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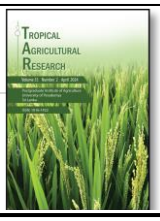

RESEARCH

Effect of Socio-Economic and Institutional Factors on Different Choices of Food Production System Practiced in Home Gardens: A Case Study in *Mahakanumulla* Village Tank Cascade System

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ARTICLE INFO

Article history:
Received: 14 October 2021
Revised version received: 07 September 2023
Accepted: 12 September 2023
Available online: 01 April 2024

Keywords:
Choice Modelling
Utility Maximization
Village Tank Cascade System
Food Production System

Citation:
Silva P.S.H. and Weerasooriya S.A. (2024). Effect of Socio-Economic and Institutional Factors on Different Choices of Food Production System Practiced in Home Gardens: A Case Study in *Mahakanumulla* Village Tank Cascade System. Tropical Agricultural Research, 35(2): 152-168.

DOI:
https://doi.org/10.4038/tar.v35i2.8746

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ABSTRACT

The global existence of small-scale food production at the household level has a wide range in terms of physical appearance and utilization. Household, market, and field gardens can be identified as three types of home food production systems in a village tank cascade system (VTCS) in the dry zone of Sri Lanka. The variation in food production systems adapted in VTCS serves differently for the community either by providing nutrient requirements or ensuring financial or food security. It is important to understand the determinants of this variation to support the community to adapt the most suitable food production system for their well-being. Based on random utility theory, this study analyzes the socio-economic and institutional factors affecting the choice of food production system practiced in home gardens in Mahakanumulla VTCS. A revealed preference approach was employed to identify the current home garden choice of households. The decision to have a household garden is more driven by socio-economic and institutional factors rather than market gardens and field gardens. The effect of these factors on the decision to have a field garden is comparatively less. Using these results policymakers can predict farm management decisions of households and plan evidence-based strategic government intervention to meet the daily nutrient requirement, ensure food security, and mitigate food scarcity.

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INTRODUCTION

Agriculture dominates in many regions of the world as a prominent land use type as a result of long-term human interaction with the environment. The two primary categories of forces that govern this relationship are biophysical features and socioeconomic characteristics. Researchers are interested in how each of these factors impacts agricultural landscapes (Grigg, 2003; Kristensen et al., 2016). Among many agricultural land use types, home gardens are considered one of the main agricultural systems that embed the relationship between biophysical and socio-economic characteristics. The primary objective of a home garden is to help people get fresh produce and improve their vegetable intake (Subair and Siyana, 2003; Kortright and Wakefield, 2011; Taylor and Lovell, 2014). Additionally, people cultivate their homesteads to earn an extra income and to strengthen their financial status during financial hardships (Eigenbrod and Gruda, 2015; Schupp and Sharp, 2012; Gray et al., 2014). Researchers have further found that home gardens improve gardeners' well-being and fitness and be used as a hobby or for aesthetic enjoyment (Kortright and Wakefield, 2011; Subair and Siyana, 2003), to reduce adverse environmental effects (Galhena et al., 2013; Kortright and Wakefield, 2011; Schupp and Sharp, 2012), to exchange products and medicinal plants, (Buchmann, 2009; Taylor and Lovell, 2014), and to communicate with others, through reciprocal giving and as a cooperative occupation that connects neighbors through common experience (Kortright and Wakefield, 2011). Instead of only being a location to cultivate sustenance and/or income crops, home gardeners place a high value on their gardens for their social, aesthetic, and habitat aspects (Nair and Sreedharan, 1986). As such, the home garden can be thought of as an agricultural system within which many sub-systems interact.

The definition of a home garden is vague in academic literature. According to the Food and Agriculture Organization (FAO), a home garden is defined as a farming system that combines physical, social, and economic functions on the area of land around the family home. According to the Department of Census and Statistics (DCS) of Sri Lanka, the home garden is defined as a piece of land in which the total area of that piece is 0.125 acres or less than 0.125 acres and has a dwelling house and some form of cultivation. Land over 0.125 acres is also considered a home garden if it has a dwelling house and the produced is largely for home consumption. According to Weerahewa et al. (2012), the home garden is a complex sustainable land-use system that combines multiple farming components, such as annual and perennial crops, livestock, and occasionally fish, of the homestead and provides environmental services, household needs, and employment and income generation opportunities to the households. According to Kumar and Nair (2004) and Kumar and Nair (2006), a home garden is defined as an intimate plant association of diverse trees and crops, often in conjunction with domestic animals, and the resulting multi-story canopy pattern around the residence. Home gardening, in general, refers to the cultivation of a small patch of land surrounding the residence or within walking distance of the house (Odebode, 2006).

Home gardens are a crucial part of the food production process. To develop interventions for improvement, it is important to recognize the enormous variation in home garden food production systems. Home gardens as food production systems have historically been a significant source of fresh food and nutrition for the rural poor, and as a result, they have a significant impact on the food security and livelihoods of agricultural communities (Sthapit et al., 2006). Home gardens may primarily consist of either one of three different food production systems namely; household gardens, market gardens, and field agriculture/field gardens (Table 1). People tend to cultivate more diverse crops in their household gardens to meet the essential nutrient requirement (Karim et al., 2021). The main purpose of the market garden is to sell the production output to get an income for financial well-being (Razanakoto et al., 2021; Airriess and Clawson, 1994). Field gardening serves the main purposes of both food security and financial stability by providing staple food for consumption and an

income by selling the surplus (Erickson et al, (2011); Howard, 2006). Ninez (1987) lists general tendencies concerning food production systems based on 15 type-specific characteristics adopted from Ruthenberg (1971). These characteristics are species density, species type, production objective, labor source, labor requirements, harvest frequency, space utilization, location, cropping pattern, technology, input cost, distribution, skills and assistance, and economic role. Based on these 15 type-specific criteria taken from Ruthenberg, Ninez (1987) identifies broad trends in home garden food production systems and provides an ethnographical synthesis of home gardens across the world (Galhena et al., 2013). Based on the objective of the household, the food production system practiced in a home garden may vary.

There is a dearth of research that has studied the choice of food production system households have employed in their home gardens taking into account socio-economic and institutional factors. Within this milieu, this study has great potential in understanding the choice of the food production system practiced in the home gardens of people in the area and how home gardens are diversified due to the specific characteristics of food production systems.

