Home Garden Fruit Cultivation in Sri Lanka: Determinants and the Role of Government Intervention

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FORWORD

The Food Production National Programme (2016- 2018) is implemented with the objectives of ensuring food security, producing supplementary food crops locally whereby minimizing food imports and increasing farmer income. The programme had clearly identified fruit crop development and home gardening as an important priority area. Current Sri Lankan per capita fruit consumption is far below the medical recommendation while Sri Lanka is having a greater potential for cultivating fruits for the domestic consumption and export markets.

This study reveals determinants of home garden fruit cultivation and strategies to expand fruit cultivation in home gardens. Further, it evaluates the progress of implementing stage of home garden fruit cultivation programme under FPNP (2016-2018). A more encouraging finding is that the implementing stage of the programme is at a satisfactory level in many ways. The findings and the formulated recommendations will be useful to strengthen the current programme and step up of concerted action to attain programme outcomes in the future.

The findings of the study are covered three climatic zones of the Sri Lanka. Hence, I hope findings and recommendations derived through this study will be useful for policy makers to promote home garden fruit cultivation in Sri Lanka.

Decision makers, the international community, academia and civil society are invited to give this report due consideration, not as the end point of an analytical endeavor, but rather as the starting point for a dialogue on strategic policy choices and processes aimed at shaping fruit production at country level.

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Director/Chief Executive Officer

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EXECUTIVE SUMMARY

Sri Lanka is blessed with ideal conditions for cultivating a wide range of tropical and temperate fruit crops due to its topography and climate. Despite the huge potential to cultivate fruit crops in Sri Lanka a substantial amount of foreign exchange is spent on fruit imports while a small share of the total production is exported. However, Sri Lankan per capita fruit consumption (100g/day) is far below the medical recommendation. The government policy is to increase fruit production in order to attain near self-sufficiency by year 2020. Under the Food Production National Programme (FPNP): 2016 – 2018, home garden-based programmes have been implemented in the community settings as a way to increase fruit production and cultivation. Household level fruit cultivation and production statistics are still not available at national level as there are very limited studies undertaken in this sphere.

Hence, the overall objective of the study is to identify determinants of home garden fruit cultivation so as to formulate strategies to expand fruit production in home gardens. Further, study deals with the degree of success of ongoing home garden fruit cultivation programme under FPNP 2016-2018 so as to make recommendations to strengthen the existing programme. Multi-stage random sampling technique was employed in sample selection. The sample of 1,100 household heads and 526 beneficiaries under FPNP: 2016-2018 representing three climatic zones of Sri Lanka were surveyed using structured questionnaire. Binary logistic regression was performed to identify the determinants of home garden fruit cultivation and a series of t-tests was performed to compare fruit tree growers and non-growers. Shannon's index was used to measure species diversity in each province. The Likert Scale analysis and descriptive statistics were used to evaluate the government intervention in promoting home garden fruit cultivation.

According to the descriptive analysis, the majority of respondents are willing to grow a fruit tree in upcoming year. There is a vast potential to enhance fruit consumption through home garden fruit cultivation as majority of the households are aware of its benefits and extra income through home garden fruit cultivation is expected by 12.6 percent households only. The binary logistic regression revealed that the intention to participate in home gardening, the positive attitudes towards home gardening and the perceived behavioural control strongly predicted the home gardening behaviour. The subjective norms do not significantly contribute for home gardening. The results of t- tests revealed that fruit tree grower have sufficient time, knowledge on fruit cultivation and management, access to information and government incentives in comparison to non-grower.

Shannons' index analysis revealed that the highest fruit tree density and the diversity existed in Uva Province and the lowest is recorded in Northern Province followed by Eastern Province. In Central Province and Uva Province avocado is the major contributor for the household fruit production while banana and mango are the major contributors in all other provinces. Loss of fruit harvest due to pest and diseases, issues related to agricultural inputs, inadequacy of waged labour,

inadequate water availability at critical stages of fruit cultivation, limited land availability and marginal lands (shades, water logging conditions in land), low soil fertility, lack of capital such as equipment and substandard planting materials are the major limitations for home garden fruit cultivation.

The evaluation results of FPNP 2016-2018 indicate that the selection of beneficiaries were made in accordance with the programme criteria. More than 50 percent of the respondents were satisfied with received fruit species, the quality of the planting materials and the knowledge and assistance provided. Further, non- consideration of farmer preferences and unsuitability of fruit species to given climatic zones, inappropriate time period of the planting materials distributed and not conducting monthly meetings in accordance with the programme guidelines are reported as drawbacks.

Distribution of plants free of charge is a welfare burden on the government, therefore the sustainability of the programme is a question to be addressed in future research. Instead, a government supported community based entrepreneurial model design which can provide certified planting materials at reasonable price is recommended. The existing community based organizations such as “Sithamu” are recommended to develop as entrepreneurial models to cater the village level demand at the initial stages. Knowledge dissemination is recommended to promote fruit cultivation and enhance fruit production in home gardens. Further research on the household fruit consumption through home gardens versus open markets might help to build a firm policy for promoting recommended level of per capita fruit consumption.

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ABBREVIATIONS

AI	Agriculture Instructor
ARPA	Agriculture Research and Production Assistant
ASC	Agrarian Services Center
DCS	Department of Census and Statistics
DS	Divisional Secretariat
DZ	Dry Zone
FAO	Food and Agriculture Organization
FPNP	Food Production National Programme
GAP	Good Agricultural Practices
GND	*Grama Niladari* Division
HH	Household
IZ	Intermediate Zone
SEM	Structural Equation Modelling
TPB	Theory of Planed Behavior
WFO	Women Farmer Organization
WHO	World Health Organization
WZ	Wet Zone

CHAPTER ONE

Introduction

Sri Lanka has 46 agro-ecological zones with a wide variation in soil and climate. Each zone is characterized by specific climate and soils making it possible to cultivate number of different types of fruit crops, about 55 varieties. A fruit is a plant part that is eaten as a dessert or snack having sweet taste, but in botany a fruit is a structure of varying morphological composition, forming after fertilization to contain the reproductive bodies (Crow, 2013). Fruits are widely accepted as an important component of a healthy diet and adequate consumption could help to reduce a wide range of diseases (Dimelu and Odo, 2013). There are many fruit species and consequently a great diversity of fruits exists in Sri Lanka (Food and Agriculture Organization and Department of Agriculture, 2007). The present economic growth will create a higher demand for fruits in the local market, to be met by a higher production. Hence, the fruit sector also has a greater potential to increase the income, employment opportunities and the nutrition and health status of the people (Dahanayake, 2015).

1.1 Importance of Fruits as a Nutrition Supplement

Fruits and vegetables are very good sources of vitamins, minerals, antioxidants and dietary fibre. Consuming a wide variety of fruits and vegetables regularly reduces the risk of obesity, diabetes, coronary heart diseases and cancers and protects against the effect of ageing. Therefore, consumption of variety of fruits and vegetables helps to fulfill most of the micronutrient requirements which needed for vital functions of the body such as metabolism and immunity (Ministry of Health, Sri Lanka, 2011).

At least five varieties of fruits and vegetables should be consumed each day as a part of healthier life. World Health Organization (WHO) has recommended that an adult needs a minimum 200 grams of fruits per day. Sri Lanka's per capita consumption of fruits (88.2 grams) remains far below the required average daily intake (200 grams) for a balanced diet (Food balance sheet, 2013). Moreover, the consumption of fruits is much less common and varies across countries. Also the average consumption is lower for fruits than vegetables in most countries (Ruel *et al*., 2004).

The study of Rambukwella and Samantha (2013) revealed that, economic, cultural, environmental and social factors affect the consumption of fruits. Out of the aforementioned factors, economic factors are the key factors that determining consumption levels. Non-availability of fresh and tasty fruits, high prices and seasonality were identified as the significant factors for low consumption of fresh fruits in this study. The consumers are more concerned with the safety and freshness of fruits. According to the same research findings majority of the interviewed expressed that they did not obtain real taste from artificially ripened fruits. Hence, it is clear that achieving household (HH) fruit requirement through current commercial

fruit supply poses a problem. Household fruit cultivation might contribute to ease the problem to a certain extent.

1.2 Fruit Trees as a Multi-Purpose Tree Species

Tropical fruit trees are important multi-purpose tree species [1]which supplement and improve the quality of diets and provide fodder, fuel, timber and medicine for smallholders. Fruits enable rural people, particularly women and children to provide nutrition for a balanced diet, supplement family income and strengthen food security. In addition, cultivation of fruit trees plays a key role in biological, chemical and hydrological cycles, protecting soils and providing ecological niches. Fruit trees are integral part of the species diversity of home gardens and tropical forests which contribute to food security by diversification with other crops, use in agro forestry systems and environmental conservation. The pressure of an increasingly greater human population means we must use more efficiently the land on which trees grown (Pushpakumara, 1999). The bulk of the genetic diversity of fruits is still conserved through home garden system, but is in danger of extinction (Food and Agriculture Organization and Department of Agriculture, 2007).

1.3 Existing Fruit Production in Sri Lanka

Despite the availability of many delicious fruits, Sri Lanka imported 76,139.3 metric tons of fruits valued at LKR 12.9 billion during 2017, while exporting 31,320 metric tons valued at LKR 6.3 billion (Central Bank report, 2017). Although, there being a demand for Sri Lanka fruits in abroad, the country faces a serious problem in finding exportable quality fruits in sufficient quantities on a continuous basis is a major constraint (Dahanayake, 2015; Central Bank Report, 2017).

A few districts lead the production of fruits at present in Sri Lanka. However, the statistics still not available for newly liberated areas in the North and East Provinces (Dahanayake, 2015). There are few medium to large scale orchards as fruit cultivation, mainly for banana, pineapple, papaya and mango. Semi commercial farmers whose individual extent of land for fruit cultivation does not exceed one hectare. Further, different types of fruits that are unevenly distributed are found either protected or cultivated in home gardens. Sri Lanka has over 60 varieties of underutilized crops (Dahanayake, 2015) and most of these species are found in wild or in home gardens (Food and Agriculture Organization and Department of Agriculture (2007)). Moreover, distribution, access and availability of fruit species largely varied in the home gardens. Hence, the volume of production and supply differ (Dimelu and Odo, 2013).

[1] Multipurpose trees are defined as all woody perennials that are purposefully grown to provide more than one significant contribution to the production and/or service functions of a land-use system (Burley and von Carlowitz, 1984).

1.4 Issues Related to Expansion of Fruit Production in Sri Lanka

Limited availability, seasonality, shelf-life, time and labour and often smaller edible portions of the fruits make final products costly (Dahanayake, 2015). Hence, Sri Lanka is facing a supply and demand gap in fruit production and the consumption levels are not in a state of food security in terms of fruit crops.

The total target production of fruits in 2018 is estimated as 1.3 million metric tons using 0.15 million hectares of land (Food Production National Programme: 2016-2018, 2015). It is estimated that the total land area in Sri Lanka is approximately 6.56 million hectares where only about 50 percent is arable due to unsuitable terrain, inland water bodies and forest reservations. Limitation of per capita arable land area, indicates heavy pressure on agricultural land use (Mapa *et al*., 2002). Further, land is scare and is enmeshed with historical, cultural and political issues that can easily complicate transactions. Therefore, land limitation is a crucial factor for developing the fruit production on a large scale commercial level (Marambe *et al.,* 2016).

However, there is an increased interest in home gardening in rural HH and also establishment of urban- intensified home production of fruits (Dimelu and Odo, 2013) as land requirement is not a constraint on home production of fruit and vegetables. Home gardens make available a small but continuous flow of subsistence food products for the HH (Wiersum, 2006). Therefore, appreciation should be given to the role that fruit cultivation can play a vital role to address HH food security (Marambe *et al*., 2016). Promotion of home production of fruit is a potential strategy to increase HH fruit consumption. However, production interventions need to be complemented by effective education and behavioural change strategies to achieve a significant impact on fruit consumption (Ruel *et al.*, 2004).

1.5 Problem Statement

Over the recent years there has been growing interest to strengthen and intensify local food production. Consequently, there is much attention towards home gardening as a strategy to enhance HH food security and nutrition. Home gardens are an integral part of local food systems and the agricultural landscape of developing countries (Galhena *et al.*, 2013).

Study of Dahanayaka (2015) revealed that Sri Lanka is having a greater potential for cultivating fruits for the domestic and export market. The most of the fruits in Sri Lanka still remain at an underutilized stage and are grown in unexploited areas without proper marketing strategies. The bulk of the genetic diversity of fruit crops exists in home gardens (Galhena *et al.*, 2013). However, it is important to note that the statistics are still not available for the fruit production at HH level as there are very limited studies on production of fruits and vegetables at home garden level in detail (Dahanayaka 2015). Therefore, it is difficult to estimate fruit production and consumption at the HH level by reviewing secondary data and a comprehensive research on the fruit production at HH level is imperative.

The policy of the government is to increase production of fruits to attain near self-sufficiency level by 2020. The Food Production National Programme (FPNP): 2016 - 2018 of the government has clearly identified fruit crop development and home gardening as an important priority area. The Ministry of Agriculture has started many projects related to fruit production such as establishment of fruit villages, year round cultivation of fruits by establishing five off-seasonal fruit zones (fruit crop zoning), intercropping fruit crops in plantation sector (under coconut, early stages of rubber plantings), fruit variety development for home gardens and commercial cultivation, increase availability of high quality and productive fruit plants etc.

The aims of the government initiatives are to promote production and consumption of fruits and healthy lifestyles among the next generation by achieving the recommended daily intake of fruits of 200 grams per person per day, ensure fruit availability in the market, to enhance export potential of fruits and to compensate current fruit imports by local fruit production. However, the expansion of horticulture sector at commercial level is hindered by the non- availability of land in large enough parcels. While land is available for commercial cultivation, the ready availability of cultivatable land is seriously constrained as most lands are owned by the state or by multiple government agencies. Therefore, serious difficulties are encountered by agri-entrepreneurs and farmers who desire to engage in commercial farming (Zaheed, 2017).

Despite the Ministry of Agriculture has introducing a wide range of assistance and development programmes for this sector since many years, it could not achieve the successful fruit production to meet the demand of local and foreign market at present. The HH level social and economic origins that favourably or adversely affect the production of fruits in home gardens need to be recognized. Without identifying these facts related to fruit production in home gardens, there is a possibility to end up the current home garden based fruit cultivation programme as previous ones. According to the study of Galhena *et al.*, (2013), there are many constraints to maintain home gardens. Hence, strategies should be developed to uplift the fruit production while identifying related issues. Therefore, it requires an understanding about the barriers, direct and indirect benefits enjoyed by HH while identifying the strategies to expand the fruit production in home gardens.

Research efforts on socio- economic aspects of fruit tree cultivation in home gardens have also been limited. Adoption of tree cultivation varies across HH. Some HHs may cultivate more trees while others cultivate few. Identification of the factors affecting adoption of tree cultivation is an initial step towards formulating policies and programmes aimed at promoting tree cultivation in home gardens (Karunarathna and Gunathilaka, 2002). The general perception of society towards fruit cultivation is unclear and critically important for policy crafting, before blanket recommendations are made (Taruvinga and Mushunje, 2010).

Hence, this study focuses on identifying factors which determine fruit cultivation in all climatic zones (Dry Zone (DZ), Wet Zone (WZ) and Intermediate Zone (IZ)) in Sri Lanka and evaluating the government intervention on promoting home garden fruit

cultivation. The findings will help policy makers to develop site specific actions in order to enhance fruit cultivation in home gardens throughout the country.

1.6 Objectives

The overall objective of the research study is to identify determinants of home garden fruit cultivation so as to formulate strategies to expand fruit cultivation and production in home gardens.

1.6.1 Specific Objectives

- To understand existing fruit cultivation and production in home gardens.
- To recognize potentials and constraints for fruit cultivation in home gardens.
- To identify factors determining fruit cultivation in home gardens.

The FPNP was initiated in year 2016 with the focus on two main sectors as crop production programme and home garden programme. The key component of the home garden sector is to promote home garden fruit cultivation through “Sithamu” Women Farmer Organizations (WFO). Hence, the study was also focused,

- To discuss the degree of success of ongoing home garden fruit cultivation programme under FPNP 2016-2018 so as to formulate recommendations in order to strengthening the existing programme.

