SOCIOECONOMIC AND ENVIRONMENTAL BENEFITS OF URBAN AGRICULTURE PRACTICES IN COLOMBO DISTRICT, SRI LANKA

By

VITHANARACHCHIGE DONA NIRUSHA AYONI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

April 2022

FP 2022 76

COPYRIGHT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

SOCIOECONOMIC AND ENVIRONMENTAL BENEFITS OF URBAN AGRICULTURE PRACTICES IN COLOMBO DISTRICT, SRI LANKA

By

VITHANARACHCHIGE DONA NIRUSHA AYONI

April 2022

Chairman : Professor Mad Nasir bin Shamsudin, PhD
Faculty : Agriculture

The district of Colombo in Sri Lanka has undergone rapid and unplanned urbanization, thus experiencing negative consequences in terms of socioeconomic and environmental perspectives. Urbanization is vital in contributing to economic development and is unavoidable. Hence, mitigation of its negative impacts is a pressing necessity. A potential initiative in combating the negative consequence of urbanization is urban agriculture (UA). If this is proven, the Colombo district can take the lead in Sri Lanka in promoting urban agriculture and reducing the negative impacts of urbanization. The study's first objective is to estimate willingness to pay (WTP) and the value of socioeconomic benefits of urban agriculture practices. The second objective is to estimate WTP and the value of environmental benefits of urban agriculture practices. The third objective is to identify the key factors that influence urban dwellers' perceptions of urban agriculture practices.

Two groups of urban residents were studied: urban agriculture practitioners and non-urban agriculture practitioners. In 2020, a sample size of 494 was drawn using the stratified random sampling technique through face-to-face interviews in the Colombo district. The benefits were elicited using the choice experiment approach. The respondents were asked to evaluate urban agriculture scenarios with socioeconomic attributes (nutritional value, personal wellness, user-friendly agriculture, and food bill reduction). The environmental attributes concerned were food safety (three levels: conventional, controlled, and organic), waste management, greenery, and landscape. Analysis was done with a random parameter logit model (RPL). Exploratory factor analysis (EFA) was used to examine the perspectives of urban inhabitants about UA with the use of perception statements rated on the *Likert* Scale.

In respect to the first objective's results, urban agriculture practitioners' and non-urban agriculture practitioners' (in the parenthesis) WTP to obtain the better levels of the socioeconomic attributes were for nutritional value LKR 224.32 (85.84), personal wellness LKR 181.14 (150.51), user-friendly agriculture LKR 133.16 (143.51), and food bill reduction LKR 71.46. The socioeconomic value created by a 10% participation rate in UA in Colombo area was LKR 27.66 million. Urban agriculture practitioners' and non-urban agriculture practitioners' (in the parenthesis) WTP to obtain the better levels of the environmental attributes were for food safety under controlled environment LKR 66.61 (198.91), food safety under organic production LKR 160.30 (189.61), waste management LKR 124.06 (130.98), greenery LKR 92.18 (106.13), and landscape LKR 45.59. In the same scenario, UA generated an environmental value of LKR 23.72 million. A six-factor model was developed by EFA to explain urban agriculture practitioners' perceptions of UA practice: resource use and support systems, environmental improvements, food security, opportunity and awareness, personal wellbeing, and economic opportunity. The views of non-urban agriculture practitioners on UA were shown by a four-factor model: unrealized benefits, knowledge and experience, attitudes, and interests.

The stated benefits of UA are overall favorable and high; hence, the study indicates that UA is essential and appropriate to promote as a strategy for reducing the negative effects of urbanization. The expenses for the activities can be charged based on WTP values, resulting in no budgetary pressure. The district will benefit from the promotion and inclusion of UA programs in the regular urban development plan. Programs must address space constraints and the non-practicing group's lack of expertise in zero-land farming. The study fills the gap by proving UA's ability to reduce the negative impacts of urbanization and therefore contributes to the advancement of UA in Colombo.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

FAEDAH SOSIOEKONOMI DAN ALAM SEKITAR AMALAN PERTANIAN BANDAR DI DAERAH COLOMBO, SRI LANKA

Oleh

VITHANARACHCHIGE DONA NIRUSHA AYONI

April 2022

Pengerusi : Profesor Mad Nasir bin Shamsudin, PhD
Fakulti : Pertanian

Daerah Colombo di Sri Lanka telah menjalani pembandaran maju dan tidak terancang yang menyebabkan daerah tersebut mengalami kesan-kesan negatif dari segi perspektif sosioekonomi dan alam sekitar. Pembandaran tidak dapat dielakkan dan penting dalam menyumbang kepada pembangunan ekonomi. Oleh itu, pengurangan impak negatif pembandaran merupakan satu keperluan yang mendesak. Pertanian bandar (UA) merupakan satu inisiatif yang berpotensi dalam memerangi kesan negatif pembandaran. Jika perkara ini dapat dibuktikan, daerah Colombo akan dapat menerajui Sri Lanka dalam mempromosikan pertanian bandar dan mengurangkan kesan negatif pembandaran. Objektif pertama kajian ini adalah untuk menganggarkan kesanggupan membayar (WTP) dan nilai faedah sosioekonomi amalan pertanian bandar. Objektif kedua adalah untuk menganggarkan WTP dan nilai faedah persekitaran amalan pertanian bandar. Objektif ketiga adalah untuk mengenal pasti faktor utama yang mempengaruhi persepsi penduduk bandar terhadap amalan pertanian bandar.

Dua kumpulan penduduk bandar telah dikaji iaitu pengamal pertanian bandar dan pengamal pertanian bukan bandar. Pada tahun 2020, saiz sampel sebanyak 494 telah diambil menggunakan persampelan rawak berstrata melalui temu bual bersemuka di daerah Colombo. Faedah telah diperoleh menggunakan pendekatan kajian pilihan. Responden diminta untuk menilai scenario pertanian bandar bersama ciri-ciri sosioekonomi (nilai pemakanan, kesejahteraan diri, pertanian mesra pengguna dan pengurangan bil makanan). Ciri-ciri persekitaran yang berkaitan ialah keselamatan makanan (tiga peringkat: konvensional, terkawal dan organik), pengurusan sisa, kehijauan dan landskap. Analisis telah dilakukan dengan menggunakan model logit parameter rawak (RPL). Analisis faktor penerokaan (EFA) telah digunakan untuk mengkaji perspektif penduduk bandar terhadap UA. Penyataan mengenai persepsi penduduk telah digunakan dan dinilai pada Skala Likert.

Hasil kajian daripada keputusan objektif pertama, WTP pengamal pertanian bandar dan pengamal pertanian bukan bandar (dalam kurungan) untuk mendapatkan tahap ciri-ciri sosioekonomi yang lebih baik adalah untuk pemakanan LKR 224.32 (85.84), kesejahteraan diri LKR 181.14 (150.51), pertanian mesra pengguna LKR 133.16 (143.51) dan pengurangan bil makanan LKR 71.46. Nilai sosioekonomi yang dicipta oleh kadar penyertaan 10% dalam UA di kawasan Colombo ialah LKR 27.66 juta. WTP pengamal pertanian bandar dan pengamal pertanian bukan bandar (dalam kurungan) untuk mendapatkan tahap ciri-ciri persekitaran yang lebih baik adalah untuk keselamatan makanan di bawah persekitaran terkawal LKR 66.61 (198.91), keselamatan makanan di bawah pengeluaran organik LKR 160.30 (189.61), pengurusan sisa LKR 124.06 (130.98), kehijauan LKR 92.18 (106.13) dan landskap LKR 45.59. Dalam senario yang sama, UA menjana nilai alam sekitar sebanyak LKR 23.72 juta. Model enam faktor telah dibangunkan oleh EFA untuk menjelaskan persepsi pengamal pertanian bandar terhadap amalan UA iaitu penggunaan sumber dan sistem sokongan, penambahbaikan alam sekitar, keselamatan makanan, peluang dan kesedaran, kesejahteraan peribadi dan peluang ekonomi. Pandangan pengamal pertanian bukan bandar mengenai UA ditunjukkan oleh model empat faktor iaitu faedah yang tidak direalisasikan, pengetahuan dan pengalaman, sikap dan minat.

Faedah UA yang dinyatakan secara keseluruhan adalah menggalakkan dan tinggi. Oleh itu, kajian menunjukkan bahawa UA adalah penting dan sesuai untuk digunakan sebagai strategi mengurangkan kesan negatif pembandaran. Perbelanjaan untuk aktiviti boleh dicaj berdasarkan nilai WTP, menyebabkan tiada tekanan belanjawan. Daerah ini akan mendapat manfaat daripada promosi dan kemasukan program UA dalam rancangan pembangunan bandar biasa. Program mesti menangani kekangan ruang dan kekurangan kepakaran kumpulan yang tidak mengamalkan dalam pertanian tanah sifar. Kajian menunjukkan bahawa pertanian bandar boleh membantu mengurangkan kesan negatif pembandaran. Ini menyumbang kepada kemajuan UA di Colombo.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my heartfelt appreciation to my supervisory committee. I am eternally grateful to Professor Datuk Dr. Mad Nasir Shamsudin, Chairman of the Supervisory Committee, for accepting me as his student and for all of his excellent guidance, patience, understanding and supervision. His precise decisions constantly assisted in placing me on the right path. I would like to extend my deepest thanks to the committee members, Assoc. Prof. Dr. Ismail Abd Latif, Dr. Nurul Nadia Ramli, and Dr. Ahmad Hanis Izani Abdul Hadi. I am fortunate to have them on my committee since they are extremely supportive and encouraging, and I learned a lot from them.

I am grateful to the Universiti Putra Malaysia (UPM), especially the Department of Agribusiness and Bioresource Economics, for allowing this research to take place.

Without the cooperation of the wonderful people of Sri Lanka, my survey would not have been possible. Mr. S.M. Nagahawatta, District Director of Agriculture, Colombo, deserves my heartfelt thanks for his support for the survey executed in Colombo district. Enumerators Ms. Hemamali, Ms. Thanuja, Ms. Priyadarshini, Ms. Mayuri and Ms. Nadee are all to be commended for their assistance in data gathering. I am grateful to all of the survey participants, who shared more about the significance of urban agriculture than any book could ever teach us.

Finally, I would like to thank my loving husband, Aruna, for his patience, encouragement, and understanding while we've been on this journey together. Hugs and kisses to my children, Udara and Oneli, who endured all the hardships while I was away from home. May my attempt serve as a source of inspiration for your future quests for knowledge.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Mad Nasir bin Shamsudin, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Ismail bin Abd. Latif, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Nurul Nadia binti Ramli, PhD
Senior Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Ahmad Hanis Izani bin Abdul Hadi, PhD
Senior Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 13 April 2023

Declaration by Members of the Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Professor Datuk Dr. Mad Nasir bin Shamsudin

Signature: _____
Name of Member of Supervisory Committee: Associate Professor Dr. Ismail bin Abd. Latif

Signature: _____
Name of Member of Supervisory Committee: Dr. Nurul Nadia binti Ramli

Signature: _____
Name of Member of Supervisory Committee: Dr. Ahmad Hanis Izani bin Abdul Hadi

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ASC	Alternative Specific Constant
CE	Choice Experiment
CLM	Conditional Logit Model
CMA	Colombo Metropolitan Area
CS	Compensating Surplus
CV	Compensating variation
CVM	Contingent Valuation Method
DCE	Discrete Choice Experiment
DCS	Department of Census and Statistics
d.o.f.	Degrees of freedom
DS	Divisional Secretariat
F	Frequency
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IIA	Independence of Irrelevant Alternative
KMO	Keiser-Meyer-Olkin
LKR	Sri Lankan Rupees
LR	Log-likelihood Ratio
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
NUV	Non-Use Value
PAF	Principal Axis Factoring
PCA	Principal Component Analysis

RPL	Random Parameter Logit
RUT	Random Utility Theory
SD	Standard Deviation
SE	Standard Error
SJMC	*Sri Jayawardenapura Kotte* Municipal Council
SQ	Status Quo
TEV	Total Economic Value
UA	Urban Agriculture
UHI	Urban Heat Island
UV	Use Value
WTA	Willingness To Pay
WTP	Willingness To Accept

LIST OF SPECIFIC TERMS IN THE STUDY CONTEXT

i. Urban agriculture
Cultivation of crops, primarily vegetables (fruits are rarely cultivated in Colombo district), in areas defined as urban, with cultivation taking place in the immediate vicinity of the house premises, i.e., land, backyard, pot cultivation, vertical agriculture, roof top, and balcony. This description is for the study's context in Colombo district, Sri Lanka.

ii. Urban agriculture practitioner
People who live in areas defined as urban and currently practice agriculture.

iii. Non-urban agriculture practitioners
People who live in areas defined as urban but are not currently practicing agriculture or have not practiced it during the last year.

iv. Administrative boundaries of Sri Lanka
Sri Lanka's administrative boundaries are divided into five levels, which are, in descending order, National, Provincial, District, Divisional Secretariat (DS), and *Grama Niladari* Division (GND)

v. Colombo Metropolitan Area (CMA)
The CMA is made up of 20 Divisional Secretariats (DSs) that administer three districts: Colombo, Gampaha, and Kalutara. The composition of the CMA by DSs (20) is as follows: 11 DSs out of 13 in Colombo, 6 DSs out of 13 in Gampaha, and 3 out of 14 in Kalutara (Japan International Cooperation Agency & Oriental Consultants Co., 2014). Some empirical evidence has addressed CMA as the study area, rather than just Colombo district.

CHAPTER 1

INTRODUCTION

This chapter begins by emphasizing the significance of urbanization, followed by a discussion of its negative consequences. The chapter then discusses the role of urban agriculture (UA) in mitigating the negative externalities of urbanization. Statistics are used to support the explanation of urbanization in the Sri Lankan context, especially how the district of Colombo has been subjected to rapid urbanization. The evidence available in terms of negative socioeconomic and environmental consequences is highlighted. Finally, the chapter is completed with the problem description, research questions, aims, and relevance of the study.

1.1 Urbanization and its Implications

Urbanization predominantly acts as an indicator of countries' economic development. The process is influenced by the economic and social benefits that can be acquired by a city population compared to a rural one. Accordingly, urbanization has become a common phenomenon in the world with the migration to cities to acquire social and economic benefits such as employment and business opportunities, education, housing, health care facilities, recreation, better living standards, sanitation, and better infrastructure. Yet, positive effects are yielded by urban agglomerations until a certain capacity is reached and, thereafter, occurrences of adverse effects are unavoidable.

Thus, besides the benefits, negative economic, social, and environmental consequences are created by rapid and unplanned urbanization (Table 1.1). Housing, water, sanitation, and health are affected by infrastructural problems. One of the significant economic issues is that urban dwellers are vulnerable to food price escalations because they are net food buyers. The main environmental problems are pollution (air, noise, and water), urban heat island (UHI) effects, and solid waste management issues. Moreover, cities tend to experience climate change-associated threats from a global point of view (Garschagen & Kraas, 2011). In the built environment of cities, further physical adjustments are very unlikely and costly. The adaptive measures are difficult to implement because the severity of the problem is linked to the size, density, and rapid growth of cities. Recognizing the vulnerability of urban areas to climate change necessitates finding adaptation and mitigation strategies. Countries have their initiatives for improving the resilience of cities to mitigate climate change (Grothmann, 2011; Heinrichs & Krellenberg, 2011; Moffet et al., 2011; Olazabal et al., 2011; van den Berg, 2011). Different facets of urbanization have proven to be a global trend. Moreover, the rate of urbanization is found to be more rapid in developing countries compared to developed countries (Chauvin et al., 2017; Cohen, 2006). Thus, it is essential to take the necessary steps to curb negative impacts while ensuring strategies for sustainable and environmentally friendly cities. As its role has evolved into a multidimensional one, UA has seen evidence of mitigating the negative effects of urbanization to some extent.