Understanding the multi-functionality of home gardens is important, especially considering both the socio-economic and bio-physical environment. Effects of complex interactions between socio-economic factors on home garden characteristics have been found in previous studies (Gbedomon et al., 2015). There are effects of socio-economic conditions on the functional diversity of home gardens as well (Gbedomon et al., 2017). Even on a worldwide level, the socio-economic and sustainability aspects of home gardens have received less attention than their ecological sustainability counterparts (Nair, 2006). In Sri Lanka also, only a few studies have addressed some of these socio-economic aspects (Ariyadasa, 2002; Premakantha et al., 2008, Weerahewa et al., 2011; Marambe et al., 2012; Mattsson et al., 2012; Weerahewa et al., 2012). In most research studies, an effort has been made to pinpoint the key socio-economic factors connected to *Kandyan* home garden systems. In Sri Lanka, the primary purpose of the home garden is to provide a family's fundamental necessities, regardless of changes in the nation's economic situation. However, because various definitions, instruments, and methodologies have been employed, these findings also cannot be compared (Pushpakumara et al., 2012). Furthermore, institutional variables, in combination with socio-economic factors, are seen to impact agricultural output in several ways (Chapoto et al., 2012). Therefore, it is important to analyze different sociological, economic, and institutional characteristics that can be affected by the variability of home gardens and household perception and subsequent engagement in home gardening. Education level, family size, agricultural involvement, income, expenditure on food, experience in home gardening, time spent for home gardening, home gardening engagement percentage, and self-sufficiency are the socio-economic variables considered in the study. Institutional variables that are considered to have an impact on the choice of the food production system in home gardens are access to institutional credit, credit availability, extension assistance, media influence, tenure type, and market access which are drawn through a literature review described broadly in the literature review section below.

Effect Of Socio-Economic Factors On The Choice Of Home Gardening Type

Education level is a significant socio-economic feature since it impacts one's ability to grasp and evaluate situations before taking action. According to Ozor (2010), a rise in farmers' educational status influences their adoption of technology and practices. Furthermore, as Opara (2010) contends, farmers with basic education are better positioned to make more informed decisions for their lives and communities, as well as to become active participants in the economic, social, and cultural elements of development.

Household size is another important socio-economic factor influencing crop output since a larger family size suggests more family

labor available for household agricultural operations (Ozor and Cynthia, 2010; Ogundari, 2008). Igben (1988) finds that when a household is large, it has a clear benefit in terms of agricultural labor supply.

Engagement in field agriculture is a significant factor that impacts the choice of food production system. With the influence of field agriculture activities, a farmer is more likely to cultivate on their homestead compared to a non-farmer. On the other hand, farming communities are more likely to experience time constraints for food production on homesteads based on work responsibilities in field agriculture (Schupp et al., 2016).

The farmer's main source of income is also one of the socio-economic variables that impact farming decisions as agricultural practices rely on capital investment, especially when the capital is reliant on current sources of revenue (Mathenge and Tschirley, 2008). Under these conditions, revenues from outside the farm may be frequently utilized to compensate for the lack of poor credit markets by providing available cash for input purchases as well as other household requirements.

Research shows that home gardens will significantly increase a household's revenue partly by reducing expenditure on food (Eigenbrod and Gruda, 2015). According to Schupp and Sharp (2012), people in Ohio who were going through financial hardship were more likely to cultivate their food. According to Gray *et al*. (2014), more than half of home gardening participants saved $500 or more a year.

It must be understood that categories listed in basic food production systems discussed here represent general tendencies and that, in reality, a wide range of variants can exist. With time, the complexity of home gardens can be increased. Experience with home gardening should be considered an important factor in the variation of the food production system home gardens have practiced.

Lack of time to manage the home gardens was mentioned as a constraint in research studies (Schreinemachers et al., 2016). Time available for spending on home gardening activities is an important socio-economic factor to be considered (Garrett and Leeds, 2015).

Home gardening will help people get more fresh produce and improve their vegetable intake at home through self-sufficiency. According to Subair and Siyana (2003), the primary motivations for home gardening in Botswana are to complement household food supplies and to earn income. Home food processing allows a family to maintain control of their diet and ensure access to foods that they find nutritious (Kortright and Wakefield, 2011; Taylor and Lovell, 2014).

Effect Of Institutional Factors On The Choice Of Home Gardening Type

One of the most important institutional factors in increasing agricultural output is access to credit (Anyiro and Oriaku, 2011). Access to credit encourages investments in high-return industries such as field cash crops, which can pay back the borrowed capital plus interest, rather than home gardening, which produces for local use and sells the surplus. As a result, access to credit may dissuade a smallholder farmer from participating in home gardening since home gardening activities may not yield enough revenue to repay the borrowed capital (Nontu, 2021). Microcredit refers to very small loans issued to poor borrowers to improve poor resource farmers' production capacity via financial investment in their human and physical capital (Okurut et al., 2005). As a result, credit-enabled families may be able to assist farmers in getting the money needed to adopt higher-profit agricultural technology and so enhance productivity (Wachira, 2012). Credit is one approach to improving farmers' access to modern technologies. The capacity of farmers to afford inputs such as better seeds and fertilizer is very crucial. Cooperative societies, saving and credit societies, banks, self-help groups, and farmer's organizations are some of the official sources of credit. Farmers who have access to finance can reduce their financial limitations and more easily purchase inputs (Rahmeto, 2007).

Research has found that access to extension services is associated with home gardening participation due to the availability of information to families that might enhance their confidence and affect their decision to cultivate at home. Farmers exchange benefits, production, and market information through extension programs, which can encourage involvement. In this regard, previous studies have found that efforts that increase rural households – extension office contact might go a long way toward encouraging home gardening participation (Nontu, 2021). Farmers who contact an extension agent are likely to receive accurate information not just on technology but also on its profitability (Wachira, 2012). Crop productivity is influenced by the number of extension contacts made either through farm visits or training sessions received before and throughout the production season (Anyiro and Oriaku, 2011). Training programs are found to have a significant influence on promoting home gardening (Larsen, and Barker-Reid, 2009). Contact with extension agents is a tool for improving farmer performance. It provides farmers with new information and skills, allowing them to appropriately implement new methods. If a farmer lacks knowledge and experience in a particular technology, he or she may be less likely to embrace it (Rahmeto, 2007). Extension agents are the primary suppliers of agricultural knowledge for farmers (Tadesse, 2008). The frequency of visits or the availability of extension services is likely the single most important element that has emerged in the majority of studies on technology transfer and adoption (Asfaw et al., 1997; Kedir, 2020).

Users' intentions to participate in gardening might be influenced by the media. Both mass media and social media are encouraging individuals to participate in home gardening (Aziz et al., 2020). The participants were persuaded to explore their interest in backyard gardening using social media. Their interest in home gardening and media articles about plants inspired them to start this behavior (Sunga and Advincula, 2021).