1.7 Organization of the Report

This report consists of seven chapters. The introductory chapter gives the background and objectives of the study. The Second Chapter reviews the literature of past studies on home gardening, preferences and HH behaviour for fruit cultivation. The Third Chapter is devoted for concepts and review factors which are affecting on HH decision of growing fruit trees in home gardens. The Fourth Chapter provides the research methodology and study locations. Chapter Five and Chapter Six presents the results, discussion and an overview of home garden fruit cultivation programme under FPNP :2016- 2018. The final chapter contains the conclusion and recommendations.

CHAPTER TWO

Literature Review

Home gardening is an age long practice although it has not been properly developed among HHs and is yet to be given the needed policy attention. It has economic as well as social implications on the livelihood system of HHs (Kelechi *et al.*, 2014) and make a significant contribution in meeting daily household needs for better nutrition and health.

2.1 Home Garden

Literature provided different definitions for home gardens. According to Food and Agriculture Organization (FAO), home garden is defined as a farming system that combines physical, social and economic functions on the area of land around the family home. Further, mixed cropping system which is cultivated in a small portion of land which may be around the HH plot or within a walking distance (Odebode in 2006). Kumar and Nair, 2004 define home garden as a multi-story, combination of various trees and crops, sometimes association with domestic animals around homestead and home garden cultivation is primarily used for domestic consumption and excess output can also be sold to generate an additional income. Number of researchers define home garden as small scale supplementary food production system maintained by HH members (Hoogbrugge and Fresco, 1993; Eyzaguirre and Linares, 2004; Sthapit *et al*., 2004; Krishna, 2006).

According to Department of Census and Statistics (DCS) of Sri Lanka, the home garden is defined as a piece of land which has a dwelling house and having some form of cultivation, if the total area of that piece of land is twenty or less than twenty perches. A land over twenty perches is also considered as a home garden, if it has a dwelling house and the produced is largely for home consumption.

2.2 Benefits of Home Garden Fruit Cultivation

Several research studies have identified benefits of home gardening. Fruit cultivation in home gardens were of economic, medicinal, nutritional and social importance to HHs, but the major attraction to their cultivation in home garden was economic in terms of income generation, labour and market. Fruit cultivation preference was based on input requirement, resistant to pest and diseases, frequency of fruiting, availability of market and others (Demelu and Odo, 2013).

Similar to participating in other types of residential yard work, home-based edible gardening can provide participants with physical and mental health benefits, serve as an expression of identity and ownership, support social interaction through the sharing of food with one's neighbours, facilitate connections with nature, and create wider awareness and support for ecological values (Gaynor 2006; Gray, 2014; Kortright and Wakefield 2011; Freeman *et al.,* 2012). Additionally, growing edible plants at home has been identified as potentially reducing grocery bills, increasing

fresh produce consumption and reduce HH's carbon footprint (Hall 2011; Kortright and Wakefield 2011; Taylor and Lovell 2015).

Home garden products are important for HH subsistence, product exchanges between rural and urban kin HHs; help sustain critical social networks that subsidize urban life, home gardening helps to maintain a sense of aesthetic pride, a social and emotional link and a psychological buffer (Antoinette, 2002). Further, Gomiero, Paoletti and Pimentel (2008) identified that edible gardening has economic, social, environmental, resiliency and sustainability consequences and extent to which these consequences are beneficial or harmful depends on the behavioural context and gardening methods.

2.3 Factors Influencing Participation in Home Garden Fruit Cultivation

Farmers' willingness to grow trees depends on many factors such as resource endowment, demand for products, institutional aspects and increase in the productivity of staple crops. Further market trends and governmental trade or pricing policy also have considerably influenced the farmers' decision on tree cultivation in Gunung Kidul district of Java (Filius, 1997). Household tree cultivation is an activity of poor households and it could potentially play a significant role in reducing rural poverty in Sri Lanka. Economic incentives to cultivate timber trees, environmental awareness programmes and secured land tenure could be used to promote tree cultivation in home gardens. As attitudes and education level play a significant role in tree cultivation decision among the smallholders, the policy makers should draw attention on those aspects as well (Karunarathna and Gunathilake, 2002).

Household income plays a major role in home gardening. Therefore, income acts as an inhibiting factor or barrier for home fruit and vegetable cultivation (Allen, 2004). A lack of interest can be seen as an incompatibility of home gardening with an individual's having values or practices for home gardening. Time, space and knowledge also act as barriers to home gardening. The motivational factors of home gardening are relative advantage, compatibility with existing values and practices, simplicity and ease of use, trialability and observable results. The absence of any of these qualities may act as a barrier to adoption (Robinson, 2009).

Although numerous studies have identified possible factors influencing gardening behaviour, none have measured the relative influence of psycho-social variables on participation. However, there are very few studies which have sought to determine the relative influence of psycho-social determinants, such as attitude, subjective norms and perceived behavioural control, on the edible gardening behaviour (Babara *et al.,* 2011). There are several research studies that have focused on factors determining the home gardening behaviour of gardeners. However, none of those researches compare the attributes of non-gardeners with the gardeners. Hence, those research approaches fail to identify the relative influence of different factors on gardening behaviour (Schupp and Sharp, 2012, Miura *et al.*, 2003).

Home-based edible gardens have recently been identified as an important part of urban sustainability initiatives, given the relatively large area of residential yard space available for food production in most cities (Zainuddin and Mercer, 2014). Increased research intervention in home gardening could create a platform to discuss home garden issues and encourage all HHs to engage in home gardening (Kelechi *et al.,* 2014). However, the research is lacking and the HH decisions to participate in home-based edible gardening have not been fully examined (Tanley, 2016). Therefore, future research should explore larger populations located in a variety of regions to better understand the ways different HH circumstances and environments influence motivations and barriers for home gardening (Stephen and Sheryl, 2011).

The research study conducted by Schupp and Sharp in 2012 found that there is an association between gardening and environmental values. The research has not studied to determine why non-gardeners do not garden. Hence, it is particularly important to consider experiences of non-growers as significantly increasing urban agricultural activity through home gardening would require numerous non-growers to start tending a garden. Understanding why former growers stopped edible gardening can potentially identify supports necessary to help residents overcome barriers beyond the initial start-up (Corlett *et al.,* 2003; Kortright and Wakefield 2011; Taylor and Lovell, 2015).

In order to fill this research gap stated in the literature, this study aims at identifying a range of barriers related to home garden fruit cultivation and determine which factors (external and individual) have the greatest influence on HH decision on home garden fruit cultivation. Further, it explores the importance of HH decision regarding whether or not to cultivate fruit trees in their home gardens by employing gardeners and non-gardeners.

This study will contribute to a greater understanding on home garden fruit cultivation. Further, it provides recommendations and strategies to enhance fruit cultivation in home gardens through government fruit cultivation programmes and HHs self-initiatives. Therefore, the findings will help policy makers to develop site specific actions in order to enhance fruit cultivation in home gardens in Sri Lanka.

CHAPTER THREE

Conceptual Framework

This study focuses on the factors determining the HH decision of growing fruit trees in homesteads of households. This practice in many countries including Europe, Africa and Asia has been introduced as urban edible gardening or edible gardening (Foes-lamb, 2007; Chiang, 2005), home gardening (Drescher *et al.,* 2006), house-lot gardening (Winklerprins, 2002) or backyard gardening (Kortright, 2007). In this study, cultivation of fruit trees in a homestead is considered as home gardening.

The previous literature on factors influencing participation in urban edible gardening or home gardening can be organized into four domains:

1. Studies focusing on broad external factors
2. Studies proposing typologies to group individuals already engaging in home gardening
3. Studies examining specific socio-demographic factors
4. Studies examining motivations for home gardening

A diverse range of theoretical and methodological approaches have been used to study these factors influencing HH tree cultivation decision (Amacher *et al.*, 1993; Scherr 1995; Thacher *et al.,* 1997; Salam *et al.*, 2000; Byron 2001; Pattanayak *et al.*, 2003; Walters *et al.*, 2005). The theoretical framework to be used in this study is drawn from existing studies related to the socio-economic, perceptional and other factors affecting HH fruit cultivation decision.

According to Theory of Planed Behavior (TPB) the HHs decision of fruit cultivation intention is a primary antecedent of behaviour, attitude, subjective norms and perceived behavioural control (Ajzen, 1991, 2002) which are influenced by several factors.

The present study, presume to capture the motivational factors that influence individuals to engage in fruit cultivation in home gardens and to measure the amount of effort individuals are planning to exert to perform this behaviour. Attitudes measure the degree to which a person evaluates fruit cultivation favourably or unfavourably. Subjective norms measure a person's perceived social pressure to perform fruit cultivation in home gardens. Perceived behavioural control measures a person's perceived ease or difficulty of performing fruit cultivation in home gardens. The researchers assume that the behaviour of fruit tree cultivation is influenced by both internal and external factors. The external factors include physical factors, environmental factors and social factors while the internal or people centric factors include psycho- social and demographic factors.

3.1 External Factors Influencing Household Level Fruit Tree Cultivation

3.1.1 Physical Factors Influencing Household Level Fruit Tree Cultivation

External factors that influence HH level tree cultivation include access to sufficient land, land-tenure laws (Kortright, 2007). According to Maxwell (1995) and Mwangi, (1995) longer residence time has been linked to higher probability of participation in home gardening. Additionally, Maxwell (1995) found that larger HHs were more likely to grow crops for the home consumption. Blaylock and Gallo (1993) reported that the residential land size, home ownership, source of income and the potential for saving money all had a significant influence on the decision to produce vegetables at home. Space constraints or land size have previously been shown to influence presence of edible gardens and other vegetation in residential yards (Pham *et al.*, 2013; Conway and Brannen, 2014). Since, in the present study it is hypothesized that access to sufficient land, land ownership status and the length of stay have strong effect on home gardening behaviour.

3.1.2 Environmental Factors Influencing Household Level Fruit Tree Cultivation

According to the past literature many researchers had identified environmental factors such as site quality (Kumar *et al.,* 2003, Jagger *et al.*, 2005) local climate and topography, prevalence of plant pests and diseases and availability of water (Nugent, 2000) has influenced the HH cultivation decisions. This study also considers that, these constraints are typical of the Sri Lankan context too.

3.1.3 Social Factors Influencing Household Level Fruit Tree Cultivation

Several researchers have identified social factors which influence HH tree cultivation, but the separate identification of these factors has not been done. Access to input markets (seeds, fertilizers, pesticides, herbicides, tools and gardening stores) (Nugent, 2000; Sander-Regier, 2008), political environmental factors such as urban planning regulations and building codes (Brown and Carter, 2003), presence of HH and local networks which provide support and demand for the agricultural products (Winklerprins, 2002) can be identified as possible social factors for tree cultivation. In this research access to input markets, presence of HH and local networks are identified as possible social factors which influence the fruit tree cultivation decision. The influence of political environment is excluded as majority of the population lives in rural areas where urban planning regulations and building code are not stringent or lacking.

3.2 Individual Factors Influencing Household Level Fruit Tree Cultivation

3.2.1 Psycho-social Determinants Influencing Household Level Fruit Tree Cultivation

Although, numerous studies had identified possible factors influencing home gardening behaviour, a very few have quantified the relative influence of psycho-social determinants, such as attitude, subjective norms and perceived behavioural control. Filling this research gap contributes to a greater understanding of participation in home gardening which can then be used to promote the same behaviour (Babara *et al.,* 2011).

According to Robbins (2007) the social pressure to maintain lawns, whether residents want to or not have a great influence on home garden in the context of New Zealand. Previous studies show that farmers' favourable or unfavourable attitudes towards tree planting (Amacher *et al.*,1993; Nibbering, 1999; Salam *et al.*, 2000) as well as other peoples' attitudes around them (Mercer, 2004) have influenced farmers' willingness to plant trees. Attitudes towards tree planting can also change over time, leading to increases or decreases in tree planting activity (Nibbering, 1999).

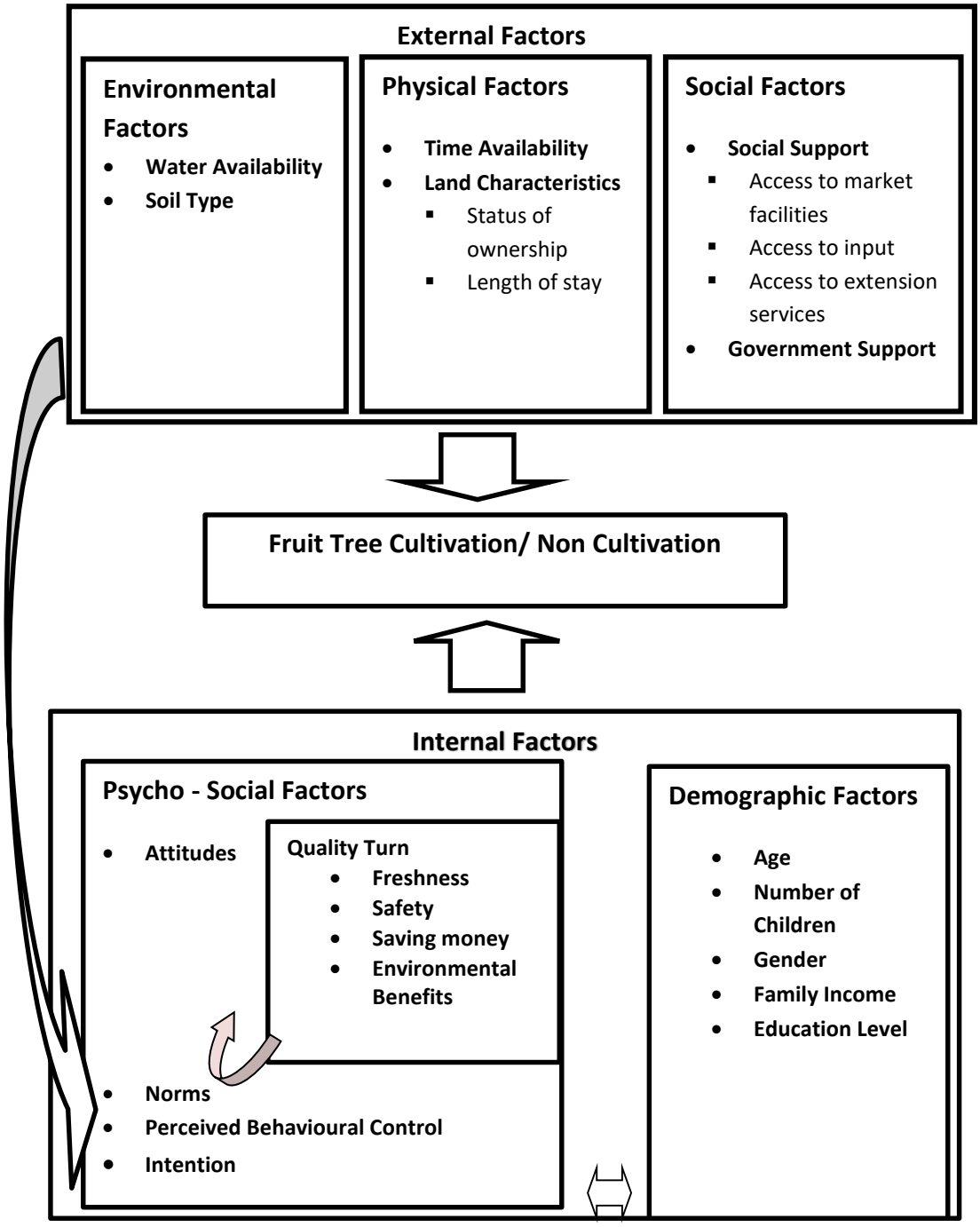
The 'quality turn' is a strong motivator that has brought more people to grow some, if not all, of their own produce at home (Baker and Crosbie, 1993). Further, culture created responsibilities of tree cultivation (Mongeout, 2000) has also influenced the individual behaviour of tree cultivation.

The research hypothesized that psycho-social determinants such as attitudes, subjective norms, perceived behavioural controls and intention have an influence on HH fruit cultivation decision. Further, the quality turn consists with factors such as freshness and safety of the fruit produced in home garden, money saving and environmental benefits.

3.2.2 Demographic Factors Influencing Household Level Fruit Tree Cultivation

Household level participation in yard work is typically related to HH characteristics, including gender and age of residents, cultural background, level of gardening experience, socioeconomic status and personal attitudes (Yakibu *et. al.*, 2008). In particular, wealth and education-level are the best predictors of tree canopy cover and plant diversity in HH level (Pham *et al.,* 2013). Through a series of studies in the United Kingdom, women were found to be more likely to participate in gardening around the home than men (Bhatti and Church, 2000). Those with mid-length residencies (15 to 20 years) engaged in the most yard work (Loram *et al.,* 2011) and participation in yard work is most common for those aged 45 to 69 (Bhatti 2006). Gender has been found to influence tree planting activity (Scherr, 1997). According to Blaylock and Gallo (1993) number and ages of adults in the HH also affect HH fruit cultivation. The research hypothesized that age, number of children, gender, average

household income and education level have significant influence on home garden behaviour as identified in previous researches as well.