Table 1.1 : Key impacts of urbanization

Impact	Economic perspectives	Social perspectives	Environmental perspectives
Positive impacts	- Industrialization - More employment opportunities - Significant proportion of country's gross domestic product (GDP) generate by cities - Efficient services - Optimal resource utilization	- Employment opportunities - High living standard - Easier access to healthcare, education , entertainment, infrastructure facilities - Social and cultural integration	- Economies of scale reduces ecological footprint via high resource use efficiency.
Negative impacts	- High cost of goods and public services (food, land, housing, water, electricity, education transport, and healthcare - High competition for employment - More congestion and traffic fatalities lead to low productivity - Urban poverty - Food security and food safety	- Increase the rate of non-communicable diseases due to change in consumption patterns - Increase of infectious diseases - Loss of tradition and culture - Increase of crime rate - Poor social interactions - Slums	- UHI - Increased food miles - Pollution-air, soil, water, noise - Energy demand outstripped population growth leads to increase in greenhouse gas emissions - Problems on waste management - Loss of biodiversity - Loss of aesthetic value as loss of greenery

(Sources: J. Chen, 2007; Drescher & Iaquinta, 2002; Martínez-Zarzoso & Maruotti, 2011)

1.2 Role of Urban Agriculture on Mitigating Negative Impacts of Urbanization

Multifunctional features are inherited in urban agriculture (UA). The multifunctional approach spreads in three different ways: firstly, to reduce certain negative urbanization consequences; secondly, to cope with urbanization or otherwise make use of urbanization benefits. Thus, this section focuses on UA from the perspective of its specific characteristics (Table 1.2). The general benefits will be elaborated upon under the sections of the literature review.

Table 1.2 : Scope of urban agriculture on urbanization

Scope	Economic perspectives	Social perspectives	Environmental perspectives
Reducing some adverse impacts of urbanization	- Increase food security - Increase nutritional security - Reduction of urban poverty	- Psychological relaxation - Physical exercises - Enabling better neighborhood	- Reduction of urban heat island effect - Improvement of micro-climate - Improvement of Air quality - Urban waste management
Contends with urbanization	- Food bill reduction - High profitability of small-scale urban agriculture than small scale rural agriculture	- Knowledge improvement - Hands on experience on cultivation specially for younger generation	- CO_2 absorption - Capture of dust particles
Makes use of the advantages of urbanization	- Improvement of productivity and quality through friendly agriculture - High potential for extra income generation for organic products	- Knowledge improvement of vertical agriculture - Development of entrepreneurial skills	- Food miles reduction - Ability for landscaping - State-of-the-art agriculture creates aesthetic value - Landscape value - Greenery

(Sources: Economic-Alaimo et al., 2008; Algert et al., 2016; Gockowski et al., 2003; Jongwe, 2014; Kutiwa et al., 2017; Maxwell et al., 1998, Social-Beyer et al., 2014; Litt et al., 2011; Nutsford et al., 2013; Ruggeri et al., 2016; Soga et al., 2017; Zick et al., 2013, and Environmental-(Food and Agriculture Organization [FAO], 2014; Lovell, 2010)

In general, the contribution of the UA sector is minor compared to the overall agriculture (total food supply) in an economy, yet the socioeconomic and environmental value it generates is important disproportionate to its size. In particular, benefits in terms of food security and nutrition aspects have been experienced by UA in developing and less developed countries. Moreover, in certain instances, it has become a likely source of income (Dölekoğlu & Gün, 2017). From an environmental perspective, the advantages are varied such as effective urban waste management, enabling organic wastes to be used productively, biodiversity enhancement, microclimate and air quality improvement, reduction of food miles (reducing greenhouse gas emissions), and storing food. Furthermore, it can reduce UHIs while increasing evapotranspiration, CO_2 capture, and dust capture (FAO, 2014; Lovell, 2010). From a social standpoint, participation in UA provides numerous benefits, such as improved neighborhood relationships when sharing knowledge and home garden products, health benefits such as psychological relaxation (Lautenschlager & Smith, 2007), physical exercise, hands-on experience with cultivation, and entrepreneurial skills.

1.3 The Status of Urban Agriculture in Colombo District

The Land Use Policy Planning Department of the Ministry of Lands has published statistics on residential gardens in the Colombo district. According to them, a home garden in Colombo district is defined as a plot of land less than or equal to 500 m^2 in size, consisting of a residence house and some form of cultivation. The data depicts that urban home gardens account for 10% of the land area in Colombo district (Land Use Policy Planning Department of Sri Lanka, 2020).

The research context here considers cultivation of agricultural types that contribute to consumption, especially vegetables and other edible cultivations. Fruit cultivation is not widely practiced on Colombo's limited land parcels, and herbs, flowers, and ornamental plants are all considered non-food crops. The national agricultural policy formulated in Sri Lanka has placed a special concern on promote and support home gardens under the thematic are of production and productivity. Yet, there is no special emphasis on urban agriculture (Ministry of Agriculture Sri Lanka, 2021). There are urban agricultural promotion programs known as the vertical agriculture program designed by the district secretariat office of Colombo, which consider land slots of less than 125 m^2. The primary goal of the program is to provide current urban agriculture practitioners with technical knowledge. In 2011, the Western Province of Sri Lanka became the country's first provincial government to include urban and peri-urban agriculture in its climate change adaptation action plan. In 2013-2014, the Resource Centers on Urban Agriculture and Food Security (RUAF) launched an urban agriculture program in Kesbewa DS in Colombo district, with 150 home gardeners occupying 26.1 ha of home gardens. They were promoted through space-intensive, small-scale production aimed at both commercial and home consumption markets. The project's space-intensive home gardening activities were discovered to increase food production. Using organic household and garden waste, 60,200 kg of urban organic compost was produced and used in the gardens over the course of the project. This also resulted in a 60,200 kg reduction in municipal solid waste. The outcome of the urban home gardening project in Kesbewa DS is a proven example of the benefits generated by urban agriculture in Colombo district.

1.4 Urbanization in Colombo District, Sri Lanka

Sri Lanka has experienced significant urbanization, as evidenced by a 6.4% growth in the urban population from 2012 to 2020 (Department of Census and Statistics Sri Lanka [DCS], 2015; The World Bank, 2021). Furthermore, the agricultural industry in Sri Lanka contributes just 7% of the country's overall GDP (Central Bank of Sri Lanka, 2021). The contribution to industrial output and GDP is 80% and 50%, respectively, by the Colombo metropolitan area (CMA), being the key economic hub in Sri Lanka (Subasinghe et al., 2016; The World Bank, 2013a). On the other hand, a transformation of industry and the service-based urban economy is represented by the increasing share of industry and service sectors in the country, as in the case of many developing countries experiencing the initial stages of development. With this backdrop, Sri Lanka is undergoing a fast-paced of urbanization. As a result, it is worthwhile to investigate the

rate of urbanization in specific locations, such as Sri Lanka's Colombo district. The most commonly used indicators for urbanization are the increase in urban population, population density increase, per capita land consumption, per capita green space, land cover changes (Fonseka et al., 2019) and built-up area, which are represented by various indicators such as normalized difference vegetation index (NDVI) and Shannon's entropy (Antalyn & Weerasinghe, 2020; Subasinghe, Nianhi, et al., 2021) and morphological spatial pattern analysis (Subasinghe, Wang, et al., 2021). Some are based on statistics, while others are based on empirical evidence. To begin with, the following paragraph depicts the statistics represent urban population and population density.

The highest concentration of urban population has been recorded in Colombo district in the Western Province, which is 78% (DCS Sri Lanka, 2015)[1] followed by Batticaloa (29%) district (Table 1.3). It accommodates approximately 50% of the total urban population and 12% of the country's total population while possessing only 6% of the total land area. Colombo city is the commercial capital, while *Sri Jayawardenapura Kotte* is the administrative capital. Colombo district extends over 699km^2 while hosting a population of 2,455,025 with a population density of 3,512 persons/km^2 (DCS Sri Lanka, 2021) and attracting 1.5 million commuters (Wickramasinghe & Subasinghe, 2016) on a working day. The urban population in Colombo district increased by 1.4 times while the population density increased by approximately 9% since 2001 (DCS Sri Lanka, 2015). The following paragraph depicts the empirical evidence based Colombo's rapid urbanization.

Morphological spatial patterns and geospatial techniques have been used by Subasinghe, Wang, et al. (2021) and concluded that CMA experienced rapid urban expansion along with a high intensity of urban expansion. Subasinghe, Nianhi, et al. (2021) examined urbanization in Colombo using various analytical techniques, including the Normalized Built-up Difference Index, Normalized Difference Vegetation Index, and Land Surface Temperature. According to the indices determined in the preceding study, the geographical diffusion of urbanization occurred in the northern and southern directions, primarily in the western section of Colombo. That is along the coastal belt. They summarized their findings by establishing the association between the indices and land surface temperature in Colombo from 1997 to 2017, observing an increasing cumulative trend of urbanization. Antalyn & Weerasinghe (2020) have been revealed a growing rate of sprawling by comparing the Shannon's entropy levels. Entropy levels in Colombo district were 0.928, 1.01, and 1.06 in 1997, 2009, and 2018, respectively. As the built-up area increased, thus was the occupied land area, which increased from 99 km2 to 277 km2 over the same time period, affecting agriculture and vegetation. In their study from 1988 to 2016, Fonseka et al. (2019) have employed land cover changes as a measure of urbanization by land surface temperature (LST). The density increment has been demonstrated by a significant increase in the mean land surface temperature (8.94 oC) across the period. The following paragraph depicts general facts on the negative effects of urbanization, which bring an overall description of Colombo's urbanization, and the

[1] The latest population statistics available in Sri Lanka

facts and figures are discussed in the 1.5 under environmental and 1.6 under socioeconomic perspective.

Colombo district urbanization commenced a few centuries ago due to unprecedented development and planning projects and converted Colombo into one of the most urbanized cities in South Asia. Colombo's vegetation cover has been occupied by constructions such as buildings, roads, parking lots, and pavements. The high vehicle density together with industrial emissions is responsible for the generation of waste heat and pollutant gases. Statistics and recent empirical evidence are good sources to prove that Colombo district has undergone significant negative consequences due to urbanization. Although some empirical data have been restricted to the CMA, that can be used as proxies for the district of Colombo. Some of the studies concentrated only on Colombo city. Such pieces of evidence are a better representation of proxies for the entire district. Hence, the explanation of the negative consequences of urbanization in Colombo district is either research-based or statistics-based as per the availability of Colombo district, CMA, or Colombo city and discussed in the next few sections (1.5 and 1.6).

Table 1.3 : Population distribution of Sri Lanka by district and residential sector-2012[2]

#	District	Urban sector		Rural sector		Estate sector		Total
		No.	%	No.	%	No.	%	
1	Colombo	1,802,904	78	513,534	22	7,911	-	2,324,349
2	Batticaloa	151,226	29	375,341	71	-	-	526,567
3	Mannar	24,417	25	75,153	75	-	-	99,570
4	Ampara	153,338	24	496,064	76	-	-	649,402
5	Trincomalee	85,123	22	294,418	78	-	-	379,541
6	Jaffna	117,575	20	466,307	80	-	-	583,882
7	Vavuniya	34,816	20	137,299	80	-	-	172,115
8	Gampaha	360,221	16	1,943,418	84	1,194	-	2,304,833
9	Galle	133,398	13	911,159	86	18,777	2	1,063,334
10	Kandy	170,544	12	1,119,221	81	85,617	6	1,375,382
11	Matale	60,276	12	405,176	84	19,079	4	484,531
12	Matara	96,570	12	694,948	85	22,530	3	814,048
13	Kalutara	109,069	9	1,075,246	88	37,633	3	1,221,948
14	Puttalam	66,952	9	693,844	91	1,600	-	762,396
15	Badulla	69,800	9	591,707	73	153,898	19	815,405
16	Ratnapura	99,451	9	888,845	82	99,711	9	1,088,007
17	Nuwara Eliya	40,151	6	290,913	41	380,580	53	711,644
18	Anuradhapura	50,595	6	809,980	94	-	-	860,575
19	Hambantota	31,709	5	568,194	95	-	-	599,903
20	Kurunegala	30,342	2	1,580,556	98	7,567	-	1,618,465
21	Kegalle	15,993	2	767,469	91	57,186	7	840,648
22	Mullaitivu	-	-	92,238	100	-	-	92,238
23	Kilinochchi	-	-	113,510	100	-	-	113,510
24	Polonnaruwa	-	-	406,072	100	16	-	406,088
25	Moneragala	-	-	442,710	98	8,348	2	451,058
	Total	**3,704,470**		**15,753,322**		**901,647**		**20,359,439**

(Source: DCS Sri Lanka, 2015)

[2] The Census of the population and housing in Sri Lanka is conducted once every 10 years, and the last Census was in 2012.

1.5 Environmental Impacts of Urbanization: Colombo District

The impacts entailed by urbanization have influenced environmental and socioeconomic aspects. Environmental problems associated with urbanization can be listed as pollution (air, noise, and water), urban heat island (UHI) effects, solid waste management issues, loss of greenery, landscape issues, extended "food miles", and soil erosion.

Loss of green cover as a result of urbanization has a number of negative consequences, including UHI, aesthetic value loss, and microclimate impairment. Land cover change can be recognized either by statistics, geographical information system mapping, or by the increase of UHIs. According to the statistics available from the Global Forest Watch (2019), it is noticeable that the reduction of tree cover percentage (based on 30% or more canopy cover) was 17% between 2000 and 2010, while it was 5.5% between 2011 and 2018. According to the World Health Organization, a city's per capita value of green space should be $9m^2$ (Saz-salazar & Rausell-Koster, 2008), and Colombo was found to have a value of $7.16m^2$, indicating that Colombo is unable to secure the necessary amount of green space (Li & Pussella, 2017). According to the Colombo metropolitan area's (CMA) green space per capita map produced by Senanayake et al. (2013b) only 16 *Grama Niladari* divisions (GND[3]) out of 55 satisfied the World Health Organization's specified minimum per capita green space requirement. The same study, using normalized difference vegetation index (NDVI) images, has further revealed that the green cover is only 24% in the CMA while 10 GNDs out of 55 possess less than 10% of the vegetation. Li and Pussella (2017), found that the annual reduction rate of the green cover was remarkable since 2001, and the respective changes were 1.37 km^2 (2001-2011) and 0.71 km^2 (2011-2015) considering from 1988-2015, using the NDVI values followed by the development of maps.

One of the significant negative impacts of urbanization is the density of UHIs in the densely populated Colombo district. Land cover changes due to the densification of built-up structures imposed by urbanization and waste heat emission lead to microclimate anomalies, particularly rising atmospheric and surface temperatures. The resulting thermal discomfort compared to the surrounding rural environment is referred to as UHI (Burkart et al., 2011; Emmanuel, 2005; Emmanuel & Fernando, 2007; Estoque et al., 2017; Maheng et al., 2019; Ranagalage et al., 2017; Senanayake et al., 2013a). In addition to the impacts of urbanization, thermal stress is influenced by rising temperatures due to climate change and waste heat (industrial and vehicle) emissions (Burkart et al., 2011). The majority of researchers have examined Colombo district for UHI, which is a measure of the negative impact of urbanization on a city's socioeconomic environment. Asmone et al. (2016) have examined (from 2000-2015 with intervals of 2000, 2003, 2013, and 2015) the impacts of the loss of green cover using both satellite images and thermal comfort as a proxy for UHI in *Sri Jayawardenapura Kotte* Municipal Council (SJMC, the administrative capital of Colombo district). Accordingly, the satellite imageries showed that the loss of green area was approximately 10% (2003), 37% (2013), and 45% (2015) compared to the base year 2000. In analytical terms, the thermal heat index and the relative stress index have been

[3] This is the smallest administrative unit in Sri Lanka

used to predict thermal comfort. Consequently, the study of Asmone et al. (2016) revealed that the upper limit of UHI (26) has been exceeded throughout the day in 2015, whereas it was observed only in the mid-day (12:00 to 18:00) of 2000. Similar to the relative stress index, the upper limit of comfort, which is 0.3, has not been exceeded in both 2000 and 2003. Yet, in 2013 and 2015, the threshold of comfort has been surpassed during mid-day even till the hours of the evening (Asmone et al., 2016). Ranagalage (2017) in his study focused on surface UHI using satellite data for the period 1997-2017 and found that the UHI effects intensified during the period 2007-2017, when the urbanization was rapid. The Colombo city area has been investigated (1997-2015) for green cover loss followed by its impact on the 2m atmospheric UHI and found that decreased green areas resulted in increased temperatures (Maheng et al., 2019). In fact, the increase was 0.8 °C and 0.2 °C in the maximum temperature and average temperature, respectively, in the Colombo city area. Accordingly, Maheng (2019) has concluded that there has been an increase in the average UHI from 0.45 °C in 1997 to 0.80 °C in 2015. By classifying Colombo city into 17 zones concerning its morphological changes, Perera and Emmanuel (2018) found that the urban/rural temperature difference in the compact high-rise zone was 4.4 °C in 2015.