There is a positive association between tenure and agricultural activity participation because land ownership encourages families to participate in cropping activities, which contributes to their livelihoods. In some areas, a lack of land and tenure rights can prohibit people from growing their food (Eigenbrod and Gruda, 2015). Land ownership with title documents grants farmers the right to use the land (security of tenure), generating an incentive for farmers to employ innovative, long-term, and even risky technologies (Rahmeto, 2007).

Market access and market availability are certain to lower marketing expenses such as transportation and other transaction costs, as well as provide favorable pricing for outputs. Market access can be measured in terms of the distance in kilometers to the market, which reflects the marketing costs incurred in the process of getting to the market. This is thought to hurt productivity because it reduces the profits that could be made from selling farm outputs (Wachira, 2012). The absence of market information is a substantial barrier to market access, particularly for smallholder products. It significantly raises transaction costs and decreases market efficiency.

Area Description

This study characterizes the dry zone home gardens and assesses the effects of socio-economic and institutional factors on the choice of food production system practiced in home gardens in Sri Lanka in a Village Tank Cascade System (VTCS) in the dry zone of Sri Lanka. The VTCS are hailed as ancient irrigation systems that were constructed by ancient civilizations of Sri Lanka.

In a VTCS, a cascade is defined as "a connected series of tanks organized within a micro-catchment of the dry zone landscape, storing, conveying, and utilizing water from an ephemeral rivulet" (Bandara, 1985). A cascade is a connected series of tanks in a watershed area. It is a mechanism of rainwater harvesting and uses that water for cultivation efficiently by the ancient people in the dry zone of Sri Lanka enabling them to do their cultivation even in periods of lower rainfall (Bandara, 1985). There are several farming systems in the VTCS. Most fruit crops,

and certain vegetables, may be readily cultivated in the home garden due to the effect of tank water and lower elevations, where the soil is improperly drained. In the VTCS terrain, home gardens are highly adapted to climate change shocks and produce a wide range of food varieties, including neglected and underused fruit species, edible medicinal plants, indigenous vegetable types, tuber crops, and spices. In these home gardens, the soil moisture is preserved for a long time, and horticulture is effectively practiced all year (Ratnayake, 2021). In the VTCS, home gardens are positioned on slopes ranging from 5% to 30%, while rice fields are located in the valley, at the base of home gardens. Through runoff, the rich nutrients created in the home gardens feed the nearby rice fields. The traditional home garden-rice field integrated agro-ecosystem as a whole is a rich mosaic of ecotones, including a diverse range of species (Marambe et al., 2012). Due to these characteristics in the home gardens situated in a VTCS, there is a growing interest in understanding the diversity of food production systems that appear in the home garden landscapes in the VTCS. Over time, the VTCS has been subjected to degradation and it is worth understanding existing food production systems to develop ways to mitigate the degradation and enhance the VTCS to its former potential. Within this setup, home gardening as a viable food production system in a VTCS can be pivotal in achieving this target and warrants a detailed analysis.

Among many VTCS in Sri Lanka, the *Mahakanumulla* cascade system which is situated in the dry zone, of North Central Province was selected as the study site as *Mahakanumulla* is emblematic of most of the problems faced by degrading VTCS. *Mahakanumulla* VTCS is a branch-type cascade with 27 small tanks. Five of the tanks are situated along the major valley. This cascade covers roughly 324 acres of paddy land, and approximately 1600 households reside there (Pannabokke et al., 2002).

The main objective of the study was to analyze the socio-economic and institutional factors affecting the choice of the food production system practiced in the home garden. The study specifically aimed to analyze the factors affecting the choice of 1.) the household garden over the market garden and field garden types, 2.) the market garden over household and field garden, and 3.) the field garden over the household garden and market garden. Increasing the awareness of the roles performed by each of the socio-economic and institutional components in determining the food production system in home gardens might therefore increase our understanding of human and environment interactions, allowing us to predict farm management decisions and enable evidence-based policy intervention.

METHODOLOGY

For the study, the home garden is defined by the specific characteristics that Ninez (1987) used to differentiate major food production systems namely; household gardens, market gardens, and field agriculture/field gardens (Table 1).

A pilot survey, field observations, as well as focus group discussions, were carried out to identify whether three food production systems are visible as major alternative home garden types among the residents. Focus group discussions were held mainly with the participation of presidents and secretaries of Farmer Organizations and Agriculture Research and Production Assistants. 3 rounds of focus group discussions were held. Among the 15 characteristics that have been used to differentiate these three food production systems, a clear variation in 8 specific characteristics such as species density, species type, production objective, economic role, labor source, harvest frequency, cropping pattern, and input cost were observed. Other attributes such as labor requirement, space utilization, technology, location, distribution, assistance, and skills did not vary among these three food production systems. Therefore, the three food production systems were identified using species density, species type, production objective, economic role, labor source, harvest frequency, cropping pattern, and input cost.

Observed decisions made by people in real-world situations serve as the foundation for revealed preferences. Stated preferences are derived from decisions made out of hypothetical scenarios. Stated preference survey results may not anticipate real behavior, resulting in hypothetical bias. Hence, we have used revealed preference data for already existing three basic types of food production systems. The revealed preferences survey is about choices that individuals have made. In terms of home gardens surveys, revealed information was species density, species type, production objective, economic role, labor source, harvest frequency, cropping pattern, and input cost. Table 2 depicts the basic characteristics that were used to differentiate these main three food production systems in the study area. From this information, it was revealed which food production system they have chosen to have from the available alternatives household garden, market garden, and field garden. Home gardens deviated from these main three food production systems and were included in "opt-out" creating realism in the sense that participants are not forced to practice between the experimentally designed three alternatives and can, instead, opt-out. One of the benefits of this approach is that it provides real choices made by users in a determined context of constraints. The households within the hydrological boundary of the *Mahakanumulla* VTCS were the study population considered in this study. This included 6 *Grama Niladhari* (GN) Divisions in the *Thirappane* Divisional Secretariat Division, namely *Mahakanumulla* (GN 540), *Wellamudawa* (GN 539), *Indigahawewa* (GN 547), *Sembukulama* (GN 550), *Payindikulama* (GN 554) and *Walagambahuwa* (GN 562). Random sampling has been done to obtain a sample in the size of 102 households representing all 13 villages in the *Mahakanumulla* VTCS, using the household registry at the GN divisions as the sampling framework.

