

Food security remains a high priority for the government of Sri Lanka. As part of the post-conflict rebuilding strategy in Sri Lanka, the government supports the establishment of home gardens as a means to reduce hunger and malnutrition and improve livelihoods of resource poor families in war affected areas. This research was conducted in the Jaffna District of the Northern Province which was severely affected during 30 years of war. Government and non-governmental organizations have established more than 500 home gardens in the Northern region since the civil war ended in 2009. The objective of this research was to characterize and assess the contribution of home gardens to household food production and food security. With this goal, 167 home gardens were surveyed in the Jaffna District. The average size of the home gardens in Jaffna area that was studied was approximately 0.4 acres. As many as 29 useful plant species were found in home gardens surveyed with an average of 9 useful plant species per garden. Plant types included vegetables, fruits, plantation crops, spices, ornamental, medicinal and herbal plants. A combination of 28 species of vegetables, 16 species of fruits, and 13 species of herbs/medicinal plants were found across all the gardens surveyed. The research revealed that home gardens are diverse and provide supplemental sources of fresh and nutritionally rich sources of food that fit with local culture and traditions. The most important constraints in home garden production identified were weeds, insect pests and diseases, shortage of capital and labor, damages due to weather, and lack of access to information and extension/advisory services. Home gardeners strongly stated the need for timely information, education, and training on

various aspects of home garden management including bee keeping, composting, maintaining nurseries of planting materials, pest and soil management, as well as integrating livestock activities and cultivating mushrooms. They also indicated that their neighbors and other farmers are the most dominant source of information for home gardening related activities. The food production data revealed that on an average, 140 kg. of vegetables, 408 kg of fruits, and 118 coconuts were produced in home gardens in one growing season. The produce was used mainly for household consumption and for marketing to generate income creating a total economic value of US \$296 per garden per growing season. Post-harvest losses were not a serious concern as most of the produce was either consumed by the households or sold in the local markets soon after the harvest. When total market value per home garden was extrapolated to a million gardens in the country as per the long-term goals of the Sri Lankan government, the value of the home garden production was estimated to be US \$296 million. Overall, the results indicate that home gardens are contributing to food security, income generation, and livelihoods in the Northern region of Sri Lanka through the production of a diverse set of vegetables, fruits, herbs, plantation crops, ornamentals, and livestock. Based on these results, it is recommended that the home garden programs be scaled-up and further expanded in the country as a supplemental source of food, income, and livelihood enhancements while considering the issue of long-term sustainability of home gardens.

Key words: *Sri Lanka, Home Gardens, Food Production, Food Security, Post-conflict, Nutrition, Livelihoods*

BACKGROUND

Food security remains a high priority in the vision and mission of the Government of Sri Lanka (The United Nations World Food Programme, Ministry of Economic Development, and Hector Kobbekaduwa Agrarian Research and Training Institute, 2011). The country is gradually recovering from a long and devastating civil war that prevailed for over 30 years. While the long conflict had a major impact on agriculture, economic, and social well-being and the overall development of the country, the repercussions were particularly severe for the Northern and the Eastern regions. With the war ending in 2009, the country was left with the arduous task of social reconciliation and economic rebuilding the various facets of the nation and rebuilding the war affected areas. Supplemental information on Sri Lanka, its economy and the importance of agriculture and food security to the country's wellbeing is provided in Appendix A.

The Government of Sri Lanka along with other non-governmental and international organizations launched a number of post-conflict rebuilding programs nationwide dedicated to rehabilitation, reconstruction, and reconciliation efforts prioritizing the conflict-affected areas. The government's strategy and policy agenda explicitly states the importance of food security and commits to ensure: *“physical, social and economic access to sufficient, safe and nutritious food to meet people's dietary needs and food preferences for an active and healthy life”* (Food Security in the Northern, Eastern and North Central Provinces - a Food Security Assessment Report 2011). Food security is thus a cornerstone in the long-term strategy of post conflict rebuilding, promotion of peace, and overall development of the country.

In 2011, the Government of Sri Lanka launched a National Food Production Drive. This was intended to encumber the adverse effects of global food insecurity as well as augment family nutrition status and support self-employment opportunities. Subsequently, the *Divi Neguma*

(Livelihood Upliftment) Program was initiated with an overarching decree to strengthen the home based economy to ensure income and employment opportunities to rural families and entail the establishment of one million home gardens to develop a “backyard economy.”

Agriculture plays an important role in the livelihoods of the 20 million people of Sri Lanka. While the agricultural contribution to GDP is about 13 percent, nearly 35 percent of the population relies on agriculture and allied sectors for their livelihoods. The civil war had a devastating impact on the agricultural research and development, institutional support services and public infrastructure particularly in the Northern and Eastern regions. Considering the importance of the agricultural sector, the government has given high priority to agricultural research and development, and introduced interventions that will have quick impacts on the food production, food security, and livelihoods. In this context, the government initiated a major program on home gardens in the country with special emphasis towards war-affected areas to enable physical and economic access to food while creating income opportunities for improved livelihood and well-being.

Home gardens have been an integral part of the local food systems since ancient times and have been practiced in most developing countries all over the world as a supplemental source of food (Brownrigg 1985; Mitchell and Hanstad, 2004; Kumar and Nair 2004; Pulami and Poudel 2006). The Government of Sri Lanka is promoting the introduction of home gardens nationwide to augment food production, food security, and livelihood activities. Home gardens in war-affected areas in the North and East have been receiving special assistance and sponsorship from the government and other organizations to address the urgent need to reduce hunger, malnutrition, and poverty. Since the civil war ended in 2009, more than 500 new home gardens have been established to assist war affected and resource poor families in the Northern

region. The objective of this research project was to assess the current status and contribution of home gardens in improving food production and food security as well as other associated benefits such as enhancement of nutrition and income generation.

METHODOLOGY

The research was conducted in the Jaffna District of Northern Sri Lanka which was severely affected by the conflict and had resulted in acute hunger and malnutrition (The United Nations World Food Programme, the Ministry of Economic Development, and Hector Kobbekaduwa Agrarian Research and Training Institute, 2011). The study was carried out in collaboration with the Faculty of Agriculture at the University of Jaffna (UoJ). Jaffna is one of the five Districts of the Northern Province in Sri Lanka. Of the population of nearly 500,000 people, more than 85 percent depend on agriculture and allied sectors for their subsistence and livelihoods. The majority of the people residing in this part of the country are of Tamil ancestry. Jaffna Peninsula falls under the dry zone low country with a total annual rainfall of about 635-1400mm (approximately 25 – 50 inches).

A comprehensive survey instrument was designed for gathering the data (Appendix C) and it was approved by the Internal Review Board (IRB) of Michigan State University (MSU). The survey questions include a combination of structured and open ended questions. The draft survey was pretested with university students and home gardeners to improve the quality of survey instrument. Bases on the feedback received, appropriate revision were also made to the survey questions. For this research project, 167 home gardens were randomly selected and surveyed in the Jaffna District where the households were accessible and safe for travel. The number home gardens selected for survey in different areas of the Jaffna District was based on

the population size in those areas. The data was collected through personal visits to home gardens during the *Maha*⁶ growing season in 2011-2012 which is the main growing season for the Northern region. A faculty member from the UoJ approved by the MSU IRB also participated in the survey and assisted with simultaneous interpretation. The information was provided by the head of the household through personal interviews during the site visits. The data and information collected included the following:

- i. Household demographics
- ii. Characteristics of home gardens
- iii. Constraints in home gardens
- iv. Inputs used and their sources
- v. Information and training sources and needs
- vi. Food production – vegetables, fruits, plantation and other crops
- vii. Livestock and fisheries activities
- viii. Use of mobile phones by home gardeners for accessing information
- ix. Quality of life impact indicators

The descriptive statistical analysis was performed using SPSS statistical software program.

RESULTS AND DISCUSSION

Household Demographics

A household pursuing home gardening was made up of an average of 4 family members (Table 3). This number is consistent with the typical size of a family in Sri Lanka. The majority

⁶ *Maha* season spreads between the months of September and March and coincides with the North-eastern Monsoon.

of the plots on which home gardens are located are owned by the families themselves. Seventy five percent of home gardens were headed by male members while 25% of home gardens were headed by women. During the long civil conflict, thousands were widowed or lost male household members. The number of female headed households can be attributed to irreversible damage the long civil conflict has brought upon the society. Helping women-headed families is a key component of the reconciliation process set forth by the Government of Sri Lanka and other developmental organizations.

Table 3: Household Demographic Characteristics of Home Gardens Surveyed in the Jaffna District of Sri Lanka

Number of Home Gardens Surveyed (N)	167	
Gender of Head of Household	Male headed	75%
	Female headed	25%
Average Age of Head of Household	50 \pm 1	
Average Number of members per Household	4 \pm 0.1	
Ownership of Household Plot Under Home garden	Owned	77%
	Leased	23%

\pm Represents Standard Error

Characteristics of Home Gardens

The average size of the gardens was found to be 0.4 acres (Table 4). Although the organization and crop composition of the home garden varied amongst the households, they were all located around the family home. This outcome was consistent with the general features of home gardens as small plots near the family dwelling (Mitchell and Hanstad, 2004 ; Kumar and Nair, 2004). Most home gardens contained food crops that were primarily cultivated for household consumption and use while the excess produce was intended to be shared or sold. This is consistent with findings from other developing countries (Torquebiau, 1992; Eyzaguirre and Linares, 2004).

A majority of respondents stated they engage in home gardening as a common day-to-day activity. Both men and women provided labor for home garden activities and more than two thirds of the households cared for their gardens on a daily basis. Nearly every household had access to simple traditional gardening tools including a hoe (*mamotty*), a machete, and a steel bar (*alawangu*). Only 23 households owned more sophisticated tools such as a two wheel tractor, or a sprayer. Most of the inputs for home gardening were obtained from the household, from neighbors, and farmers.

Table 4: Characteristics of Home Gardens Surveyed in the Jaffna District of Sri Lanka

Average Size of Home Garden in Lachum¹	7 ± 1
Average Size of Home Garden in Acres	0.4
Average Number of Useful Plant Species per Home Garden²	9
Average Number of Edible Plant Species per Home Garden³	7

¹ 1 acre = 18 Lachum

² Vegetables, Fruits, Spices, Plantation, and Herbal plants

³ Number of useful plant species ranged from a maximum of 29 to a minimum of 1.

± Represents Standard Error

Crop Diversity

The home gardens included a diverse set of plants that are locally preferred and adapted to local conditions. An average of nine plant species was found per garden. As many as 29 useful plant species were found in individual home gardens. Plant types included vegetables, fruits, plantation crops, flowering plants, medicinal and herbal plants. The gardens were found to be diverse and rich with locally adapted and locally-preferred food crops including indigenous plants. Across all gardens, a maximum of 28 species of vegetable crops, 16 species of fruit crops, and 13 species of herbs/medicinal plants were found (Tables 5, 6, and 7). While a majority of the gardens were diverse, a few were specialized with one or two plants.

Table 5: Vegetable Crops in Home Gardens, their Distribution, Market Value, and Nutritional Composition

Scientific Name	Common Name	Number of Gardens	Market price (LKR.) per kg.	¹ Carbohydrate	Protein	Total lipid	Fiber	Calcium	Iron	Magnesium	Phosphorus	Potassium	Sodium	Zinc	² Vitamin A	Vitamin B	Vitamin C	Vitamin D	Vitamin E	Vitamin K
<i>Solanum melongena</i>	Eggplant	83	55.00																R	
<i>Abelmoschus esculentu</i>	Okra	60	45.00										R			R				R
<i>Capsicum frutescenes</i>	Green Chilli	52	55.00	R												R	M		R	
<i>Vigna unguiculata</i>	Long Beans	51	57.50								R		R			R				
<i>Momordica charantia</i>	Bitter Gourd	35	58.00							R	R	R	R			M	R		M	M
<i>Amaranthus viridis</i>	Amaranth	25	15.00					R		R	R	R	R	R	R	R	R			
<i>Lycopersicon esculentum</i>	Tomato	25	15.00										R						R	
<i>Trichosanthes cucumerina</i>	Snake Gourd ^a	17	46.50							*		*	*	*	*			*	*	*
<i>Cucurbita maxima</i>	Pumpkin	16	38.00										R		R				R	
<i>Manihot esculenta</i>	Cassava	15	25.00	R												R				
<i>Moringa oleifera</i>	Moringa leaves	12	*		R			R		R	R		R		R	M				R
<i>Moringa oleifera</i>	Moringa pods	12	12.00				R						R				R			
<i>Phaseolus vulgaris</i>	Green Beans	9	90.00	R	R		R			R	R		R	R		R				
<i>Allium ascalonicum</i>	Red Onions	8	65.00	R			R				R					R				
<i>Beta vulgaris</i>	Beets	8	40.00	R									R			R				
<i>Amorphophallus paeoniifolius</i>	Elephant foot Yam ^b	5	70.00	R			R							R	*	R	*	*	*	*
<i>Capsicum annuum</i>	Yellow Wax Pepper	3	75.00	R												R	R		R	
<i>Ipomoea batatas</i>	Sweet Potato	3	47.00	R			R				R		R		M	R			R	
<i>Daucus carota ssp. sativa</i>	Carrot	3	35.00	R									M		R				R	
<i>Dioscorea alata</i>	Yam	2	70.00	R			R						R			R				
<i>Psophocarpus tetragonolobus</i>	Wing beans	2	54.00		R	R		R		R	M		R	R		M				
<i>Musa acuminata</i>	Plantains	2	50.00	M												R				

Table 5 (cont'd)

<i>Brassica oleracea</i> var. <i>capitata</i>	Cabbage	2	48.50															R	R				R
<i>Sesbania grandiflora</i>	Sesbania ^c	2	15.00	R	M	R	R	M		*	R	*	*	*	*			R	R	*	*	*	
<i>Luffa acutangula</i>	Ridged Gourd	1	35.00	R																			
<i>Cucumis sativus</i>	Cucumber	1	26.00																				
<i>Ipomoea aquatica</i>	Water Spinach ^d	1	15.00	R	R	M	M	R	M	M	R	M			M	*	*	*	*	*	*	*	*

Source: Extracted from USDA National Nutrient Database for Standard Reference, Release 25 (2012)

^a Commonwealth of Australia, Food Standards Australia New Zealand, and the University of New South Wales 2012; ^b Siemonsma and Piluck 1993; ^c Duke 1983; ^d Umar, et al. 2007

For Table 5 and 6

“M” denotes that the referred vegetable contained the maximum amount of the corresponding nutrient compared to represented collection of vegetables.