Urbanization has a negative impact on the environment, which can be measured by pollution levels. Accordingly, environmental pollution in an urban area can be categorized into two forms: particulate pollution such as CO_2, NO_2, SO_2, inorganic compounds, photochemical smog, and hydrocarbons (Ileperuma, 2000) and heavy metal pollution such as Zn, Cu, Fe, Mn, and Cr. Two air quality maps in the CMA have been created by Senanayake et al. (2013b) utilizing NO_2 and SO_2 as indicators and air quality measurement data from 2002 to 2008. The presence of the highest concentrations of NO_2 and SO_2 has been matched with the highest vehicle density in the area considered to be Colombo's public transportation hub (e.g., the Colombo Fort area). Heavy metal pollution has been examined in CMA by Herath et al. (2016) using road deposited sediments and found that the concentrations of Cu, Pb, Fe, and Cr are high in industrial areas, while Zn and Mn concentrations are high in commercial areas. Furthermore, they focused on road dust and observed that, with the exception of Fe, all other elements found in road deposited sediments were also present in larger concentrations in road dust.

Food supply linked to "food miles" has implications for greenhouse gas emissions associated with transportation, again coupled with environmental issues. Colombo relies on food supply originating from various rural areas scattered in the country, hence its compliance with diverse food supply channels. Hence, it is inevitable that there will be high food miles with multiple stakeholders besides traditional intermediaries, i.e., commission agents in modern supply chains with misconduct behavior which can cause a rise in market price. Moreover, Colombo district is highly vulnerable to food price fluctuations as it depends on the food production in other regions that encounter frequent climate change. Hence, investing in shorter food supply chains in urban areas would bring about the advantage of the resilience of food price escalations due to climatic disasters in rural areas (FAO, 2018).

Waste generated in a congested urban area like Colombo is an inevitable obstacle encountered by urban planners with environmental concerns. Waste generation in a city can be categorized in terms of solid waste and food waste. Solid waste is generated by Sri Lanka at an approximate rate of 10,800 mt/day since 2009 (Japan International Cooperation Agency, 2016). The district of Colombo is accountable for the generation of 49.8% (1670 mt/day) of the amount produced in the Western Province (Colombo, Gampaha, and Kalutara districts), which is 3,360 mt/day (2015). Food waste generated in Colombo city is approximately half of the total waste generated, while food loss, particularly during transportation, ranges between 2.5–10% (FAO, 2018).

1.6 Socioeconomic Impacts of Urbanization

The unplanned, rapid growth of the population in emerging economies and developing countries has caused adverse implications for cities' socioeconomic status. The negative socioeconomic consequences can be summarized as unemployment, economic inequalities, urban poverty, crime and social violence, drug abuse, haphazard housing services, sedentary lifestyle, degraded health, food and nutrition security, traffic congestion, and decrease neighborhood amenities (Borzenko, 2019; Festus et al., 2020; Fuladlu, 2019).

Considering the aforesaid concerns, it is paramount that the competence of the UA in addressing the key negative socioeconomic consequences (Algert et al., 2016; Burghardt & Schneider, 2018; Kutiwa et al., 2017; Mbiba, 2000; McDougall et al., 2019; Paradelo et al., 2021; Ruggeri et al., 2016). Therefore, food and nutrition, urban poverty and personal-wellness in an urban community were outlined limiting for the scope of the study. How and why urban areas are facing food and nutrition security issues will be discussed in the following section, followed by the food and nutritional status of the study area. In the next subsections 1.6.2 discusses urban poverty in general and the urban poverty in the study area and 1.6.3 discusses health and well-being situations in an urban area.

1.6.1 Food Security

Rising food demand is being confronted by the continuing population growth in urban areas of emerging economies and developing countries. Apparently, urban areas lacking agricultural lands have a minimum potential to grow a significant proportion of their food requirements. Therefore, issues are being faced by city dwellers on food security issues as they rely on rural areas for their food requirements.

Urbanization has been shown to affect four aspects of food security: availability, access, use, and stability (FAO, 2011b). Food availability has two facets: demand and supply (Figure 1.1). Since almost all urban dwellers are net food buyers, they have to rely upon the production and supply processes of rural areas, which tend to be susceptible to natural calamities like drought and floods, which will occur frequently (Korth et al., 2014).

Accordingly, the supply and demand for food prices are affected by the production loss in the absence of adaptive capacity. Selling agricultural lands for non-agricultural purposes, which are located in urban peripheries, facilitates the expansion of urban sprawl and further affects the production supply process. Higher incomes and lifestyles possessed by urban dwellers have changed the composition of food demand. Protein-rich foods, fruits, and vegetables, for example, have arisen in their diets when they deviate from staple foods. Thus, urbanization has changed the composition of food demand (Akparibo et al., 2021). Because of their lifestyles, urban dwellers have an increased demand for convenience foods (ready-to-eat) that are high in energy but low in nutrition. This phenomenon has resulted in an increase in the prevalence of no communicable diseases among city dwellers. This can be referred to as food availability and access issues exacerbating food insecurity in urban areas (Akparibo et al., 2021; Holdsworth et al., 2020).

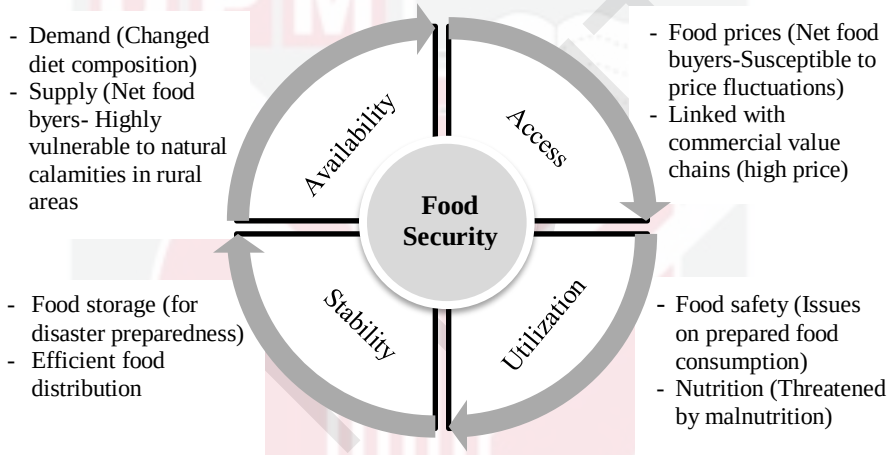

Figure 1.1 :Urbanization-food security nexus
Note: The concept was adapted from FAO (2011a)

Access to food is related to food prices. A larger share of the monthly expenditure bill of urban poor communities has been spent on food. Hence, they are highly vulnerable to food price escalation. Moreover, the majority of the community has to rely upon formal sectors, herein referred to as commercial value chains, such as supermarkets and food processors, where prices are comparably high. In contrast, rural communities have the opportunity to make their purchases from more informal/traditional sources such as farm-gate, street vendors, traditional fairs, and small-scale retailers where prices are low due to a low number of intermediaries. Therefore, city dwellers have a high level of urban food in security prevalence (Kroll et al., 2019).

Urbanization has some negative implications for food utilization per se and food safety issues. Statistics have proven that spending on prepared foods is significant among urban dwellers compared to rural areas. Such food arrives from outside the house. In particular,

the poor segments of the community who are accustomed to this usually buy street foods, which lack concerns over food safety. Aside from the risks of such food in terms of handling, storage, materials, and so on, malnutrition incidences may rise as a result of the consumption of energy-rich foods (Akparibo et al., 2021). In their scoping review of literature, Akparibo et al. (2021) have presented many studies covering the four aspects of food security and concluded with poor food safety and quality in the concerned areas.

In terms of the final dimension of food security, a system can be considered stable if and only if foods are adequately stored for disaster preparedness and the food distribution system is efficient all year. Such stability can be observed in urban cities in a well-developed country, yet in the urban poor segment of developing countries, such a system is considered underdeveloped. Thus, urbanization in developing countries has negative implications for food stability as those countries are lacking the ability to maintain buffer stocks to fully meet the demand of a rising population. In terms of the efficient food distribution process, there is a matter of infrastructure facilities, i.e., transport infrastructure and supply structures. It is uncertain if emerging countries will be able to meet the demands of a growing population with inadequate infrastructure.

1.6.1.1 The Status of Food Security in Colombo District

The status of food security in Colombo district is examined using statistics and previous studies. According to Mayadunne and Romeshun (2013), deprivation of per capita dietary energy intake as an indicator, revealed that Colombo is the most food-insecure district (38%), based on the FAO classification of minimum dietary energy requirement per capita per day (1,810 kcal). The results are contrary to the concept of the movement of the poverty level (Colombo has the lowest poverty level) and food security in the same direction because the expenditure on energy-yielding staples is low. Thus, the low dietary energy intake of Colombo people exerts pressure on the food security of Colombo district regardless of the low poverty level. Accordingly, 1/3 of the population in the district is not able to meet at least the daily energy requirement. Besides that, another 30% of the population is overweight, and of those, approximately 10% suffer from obesity. The tragedy is that the majority of overweight and obese residents suffer from non-communicable diseases. For instance, the reported percentages of blood pressure patients and those with diabetes are 11.9% and 11.2%, respectively (FAO, 2018).

1.6.2 Poverty

Increasing urbanization and rising socioeconomic inequality are both linked. As cities have become more crowded as a result of urbanization, the rate of unemployment has increased, and access to water, sanitation, and electricity has become increasingly difficult. In most Asian urban cities, the presence of slums reflects urban poverty in the midst of city development. This is considered to be a common phenomenon among Asian countries, particularly in neighboring India (Mohanty & Vasishtha, 2021). There is evidence for a link between urbanization and poverty levels (K. M. Chen et al., 2019).

Furthermore, child mortality and malnutrition have been identified as significant contributors to urban poverty (Aguilar & Sumner, 2020). In India, for example, a study of the urban poor revealed a vulnerability to higher levels of under nutrition and morbidity. To some extent, urban agriculture can alleviate urban poverty. Urban agriculture raises the socioeconomic standard, allowing for the reduction of urban poverty. It provides a source of income for urban agriculture practitioners while also fulfilling nutritional requirements and reducing malnutrition problems (Nandwani & Akaeze, 2020).

1.6.2.1 The Status of Poverty in Colombo District

Concerning the poverty in Sri Lanka, it can be observed that an apparent reduction in all the sectors from 1990/91 (Figure 1.2) is a great achievement. In 2016, the lowest poverty head count index[4] has been possessed by the urban sector, which is 1.9%, while the rural sector and the estate sector have possessed 4.3% and 8.8%, respectively. Poverty status is estimated by comparing the monthly real per capita expenditure on food and non-food items with the official poverty line[5]. Thus, it is worthwhile to observe the indicators of food and non-food expenditure to understand the status of poverty.

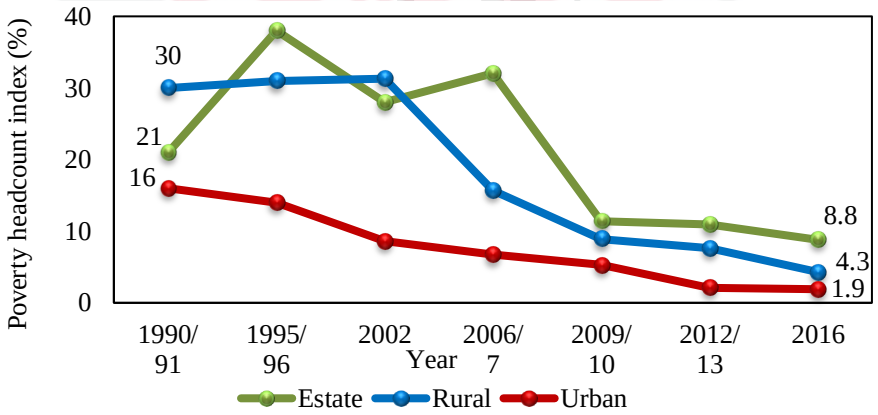

Figure 1.2 : Poverty headcount ratio/index (%)
(Source: DCS Sri Lanka, 2017)

Accordingly, food expenditure is high in the estate sector (48%), followed by 35% and 31% in the rural and urban sectors, respectively. The breakdown by food category is depicted in Figure 1.3 and given that in the urban sector, people expend the most on prepared food, followed by cereals, fish, condiments, milk, and other foods. Their

[4] Poverty head count index is the percentage of population below the national poverty line
[5] The official poverty line is the real per capita expenditure per month for a person fixed at a specific welfare level, including food and non-food consumption expenditure (DCS Sri Lanka, 2017)

.

expenditure is lower on vegetables. The district of Colombo possesses more or less similar expenditure patterns (Figure 1.4) corresponding to the sector figures. The highest share of prepared foods is spent by the residents of Colombo, yet less on vegetables and fruits.

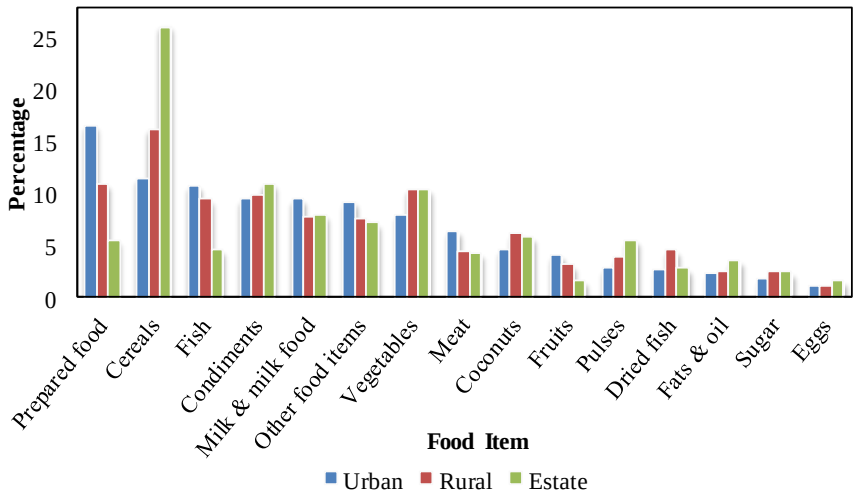

Figure 1.3 : Average monthly household expenditure (%) on major food groups by sector
(Source: DCS Sri Lanka, 2018)

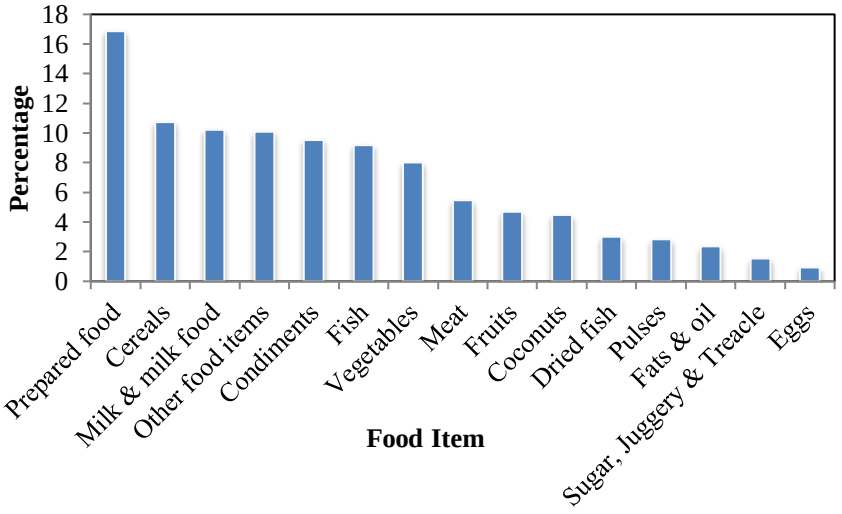

Figure 1.4 : Share of monthly household expenditure (%) out of total food expenditure-Colombo district
(Source: DCS Sri Lanka, 2018)

Unequal income distribution in the urban sector is evident in Colombo district besides the lowest poverty head count index, which is 0.9 (the highest is in Kilinochchi district, 18.2). The estimated mean monthly urban household total expenditure (USD 509[6]) is approximately 1.5 times higher than the rural sector (USD 338) and the mean income of the estate sector is USD 229 (DCS Sri Lanka, 2017). The mean monthly urban total household expenditure lies in the second-highest expenditure decile, which is a proxy for the income earned. Consequently, the commoditization of the urban sector is reflected by the higher expenditure pattern of the urban sector compared to the rural and estate sectors. Differences between the income distribution and the distribution inequality can easily be captured via the "decile" groups. Figure 1.5 shows that there is a disparity in the income distribution of both urban and estate sectors as there has been observed a deviation from the circular pattern.