Table 1: Primary food production systems and their specific characteristics according to Ninez (1987) classification

Food production systems employed in home gardens	Household garden	Market garden	Field agriculture
Species density	High	Medium to low	Low
Species type	Staples, vegetables, fruit (Cultural)	Vegetable, fruit (market-oriented)	Staple (subsistence agro-industrial)
Production objective	Home consumption	Subsistence, market sale	Market sale
Labor source	Family	Family or family and hired	Family and hired
Labor requirement	Part-time	Full time	Full time
Harvest frequency	Daily, Seasonal	Short seasonal	Long seasonal
Space utilization	Horizontal, vertical	Horizontal, vertical	Horizontal
Location	Close to dwelling	Close to an urban market	Rural setting, close or distant from homestead
Cropping pattern	Irregular, row	Row	Row
Economic role	Supplementary	Major economic activity	Major economic activity
Technology	Simple hand tool	Hand tool or mechanized	Mechanized, if possible, hand tool
Input cost	Low	Medium	High
Distribution	Rural and urban	Sub-urban	Rural
Skills	Garden-horticultural	Market-horticultural	Agricultural, commercial
Assistance	None or minor	Credit	Credit, extension

Table 2: Basic food production systems practiced in home gardens in the study area and identified specific characteristics to differentiate basic food production systems

Type-specific characteristics	Household garden	Market garden	Field agriculture/ field garden	Opt-out
Species density	High	Medium to low	Low	Any other food production type
Species type	Staples, vegetables, fruit (Cultural)	Vegetable, fruit (market-oriented)	Staple (subsistence agro-industrial)	
Production objective	Home consumption	Subsistence, market sale	Market sale	
Labor source	Family	Family or family and hired	Family and hired	
Harvest frequency	Daily, Seasonal	Short seasonal	Long seasonal	
Economic role	Supplementary	Major economic activity	Major economic activity	
Input cost	Low	Medium	High	
Assistance	None or minor	Credit	Credit, extension	

Discrete choice models are derived under the assumption of maximizing the utility of the decision-maker. The theoretical basis for the specification of the econometric model is the random utility theory (Ortu´zar and Willumsen, 2001). Any good can be described as a group of characteristics or attributes and the levels it takes; being consumer decisions based on the utility of the attributes; it is the level of satisfaction that an individual obtains from a given alternative (Markandya et al., 2001). However, it is difficult to describe everything in terms of its characteristics. Therefore, the random-utility model adds an error term for the unobservable elements (Bateman, 2002). The random utility model was tested using a multinomial logit (MNL) model. A decision maker *n* must choose among *j* alternatives. Decision maker *n* obtains a level of utility, U_{ni}, from alternative *i* if that alternative is chosen. The principle of utility maximization describes that the decision maker decides to favor alternative *i* if and only if the individual expects to gain more utility from alternative *i* compared to any other available alternative. Thus, if the decision maker decides to have alternative *i*, then that person must expect to gain less utility from other alternatives (Equation 1).

$$U_{ni} > U_{nj} \forall j \neq i \quad (1)$$

The analyst incompletely observes utility, so that generally $U_{ni} \neq V_{ni}$. The utility is written as the sum of representative utility V_{ni} and the term ε_{ni} is treated as random and captures the factors that determine utility but are not observable (Equation 2).

$$U_{ni} = V_{ni} + \varepsilon_{ni} \quad (2)$$

The probability that decision maker *n* chooses alternative *i* is the probability that the utility derived from choosing *i* is greater than the utility derived from any other alternative among choices (Equation 3).

$$P_{ni} = Pr(U_{ni} > U_{nj} \forall j \neq i) \quad (3)$$

Substituting (2) into (3) equation 4 and equation 5 can be derived.

$$P_{ni} = Pr(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj} \forall j \neq i) \quad (4)$$

$$P_{ni} = Pr(\varepsilon_{nj} - \varepsilon_{ni} > V_{ni} - V_{nj} \forall j \neq i) \quad (5)$$

The representative utility can be expressed as below (Equation 6).

$$V_{ni} = \sum_{k=1}^{K} \beta_{ki} X_{kn} \quad (6)$$

In the MNL model, k is the number of predictor variables in the model, X_{kn} is the value of the kth predictor variable for the observational unit (e.g., decision maker) n, and β_{ki} is a parameter associated with the kth predictor variable and alternative *i*. Note that the variables X_{kn} vary only across the decision makers

n, but not across the alternatives (they have no i subscript). Characteristics of the alternatives do not explicitly play a role in this model.

In the general model that encompasses MNL, the choice probability, P_{ni}, the probability that decision maker n chooses alternative *i*, is given by (Equation 7):

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_{j=1}^{J} e^{V_{nj}}} \quad (7)$$

Let X_{kn} stand for the characteristics of individual n with the corresponding parameter vectors denoted by β_{ki} . Substituting (6) into (7) P_{ni}; the probability that individual *n* chooses alternative *i*. The choice probability in the multinomial logit is expressed as (Equation 8),

$$P_{ni} = \frac{e^{\sum_{k=1}^{K} \beta_{ki} X_{kn}}}{\sum_{j=1}^{J} e^{\sum_{k=1}^{K} \beta_{kj} X_{kn}}} \quad (8)$$

MNL models use choice as a function of the chooser's characteristics, whereas conditional logit models use the choice as a function of the choices' characteristics. Conditional logit models are appropriate when the choice among alternatives is modeled as a function of the characteristics of the alternatives, rather than (or in addition to) the characteristics of the individual making the choice. Since the independent variables do not vary between the 3 alternative food production types employed in the garden, the use of MNL regression analysis is warranted. Socio-economic as well as institutional factors have been identified to affect the variation of home gardens which have been employed as independent variables in the model. They are education level, family size, agricultural involvement, income, expenditure on food, experience in home gardening, time spent for home gardening, home gardening engagement percentage, self-sufficiency, access to institutional credit, credit availability, extension assistance, media influence, tenure type, and market access (Table 3).

RESULTS AND DISCUSSION

Among 102 households surveyed, 28% of households practice household gardens, 29% of households have chosen to practice market gardens and 34% of households have chosen to practice field agriculture. Around 45% of the sample have an education level up to General Certification of Education Advanced Level as the highest education level of the household. Family sizes vary from 1 to 9 and 38% of households have 4 members in the family. Every household engages in farming either as a main livelihood or as a supplementary livelihood. The average income of the household was LKR 44,304 and the average expenditure on food was LKR 19,245. The multinomial log odds, Relative Risk Ratios (RRR) (Table 4), and marginal effects (Table 5) are as below.

The coefficients derived from multinomial logit are difficult to interpret since they are relative to the base outcome. In this study, the base outcome is opt-out home garden production systems. To assess the impact of covariates, it is also possible to look at the minimal effect of altering their values on the likelihood of obtaining a certain result. When using the MNL model, *k-1* models are estimated, with the k^{th} equation being relative to the referent group. The RRR of a coefficient shows how a variable impacts the likelihood that an event will occur in the comparison group as opposed to the referent group. Here referent group is opting out of home garden production systems. A RRR > 1 denotes that when the variable rises, the risk of the outcome occurring in the comparison group compared to the risk of the outcome occurring in the reference group increases. The comparison result is therefore more probable. If the RRR is less than 1, it means that when the variable is increased, there is a lower probability of the outcome occurring in the comparison group compared to the referent group. The referent group is more likely to receive the outcome if the RRR is less than 1. In this study, we have used multinomial log odd coefficients, RRR, and marginal effects to interpret the results.