Source: Authors own work

Figure 3.1: ***Conceptual Framework***

CHAPTER FOUR

Research Method

4.1 Operationalization of Variables in Objectives

4.1.1 Understanding of Existing Fruit Cultivation and Production in Home Gardens

The following variable presented in Table 4.1 is used to measure the existing fruit cultivation and production in home gardens. The fruit tree diversity in HHs was calculated using Shannon's index.

Table 4.1: Variables Used for Measuring Existing Fruit Cultivation and Production in Home Gardens

Variable	Meaning	Measuring
Number of fruit trees exist in the HH	To identify the fruit tree density at each HH	A quantitative variable and measured as the number of fruit trees per HH
Types of existing fruit trees in HH	To identify the fruit tree diversity at HH	Shannon's index: a quantitative variable and measured as total number of species in the community or species richness
HH land allocation for fruit tree cultivation	To understand the HH land use patterns in each climatic zone	A quantitative variable and presented as ratio to the total land extend
HH fruit production in year 2016	To understand the existing contribution of home garden practices in fulfilling the fruit consumption needs of HH	A quantitative data and measured in kilo grams (kg)
Amount of fruit production allocated for marketing purposes	To measure HH contribution for fruit market	A quantitative data and measured in kilo grams (kg)

Source: Authors own work

4.1.2 Recognizing Potentials and Barriers for Fruit Cultivation in Home Gardens

As suggested by Francis *et al*., (2003), individual intention with regard to fruit cultivation in home garden can be considered as dichotomous variable i.e. that is intention of growing fruit crops and intention of not growing fruit crops in home gardens. Then a series of t-tests are conducted to determine factors causing changes in individual intention of growing or not growing fruits in home gardens.

Logistic regression was performed to examine the prediction of self-reported behaviour, showing the intention of fruit cultivation. A series of t-tests were performed to compare those who intend to grow in the future with those who do not intend to grow.

4.1.3 Identifying Factors Determining Fruit Cultivation in Home Gardens

4.1.3.1 Measures

Dependent Variable

Ajzen's (2002) TACT method—(T)arget, (A) ction, (C)ontent and (T)ime— was used to define fruit cultivation in home gardens as "growing (action) fruits (target) on ones' residential property (context) in 2016 (time). The same variable of fruit cultivation or not at HH level was used as the depended variable in analysis.

Table 4.2: Independent Variables

Variable	Meaning	Measuring
External Factors		
Environmental Factors		
Water Availability Soil Type	Presence of favourable environment factors which influence the fruit tree cultivation decision on HH level	A qualitative data on availability of water sources for fruit cultivation and the soil quality and measured using Likert Scale*
Physical Factors		
Time availability	The HH decision of fruit tree cultivation depends on the time availability for gardening by the HH	A qualitative data on time availability and measured using Likert Scale*

Land Characteristics	The status of ownership of the land, length of stay at the residential land is a determinant of fruit tree cultivation decision	Status of ownership by type of ownership measured using dummy variables*, length of stay in years
Social Factors		
Access to market facilities Access to input Access to extension services Government support	The social and the government support on fruit cultivation influences the fruit tree cultivation decision	Distance to nearest fruit market measured by using Kilo metre (Km), Number of times the extension services is provided, Membership of village societies (Govi Samithi, Samurdhi, Women societies), Receive or not received the freely distributed fruit trees by government and measured using dummy variables(1 for received and 0 otherwise)
Psycho-social Factors		
Attitude	To measure individual favour to engage in fruit tree cultivation	A qualitative data and measured by Likert Scale*.
Norms	To measure the social pressure on individuals in engaging fruit tree cultivation	A qualitative data and measured by Likert Scale*
Perceived Behavioural Control	To measure the level of individual control over doing the action or the individuals perceived barriers on cultivating the fruit trees	A qualitative data and measured by Likert Scale*
Demographic Factors		
Age	Age of the HH decision maker influence the fruit tree cultivation	Age by number of years

Number of Children in HH	The presence of higher number of children in the family influence the HH decision of fruit cultivation	By number
Gender	Female HH decision-makers have a great influence in HH fruit cultivation decision	A binary variable(1- Male,0 - Female)
Family income	Higher family income tends to reduce the behaviour of fruit tree cultivation	A categorical variable and measured using dummy variables*

*The questions/ dummies used to measure the variable are presented in Annex 5
Source: Authors own work

4.1.4 Evaluate the Government Intervention on Promoting Home Garden Fruit Cultivation

To evaluate the government intervention on promoting home garden fruit cultivation a descriptive analysis was conducted to identify the percentages of population who received any government support in promoting home gardens in the last five-year period (2012-2016). Further, evaluation was conducted to compare the pre and post situation of the programme. The descriptive analysis was conducted to evaluate whether project formulation goals were achieved in project implementation and Likert Scale analysis was conducted to identify the perception of the beneficiary on FPNP implemented during 2016-2018.

4.2 Analysis

4.2.1 Understanding the Existing Fruit Cultivation and Production in Home Gardens

The data was analyzed using a descriptive method which includes tables, graphs and charts. The Shannon's index was calculated to identify the fruit tree diversity at HH.

This study attempts to quantify the fruit production in home gardens. The study uses 19 fruit species to estimate HH fruit production which forms at least 10 percent of the surveyed home gardens. The average weights used for the calculation of fruit production through each species is presented in annex 2. The research assumes that the average weight used in the calculation is true to all home gardens, despite the seasonal variation of fruit production, varietal improvements, management practices and environmental factors.

4.2.1.1 Shannon's Index

Shannon's index is a measure of species diversity in a community. Diversity indices provide more information about community composition considering rarity and commonness of a species in the community, the index also takes the relative abundances of different species into account in calculating the species diversity and density. Shannon's index is calculated by;

$$H = -\sum_{i=1}^{S} Pi \ln Pi$$

Where:
H= Shannon's diversity index
S= total number of species in the community or home garden (richness)
P_i = proportion of individuals found in the i^{th} species

Shannon's equitability (E_h) assumes a value between 0 and 1 with 1 being complete evenness and calculated by;

$$E_h = H / H_{max} = H / \ln S$$

4.2.2 Recognizing the Potentials and Barriers for Fruit Cultivation and Production in Home Gardens

The data relevant to this objective was analyzed using descriptive method which includes tables, graphs and charts and using t-statistics.

4.2.3 Identifying Factors Determining Fruit Cultivation in Home Gardens

4.2.3.1 Binary Logistic Regression Model

$$Y_i = \beta_0 + \sum_{i=1}^{n=4} \beta_{ij} X_{ij} + \varepsilon$$

Where:
Y_i = Home gardening behaviour of i^{th} HH
X_{ij} = j^{th} determinant of i^{th} HH
β_0 = Intercept of the equation
β_{ij} = Coefficient of the j^{th} determinant of the i^{th} HH
ε = Error term

This study focuses on identifying factors which determine the cultivation behaviour of fruit trees. The behaviour was measured as growing (action) fruits (target) on one's homestead (context) in 2016 (time). The cultivation of at least one fruit tree in

one' home garden was considered as the HH has the behaviour of cultivating and cultivation of none of fruit crops was considered as behaviour of not cultivating fruit crops. Hence, the behaviour to cultivate a fruit tree was identified as a binary variable[2]. So the binary logistic regression was conducted.

Further, t-test was performed to identify the factors that differ growers from non-growers. In this analysis who grew at least one fruit tree in the year 2016 was identified as grower and others as non-growers.

4.2.4 Evaluate the Government Intervention on Promoting Home Garden Fruit Cultivation

The data relevant to this objective was analyzed using descriptive method which includes tables, graphs and charts and using Likert Scale analysis.

4.3 Data Collection Methods

The study was based on both primary and secondary data.

4.3.1 Primary Data Collection

The primary data required for qualitative and quantitative analysis of the study were gathered during the field survey conducted from 01.07.2017 to 31.12.2017. A structured questionnaire was used for data collection.

The key informant interviews were conducted to collect data on the present status of government fruit cultivation programmes by interviewing agriculture sector officers such as deputy directors of Department of Agriculture, Agriculture Instructors (AI) and Agriculture Research and Production Assistants (ARPA). Focus group discussions also conducted using 'Sithamu'' Women Farmer Organization leaders and randomly selected female HH heads.

4.3.2 Secondary Data Collection

The secondary data was mostly collected from the secondary data sources of Department of Census and Statistics (DCS), Department of Agriculture, Department of Agrarian Development, Fruit Research Institute and its affiliated institutions. In addition, secondary information was gathered through research reports, journals and newspaper articles.

[2] The home gardening behaviour was measured using dummy variables. 1: Cultivation of minimum of one fruit tree in once home garden in year 2016, 0: otherwise.

4.4 Research Unit

Research unit of this study is a household which have a home garden define by the study.

In this research study home garden was defined as “A piece of land which has a dwelling house, having multi-story, mixed cropping (a combination of various trees and crops sometimes association with domestic animals) subsistence agriculture system maintain by the HH members primarily for domestic consumption and excess output can also be sold to generate additional income”.

4.5 Study Location

The fruit cultivation and the production mainly depend on the agro climatic condition of the region. The researchers intended to incorporate their findings to the existing government fruit cultivation programme (Under FPNP, 2016-2018) where fruit plants are distributed among the HHs based on the climatic zones.

Multi-stage sampling design was employed in this study. The study locations were selected from three climatic zones (DZ, WZ and IZ) of Sri Lanka. Thus the climatic zone is used as the first stage. Seventeen districts which recorded the highest number of HHs in each climatic zone, according to the “Summary Report on Agricultural Activities, Economic Census 2013/14” of the DCS used as the second stage. In the final stage a proportionate number of HH were selected randomly in each Divisional Secretariats (DS). The selected HHs were interviewed individually using a structured questionnaire.

4.6 Sample Selection

The individual HH who has a home garden according to the above definition was selected as the sampling unit. The total number of 1,100 individual HHs were surveyed during the study period.

The total of 526 beneficiaries were separately surveyed during the same period in the same districts. The survey data gathered through this exercise was employed in the on- going evaluation of FPNP. Households who received fruit plants for home gardens through FPNP, 2016- 2018 as an incentive were defined as beneficiaries.

The detailed information about the districts and DS divisions selected for the study and the distribution of sample is given in Table 4.3.

Table 4.3: Sampling Method

Climatic Zone	District	No of HH Surveyed	
Dry Zone		**HH Heads**	**Beneficiaries**
	Jaffna	33	16
	Kilinochchi	39	18
	Anuradhapura	58	26
	Batticaloa	32	14
Wet Zone	Kandy	82	40
	Galle	65	28
	Matara	47	26
	Colombo	136	64
	Gampaha	138	67
	Kalutara	75	35
	Rathnapura	68	30
	Kegalle	53	25
	Nuwara-Eliya	37	17
Intermediate	Badulla	51	23
Zone	Hambantota	34	18
	Kurunegala	103	54
	Putlam	49	25
	Total HH	1100	526

Source: Authors own work

Note: * The DS divisions selected for each district is as follows

***Jaffna**: Thenmaradchi, Nallur**, Kilinochchi**: Kandavalai, Karachchi, **Anuradhapura:** Nochchiyagama, Mahavilachchiya, Mihintale, **Batticaloa**: Eraur Town, Eraur Pattu, **Kandy:** Doluwa, Deltota, Harispattuwa, Hatharaliyadda, Poojapitiya, **Galle:** Nagoda, Balapitiya, Elpitiya, Welivitiya-Divithuru, Karandeniya **Matara:** Kamburupitiya, Devinuwara, Malimbada, **Colombo**:Homagama, Maharagama, Padukka, Seethawaka, Kasbawa, Kaduwela, **Gampaha**:Minuwangoda, Mahara, Gampaha, Mirigama, Attanagalla, Divulapitiya **Kalutara:** Kalutara, Bandaragama, Madurawala, Matugama, **Rathnapura:** Pelmadulla, Kuruwita, Kiriella, **Kegalle**:Rambukkana, Galigamuwa, Bulathkohupitiya, **Nuwara-Eliya**:Nuwara-Eliya,Hanguranketha,Kotmale, **Badulla**: Haldummulla, Hali-Ela **Hambantota**:Katuwana, Walasmulla, Weerakatiya **Kurunegala**:Narammala, Mawathagama, Alawwa, Mahawa, ,Wariyapola **Putlam:** Madampe, Arachchikattuwa*

CHAPTER FIVE

Determinants and Status of Fruit Tree Cultivation in Home Gardens

The research work was conducted in 17 districts of Sri Lanka covering randomly selected HHs of 1,100 in WZ, IZ and DZ. The results of the descriptive analysis, binary logistic regression and t-test are presented in chapter five. The chapter presents the socio-economic characteristics of the surveyed sample followed by existing fruit cultivation and production, factors determining fruit cultivation, potentials and limitations faced by home dwellers for fruit cultivation in home gardens.

5.1 Socio –Economic Characteristics

According to the result presented in Table 5.1**,** majority (51.0%) of the sample population consist with females while the rest is males. The findings are consistent with the national statistics (Central Bank Report, 2017). The majority belong to the age category of 15- 64 years accounting for 70.8 percent of sample population. This result indicates that the findings are in accordance with the national average and the HH dwellers are in economically productive age. Further, these age groups take the responsibility of fulfilling HH needs.

The results in Figure 5.1 further revealed that most of the respondents have the intention to cultivate a fruit tree in their home garden which is supported the finding of majority HHs belong to age of 15- 64 years. Around 11 percent belong to the age category of over 60 years. According to the analysis the majority (78%) revealed that they have time and the ability to cultivate fruit trees and very few revealed physical inability as a constraint. Further, the results also revealed that 32 percent HH heads are over 60 years of age and 24.8 percent belong to the age group of 50- 60 years.

Average HH size is four which is in accordance with the national statistics in 2017 (Central Bank Report, 2017). The results in Table 5.1, further revealed that the average HH composition (number of children) is two in majority which also in accordance with the national statistics in 2017 (Central Bank Report, 2017).

The result revealed that majority (93. 1%) has formal education which is also the national data on literacy rate. The average monthly income of the majority (50.2 per cent) is less than 30,000 LKR. This is far below the national average monthly income level of 62,237 LKR per month (Central Bank Report, 2017). The majority (82.7%) are employed as in-formal sector workers which could be the main reason for having comparatively low average monthly income levels.

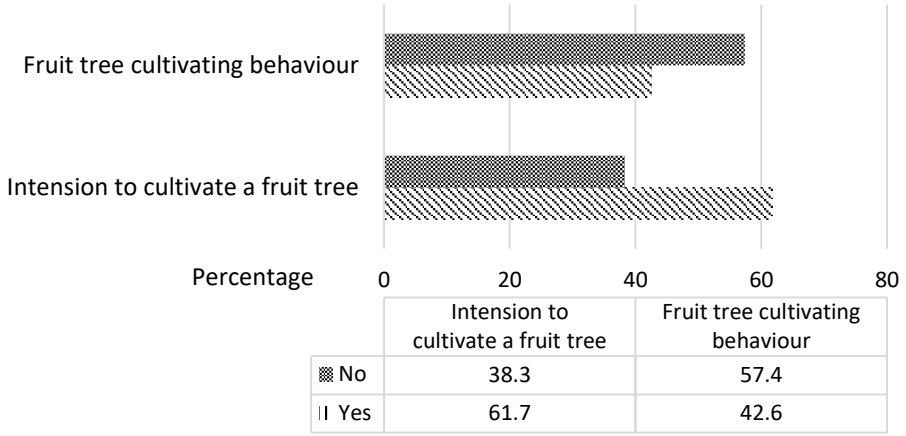
Table 5.1: Socio- Economic Characteristics of the Households

Variables	Frequency	Percentage
Gender		
Male	1976	49.00
Female	2058	51.00
Total	4034*	100.00
Age categories		
0-14 years	742	18.40
15-64 years	2855	70.80
65 years and over	437	10.80
Total	4034*	100.00
Age categories of HH head		
20-30	41	3.7
30-40	174	15.8
40-50	258	23.5
50-60	273	24.8
61<=	354	32.2
Total	1100	100
Average HH size	4	31.4
Average HH composition (number of children)	2	21.2
Formal education		
No formal education	278	6.90
1-5 Years	860	21.30
6 -11 Years	1691	41.90
12 and above	1205	29.90
Total	4034*	100.00
Occupation		
Public sector employees	365	9.00
Non- government sector employees	332	8.20
Other	3337	82.70
Total	4034*	100.00
Average monthly income (LKR)		
0-30,000	552	50.2
31,000- 60,000	473	43
>61,000	75	6.8
Total	1100	100

Source: Authors' compilation based on field survey (2017)
Note: *4,034 includes the all HH members in the surveyed HHs of 1,100

5.2 Existing Fruit Cultivation and Production in Home Gardens

Household head and spouse share the HH decision of fruit tree cultivation. In 90 per cent HHs either HH head or the spouse makes the decision of fruit tree cultivation.