“R” denotes that the corresponding vegetable contain above average amount of the corresponding nutrient relative to the entire collection of vegetables.

* indicates that respective nutrient data was not found.

Green cell indicates that corresponding nutrient is present in the referred vegetable

White cell indicates that corresponding nutrient is not present in the referred vegetable.

¹ Carbohydrate *by difference* is the standard method to determine the amount of carbohydrates in foods by deducting the sum of the measured moisture, ash (inorganic components), protein, and fat from the total weight (100g) (Southgate 1969).

² Vitamin A is quantified in Retinol Activity Equivalent (RAE), where each µg RAE is equivalent to 1 µg of retinol, 2 µg of β-carotene in oil, 12 µg of "dietary" beta-carotene, or 24 µg of Pro-vitamin A carotenoids (α-Carotene, Beta-cryptoxanthin, and γ-carotene) (Institute of Medicine 2001).

Table 6: Fruit Crops in Home Gardens, their Distribution, Market Value, and Nutritional Composition

Scientific Name	Common Name	Number of Gardens	Market price (LKR.) per kg.	¹ Carbohydrate	Protein	Total lipid	Fiber	Calcium	Iron	Magnesium	Phosphorus	Potassium	Sodium	Zinc	² Vitamin A	Vitamin B	Vitamin C	Vitamin D	Vitamin E	Vitamin K
<i>Musa sapientum</i>	Banana	123	100	R						R		R								
<i>Mangifera indica</i>	Mango	96	20.00/fruit												R	R				
<i>Citrus madurensis</i>	Key lime	46	340					R	R											
<i>Punica granatum L</i>	Pomegranate	43	85	R	R		R		R		R		R	R		R			R	
<i>Artocarpus heterophyllus lam</i>	Jack fruit	42	100	R	R					M		R								
<i>Psidium guajava L.</i>	Guava	33	125		R		R			R	R	R		R		R	M			
<i>Carica papaya</i>	Papaya	33	24							R			M		R	R	R			
<i>Citrus sinensis (L) Osbeck</i>	Sweet Orange	14	15.00/fruit	R			R	R	M							R	R			
<i>Citrus limon L. Burm</i>	Lemon juice	6	340																	
<i>Passiflora edulis f. flavicarpa</i>	Golden Passion fruit	5	27.50/fruit						R				R		R					
<i>Limonia acidissima</i>	Woodapple ^a	5	15.00/fruit	R	M	R	*	M		*	M	*	*	*	R			*	*	*
<i>Spondias dulcis Saland</i>	Ambarella ^a	2	120				*	R		*	R	*	*	*	M			*	*	*
<i>Vitis venefera</i>	Grapes	2	25				R	R							*	R		*	*	*
<i>Persea americanna Miller</i>	Avocado	1	30/fruit		R	M	M		R	R	R	R	R	M		M			M	M
<i>Artocarpus altilis</i>	Bread fruit	1	19/fruit	M			R		R	R		M								

Source: Extracted from USDA National Nutrient Database for Standard Reference, Release 25 (2012)

^a Department of Agriculture, Government of Sri Lanka (2006)

Table 7: Medicinal and Herbal plants in Home Gardens, their Distribution, Health, and other Benefits

Type of Herbal and Medicinal plants	Scientific Name	No. of Gardens	Health and other Benefits
Tulasi	<i>Ocimum sanctum</i>	22	Cold, cough, bronchospasm, general debility, stress disorders, skin infections, wounds, indigestion, nausea, essential oil in flavoring, spiritual value
Purple Fruited Pea Eggplant^a	<i>Solanum trilobatum</i>	17	Treat the common cold, cough and asthma, itching, and strengthen the body
Gymnema	<i>Gymnema sylvestre</i>	14	Antidiabetic, cardiac stimulant, eye diseases, diuretic
Centella	<i>Centella asiatica</i>	14	Memory enhancer, anxiety, neurosis, general debility, wound healing, leprosy, eczema, psoriasis
Betle vine	<i>Piper betle</i>	9	Antiseptic, aphrodisiac, expectorant, bronchitis, rheumatism, stimulant, carminative, wounds
Ginger	<i>Zingiber officinale</i>	6	Asthma, skin diseases, de-worming, nausea, carminative, common colds
Margosa	<i>Azadirachta indica</i>	5	Bronchitis, diabetes, ulcers, haemorrhoids, skin diseases, tumors, syphilis, antiseptic, dandruff, contraception, dental care, insecticide
Aloe vera	<i>Aloe vera</i>	5	Health drink, burns, cuts, skin diseases, leprosy, piles, liver ailments, dysentery
Indian Gooseberry	<i>Emblica officinalis</i>	4	Aging and general debility, acid-peptic diseases, hair loss, dyspepsia, laxative, cooling, diuretic, ulcers
Turmeric	<i>Curcuma longa</i>	3	Antiseptic, skin allergies, viral hepatitis, wounds, antibacterial, anti-inflammatory, sore throat
Mint	<i>Mentha arvensis</i>	3	Cough syrups, flavoring agent, expectorant, pain reliever
Parsley	<i>Petroselinum hortense</i>	1	Flavoring and Antiafolotoxin
Alternanthera^b	<i>Alternanthera sessilis</i>	1	Antimicrobial and wound healing properties

Source: Adapted from Rao and Rajeswara Rao, 2006; ^aMuthu, et al., 2006 and ^bJalalpure, Agrawal, Patil, Chimkode, and Tripathi, 2008

The common vegetable crops in the home gardens included eggplant, okra, chili, long bean, bitter melon, tomato, and amaranth. The dominant fruit species included banana, mango, lime, pomegranate, jack fruit, guava, and papaya. Thus, vegetables and fruits topped the list of identified useful crops in the study region, in a study of home gardens in Nigeria, Olajide-Taiwo et. al. (2010) found a similar pattern. Nutritional value of the vegetables and fruits found in home gardens surveyed are represented in Appendix B. The dominant herbs included Tulsi, Purple fruited pea eggplant, Gymnema, and Centella. The considerable diversity of useful plants found in home gardens surveyed is consistent with the findings from home gardens in other countries (Niñez, 1984; Trinh, et al., 2003).

Integration of Livestock, Poultry, Bee-keeping and Fisheries

Livestock and poultry activities are an integral component of agricultural systems in Sri Lanka and other developing countries (Figure 5). Among the 167 gardens surveyed, 112 gardens contained some combination of livestock including cattle, goats, poultry, or swine, with 79 gardens having cattle, 74 with goats, 85 with chickens, and 1 garden with swine.

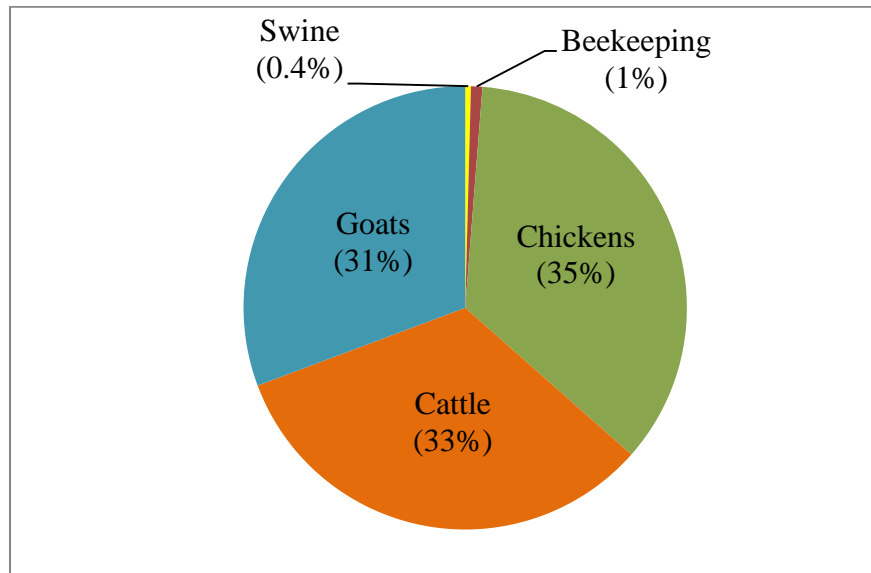
Only two gardens were practicing bee keeping. None of the home gardeners were engaged in fisheries or aquaculture. Home gardeners expressed a strong interest to learn and adopt bee keeping in their gardens.

Constraints identified by Home Gardeners

Like any other agricultural production system, home gardeners also face a number of limitations. The constraints they identified in their gardens are listed in Table 8. Common and important constraints across the home gardens surveyed included weeds, insect pests and

diseases, lack of capital, labor shortage, damage due to weather, and access to information and extension/advisory services.

Figure 5: Engagement of Home gardeners in Livestock, Poultry, and Beekeeping in Jaffna District of Sri Lanka



Problems associated with pests should be taken into consideration when designing and implementing programs to enhance home gardens. Seven species of weeds were commonly found in the home gardens. Amongst these *Cyperus rotundus*, *Brassica sp.* (wild species), and *Cyanodon dactylon peces* were most abundant. Some of the most destructive insect pests include mealy bug, thrips, white flies, leaf miners, leaf hoppers and aphids. In addition, some crops were found to be infested with mites. Amongst plant diseases affecting the home gardens, viral and fungal diseases including yellow mosaic virus, bunchy top virus, and powdery mildew were frequently mentioned. The occurrence of pests and diseases vary with the type of crop, environment, and the time of the growing season. A list of common weeds, insect pests, and diseases along with the severity of incidence is provided in Appendix D.

Table 8: Most important constraints in Home Gardens in Jaffna District of Sri Lanka

Constraint	Problem	Not a Problem	Do not Know
Weeds	88%	9%	3%
Insect pest and diseases	87%	8%	5%
Lack of capital	78%	17%	5%
Damage by weather related issues	78%	15%	7%
Limited family labor	77%	20%	3%
Limited access to quality seeds and planting material	67%	24%	9%
Access of agricultural tools and equipment	65%	28%	7%
Unavailability of information and advisory support	65%	25%	10%
Destruction by animal pests	61%	30%	9%
Market related issues	58%	25%	17%
Shortage of manure and fertilizer	58%	32%	10%
Poor soils	54%	41%	5%
Shortage of land	52%	48%	0%
Nematodes	46%	31%	23%
Shortage of water	39%	58%	2%
Theft	23%	68%	9%

Use of Agricultural Inputs

A majority of the gardeners used various planting materials including traditional varieties, new varieties and hybrids, saved seeds, tubers and suckers, seedlings, as well as branch and stem cuttings (Figure 6). Nonetheless, it can be noted that the use of traditional seeds, saved seeds, tubers and suckers, seedlings, and cuttings were more common compared to the use of new and hybrid varieties.

Manure and compost were commonly used by the home gardeners. The use of chemical fertilizer however, was somewhat limited. The use of vermi-compost was also very low (Figure 7). However, there was an interest among home gardeners to learn and adopt vermi-composting practices. Home gardeners use a number of tools to prepare and maintain their home gardens such as mammoties, pruning knives, steel bars (alavangu), and machetes. Due to the small size of the land holding, animal power was not extensively used.