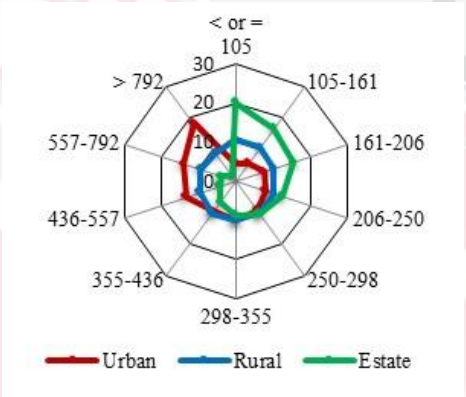

Figure 1.5 : Share of income to total household income by national household income decile and sector
(Source: DCS Sri Lanka, 2018)
Notes: The "X" axis represents the percentages, the "Y" axis represents the 10 income deciles, and the income is in USD.

Unlikely, a more or less equal distribution pattern of income across the income deciles is possessed by the rural sector. Approximately 20% of the urban sector households receive 51% of the total urban sector income, which is more than USD 792[7] (tenth decile). This indicates that one-half of the urban sector's income is possessed by 1/5th of the urban sector households per se, and significant percentage (20%) is extremely rich. Hence, there is an extreme disparity in income distribution in the urban sector, revealing that the majority experience food security issues. The statistics discussed in the above paragraphs under different studies on the impacts of urbanization in Colombo district are summarized in Tabel 1.4 below.

[6] USD 1=LKR 152 in 2017 (Central Bank of Sri Lanka, 2017).
[7] USD 1=145 LKR in 2016 (Central Bank of Sri Lanka, 2017)

Table 1.4 : A summary of negative impacts of urbanization in Colombo district: Empirical evidence and statistics

Environment impacts			Socioeconomic impacts
1. Reduction of green cover	**2. UHI**	**3. Air Quality/Solid waste**	
a) Reduction of green cover i. Colombo district 2000-2010 – 17% 2011-2018 – 5% (Global Forest Watch, 2019) ii. CMA 24% out of 55 GNDs 10 possess less than 10% vegetation (NDVI images) (Senanayake et al., 2013a) iii. Annual reduction 2001-2011 – 1.3 km^2 2011-2015 – 0.71 km^2 (Li & Pussella, 2017) iv. Administrative Capital of Colombo district (SJMC) 2003 – 10%, 2013 – 37%, 2015 – 45% (base year 2000) (Asmone et al., 2016) **b) Per capita green space** (Standard is 9 m^2/person) i. 7.16 m^2/person (Li & Pussella, 2017) ii. In CMA out of 55 GNDs, only 16 possess the standard (Senanayake et al., 2013a)	**a) UHI** i. Up to 2m height in Colombo city limits Rise of temperature from 1997–2015, 0.8°C maximum temperature and 0.2°C average temperature ii Average UHI Colombo city limits 0.45°C in 1997 to 0.80°C in 2015 (Maheng et al., 2019) **b) Thermal heat index (Indicator for UHI)** Administrative capital of Colombo district (SJMC) 2000 - Upper limit (26) exceeds only in mid-day (12:00 – 18:00) 2015 - Upper limit (26) exceeds throughout the day (Asmone et al., 2016) **c) Relative stress index (Indicator for UHI)** Administrative capital of Colombo district (SJMC) In 2000 and 2003 the upper limit (0.3) not exceeded 2015-The upper limit is exceeded not only during mid-day but until late evening. (Asmone et al., 2016)	**a) Air quality** CMA (Colombo Fort area which is the main transportation hub) Higher concentration of NO_2 and SO_2 (2000-2008) (Ileperuma, 2000) **b) Heavy metal pollution** CMA **Road deposited sediment analysis** Higher concentration of Cu, Pb, Fe and Cr in industrial area Higher concentration of Zn and Mn in the commercial area **Road dust analysis** Higher concentration of Cu, Pb, Fe, Cr, Zn and Mn (Herath et al., 2016) **d) Solid waste** Colombo district Solid waste – 1670 mt/day Food wastes approximately 800 mt/day Food loss during transportation 2.5-10% (FAO, 2018; Japan International Cooperation Agency, 2016).	**a) Food insecurity** i. Most food insecure district (38%) (Mayadunne & Romeshun, 2013) ii. Minimum daily energy requirement is not met by 1/3rd of population iii. 30% of population over weight iv. Of the overweight percentage 10% obese (FAO, 2018). **b) Income inequality** 20% of the urban sector households receive 51% of the total urban sector income (DCS Sri Lanka, 2018) **c) Food consumption behavior** i. Expenditure out of total food expenditure Prepared foods-17%, Vegetables-8%, Fruits-5% ii. Food vs. non-food expenditure ratio 1:2.5 (DCS Sri Lanka, 2018)

1.6.3 Personal Well-being

Urbanization is a complex process, and hence not merely a demographic transformation, but socio-cultural-psychological changes are carried alongside. The evolution of urbanization in developed countries and developing countries has a distinct difference. The developed countries experienced such a process in the past, which occurred in parallel with industrialization. Nevertheless, in developing and underdeveloped countries, the process is rapid and occurs within a short time (Turan & Besirli, 2008). Hence, city dwellers in developing and underdeveloped countries undergo sudden psychological, physical, and cultural changes due to a rapid and unplanned increase in population. Further, social illness and negative impacts on health and well-being are also interconnected issues. Unemployment increases poverty, urban slums, crime rates, and social instability, and it has a negative impact on mental health. The impact on the elderly is also not to be neglected as they are left to fend for themselves, lacking physical activity and mental distress due to loneliness, which leads to many social issues.

Contrary to the urban poverty in cities, the lifestyle of the rich segment has different implications for health and well-being due to their sedentary lifestyle. In a city, physical activities are made more difficult by a lack of public places, motorized transportation, and traffic congestion. The combined effect of a lack of physical activity and poor eating habits leads to a high rate of non-communicable diseases. Changes in lifestyles, particularly in urban areas, as a result of unhealthy eating habits and sedentary behavior, have an impact on health issues such as obesity. Two-thirds of adults who took part in a study in Colombo district were either overweight or obese, which confirming the above scenario (Somasundaram et al., 2019). The rise of non-communicable diseases in urban areas is a risk associated with this.

1.7 The Link between Urbanization and Urban Agriculture

Despite the two facts of urbanization, its inevitability and economic contribution to a country, unplanned and rapid urbanization has negative socioeconomic and environmental consequences. The most visible negative environmental impacts are energy-related issues (GHG emissions), changes in land use pattern, loss of green cover, which leads to urban heat islands (UHIs) (Emmanuel & Fernando, 2007; Fonseka et al., 2019; Martínez-Zarzoso & Maruotti, 2011; Ranagalage et al., 2017), solid waste accumulation, loss of landscape values (Drescher & Iaquinta, 2002), and food safety concerns (Festus et al., 2020). There are also socioeconomic consequences, including food and nutritional security (Akparibo et al., 2021; Holdsworth et al., 2020; Korth et al., 2014; Kroll et al., 2019), urban poverty (Aguilar & Sumner, 2020; K. M. Chen et al., 2019; Mohanty & Vasishtha, 2021; Nandwani & Akaeze, 2020) , and personal wellness (Borzenko, 2019; Gelormino et al., 2015; Roe et al., 2020; Somasundaram et al., 2019; Turan & Besirli, 2008).

In response to the urbanization, urban agriculture has a role to play owing to its multifunctional role (Gonfa, 2019; Lovell, 2010; van Leeuwen et al., 2010). The multifunctional role of UA has been determined to be one of the most appropriate strategies for mitigating some of the key negative socioeconomic repercussions of urbanization. Moreover, one of the advantages of urban agriculture is that it contributes to the sustainability of cities (Mohd Salleh et al., 2020). Urban agriculture's contribution on mitigation negative impacts supports though socio-economic and environmental perspectives (Gonfa, 2019; Jürkenbeck et al., 2019; McDougall et al., 2019). The key phenomenon is that the economic and environmental value it generates is significantly disproportionate to its size. Urban agriculture has witnessed a significant role to play in socioeconomic terms in urban areas, such as improving food security and nutrition, reducing food bill, generating additional income, reducing urban poverty, improving personal well-being (both psychological and physical), increasing knowledge and skills, and strengthening social cohesiveness. The empirical evidence is discussed in Chapter two under Section 2.1.1. Yet, to summarize the proven socioeconomic benefits of UA per se favorable influence on food security and nutrition, the academicians who work on quantitative research (Algert et al., 2016; Gockowski et al., 2003; Kutiwa et al., 2017; Maxwell et al., 1998; Mbiba, 2000) have proven the implications. Furthermore, in some cases, UA has become a potential source of food bill reduction (Algert et al., 2016; Armar-Klemesu & Maxwell, 2000; CoDyre et al., 2015; Jacobi et al., 2000; Moustier & Danso, 2006). It is obvious that with urbanization comes an increase in food demand to feed the urban population. In that sense, the urban poor are a vulnerable group who are perceived to be at high risk. The resiliency of poor urban communities can be emphasized by improving their livelihoods and survival through urban agriculture. As a result, urban agriculture can help to alleviate urban poverty (Algert et al., 2016; Gockowski et al., 2003; Kutiwa et al., 2017; Maxwell et al., 1998). Socially, involvement in UA provides various advantages, including better neighborly connections in information exchange and home gardening products, health benefits (Beyer et al., 2014; Litt et al., 2011; Nutsford et al., 2013; Ruggeri et al., 2016; Soga et al., 2017; Zick et al., 2013) including psychological relaxation, exercise, hands-on experience and entrepreneurial skills.

In addition, environmental benefits of urban agriculture also bring sustainability aspects of urban cities by curbing the environmental impairments such as increase of UHI, loss of greenery, disturbance to the landscape designs, pollution (soil, water, air) and solid waste accumulation. The empirical evidence is summarized in Chapter two under Section 2.1.2 while highlighting the primary environmental benefits of UA that can alleviate the negative repercussions of urbanization. The environmental benefits of UA in terms of reduction of UHI due to reduced GHG emissions, reduced energy use in food transport and storage, and increased greenery have been empirically proven (Bowler et al., 2010; Eom et al., 2012; Knight et al., 2016; Lovell, 2010; Susca et al., 2011a). Lovell (2010) and Surat and Yaman (2017) have been explored the concept of landscape in order to create sustainable cities. Reduced entry of run-off water and organic waste originating from urban solid waste into the waste stream have been revealed using life cycle analysis (Cleveland et al., 2017; Fisher & Karunanithi, 2014) while UA's capacity to manage waste have been studied in some literature (Brock & Foeken, 2006; Novo & Murphy, 2000; Orsini et al., 2009; Ruma & Sheikh, 2010). Urban agriculture has the potential to improve urban biodiversity by replacing low-diversity vegetation (grass), with more diverse plant varieties, which can provide habitat and resources for both flora

and fauna (e.g. pollinators) (Goldstein et al., 2016). Food safety implications have been found to be minimum or controlled due to minimal use of agro-chemicals or absolutely organic production (Orsini et al., 2013).

1.8 Problem Statement

Sri Lanka's growing urban population as a percentage of the total population from 2012 to 2021 (6.4%) shows that urbanization is increasing at an apparent common and continuous rate. From 2012 to 2021, the Colombo district in Sri Lanka experienced a 43% increase in urbanization (The World Bank, 2021). The trend of urbanization is expected to continue in the future as well, due to the migration of rural people into urban areas to enjoy the benefits that exist in urban areas, such as education, higher wages, and opportunities in manufacturing and services. On a positive note, there exists a link between urbanization and the contribution to the GDP (Subasinghe, Nianhi, et al., 2021). Hence, urbanization is an inevitable and increasing phenomenon that drives a nation toward economic development and growth (Subasinghe et al., 2016; Subasinghe, Nianhi, et al., 2021). Urbanization has its own set of drawbacks, both as a result of a process itself and as a consequence of it. In order to avoid or mitigate the negative effects of unplanned and rapid urbanization, action must be taken immediately.

Considering the pressing negative consequences of urbanization in Colombo district, the urban inhabitants face both food security and food safety challenges as net food buyers (Food and Agriculture Organization, 2018; Mayadunne & Romeshun, 2013). Despite declining poverty rates in Colombo, income disparities persist; as a result, the urban poor are particularly vulnerable to food price increases (Department of Census and Statistics, 2018; Department of Census and Statistics Sri Lanka, 2017). Colombo is nearly reliant on rural areas for perishable goods, resulting in longer food miles. In terms of the environment, the loss of green cover in the district of Colombo is most commonly associated with high urban heat island (UHIs), which are followed by several negative consequences (Fonseka et al., 2019; Subasinghe et al., 2016; Subasinghe, Nianhi, et al., 2021; Subasinghe, Wang, et al., 2021; Wickramasinghe & Subasinghe, 2016).

Urbanization, being an unavoidable inevitability, plays a critical role in economic progress (Subasinghe, Nianhi, et al., 2021). Therefore, the negative impacts must be addressed with the most feasible and practical strategies where the need is fulfilled by the UA to a certain extent. Thus, the feasibility of UA to address the majority of the aforementioned negative externalities connected with rapid and unplanned urbanization is worth investigating, particularly from a socioeconomic and environmental standpoint. The perspectives of urban agriculture have evolved over time, from traditional food production to multifunctional agriculture (Artmann & Sartison, 2018; Jung, 2020; Lovell, 2010; Poulsen et al., 2017; van Leeuwen et al., 2010). Various dimensions of benefits are comprised of food and nutrition security, food bill reduction, personal-wellbeing, educational aspects and user-friendliness of UA, in terms of socioeconomics (Algert et al., 2016; CoDyre et al., 2015; Kutiwa et al., 2017; McDougall et al., 2019; Paradelo et al., 2021; Ruggeri et al., 2016; Soga et al., 2017). The environment-oriented focus of UA is on reducing the impact of urban heat islands, food safety aspects, waste

management landscape, and greenery improvement toward a sustainable city (Brock & Foeken, 2006; Knight et al., 2016; Lovell, 2010; Orsini et al., 2009, 2013; Ruma & Sheikh, 2010; Surat & Yaman, 2017). However, it has yet to be determined whether UA can play a significant role in reducing negative urbanization externalities created in Colombo district of Sri Lanka, leaving a research gap. Therefore, the study intends to estimate the value of UA in Colombo district in view of the multifunctional role of UA in addressing negative issues of urbanization in terms of social and environmental aspects.