	Intension to cultivate a fruit tree	Fruit tree cultivating behaviour
No	38.3	57.4
Yes	61.7	42.6

Source: Authors' own calculation based on field survey (2017)

Figure 5.1: Household Fruit Cultivation Decision in Year 2016 and 2017

As shown in Figure 5.1, majority (57.4%) are not participate in fruit cultivation in the year 2016. However, the vast majority reported that their willingness to grow a fruit tree in their home gardens in the upcoming year. This results show that HH members have the intention of cultivating a fruit tree in their residential property. Further, almost all are aware that cultivating a fruit tree in the home garden provides fresh, safe fruit to eat, have environmental benefits, saves HH expenditure on fruit purchasing, increases HH fruit consumption levels and enhances mental satisfactions as well. Only 12.6 percent expect an extra income through HH fruit cultivation. Since the majority do not expect extra income through selling the home garden produced fruits, there is a vast potential to enhance fruit consumption through HH fruit cultivation.

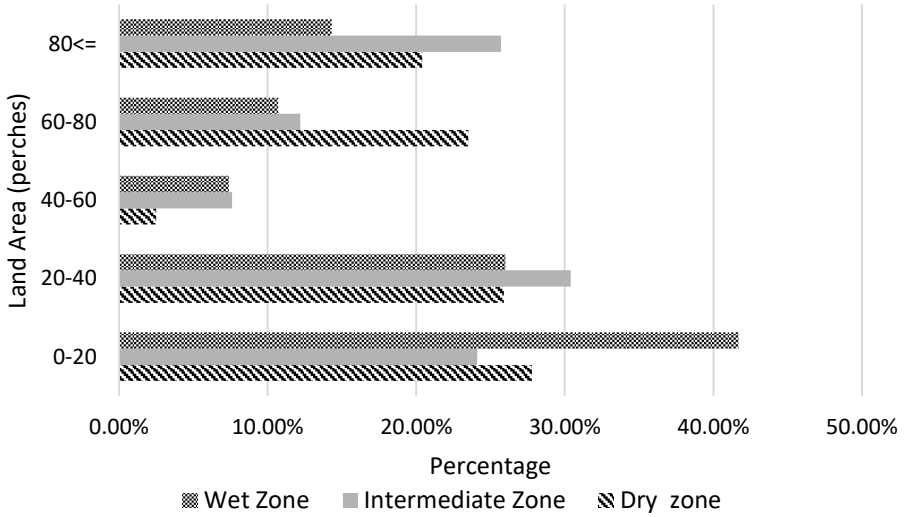
However, the propensity to initiate action to grow a fruit tree in residential property is low. The data on randomly selected sample of 1,100 HH revealed that only 26.7 per cent of the HHs received any kind of government incentive designed to promote home gardens in the last five years: 2012 to 2016. Majority (73.3 %) had not received any government incentive during the period of 2012 to 2016. Further, 58.8 percent of respondents had not witnessed any government officer engaged in fruit cultivation promotion programmes.

According to the analysis 27.3 percent of the HH members do not have membership in agriculture related community based organizations (Farmer organization, WFO: "Sithamu" or other). However, 82.3 percent HHs have participated to community base organizations mainly Dead Benevolence societies. In addition, membership in an agriculture related community base organization is considered as a pre-requisite

to be selected as a beneficiary in most of the government incentive programmes. This may be the reason for 73.3 percent of the HHs to be deprived of any type of government incentives.

5.2.1 Household Land Use Patterns

In the context of island wide HH land use pattern, 35.8 percent of the population own a land parcel less than 20 perch and 26.9 percent own 20-40 perch land parcels. However, 17.6 percent are endowed with land parcels of more than 80 perch. In DZ and WZ majority of the home garden land extent is limited to less than twenty perch limit (DZ: 27.8 %, WZ: 41.7%). In those two climatic zones, WZ has the highest number of small land parcel as home gardens and 41.7 percent of the WZ home gardens are less than 20 perch in extent.



Source: Authors' own calculation based on field survey (2017)

Figure 5.2: Household Land Use Pattern

Majority of the HHs (87.2 %) own transferable land rights and only 2.2 percent lives in rented land slots. One percent of the respondents live on state lands with no ownership rights and only 9.3 percent have other types of ownership to their home gardens. This reveals that the majority of the population have control over their land area in making a decision to cultivate at least one perennial tree such as a fruit tree. As for their period of stay at the residential property, 76.6 percent have been in occupation of the same land area for more than 20 years and 11.5 percent have stayed up to 11.5 years in the same land. Only three percent of the population have live less than one year in the land area. According to Maxwell, 1995 and Mwangi, 1995 longer residence time has a linked to higher probability of participation in home gardening.

However, according to the study very few residents prioritize fruit growing on their land: only 9.3 percent of respondents use more than 40 percent of their residential property to cultivate fruit trees, whereas 28.0 percent grew fruits on a space less

than 10 percent of their land. These findings show that while the overwhelming majority of respondents engage in home gardening, the extent they cultivate fruit trees was limited due to their prioritizing non-edible gardening and other uses for their land.

5.2.2 Fruit Tree Density and Diversity

Fruit tree density and diversity in the home garden greatly contributed to the level of HH fruit consumption diversity through home gardening. The high fruit tree density with the high diversity indicates that HHs have the possibility to consume a fruit dish with a variety of fruits. Diversified fruit dish fulfill the FAO recommendation and the target of FPNP: 2016-2018 of consuming 200g/day of fruits in five colours.

In order to assess the fruit tree density and the diversity the study used the Shannons' index. The results (Table 5.2) of the analysis revealed that the highest fruit tree density and the diversity existed in the Uva Province with the Shannon's equitability (E_H) index of 0.71 and Shannon's diversity index of 0 .71 and the lowest is recorded in the Northern Province followed by the Eastern Province with E_H index of 0.46, 0.48 respectively and 0.93, 0.87 Shannon's diversity index respectively. This indicates that the highest fruit tree diversity exists in home gardens in Uva Province.

At least 10 percent of home gardens in the Uva Province have mango, banana, pineapple, rambutan, avocado, pomegranate, anoda, orange, papaw, veralu, guava, jambu and naran as fruit species while the Northern Province home gardens consist of mango, banana, pomegranate, lime, orange, varaka, guava, jambu as fruit species. The moderate fruit tree diversity and density observe in the North Central Province, the Sabaragamuwa Province, the Central Province, the Western Province and the North Western Province. Considering the all island fruit tree diversity and density it was observed the H index of 1.35 and E_H index of 0.55 indicating that the Sri Lanka has moderate fruit tree diversity and density in home gardens.

Table 5.2: Shannon's Diversity (H) Index and Shannon's Equitability (E_H) Index

Description	Cases	H index	Min.	Max.	S.D	$E_H = H/H_{max}$	S.D
Northern Province	72	0.93	0	2.01	0.56	.46	.27
North Central Province	58	1.39	0	2.31	0.54	.59	.23
Eastern Province	32	0.87	0	1.79	0.58	.48	.32
Sabaragamuwa Province	121	1.32	0	2.28	0.54	.57	.23
Central Province	119	1.41	0	2.62	0.52	.53	.19
Western Province	349	1.38	0	2.68	0.57	.51	.21
Southern Province	146	1.52	0	2.27	0.46	.66	.20
Uva Province	51	1.61	0	2.25	0.46	.71	.20
North Western Province	152	1.32	0	2.39	0.52	.55	.21
All Island	1100	1.35	0	2.68	0.55	0.55	0.23

Source: Authors' own calculation based on field survey (2017)

Figure 5.3 shows the province wise home garden fruit production and sales. Mango is the most produced fruit in all the provinces except the Central Province and the Uva Province. In the Central Province and the Uva Province avocado is the major contributor for the HH fruit production. The highest home garden mango production is recorded in the North Central Province (947.72 kg/HH/year) followed by the North Western (396.27kg/HH/year) and the Western Province (247.00 kg/HH/year). The highest avocado production in home gardens is recorded in the Central Province (243.76 kg/HH/year). Considering the sales of HH produced fruits, 27 percent of the mango and 34 percent of banana production in home gardens are sold at the open market. Thereby deriving a supplementary income by the HH. The other fruit types have less or fewer contribution to the HH income generation through sales.

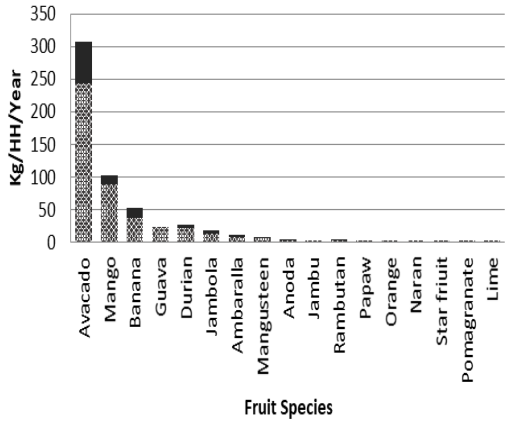


Figure 5.3.1: Central Province

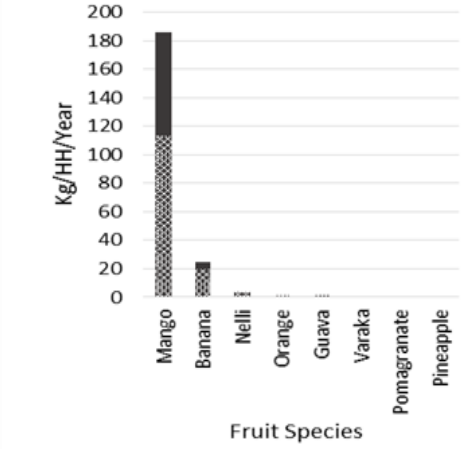


Figure 5.3.2: Eastern Province

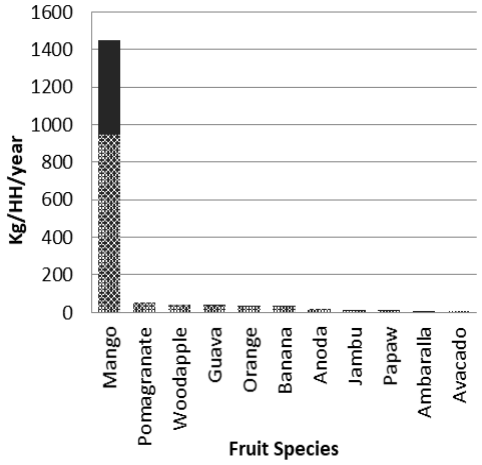


Figure 5.3.3: North Central Province

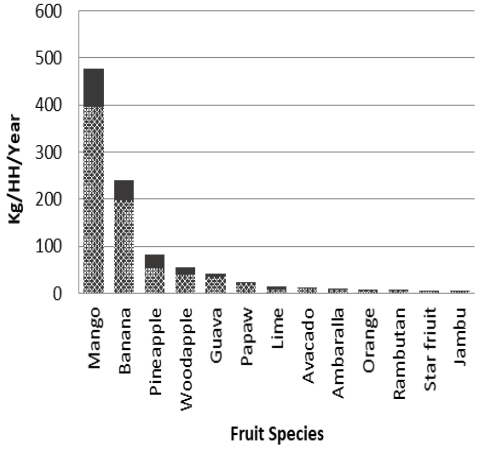


Figure 5.3.4: North Western Province

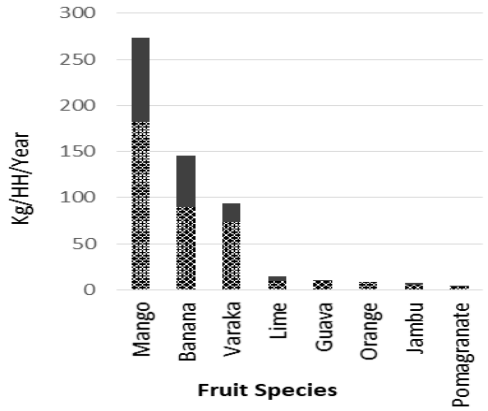


Figure 5.3.5: Northern Province

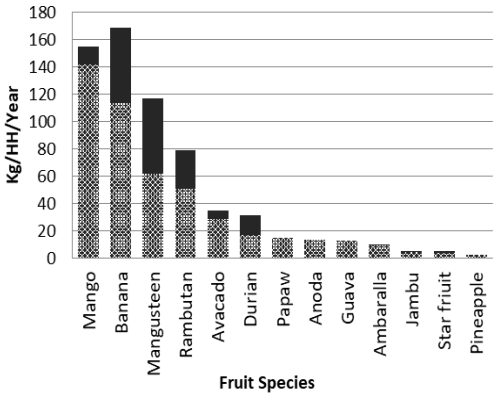


Figure 5.3.6: Sabaragamuwa Province

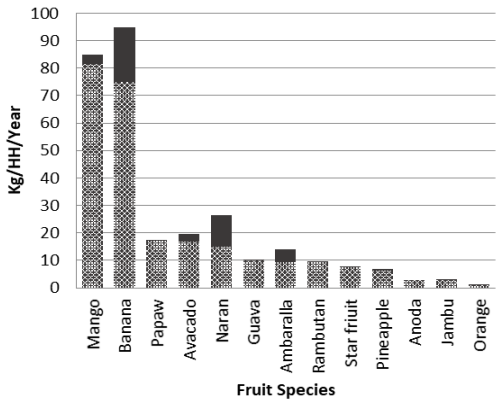


Figure 5.3.7: Southern Province

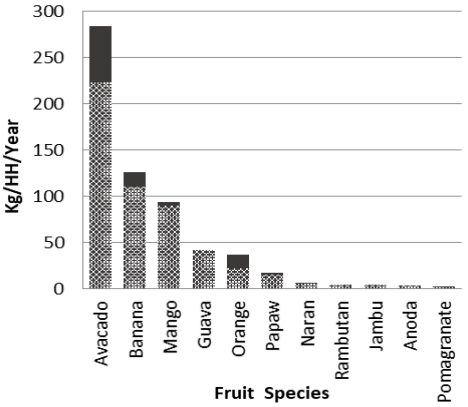


Figure 5.3.8: Uva Province

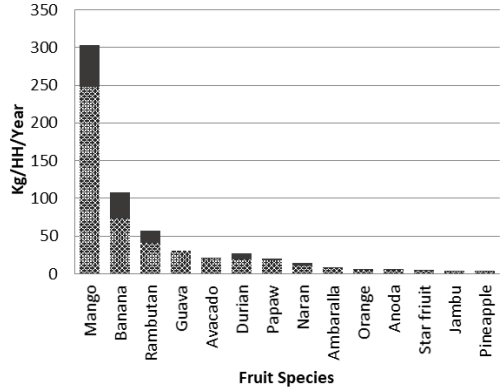
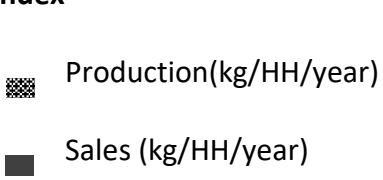


Figure 5.3.9 : Western Province



Source: Authors own compilation

Figure 5.3: Province vise Home Garden Fruit Production and Sales

Mango and banana account for 60 percent of HH fruit consumption from home garden (Annex 3). The Central and the Uva Provinces are exceptions. In the Central Province HH fruit consumption basket consist of avocado (50.79%) and mango (21.26%) while in the Uva Province it is avocado (38.39 %), banana (22.31%) and mango (20.05%).

