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Socio-Demographic Factors Influencing the Extent of Residential Green Spaces in Galle City, Sri Lanka

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ABSTRACT

Due to increasing urbanization, the distribution of human settlements is changing and this has led to the rapid decline of vegetation cover in cities and townships. Urbanization tends to decrease the proportion of land that is dedicated to public green spaces. Therefore, residential gardens (private gardens) will need to play a major role in contributing to urban green space in future though presently little attention is given to their relative value and importance. Several factors influence the function of residential gardens in an urban area. The main objective of this paper is to evaluate the socio demographic factors that influence the size and presence of residential green spaces in an urban residential zone. As a case study, this research selected a primary residential zone in Galle City, Sri Lanka. Every housing unit (n=280) in a residential zone was surveyed to collect the data for multiple regression analysis. The analysis showed that factors such as land extent (LE), nature orientation (NO), perceptions about advantages of growing residential greenery (PA), perception about disadvantages resulting from residential garden (PDA), occupational status (husband and wife are not occupied) (D_1), and their educational level (higher than degree) (D_2) significantly affect to the extent of green area maintained by an urban residence. The relationship between extent of residential green space (EGA) and socio demographic factors can be explained by this model: $EGA = 0.091 + 0.003LE + 0.060NO + 0.030PA - 0.040PDA + 0.198D_1 + 0.240D_2$.

KEYWORDS

Functions of Residential Garden, Green Space, Private Garden, Residential Greenery, Urbanization

1. INTRODUCTION

In the year 1990, less than 40% of the global population lived in cities, but as of 2010, more than one-half of all people were living in an urban area. By the year 2030, 6 out of every 10 people will live in a city, and by 2050 this proportion will increase to 7 out of 10 people (UN HABITAT, 2014). As a result of urbanization and densification, the consumption of land by new residential developments can lead to a loss of green spaces (Kabisch et al., 2015).

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Urbanization has brought the convenience of city life to many people but has also subjected them to a harsher environment. Urban environmental problems such as air pollution, noise, and urban 'heat island' effect pose serious risks to the health of urban residents (Douglas, 2012). With the increased concern on climate changes, urban greening has gained new importance by serving as a low-cost approach for cities to mitigate and adapt to these changes (Gill, S. E., et al., 2007).

There has been growing interest in urban green space research due to evidence that nature positively impacts human wellbeing (Frumkin, 2013, Taylor & Hochuli, 2015). Extensive studies have shown that urban green spaces can generate multiple environmental benefits, including cleaning the air, lowering noise levels, reducing urban heat island intensity, and improving storm water runoff quality (McPherson and Simpson, 2002). Urban green spaces can also provide significant psychological and socio-economic benefits to their residents such as relieving stress and increasing property value (Fuller et al., 2007).

Urban green spaces are vegetated public and residential (private) spaces in cities that are typically categorized by land use and land cover (Kendal *et al*., 2016). Most research attention has been paid to sizable urban green spaces such as urban parks and urban forests (Jauregui, 1990/1991; Chang et al., 2007; Chen and Wong, 2006), not much work focuses on the micro-scale greening and residential gardens.

Residential gardens are recognized as an important component of urban green space (Loram *et al*., 2007), but their specific contribution has rarely been assessed. Urbanization naturally tends to decrease the extent of land that is dedicated to gardens (Mathieu, R., Freeman, C., Aryal, J., 2007 & Smith, C., 2010). Within this context, residential gardens play a major role in green infrastructure (Loram, A., Tratalos, J., Warren, P.H., & Gaston, K.J., 2007) though little attention is given to their value and importance.

In low-density cities with extensive suburban areas, private gardens represent a large proportion of the overall urban green infrastructure network (Cameron et al., 2012; Ghosh & Head, 2008; Loram et al., 2007). Private residential land in Sydney provides 43% of foliage cover and 77% of Australian capital city residences have one or more trees in their private gardens (Kirkpatrick et al., 2011; Lin et al., 2015). More than 50% of total greenspace in Dunedin, New Zealand comes from private gardens (Mathieu, Freeman, & Aryal, 2007). Lin et al. (2015) suggest that residential areas present the largest opportunity for increasing tree cover in cities.

A large number of studies, especially in Western countries, have looked at how residential green spaces are used and function. However, scientific evidence for residential garden in Sri Lanka is hard to find there are no any studies carried out to understand the residential garden practices in urban cities in Sri Lanka. However residential garden in the highly populated Wet zone have suffered a considerable degradation in the past two decades due to fragmentation and urbanization in Sri Lanka (Pushpakumara, et al, 2010).

Socioeconomic variables (e.g. population, housing density, education, and home ownership) were apparently better predictors of the extent and type of vegetation cover in private garden than biophysical variables (e.g. rainfall, soil fertility, and solar radiation, etc.) (Luck *et al*., 2009). A range of factors influences the presence and size of the residential gardens in an urban area. Therefore, this paper sought to investigate the impact of socio demographic factors to the size of residential green spaces in a highly urbanized city in Sri Lanka.

The research objectives are:

1. Identifying all socio demographic factors that influence the size and presence of a residential green space.
2. Assessing the most significant factors effect on the size and presence of a residential green space.
3. Developing a model to illustrate the relationship between the extent of residential green space and socio demographic factors in an urban settlement.