Even though urban agriculture is practiced in the district of Colombo, it is clear from searching through empirical evidence, statistics, and communication with relevant stake holders that no valuation studies have been conducted. As a result, urban policy planners in Colombo district can use estimations of the value of the socioeconomic and environmental benefits of urban agriculture, as well as the associated implications of the respective attributes, to help them foresee the future prospects of urban agriculture in the district. In Sri Lanka, the application of choice experiment (CE) in evaluating the benefits of urban agriculture practices, in particular, can be considered novel. Furthermore, the sequence of application of CE, checking the assumption of independence of irrelevant alternatives (IIA), and remedial measures in the event of a violation will be added to the body of literature, enhancing researchers' analytical capacity on CE.

1.9 Research Questions

Having identified the importance of examining the ability of urban agriculture to address most of the negative impacts that occur due to urbanization from a socioeconomic and environmental point of view, the following specific research questions are formulated under the problem statement.

i. What are the WTP values and estimated values of the socioeconomic benefits urban agriculture practices?

ii. What are the WTP values and estimated values of the environmental benefits of urban agriculture practices?

iii. What are the key factors that influence urban dwellers' perceptions on urban agriculture practices?

1.10 Objectives of the Study

The general objective of the study is to assess the socioeconomic and environmental benefits of urban agriculture practices in Colombo district of Sri Lanka.

The specific objectives are:

i. To estimate willingness to pay (WTP) and the value of socioeconomic benefits of urban agriculture practices.

ii. To estimate WTP and the value of environmental benefits of urban agriculture practices.

iii. To identify the key factors that influence urban dwellers' perceptions on urban agriculture practices.

1.11 Significance of the Study

In this study, the significance can be considered in two perspectives: as a contribution to the literature and as a set of strategies and recommendations to policymakers related to urban agriculture practices. Policy perspectives will contribute as follows:

i. Upon valuation of the benefits of urban agriculture in terms of socioeconomic and environmental terms capable of providing a rational to promote urban agriculture in Colombo district.

ii. City planners and policymakers in Colombo district would benefit from learning more about the critical factors that influence urban agriculture practices in the city. This would assist them in planning future campaigns to encourage more people in the city to grow their own food, which would be beneficial.

As far as making a significant contribution to the body of literature in Sri Lanka is concerned, the use of choice experiment (CE) in evaluating the benefits of urban agriculture practices, in particular, can be considered groundbreaking. The application of CE in both socioeconomic and environmental benefits will contribute to the growing body of literature on the overall benefit effects of environmental conservation. Also included will be the sequence in which CE should be used, how to check the assumption of independence of irrelevant alternatives (IIA), and what to do if a violation is discovered, all of which will aid researchers in their understanding of CE.

1.12 The Scope of the Study

When considering possible mitigation techniques for the negative consequences of urbanization, the multifunctional capacity of urban agriculture is found to have the greatest potential. The study focuses on the socioeconomic and environmental attributes that are initially identified in the literature as empirical evidence sought for benefits, and then prioritized using a focus group discussion. The monetary value of the benefits is selected for analysis using choice experiment (CE) as the best match technique. The CE analysis begins with the basic model, conditional logit model (CLM), and the basic assumption checks on IIA, which is triggered by a violation of the higher order model, random parameter model (RPL). The second goal of perception analysis has been addressed with the perceptions derived from the literature review and analyzed with exploratory factor analysis (EFA) to reduce the factors.

1.13 Organization of the Thesis

The remainder of this thesis is laid out as follows: Chapter two reviews literature on urban agriculture practices and potential methodological frameworks to be used in the study. This chapter is organized into two perspectives; (i) empirical evidence for the benefits of urban agriculture, and (ii) an overview of the best approach for valuing non-market goods, the choice eperiment method. Chapter three explains the research methodology that applies to the study, where the theoretical and conceptual frameworks of the study will be explained. Additionally, the data collection procedure and a description of the study area are also provided. An analysis of the study results and discussion are provided in Chapter four. This chapter answers the research questions raised in the study. Finally, in Chapter five, conclusions are drawn and policy implications are inferred based on the study results.

REFERENCES

Abdul Hadi, A. H. I. B. (2018). *Socioeconomic and environmental impact of urban agriculture practices in the Klang Valley, Malaysia*. [Doctoral dissertation, University Putra Malaysia].

Abdullah, S., Markandya, A., & Nunes, P. A. L. D. (2011). Introduction to economic valuation methods. In A. Batabyal & P. Nijkamp (Eds.), *Research tools in natural resource and environmental economics* (pp. 143–187). World Scientific.

Adamowicz, W., Louviere, J., & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management*, *26*(3), 271–292. https://doi.org/10.1006/jeem.1994.1017

Adamowicz, W., Swait, J., Boxall, P., Louviere, J., & Williams, M. (1997). Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. *Journal of Environmental Economics and Management*, *32*(1), 65–84. https://doi.org/10.1006/jeem.1996.0957

Aguilar, G. R., & Sumner, A. (2020). Who are the world's poor? A new profile of global multidimensional poverty. *World Development*, *126*. https://doi.org/10.1016/j.worlddev.2019.104716

Akaichi, F., Gil, J. M., & Nayga, R. M. (2012). Assessing the market potential for a local food product: Evidence from a non-hypothetical economic experiment. *British Food Journal*, *114*(1), 19–39. https://doi.org/10.1108/00070701211197347

Akparibo, R., Aryeetey, R. N. O., Asamane, E. A., Osei-Kwasi, H. A., Ioannou, E., Solar, G. I., Cormie, V., Pereko, K. K., Amagloh, F. K., Caton, S. J., & Cecil, J. E. (2021). Food security in ghanaian urban cities: A scoping review of the literature. *Nutrients*, *13*(10). https://doi.org/10.3390/nu13103615

Alaimo, K., Packnett, E., Miles, R. A., & Kruger, D. J. (2008). Fruit and vegetable intake among urban community gardeners. *Journal of Nutrition Education and Behavior*, *40*(2), 94–101. https://doi.org/10.1016/j.jneb.2006.12.003

Algert, S. J., Baameur, A., Diekmann, L. O., Gray, L., & Ortiz, D. (2016). Vegetable output, cost savings, and nutritional value of low-income families' home gardens in San Jose, CA. *Journal of Hunger and Environmental Nutrition*, *11*(3), 328–336. https://doi.org/10.1080/19320248.2015.1128866

Almeida, A., & Machado, L. P. (2021). Rural development and rural tourism: The impact of infrastructure investments. In R. A. Castanho, G. Couto, & R. Santos (Eds.), *Peripheral territories, tourism, and regional development* (pp. 81–102). IntechOpen.

Antalyn, B., & Weerasinghe, V. P. A. (2020). Assessment of urban sprawl and its impacts on rural landmasses of Colombo district: A study based on remote sensing and GIS techniques. *Asia-Pacific Journal of Rural Development*, *30*(1–2). https://doi.org/10.1177/1018529120946245

Armar-Klemesu, M., & Maxwell, D. (2000). Accra: Urban agriculture as an asset strategy supplementing income and diets. In H. de Z. Bakker, N., M. Dubbeling, S. Guendel, U. Sabel Koschella (Ed.), *Growing cities, growing food: Urban agriculture on the policy agenda* (pp. 183–208). Deutsche Stiftung für internationale Entwicklung (DSE).

Artmann, M., & Sartison, K. (2018). The role of urban agriculture as a nature-based solution: A review for developing a systemic assessment framework. In *Sustainability (Switzerland)* (Vol. 10, Issue 6). https://doi.org/10.3390/su10061937

Asmone, A. S., Conejos, S., Chew, M. Y. L., & R.U.K., P. (2016). Urban green cover protocol to reduce urban heat island in Sri Lanka. In W. N. Hien & S. K. Jusuf (Eds.), *4th International conference on countermeasures to Urban Heat Island (UHI) 2016*. Elsevier Ltd.

Audate, P. P., Fernandez, M. A., Cloutier, G., & Lebel, A. (2019). Scoping review of the impacts of urban agriculture on the determinants of health. In *BMC Public Health* (Vol. 19, Issue 1). https://doi.org/10.1186/s12889-019-6885-z

Balbontin, C., Hensher, D. A., Collins, A. T., & Gyovai, G. (2017). Do familiarity and awareness influence voting intention: The case of road pricing reform. *Journal of Choice Modelling*, *25*, 11–27. https://doi.org/10.1016/j.jocm.2017.01.005

Bateman, I., Loomes, G., Mourato, S., Ozdemiroglu, E., Prearce, D. W., Sugden, R., & Swanson, J. (2002). *Economic valuation with stated preference techniques: A manual* (I. J. Bateman (ed.)). Edward Elgar.

Bennett, J. W. (1999). *Choice modeling research report: Some fundamentals of choice modeling*. ps://crawford.anu.edu.au/pdf/staff/jeff_bennett/chmdrr11.pdf

Beyer, K. M. M., Kaltenbach, A., Szabo, A., Bogar, S., & Nieto, F. J. (2014). Exposure to neighborhood green space and mental health: Evidence from the survey of the health of Wisconsin. *International Journal of Environmental Research and Public Health*, *11*, 3453–3472. https://doi.org/10.3390/ijerph110303453

Birol, E., & Koundouri, P. (2008). *Choice experiments informing environmental policy: A European perspective*. Edward Elgar Publishing Ltd.

Birol, E., Smale, M., & Gyovai, A. (2006). Using a choice experiment to estimate farmers' valuation of agrobiodiversity on Hungarian small farms. *Environmental and Resource Economics*, *34*, 439–469. https://doi.org/10.1007/s10640-006-0009-9

Bishop, G. F. (1987). Experiments with the middle response alternative in survey questions. *Public Opinion Quarterly*, *51*(2), 220–232. https://doi.org/10.1086/269030

Borzenko, O. (2019). Influence of urbanization on economic social scope: negative consequences. *Transfer of Innovative Technologies*, *2*(1), 75–82. https://doi.org/10.31493/tit1921.0303

Bowler, D. E., Buyung-Ali, L., Knight, T. M., & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence. *Landscape and Urban Planning*, *97*, 147–155. https://doi.org/10.1016/j.landurbplan.2010.05.006

Boxall, P. C., Adamowicz, W. L., Swait, J., Williams, M., & Louviere, J. (1996). A comparison of stated preference methods for environmental valuation. *Ecological Economics*, *18*, 243–253.

Brock, B., & Foeken, D. (2006). Urban horticulture for a better environment: A case study of Cotonou, Benin. *Habitat International*, *30*, 558–578. https://doi.org/10.1016/j.habitatint.2005.02.001

Burghardt, W., Morel, J. L., & Zhang, G. L. (2015). Development of the soil research about urban, industrial, traffic, mining and military areas (SUITMA). *Soil Science and Plant Nutrition*, *61*. https://doi.org/10.1080/00380768.2015.1046136

Burghardt, W., & Schneider, T. (2018). Bulk density and content, density and stock of carbon, nitrogen and heavy metals in vegetable patches and lawns of allotments gardens in the northwestern Ruhr area, Germany. *Journal of Soils and Sediments*, *18*(2), 407–417. https://doi.org/10.1007/s11368-016-1553-8

Burkart, K., Schneider, A., Breitner, S., Hossain, M., Krämer, A., & Endlicher, W. (2011). The effect of atmospheric thermal conditions and urban thermal pollution on all-cause and cardiovascular mortality in Bangladesh. *Environmental Pollution*, *159*(8–9), 2035–2043. https://doi.org/10.1016/j.envpol.2011.02.005

Carson, R. T., & Louviere, J. J. (2011). A common nomenclature for stated preference elicitation approaches. *Environmental and Resource Economics*, *49*, 539–559. https://doi.org/10.1007/s10640-010-9450-x

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research*, *1*(2), 245–276. https://doi.org/10.1207/s15327906mbr0102_10

Central Bank of Sri Lanka. (2017). *Indicative US dollar spot exchange rate*. https://www.cbsl.gov.lk/en/rates-and-indicators/exchange-rates/daily-indicative-usd-spot-exchange-rates

Central Bank of Sri Lanka. (2021). *Annual report 2020*. https://www.cbsl.gov.lk/en/publications/economic-and-financial-reports/annual-reports/annual-report-2020

Cerda, C., Ponce, A., & Zappi, M. (2013). Using choice experiments to understand public demand for the conservation of nature: A case study in a protected area of Chile. *Journal for Nature Conservation*, *21*, 143–153. https://doi.org/10.1016/j.jnc.2012.11.010

Chauvin, P. J., Glaeser, E., Ma, Y., & Tobio, K. (2017). What is different about urbanization in rich and poor countries? Cities in Brazil, China, India and the United States. *Journal of Urban Economics*, *98*, 17–49. https://doi.org/10.1016/j.jue.2016.05.003

Chen, H. (2019). Economic valuation of Green Island, Taiwan: A choice experiment method. *Sustainability*, *11*(2), 403. https://doi.org/10.3390/su11020403

Chen, J. (2007). Rapid urbanization in China: A real challenge to soil protection and food security. *Catena*, *69*(1), 1–15. https://doi.org/10.1016/j.catena.2006.04.019

Chen, K. M., Leu, C. H., & Wang, T. M. (2019). Measurement and determinants of multidimensional poverty: evidence from Taiwan. *Social Indicators Research*, *145*(2), 459–478. https://doi.org/10.1007/s11205-019-02118-8

Cheng, S., & Long, J. S. (2007). Testing for IIA in the multinomial logit model. *Sociological Methods and Research*, *35*(4), 583–600. https://doi.org/10.1177/0049124106292361

Chipman, J. S. (1960). The foundations of utility. *Econometrica*, *28*(2), 193–224. https://doi.org/10.2307/1907717

Clark, M. D., Determann, D., Petrou, S., Moro, D., & de Bekker-Grob, E. W. (2014). Discrete choice experiments in health economics: A review of the literature. *PharmacoEconomics*, *32*, 882–902. https://doi.org/10.1007/s40273-014-0170-x

Cleveland, D. A., Phares, N., Nightingale, K. D., Weatherby, R. L., Radis, W., Ballard, J., Campagna, M., Kurtz, D., Livingston, K., Riechers, G., & Wilkins, K. (2017). The potential for urban household vegetable gardens to reduce greenhouse gas emissions. *Landscape and Urban Planning*, *157*, 365–374. https://doi.org/10.1016/j.landurbplan.2016.07.008

CoDyre, M., Fraser, E. D. G., & Landman, K. (2015). How does your garden grow? An empirical evaluation of the costs and potential of urban gardening. *Urban Forestry and Urban Greening*, *14*(1), 72–79. https://doi.org/10.1016/j.ufug.2014.11.001

Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in Society*, *28*, 63–80. https://doi.org/10.1016/j.techsoc.2005.10.005

Comrey, A. L., & Lee, H. B. (2013). A first course in factor analysis. In *A first course in factor analysis* (2nd ed.). Psychology Press. https://doi.org/10.4324/9781315827506

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation*, *10*(7). https://doi.org/10.7275/jyj1-4868

Crespo-cebada, E., Díaz-Caro, C., Robina-Ramírez, R., & Sánchez-Hernández, M. I. (2020). Is biodiversity a relevant attribute for assessing natural parks? Evidence from Cornalvo Natural Park in Spain. *Forests*, *11*(4), 410–422.

de Bekker-Grob, E. W., Donkers, B., Jonker, M. F., & Stolk, E. A. (2015). Sample size requirements for discrete-choice experiments in healthcare: a practical guide. *Patient*, *8*(5). https://doi.org/10.1007/s40271-015-0118-z

DeCoster, J. (1998). *Overview of factor analysis*. http://www.stat-help.com/notes.html

DeMeritt, J. H. R. (2020). *Discrete choice models 1*. https://jdemeritt.weebly.com/uploads/2/2/7/7/22771764/unordered_multiresponse.pdf

Department of Census and Statistics, S. L. (2018). *Sri Lanka labour force survey, Annual report 2017*. Department of Census and Statistics, Sri Lanka.