5.3 Factors Determining Fruit Cultivation in Home Gardens

Structural Equation Modelling (SEM) is used to analyze how the TPB factors predict intention, and then binary logistic regression was performed to examine the prediction on self-reported behaviour of fruit cultivation. The model fits with the Nagelkerke R- square of 0.219 and $\chi 2$ (162) = 25.154, $p < 0.001$; $\chi 2/df = 3.14$. According to the binary logistic regression model the intention to participate in home gardening strongly predicted the home gardening behaviour (β= 1.247), the strongest influence on behaviour of fruit cultivation was attitudes (β= 0.397) and perceived behavioural control (β= 0.378) while subjective norms do not significantly contribute to the behaviour of fruit cultivation.

$$Yi = -2.161 + 0.397\ At + 0.032\ SN + 0.378\ PBC + 1.247\ In + \mathcal{E}$$

Where,

Yi= Home gardening behaviour

At= Attitude

SN= Subjective Norms

PBC= Perceived Behavioural Controls

In= Intention (Cultivate in 2017)

$\mathcal{E}$ = Error term

Table 5.3: TBP Estimates for Determinants of Stated Behaviour of Home Gardening

Variable	B	S.E	Sig.	Exp(B)
Attitude	0.397 ***	0.087	0.000	1.487
Subjective Norms	0.032	0.104	0.760	1.032
Perceived Behavioural Controls	0.378 ***	0.058	0.000	1.460
Intention (Cultivate in 2017)	1.247 ***	0.146	0.000	3.480
Constant	-2.161 ***	0.197	0.000	0.115

Source: Authors' own calculation based on field survey (2017)

Note: *** significant at 0.000 significant level, ** significant at 0.05 significant level, *significant at 0.100 significant level 0.1

In order to determine which perceived behavioural control beliefs had the greatest influence on intention, a series of t-tests were performed comparing those who actually engage in self- reported behaviour of cultivating a fruit tree in 2016 in their home garden with those who did not grow any fruit tree in 2016.

t- tests were performed to compare scores of respondents who grew nothing/non-growers (*n* = 626) versus those who grew at least one fruit tree in year 2016/growers (*n* = 474). As expected, participants who already engage in fruit cultivation reported positive intentions to perform the behaviour, whereas non-participants reported negative intentions. More importantly, growers reported strong positive attitudes towards the behaviour, weak negative social pressure against gardening and stronger positive perceptions of behavioural control.

Four out of the eleven behavioural control beliefs discriminated between the growers and non-growers beliefs about having sufficient time, knowledge about the fruit cultivation and management, access to information on fruit cultivation and government incentive as subsidies has higher influence on fruit cultivation. This finding indicates that individual factors (inadequate knowledge on fruit cultivation and management and lack of time availability), absence of social support through institutions, non-receipt of incentives were perceived as barriers to fruit cultivation. However, environmental factors such as soil fertility influence the home gardening behavior but unavailability of water is not perceived as a barrier to home gardening.

Finally, t-tests were performed to assess whether demographic variables would influence the fruit cultivation. Rates of participation in fruit cultivation were assessed over eight demographic variables: age, number of children in HH, gender, family income, education level of the decision-maker and status of land ownership. Results indicate that the education level of the decision-maker has influenced the HH fruit tree cultivation. Rate of participation in fruit cultivation is significantly higher ($p < .01$) for respondents who have eleven years of schooling (Ordinary level). This may be due to the majority of the respondents belonging to this category engaged in informal sector jobs which gave them a relatively more time availability for home gardening. Further, t-test were conducted to identify the influence of social factors; access to input markets, to the open market and to extension services in distance, which make no significant contribution to the fruit cultivation behaviour. Further, results indicate that HHs having access to information on fruit cultivation through mass media ($P<.01$) and access to quality planting materials prioritized fruit cultivation rather than social support. This results justify that lack of quality planting materials as a major constraint for fruit cultivation as identified by majority of the respondents (55 percent).

Table 5.4: Estimate of Factors Determining Fruit Tree Cultivation in Home Gardens In Sri Lanka

Description	t-value	Sig.	SD	95% CI
▪ Attitudes	8.320	0.000***	0.054	0.343-0.555
▪ Subjective norms	3.123	0.002**	0.408	0.047-0.207
▪ Perceived behavioural controls	8.259	0.000***	0.072	0.455-0.740
Environmental factors				
▪ Soil fertility	-1.882	0.060*	0.061	(-0.233)-0.005
▪ Water availability	-0.454	0.650	0.056	0.133-0.083
Physical factors				
▪ Time availability	-5.496	0.000***	0.048	(-0.359)-(-0.170)
▪ Land ownership status	-0.164	0.870	0.1027	(-0.218)-0.0184
▪ Length of stay	0.596	0.552	0.049	(-0.067)-0.126
Social factors				
▪ Access to input markets	-0.203	0.839	0.273	(-0.591)-0.480
▪ Access to open markets	0.333	0.739	0.166	(-0.271)-0.382
▪ Access to extension services	0.176	0.861	0.213	(-0.381)-0.456
▪ Access to information	-2.676	0.008**	0.026	(-0.120)-(-0.018)
▪ Government incentive	-10.898	0.000***	0.027	(-0.332)-(-0.227)
Demographic factors				
▪ Age	-1.388	0.165	0.874	(-2.928)-0.502
▪ Household size (number of children)	0.799	0.424	0.064	(-0.074)-0.176)
▪ Gender of the decision-maker	-1.152	0.250	0.030	(-0.093)-0.024
▪ HH income	1.038	.299	0.038	(-0.035)-0.113
▪ Occupation	-0.464	0.643	0.251	(-0.608)-0.376
▪ Education level of the decision-maker	1.909	0.056*	0.049	(-0.003)-0.191
Intention to cultivate fruit trees				
▪ Land allocation for home gardening	3.922	0.000***	1.982	3.884-11.6629
▪ HH fruit tree density	3.678	0.000***	0.985	1.692-5.561

Source: Authors' own calculation based on field survey (2017)
Note: *** significant at 0.000 significant level, ** significant at 0.05 significant level, *significant at 0.100, significant level
df = 1098

In order to identify regional differences in fruit cultivation decision, three separate t-tests among growers and non-growers were conducted in WZ, IZ and DZ. The results indicate that the education level of the decision-maker, time availability, receipt of

government incentive and access to information have a greater influence on fruit cultivation decision in the home garden in WZ while soil fertility, water availability, land ownership status, length of their stay in residential lands, age of the decision maker, occupation and HH size do not significantly influence the HH decision of fruit cultivation. In DZ gender of the decision maker, time availability, land ownership and receipt of government incentive significantly influence the fruit cultivation decision. The results show that female has more tendencies to cultivate in DZ (66.7%) rather than male. Considering IZ the major concerns of the fruit tree growers includes internal factor as age of the decision-maker and external factors such as soil fertility, distance to input markets, distance to extension services through Agrarian Services Centres (ASC) and government incentives.

Table 5.5: Estimates of Factors Determining Fruit Tree Cultivation in Home Gardens In Sri Lanka

Description	Wet Zone		Intermediate Zone		Dry Zone	
	t-value	Sig.	t-value	Sig.	t-value	Sig.
▪ Attitudes	7.741	0.000***	1.425	0.155	3.351	0.001**
▪ Subjective norms	2.872	0.004**	1.712	0.088*	(-0.121)	0.904
▪ Perceived behavioural controls	6.794	0.000***	2.508	0.013*	4.603	0.000***
Environmental factors						
▪ Soil fertility	(-1.352)	0.177	(-2.023)	0.044**	1.280	0.203
▪ Water availability	(-0.342)	0.732	(-0.103)	0.918	1.435	0.153
Physical factors						
▪ Time availability	(-4.457)	0.000***	(-1.141)	0.225	(-3.362)	0.001**
▪ Land ownership status	(-0.850)	0.396	(-0.468)	0.640	1.932	0.055*
▪ Length of stay	0.866	0.387	(-0.955)	0.341	0.790	0.431
Social factors						
▪ Access to input markets	(-0.062)	0.951	1.942	0.053*	(-1.297)	0.197
▪ Access to open markets	(-1.277)	0.202	0.0368	0.713	(-0.538)	0.592
▪ Access to extension services	0.273	0.785	1.707	0.089*	(-1.052)	0.294
▪ Access to information	(-3.081)	0.002**	0.097	0.923	(-0.378)	0.706
▪ Government incentive	(-7.839)	0.000***	(-3.977)	0.000***	(-8.056)	0.000***
Demographic factors						
▪ Age	(-0.917)	0.359	(-2.670)	0.008**	0.326	0.745
▪ Household size (number of children)	(-0.080)	0.936	1.975	0.050*	0.353	0.725
▪ Gender of the decision-maker	(-0.574)	0.566	0.406	0.685	(-1.665)	0.098*
▪ HH income	1.155	0.249	(-1.213)	0.226	0.856	0.393

▪ Occupation	0.004	0.996	(-0.397)	0.692	(-1.008)	0.315
▪ Education level of the decision-maker	2.608	0.009**	(-8.881)	0.379	0.710	0.479
Intention to cultivate fruit trees						
▪ HH land allocation for home gardening	2.402	0.017**	1.228	0.221	4.552	0.000***
▪ HH fruit tree density	2.520	0.012**	1.551	0.122	4.436	0.000***

Source: Authors' own calculation based on field survey (2017)

Note: *** significant at 0.000 significant level, ** significant at 0.05 significant level, *significant at 0.100 significant level

df : Wet Zone = 699, Intermediate Zone = 235, Dry Zone=160

5.4 Limitations for Fruit Cultivation in Home Gardens

All three climatic zones suffer from the issues related to agricultural inputs. Damage due to pest and disease is reported as major constraint for home garden fruit cultivation. According to Table 5.6, 86.5 percent in WZ, 69.6 percent in DZ and 72.4 percent in IZ HHs reported loss of fruit harvest due to pest and diseases. Animals that damage fruit plants and harvest includes monkey (*Toque macaque* and *Trachypithecus vetulus*), giant squirrel (*Ratufa macroura)*, wild boar *(Sus scrofa*), porcupines (*Hystrix indica*) and elephants (*Elephas maximus maximus*). Heavy damage done by monkeys on fruit crops in home gardens were reported.

Fruit fly (*Bactocera dorsalis*) damage is one of the main causes for the decline of fruit production in HH level specially in case of mango and guava. Fruit cracking and damage due to pomegranate butterfly (*Virachola isocrates*) also commonly seen in pomegranates. Powdery mildew is a fungal disease of the foliage, stems and occasionally flowers and fruit where a superficial fungal growth covers the surface of the plant. It also an important constraint for having successful harvest in papaya, rambutan, guava, pineapple etc. Yellow mosaic virus is another disease which attacks mainly the papaya plants of all age groups, but is most commonly observed on young plants. Further, Panama disease (Fusarium wilt) and Banana Bunchi-top disease were observed in banana cultivations at HH level.

Table 5.6: Limitations for Fruit Cultivation in Home Gardens as Perceived by Households

Attribute	Variables	All cases (%)
Perception of HH dwellers* (in percentage)	**Constraints for fruit cultivation in Wet Zone home gardens**	
	Damage due to pest and diseases	86.50
	Problems related to agricultural inputs (capital, land, labour, entrepreneurship)	67.90
	Inadequate knowledge on agronomic practices related to fruit cultivation	9.90
	Issues related to planting materials, other inputs (fertilizer, pesticides) and access to input	9.10
	Inadequate institutional support	5.00
	Natural disasters	4.70
	Constraints for fruit cultivation in Dry Zone home gardens	
	Damage due to pest and diseases	69.60
	Problems related to agricultural inputs (capital, land, labour, entrepreneurship)	53.90
	Natural disasters	11.30
	Inadequate knowledge on agronomic practices related to fruit cultivation	10.40
	Issues related to planting materials, other inputs (fertilizer, pesticides) and access to input	2.60
	Inadequate institutional support	0.90
	Constraints for fruit cultivation in Intermediate Zone home gardens	
	Problems related to agricultural inputs (capital, land, labour, entrepreneurship)	78.00
	Damage due to pest and diseases	72.40
	Inadequate knowledge on agronomic practices related to fruit cultivation	11.70
	Issues related to planting materials, other inputs (fertilizer, pesticides) and access to input	8.40
	Inadequate institutional support	5.10
	Natural disasters	4.70

Source: Authors' own calculation based on field survey (2017)

Note: Total percentage of categories used for constrains exceed 100 in all three climatic zones, because many of the HHs have multi responses

The issues related to agricultural inputs account to 67.9 percent of HHs in WZ, 53.9 percent in DZ and 78.0 percent in IZ. The average time spend for home gardening by a HH is 1-2 hours occasionally as deemed necessary. This finding shows that the residences of the HHs have comparatively less time allocation for home gardening. This indicates the need for more wage labour participation for home gardening and 57 percent of the respondents identify the lack of waged labour as a main limitation for the home gardening fruit cultivation. The other issues related to agricultural inputs (land, labour, capital and entrepreneurship) includes inadequate water availability at critical stages of fruit cultivation, limited land availability and marginal lands (shade and water logging conditions in land), low soil fertility and the inability to purchase of quality planting materials.

Inadequate knowledge on agronomic practices related to fruit cultivation is another issue which consists with selecting fruit varieties suit to climatic zone, proper management techniques such as trimming, budding, pruning, fertilizing and pest and disease control. Around 35 percent of the population owns a home garden less than 20 perch in extent. Hence, knowledge on agronomic practices is required to obtain substantial fruit production from limited land extents. Low quality planting materials, unavailability of preferred fruit varieties, relatively high prices of budded fruit plants, uncertainty of varietal characteristics of some fruit species are collectively create the issue of planting materials. Issues related to natural disasters affect HH fruit cultivation, specially at early stages of planting. In WZ mainly due to flood and prolong drought conditions in the DZ. Households expect support from government institutions by the means of incentives, subsidies, extension and training to promote home garden fruit cultivation.

CHAPTER SIX

An On-going Evaluation of Home Garden Fruit Cultivation Programme under Food Production National Programme (2016 - 2018)

As per the concept of the study, potentials and barriers of promoting home garden fruit cultivation was presented in the previous chapter. In parallel to the study, ongoing evaluation of home garden fruit cultivation programme under FPNP (2016-2018) was conducted to examine whether the programme activities are in line with project targets. The beneficiaries (526) who received fruit plants for their home gardens as incentive in 2016 were selected for the evaluation.

6.1 Food Production National Programme (FPNP): 2016-2018

The Food Production National Programme is implemented with the objective of ensuring food security, producing supplementary food crops locally whereby minimizing food imports and increasing farmer income. This programme is launched under the following main sectors,

- Crop production programme
- Home garden programme

Above two sectors had clearly identified fruit crop development and home gardening as an important priority area. The Ministry of Agriculture currently started many projects to promote fruit production, consumption of fruits and healthy lifestyles among the next generation by facilitating them to achieve the recommended daily intake of fruits of 200 grams per person per day, ensure fruit availability in the market, enhance export potential of fruits and to substitute current fruit imports by local fruit production.

The Ministry of Agriculture plans to cultivate 150,000 hectare of fruits and 1.3 million metric tons of production by 2018 through;

- Increase availability of high quality and productive fruit plants
- Cultivate fruits as an inter-crop in coconut lands
- Establish off season fruit cultivation zones in non-traditional areas
- Establish commercial farms
- Usage of modern management techniques (for trimming, budding and pruning)
- Executing Good Agricultural Practices(GAP)
- Conduct workshops to educate people about the damage made by fruit fly
- Introducing new technologies to improve productivity and to reduce post-harvest damages
- Establish fruit processing centers
- Expand foreign market opportunities for mass production

6.1.1 Establishment of Fruit Villages

The project was conducted under two phases. The first phase is to establish fruit villages in GN divisions. In each village 900 fruit plants of selected fruit crop are to be cultivated. The second phase is to establish commercial fruit cultivation under coconut plantations. The main coconut cultivation districts namely Kurunegala, Puttlam and Gampaha were selected for establishing commercial fruit cultivation under coconut plantations.

Expected targets of the project are to popularize recommended fruit varieties in island wide and enhance consumption of fruits up to 200g/person/day by increasing fruit availability at the market. Selection of beneficiaries and field level activities were done by the Department of Agrarian Development, Provincial/ Inter Provincial Agriculture Extension staff and the Mahaweli Authority.

6.1.2 Home Garden Fruit Cultivation Programme

Promotion of home gardening has been conducted to develop 0.5 million home gardens with the objective of increasing overall food production in the country while fulfilling family food and nutrition requirement.

Twenty HHs were selected in each village as beneficiaries in year 2016 at the initial stage. Beneficiary selection was conducted by government officers namely AI and ARPAs.