Table 3: Description of independent variables

Independent variable	Description	Measurement
Education level	A categorical variable	1= Below school grade 5, 2= Between school grade 5-10, 3= General Certificate of Education Ordinary Level (School grade 10), 4= General Certificate of Education Advanced level (School grade 12-13), 5= Diploma level, 6= Graduate level
Family size	Number of members in the household	A continuous variable
Agricultural involvement	Number of members in the household engaged in agriculture-related livelihood (Part-time engagement also considered)	A continuous variable
Income	Household monthly income in LKR	A continuous variable
Expenditure on food	Household monthly expenditure on food in LKR	A continuous variable
Experience in home gardening	Number of years engage in home gardening	A continuous variable
Time spent on home gardening	Daily time spent in home garden activities in hours	A continuous variable
Home gardening engagement percentage	Percentage of the family from the household who engage in home gardening activities	As a percentage
Self-sufficiency	The extent to which households depend on the foods cultivated in the home garden through a 5-point Likert scale	1= Extremely low, 2= Low, 3= Medium, 4= High, 5= Extremely high
Access to institutional credit	The extent to which institutional credit was available through a 5-point Likert scale	1= Extremely low, 2= Low, 3= Medium, 4= High, 5= Extremely high
Access to credit	If had sufficient income to engage in home gardening	1= Yes, 0= No
The assistance of extension service	If had received assistance from the government/NGO for home gardening several times per year an extension agent met	A continuous variable
Media influence	The number of social media program names respondents answered	A continuous variable
Land tenure	Based on the land title for the home garden land	1= Sinnakkara[1] (Solely owned), 2= Jayabhumi deed[2] , 3= Swarnabhumi deed, 4=LDO permit[3]
Market access	Distance to the major market for their production	A continuous variable

[1] Sinnakkara deeds are private lands solely owned by individuals.

[2] Jayabhumi and Swarnabhumi deeds are state lands which are alienated to a person by a grant. They cannot be sold or cannot even transfer without the approval of Divisional Secretary.

[3] LDO Permits are state lands given to landless people asking to pay a monthly rental to state. The permits are issued by the Land Development Authority (LDO).

The results reflected that educated people are more likely to choose a field garden and people with a lower education level tend to choose a market garden. Education level does not show a significant effect on choosing a household garden. This may be due to field gardens needing agricultural, commercial, and technological knowledge compared to other home garden alternatives. To have a market garden, people need marketing and horticultural skills which can be gained through practice. As observed in this study, when the family size increases, there is a higher probability of choosing a market garden, and when the number of people in a household decreases, there is a probability of choosing a field garden over other alternatives. Family size does not show a significant effect on choosing a household garden. Field gardens, mostly use mechanized methods, and less labor is required compared to a market garden.

When a family member tends to engage in agricultural employment, their main focus is their main agricultural livelihood and that may be the issue of losing interest in a household garden which is not a major economic activity for them. When income increases, people do not tend to engage in home gardening as a major economic activity such as a market garden or field garden, rather, they consider having fresh products and sometimes organic products from a household garden. The results revealed that when food expenditure increases, people are more likely to have chosen a market garden or a field garden. In the household garden, their major objective is home consumption, and thus their food expenditure is less compared to other alternatives. People who have chosen market gardens and field gardens do not meet their food requirements from their home gardens since they produce them to sell and have an income.

The results revealed that all three main household garden types are less likely to be practiced by households when their gardening experience is high. The reason may be home gardens become complex and they may not be included in these typical food production systems rather, they may have different characteristics that vary from those food production systems. When people have more time available, they may tend to use the time for gardening types such as a market garden and a field garden which enables them to earn an extra income, since the opportunity cost of time is then less than engaging in household gardening.

According to the results of the study when self-sufficiency increases, people are more likely to have chosen a household garden. In a household garden, their major objective is consumption, and thus self-sufficiency is higher compared to other alternatives. People who have chosen market gardens to produce food for sale may have to buy their foods in an external market since they produce only a few market-oriented crops and that may not be sufficient to fulfill their food requirements.

Even though the results obtained in this study on the effect of credit availability for the field garden are controversial, it reveals that people are willing to spend borrowed or received money in agriculture and not willing to invest their own money in agriculture. In some unfavorable conditions such as droughts etc., if people have invested borrowed money, they might get cancellations of loans or get compensation through the government to bear the loss. They might have insurance to avoid the risk. However, investing their own money has a risk of unfavorable circumstances.

According to the results from the study, having extension assistance may include providing necessary knowledge of home gardening which enables households to gain an extra income. Therefore, extension assistance in a household garden is none or minor but in a market garden, it is important to have some technical knowledge and support. The results depict that media influence such as television and radio programs, newspaper articles, etc. can convince more to engage in household gardening which can fulfill daily food requirements most of the time, and also engage in market gardening to gain an extra income while fulfilling household food requirements.