Department of Census and Statistics Sri Lanka. (2015). *Census of population and housing 2012*. Government of Sri Lanka. http://www.statistics.gov.lk/Population/StaticalInformation/CPH2011/CensusPopulationHousing2012-FinalReport

Department of Census and Statistics Sri Lanka. (2017). *Poverty indicators 2016*. http://www.statistics.gov.lk/Poverty/StaticalInformation/PovertyIndicators-2016

Department of Census and Statistics Sri Lanka. (2020a). *District statistical hand book 2020*. http://www.statistics.gov.lk/ref/HandbookDictionary

Department of Census and Statistics Sri Lanka. (2020b). *Household income and expenditure survey 2019*. Government of Sri Lanka. http://www.statistics.gov.lk/IncomeAndExpenditure/StaticalInformation

Department of Census and Statistics Sri Lanka. (2021). *District statistical hand book 2021*. http://www.statistics.gov.lk/ref/HandbookDictionary

Dionysis, & Latinopoulos, D. (2014). Using a choice experiment to estimate the social benefits from improved water supply services. *Journal of Integrative Environmental Sciences*, *11*, 187–204. https://doi.org/10.1080/1943815X.2014.942746

Dölekoğlu, C. Ö., & Gün, S. (2017). Urban agriculture: Search for agricultural practice in urbanized rural areas. *Turkish Journal of Agriculture - Food Science and Technology*, *5*(12), 1461–1469. https://doi.org/10.24925/turjaf.v5i12.1461-1469.1432

Drescher, A. W., & Iaquinta, D. L. (2002). *Urbanization: Linking development across the changing landscape*. FAO State of Food and Agriculture (SOFA). http://www.fao.org/fileadmin/templates/FCIT/PDF/sofa.pdf

Dupras, J., Laurent-lucchetti, J., Revéret, J., & DaSilva, L. (2017). Using contingent valuation and choice experiment to value the impacts of agri-environmental practices on landscapes aesthetics. *Landscape Research*. https://doi.org/10.1080/01426397.2017.1332172

Emmanuel, R. (2005). Thermal comfort implications of urbanization in a warm-humid city: the Colombo Metropolitan Region (CMR), Sri Lanka. *Building and Environment*, *40*, 1591:1601. https://doi.org/10.1016/j.buildenv.2004.12.004

Emmanuel, R., & Fernando, H. J. S. (2007). Urban heat islands in humid and arid climates: role of urban form and thermal properties in Colombo, Sri Lanka and Phoenix, USA. *Climate Research*, *34*, 241–251. https://doi.org/10.3354/cr00694

Eom, K., Jung, P., Park, S., Yoo, S., & Kim, T. (2012). Evaluation of the effect of urban-agriculture on urban heat island mitigation. *Korean Journal of Soil Science and Fertilizer*, *45*(5), 848–852. https://doi.org/10.7745/KJSSF.2012.45.5.848

Estoque, R. C., Murayama, Y., & Myint, S. W. (2017). Effects of landscape composition and pattern on land surface temperature: An urban heat island study in the megacities of Southeast Asia. *Science of the Total Environment*, *577*, 349–359. https://doi.org/10.1016/j.scitotenv.2016.10.195

Evans, W. N. (n.d.). *ECON 60303: Econometrics II (Graduate)-Multi choice models*. Retrieved August 5, 2020, from https://www3.nd.edu/~wevans1/ecoe60303/handouts.htm

Fedrigotti, V. B., Troiano, S., Fischer, C., & Marangon, F. (2020). Public preferences for farmed landscapes: The case of traditional chestnut orchards in South Tyrol. *European Countryside*, *12*(1), 99–118. https://doi.org/10.2478/euco-2020-0006

Festus, I. A., Omoboye, I. F., & Andrew, O. B. (2020). Urban sprawl: Environmental consequence of rapid urban expansion. *Malaysian Journal of Social Sciences and Humanities*, *5*(6), 110–118. https://doi.org/10.47405/mjssh.v5i6.411

Fisher, S., & Karunanithi, A. (2014). Contemporary comparative LCA of commercial farming and urban agriculture for selected fresh vegetables consumed in Denver, Colorado. In R. Schenck & D. Huizenga (Eds.), *Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector*. American Center for Life Cycle Assessment.

Foeken, D., & Klaver, W. (2006). The benefits. In *To subsidise my income: Urban farming in an East-African town* (pp. 79–92). https://openaccess.leidenuniv.nl/handle/1887/14742

Fonseka, H. P. U., Zhang, H., Sun, Y., Su, H., Lin, H., & Lin, Y. (2019). Urbanization and its impacts on land surface temperature in Colombo metropolitan area, Sri Lanka, from 1988 to 2016. *Remote Sensing*, *11*(8). https://doi.org/10.3390/rs11080957

Food and Agriculture Organization. (2011a). *Food, agriculture and cities: Challenges of food and nutrition security, agriculture and ecosystem management in an urbanizing world*. http://www.fao.org/fileadmin/templates/FCIT/PDF/FoodAgriCities_Oct2011.pdf

Food and Agriculture Organization. (2011b). *The place of urban and peri-urban agriculture (UPA) in national food security programmes*. https://www.fao.org/3/i2177e/i2177e00.pdf

Food and Agriculture Organization. (2014). *Growing greener cities in Latin America and the Caribbean*. http://www.fao.org/3/a-i3696e.pdf

Food and Agriculture Organization. (2018). *Assessing and planning city region food system-Colombo (Sri Lanka) Synthesis report*. https://www.fao.org/3/CA1159EN/ca1159en.pdf

Freese, J., & Long, S. (2001). Tests for the multinomial logit model. In J. H. Newton (Ed.), *Stata Technical Bulletin* (Vol. 10, Issue 58, pp. 19–26). StataCorp LP. http://stata-press.com/journals/stbcontents/stb58.pdf

Fry, T. R. L., & Harris, M. N. (1998). Testing for independence of irrelevant alternatives some empirical results. *Sociological Methods and Research*, *26*(3), 401–423. https://doi.org/10.1177/0049124198026003005

Fuladlu, K. (2019). Urban sprawl negative impact: Enkomi return phase. *Journal of Contemporary Urban Affairs*, *3*(1), 44–51. https://doi.org/10.25034/ijcua.2018.4709

Garschagen, M., & Kraas, F. (2011). Urban climate change adaptation in the context of transformation: Lessons from Vietnam. In K. Otto-Zimmermann (Ed.), *Resilient Cities: Cities and Adaptation to Climate Change Proceedings of the Global Forum 2010* (pp. 130–140). https://doi.org/10.1007/978-94-007-0785-6_13

Gelormino, E., Melis, G., Marietta, C., & Costa, G. (2015). From built environment to health inequalities: An explanatory framework based on evidence. *Preventive Medicine Reports*, *2*, 737–745. https://doi.org/10.1016/J.PMEDR.2015.08.019

Giles, E. L., Becker, F., Ternent, L., Sniehotta, F. F., McColl, E., & Adams, J. (2016). Acceptability of financial incentives for health behaviours: A discrete choice experiment. *PLoS ONE*, *11*(6). https://doi.org/10.1371/journal.pone.0157403

Global Forest Watch. (2019). *Global Forest Watch*. https://www.globalforestwatch.org/dashboards/country/LKA/5

Gockowski, J., Mbazo, J., Mbah, G., & Moulende, F. T. (2003). African traditional leafy vegetables and the urban and peri-urban poor. *Food Policy*, *28*, 221–235. https://doi.org/10.1016/S0306-9192(03)00029-0

Goldstein, B., Hauschild, M., Fernández, J., & Birkved, M. (2016). Urban versus conventional agriculture, taxonomy of resource profiles: a review. *Agronomy for Sustainable Development*, *36*(1). https://doi.org/10.1007/s13593-015-0348-4

Golnaz Rezai. (2012). Consumers' awareness and consumption intention towards green foods. *African Journal of Business Management*, *6*(12), 4496–4503. https://doi.org/10.5897/ajbm11.1414

Gonfa, L. (2019). The Role of Urban Agriculture in Economic, Social and Environmental Sustainability in Africa. *Journal of Natural Sciences Research*. https://doi.org/10.7176/jnsr/9-2-03

Gorsuch, R. L. (2015). *Factor analysis: Classic edition* (Classic Ed). Routledge. https://books.google.pt/books?id=LDecBQAAQBAJ

Grace-Martin, K. (n.d.). *The fundamental difference between principal component analysis and factor Analysis*. The Analysis Factor. Retrieved March 25, 2021, from https://www.theanalysisfactor.com/the-fundamental-difference-between-principal-component-analysis-and-factor-analysis

Greene, W. (2012). Multinomial choices and event counts. In *Econometric Analysis* (7th ed., pp. 826–917). Prentice Hall.

Grilli, G., Notaro, S., & Campbell, D. (2018). Including value orientations in choice models to estimate benefits of wildlife management policies. *Ecological Economics*, *151*, 170–181. https://doi.org/10.1016/j.ecolecon.2018.04.035

Grothmann, T. (2011). Governance recommendations for adaptation in European urban regions: Results from five case studies and a European expert survey. In K. Otto-Zimmermann (Ed.), *Resilient Cities: Cities and Adaptation to Climate Change Proceedings of the Global Forum 2010* (pp. 167–176). https://doi.org/10.1007/978-94-007-0785-6_17

Growing Cities, Growing Food: Urban Agriculture on the Policy Agenda. (2000). In N. Bakker, M. Dubbeling, S. Gundel, U. Sabel-Koschella, & H. de Zeeuw (Eds.), *Growing cities, growing food: Urban agriculture on the …*. Deutsche Stiftung fur internationale Entwicklung (DSE).

Gunatilake, H. M. (2003). *Environmental valuation: Theory and applications*. Postgraduate Institute of Agriculture, University of Peradeniya.

Haipeng, Z., & Xuxuan, X. (2013). Combining Stated Preference and Revealed Preference Methods for the Valuation of Non-market Goods. *Chinese Journal of Population Resources and Environment*, *10*(4), 121–126. ps://doi.org/10.1080/10042857.2012.10685119

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis. In *Vectors* (7th ed.). Prentice-Hall Inc. https://doi.org/10.1016/j.ijpharm.2011.02.019

Hanemann, W. M. (1982). *Applied welfare analysis with qualitative response models* (CUDARE Working Paper No. 7160).

Hanemann, W. M. (1984). Welfare evaluations in contingent valuation experiments with discrete responses. *American Journal of Agricultural Economics*, *66*(3), 332–341. https://doi.org/10.2307/1240800

Hanley, N., Wright, R. E., & Adamowicz, W. (1998). Using choice experiments to value the environment design. *Environmental and Resource Economics*, *11*(3–4), 313–428.

Hanley, N., Wright, R. E., & Koop, G. (2002). Modelling recreation demand using choice experiments: Climbing in Scotland. *Environmental and Resource Economics*, *22*(February), 449–466. https://doi.org/10.1023/A:1016077425039

Harman, H. H. (1976). *Modern factor analysis* (3rd ed.). The University of Chicago Press.

Hausman, J. (1978). Specification tests in econometrics. *Econometrica*, *46*(6), 1251–1271. https://doi.org/10.2307/1913827

Hausman, J., & McFadden, D. L. (1984). Specification tests for the multinomial logit model. *Econometrica*, *52*(5), 1219–1240. https://doi.org/10.2307/1910997

Heinrichs, D., & Krellenberg, K. (2011). Climate adaptation strategies: Evidence from Latin American city-regions. In K. Otto-Zimmermann (Ed.), *Resilient cities:Cities and adaptation to climate change proceedings of the global forum 2010* (pp. 223–230). https://doi.org/10.1007/978-94-007-0785-6_23

Hensher, D. A. (2006). How do respondents process stated choice experiments? Attribute consideration under varying information load. *Journal of Applied Econometrics*, *21*(6), 861–878. https://doi.org/10.1002/jae.877

Hensher, D. A., & Greene, W. H. (2003). The mixed logit model: The state of practice. *Transportation*, *30*(2), 133–176. https://doi.org/10.1023/A:1022558715350

Hensher, D. A., Rose, J. M., & Greene, W. H. (2005). *Applied choice analysis: A primer*. Cambridge University Press.

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research: Common errors and some comment on improved practice. *Educational and Psychological Measurement*, *66*(3), 393–416. https://doi.org/10.1177/0013164405282485

Herath, D., Pitawala, A., & Gunatilake, J. (2016). Heavy metals in road deposited sediments and road dusts of Colombo Capital , Sri Lanka. *Journal of Science Foundation Sri Lanka*, *44*(2), 193–202.

Hicks, J. R. (1939). The foundations of welfare economics. *The Economic Journal*, *49*(196). https://doi.org/10.2307/2225023

Hilbe, J. M. (2009). *Logistic regression models* (1st ed.). CRC Press.

Hogarty, K. Y., Hines, C. V., Kromrey, J. D., Perron, J. M., & Mumford, A. K. R. (2005). The quality of factor solutions in exploratory factor analysis: The influence of sample size, communality, and overdetermination. *Educational and Psychological Measurement*, *65*(2), 222–226. https://doi.org/10.1177/0013164404267287

Holdsworth, M., Pradeilles, R., Tandoh, A., Green, M., Wanjohi, M., Zotor, F., Asiki, G., Klomegah, S., Abdul-Haq, Z., Osei-Kwasi, H., Akparibo, R., Bricas, N., Auma, C., Griffiths, P., & Laar, A. (2020). Unhealthy eating practices of city-dwelling Africans in deprived neighbourhoods: Evidence for policy action from Ghana and Kenya. *Global Food Security*, *26*. https://doi.org/10.1016/j.gfs.2020.100452

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, *30*(2), 179–185. https://doi.org/10.1007/BF02289447

Houessionon, P., Fonta, M. F., Bossa, A. Y., Safiétou, S., Thiombiano, N., Zahonogo, P., Yameogo, T. B., & Balana, B. (2007). Economic valuation of ecosystem services from small-scale agricultural management interventions in Burkina faso: A discrete choice experiment approach. *Sustainability*, *9*, 1187–1672. https://doi.org/10.3390/su9091672

Howitt, D., & Cramer, D. (2011). *Introduction to statistics in psychology* (5th Ed.). Prentice Hall.

Ileperuma, O. A. (2000). Environmental pollution in Sri Lanka: a review. *Journal of National Science Foundation*, *28*(4), 301--325. https://doi.org/10.4038/jnsfsr.v28i4.2644

Jacobi, P., Amend, J., & Kiango, S. (2000). Urban agriculture in Dar es Salaam: Providing for an indispensable part of the diet. In N Bakker, M. Dubbeling, S. Gündel, U. Sabel-Koschella, & H. de Zeeuw (Eds.), *Growing cities growing food: Urban agriculture on the policy agenda* (pp. 257–284). Deutsche Stiftung für internationale Entwicklung (DSE).

Japan International Cooperation Agency. (2016). *Data collection survey on solid waste management in democratic socialist republic of Sri Lanka*. Kokusai Kogyo Co., Ltd.

Japan International Cooperation Agency, & Oriental Consultants Co., L. (2014). *Urban transport system development project for Colombo Metropolitan Region and suburbs*.

Johnson, R. M., & Orme, B. K. (2003). *Sawtooth software getting the most from CBC*. Sawtooth Software Research Paper Series. https://sawtoothsoftware.com/resources/technical-papers/getting-the-most-from-cbc

Jongwe, A. (2014). Synergies between urban agriculture and urban household food security in Gweru City, Zimbabwe. *Journal of Development and Agricultural Economics*, *6*(2), 59–66. https://doi.org/10.5897/jdae2013.0506

Jung, H. (2020). Estimating the social value of multifunctional agriculture (MFA) with choice experiment. *Agricultural Economics*, *66*(3), 120–128. https://doi.org/10.17221/147/2019-AGRICECON

Jürkenbeck, K., Heumann, A., & Spiller, A. (2019). Sustainability matters: Consumer acceptance of different vertical farming systems. *Sustainability (Switzerland)*, *11*(15). https://doi.org/10.3390/su11154052

Kass, R. A., & Tinsley, H. E. A. (1979). Factor analysis. *Journal of Leisure Research*, *11*(2), 120–138. https://doi.org/10.1080/00222216.1979.11969385

Khan, S. U., Khan, I., Zhao, M., Khan, A. A., & Ali, M. A. S. (2019). Valuation of ecosystem services using choice experiment with preference heterogeneity: A benefit transfer analysis across inland river basin. *Science of the Total Environment*, *679*, 126–135. https://doi.org/10.1016/j.scitotenv.2019.05.049

Kim, Y., Kling, C. L., & Zhao, J. (2015). Understanding behavioral explanations of the WTP-WTA divergence through a neoclassical lens: Implications for environmental policy. *Annual Review of Resource Economics*, *7*(1), 169–187. https://doi.org/10.1146/annurev-resource-100913-012501

Kjær, T. (2005). *A review of the discrete choice experiment - with emphasis on its application in health care* (No. 1; Health Economics Papers).