Criteria used for selecting beneficiaries:

- Adequate land area for home gardening
- Permanent water source
- Personal interest in home gardening
- Time availability to participate training programmes
- Ability to maintain an ideal home garden
- Preference for being a member of WFO

Fruit plant distribution

A beneficiary HH receives five fruit plants (one or two budded plants, seed plants and plants propagated using stems) worth LKR 550.00 including one lime plant. When lime is not suitable, any other fruit species is provided according to the climatic zone. Incentives are given to selected farmer women to enhance fruit production at HH level. Beneficiary should have membership in “Sithamu Govi Kantha Samithi” to be eligible for the government incentives.

6.2 The Progress and Status of Home Garden Fruit Cultivation Programmes under FPNP: 2016-2018

6.2.1 Fruit Plant Species Distributed in Study Areas

The study records a total of 23 fruit species in the surveyed home gardens received under FPNP: 2016-2018. Fruit species of mango, pomegranate, guava, orange and lime are among the mostly distributed planting materials. Sapodilla, nelli, lovi, gadiguda and belli are observed as scarce among the distributed species. Among the distributed species majority represent underutilized fruit species (twenty one) which include: amberalla, anoda, avocado, belli, durian, gadiguda, guava, jambu, lemon, lime, lovi, naran, nelli, pani dodam/orange, passion fruit, pomegranate, rambutan, sapodilla, starfruit, uguressa and woodapple.

6.2.2 Socio –Economic Profile of Beneficiaries

The results summarized in Table 6.1, show that majority (98.3%) of the beneficiaries under FPNP: 2016-2018 consist female while only 1.7 percent are male. It reveals that females predominate among the beneficiaries of the programme. This result accords with the government programme as incentives were given to farmer women in the "Sithamu Govi Kantha Samithi". The age bracket of most respondents (55%) fell within the age group of 41- 60 years. The average age of the beneficiaries is 50 years. This implies that the majority of beneficiaries are in the capacity of HH decision-making and are in an economically productive age to cope with the desired results of the programme.

Table 6.1: Socio-Economic Characteristics of Beneficiaries

Variables	Frequency	Percentage
Gender		
Male	9	1.7
Female	517	98.3
Total	526	100
Age categories		
20-30	23	4.4
31-40	110	20.9
41-50	145	27.6
51-60	145	27.6
61 years and above	103	19.6
Total	526	100
Average HH size	3	30.4
Formal education		
No formal education	8	1.5

1-5 Years	59	11.2
6 -11 Years	272	51.7
12 and above	187	35.6
Total	526	100
Average monthly income (LKR)		
<30,000	250	47.5
31,000- 60,000	227	43.2
>61,000	49	9.3
Total	526	100

Source: Authors' compilation based on field survey (2017)

Average HH size is three. Results reveal that majority of the beneficiaries (51.7%) had received formal education of six to eleven years and 35.6 percent had secondary educational qualifications. Hence, majority of the beneficiaries are literate enough to comprehend, understand and manage the government incentives given under the programme. Therefore, those results predict possibilities of good performances at their HHs to achieve the stated objectives of the programme.

In the data collection process the income data grouped under three income categories. According to the findings 90 percent of the beneficiary HHs average monthly income is below the national average monthly income of year 2016. Hence, the beneficiary selection criteria was in satisfactory level when distributing government incentives.

Table 6.2: Descriptive Statistics of the Surveyed Beneficiary Households

Description	Measurement (unit)	Min.	Mean	Max.	Std. Dev.
HH total land holding	Hectare(ha)	2	0.21	2.83	0.26
HH land allocation for fruit cultivation	Hectare(ha)	0.1	0.04	0.81	0.06
Time spend for home gardening	Hours / week	0	14.14	56	10.55
Distance for input market	Km	0	3.58	30	5.08
Distance for fruit market	Km	0	2.40	30	3.72
Distance for extension services	Km	0	3.34	50	5.21

Source: Authors' compilation based on field survey (2017)

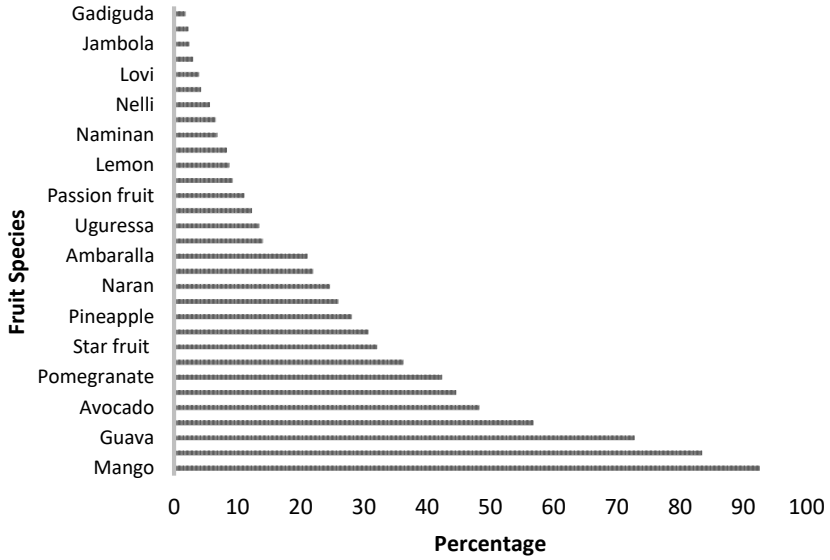
According to Table 6.2, the mean land holding size per beneficiary HH is 0.21 hectares (83 perch) and the mean HH land allocation for fruit cultivation is 0.04

hectares (15 perch). Therefore, around 19.0 percent of the HH land is allocated for fruit cultivation by the beneficiaries. The survey findings indicates that majority of the respondents (57.4%) engaged in home gardening as a daily routine. Further, 22.4 percent and 19.6 percent engage in home gardening by weekly and random basis respectively. The mean time spend for home gardening by the beneficiary is 14 hours per week. Such findings indicate that the selected farmer women for the programme devote the essential land and time for home garden fruit cultivation. Adequate land area for home gardening and personal interest in home gardening are the selection criteria employed by the FPNP: 2016-2018 to select HHs as a beneficiary. Those results show that the selection was conducted in accordance with the programme criteria.

According to Table 6.2, majority of the beneficiaries have access to input market (planting materials, fertilizer and chemicals, equipment etc.) fruit market (fresh fruits) and extension services through Agrarian Services Centers (ASC). However, the mean values in this connection accounted for 3.6 km, 2.4 km and 3.3 km respectively. Those results show that beneficiaries have marginal access to input, extension and fruit markets. To promote the home garden fruit cultivation and HH fruit consumption it is a vital requirement to provide convenient input, extension and fruit market access.

6.2.3 Fruit Production in Beneficiary Households

FPNP: 2016-2018 intends to promote home garden fruit cultivation as a method of increasing HH fruit consumption levels. Fruit species which already existed in the beneficiary HH were used to calculate the existing fruit production of beneficiary home gardens.

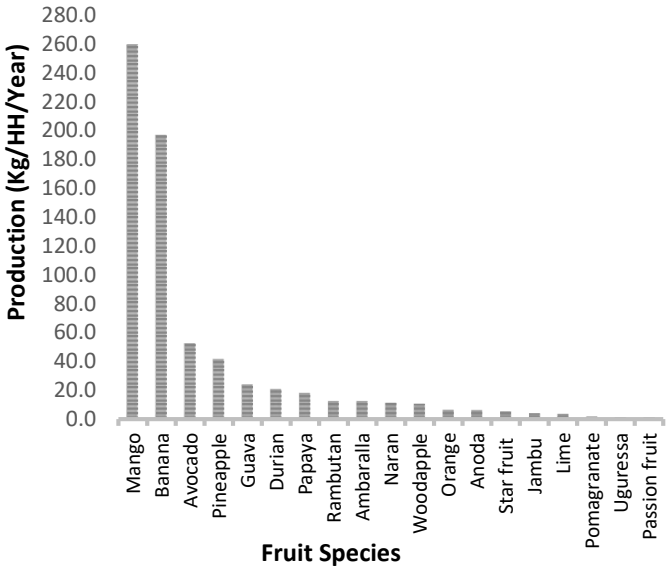


Source: Authors' calculation based on field survey (2017)

Figure 6.1: Existing Fruit Species in Beneficiary Home Gardens

The survey findings indicate that a total of 42 species are used as fruits by beneficiary HHs. The study estimates revealed that more than eighty percent of the surveyed beneficiary home gardens already had mango and banana as fruit species. Some species beli, lemon, veralu, naminan, mangusteen, nelli, grapes, lovi, sapodilla, jambola, dragon fruit and gadiguda are evident in only one or few home gardens, although these are not rare species. Mango, banana, guava, rambutan, avocado, orange , pomegranate, lime, star fruit, papaya, pineapple, anoda, naran, jambu, ambaralla, durian, uguressa, woodapple and passion fruit are identified as common fruit species which represent at least ten percent of the beneficiary home gardens.

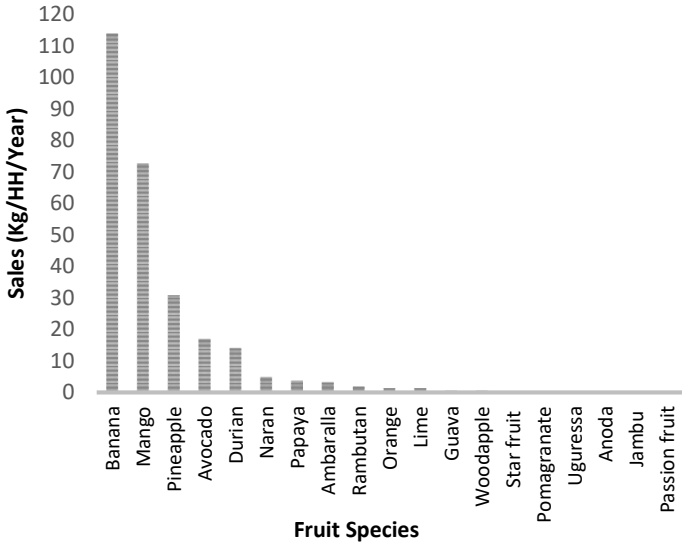
Most of the fruit species received under the home garden programme were not at the harvesting stage. Hence, existing fruit species which represent at least ten percent of the beneficiary HH were used to calculate the fruit production in beneficiary home gardens. The highest annual production (260kg/year/HH) comes from mango and the second highest annual production is from banana which accounted for 197kg/year/HH. When examining the existing fruit production in beneficiary home gardens, quantities produced from underutilize fruit species were lesser compared to mango and banana production. Hence, the selection and distribution of underutilized fruit species under the programme is useful to beneficiaries.



Source: Authors' calculation based on field survey (2017)

Figure 6.2: Annual Fruit Production from Beneficiary Home Gardens

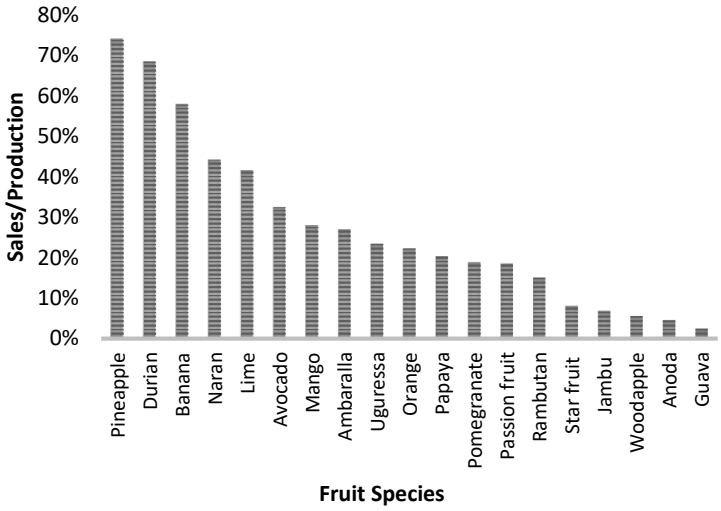
Households are benefited from home produced fruits in several ways. Almost all HHs (99%) perceived that fruit cultivation in home garden provides fresh and safe fruits than fruits available in the open market. Other than that they gain environmental benefits, enhance fruit consumption, mental satisfaction, social-coherence, save money and provide extra HH income through sale of fruits.



Source: Authors' calculation based on field survey (2017)

Figure 6.3: Annual Fruit Sales from Beneficiary Home Gardens

The surveyed HHs use only 12 fruit species out of 42 fruit species to earn cash after subsistence consumption to supplement family income. From these fruit species minimum of 1kg/ HH/ year reach to the market. Further, survey findings indicate that among those 42 fruit species banana, mango, pineapple, avocado and durian are the major species coming to the fruit market from beneficiary home gardens.



Source: Authors' own calculation based on field survey (2017)

Figure 6.4: Fruit Sales per Production from Beneficiary Home Gardens

Home gardens appear to be providing both subsistence and commercial value. The results show that beneficiaries use home garden fruits for both HH consumption and income generation. Figure 6.4 shows the ratio of sales of home producing fruits species. The findings reveal that more than 50 percent of the home producing pineapple (74%), durian (68%) and bananas (58%) are used for generating cash.

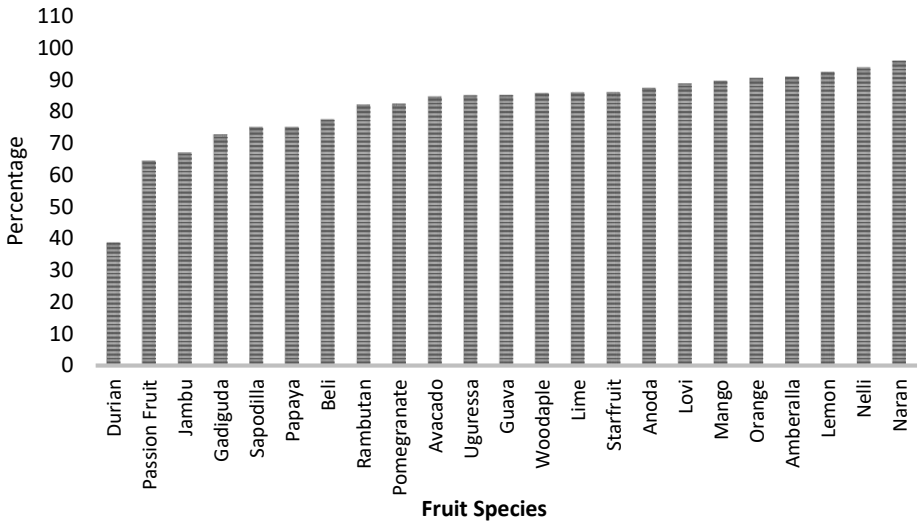
6.2.4 Beneficiary Perception on Government Incentives under FPNP

Majority of the sample beneficiaries (78.1%) who received fruit plants as an incentive in the year 2016 are inclined to cultivate fruit trees in their HHs in 2017 but 21.9 per cent of the beneficiaries are not likely to do so.

6.2.4.1 Distributed Fruit Species Exist in Beneficiary Home Gardens

This study records that a total number of 23 fruit species were distributed in the study areas under FPNP during 2016-2017. Home gardens offer a congenial environment for the growth of different species at the beginning and due to physical, biological and environmental constraints their existence in home gardens varied with the fruit species.

Figure 6.5, shows that out of 23 fruit species distributed 16 fruit species are recorded to have more than 80 percent existence in the surveyed beneficiary home gardens. Out of the total fruit species naran, nelli, lemon, amberalla, oranges showed more than 90 percent existence. Beli, papaya, sapodilla, gadiguda, jambu and passion fruit showed in-between 50-80 percent species existence. Durian showed the lowest percentage of 37.8.



Source: Authors' own calculation based on field survey (2017)

Figure 6.5: Distributed Fruit Species Exist in Beneficiary Home Gardens in Percentage Terms

6.2.4.2 Level of Beneficiary Satisfaction on Received Fruit Plants

Table 6.3 shows that overall 65 percent of the respondents (among 526) are satisfied on fruit species given under FPNP: 2016-2018. About 24 percent of respondents displayed extreme satisfaction about the given fruit species as those species blend with their preference, currently unavailable in their home gardens and suitability to the prevailing climatic conditions of their residential area.

Table 6.3: Fruit Species Received

Level of Satisfaction	Very high	High	Normal	Low	Very low	Total
Frequency	125	344	9	41	7	526
Percentage	23.8	65.4	1.7	7.8	1.3	100

Source: Authors' own calculation based on field survey (2017)

Table 6.4: Quality of the Planting Materials Given

Level of Satisfaction	Very high	High	Normal	Low	Very low	Total
Frequency	97	343	16	56	14	526
Percentage	18.4	65.2	3	10.6	2.7	100

Source: Authors' own calculation based on field survey (2017)

As describe in the Table 6.4, majority of the beneficiaries (65.2%) are satisfied, about 18.4 percent highly satisfied while 10.6 percent of the beneficiaries are not contented with the quality of given planting materials considering the sample as a whole.