Figure 6: Planting Inputs used for Home Gardens in Jaffna District of Sri Lanka

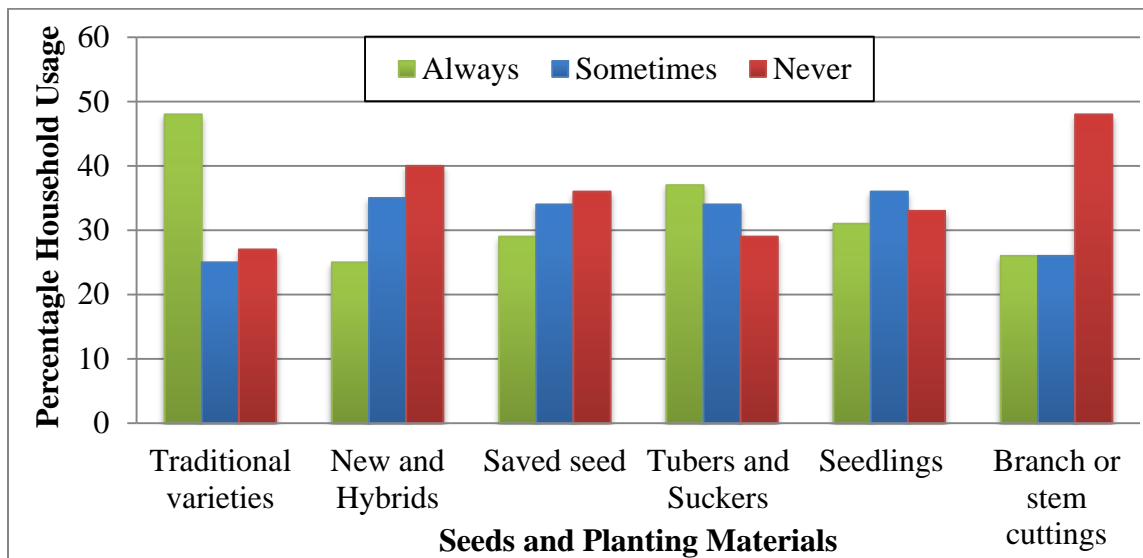
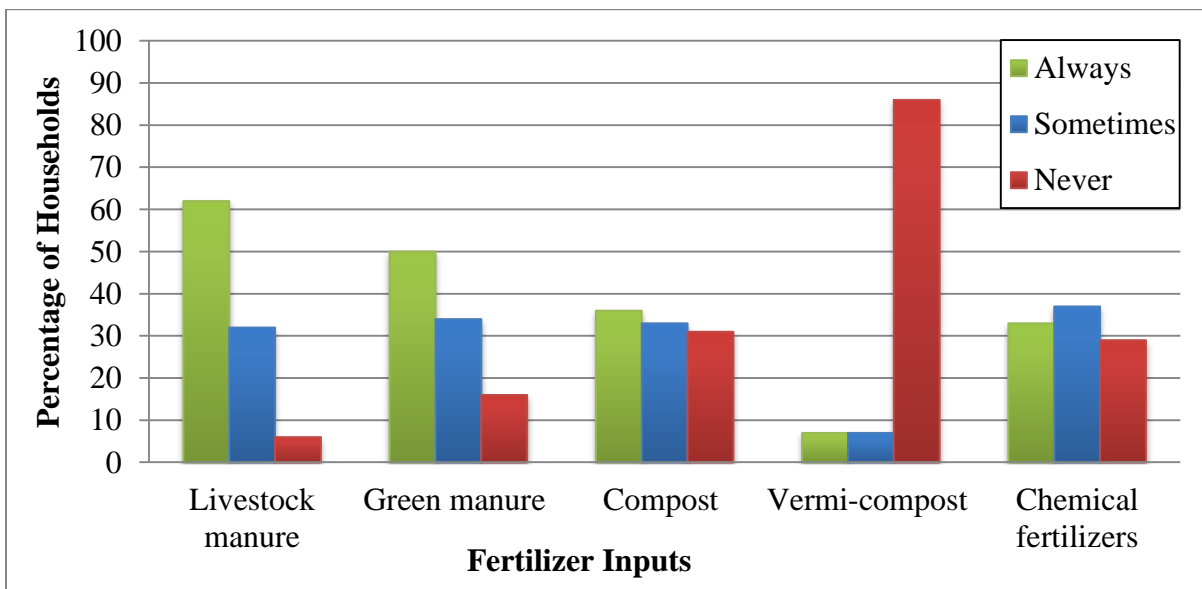


Figure 7: Fertilizer Inputs used for Home Gardens in Jaffna District of Sri Lanka

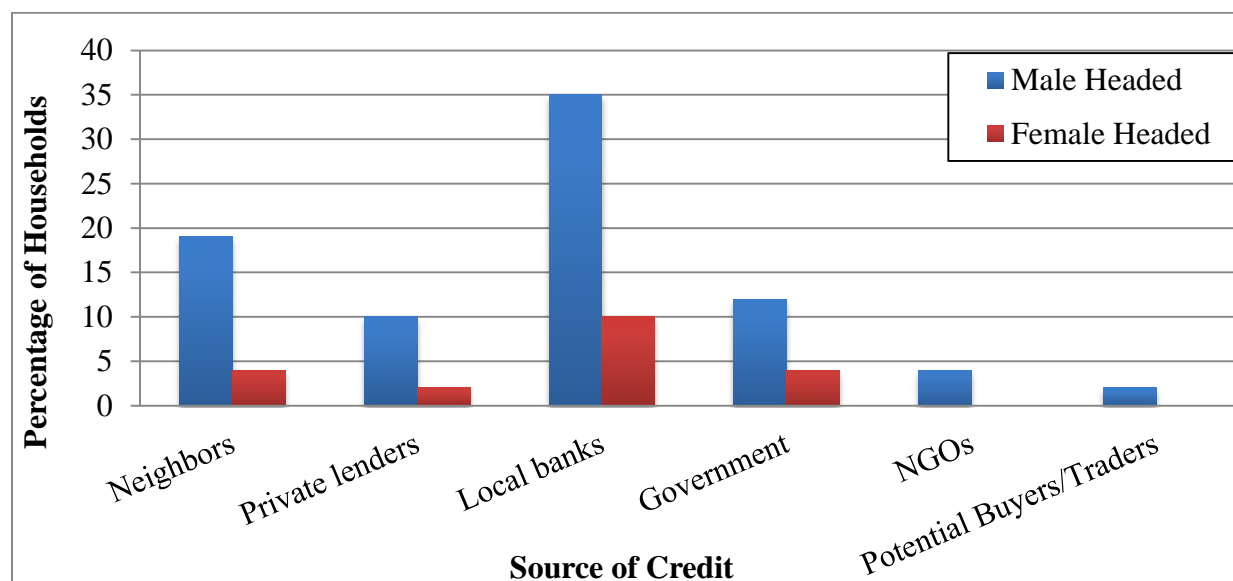


Access to Credit

The results indicate that only 27 percent of the home gardeners borrowed money to support home gardening activities. The home gardeners' various sources of credit included money borrowed from neighbors, private lenders, local banks, government and NGO-run

microcredit programs. Gardeners also borrowed from potential buyers of home garden produce (Figure 8). In general, male-headed households had more access to different sources of credit compared to female-headed households. The low percentage of access to credit by female-headed households could be due to the fact that they are often hesitant to borrow money and their tendency towards risk-aversion.

Figure 8: Sources of Capital/Credit for Home Gardeners in Jaffna District of Sri Lanka



Information, Education, and Training

The home gardeners strongly stated the need for timely availability and access to information, education, and training on various aspects of home garden management. A substantial number of home gardeners requested training and information on a number of home gardening activities. Amongst these beekeeping, composting, maintaining nurseries of planting materials, cultivating mushrooms, managing insect pests, diseases, and soil, as well as managing livestock activities were the mostly requested items (Table 9).

Home gardeners indicate that their neighbors and other farmers are the most important source of information for their home gardening activities (Table 10). This result is consistent

with findings of other countries where progressive farmers have been reported to be the most reliable and dominant source of information (National Sample Survey Organization, 2005).

Table 9: Information, Education and Training Needs of Home Gardeners in Jaffna District of Sri Lanka

Training Needs of Home Gardeners	Number of Households
Bee keeping	47
Compost production	44
Producing seedlings (nurseries)	42
Mushroom Cultivation	41
Integrated Pest management	40
Animal husbandry	40
Soil and land management	36
Crop diversification	33
Water management	29
Weed management	27
Selection and applications of fertilizer	25
Selection and applications of pesticides	23
Food processing and preserving	23
Using animal and green manure	22
Marketing and Management	20
Pruning and trimming	17

Table 10: Sources of Information and Training for Home Gardeners

Sources of Information and Training	Percent of Home Gardeners
Other farmers	34%
University and Govt. extension service	23%
Dealers and private firms	19%
NGOs and self-help groups	15%
Media	10%

The government extension system and the support from the University of Jaffna also continue to play an important role in providing information and training to home gardeners. Another interesting finding was that nearly 80 percent of the home gardeners own mobile/cell phones. However, only 8 percent of them utilized mobile phones to access and obtain home gardening related information. This indicates a potential opportunity when devising future

strategies to deliver information and advice. The extensive use and convenience offered by mobile phones could enable the real-time distribution of information and advisory services to home gardeners.

Production and Market Value of Vegetables, Fruits, and Plantations Crops

On an average, 140 kg. of vegetables, 408 kg. of fruits, and 118 coconuts were produced in home gardens during the *Maha* growing season (Table 11). Of the total production, 36 kg. of vegetables, 132 kg. of fruits, and 67 coconuts were consumed by households themselves, while 80 kg. vegetables, 244 kg. fruits, and 29 coconuts were marketed. This generated an average total value of LKR. 38,440 per season for each garden (equivalent to US \$ 296). This is consistent with Mitchell and Hanstad (2004) who reported that home gardens can contribute to household income from the sale of home garden products. The fruits generate more economic value compared to vegetables and coconuts. The aggregate economic value was calculated based on the prevailing wholesale market prices in Jaffna obtained through personal visits to three major fresh produce markets and in Dambulla extracted from the Tradenet web resource (Dialog Tradenet and Govi Gnana Seva, 2010).

Table 11: Total Production of Vegetables, Fruits, and Coconuts and Post-harvest losses in Home Gardens in Jaffna District of Sri Lanka

Commodity	Total Production per home garden per season		
	Total Harvest	Total consumed/sold	Percentage Losses
Vegetables	140 Kg. \pm 35	116 Kg.	17%
Fruits	408 Kg. \pm 74	376 Kg.	8%
Coconuts	118 nuts \pm 31	96 nuts	19%
Average per garden			12%

\pm Represents Standard Error

When total market value per home garden was extrapolated to a million gardens as per the long-term goals of the Sri Lankan government, the value of the home garden production is

estimated to be nearly US \$ 300 million (Table 12). Of course, there could be multiplier effects such that increased production may lead to the expansion of vegetable and fruit processing enterprises. On the other hand may lead to excess supply and wastage, thus necessitates shift in the crop choices.

Table 12: Total Consumption, Sales, and Market Value of Vegetables, Fruits, and Plantation Crops in Home Gardens in Jaffna District of Sri Lanka

Commodity	Total Production per home garden per season		Total Market Value	In US \$ Equivalent*
	Consumed at Home	Sold in the Market	in LKR*	
Vegetables	36 Kg. \pm 8	80 Kg. \pm 16	4,199 \pm 737	\$33
Fruits	132 Kg. \pm 26	244 Kg. \pm 62	31,746 \pm 6,279	\$244
Coconuts	67 nuts \pm 18	29 nuts \pm 13	2,495 \pm 716	\$19
Total per garden			LKR 38,440	\$296
Total for 1 million home gardens				\$ 296 Million

*Based on current production and market prices, \pm Represents Standard Error

In developing countries where infrastructure and marketing systems are profoundly weak, depending on the food commodity, post-harvest losses in fresh produce range from 25-50 percent (The Institute of Post Harvest Technology, 2002). However, in this study, the post-harvest losses experienced in home gardens in Jaffna District were lower and varied between 8-19 percent. This relatively small loss in production may be due the fact that most of the produce is either consumed and shared by the household or sold in the local market (Table 11).

Quality of Life Impact Indicators

The ultimate goal of home gardening programs in Sri Lanka is to improve food security, livelihoods, nutritional enhancement and quality of life of the people. Table 13 summarizes the responses of home gardeners to a series of questions related to quality of life indicators. A majority of the home gardeners indicated the positive impact of home gardens in terms of improving food availability, access and utilization as well as other social, economic and environmental benefits.