Kline, P. (1994). *An easy guide to factor analysis*. Routledge.

Klinglmair, A., Bliem, M. G., & Brouwer, R. (2015). Exploring the public value of increased hydropower use: a choice experiment study for Austria. *Journal of Environmental Economics and Policy*, *4*(3), 315–336. https://doi.org/10.1080/21606544.2015.1018956

Knight, T., Price, S., Bowler, D., & King, S. (2016). How effective is "greening" of urban areas in reducing human exposure to ground-level ozone concentrations, UV exposure and the "urban heat island effect"? A protocol to update a systematic review. *Environmental Evidence*, *5*(3). https://doi.org/10.1186/s13750-016-0054-y

Korth, M., Stewart, R., Langer, L., Madinga, N., Rebelo Da Silva, N., Zaranyika, H., Van Rooyen, C., & De Wet, T. (2014). What are the impacts of urban agriculture programs on food security in low and middle-income countries: A systematic review. In *Environmental Evidence* (Vol. 3, Issue 21, pp. 1–10). https://doi.org/10.1186/2047-2382-3-21

Kroll, F., Swart, E. C., Annan, R. A., Thow, A. M., Neves, D., Apprey, C., Aduku, L. N. E., Agyapong, N. A. F., Moubarac, J. C., Toit, A. du, Aidoo, R., & Sanders, D. (2019). Mappobesogenic food environments in South Africa and Ghana: Correlations and contradictions. *Sustainability*, *11*(14). https://doi.org/10.3390/su11143924

Krucien, N., Le Vaillant, M., & Pelletier-Fleury, N. (2015). What are the patients' preferences for the chronic care model? An application to the obstructive sleep apnoea syndrome. *Health Expectations*, *18*(6), 2536–2548. https://doi.org/10.1111/hex.12222

Kuhfeld, W. F. (2005). Experimental design: Efficiency, coding, and choice designs. In *Marketing research methods in SAS: Experimental design, choice, conjoint, and graphical techniques* (p. 53:241). SAS Institute Inc.

Kuhfeld, W. F., Tobias, R. D., & Garratt, M. (1994). Efficient experimental design with marketing research applications. *Journal of Marketing Research*, *31*(4), 545–557. https://doi.org/10.1177/002224379403100408

Kutiwa, S., Boon, E., & Devuyst, D. (2017). Urban agriculture in low income households of Harare: An adaptive response to economic crisis. *Journal of Human Ecology*, *32*(2), 85–96. https://doi.org/10.1080/09709274.2010.11906325

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy*, *74*(2). https://doi.org/10.1086/259131

Lancsar, E., Fiebig, D. G., & Hole, A. R. (2017). Discrete choice experiments: A guide to model specification, estimation and software. *PharmacoEconomics*, *35*(7). https://doi.org/10.1007/s40273-017-0506-4

Lancsar, E., & Louviere, J. (2008). Conducting discrete choice experiments to inform healthcare decision making: A user's guide. In *PharmacoEconomics* (Vol. 26, Issue 8, pp. 661–677). https://doi.org/10.2165/00019053-200826080-00004

Lancsar, E., & Savage, E. (2004). Deriving welfare measures from discrete choice experiments: Inconsistency between current methods and random utility and welfare theory. *Health Economics*, *13*(9), 901–907. https://doi.org/10.1002/hec.870

Land Use Policy Planning Department of Sri Lanka. (2020). *Data and information of home gardens in Sri Lanka*. Ministry of Lands and Land Development. https://luppd.gov.lk/images/Main_report_Full_Revised_compressed.pdf

Lautenschlager, L., & Smith, C. (2007). Beliefs, knowledge, and values held by inner-city youth about gardening, nutrition, and cooking. *Agriculture and Human Values*, *24*(2), 245–258. https://doi.org/10.1007/s10460-006-9051-z

Lee, D. E., & Du Preez, M. (2016). Determining visitor preferences for rhinoceros conservation management at private, ecotourism game reserves in the Eastern Cape Province, South Africa: A choice modeling experiment. *Ecological Economics*, *130*, 106–116. https://doi.org/10.1016/j.ecolecon.2016.06.022

Legesse, A., Tesfay, G., & Abay, F. (2016). The impact of urban home gardening on household socio-economy. *Arts and Design Studies*, *39*, 21–30.

Li, L., & Pussella, P. G. R. N. I. (2017). Is Colombo city, Sri Lanka secured for urban green space standards? *Applied Ecology and Environmental Research*, *15*(3), 1789–1799.

Lima, P. T., Sánchez, L. M. R., & Uriza, B. I. G. (2000). Mexico city: the integration of urban agriculture to contain urban sprawl. In N Bakker, M. Dubbeling, S. Gündel, U. Sabel-Koschella, & H. de Zeeuw (Eds.), *Growing cities growing food: Urban agriculture on the policy agenda* (p. 363:390). Deutsche Stiftung für internationale Entwicklung (DSE).

Litt, J. S., Soobader, M. J., Turbin, M. S., Hale, J. W., Buchenau, M., & Marshall, J. A. (2011). The influence of social involvement, neighborhood aesthetics, and community garden participation on fruit and vegetable consumption. *American Journal of Public Health*, *101*(8), 1466–1473. https://doi.org/10.2105/AJPH.2010.300111

Lokkerbol, J., van Voorthuijsen, J. M., Geomini, A., Tiemens, B., van Straten, A., Smit, F., Risseeuw, A., van Balkom, A., & Hiligsmann, M. (2019). A discrete-choice experiment to assess treatment modality preferences of patients with anxiety disorder. *Journal of Medical Economics*, *22*(2), 169–177. https://doi.org/10.1080/13696998.2018.1555403

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: Analysis and application*. Cambridge University Press.

Louviere, J. J., Pihlens, D., & Carson, R. (2010). Design of discrete choice experiments: A discussion of issues that matter in future applied research. *Journal of Choice Modelling*, *4*(1), 1–8.

Louvire, J., & Woodworth, G. (1983). Choice allocation consumer experiments: An approach aggregate aata. *Journal of Marketing Research*, *20*(4), 350–367. https://doi.org/10.2307/3151440

Lovell, S. T. (2010). Multifunctional urban agriculture for sustainable land use planning in the United States. *Sustainability*, *2*, 2499–2522. https://doi.org/10.3390/su2082499

Luce, R. D. (1958). A probabilistic theory of utility. *Econometrica*, *26*(2), 193–224. https://doi.org/10.2307/1907587

Lum, E. P. M., Page, K., Whitty, J. A., Doust, J., Graves, N., & Grove, K. (2018). Antibiotic prescribing in primary healthcare: Dominant factors and trade-offs in decision-making. *Infection, Disease & Health*, *23*(2), 74–86. https://doi.org/10.1016/j.idh.2017.12.002

MacCallum, R. C., Widaman, K. F., Preacher, K. J., & Hong, S. (2001). Sample size in factor analysis: The role of model error. *Multivariate Behavioral Research*, *36*(4), 611–637. https://doi.org/10.1207/S15327906MBR3604_06

Maheng, D., Ducton, I., Lauwaet, D., Zevenbergen, C., & Pathirana, A. (2019). The sensitivity of urban heat island to urban green space-A model-based study of city of Colombo, Sri Lanka. *Atmosphere*, *10*(151), 1:17. https://doi.org/10.3390/atmos10030151

Manski, C. F. (1977). The structure of random utility models. *Theory and Decision*, *8*(3), 224–254. https://doi.org/10.1007/BF00133443

Marshall, D., Bridges, J. F. P., Hauber, B., Cameron, R., Donnalley, L., Fyie, K., & Johnson, F. R. (2010). Conjoint analysis applications in health-how are studies being designed and reported?: An update on current practice in the published literature between 2005 and 2008. *Patient*, *3*(4), 249–256. https://doi.org/10.2165/11539650-000000000-00000

Martínez-Zarzoso, I., & Maruotti, A. (2011). The impact of urbanization on CO2 emissions: Evidence from developing countries. *Ecological Economics*, *70*(7), 1344–1353. https://doi.org/10.1016/j.ecolecon.2011.02.009

Maxwell, D., & Armar-Klemesu, M. (1998). *Urban agriculture: Introduction and review of literature*.

Maxwell, D., Levin, C., & Csete, J. (1998). Does urban agriculture help prevent malnutrition? Evidence from Kampala. *Food Policy*, *23*(5), 411–424.

Mayadunne, G., & Romeshun, K. (2013). Estimation of prevalence of food insecurity in Sri Lanka. *Sri Lankan Journal of Applied Statistics*, *14*(1), 27–40.

Mazzanti, M. (2003). Discrete choice models and valuation experiments. *Journal of Economic Studies*, *30*(5–6), 584–604. https://doi.org/10.1108/01443580310504453

Mbaye, A., & Moustier, P. (2000). Market-oriented urban agricultural production in Dakar. In N Bakker, M. Dubbeling, S. Gündel, U. Sabel-Koschella, & H. de Zeeuw (Eds.), *Growing cities growing food: Urban agriculture on the policy agenda* (pp. 235–256). Deutsche Stiftung für internationale Entwicklung (DSE).

Mbiba, B. (2000). Urban agriculture in Harare: between suspicion and repression. In N Bakker, M. Dubbeling, S. Gündel, U. Sabel-Koschella, & H. de Zeeuw (Eds.), *Growing cities growing food: Urban agriculture on the policy agenda* (pp. 285–302). Deutsche Stiftung für internationale Entwicklung (DSE).

McDougall, R., Kristiansen, P., & Rader, R. (2019). Small-scale urban agriculture results in high yields but requires judicious management of inputs to achieve sustainability. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(1), 129–134. https://doi.org/10.1073/pnas.1809707115

McFadden, D. L. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.), *Frontiers in Econometrics (Economic theory and mathematical economics)* (pp. 105–142). Academic Press Inc. https://eml.berkeley.edu/~mcfadden/dlmcv10.html

Merschak, J. (1960). Binary choice constraints on utility measurements. In K. Arrow (Ed.), *Mathematical methods in the social sciences, 1959 : proceedings of the 1st Stanford Symposium* (pp. 312–329). Stanford University Press.

Miners, A., Llewellyn, C., King, C., Pollard, A., Roy, A., Gilson, R., Rodger, A., Burns, F., & Shahmanesh, M. (2018). Designing a brief behaviour change intervention to reduce sexually transmitted infections: a discrete choice experiment. *International Journal of STD and AIDS*, *29*(9). https://doi.org/10.1177/0956462418760425

Ministry of Agriculture Sri Lanka. (2021). *National Agriculture Policy (NAP)*. https://www.agrimin.gov.lk/

Moffet, V., Alibert, M., & Larrivée, C. (2011). Interdisciplinary and multi-institutional approaches to climate change adaptation. In K. Otto-Zimmermann (Ed.), *Resilient cities: Cities and adaptation to climate change proceedings of the global forum 2010* (pp. 2013–2222). https://doi.org/10.1007/978-94-007-0785-6_22

Mohanty, S. K., & Vasishtha, G. (2021). Contextualizing multidimensional poverty in urban India. *Poverty and Public Policy*. https://doi.org/10.1002/pop4.314

Mohd Salleh, A., Harun, N. Z., & Abdul Halim, S. (2020). Urban Food Insecurity: The relationship between community resilience and urban agriculture. *Asian Journal of Quality of Life*, *5*(18), 57–73. https://doi.org/10.21834/ajqol.v5i18.206

Moors, G. (2008). Exploring the effect of a middle response category on response style in attitude measurement. *Quality and Quantity*, *42*(6), 779–794. https://doi.org/10.1007/s11135-006-9067-x

Morrison, M., Bennett, J., & Blamey, R. (1999). Valuing improved wetland quality using choice modeling. *Water Resources Research*, *35*(9), 2805–2814. https://doi.org/10.1029/1999WR900020

Morrison, M., Bennett, J., Blamey, R., & Louviere, J. (2002). Choice modeling and tests of benefit transfer. *American Journal of Agricultural Economics*, *84*(1). https://doi.org/10.1111/1467-8276.00250

Moustier, P., & Danso, G. . (2006). Local economic development and marketing of urban produced food. In R. van Veenhuizen (Ed.), *Cities farming for the future: Urban agriculture for sustainable cities* (pp. 171–206). RUAF Foundation, IDRC and IIRR.

Mulaik, S. A. (1987). A brief history of the philosophical foundations of exploratory factor analysis. *Multivariate Behavioral Research*, *22*(3). https://doi.org/10.1207/s15327906mbr2203_3

Mulaik, S. A. (2009). Foundations of factor analysis. In *Foundations of factor analysis*. Taylor & Francis. https://doi.org/10.1201/b15851

Nandwani, D., & Akaeze, O. (2020). Urban agriculture in Asia to meet the food production challenges of urbanization: A review. *Urban Agriculture and Regional Food Systems*, *5*(1). https://doi.org/10.1002/uar2.20002

Ngahdiman, I., Terano, R., Mohamed, Z., & Sharifuddin., J. (2017). Factors affecting urban dwellers to practice urban agriculture. *International Journal of Advanced Research*, *5*(7), 1580–1587. https://doi.org/10.21474/ijar01/4872

Novo, M. G., & Murphy, C. (2000). Urban agriculture in the city of Havana: A popular response to a crisis. In N Bakker, M. Dubbeling, S. Gündel, U. Sabel-Koschella, & H. de Zeeuw (Eds.), *Growing cities, growing food urban agriculture on the policy agenda* (pp. 329–348). Deutsche Stiftung für internationale Entwicklung (DSE).

Nutsford, D., Pearson, A. L., & Kingham, S. (2013). An ecological study investigating the association between access to urban green space and mental health. *Public Health*, *127*(11), 1005–1011. https://doi.org/10.1016/j.puhe.2013.08.016

Olazabal, M., Feliú, F., Izaola, B., Pon, D., Pooley, M., Alonso-Martin, M., & Castillo, C. (2011). Local strategies for climate change adaptation: Urban planning criteria for municipalities of the Basque Country, Spain. In K. Otto-Zimmermann (Ed.), *Resilient Cities:Cities and Adaptation to Climate Change Proceedings of the Global Forum 2010* (pp. 253–264). https://doi.org/10.1007/978-94-007-0785-6_26

Orme, B. K. (2010). Sample size issues for conjoint analysis. In *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research* (2nd ed., pp. 57–65). Research Publishers LLC.

Orsini, F., Kahane, R., Womdim, R. N., & Gianquinto, G. (2013). Urban agriculture in the developing world: A review. *Agronomy for Sustainable Development*, *33*(4), 695–720. https://doi.org/10.1007/s13593-013-0143-z

Orsini, F., Michelon, N., & Gianquinto, G. (2009). Farmers-to-consumers: An example of sustainable soilless horticulture in urban and peri-urban areas. *Acta Horticulture*, *809*, 209–220. https://doi.org/10.17660/ActaHortic.2009.809.21

Osborne, J. W. (2014). *Best practices in exploratory factor analysis*. CreateSpace Independent Publishing Platform.

Pallant, J. (2007). *SPSS survival manual: a step by step guide to data analysis using IBM SPSS* (3rd ed.). Open University Press/McGraw-Hill.

Paradelo, R., Herbón, C., & Barral, M. T. (2021). Composition and chemical properties of the soils of the city of Santiago de Compostela, northwestern Spain. *Journal of Environmental Quality*, *50*(1). https://doi.org/10.1002/jeq2.20094

Pearce, D. W., & Ozdemiroglue, E. (2002). *Economic valuation with stated preference techniques: Summary guide*. Department for Transport, Local Government and the Regions.