Table 6.5: Time Period of the Year Planting Materials are Given

Level of Satisfaction	Very high	High	Normal	Low	Very low	Total
Frequency	33	253	50	149	41	526
Percentage	6.3	48.1	9.5	28.3	7.8	100

Source: Authors' own calculation based on field survey (2017)

Table 6.5 shows that 54 percent of the respondents are satisfied with the time period of the year planting materials are given. Due to heavy rain and drought conditions 36 percent of the beneficiaries showed their displeasure in this context.

Table 6.6: Knowledge/Assistance Provided

Level of Satisfaction	Very high	High	Normal	Low	Very low	Total
Frequency	96	281	59	67	23	526
Percentage	18.3	53.4	11.2	12.7	4.4	100

Source: Authors' own calculation based on field survey (2017)

Table 6.6 shows the beneficiary satisfaction on knowledge and assistance provided by the government officers during the programme. According to the responses 18.3 per cent of the beneficiaries are highly satisfied about the knowledge and assistance provided while 53.4 percent are express their moderate satisfaction. Agriculture

instructors, ARPAs and training officers are involved in the dissemination of agricultural knowledge by conducting training programmes, monthly meetings, formal discussions etc. Among the beneficiaries, 17 percent remaining unsatisfied in this connections.

Table 6.7: Transparency and Criteria Used for Selecting Beneficiaries

Level of Satisfaction	Very high	High	Normal	Low	Very low	Total
Frequency	102	313	74	26	11	526
Percentage	19.4	59.5	14.1	4.9	2.1	100

Source: Authors' own calculation based on field survey (2017)

Most of the respondents (79%) are satisfied about the transparency and criteria used for selecting the beneficiaries. Farmer women who are interested in home gardening and have membership in the "Sithamu Govi Kantha Samithi" received the fruit plants as an incentive.

Table 6.8 Evaluation /Monitoring by Government Officials after Intensive was Given

Level of Satisfaction	Very high	High	Normal	Low	Very low	Total
Frequency	102	260	35	99	30	526
Percentage	19.4	49.4	6.7	18.8	5.7	100

Source: Authors' own calculation based on field survey (2017)

As described in Table 6.8, Sixty nine percent of beneficiaries satisfied with the monitoring and evaluation conducted by government officials after intensives were provided, while 25 percent of respondents are dissatisfied.

6.2.5 Programme Monitoring, Evaluation and Knowledge Dissemination

Table 6.9 presents the frequency of government officers' visit and interacting with beneficiaries during pre and post period of the incentives given. According to the programme ARPAs are responsible to conduct monitoring and evaluation.

Table 6.9: Frequency of Government Officials Visited to Beneficiary Home Gardens

Description	Frequency	Percentage
Once a week	110	20.9
Twice a week	68	12.9
Once a month	198	37.6
When informed	57	10.8
Occasionally	46	8.7
Once a year	9	1.7
Never	30	5.7
Other	8	1.5
Total	526	100

Source: Authors' own calculation based on field survey (2017)

The officers and the beneficiaries were instructed to conduct monthly meetings at the members' residences by rotation or at a public place in the village at the initiation of the programme. However, 38 percent of the respondents stated that ARPA visited their residence once a month to monitor and update current status of the programme while 28 percent of the respondents mention that the meetings were not conducted according to the programme criteria.

6.2.6 Limitations Perceived by the Farmers in FPNP (2016-2018): Home Garden Fruit Cultivation Programme

In considering all the three climatic zones the following major limitations were identified by the beneficiaries on home garden fruit production programme under FPNP: 2016-2018.

6.2.6.1 Limitations of Home Garden Fruit Cultivation Programme Perceived by Beneficiaries of Dry Zone

Majority of the respondents (63.5%) in the DZ were not responded regarding the perceived limitations and only 36.5 percent of the beneficiaries perceive some limitations of the programme. Among the respondents, 41 percent of farmer women state that a major limitation to home garden fruit cultivation with regard to FPNP: 2016-2018 in DZ is lack of extension services and training on fruit cultivation and production. Awareness among beneficiaries, on the objectives of the programme is critical to its effective implementation. Beneficiaries expect the government officers' assistance to develop certain skill set or competence related to home garden fruit cultivation.

The need for education and training programmes with the focus of enhancing the knowledge, skills and attitudinal change towards cultivating more fruit trees was highlighted by the beneficiaries in order to achieve the desired benefit of the programme. Knowledge and skills transfer through informal education, training and extension should be prioritized to support the current programme while providing the continuous monitoring and evaluation through the government officers.

The low quality planting materials and the unsuitability of the distributed fruit varieties for the given area were identified by 22 percent of the respondents. Further, planting material distributed in unfavourable weather conditions is also recorded as a limitation. The distribution of planting materials in favourable weather conditions is a pre requisite for the successful establishment of cultivation. In fact, drought has a heavy negative impact on fruit cultivation in DZ, as beneficiaries and the government officials have a tendency to keep the planting materials in pots until the onset of rainfall which ultimately leads to growth retardation and death of the fruit plants given. Fifteen percent of the respondents recognized constraints with regard to the participation of WFO activities as they have to engage in paddy cultivation activities in both *Maha* and *Yala* seasons.

6.2.6.2 Limitations of Home Garden Fruit Cultivation Programme Perceived by Beneficiaries of Intermediate Zone

Majority of the respondents (61%) in the IZ, responded regarding the perceived limitations of the programme. Among the respondents, the results showed that 41 percent of the respondents have constraints related to community participation. The issues related to community participation are memberships of the society limited to 20 or 25 farmer women, lack of motivation by government officers, non-receipt of incentives adequately, societies are not functioning well and participation is not at satisfactory level for various programmes conducted by WFO outside the near residential area. Inadequate extension and training (18%) is also a considerable drawback of the programme. Further, 13 percent of the respondents mentioned that providing fruit plants only could not ensure success of the current fruit cultivation programme and it should include fertilizer, pots, equipment as subsidies.

6.2.6.3 Limitations of Home Garden Fruit Cultivation Programme Perceived by Beneficiaries of Wet Zone

Majority of the respondents (58.7%) in the WZ were not responded regarding the perceived limitations and only 41.3 percent of the beneficiaries were perceived some limitations of the programme. Among the respondents, only 28 percent of the respondents have constraints related to community participation. The problems related to community participation are memberships of the society limited to 20 or 25 farmer women, benefits or incentives were not received adequately and difficulties to participate in activities related to farmer organization as majority of women engage in routine jobs. Further, 22 percent and 19 percent of the respondents have constraints with time period of plants distribution and quality of the planting materials.

According to the findings 15 percent of the beneficiaries in WZ revealed a lower preference to given fruit species because most of them already exist in home gardens, they also observed relatively less variation among these species, less market value and unsuitability of these fruit plants for home gardens because of the land limitation and adverse flood conditions.

6.2.7 Constraints for Fruit Cultivation in Beneficiary Home Gardens

The main cause of dismal performance of HH fruit production as a whole in every climatic zone is damages due to pest and disease. Animals that damage fruit plants and harvest includes monkey (*Toque macaque* and *Trachypithecus vetulus*), giant squirrel (*Ratufa macroura)*, wild boar *(Sus scrofa*), porcupines (*Hystrix indica*), and elephants (*Elephas maximus maximus*). Fruit fly damage, fruit cracking and damage due to pomegranate butterfly also commonly seen in beneficiary HHs. Powdery mildew was most common constraint for papaya, rambutan, guava, pineapple etc. Yellow mosaic virus is another disease which damage mainly, papaya.

Table 6.10: Constraints for Fruit Cultivation in Beneficiary Home Gardens

Attribute	Variables	All cases (%)
Perception of beneficiaries* (in percentage)	**Constraints for fruit cultivation in Wet Zone home gardens**	
	Damage due to pest and diseases	93
	Problems related to agriculture inputs	50
	Inadequate knowledge on agronomic practices related to fruit cultivation	11
	Issues related to planting materials	9
	Natural disasters	8
	Inadequate institutional support	2
	Constraints for fruit cultivation in Dry Zone home gardens	
	Damage due to pest and diseases	82
	Problems related to agriculture inputs	43
	Inadequate knowledge on agronomic practices related to fruit cultivation	8
	Natural disasters	7
	Issues related to planting materials	3
	Constraints for fruit cultivation in Intermediate Zone home gardens	
	Damage due to pest and diseases	83
	Problems related to agriculture inputs	75
	Inadequate knowledge on agronomic practices related to fruit cultivation	16
	Issues related to planting materials	8
	Natural disasters	2
	Inadequate institutional support	1

Source: Authors' own calculation based on field survey (2017)

Note: Total percentage of categories used for constrains exceed 100 in all three climatic zones, because many of the HHs have multi responses

Issues regarding agricultural inputs are another constraint as stated by many surveyed respondents. Survey found that HHs have difficulties with land, labour and inputs. Land is a limiting factor for WZ urban or suburban home gardens. Limited space, no ownership of the land and low quality of the land parcel, difficulties in finding wage labour are problematic in WZ home gardens.

Finding quality planting materials, high price of the budded fruit plants, problems regarding transportation as plant nurseries are located far away from the residence are reported as problems relevant to planting materials. Further, uncertainty of varietal characteristics of fruits, low production of existing fruit plants and difficulties of finding certified fruit plants according to HH preference also act as barriers in home fruit production as perceived by HH.

Lack of knowledge and training also act as an impediment to produce fruits at HH level. Selecting fruit varieties to suit the climatic zone, proper management practices of fertilizing, pruning and training of plants, pest and disease control contribute to satisfactory fruit production. Poor assistance and intervention of government institutions, less or absence of monitoring and evaluation and the poor performance of WFO also negatively affect the domestic fruit production.

Table 6.11: Status of Accessibility

Particulars	Frequency	Percentage
Access to input market	497	94.5
Access to fresh fruit market	515	97.9
Access to extension services	517	98.3

Source: Authors' own calculation based on field survey (2017)

The accessibility to markets in the locality would enable the people to buy inputs related to fruit cultivation and fresh commodities at a fair and reasonable price. Access to planting materials, fertilizer, pesticides, pots and agricultural equipment was considered as access to input market. Table 6.11 highlights that the majority (94.5%) of the beneficiaries had sufficient market access to inputs. Further, 97.9 per cent had adequate access to fresh fruit market to buy fresh commodities. According to the responses 98 percent of the beneficiaries had facilities to access extension services with regard to home garden fruit cultivation. In this survey ASC was considered as the key institution to access extension services.

Table 6.12: Sources of Information Used by Beneficiary for Home Garden Fruit Cultivation

Source	Frequency	All Cases (%)
Mass- media		
• Television	265	50.4
• Newspapers/ Magazine	86	16.3
• Radio	32	6.1
Access to internet	9	1.7
Other	30	5.7
Not responded		19.8

Source: Authors' own calculation based on field survey (2017)

The various sources of information on home garden fruit cultivation as rated by respondents are presented in Table 6.12. Majority of the beneficiaries (50.4%) rated that their dependence on the television because it transmits several programmes to get the people better informed in ways of carrying out their home garden cultivations. Apart from the television, respondents (16.3%) read newspapers and magazines. Radio and internet are rarely used. Further, 5.7 percent respondents rely on other methods such as workshops, training programmes, consultation with government officers, own knowledge accumulated through personal experience and knowledge sharing with neighboring farmer women.

Table 6.13: Accessibility to Social Assets

Description	Frequency	% from Respondents
Agricultural Societies	261	49.6
Women Societies	455	86.5
Welfare Societies	444	84.4
Other	30	5.7

Source: Authors' own calculation based on field survey (2017)
Note: Total percentage of categories used for constrains exceed 100, because many of the HHs have multi responses

Several programmes were implemented by various government and non-governmental organizations for the socio- economic upliftment of the HHs. Table 6.13 represents local societies functioning with the involvement of beneficiaries. According to the Table 6.13 beneficiary women were interested and actively participated in women (86.5%) and welfare (84.4%) activities other than their HH activities. This means majority of the beneficiary women preferred to engage in a variety of pursuits inside their social groups in improving their livelihood.

“Sithamu Govi Kantha Samithi” is one such attempt which follows group approach. Women were the main target group under this programme. It provides adequate scope for the rural HHs, especially women, to help in developing self-worth and social behaviour through a series of training programme and group meetings organized by the government officers once a month. According to Table 6.13 majority of the beneficiaries were involved in agriculture and social welfare societies in the area. Based on the above finding, it can be said that there are ample opportunities for the government officers to work with beneficiary women for creating awareness towards better utilization of existing resources to improve home garden fruit cultivation.

CHAPTER SEVEN

Conclusion and Recommendations

7.1 Conclusion

- Majority of the respondents have intention and 78 percent have time and ability to engage in home garden fruit cultivation in the upcoming year. However, 57 percent did not participated in fruit cultivation in year 2016.

- Households are aware that cultivation of fruit trees in home garden provides fresh, safe fruits to eat, have environmental benefits, save HH expenditure on fruit purchasing, increase fruit consumption levels and enhance mental satisfactions as well.

- Only 13 percent of the respondents expect an extra income through HH fruit cultivation while majority used for their own consumption. Since, there is a vast potential to enhance fruit consumption through HH fruit cultivation.

- The overwhelming majority of respondents engage in home gardening but very few residents prioritize fruit growing on their land. The extent to which they cultivate fruit trees was limited due to plantation crops, minor-export crops and non-edible gardening which claim more space.

- Shannons' index analysis revealed that the highest fruit tree density and the diversity existed in the Uva Province and the lowest is recorded in the Northern Province followed by the Eastern Province.

- Mango is the mostly produced fruit in home gardens in all provinces except the Central Province and the Uva Province. The highest average mango production in home gardens is recorded in the North Central Province (947.72 kg/HH/year) followed by the North Western (396.27kg/HH/year) and the Western Province (247.00 kg/HH/year).

- In the Central Province and the Uva Province, avocado dominates the HH fruit production. The highest average avocado production from home gardens is recorded in the Central Province (243.76 kg/HH/year).

- Household produced, 34 percent of banana and 27 percent of the mango production are used as a mean of supplementary income. Contribution of other fruit species in generating an income is almost negligible.

- Mango and banana account for 60 percent of HH fruit consumption through home gardens except in the Central and the Uva Provinces. In the Central Province HH fruit consumption basket consists of avocado (50.79%) and

mango (21.26%) while in the Uva Province HH consists of avocado (38.39 %), banana (22.31%) and mango (20.05%).

- According to the binary logistic regression model the intention to participate in home gardening strongly predicted the home gardening behavior, the strongest influence on behaviour of fruit cultivation was attitudes and perceived behavioural control.

- Beliefs about having sufficient time, knowledge about the fruit cultivation and management, access to information on fruit cultivation and government incentives have higher influence on fruit cultivation.

- Individual factors (inadequate knowledge on fruit cultivation and management and lack of time availability), inadequate social support through institutions, inadequate incentives were perceived as barriers to fruit cultivation. However, environmental factors such as soil fertility influence the home gardening behaviour but water availability did not perceive as a major limitation to HH fruit cultivation.

- Education level of the decision-maker, time availability, receipt of government incentive and access to information have a significant effect on fruit cultivation decision in home gardens in WZ.

- In DZ, gender of the decision-maker, time availability, land ownership status and receipt of government incentives significantly influence on fruit cultivation decision. Females showed a better tendency in DZ (66.7%) to engage in this pursuit. This is an encouraging prospect which needs more exploration to increase home garden fruit cultivation.

- The major concerns of the fruit tree growers in IZ, includes age of the decision maker, soil fertility, distance to input markets, distance to extension services through ASC and government incentives.

- Majority of the respondents (WZ (87%), DZ (70%) and IZ (72%)) stated that pest and diseases as major constraint of loss of fruit harvest at HH level.

- The HHs face issues (WZ (68%), DZ (54%) and IZ (78%)) related to agricultural inputs. The other issues include inadequate water availability at critical stages of fruit cultivation, limited land availability and marginal lands (shades, water logging conditions in land), low soil fertility, lack of capital and substandard planting materials.

- Only 27 percent of the HHs received any kind of government incentive designed to promote home garden fruit cultivation in the last five years: 2012 to 2016. Further, 59 percent of respondents stated that motivation and

promotion offered by agriculture officers for those engaged in fruit cultivation and home gardening is not encouraging.