Table 13: Quality of Life Impact Indicators of Home Gardens in Jaffna District of Sri Lanka

Quality of Life - Impact Indicators	Strongly Agree	Agree	Disagree	Strongly Disagree	No Change
Fresh and healthy food products	75%	16%	3%	0%	7%
More food for the family to eat	53%	35%	5%	1%	5%
Higher share of vegetables and fruits	48%	39%	4%	2%	8%
Reduce Cost of Food Bill	45%	43%	4%	0%	8%
Benefited the family	45%	42%	2%	0%	11%
Wider variety of foods to eat	43%	40%	5%	1%	11%
Enable to earn additional income	43%	40%	7%	1%	10%
Help Conserve Environment	40%	50%	2%	0%	9%
Help relax	37%	41%	14%	0%	8%
Help engage in some physical activity as a family	37%	48%	2%	0%	13%
Enable to start small home based business/enterprise	29%	32%	21%	0%	18%
Better able to afford non-food items	20%	36%	15%	0%	29%

SUMMARY AND CONCLUSIONS

The results of this research support the benefits of home gardens in terms of contributing to food production and providing diverse sources of locally produced fresh and nutritious food to resource-poor families. Many of the crops grown in home gardens represent locally preferred indigenous crops rich in calories, vitamins, and minerals leading to healthy diets. While the benefits of the home gardens are enormous, there are several constraints identified by the home gardeners. The most common constraints include the problem related to weeds, insect pests, capital, labor, weather related damage and access to inputs. To address these constraints, an integrated approach will be required to develop and implement programs that would help provide rapid and easy access to timely information and advice. Priorities should include agricultural inputs and best practices for pest, crop, soil, and water management as well as post-harvest handling and marketing of the products. Favorable policies and programs are needed to improve easy access to credit and land with due consideration to gender equality.

The research results indicate that farmers are the most dominant sources of information for other farmers. Programs need to be initiated to build and utilize a network of innovative farmers to support other farmers in the local areas. There is a great need to develop and implement research, educational and outreach programs, with increased focus on nutritional aspects, soil and pest management, composting, and integration of livestock and bee keeping activities to enhance the productivity and profitability of home gardens.

Overall, the results indicate that home gardens are providing a supplemental source of food and income for households in the Northern region of Sri Lanka through the production of a diverse set of vegetables, fruits, herbs, plantation crops, and livestock products. This study shows that home gardens can indeed contribute to the National Food Production Drive. Further, home gardening can help improve the family's nutritional status and create home-based employment opportunities especially for the poor and marginalized families in the war-torn area. Expansion and scaling-up of home garden programs is thus recommended as a mechanism to minimize adversities of food insecurity, malnutrition, and poverty on communities in Northern Province and other parts of the country. In doing so, the issue of long-term sustainability must be taken into consideration.

APPENDICES

APPENDIX A: Nutritional Composition of the Vegetables and Fruits in Home Gardens in the Jaffna District of Sri Lanka

Table 14: Nutritional Value of the Vegetables Found in Home Gardens

Scientific Name	Common Name	Water (g)	Energy (kcal)	Macronutrients				Minerals						Vitamins											
				Carbohydrate ¹ (g)	Protein (g)	Lipid (g)	Dietary Fiber (g)	Sugars (g)	Calcium (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)	Vitamin A ² (μg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin B-6 (mg)	Folate ³ (μg)	Vitamin C (mg)	Vitamin D, (μg)	Vitamin E (mg)	Vitamin K (μg)
<i>Amaranthus viridis</i>	Amaranth	91.5	21	4.1	2.11	0.2	0	0	209	2.3	55	72	641	257	0.9	139	0	0.1	0.6	0.2	57	41.1	0	0	
<i>Beta vulgaris</i>	Beets	87.1	44	10	1.68	0.2	2	7.96	16	0.8	23	38	305	285	0.4	2	0	0	0.3	0.1	80	3.6	0	0	0.2
<i>Momordica charantia</i>	Bitter Gourd	88.7	32	6.2	3.6	0.2	2	1.04	42	1	94	77	602	249	0.3	121	0.2	0.3	1	0.8	88	55.6	0	1.5	163
<i>Brassica oleracea var. capitata</i>	Cabbage	92.6	23	5.5	1.27	0.1	2	2.79	48	0.2	15	33	196	255	0.2	4	0.1	0	0.3	0.1	30	37.5	0	0.1	109
<i>Daucus carota ssp. sativa</i>	Carrot	90.2	35	8.2	0.76	0.2	3	3.45	30	0.3	10	30	235	302	0.2	852	0.1	0	0.7	0.2	2	3.6	0	1	13.7
<i>Manihot esculenta</i>	Cassava	59.7	160	38.1	1.36	0.3	2	1.7	16	0.3	21	27	271	14	0.3	1	0.1	0.1	0.9	0.1	27	20.6	0	0.2	1.9
<i>Cucumis sativus</i>	Cucumber	96.7	12	2.2	0.59	0.2	1	1.38	14	0.2	12	21	136	2	0.2	4	0	0	0	0.1	14	3.2	0	0	7.2

Table 14 (cont'd)

<i>Solanum melongena</i>	Eggplant	89.7	33	8.1	0.83	0.2	3	3.2	6	0.3	11	15	123	239	0.1	2	0.1	0	0.6	0.1	14	1.3	0	0.4	2.9
<i>Amorphophallus paeoniifolius</i>	Elephant foot Yam ^a	79	17	*	1.5	0.3	4	*	85	2.3	33	*	450	3	0.9	*	*	*	0.3	*	*	*	*	*	*
<i>Phaseolus vulgaris</i>	Green Beans	66.5	129	24	7.05	0.8	9	0	63	1.1	56	102	370	242	0.6	0	0.1	0.1	0.6	0.1	75	1.2	0	0	*
<i>Capsicum frutescens</i>	Green Chili	87.7	40	9.5	2	0.2	2	5.1	18	1.2	25	46	340	7	0.3	59	0.1	0.1	1	0.3	23	243	0	0.7	14.3
<i>Vigna unguiculata</i>	Long Beans	87.5	47	9.2	2.53	0.1	0	0	44	1	42	57	290	240	0.4	23	0.1	0.1	0.6	0	45	16.2	0	*	*
<i>Moringa oleifera</i>	Moringa leaves	81.7	60	11.2	5.27	0.9	2	1	151	2.3	151	67	344	245	0.5	351	0.2	0.5	2	0.9	23	31	0	0.1	108
<i>Moringa oleifera</i>	Moringa pods	88.4	36	8.2	2.09	0.2	4	0	20	0.5	42	49	457	279	0.4	4	0.1	0.1	0.6	0.1	30	97	0	*	*
<i>Abelmoschus esculentu</i>	Okra	92.6	22	4.5	1.87	0.2	3	2.4	77	0.3	36	32	135	241	0.4	14	0.1	0.1	0.9	0.2	46	16.3	0	0.3	40
<i>Musa acuminata</i>	Plantains	67.3	116	31.2	0.79	0.2	2	14	2	0.6	32	28	465	5	0.1	45	0.1	0.1	0.8	0.2	26	10.9	0	0.1	0.7
<i>Cucurbita maxima</i>	Pumpkin	93.7	18	4.3	0.72	0.1	1	2.08	15	0.6	9	30	230	237	0.2	288	0	0.1	0.4	0	9	4.7	0	0.8	0.8
<i>Allium ascalonicum</i>	Red Onions	79.8	72	16.8	2.5	0.1	3	7.87	37	1.2	21	60	334	12	0.4	0	0.1	0.2	0.4	0.4	34	8	0	0	0.8

Table 14 (cont'd)

<i>Luffa acutangula</i>	Ridged Gourd	84.3	56	14.3	0.66	0.3	3	5.17	9	0.4	20	31	453	21	0.2		0.1	0	0.3	0.1	12	5.7	0	0.2	1.7
<i>Sesbania grandiflora</i>	Sesbania ^b	73.1	321	47.1	36.3	7.5	9	*	1130	3.9	*	80	*	*	*	*	0.2	0.1	1.2	*	*	169	*	*	*
<i>Trichosanthes cucumerina</i>	Snake Gourd ^c	94	17	4	0.6	0.3	1	*	26	0.3	*	20	*	*	*	*	0	0	0.3	*	*	12	*	*	*
<i>Ipomoea batatas</i>	Sweet Potato	75.8	92	20.7	2.01	0.2	3	11.1	38	0.7	27	54	475	246	0.3	961	0.1	0.1	1.5	0.3	6	19.6	0	0.7	2.3
<i>Lycopersicon esculentum</i>	Tomato	94.3	18	4	0.95	0.1	1	2.49	11	0.7	9	28	218	247	0.1	24	0	0	0.5	0.1	13	22.8	0	0.6	2.8
<i>Ipomoea aquatica</i>	Water Spinach ^d	73	301	54	6	11	18	*	417	210	302	109	5458	135	2	*	*	*	*	*	*	*	*	*	*
<i>Psophocarpus tetragonolobus</i>	Wing beans	67.2	147	14.9	10.6	5.8	0	0	142	4.3	54	153	280	249	1.4	0	0.3	0.1	0.8	0.1	10	0	0	*	*
<i>Dioscorea alata</i>	Yam	70.1	114	27	1.49	0.1	4	0.49	14	0.5	18	49	670	244	0.2	6	0.1	0	0.6	0.2	16	12.1	0	0.3	2.3
<i>Capsicum annuum</i>	Yellow Wax Pepper	91.5	29	6.7	0.8	0.4	1	3.53	12	0.5	16	29	202	1	0.3	41	0.1	0.1	1.1	0.5	53	92.9	0	0.5	9.9

Source: Extracted from USDA National Nutrient Database for Standard Reference, Release 25 (2012)

^a Commonwealth of Australia, Food Standards Australia New Zealand, and the University of New South Wales 2012; ^b Duke 1983;

^c Siemonsma and Piluck 1993; ^d Umar, et al. 2007

Table 15: Nutritional Value of the Fruits Found in Home Gardens

Scientific Name	Common Name	Water (g)	Energy (kcal)	Macronutrients				Minerals						Vitamins											
				Carbohydrate ¹ (g)	Protein (g)	Lipid (g)	Dietary Fiber (g)	Sugars (g)	Calcium (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)	Vitamin A ² (μg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin B-6 (mg)	Folate ³ (μg)	Vitamin C (mg)	Vitamin D (μg)	Vitamin E (mg)	Vitamin K (μg)
<i>Persea americana</i> Miller	Avocado ^a	73.2	160	8.53	2	14.7	7	0.66	12	0.6	29	52	485	7	0.6	7	0.07	0.13	1.74	0.26	81	10	0	2.1	21
<i>Musa sapientum</i>	Banana	74.9	89	22.8	1.1	0.33	3	12.2	5	0.3	27	22	358	1	0.2	3	0.03	0.07	0.67	0.37	20	8.7	0	0.1	0.5
<i>Artocarpus altilis</i>	Bread Fruit	70.7	103	27.1	1.1	0.23	5	11	17	0.5	25	30	490	2	0.1	0	0.1	0.03	0.9	0.1	14	29	0	0.1	0.5
<i>Passiflora edulis</i> f. <i>flavicarpa</i>	Golden Passion Fruit	84.2	60	14.5	0.7	0.18	0.2	14.3	4	0.4	17	25	278	6	0.1	47	0	0.1	2.24	0.06	8	18.2	0	0	0.4
<i>Vitis venefera</i>	Grapes	80.5	69	13.9	0.8	0.47	4	15.5	37	0.3	14	24	203	1	0.1	*	67	0	*	*	*	3	*	*	*
<i>Psidium guajava</i> L.	Guava	80.8	68	14.3	2.6	0.95	5	8.92	18	0.3	22	40	417	2	0.2	31	0.07	0.04	1.08	0.11	49	228	0	0.7	2.6
<i>Artocarpus heterophyllus</i> lam	Jack Fruit	73.5	95	23.3	1.7	0.64	2	19.1	24	0.2	29	21	448	2	0.1	5	0.11	0.06	0.92	0.33	24	13.7	0	0.3	0
<i>Citrus madurensis</i>	Key lime	88.3	30	10.5	0.7	0.2	3	1.69	33	0.6	6	18	102	2	0.1	2	0	0.02	0.2	0.04	8	29.1	0	0.2	0.6

Table 15 (cont'd)

<i>Citrus limon L. Burm</i>	Lemon juice	92.3	22	6.9	0.4	0.24	0.3	2.52	6	0.1	6	8	103	1	0.1	0	0.02	0.02	0.09	0.05	20	38.7	0	0.2	0
<i>Mangifera indica</i>	Mango	83.5	60	15	0.8	0.38	2	13.7	11	0.2	10	14	168	1	0.1	54	0.03	0.04	0.67	0.12	43	36.4	0	0.9	4.2
<i>Carica papaya</i>	Papaya	88.1	43	10.8	0.5	0.26	2	7.82	20	0.3	21	10	182	8	0.1	47	0.02	0.03	0.36	0.04	37	60.9	0	0.3	2.6
<i>Punica granatum L.</i>	Pomegranate	77.9	83	18.7	1.7	1.17	4	13.7	10	0.3	12	36	236	3	0.4	0	0.07	0.05	0.29	0.08	38	10.2	0	0.6	16
<i>Citrus sinensis (L) Osbeck</i>	Sweet Orange	82.3	63	15.5	1.3	0.3	5	0	70	0.8	14	22	196	2	0.1	13	0.1	0.05	0.5	0.09	30	71	0	0	0
<i>Limonia acidissima</i>	Woodapple ^a	*	134	18.1	7.1	3.7	*	*	130	0.06	*	110	*	*	*	40	0.02	*	*	*	*	0.003	*	*	*

Source: Extracted from USDA Agricultural Research Service 2012, National Nutrient Database for Standard Reference, Release 25;

^aDepartment of Agriculture, Government of Sri Lanka 2006

For Table 14 and 15

¹Carbohydrate *by difference* is the standard method to determine the amount of carbohydrates in foods by deducting the sum of the measured moisture, ash (inorganic components), protein, and fat from the total weight (100g) (Southgate 1969).