Table 4: Coefficients and relative risk ratios of the multinomial logit model

Choice	**Household garden**		**Market garden**		**Field garden**	
Independent variable	RRR	Coefficient	RRR	Coefficient	RRR	Coefficient
Education level	2.634 (2.000)	0.969 (0.761)	0.750 (0.536)	-0.288 (0.714)	1.993 (1.450)	0.690 (0.728)
Family size	0.430 (0.356)	-0.843 (0.827)	0.818 (0.570)	-0.201 (0.696)	0.398 (0.278)	-0.922 (0.698)
Agricultural involvement	0.070 (0.087)	-2.667** (1.256)	1.025 (1.054)	0.025 (1.029)	0.635 (0.672)	-0.455 (1.058)
Income	0.999 (0.000)	0.0001* (0.000)	1.000 (0.000)	-0.000 (0.000)	1.000 (0.000)	-0.000 (0.000)
Expenditure on food	0.999 (0.000)	-0.0001 (0.000)	1.000 (0.000)	0.0004** (0.000)	1.000 (0.000)	0.0004** (0.000)
Experience in home gardening	0.857 (0.061)	-0.155** (0.071)	0.932 (0.050)	-0.071 (0.053)	0.908 (0.048)	-0.096* (0.053)
Time spent on home gardening	0.474 (0.205)	-0.747** (0.433)	1.097 (0.373)	0.093 (0.340)	1.143 (0.390)	0.133 (0.341)
Home gardening engagement	0.694 (0.804)	-0.365 (1.158)	0.533 (0.475)	-0.629 (0.891)	0.970 (0.909)	-0.031 (0.938)
Self-sufficiency	27.989 (29.592)	3.332*** (1.057)	1.785 (1.168)	0.579 (0.654)	1.978 (1.281)	0.682 (0.648)
Access to institutional credit	0.686 (0.481)	-0.376 (0.701)	0.775 (0.426)	-0.255 (0.549)	1.375 (0.751)	0.318 (0.547)
Credit availability	0.247 (0.351)	-1.397 (1.419)	0.245 (0.351)	-1.406 (1.433)	0.058 (0.084)	-2.847** (1.443)
Extension assistance	0.766 (0.121)	-0.267* (0.158)	1.004 (0.141)	0.004 (0.140)	0.942 (0.130)	-0.059 (0.138)
Media influence	7.696 (7.774)	2.041** (1.010)	4.324 (3.673)	1.464* (0.850)	0.942 (4.081)	1.570 (0.849)
Jayabhumi deeds	0.000 (0.017)	-11.148 (1185.34)	0.002 (0.000)	-15.209 (1185.34)	0.942 (0.000)	-15.109 (1185.34)
Swarnabhumi deeds	0.007 (0.000)	-14.093 (1185.34)	0.004 (0.001)	-14.668 (1185.34)	0.008 (0.001)	-13.953 (1185.34)
LDO Permits	89.867 (152177.7)	4.498 (1693.37)	0.935 (1583.15)	-0.067 (1693.37)	1.432 (2425.3)	0.359 (1693.37)
Market access	0.999 (0.000)	-0.0001* (0.000)	1.000 (0.000)	0.000 (0.000)	0.999 (0.000)	0.009 (0.000)
Constant	62502.14 (8126.05)	11.043 (1185.35)	88507.55 (3130)	11.391 (1185.35)	36301.05 (4715.52)	10.500 (1185.35)

*p <0.10, **p < 0.05, ***p <0 .01

Table 5: Average marginal effects

Choice	Household garden	Market garden	Field garden
Independent variable	Coefficient	Coefficient	Coefficient
Education level	0.061 (0.038)	-0.126*** (0.044)	0.085** (0.041)
Family size	-0.029 (0.044)	0.077* (0.040)	-0.080* (0.041)
Agricultural involvement	-0.193*** (0.058)	0.122 (0.080)	0.025 (0.082)
Income	0.024*** (0.006)	-0.010 (0.007)	-0.015 (0.008)
Expenditure on food	-0.00003*** (0.023)	0.00002** (0.023)	0.00003*** (0.022)
Experience in home gardening	-0.007* (0.004)	0.003 (0.003)	-0.002 (0.0032582)
Time spent on home gardening	-0.065*** (0.025)	0.024 (0.028)	0.035 (0.029)
Home gardening engagement percentage	-0.009 (0.071)	-0.070 (0.076)	0.061 (0.074)
Self-sufficiency	0.219*** (0.056)	-0.081* (0.044)	-0.067 (0.043)
Access to institutional credit	-0.032 (0.042)	-0.050 (0.039)	0.077* (0.040)
Credit availability	0.023 (0.064)	0.099 (0.080)	-0.213*** (0.078)
Extension assistance	-0.019*** (0.006)	0.014* (0.008)	0.000 (0.008)
Media influence	0.063 (0.048)	0.001 (0.045)	0.021 (0.047)
Jayabhumi deeds	0.235*** (0.084)	-0.180 (0.166)	-0.166 (0.163)
Swarnabhumi deeds	-0.012 (0.087)	-0.147 (0.176)	0.045 (0.175)
LDO Permits	0.290* (0.159)	-0.179 (0.195)	-0.110 (0.207)
Market access	-0.021*** (0.006)	0.023*** (0.005)	-0.003 (0.005)

*p <0.10, **p < 0.05, ***p <0 .01

Swarnabhumi deeds do not show a significant effect on selecting a particular home gardening type but having a *Jayabhumi* deed and an LDO permit compared to having a *Sinnakkara* deed has an increasing average probability of selecting a household garden. This indicates that people are less likely to choose a field garden in deeds like *Jayabhumi* and LDO permits. That may be due to the insecurity of their tenure rights in the future for deeds like *Jayabhumi* and LDO permits. In a field garden, they may have to invest a large amount of money and they do not like to risk their investments in an insecure tenure situation. Market access also has a significant impact on choosing a market garden. The results of this study revealed that when people have market access, they are more likely to choose a market garden whose main objective is selling home garden production.

CONCLUSIONS

Home gardens in the typical VTCS in Sri Lanka can be identified as three basic food production systems such as household gardens, market gardens, and field gardens. Several socio-economic and institutional factors affected farmers' choice of which type of home garden production system they should have on their homestead. The decision to have a household garden is more driven by socio-economic and institutional factors rather than market gardens and field gardens. The effect of these factors on the decision to have a field garden/field agriculture is less. Household garden food production systems are more oriented toward enhancing household food security and addressing food scarcity problems. Market gardens are production systems that are mostly market-oriented and production is based on earning an income rather than fulfilling a daily nutrient requirement or being self-sufficient. Field garden/field agriculture is a type of food production system that mainly focuses on producing staple foods to fulfill the household's food security as well as to earn an income. In an environment where food security is an emerging requirement, promoting either a household garden or field agriculture is strategic. In an agricultural setting where their basic requirement is the economic well-being of the people, promoting a market garden or field agriculture is more suitable. To fulfill daily nutritional requirements promoting either a household garden or a market garden will be suitable since their nutrient diversity is higher compared to a field garden. As such, each type of food production system plays a different role in fulfilling the household's essential requirements. From this research, it can be identified which socio-economic factors are influential in having which type of a home garden system. Understanding the socio-economic and institutional drivers behind the existence of diverse food production systems in home gardens not only deepens our comprehension of human and environmental interactions but also provides valuable insights for decision-makers regarding the development of socio-economic determinants aimed at encouraging the adoption of each type of home garden system. Policymakers gain the ability to predict farm management decisions and plan evidence-based strategic government intervention to ensure food security, mitigate food scarcity, and enhance the livelihoods of people in village settings.

The shortcomings of this type of study are that the complexity of home garden landscapes restricts the identification of well-differentiated food production systems. Many other cultural, political, and psychological factors can affect the variability in food production systems in home gardens which are not captured in this study. It is worthy to employ the factors that have not been captured in this study to differentiate home garden food production systems and to predict the variability of home garden food production systems. Future research can be directed towards identifying the effect of other characteristics on the variability of home garden food production systems. It will be helpful to mitigate the danger of emerging food and economic crises by implementing well-organized strategic plans. To aid it, initiatives should be undertaken to assist households focused on the most appropriate food production systems in their home gardens, as well as to encourage households that have deviated from the most appropriate home gardens to alter their ways.