- The selection of beneficiaries for home garden fruit cultivation programme under FPNP: 2016-2018 is conducted in accordance with the programme criteria. Among the distributed fruit species, 91 percent are underutilized fruit species which are not commonly existed in home gardens.

- More than 50 percent of the beneficiaries are satisfied on fruit species received, the quality of the planting materials, time period of the distribution and knowledge and assistance provided.

- Women Farmer Organization memberships are limited to 20 or 25 farmer women in the village, unable to conduct monthly meetings accordance to programme guidelines, benefits or incentives are not received adequately for all the beneficiaries, poor monitoring and evaluation are limitations of the ongoing programme as perceived by beneficiaries.

7.2 Recommendations

Great majority of the population has intention to cultivate but lack in behaviour of cultivating a fruit tree in their residential properties. The promotion of fruit cultivation behaviour in home gardens through promotional programme is recommended as a way to behavioral changes of HHs towards this pursuit.

Extension and training programmes should be implemented to enhance knowledge on fruit cultivation and management to achieve substantial amount of fruit production through home gardens. Preferably, programmes through mass media will be one of the better informed ways. These programmes will attract those who show little propensity for this activity.

Northern and Eastern Provinces have the lowest fruit species diversity in home gardens. This may be due to the climatic condition of the regions which hinders the diversified fruit cultivation. To achieve the recommended level of fruit consumption, the arrangement of markets for HH to gain easy access for diversified fruit purchase is important.

The implementing stage of the home garden fruit cultivation programme under FPNP (2016- 2018) is at a satisfactory level in many ways. However, the programme is not a sustainable model as distribution of five fruit plants per each HH as free of charge is a welfare burden to the government. Hence, a government supported, community based entrepreneurial model design, which can provide certified planting materials at reasonable price and knowledge dissemination is recommended to promote home garden fruit cultivation. The existing community based organizations such as “Sithamu” may develop as entrepreneurial models to cater the village level demand at the initial stages.

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ANNEXES

Annex 1: Fruit Species

Common Name	Scientific Name
Amberalla	*Spondias dulcis*
Anoda	*Annona muricata*
Avocado	*Persea americana*
Beli	*Aegle marmelos*
Durian	*Durio zibethinus*
Gadiguda	*Baccaurea motleyana*
Guava	*Psidium guajava*
Jambu	*Syzygium aqueum*
Lemon	*Citrus limon*
Lime	*Citrus aurantiifolia*
Lovi	*Flacourtia inermis*
Mango	*Mangifera indica*
Naran	*Citrus reticulata*
Nelli	*Phyllanthus emblica*
Pani Dodam/Orange	*Citrus sinensis*
Papaya	*Carica papaya*
Passion Fruit	*Passiflora edulis*
Delum/Pomegranate	*Punica granatum*
Rambutan	*Nephelium lappaceum*
Sapodilla	*Manilkara zapota*
Starfruit	*Averrhoa carambola*
Uguressa	*Flacourtia indica*
Woodapple	*Limonia acidissima*

Annex 2: Average weights of fruits used in fruit production calculations

- The study uses 19 fruit species[1] to estimate HH fruit production which are present at least 10 percent of the surveyed home gardens. The list of fruit species is presented below.
- The research assume that the average weight used in the calculation is true to all home gardens, in despite of seasonal variation of fruit production, variety and varietal improvements, management practices and environmental factors.
- Average fruit weights were taken from:
  - USDA Food Composition Database - United States Department of Agriculture, Available at: (https://ndb.nal.usda.gov/ndb/search/list?qlookup=09315&format=Full).

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- Average weight of Uguressa was assumed as 15 g in this calculation.

Fruit Species	**Average Weight (kg)/fruit**
Ambaralla	0.130
Anoda	1.200
Avocado	0.500
Banana	14.400 (Kg/bunch of banana)
Beli	0.500
Durian	1.500
Guava	0.200
Jambola/pomelo	1.000
Jambu	0.024
Lime	0.040
Mango	0.350
Mangusteen	0.113
Naminam	0.024
Naran	0.088
Nelli	0.015
Orange	0.184
Papaya	1.500
Passion fruit	0.075
Pineapple	1.500
Pomegranate	0.282
Rambutan	0.033
Star fruit	0.124
Uguressa	0.015
Varaka	18.00
Veralu	0.005
Woodapple	0.179

Annex 3: Annual Average Fruit Production in Surveyed Home Gardens (Province vise)

Northern Province					
Fruit	**Average Weight (Kg)**	**Production (Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales (Fruits/HH/Year)**	**Sales (Kg/HH/Year)**
Mango	0.350	521.250	182.438	259.722	90.903
Banana	14.400	6.264	90.200	3.819	55.000
Pomegranate	0.282	12.431	3.505	0.833	0.235
Lime	0.040	237.500	9.500	138.889	5.556
Orange	0.184	45.833	8.433	0.000	0.000
Varaka	18.000	4.097	73.750	1.111	20.000
Guava	0.200	45.347	9.069	6.944	1.389
Jambu	0.024	222.222	5.333	87.500	2.100

North Central Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	2707.759	947.716	1433.276	501.647
Banana	14.400	2.138	30.786	0.448	6.455
Pineapple	1.500	6.103	9.155	0.000	0.000
Woodapple	0.179	229.483	41.077	0.000	0.000
Avocado	0.500	5.948	2.974	0.000	0.000
Star fruit	0.124	43.103	5.345	0.000	0.000
Amberalla	0.130	22.931	2.981	4.310	0.560
Pomegranate	0.282	186.621	52.627	0.000	0.000
Anoda	1.200	15.431	18.517	0.000	0.000
Lime	0.040	8.448	0.338	0.000	0.000
Orange	0.184	178.707	32.882	12.069	2.221
Papaw	1.500	3.448	5.172	0.690	1.034
Uguressa	0.015	87.931	1.319	0.000	0.000
Beli	0.500	19.138	9.569	0.000	0.000
Veralu	0.005	52.241	0.261	0.000	0.000
Guava	0.200	189.086	37.817	2.586	0.517
Jambu	0.024	221.207	5.309	12.069	0.290

Eastern Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	324.375	113.531	206.250	72.188
Banana	14.400	1.344	19.350	0.375	5.400
Pineapple	1.500	0.063	0.094	0.000	0.000
Pomegranate	0.282	1.719	0.485	0.000	0.000
Orange	0.184	7.063	1.300	0.000	0.000
Passion fruit	0.075	4.844	0.363	0.000	0.000
Nelli	0.015	218.750	3.281	0.000	0.000
Varaka	18.000	0.031	0.563	0.000	0.000
Guava	0.200	6.031	1.206	0.000	0.000

Sabaragamuwa Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	404.959	141.736	38.017	13.306
Banana	14.400	7.876	113.414	3.843	55.339
Pineapple	1.500	1.579	2.368	0.000	0.000
Rambutan	0.033	1531.157	50.528	869.430	28.691
Avocado	0.500	57.835	28.917	12.562	6.281
Star fruit	0.124	32.744	4.060	8.430	1.045
Durian	1.500	11.364	17.045	9.669	14.504
Amberalla	0.130	73.099	9.503	4.959	0.645
Pomegranate	0.282	1.612	0.454	0.000	0.000
Anoda	1.200	11.289	13.547	0.000	0.000
Lime	0.040	2.843	0.113	0.000	0.000
Orange	0.184	10.661	1.962	0.000	0.000
Papaw	1.500	10.182	15.273	0.000	0.000
Mangusteen	0.113	549.587	62.103	484.711	54.772
Guava	0.200	63.116	12.623	0.000	0.000
Jambu	0.024	188.843	4.532	24.793	0.595
Naran	0.088	25.000	2.200	0.000	0.000

Central Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	254.126	88.944	38.655	13.529
Banana	14.400	2.613	37.634	0.992	14.279
Rambutan	0.033	81.387	2.686	4.202	0.139
Avocado	0.500	487.521	243.761	127.143	63.571
Star fruit	0.124	6.655	0.825	0.000	0.000
Durian	1.500	14.454	21.681	2.773	4.160
Amberalla	0.130	63.303	8.229	18.487	2.403
Jambola	1.000	13.571	13.571	4.706	4.706
Pomegranate	0.282	2.277	0.642	0.000	0.000
Anoda	1.200	2.454	2.945	0.059	0.071
Lime	0.040	0.261	0.010	0.000	0.000
Orange	0.184	13.218	2.432	0.000	0.000
Papaw	1.500	1.664	2.496	0.000	0.000
Mangusteen	0.113	53.739	6.073	16.807	1.899
Guava	0.200	118.185	23.637	0.000	0.000
Jambu	0.024	119.202	2.861	0.000	0.000
Naran	0.088	12.454	1.096	0.000	0.000

Western Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	708.238	247.883	159.172	55.710
Banana	14.400	5.100	73.444	2.352	33.875
Pineapple	1.500	1.421	2.132	0.330	0.494
Rambutan	0.033	1231.991	40.656	486.685	16.061
Avocado	0.500	39.009	19.504	2.579	1.289
Star fruit	0.124	33.888	4.202	0.860	0.107
Durian	1.500	12.521	18.782	5.731	8.596
Amberalla	0.130	55.318	7.191	6.476	0.842
Pomegranate	0.282	1.143	0.322	0.000	0.000
Anoda	1.200	3.808	4.570	0.115	0.138
Lime	0.040	5.034	0.201	0.000	0.000
Orange	0.184	25.920	4.769	9.169	1.687
Naminam	0.024	19.352	0.464	0.000	0.000
Papaw	1.500	11.464	17.196	1.777	2.665
Veralu	0.005	66.476	0.332	2.865	0.014
Guava	0.200	150.951	30.190	0.000	0.000
Jambu	0.024	89.381	2.145	1.433	0.034
Naran	0.088	123.255	10.846	37.249	3.278

Southern Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	232.733	81.457	9.589	3.356
Banana	14.400	5.212	75.058	1.384	19.923
Pineapple	1.500	4.055	6.082	0.473	0.709
Rambutan	0.033	278.425	9.188	0.685	0.023
Avocado	0.500	33.438	16.719	5.822	2.911
Star fruit	0.124	60.377	7.487	1.027	0.127
Amberalla	0.130	72.123	9.376	34.932	4.541
Pomegranate	0.282	1.089	0.307	0.000	0.000
Anoda	1.200	2.301	2.762	0.000	0.000
Orange	0.184	5.418	0.997	1.027	0.189
Papaw	1.500	11.308	16.962	0.034	0.051
Veralu	0.005	140.514	0.703	0.000	0.000
Guava	0.200	49.945	9.989	0.014	0.003
Jambu	0.024	110.342	2.648	2.055	0.049
Naran	0.088	169.418	14.909	130.137	11.452

Uva Province					
Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH/Year)**	**Sales(Kg/HH/Year)**
Mango	0.350	255.314	89.360	11.765	4.118
Banana	14.400	7.686	110.682	1.098	15.812
Pineapple	1.500	0.745	1.118	0.000	0.000
Rambutan	0.033	138.431	4.568	0.000	0.000
Avocado	0.500	447.059	223.529	120.588	60.294
Pomegranate	0.282	4.608	1.299	3.137	0.885
Anoda	1.200	3.196	3.835	0.000	0.000
Orange	0.184	120.098	22.098	81.373	14.973
Papaw	1.500	10.118	15.176	1.176	1.765
Veralu	0.005	99.020	0.495	0.000	0.000
Guava	0.200	209.275	41.855	0.000	0.000
Jambu	0.024	190.196	4.565	0.000	0.000
Naran	0.088	58.039	5.107	7.843	0.690

North Western Province					
Fruit	**Average Weight(Kg)**	**Production (Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH /Year)**	**Sales(Kg/HH /Year)**
Mango	0.350	1132.211	396.274	234.539	82.089
Banana	14.400	13.671	196.863	3.059	44.053
Pineapple	1.500	35.020	52.530	20.296	30.444
Woodapple	0.179	222.237	39.780	84.211	15.074
Rambutan	0.033	177.072	5.843	16.447	0.543
Avocado	0.500	20.013	10.007	6.250	3.125
Star fruit	0.124	30.132	3.736	9.868	1.224
Amberalla	0.130	65.789	8.553	16.447	2.138
Pomegranate	0.282	5.480	1.545	0.000	0.000
Anoda	1.200	2.638	3.166	0.000	0.000
Lime	0.040	212.171	8.486	176.316	7.052
Orange	0.184	34.500	6.348	6.579	1.211
Papaw	1.500	13.829	20.743	0.987	1.480
Uguresa	0.015	28.684	0.430	0.000	0.000
Veralu	0.005	76.316	0.382	0.000	0.000
Nelli	0.015	99.013	1.485	0.000	0.000
Guava	0.200	180.612	36.122	32.039	6.408
Jambu	0.024	133.289	3.199	2.632	0.063

Annex 4: Average Fruit Production in Beneficiary Home Gardens

Fruit	**Average Weight(Kg)**	**Production(Fruits/HH/Year)**	**Production (Kg/HH/Year)**	**Sales(Fruits/HH /Year)**	**Sales(Kg/HH /Year)**
Mango	0.350	741.690	259.592	207.745	72.711
Banana	14.400	13.665	196.782	7.916	113.995
Avocado	0.500	104.713	52.356	34.013	17.007
Pineapple	1.500	27.759	41.638	20.555	30.833
Guava	0.200	119.131	23.826	3.049	0.610
Durian	1.500	13.774	20.661	9.430	14.144
Papaya	1.500	12.034	18.051	2.452	3.679
Rambutan	0.033	373.778	12.335	56.658	1.870
Amberalla	0.130	94.053	12.227	25.380	3.299
Naran	0.088	126.490	11.131	55.894	4.919
Woodapple	0.179	58.198	10.417	3.232	0.579
Orange	0.184	34.496	6.347	7.681	1.413
Anoda	1.200	5.076	6.091	0.228	0.274
Star fruit	0.124	42.428	5.261	3.422	0.424
Jambu	0.024	165.551	3.973	11.407	0.274
Lime	0.040	49.644	1.986	20.627	0.825
Pomegranate	0.282	6.162	1.738	1.160	0.327
Uguressa	0.015	42.110	0.632	9.886	0.148
Passion fruit	0.075	15.409	1.156	2.854	0.214

Annex 5: Questions used in measuring intention, attitude, subjective norms and perceived behavioural control/ the dummy variables used in analysis of each variable

Variable	Questions/ dummies used
Home gardening behaviour	**1:** cultivate a fruit tree in home garden in year 2016**, 0:** not cultivate a fruit tree in HG in year 2016
Attitudes*	1. For me growing a fruit tree in my home garden is beneficial in finding the HH food needs and has benefits to my family 2. In my opinion growing a fruit tree in my home garden is a good practice to do 3. For me growing fruit is an enjoyable and pleasant activity 4. In my opinion growing fruit trees in my garden is valuable/ worthless
Subjective norms*	1. Most people who are important to me think that I should/should not cultivate fruit trees in my home garden 2. I feel under social pressure through government programmes, promotions etc. to cultivate fruit trees in my home garden 3. I think, I should cultivate fruits in my home garden for people who are important to me
Perceived behavioural control*	1. I am confident that I have necessary knowledge and resources for cultivating a fruit tree in my home garden 2. I have difficulties and barriers for cultivating fruit trees in my home garden
Intention	**1**: Willing to cultivate a fruit tree/trees in home garden in year 2017,**2**: Not willing to cultivate a fruit tree/trees in home garden in year 2017
Gender	**1**: Male, **2**: Female
Education level	**1**: No schooling, **2**: Up to year 5, **3**: Up to O/L, **4**: UP to A/L: **5**: University Education, **6**: Tertiary & Vocational Education and Training
Average monthly income of HH	**1**: 0-30,000, **2**: 31,000- 60, 000 **3**: >61,000
Water availability	**1**: Highly Favourable for fruit cultivation, **2**: Favourable for fruit cultivation, **3**: Adequately available, **4**: Unfavourable, **5**: Highly Unfavourable

Soil fertility	**1**: Highly Favourable for fruit cultivation, **2**: Favourable for fruit cultivation, **3**: Adequately available, **4**: Unfavourable, **5**: Highly Unfavourable
Time availability	**1**: Strongly believe, **2**: Believe, **3**: Neutral, **4**: Disagree, **5**: Strongly disagree, that the HH have time to establish and maintain fruit tree cultivation
Land ownership	**1**: Own land(with land deed/ transferable land), **2**: Rented in, **3**: Government reservation,**4**: Other

*Likely outcomes of the behaviour (measured on a scale of 1-7) and evaluations of these outcomes (measured on a scale of -3 to +3), and two item parcels were then created.