²Vitamin A is quantified in Retinol Activity Equivalent (RAE), where each µg RAE is equivalent to 1 µg of retinol, 2 µg of β-carotene in oil, 12 µg of "dietary" beta-carotene, or 24 µg of Pro-vitamin A carotenoids (α-Carotene, Beta-cryptoxanthin, and γ-carotene) (Institute of Medicine 2001).

³Folate is expressed in Dietary Folate Equivalent (DFE) where 1 µg DFE refers to 1.0 µg food folate, 0.6 µg folic acid taken with in foods, and 0.5 µg folic acid taken without food (Suitor and Bailey 2000).

* indicates that respective nutrient data was not found.

APPENDIX B: Survey Instrument

University of Jaffna and Michigan State University Collaboration Baseline Survey on Home Gardens (HG) in the Northern Regions of Sri Lanka

SECTION A: HOUSEHOLD DEMOGRAPHICS

A1	Date of the Survey: __/__/__					
A2	For how long have you been residing at your present household location?	__Weeks	__Months	__Years		
A3	Respondents Relationship to the head of the household?	1. Head of the Household				
		2. Spouse				
		3. Other specify:_____				
A4	Gender:	<input type="checkbox"/> Male <input type="checkbox"/> Female				
A5	Age: (must be over 21)					
A6	Marital Status:	<input type="checkbox"/> Married <input type="checkbox"/> Single <input type="checkbox"/> Widowed				
A7	How many members in your household?	__1	__2	__3	__4	__>4
A8	What is the current occupation of the head of the household? (Select all that apply)	1. Crop Producer: cereals, fruits, vegetables....				
		2. Livestock Producer				
		3. Farm laborer				
		4. Self Employed				
		5. Trader				
		6. Artisan				
		7. Retired				
		8. Unemployed				
		9. Other specify:_____				

SECTION B: HOME GARDEN CHARACTERISTICS

B1	Are you involved in HG?		Yes	No			
B2	Are any of your family members involved in HG?		Yes	No			
B3	How many HG plots do your household own?	__1	__2	__3	__4	__>4	__None Skip to
B4	What is the size of your HG? (Lachum = Local unit of land area)				Lachs		
B5	Approximately what percentage of your HG plot/s is cultivated?	__< 5 %	__< 5 %	__< 5 %	__< 5 %		
		__< 25%	__< 25%	__< 25%	__< 25%		
		__< 50%	__< 50%	__< 50%	__< 50%		
		__<75%	__<75%	__<75%	__<75%		
		__~100%	__~100%	__~100%	__~100%		

B6	Approximately what percentage of your HG plot is irrigated?	<input type="checkbox"/> < 5 % <input type="checkbox"/> < 25% <input type="checkbox"/> < 50% <input type="checkbox"/> < 75% <input type="checkbox"/> ~100%	<input type="checkbox"/> < 5 % <input type="checkbox"/> < 25% <input type="checkbox"/> < 50% <input type="checkbox"/> < 75% <input type="checkbox"/> ~100%	<input type="checkbox"/> < 5 % <input type="checkbox"/> < 25% <input type="checkbox"/> < 50% <input type="checkbox"/> < 75% <input type="checkbox"/> ~100%	<input type="checkbox"/> < 5 % <input type="checkbox"/> < 25% <input type="checkbox"/> < 50% <input type="checkbox"/> < 75% <input type="checkbox"/> ~100%
B7	For how long have you and/or your family been gardening at your garden plot/s?	<input type="text"/> Months <input type="text"/> Years	<input type="text"/> Months <input type="text"/> Years	<input type="text"/> Months <input type="text"/> Years	<input type="text"/> Months <input type="text"/> Years
B8	Does your family own the land belonging to the home garden plot/s?	<input type="text"/> Yes <input type="text"/> No	<input type="text"/> Yes <input type="text"/> No	<input type="text"/> Yes <input type="text"/> No	<input type="text"/> Yes <input type="text"/> No

SECTION C: LEVEL OF HOUSEHOLD ENGAGEMENT IN HOME GARDEN ACTIVITIES

C1	How did your household get introduced to home gardening? Can select more than one		1. Common day to day activity
			2. Talking to neighbors
			3. Through School
			4. Through social organizations
			5. Through government program
			6. Through NGO program
			7. Through military personnel
			8. Other, specify: _____
C2	How many members of your household have been involved in home gardening during the past year?	1. Male	
		2. Female	
C3	On average how often does your household engage in home gardening activities?		1. Daily
			2. 2-3 times a week
			3. 4-5 times a week
			4. Once a week
			5. Less than once a week
			6. Hardly ever
C4	Why does your household maintain a home garden? List all Denote the primary factor with ✓*		1. To produce food for my family
			2. To generate additional income
			3. To spend time with my family
			4. For mental and physical relaxation
			5. To beautify my home surroundings
			6. To attract helpful organisms
			7. As a means of employment
			8. I have no significant benefit
			9. Other, specify: _____

C5	Listed below are some factors that may affect the productivity of your home garden. How often is your home garden affected by these factors?					
	Rate the following issues	Always a problem	Often a problem	Sometimes a problem	Never a problem	Don't know
	C5a. Shortage of Water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5b. Shortage of Land	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5c. Shortage of Manure and Fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5d. Insect pest and Diseases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5e. Nematodes issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5f. Weeds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5g. Shortage of quality seeds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5h. Poor soils	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C5i. Access of Agricultural tools	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6j. Limited family labor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6k. Lack of finances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6l. Destruction by animal pests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6m. Damage by weather related issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6n. Unavailability of Information and advisory support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6o. Theft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	C6p. Other Specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6	From the list below, choose most important 3 factors that affect the productivity of your home garden (Start with the most significant)		#1 _____ #2 _____ #3 _____			

SECTION D: SECTION E: INPUTS FOR HOME GARDEN: Water

D1	How do you irrigate your HG?	1. Rain
		2. Public water system
		3. Well – Own / Sharing
		4. Electric pumps
		5. Tanks or Reservoirs
		6. Canal
		7. Drip irrigation system
		8. Sprinkler system
		9. Other specify: _____
D2	List key problem/s in obtaining water for irrigating your HG?	

D3	Is your household a part of any water management group/association?	Yes	No
----	---	-----	----

SECTION E: INPUTS FOR HOME GARDEN: Manure, Fertilizer and Agro-chemicals

E1	How often do you use the following inputs in your home garden?
----	--

	Rate the following	Frequently	Seldom	Never
	E1a. Livestock manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E1b. Green manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E1c. Compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E1d. Vermi-compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E1e. Chemical fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E1f. Other: (Specify)_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E2	How does your household obtain Manure, Fertilizer and Agro-chemicals?
----	---

	Rate the following	Household	Neighbors	Stores	Govt. assist.	Private firms	NGOs	Other farmers
	E2a. Livestock manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E2b. Green manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E2c. Compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E2d. Vermi-compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E2e. Chemical fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E2f. Other (Specify):_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E3	Name the public or private organization/s that is currently assisting you with Manure, Fertilizer and Agro-chemicals?
----	---

E4	Do you find it difficult to obtain these inputs?
----	--

	Rate the following	Always	Often	Sometimes	Never
	E4a. Livestock manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E4b. Green manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E4c. Compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E4d. Vermi-compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E4e. Chemical fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E4f. Other (Specify)_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E5	List you key issues to obtaining Manure, Fertilizer and Agro-chemicals for your home garden?
----	--

E6	How did you learn to use these inputs?									
	Rate the following	On my own	from neighbors	Self-help groups	Govt. and Extension	Private firms	NGO	farmer	Media	I do not know
	E6a. Livestock manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E6b. Green manure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E6c. Compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E6d. Vermi-compost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E6e. Chemical fertilizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	E6f. Other(Specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E7	Name the public or private organization/s that is currently assisting you with manure, fertilizer and agro-chemicals?									

SECTION F: INPUTS FOR HOME GARDEN: Seeds and Seedlings

F1	How often do you use the following for your home garden?							
	Rate the following	Always	Often	Sometimes	Never	Don't know		
	F1a. Traditional varieties	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	F1b. New varieties and Hybrid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	F1c. Saved seed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	F1d. Mushroom Spawn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	F1e. Tubers and Suckers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	F1f. Seedlings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	F1g. Branch or stem cuttings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
F2	Do you have your own seed nursery at home?			Yes	No			
F3	How do you obtain seeds and plants for your home garden?							
	Rate the following	my nursery	From neighbors	From farmers	Self-help groups	Govt.	Private firms	NGOs
	F3a. Traditional varieties	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	F3b. New varieties and Hybrid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	F3c. Saved seed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	F3d. Mushroom Spawn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	F3e. Tubers and Suckers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	F3f. Seedlings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	F3g. Branch or stem cuttings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

F4	Name the public or private organization/s that is currently assisting you with seeds, seedling etc.?
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SECTION G: INPUTS FOR HOME GARDEN: Gardening Tools and supplies

G1	Do you use farm animals to prepare your home garden for cultivation?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
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G2	Do you use gardening tools?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
----	-----------------------------	--------------------------	-----	--------------------------	----

G3	List the gardening tools and supplies that you use in your home garden and how you obtain them?	Own	From neighbors	Hired	Govt.	Private firms	NGOs
	1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

G4	Name the public or private organization/s that is currently assisting you with gardening tools and supplies?
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SECTION H: INPUTS FOR HOME GARDEN: Credit

H1	Do you obtain credit for your home garden activities?	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
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H2	From whom do you obtain credit?	<input type="checkbox"/>	1. From neighbors
		<input type="checkbox"/>	2. From private lender
		<input type="checkbox"/>	3. From local banks
		<input type="checkbox"/>	4. From government
		<input type="checkbox"/>	5. From NGOs
		<input type="checkbox"/>	6. Potential Buyers
		<input type="checkbox"/>	7. Other (specify): _____

H3	Name the public or private organization/s that is currently assisting you with credit?
----	--

SECTION I: HOME GARDEN DEVELOPMENT

I1	Have you or any one of your family members participated in any agricultural or home gardening training?		Yes		No
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I2	How many members of your household took part in this training?	1. Male	
		2. Female	

I3	Who provided this training?	<input type="checkbox"/>	1. Relatives, Neighbors, or friends
		<input type="checkbox"/>	2. Self-help groups
		<input type="checkbox"/>	3. Government
		<input type="checkbox"/>	4. Private firms
		<input type="checkbox"/>	5. NGOs
		<input type="checkbox"/>	6. Academic institutions: School, vocational training centers, University
		<input type="checkbox"/>	7. Private Companies
		<input type="checkbox"/>	8. Other (specify): _____

I4	Name the public or private organization/s that is currently assisting you with credit
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I5	Select the type/s of training you/your family members received?	<input type="checkbox"/>	1. Soil and land management
		<input type="checkbox"/>	2. Water management
		<input type="checkbox"/>	3. Producing Seeds and seedlings (nurseries)
		<input type="checkbox"/>	4. Compost production
		<input type="checkbox"/>	5. Using animal and green manure
		<input type="checkbox"/>	6. Integrated Pest management
		<input type="checkbox"/>	7. Integrated Weed management
		<input type="checkbox"/>	8. Animal husbandry
		<input type="checkbox"/>	9. Bee keeping
		<input type="checkbox"/>	10. Mushroom Cultivation
		<input type="checkbox"/>	11. Pruning and trimming
		<input type="checkbox"/>	12. Crop diversification
		<input type="checkbox"/>	13. Selection and applications of fertilizer
		<input type="checkbox"/>	14. Selection and applications of pesticides
		<input type="checkbox"/>	15. Food processing and preserving
		<input type="checkbox"/>	16. Marketing and Management
		<input type="checkbox"/>	17. Other (specify): _____

I6	Did you find this training useful to improve your home garden?		Yes		No
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I7	Has the Government home garden initiative encouraged you to engage in home gardening?		Yes		No
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I8	What is your biggest educational need to enhance your home garden?
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I9	Would you like to receive training on home gardens in future?		Yes		No
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I10	On what aspects?	<input type="checkbox"/>	1. Soil and land management
		<input type="checkbox"/>	2. Water management
		<input type="checkbox"/>	3. Producing Seeds and seedlings (nurseries)
		<input type="checkbox"/>	4. Compost production
		<input type="checkbox"/>	5. Using animal and green manure
		<input type="checkbox"/>	6. Integrated Pest management
		<input type="checkbox"/>	7. Integrated Weed management
		<input type="checkbox"/>	8. Animal husbandry
		<input type="checkbox"/>	9. Bee keeping
		<input type="checkbox"/>	10. Mushroom Cultivation
		<input type="checkbox"/>	11. Pruning and trimming
		<input type="checkbox"/>	12. Crop diversification
		<input type="checkbox"/>	13. Selection and applications of fertilizer
		<input type="checkbox"/>	14. Selection and applications of pesticides
		<input type="checkbox"/>	15. Food processing and preserving
		<input type="checkbox"/>	16. Marketing and Management
		<input type="checkbox"/>	17. Other (specify):_____

SECTION J: HOME GARDEN COMPOSITION AND REVENUE

What are the vegetables and leafy vegetable crops grown in your HG?								
J1	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		7.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		8.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		9.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		10.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		11.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		12.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		13.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		14.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		15.	<input type="checkbox"/> Y <input type="checkbox"/> N					

J2	What are the fruit shrubs and trees grown in your HG?							
	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		7.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		8.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		9.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		10.	<input type="checkbox"/> Y <input type="checkbox"/> N					

J3	What are the cereal crops grown in your HG?							
	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		7.						