ACKNOWLEDGEMENT

This work was financially supported by the project grant of AHEAD/RA3/DOR/STEM/PDN/No 52 of the program titled Accelerating Higher Education Expansion and Development (AHEAD) administered by the Ministry of Higher Education, Sri Lanka.

REFERENCES

Airriess, C. A., and Clawson, D. L. (1994). Vietnamese market gardens in New Orleans. *Geographical Review*, 16-31.

Anyiro, C. O., and Oriaku, B.N. (2011). Access to and investment of formal micro-credit by smallholder farmers in Abia State, Nigeria: A case study of Absu Micro Finance Bank, Uturu. *Journal of Agricultural Sciences – Sri Lanka*, 6(2), 69–76.

Ariyadasa, K.P. (2002) *Assessment of tree resources in the home gardens of Sri Lanka.* Bangkok, ECFAO Partnership Programme on Information and Analysis for Sustainable Forest Management (FAO, 2005)

Asfaw, Z., and Woldu, Z. (1997). Crop associations of home gardens in Welayta and Gurage in Southern Ethiopia. *SINET: Ethiopian Journal of Science*, *20*(1), 73-90.

Aziz, S. R. A., Zain, N. H. M., Zulkipli, N. H. N., and Azam, N. A. A. (2020). Factors influencing people's participation in home garden project during Covid-19 pandemic: A review. *International Journal of Advanced Trends in Computer Science and Engineering*, *9*(1.4), 184-191.

Bandara, M. (1985). Catchment ecosystems and village tank cascades in the dry zone of Sri Lanka a time-tested system of land and water resource management. In *Strategies for river basin management*, Springer, Dordrecht. 99-113.

Bateman, I. J., Carson, R. T., Day, B., Hanemann, W. M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Özdemirog˘lu, E., Pearce, D. W., Sugden R., and Swanson, J. (2002). *Economic Valuation with Stated Preference Techniques: A Manual*. Edward Elgar Publishing, Cheltenham.

Brookfield, H., Padoch, C., Parsons, H., and Stocking, M. (2002). *Cultivating biodiversity: Understanding, analysing and using agricultural diversity*. ITDG Publishing.

Chapoto, A., Haggblade, S., Hichaambwa, M., Kabwe, S., Longabaugh, S., Sitko, N. J., and Tschirley, D. L. (2012). *Agricultural transformation in Zambia: Alternative institutional models for accelerating agricultural productivity growth, and commercialization* (Working paper No 66). Indaba Agricultural Policy Research Institute (IAPRI). http://dx.doi.org/10.22004/ag.econ.132339

Eigenbrod, C., and Gruda, N. (2015). Urban vegetables for food security in cities: A review. *Agronomy for Sustainable Development*, *35*(2), 483-498.

Erickson, D. L., Lovell, S. T., and Méndez, V. E. (2011). Landowner willingness to embed production agriculture and other land use options in residential areas of Chittenden County, VT. *Landscape and Urban Planning*, *103*(2), 174-184.

Food and Agriculture Organization (2009). *"Sri Lanka forestry sector outlook study by Forest Department"* (Working Paper No. APFSOS II/WP/2009/29). FAO, Regional Office for the Asia and the Pacific, Bangkok, Thailand.

Galhena, D. H., Freed, R., and Maredia, K. M. (2013). Home gardens: A promising approach to enhance household food security and wellbeing. *Agriculture and food security*, *2*(1), 1-13.

Garrett, A., and Leeds, M. A. (2015). The economics of community gardening. *Eastern Economic Journal*, *41*(2), 200-213.

Gbedomon, R. C., Fandohan, A. B., Salako, V. K., Idohou, A. F. R., Kakaï, R. G., and Assogbadjo, A. E. (2015). Factors affecting home gardens ownership, diversity and structure: A case study from Benin. *Journal of ethnobiology and ethnomedicine*, *11*(1), 1-16.

Gbedomon, R. C., Salako, V. K., Fandohan, A. B., Idohou, A. F. R., Kakaï, R. G., and Assogbadjo, A. E. (2017). Functional diversity of home gardens and their agrobiodiversity conservation benefits in Benin, West Africa. *Journal of Ethnobiology and Ethnomedicine*, *13*(1), 1-15.

Grigg, D. (2003). *An introduction to agricultural geography*. Routledge.

Gray, L., Guzman, P., Glowa, K. M., and Drevno, A. G. (2014). Can home gardens scale up into movements for social change? The role of home gardens in providing food security and community change in San Jose, California. *Local Environment*, *19*(2), 187-203.

Howard, P. L. (2006). Gender and social dynamics in swidden and home gardens in Latin America. In *Tropical home gardens: A time-tested example of sustainable agroforestry* (pp. 159-182). Dordrecht: Springer Netherlands.

Igben, M. S. (1988). *The Nigerian farmer and agricultural institutions: An assessment*. Nigerian Institute of Social and Economic Research.

Karim, S. M. R., Ahmed, M. M., Ansari, A., Khatun, M., Kamal, T. B., and Afrad, M. S. I. (2021). Homestead vegetable gardening as

a source of calorie supplement at Ishurdi Upazila, Bangladesh. *ISABB Journal of Food and Agricultural Sciences*, *10*(1), 13-20.

Kedir, U. (2020). Agricultural Broadcasting Media (ABM) for Agricultural Developments and Structural Change within and Across the Countries: A Review. *New Media and Mass Communication*, 91, 1-6.

Kortright, R., and Wakefield, S. (2011). Edible backyards: A qualitative study of household food growing and its contributions to food security. *Agriculture and Human Values*, *28*(1), 39-53.

Kristensen, S. B. P., Busck, A. G., van der Sluis, T., and Gaube, V. (2016). Patterns and drivers of farm-level land use change in selected European rural landscapes. *Land Use Policy*, *57*, 786-799.

Kumar, B. M., and Nair, P. R. (2004). The enigma of tropical home gardens. *Agroforestry Systems*, *61*(1), 135-152.

Kumari, M. S., Kansuntisukmongkol, K., and Brockelman, W. Y. (2009). Plant diversity in home gardens and its contribution to household economy in suburban areas in Sri Lanka. *Environment and Natural Resources Journal*, *7*(2), 12-29.

Kumar, B. M., and Nair, P. K. R. (2006). *Tropical home gardens* (p. 377). Dordrecht: Springer.

Larsen, K., and Barker-Reid, F. (2009). Adapting to climate change and building urban resilience in Australia. *Urban Agriculture Magazine*, *22*, 22-24.