Peng, M., & Oleson, K. L. L. (2017). Beach recreationalists' willingness to pay and economic implications of coastal water quality problems in Hawaii. *Ecological Economics*, *136*, 41–52. https://doi.org/10.1016/j.ecolecon.2017.02.003

Perera, N. G. R., & Emmanuel, R. (2018). A "Local Climate Zone" based approach to urban planning in Colombo, Sri Lanka. *Urban Climate*, *23*, 188:203. https://doi.org/10.1016/j.uclim.2016.11.006

Pett, M. A., R., N. L., & Sullivan, J. J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*. SAGE Publications, Inc.

Phulkerd, S., Thapsuwan, S., Gray, R. S., & Chamratrithirong, A. (2020). Characterizing urban home gardening and associated factors to shape fruit and vegetable consumption among non-farmers in Thailand. *International Journal of Environmental Research and Public Health*, *17*(15). https://doi.org/10.3390/ijerph17155400

Poulsen, M. N., Neff, R. A., & Winch, P. J. (2017). The multifunctionality of urban farming: perceived benefits for neighbourhood improvement. *Local Environment*, *22*(11), 1411–1427. https://doi.org/10.1080/13549839.2017.1357686

Rai, R. K., Shyamsundar, P., Nepal, M., & Bhatta, L. D. (2018). Financing watershed services in the foothills of the Himalayas. *Water*, *10*, 965–976. https://doi.org/10.3390/w10070965

Rajapaksa, G. (2019). *Vistas of prosperity and splendour*. https://gota.lk/sri-lanka-podujana-peramuna-manifesto-english.pdf

Ranagalage, M., Estoque, R. C., & Murayama, Y. (2017). *An urban heat island study of the Colombo Metropolitan Area, Sri Lanka, based on landsat data (1997-2017)*. https://doi.org/10.3390/ijgi6070189

Reed Johnson, F., Kanninen, B., Bingham, M., & Özdemir, S. (2006). Experimental design for stated choice experiments. In B. J. Kanninen (Ed.), *Valuing environmental amenities using stated choice studies a common sense approach to theory and practice* (pp. 159–202). Springer.

Reed Johnson, F., Lancsar, E., Marshall, D., Kilambi, V., Mühlbacher, A., Regier, D. A., Bresnahan, B. W., Kanninen, B., & Bridges, J. F. P. (2013). Constructing experimental designs for discrete-choice experiments: Report of the ISPOR conjoint analysis experimental design good research practices task force. *Value in Health*, *16*(1), 3–13. https://doi.org/10.1016/j.jval.2012.08.2223

Revelt, D., & Train, K. (1998). Mixed logit with repeated choices: Households' choices of appliance efficiency level. *Review of Economics and Statistics*, *80*(4), 435–462. https://doi.org/10.1162/003465398557735

Roe, J., Mondschein, A., Neale, C., Barnes, L., Boukhechba, M., & Lopez, S. (2020). The urban built environment, walking and mental health outcomes among older adults: A pilot study. *Frontiers in Public Health*, *8*. https://doi.org/10.3389/fpubh.2020.575946

Rolfe, J., Bennett, J., & Louviere, J. (2000). Choice modelling and its potential application to tropical rainforest preservation. *Ecological Economics*, *35*(2), 289–302. https://doi.org/10.1016/S0921-8009(00)00201-9

Rose, J. M., & Bliemer, M. C. J. (2004). *The design of stated choice experiments: The state of practice of practice and future challenges* (ITS-WP-04-09; Institute of Transport Studies Working Paper).

Rose, J. M., & Bliemer, M. C. J. (2009). Constructing efficient stated choice experimental designs. *Transport Reviews*, *29*(5), 587–617. https://doi.org/10.1080/01441640902827623

Rose, J. M., & Bliemer, M. C. J. (2013). Sample size requirements for stated choice experiments. *Transportation*, *40*(5), 1021–1041. https://doi.org/10.1007/s11116-013-9451-z

Ruggeri, G., Mazzocchi, C., & Corsi, S. (2016). Urban gardeners' motivations in a Metropolitan city: The case of Milan. *Sustainability*, *8*(11). https://doi.org/10.3390/su8111099

Ruma, M. M., & Sheikh, A. U. (2010). Reuse of wastewater in urban farming and urban planning implications in Katsina metropolis , Nigeria. *African Journal of Environmental Science and Technology*, *4*(1), 28–33. http://www.academicjournals.org/AJEST

Russell, D. W. (2002). In search of underlying dimensions: The use (and abuse) of factor analysis in Personality and Social Psychology Bulletin. *Personality and Social Psychology Bulletin*, *28*(12), 1629–1646. https://doi.org/10.1177/014616702237645

Ruto, E., & Garrod, G. (2009). Investigating farmers' preferences for the design of agri-environment schemes: A choice experiment approach. *Journal of Environmental Planning and Management*, *52*(5), 631–647. https://doi.org/10.1080/09640560902958172

Ryan, M., Kolstad, J. R., Rockers, P. C., & Dolea, C. (2012). *How to conduct a discrete choice experiment for health workforce recruitment and retention in remote and rural areas: A user guide with case studies*. https://documents1.worldbank.org/curated/en/586321468156869931/pdf/NonAsciiFileName0.pdf

Saz-salazar, S., & Rausell-Koster, P. (2008). A Double-Hurdle model of urban green areas valuation: Dealing with zero responses. *Landscape and Urban Planning*, *84*, 241–251. https://doi.org/10.1016/j.landurbplan.2007.08.008

Scalone, L., Sarzi-Puttini, P., Sinigaglia, L., Montecucco, C., Giacomelli, R., Lapadula, G., Olivieri, I., Giardino, A. M., Cortesi, P. A., Mantovani, L. G., & Mecchia, M. (2018). Patients', physicians', nurses', and pharmacists' preferences on the characteristics of biologic agents used in the treatment of rheumatic diseases. *Patient Preference and Adherence*, *12*, 2153–2168. https://doi.org/10.2147/PPA.S168458

Schaafsma, M., van Beukering, P. J. H., & Oskolokaite, I. (2017). Combining focus group discussions and choice experiments for economic valuation of peatland restoration: A case study in Central Kalimantan, Indonesia. *Ecosystem Services*, *27*, 150–160. 10.1016/j.ecoser.2017.08.012

Senanayake, I. P., Welivitiya, W. D. D. P., & Nadeeka, P. M. (2013a). Remote sensing based analysis of urban heat islands with vegetation cover in Colombo city, Sri Lanka using Landsat-7 ETM+ data. *Urban Climate*, *5*, 19–35. https://doi.org/10.1016/j.uclim.2013.07.004

Senanayake, I. P., Welivitiya, W. D. D. P., & Nadeeka, P. M. (2013b). Urban green spaces analysis for development planning in Colombo, Sri Lanka , utilizing THEOS satellite imagery – A remote sensing and GIS approach. *Urban Forestry & Urban Greening*, *12*, 307–314. https://doi.org/10.1016/j.ufug.2013.03.011

Shamsudin, M. N., Rezai, G., & Kit Teng, P. (2014). Public attitude toward urban agriculture in Malaysia: Study on values and knowledge in Klang Valley. *Journal of Food Products Marketing*, *20*, 35–48. https://doi.org/10.1080/10454446.2014.921873

Snowball, J. D. (2008). *Measuring the value of culture: Methods and examples in cultural economics*. Springer.

Soga, M., Cox, D. T. C., Yamaura, Y., Gaston, K. J., Kurisu, K., & Hanaki, K. (2017). Health benefits of urban allotment gardening: Improved physical and psychological well-being and social integration. *International Journal of Environmental Research and Public Health*, *14*(1). https://doi.org/10.3390/ijerph14010071

Somasundaram, N., Ranathunga, I., Gunawardana, K., Ahamed, M., Ediriweera, D., Antonypillai, C. N., & Kalupahana, N. (2019). High prevalence of overweight/obesity in urban Sri Lanka: Findings from the Colombo urban study. *Journal of Diabetes Research*, 1–9. https://doi.org/10.1155/2019/2046428

Sroka, W. (2018). Perception of benefits of urban and peri-urban agriculture – A study in Polish metropolitan areas. *Annals of the Polish Association of Agricultural and Agribusiness Economists*, *XX*(6). https://doi.org/10.5604/01.3001.0012.7767

StataCorp. (n.d.). *Hausman specification test*. Retrieved December 10, 2020, from https://www.stata.com/manuals13/rhausman.pdf.

Subasinghe, S., Estoque, R. C., & Murayama, Y. (2016). Spatiotemporal analysis of urban growth using GIS and remote sensing: A case study of the Colombo Metropolitan Area, Sri Lanka. *International Journal of Geo-Information*, *5*(197), 1:19. https://doi.org/10.3390/ijgi5110197

Subasinghe, S., Nianhi, R., Rajapaksha, G., & Gamage, I. (2021). Monitoring the impacts of urbanisation on environmental sustainability using geospatial techniques: A case study in Colombo district, Sri Lanka. *Journal of Geospatial Surveying*, *1*(2). https://doi.org/10.4038/jgs.v1i2.29

Subasinghe, S., Wang, R., Simwanda, M., Murayama, Y., & Vitanova, L. L. (2021). Neighborhood dynamics of urban expansion based on morphological spatial pattern analysis and geospatial techniques: A case study of the Colombo metropolitan area, Sri Lanka. *Asian Geographer*. https://doi.org/10.1080/10225706.2021.1903519

Surat, H., & Yaman, Y. K. (2017). Evaluation of plant species in home gardens : A case study of Batumi city (Adjara). *Turkish Journal of Forestry*, *18*(1), 11–20. https://doi.org/10.18182/tjf.308755

Susca, T., Gaffin, S. R., & Dell'Osso, G. R. (2011a). Positive effects of vegetation: Urban heat island and green roofs. *Environmental Pollution*, *159*, 2119–2126. www.elsevier.com/locate/envpol

Susca, T., Gaffin, S. R., & Dell'Osso, G. R. (2011b). Positive effects of vegetation: Urban heat island and green roofs. *Environmental Pollution*, *159*, 2119–2126.

Symmank, L., Profeta, A., & Niens, C. (2020). Valuation of river restoration measures – Do residential preferences depend on leisure behaviour? *European Planning Studies*, 1–21. https://doi.org/10.1080/09654313.2020.1760792

Tabachnick, B. G., & Fidell, L. S. (2013). Using multivariate statistics. In *New York: Harper and Row* (6h ed.). Pearson Publication Ltd.

Tang, L., Luo, X., Cheng, Y., Yang, F., & Ran, B. (2014). Comparing the state-of-the-art efficient stated choice designs based on empirical analysis. *Mathematical Problems in Engineering*, *2014*. https://doi.org/10.1155/2014/740612

The World Bank. (2013a). *The heartbeat of Sri Lanka*. www.worldbank.org/en/news/feature/2013/03/21/colombo-heartbeat-sri-lanka

The World Bank. (2013b). *Urban agriculture: Findings from four city case studies (Urban development series knowledge papers)*. https://www.worldbank.org/en/topic/urbandevelopment/publication/urban-agriculture-four-city-case-studies

The World Bank. (2021). *Urban population (% of total population) - Sri Lanka*. Data. https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=LK

Thompson, B. (2006). Exploratory and confirmatory factor analysis: Understanding concepts and applications. In *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. American Psychological Association. https://doi.org/10.1037/10694-000

Thompson, B., & Daniel, L. G. (1996). Factor Analytic evidence for the construct validity of scores: A historical overview and some guidelines. In *Educational and Psychological Measurement* (Vol. 56, Issue 2, pp. 197–208). https://doi.org/10.1177/0013164496056002001

Thurstone, L. L. (1927). A law of comparative judgment. *Psychological Review*, *34*(4). https://doi.org/10.1037/h0070288

Train, K. (2009). *Discrete choice methods with simulation*. Cambridge University Press.

Turan, M. T., & Besirli, A. (2008). Impacts of urbanization process on mental health. *Anatolian Journal of Psychiatry*, *9*, 238–243.

van den Berg, M. M. (2011). Climate change adaptation in Dutch municipalities: Risk perception and institutional capacity. In K. Otto-Zimmermann (Ed.), *Resilient Cities:Cities and Adaptation to Climate Change Proceedings of the Global Forum 2010* (pp. 265–272). https://doi.org/10.1007/978-94-007-0785-6_27

Van Dongen, R., & Timmermans, H. J. P. (2019). Urban forestry and urban greening preference for different urban greenscape designs: A choice experiment using virtual environments. *Urban Forestry & Urban Greening*, *44*. https://doi.org/10.1016/j.ufug.2019.126435

van Leeuwen, E., Nijkamp, P., & Vaz, T. D. N. (2010). The multifunctional use of urban greenspace. *International Journal of Agriculture Sustainability*, *8*(1–2), 20–25. https://doi.org/10.3763/ijas.2009.0466

Vanniyasingam, T., Cunningham, C. E., Foster, G., & Thabane, L. (2016). Simulation study to determine the impact of different design features on design efficiency in discrete choice experiments. *BMJ Open*, *6*(7). https://doi.org/10.1136/bmjopen-2016-011985

W Mohamad, W. N. (2018). *Assessing preference elicitation methods in choice experiments: A case study of tourism facilities at Kenyir Lake, Malaysia* [Doctoral dissertation, Newcastle University]. https://theses.ncl.ac.uk/jspui/bitstream/10443/4146/1/W Mohammed 2018.pdf

Warner, R. (2007). Applied statistics: From bivariate through multivariate techniques. In *Components* (2nd ed.). SAGE Publications, Inc.

Watkins, M. W. (2006). Determining parallel analysis criteria. *Journal of Modern Applied Statistical Methods*, *5*(2), 344–346. https://doi.org/10.22237/jmasm/1162354020

Whitman, C. B., Shreay, S., Gitlin, M., van Oijen, M. G. H., & Spiegel, B. M. R. (2013). Clinical factors and the decision to transfuse chronic dialysis patients. *Clinical Journal of the American Society of Nephrology*, *8*(11), 1942–1951. https://doi.org/10.2215/CJN.00160113

Wickramasinghe, L. S., & Subasinghe, S. M. C. U. P. (2016). Spatial and temporal changes of the green cover of Colombo city in Sri Lanka from 1956 to 2010. *Journal of Environmental of Professional Sri Lanka*, *5*(1), 53–66.

Williams, B., Onsman, A., & Brown, T. (2010). Exploratory factor analysis: A five-step guide for novices. *Journal of Emergency Primary Health Care*, *8*(3). https://doi.org/10.33151/ajp.8.3.93

Xuan, B. B., Sandorf, D. E., & Aanesen, M. (2017). Informing management strategies for a reserve : Results from a discrete choice experiment survey. *Ocean and Coastal Management*, *145*, 35–43. https://doi.org/10.1016/j.ocecoaman.2017.05.004

Yang, J. C., Johnson, F. R., Kilambi, V., & Mohamed, A. F. (2015). Sample size and utility-difference precision in discrete-choice experiments: A meta-simulation approach. *Journal of Choice Modelling*, *16*, 50–57. https://doi.org/10.1016/j.jocm.2015.09.001

Zahina-Ramos, J. G. (2013). *Attitudes and perspectives about backyard food gardening: A case study in south Florida*. Florida Atlantic University.

Zeng, T. (2011). *Essays on the random parameter logit models* [Doctoral dissertation, Louisiana State University]. https://digitalcommons.lsu.edu/gradschool_dissertations/1584/

Zezza, A., & Tasciotti, L. (2010). Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. *Food Policy*, *35*(4), 265–273. https://doi.org/10.1016/j.foodpol.2010.04.007

Zick, C. D., Smith, K. R., Kowaleski-jones, L., Uno, C., & Merrill, B. J. (2013). Harvesting more than vegetables: The potential weight control benefits of community gardening. *American Journal of Public Health*, *103*(6), 1110–1115. https://doi.org/10.2105/AJPH.2012.301009

Zwick, W. R., & Velicer, W. F. (1982). Factors influencing four rules for determining the number of components to retain. *Multivariate Behavioral Research*, *17*(2), 253–269. https://doi.org/10.1207/s15327906mbr1702_5