J4	What are the plantation crops grown in your HG?							
	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		7.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		8.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		9.	<input type="checkbox"/> Y <input type="checkbox"/> N					
	10.	<input type="checkbox"/> Y <input type="checkbox"/> N						

J5	What are the spices grown in your HG?							
	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		7.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		8.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		9.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		10.	<input type="checkbox"/> Y <input type="checkbox"/> N					

J6	What mushrooms varieties are grown in your HG?							
	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					

J7	What are the herbal/medicinal plants grown in your HG?							
	Plot #	List	Existing	Amount Harvested (in Kg.)	Amount Consumed (in Kg.)	Amount Sold (in Kg.)	Market price per Kg.	Income/ Savings
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		7.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		8.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		9.	<input type="checkbox"/> Y <input type="checkbox"/> N					
		10.	<input type="checkbox"/> Y <input type="checkbox"/> N					

J8.	What are the Flowering and Ornamental Plants your HG?		
	Plot #	List	Planted this year
		1.	<input type="checkbox"/> Y <input type="checkbox"/> N
		2.	<input type="checkbox"/> Y <input type="checkbox"/> N
		3.	<input type="checkbox"/> Y <input type="checkbox"/> N
		4.	<input type="checkbox"/> Y <input type="checkbox"/> N
		5.	<input type="checkbox"/> Y <input type="checkbox"/> N
		6.	<input type="checkbox"/> Y <input type="checkbox"/> N
		7.	<input type="checkbox"/> Y <input type="checkbox"/> N
		8.	<input type="checkbox"/> Y <input type="checkbox"/> N
		9.	<input type="checkbox"/> Y <input type="checkbox"/> N
	10.	<input type="checkbox"/> Y <input type="checkbox"/> N	

SECTION K: HOME GARDEN: PROCESSING AND VALUE ADDITION

K1	Do you process the output from your HG?			<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
K2	What methods do you use?	<input type="checkbox"/>	1. Drying				
		<input type="checkbox"/>	2. Pickling				
		<input type="checkbox"/>	3. Preserving				
		<input type="checkbox"/>	4. Other specify:_____				
K3	What are the key problems you face when processing and value adding to your home garden products?						
	1.						
	2.						
	3.						

SECTION L: HOME GARDEN AND MARKETING

L1	Do you sell products from your HG?			<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
L2	How do you sell the products from your home garden?						
	Because of my home gardens.....			Always	Sometimes	Never	
	L2a. On my own			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	L2b. Through traders			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	L2c. Through cooperatives and self-help groups			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	L2d. Other specify:_____			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
L3	Do you find it difficult to sell products from your HG?			<input type="checkbox"/>	Yes	<input type="checkbox"/>	No
L4	What are the key problems you face when selling home garden products?						
	1.						
	2.						
	3.						

SECTION M: HOME GARDEN AND LIVESTOCK ACTIVITIES

M1	Does your household carry out any livestock activities at home?		Yes		No
M2	List the animals raised at home and their numbers?	Type			No.
		1. Cattle			
		2. Goats			
		3. Chickens			
		4. Pigs			
		5. Other specify:			

SECTION N: HOME GARDEN AND LIVESTOCK ACTIVITIES

N1	Does your household carry out any Bee keeping activities at home?		Yes		No
N2	Does your household consume bee honey?	<input type="checkbox"/> Daily	<input type="checkbox"/> Often	<input type="checkbox"/> Sometime	<input type="checkbox"/> Never

SECTION O: HOME GARDEN AND FISHERIES ACTIVITIES

O1	Does your household raise any fish at home for domestic consumption?		Yes		No
----	--	--	-----	--	----

SECTION P: USE OF CELL PHONES

P1	Do you own a cell/mobile phone?		Yes		No
P2	Do you use it to obtain information related to home garden activities?		Yes		No
P3	Name the public or private organization/s that is provides you this information?				

SECTION Q: HOME GARDEN IMPACT

Q1	Please share your ideas about					
	Because of my home gardens.....	Strongly Agree	Agree	Disagree	Strongly Disagree	No Change
	Q1a. My family have more food to eat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1b. My family gets a higher share of vegetables and fruits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1c. Food from HG is fresh and healthy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1d. We get to eat a wider variety of foods to eat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1e. We are better able to afford non-food items	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1f. We feel relaxed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1g. We are engaged in some physical activity as a family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Q1h. We were able to start a small business at home using the product from my home garden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1i. HG help conserve my environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1j. HG help reduce our food cost	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1k. HG enable us to earn additional income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1l. Home gardening has benefited my family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1m. I intend to continue to pursue Home gardening activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Q1n. I will encourage others to pursue home gardening	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

THE END

Thank you for your cooperation

APPENDIX C: Insect Pests, Weeds, and Diseases in Home Gardens

Table 16: Insects and Mites Commonly Found in Home Gardens in Northern Sri Lanka and the Severity of Incidence

Crop	Common name	Zoological name	Severity of Incidence
Banana	Rhizome weevil	<i>Cosmopolites sordidus</i>	*
	Pseudo stem weevil	<i>Odoiporus longicollis</i>	*
	Red spider mite ²	<i>Tetranychus</i> sp	***
Chilli	Mealy bug	<i>Paracoccus marginatus</i>	**
	Thrips	<i>Scirtothrips dorsalis</i>	***
	Broad mite	<i>Polyphagotarsonemus latus</i>	**
Okra	Aphid	<i>Aphis gossypii</i>	*
	Red spider mite	<i>Tetranychus</i> sp	***
	Yellow mosaic	Virus- <i>Bemisia tabaci</i> vector	*
Eggplant	Fruit borer	<i>Earias vitella</i> , <i>E. insulana</i>	*
	Shoot and fruit borer	<i>Leucinodes orbonalis</i>	**
Tomato		<i>Liriomyza</i> sp.	
	Leaf minor	<i>L. sativae</i> , <i>L. huidobrensis</i>	*
	DBM	<i>Plutella xylostella</i>	***
Cabbage	Cabbage borer	<i>Crocidolomya binotalis</i>	**
	Flea beetle	<i>Phyllotreta citroli</i>	**
	Mealy bug	<i>Paracoccus marginatus</i>	***
Pomegranate	Mealy bug	<i>Paracoccus marginatus</i>	***
Long beans	Pod borer	<i>Helicoverpa armigera</i>	***
	Spottedpod borer	<i>Maruca testulalis</i>	**
	Leaf minor	<i>Liriomyza</i> sp.	***
Papaya	Mealy bug	<i>Paracoccus marginatus</i>	***
Coconut	Coconut mite	<i>Aceria guarreronis</i>	****
	Rhinoceros beetle	<i>Oryctes rhinoceros</i>	****
	Squirrels	<i>Funambulus palmarum</i>	**
Mango	Mango hoppers	<i>Amritodes atkinsoni</i>	****
	Leaf burning	<i>Not known</i>	****
Arecanut	Thrips	<i>Not identified</i>	*
Glyricidia ¹	Mite	<i>Not identified</i>	***
<i>Thespecia</i> sp ¹	Thrips ²	<i>Not identified</i>	**
Croton ³	Mealy bug	<i>Paracoccus marginatus</i>	***
Hibiscus ³	Mealy bug	<i>Paracoccus marginatus</i>	***

****Severe, ***Moderate, **Less Severe, and *Least Severe

¹ Green leaf manures and fodder trees grown in the life fence, ² Occur during the dry seasons,

³ Ornamental plants

Table 17: Weeds Commonly Found in Home Gardens in Northern Sri Lanka and the Severity of Incidence

Weeds Botanical names	Family	Severity of Incidence
<i>Cyperus rotundus</i>	Poaceae	****
<i>Trianthema portulacastum</i>	Aizoaceae	**
<i>Brassica</i> sp (wild species)	Brassicaceae	***
<i>Euphorbia hirta</i>	Euphorbiaceae	*
<i>Tridax procumbans</i>	Asteraceae	**
<i>Cyanodon dactylon</i>	Poaceae	***
<i>Gynandropis</i> sp	Brassicaceae	*

****Severe, ***Moderate, **Less Severe, and *Least Severe

Table 18: Diseases Commonly Found in Home Gardens in Northern Sri Lanka and the Severity of Incidence

Crop	Common name	Zoological name	Severity of Incidence
Banana	Bunch top of banana	<i>Fusarium oxysporum f.sp cubense</i>	*
	Stem rot	<i>Marasmiellus inoderma</i>	*
		<i>Cercospora</i>	*
Okra	Yellow mosaic	<i>Virus-Bemissia tabaci vector</i>	*
Citrus	Canker	<i>Xanthomonas axonopodis</i>	**
	Gummosis	<i>Phytophthora parasitica</i>	**
Long Beans	Powdery mildew	<i>Erisiphe</i> sp.	*
	Leaf spot	<i>Cercospora</i> sp	**
Mango	Leaf burning	Not known	****

****Severe, ***Moderate, **Less Severe, and *Least Severe

Source: Information provided by Department of Agricultural Biology, University of Jaffna (2012)

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5. INNOVATIVE APPROACHES TO ENHANCE HOME GARDENS FOR IMPROVED FOOD SECURITY, NUTRITION, AND LIVELIHOODS IN SRI LANKA

ABSTRACT

As a part of the overall strategy for the post-conflict rebuilding of northern Sri Lanka, the government is taking positive steps to enhance food security and livelihoods of the victims of the 30-year conflict. In this direction, the government launched a home gardens initiative in the country for enhancing household food security and livelihoods. This program aims to promote and scale-up home gardens as an intervention to enhance national and local food security particularly in the post-conflict areas. Since the civil war ended in 2009, more than 500 new home gardens have been supported and established by government and non-governmental organizations. The gardens are contributing to household food and nutritional security and, in some cases, to income generation for resource poor families in the North. This paper discusses strategies and presents potential interventions for enhancing and sustaining home gardens in the Northern region of Sri Lanka. The University of Jaffna (UoJ) is proactively engaged in enhancing agricultural research and rural development in the North. Under the South Asia Partnership Initiative, Michigan State University (MSU) is collaborating with UoJ to design and implement a long-term program and an action plan for agricultural development. This will complement the national strategy to improve food and nutritional security and economic growth. The UoJ is partnering with MSU to establish a model home garden at their new campus location in Killinochchi to serve as a research, education, and extension/outreach site that will be launched in 2013. In addition, MSU will collaborate with UoJ to develop a Master Home

Gardener Program (MHGP) that will involve innovative gardeners and farmers in the region in implementing an education and outreach programs. The UoJ-MSU partnership will also lead to the enhancement of curriculum through the development of a resource manual for students, trainers, and home gardeners. Leveraging on the new tools of Information and Communication Technology (ICT), an innovative program will be launched for empowering local home gardeners with up-to-date information through the use of cell phones. The proposed UoJ and MSU collaborative programs will give due consideration to social equity and will serve the interest of poor and female-headed households in the North.

Key words: *Home Gardens, Food Security, Livelihood, Nutrition, Women Empowerment, Post-conflict, cell phones*

BACKGROUND

Enhancing agricultural productivity and food security remains a high priority of the Sri Lankan government for the post-conflict rebuilding and the reconciliation process and as well as in the overall welfare of the country (Petersson, et al., 2011). A number of innovative programs have been launched to improve agriculture and livelihoods of resource poor families in the war affected areas.

Among these programs, the establishment and development of home gardens has captured much attention. Over the past three years, governmental and other non-governmental organizations involved in post-conflict rebuilding activities have supported the establishment of more than 500 new home gardens in the conflict-affected areas in the North targeting war victims and displaced families. Home gardening is a longstanding agricultural practice in many parts of the world (Ninez, 1985; Hoogerbrugge and Fresco, 1993; Mitchell and Hanstad, 2004). The extensive literature review conducted by Galhena et al. (2012a) also found multiple benefits from home gardens to communities in developing countries. As a part of the long-term national strategy, the Sri Lankan government aims to establish around one million home gardens throughout the country to contribute towards national food security.