Marambe, B., Weerahewa, J., Pushpakumara, G., Silva, P., Punyawardena, R., Premalal, S., and Roy, J. (2012). Vulnerability of home garden ecosystems to climate change and its impacts on food security in South Asia. *Asia-Pacific Network for Global Change Research, Kobe*.

Marambe, B., Pushpakumara, G., and Silva, P. (2012). Biodiversity and agrobiodiversity in Sri Lanka: Village tank systems. In *The Biodiversity Observation Network in the Asia-Pacific Region* (pp. 403-430). Springer, Tokyo.

Markandya, A., and Hunt, A. (2001). Market-based instruments for environmental policy in SAP MED countries. In *Instructive seminar on the development and application of economic instruments for the implementation of SAP/MED* (pp. 9-10).

Mathenge, M., and Tschirley, D. (2008). *Off-farm work and farm production decisions: Evidence from maize-producing households in rural Kenya*. Tegemeo Institute of Agricultural Policy and Development, Nirobi, Kenya.

Mattsson, E., Persson, U. M., Ostwald, M., and Nissanka, S. P. (2012). REDD+ readiness implications for Sri Lanka in terms of reducing deforestation. *Journal of Environmental Management*, *100*, 29-40.

Nair, M. A., and Sreedharan, C. (1986). Agroforestry farming systems in the homesteads of Kerala, Southern India. *Agroforestry Systems*, *4*(4), 339-363.

Nair, P. K. R. (2006). Whither home gardens? In *Tropical Home Gardens* (pp. 355-370). Springer, Dordrecht.

Niñez, V. (1987). Household gardens: Theoretical and policy considerations. *Agricultural Systems*, *23*(3), 167-186.

Nontu, Y. (2021). Determinants of home gardening participation among rural households: Evidence from Ingquza Hill local municipality, South Africa. *Journal of Agribusiness and Rural Development*, *60*(2), 213-220.

Odebode, S. O. (2006). Assessment of home gardening as a potential source of household income in Adinyele Local Government area of Oyo State. *Nigerian Journal of Horticultural Science*, *11*(1), 47-55.

Opara, U. N. (2010). Personal and socio-economic determinants of agricultural information use by farmers in the Agricultural Development Programme (ADP) zones of Imo State, Nigeria. *Library Philosophy and Practice*, *434*.

Ogundari, K. (2008). Resource-productivity, allocative efficiency and determinants of technical efficiency of rainfed rice farmers: A guide for food security policy in Nigeria. *Zemedelska Ekonomika-Praha*, *54*(5), 224.

Okurut, F. N., Schoombee, A., and Van der Berg, S. (2005). Credit Demand and Credit Rationing in the Informal Financial Sector in Uganda. *South African Journal of Economics*, *73*(3), 482-497.

Ozor, N. (2010). Difficulties in adaptation to climate change by farmers in Enugu State, Nigeria. *Journal of Agricultural Extension*, *14*(2), 106-122.

Premakantha, K. T., Pushpakumara, D. K. N. G., and Dayawansa, N. K. D. (2008). Identification of tree resources outside forest in up country of Sri Lanka using medium resolution satellite imagery. *Tropical Agriculture Research*, 20, 354–365

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

Rahmeto, N. (2007). *Determinants of adoption of improved haricot bean production package in Alaba Special Woreda, Southern Ethiopia.* [Doctoral dissertation, Haramaya University]. www. ipmsethiopia.org

Ratnayake, S. S., Kumar, L., Dharmasena, P. B., Kadupitiya, H. K., Kariyawasam, C. S., and Hunter, D. (2021). Sustainability of village tank cascade systems of Sri Lanka: Exploring cascade anatomy and socio-ecological nexus for ecological restoration planning. *Challenges*, *12*(2), 24.

Razanakoto, O. R., Raharimalala, S., Sarobidy, E. J. R. F., Rakotondravelo, J. C., Autfray, P., and Razafimahatratra, H. M. (2021). Why smallholder farms' practices are already agroecological despite conventional agriculture applied on market-gardening. *Outlook on Agriculture*, *50*(1), 80-89.

Ruthenberg, H. (1971). Farming Systems in the Tropics. Clarendon Press, Oxford, UK.

Schreinemachers, P., Patalagsa, M. A., and Uddin, N. (2016). Impact and cost-effectiveness of women's training in home gardening and nutrition in Bangladesh. *Journal of Development Effectiveness*, *8*(4), 473-488.

Schupp, J. L., and Sharp, J. S. (2012). Exploring the social bases of home gardening. *Agriculture and Human Values*, *29*(1), 93-105.

Schupp, J. L., Som Castellano, R. L., Sharp, J. S., and Bean, M. (2016). Exploring barriers to home gardening in Ohio households. *Local Environment*, *21*(6), 752-767.

Sthapit, B., Gautam, R., and Eyzaguirre, P. (2006). The value of home gardens to small farmers. In Home Gardens in Nepal. In *Proceeding of a workshop on "Enhancing the contribution of home garden to on-farm management of plant genetic resources and to improve the livelihoods of Nepalese farmers: Lessons learned and policy implications"*, Bioversity International and SDC. Pokhara, Nepal.

Subair, S. K., and Siyana, M. (2003). Attitude toward backyard gardening in Botswana. In *Proceedings of 19th Annual Conference, Association for International Agricultural and Extension Education* (pp. 612-622).

Sunga, A. B., and Advincula, J. L. (2021). The" plantito/plantita" home gardening during the pandemic. *Community Psychology in Global Perspective*, *7*(1), 88-105.

Tadesse, D. (2008). *Access and utilization of agricultural information by resettler farming households: The case of Metema Woreda, North Gondar, Ethiopia* [Doctoral dissertation, Haramaya University].

Taylor, J. R., and Lovell, S. T. (2014). Urban home food gardens in the Global North: Research traditions and future directions. *Agriculture and human values*, *31*(2), 285-305.

Wachira, I. M., and Kihiu, E. N. (2012). *Impact of financial literacy on access to financial services in Kenya*. ZEF-Discussion Papers on Development Policy No. 215. Center for Development Research.

Weerahewa, J., Wijerathne, B., and Pushpakumara, D. K. N. G. (2011). Home gardens as a source of micronutrients: An analysis of food harvested from home gardens in Kandy, Kurunegala and Batticaloa Districts in Sri Lanka. *Tropical Agriculturist*, *159*, 107-134.

Weerahewa, J., Pushpakumara, G., Silva, P., Daulagala, C., Punyawardena, R., Premalal, S., and Marambe, B. (2012). Are home garden ecosystems resilient to climate change? An analysis of the adaptation strategies of home gardeners in Sri Lanka. *APN Science Bulletin*, *2*(2), 22-27.