ROLE OF UNIVERSITY OF JAFFNA AND AGRICULTURAL DEVELOPMENT IN NORTHERN AREAS OF SRI LANKA

The University of Jaffna, established in 1979 (website: <http://www.jfn.ac.lk>), is a public university whose Faculty of Agriculture has a mandate for research and education. The Government of Sri Lanka has allocated more than 600 acres of land to the university to establish a new campus for the Faculty of Agriculture in the Killinochchi area in the Northern Province.

Due to the growing demand from local communities for agricultural development, the University of Jaffna aims to position itself as the principal institution for conducting and disseminating agricultural education, research, and outreach programs to home gardeners, farmers, self-help groups, and rural communities as well as training the next generation of leaders and stakeholders in agriculture.

Under the South Asia Partnership initiative, Michigan State University has signed a Memorandum of Understanding (MoU) with the University of Jaffna with an intention to develop a number of collaborative programs in agricultural research, education, and development. One of the collaborative programs between UoJ and MSU focuses on home gardens to enhance food security in post-conflict areas.

A preliminary needs assessment was conducted in collaboration with UoJ through a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. The information for the SWOT analysis was gathered through personal interviews with various stakeholders which included home gardeners, farmers, faculty member of UoJ, and representatives of self-help groups, local and international non-governmental organizations (NGOs), and government officials in the Northern areas. As a part of this process, personal visits were made to 20 home gardens across the region and the views from home gardeners were documented. The majority of the stakeholders stressed the need for better access to information, research, education, outreach, and advisory services on home gardening in order to make home gardening a successful venture (Figure 9).

In addition, 167 home gardens were surveyed throughout the Jaffna District of Sri Lanka (Galhena, et al., 2012b). The survey reveals that home gardening has resulted in many benefits to families affected by the civil war in terms of enhancing food security and household

Figure 9: SWOT Analysis of Home Gardens in Sri Lanka

Strengths

- Access to additional sources of fresh, nutrient-rich, and diversified food sources such as vegetables and fruits
- Provide additional income to households
- Provide eco-systems services, conserve local biodiversity and indigenous knowledge
- Provide resilience against food shortages and price fluctuations
- Involve local self-help groups in home garden activities

Weaknesses

- Limited access to land to expand
- Poor access to inputs such as seeds, water, credit and post-harvest practices
- Weak extension/outreach and advisory services
- Poor access to markets and market information
- Ensuring long-term sustainability

Opportunities

- Providing additional income generation and livelihood activities
- Empowering women and improving the standard of living of women-headed households
- Introducing high value and under-utilized crops for food and medical markets
- Developing new education, outreach, and extension programs on home gardening
- Developing research programs on home garden models for various agro-ecological zones and scaling up in other parts of Sri Lanka
- Innovating technologies for post-harvest management, processing, value-addition, and marketing
- Using new Information Communication Technologies (ICTs) to deliver real-time information on home gardens
- Leveraging indigenous knowledge, local biodiversity, and best practices for home gardeners
- Creating education opportunities for students, youth, and trainers

Threats

- Possible loss of government support for home gardens and agricultural development
 - Continuing economic hardships
 - Impacts of climate change on food production and abiotic and biotic stresses
 - Cultural and social norms that exists amongst communities and home gardeners
-

livelihoods. The results of the survey further reinforces the need for research, training, education, and advisory services to enhance the productivity and profitability of home gardens. The broad areas of applied research, education, and outreach fit very well with the mission and goals of MSU and UoJ. Hence, as a collaborative activity between the two universities, the following four innovative programs will be developed and implemented over the next 3 to 5 years.

PROPOSED COLLABORATIVE PROGRAMS BETWEEN MICHIGAN STATE UNIVERSITY AND UNIVERSITY OF JAFFNA FOR ENHANCING HOME GARDENS IN THE NORTHERN AREAS OF SRI LANKA

Model Home Garden

Home gardens can play a major role in improving food security and livelihoods. In line with the institutional capacity building process, the Faculty of Agriculture of UoJ in collaboration with MSU will be establishing a model home garden at UoJ's new campus in Killinochchi. This model home garden will be an integral part of the proposed Agricultural Innovation, Training and Outreach Center of the university that will be located at the new campus. The university has already allocated one acre of land for the establishment of this Model Home Garden. The Model gardens will serve as a Student Field School (SFS) for demonstrating agricultural technologies and training university students, youth, and school children. In addition, SFS will play a key role in educating and training local home gardeners, farmers, and trainers in the region.

The university also aims to enhance its current curriculum for students and develop special training modules for local trainers including innovative home gardeners and farmers through a Training of Trainers Program (ToT). Practical hands-on short courses will also be offered for home gardeners. These programs will include both generic and specialized courses

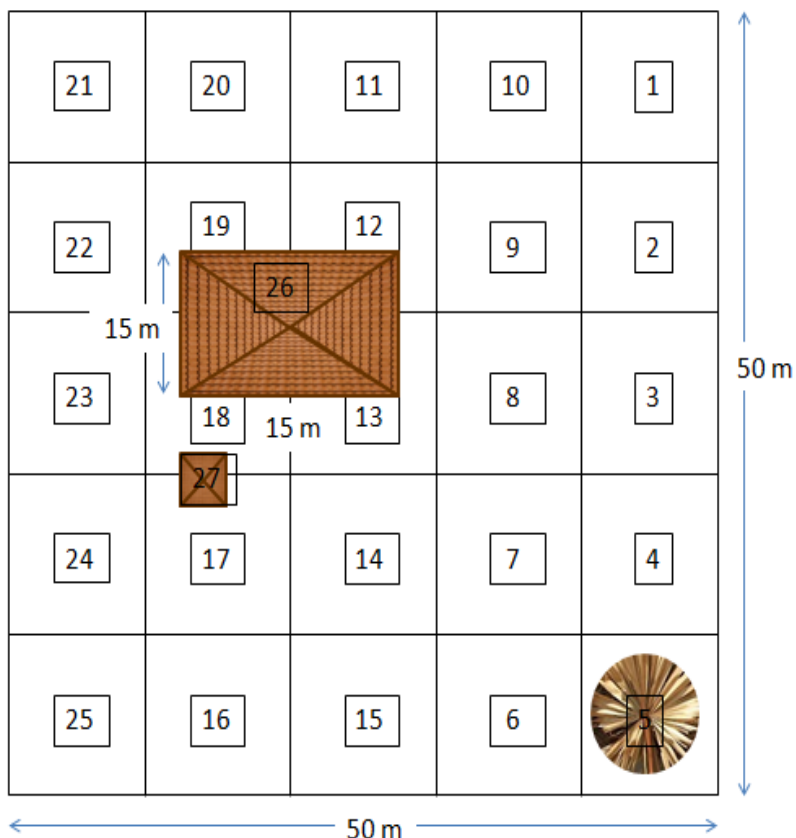
and modules based on the training requirements identified by Galhena, et al. (2012b) and emerging home gardening related issues. The education and outreach programs will place special emphasis on serving the marginalized communities including poverty stricken and female-headed households in the North. In designing the Model Home Garden, five core principles will be considered. They include:

- I. Diversification by including a variety of crops, livestock, and beekeeping
- II. Intensification through methods such as inter-cropping, vertical gardening and permaculture
- III. Spatial and Temporal distribution as well as crop rotations
- IV. Integrated soil, water, and pest management
- V. Harvest, post-harvest handling, and value addition.

The types of crops and other components that will be included in the Model Home Garden are outlined in Figure 10. The Model Home Garden will be developed using the best components and best practices existing in successful home gardens of innovative gardeners in the region as well as innovative practices deduced by best practices for crop production. To simulate real world home garden, the home garden will include a house where a family will live and manage the home garden. Prior to establishing the Model Home Garden, a stakeholder consultation will be held to seek input from home gardeners and other stakeholders supporting home gardens. The model garden also will harness and utilize experiences and expertise from other parts Sri Lanka and other developing countries. Concerted efforts will be made to utilize local resources and local biodiversity, while blending indigenous knowledge with modern technologies and low-input strategies.

Figure 10: Schematic Diagram of Home Garden to be established in Faculty of Agriculture, University of Jaffna at Killinochchi, Sri Lanka

Plot	Description
1	Leafy vegetable and medicinal plants
2	Banana and Ginger
3	Vegetable garden 1
4	Compost unit
5	Animal house
6	Multiple garden 1
7	Vegetable garden 2
8	Vegetable – climbers
9	Spice and medicinal plants
10	Vegetable garden 3
11	Vegetable garden 4
12	Kitchen garden
13	Banana and other medicinal plants
14	Fruit crops and medicinal plants
15	Multiple garden 2
16	Multipurpose Trees and vegetables
17	Fruits crops
18	Plant Nursery Unit
19	Courtyard and ornamental section
20	Leafy vegetables and medicinal plants
21	Ornamental and medicinal plants
22	Multiple garden 3
23	Multiple garden 4
24	Fruit trees and shrubs
25	Fruit trees and shrubs
26	Family home
27	Lavatory

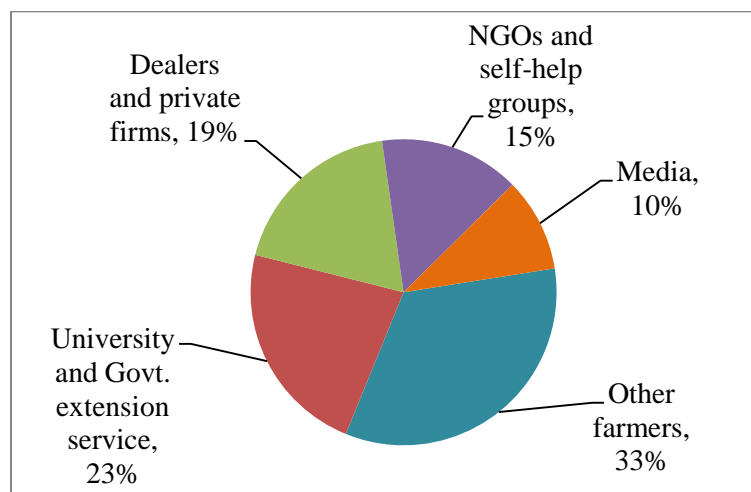


Multiple gardens will consist of all kinds of crops in different strata including root and tuber crops, herbs, and medicinal plants. Since each plot is 100m² (10m X 10m), plants will be selected based on their canopy strength and productivity. The four sides will be with live fence having tree crops, green-leaf manures, medicinal plants, and fodder. Bee hives will also be included in the model home garden.

Master Home Gardener Program (MHGP)

Experiences from around the world have shown that the local farmers are the most dominant source of information for other farmers (National Sample Survey Organization, India, 2005). The research survey conducted on 167 home gardens in the Jaffna District confirms that neighbors and other farmers are the most dominant source of information for home gardeners (Figure 11).

Figure 11: Sources of Information and Training for Home Gardeners



Source: Galhena, et al., 2012

These gardeners are a logical focal point for generation and dissemination of information to their regions. University of Jaffna and Michigan State University will collaborate to develop a Master Home Gardener Program (MHGP) to promote and enhance home gardens. The goal of this program is to empower and share the knowledge, expertise, and experiences of innovative home gardeners and use their home gardens as on-farm research and demonstration sites for providing education and training to other home gardeners in the region. The innovative gardeners selected for the MHGP program will be trained at the Model Home Garden at UoJ and will become a part of the network of trainers for a specific period time through a mutual

agreement. Training and outreach programs offered by the MHGP program will provide equal opportunities to people from various social and economic backgrounds and give due consideration to vulnerable sections of the society.

Initially, three to four innovative farmers will be selected representing different ecosystems of the Northern region. Their home gardens will serve as “Seeing is believing” – demonstration sites to practically exhibit successful home gardens to other home gardeners. Additionally, these gardens will be utilized as Gardener Field Schools (GFS) and will be used for field days in extension and outreach programs implemented by the University of Jaffna. As incentive for the participation in the MHGP, these leading home gardeners will be rewarded financially and will be given a certificate of “*Master Home Gardener*” by the university and the government.

Home Garden Manual

Another collaborative activity through the UoJ-MSU partnership will be to jointly develop a comprehensive resource manual on home gardens. This manual will serve as a home garden training and outreach guide and will be used in SFS and GFSs. An outline of this manual is presented in Figure 12. This framework will be shared with progressive home gardeners, extension workers, and subject-matter specialists to seek their input and feedback.

The Home Garden Manual will be written in simple and easy to read format with photos and diagrams demonstrating various concepts, techniques, and best practices in home gardening. The manual will be published in English, Tamil, and Sinhala languages. Other guides that might be useful in the development of this manual are identified in Figure 12. An electronic version of the Home Garden Manual will be freely available to home gardeners through UoJ’s Faculty of

Figure 12: Handbook of Home Gardening in Sri Lanka

I.	Background <ul style="list-style-type: none">• What is home gardening?• Why do we need a home garden?• What are the benefits of Home Gardening?
II.	Introduction to home gardening <ul style="list-style-type: none">• Inputs required for home gardening• Low input sustainable methods of home gardening• Kinds of crops grown in home gardens and crop calendar• Common problems related home gardening
III.	Gardening Tools and Equipment
IV.	Seeds and Planting Material Selection of crops and seed sources Diversification - Crop Rotation, Intercropping, and Vertical Gardening
V.	Sowing, Transplanting and Crop Establishment
VI.	Livestock, fisheries, and bee keeping activities
VII.	Soil and Fertility Management Use of Manure, Compost, and Fertilizer Vermi-composting
VIII.	Water Management
IX.	Integrated Pest Management - Identification and Management Insect, Diseases, Weeds, and Vertebrate Pests Botanical Pesticides and Biological Control Agents
X.	Harvesting, Storage, Processing, and Preservation
XI.	Marketing of Home Garden Products
XII.	Monitoring and Evaluation of Home Gardens
XIII.	Selected Photos
XIV.	Fact Sheets: Production and Nutrition
	Additional Resources for Home Gardening: <ul style="list-style-type: none">• Helen Keller International - Cambodia. (2003). <i>Handbook of Home Gardening in Cambodia – The Complete Manual for Vegetable and Fruit Production</i>. (A. Talukder, Ed.) Phnom Penh, Cambodia: Helen Keller Worldwide.• Landon-Lane, C. (2011). <i>Livelihoods Grow in Gardens - Diversifying Rural Income Through Home Garden</i> (2 ed.). Rome, Italy: Food and Agriculture Organization of the United Nations.• Ranasinghe, T. T. (2009). <i>Manual of Low/No-Space Agriculture cum-Family Business Gardens</i>. AN Leusden, The Netherlands: RUAF Foundation.• Weimer, A. (2008). <i>Homestead Gardening: a manual for Program managers, implementers, and Practitioners</i>. Maryland, USA: Catholic Relief Services—United States Conference of Catholic Bishops.

Agriculture website as well as in a portable CD. Along with the manual, several information fliers, brochures, and handbooks will also be produced targeting specific aspects of home gardening such as common weeds, insects and diseases, composting, bee keeping, mushroom cultivation, etc.. These outreach materials will be developed in consultation with subject-matter specialists at the University of Jaffna and other institutions in the country.

Cell Phone enabled Advisory Services

The SWOT analysis and the results of the survey of home gardens indicated that access to information and advisory services is a major constraint in home gardening (Galhena, et al., 2012b). The existing extension and advisory system is inadequate to meet the information needs of the home gardeners. There is limited access to information by farmers and home gardeners. They need timely information on “*know-how*” to manage home gardens. Fundamental informational needs include:

- I. “*Cultivation Information*” such as what and when to plant
- II. “*Contextual information*” such as weather, best practice for cultivation, and pest outbreaks in the locality
- III. “*Market information*” such as wholesale prices and demand indicators
- IV. “*Logistical information*” such as extension meetings and agricultural fairs

The recent advances in Information and Communication Technologies (ICT) offer a gainful opportunity to deliver information to farmers and households in an inexpensive and efficient manner. Cell phones (also referred as mobile phones) have been the fastest adopted ICT technology in the developing world (Indian Council for Research on International Economic Relations, 2009) including Sri Lanka (The World Bank, 2012). In addition to their portability, simplicity, and convenience, cell phones are often the only means of telecommunication in rural

areas where public telephone services are sparsely developed. Hence, cell phone technology offers a lucrative solution for people to communicate and access information.

The home gardeners that participated in the needs assessment in Jaffna area indicated that nearly 75 percent of them own and use cell phones in their daily life (Galhena et al. 2012). The increasing penetration of cell phones into agricultural communities in Sri Lanka presents an opportunity to widely deliver agricultural information. The recent introduction of a number of cell phone enabled information service applications opens new doors and facilitates the dissemination of a wide range of information to home-based food producers and small-scale farmers in Sri Lanka.

There are multiple ways that home gardens can benefit from a cell phone enabled advisory service. For instance, information related to extension meetings can be delivered through a SMS. Also home gardeners can receive market information such as prices and potential buyers. Furthermore, as this technology advances, home gardeners can use cell phone to identify and diagnose specific problems in home gardens including pests, diseases, and nutrient deficiencies through Multimedia Message Services (MMS).

Michigan State University has initiated a pilot project on cell phone enabled agro-advisory services with the International Horticulture Innovation and Training Center (IHITC) based in India. In addition, MSU has collaborative links with M.S. Swaminathan Research Foundation that is currently exploring the use of ICT tools to deliver agricultural information. Through these links, MSU will work with the scientists and ICT specialists from University of Jaffna to design and implement a cell phone enabled advisory program for home gardeners in Northern areas of Sri Lanka.

WAY FORWARD

The University of Jaffna in collaboration with Michigan State University has developed and submitted a proposal to the National Science Foundation (NSF) of Sri Lanka for a five-year grant towards enhancing home gardens in Sri Lanka with a focus on the Northern region. This collaborative proposal has received a favorable response from the NSF-Sri Lanka and is expected to begin early next year. The proposed collaborative activities between UoJ and MSU will be implemented under this grant program.

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6. SYNTHESIS

Food Security remains a major challenge for developing countries around the world and for Sri Lanka as the population continues to grow. The looming impacts of climate change and depleting natural resources are threatening food production and agricultural productivity worldwide. The food security challenges for Sri Lanka are even more daunting as the country is just coming out of a 30-year long civil war and the devastation caused by the 2004 Tsunami. With the civil conflict ending in 2009, the major challenge for the Sri Lankan Government is to meet the immediate food needs and create quick impacts in terms of meeting the local food demands and reducing poverty, hunger and malnutrition in communities in war affected areas. This is very important for building peaceful communities and the reconciliation process in post-conflict Sri Lanka.

As a part of the post-conflict rebuilding of Sri Lanka, the government is implementing multiple approaches for meeting short-term needs while addressing long-term development of agricultural sector to enhance food security in a sustainable manner. In this context, along with the broader agricultural development programs, the government is promoting and supporting the establishment of home gardens to enhance household food security and improving livelihoods of the people in war affected and other areas of the country. As a part of the national strategy, the government aims to establish one million home gardens in the country.

Additionally, in the wake of recent global food crisis and the soaring food prices, there has been increased emphasis on enhancing and building local food systems. In this context, there is renewed attention to food production and livelihood enhancement through home gardens.

Home gardens have been an integral part of local food systems and agricultural landscapes of developing countries all over the world, including Sri Lanka.

LESSONS FROM THE PAST

While the Sri Lankan government is promoting and plans to scale-up home gardens nationally, a research study was needed to analyze the potential contributions of home gardens in enhancing local food production and food security. The extensive review of the literature on home gardens from developing countries in Asia, Africa, and Latin America strongly support the positive contributions of home gardens for social and economic development. The literature supports that home gardens fulfill social, economic, cultural needs, while providing a number of ecosystem services. The literature pinpoints that the home gardens provide supplemental sources of food and nutritional security. Although the structure, functions, and contributions of home gardens vary in different geographic regions of the world, home gardens fit well with the broader agricultural research and development agenda in terms of serving as a locally available source of fresh food products, especially vegetables, fruits, roots and tubers, herbs, medicinal plants and livestock based foods.

While there are multiple benefits of home gardens for resource poor families in developing countries, the literature also highlights key constraints in home gardens and makes recommendations for improving home gardens and making them a viable and sustainable enterprise. New programs are required to help support home gardeners to sustain their activities and scale-up and transition to small-scale commercial farms through the formation of cooperatives and links with agri-businesses and value chains. Home gardens only provide a partial solution to food and nutritional security. The comprehensive food security programs

therefore must include and address issues related to both home gardens as well as field-based and commercial agricultural production systems.

Overall, the findings from the developing world support the inclusion and promotion of home gardens as an eco-friendly sustainable agricultural practice to improve food security. More empirical evidence on the value and importance of home gardens in conflict and post-conflict situations needs to be researched and documented. Further, long-term research is needed on the cost-benefit analysis of home gardening to determine the economic value and describe viable models that hold the most promise in different contexts and their impacts on nutrition, gender issues, and long-term sustainability.

HOME GARDENS AND FOOD SECURITY IN SRI LANKA

As mentioned earlier, food security remains a high priority for the government of Sri Lanka. As a part of the post-conflict rebuilding of Sri Lanka, the government has established more than 500 home gardens in the Northern region of Sri Lanka which was severely affected during the long civil war. This research study examined the current role of home gardens as a supplemental source of food using the research data obtained through the survey of 167 home gardens in the Jaffna District of Sri Lanka.

The average size of the home gardens was found to be 0.4 acre. As many as 29 useful plant species were found in home gardens surveyed with an average of nine useful plant species including vegetables, fruits, plantation crops, spices, and ornamental, medicinal and herbal plants. Of these nine species, seven were edible plants. A combination of 28 species of vegetables, 16 species of fruit crops, and 14 species of herbs/medicinal plants were found across the gardens surveyed. The home gardens surveyed were found to be diverse and providing

supplemental sources of fresh and nutritionally rich sources of food that fit with local culture and traditions. The most important constraints identified included weeds, insect pests and diseases, limited capital, shortage of labor, damage due to weather, and lack of access to information and extension/advisory services. The home gardeners strongly stated the need for timely information, education, and training on various aspects of home garden management including bee keeping, composting, maintaining nurseries of planting materials, pest and soil management, as well as integrating livestock activities and cultivating mushrooms. Home gardeners indicated that their neighbors and other farmers are the most important source of information for home gardening related activities.

The food production data revealed that on an average 140 kg of vegetables, 408 kg of fruits, and 118 coconuts were produced in home gardens in one growing season. The produce was mainly used for household consumption and for marketing to generate income creating a total economic value of US \$296 per garden per growing season. The post-harvest losses were found to be lower as most of the produce was either consumed by the households, shared with neighbors, or sold in the local markets soon after the harvest. When total market value per home garden was extrapolated to a million gardens in the country as per the long-term goals of the Sri Lankan government, the value of the home garden production was estimated to be US \$296 million.

ENHANCING AND SCALING-UP HOME GARDENS IN SRI LANKA

The findings of this research study are being used by the University of Jaffna to develop innovative strategies to enhance and promote home gardens as a mechanism to improve food and nutritional security. Based on the needs and constraints identified by the home gardeners, four

joint collaborative programs are proposed to be designed and implemented between University of Jaffna (UoJ) and Michigan State University (MSU). First, a model home garden will be established at the UoJ campus in Killinochchi to serve as a research, education and outreach site. Second, a Master Home Gardener Program will be developed involving progressive gardeners to serve as trainers to other home gardeners. Third, a user-friendly resource manual on best practices in home gardening will be developed to enhance educational and training programs. Lastly, an innovative program will be launched using mobile phones to empower local home gardeners with up-to-date information on various aspects of home gardening. The funding for these collaborative programs will be provided through a 5 year grant from the National Science Foundation of Sri Lanka.

This research study may lead to some policy implications in terms of agricultural research and development in Sri Lanka. The research results clearly indicate that home gardens are contributing to food security, income generation, and livelihoods in the Northern region of Sri Lanka through the production of diverse set of vegetables, fruits, herbs, plantation crops, ornamentals, and livestock products. The enhanced food availability through home gardens is contributing to the Sri Lankan Government's National Food Drive as well as the UN Millennium Development goals in terms of reducing hunger and poverty. Food Security will always remain a corner stone of economic growth in any country. Food Security will play an important role in building a peaceful society in post-conflict Sri Lanka. This research study serves as an important baseline and a reference point for enhancing and scaling up home gardens in Sri Lanka. Based on the research results, it is recommended that home garden programs should be scaled-up and further expanded in the country as a supplemental source of food and nutrition, income, and livelihood enhancements while considering the long-term sustainability of home gardens.

POTENTIAL AREAS FOR FURTHER RESEARCH

This research study has raised many questions and issues that need further research. Some of the key questions and issues raised include the following:

- I. Long-term impacts of home gardens on household food security and economic growth in post-conflict situations?
- II. How livestock/poultry can be better integrated into current home gardening systems in Sri Lanka.
- III. What long-term role home gardens can play in terms of dietary diversification and family nutrition?
- IV. What long-term role home gardens can play in terms of women empowerment and gender equity?
- V. What role home gardens can play in terms of building local markets and value chain systems for economic growth?
- VI. Cost-benefit analysis of home gardening to determine the economic value and viable models that hold the most promise in different contexts.
- VII. Long-term sustainability of home gardens.
- VIII. What role research, education, training and outreach programs can play in terms of enhancing productivity, scalability and sustainability of home gardens?

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