2. LITERATURE REVIEW

2.1. Urban Green Space and Residential Greenery

Though the definition of green space has for long been argued about, a universally accepted definition is still lacking (Byomkesh *et al*., 2012). The European Commission (2013) defined green space as a strategically planned network of high quality natural and partly built-up areas replete with many environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings. In other words, urban green space is land situated in urban areas with natural surfaces of bare soil or soil covered with vegetation (Swanwick *et al*., 2003, p97).

Jim and Chen (2003) defined urban green spaces as vegetated areas found in urban environments that could be described as semi-natural areas such as parks, forest patches, open spaces, residential gardens and long row of trees lining one or both sides of a roadway.

Urban green spaces includes a range of landscape types of varying complexity and morphology including parks, public green spaces, allotments, green corridors, street trees, urban forests, roof gardens, vertical greenery on walls and private(Residential) gardens (Cameron *et al*., 2012).

Cameron *et al*.'s (2012, p.129) definition of Residential garden as "the area adjoining a private dwelling, whether it is owned or rented" means that it is not accessible to the general public. Residents' autonomy over the garden is a key feature of residential gardens, although householders may give the design and maintenance responsibilities to other parties such as landscape architects, professional gardeners or caretakers. Residential gardens vary in form, function and size (Cameron *et al*., 2012). Garden size is closely associated with housing type and density (Whitford *et al*., 2001). In a study of five English cities, Loram *et al*. (2007) found that while terraced houses were the most numerous of three housing types in each of these cities, semi-detached and detached houses had the highest cumulative area of gardens.

2.2. Importance of Residential Gardens

With the world's urban population continuing to grow rapidly, many cities are transitioning to higher density, compact housing (Loibl & Toetzer, 2003; Radeloff, Hammer, & Stewart, 2005). Urban growth will inevitably lead to changes in urban vegetation cover and access to private green space – that is, people's private (domestic) gardens, back yards, and front yards. In areas of high residential density, each householder's green coverage is likely to either disappear or decline in size, while people living in the sprawling outskirts of cities may still have the opportunity to choose both the size and natural content of these spaces (Conway & Hackworth, 2007; Lowry, Baker, & Ramsey, 2012).

Residential gardens are important because they provide city residents with immediate access to urban green space (Gaston, Warren, Thompson, & Smith, 2005; Shanahan, Lin, Gaston, Bush, & Fuller, 2014). However, they also play a significant role in contributing to overall vegetation cover in cities, as residential areas contribute to more than 50% of all available green space in many cities (Gaston *et al*., 2005; Lin, Meyers, & Barnett, 2015; Loram, Tratalos, Warren, & Gaston, 2007; Mathieu, Freeman, & Aryal, 2007; Shanahan *et al*., 2014).

According to previous research, both public green spaces and private gardens can provide similar benefits. These include opportunities for social interaction and enhancement of social cohesion (Cheng & Pegg, 2016; Peters *et al*., 2010; Shanahan *et al*., 2015), improving mental health and sense of well-being (Cervinka *et al*., 2016; Cheng & Pegg, 2016; Lee & Maheswaran, 2011; Shanahan *et al*., 2015), and positively contributing to biodiversity (Cameron *et al*., 2012; Kong *et al*., 2010; Vickery, 1995). Private gardens bring socioeconomic benefits to local communities by improving the locality and raising property values (Clayton, 2007; Tyrvainen, 1997).

Vegetation around the home can provide a variety of important ecosystem services that contribute to human and environmental health at local, neighborhood, and regional scales (Bolund & Hunhammar, 1999). For example, benefits such as climate regulation, shade and shelter can be delivered passively

even when the human recipient does not actively spend time in the yard (Bowler, Buyung-Ali, Knight, & Pullin, 2010). These benefits can reduce the energy requirements for air conditioning and lower the peak demand for energy, thereby reducing consumer costs in residential homes (McPherson, 1994). The physical presence of vegetation around the home can also provide benefits of noise reduction by buffering residential areas from urban noise pollution, and enhance privacy by blocking the views from neighboring properties.

2.3. Factors Influencing the Function of Residential Greenery

Socioeconomic variables (e.g. population, housing density, education, and home ownership) were apparently better predictors of the extent and type of vegetation cover in private gardens than biophysical variables (e.g. rainfall, soil fertility, and solar radiation, etc.) (Luck *et al*., 2009). Larger domestic gardens (Smith *et al*., 2005), those associated with older properties (Hope *et al*., 2003), or with higher income or tertiary-educated residents tended to have proportionally more vegetation, greater diversity of plants, and more complex garden styles (Daniels & Kirkpatrick, 2006).

A range of factors influences the amount and type of vegetation in people's yards and Cultural background, demographics, housing type and ownership can all affect the decision to plant and maintain vegetation in private green spaces (Grove *et al*., 2006; Perkins, Heynen, & Wilson, 2004; Troy, Grove, O'Neil-Dunne, Pickett, & Cadenasso, 2007). For instance, people who own their own homes may be more likely to invest in tree cover to save money on heating and cooling or to enhance privacy (Bowler *et al*., 2010; Summit & McPherson, 1998). How long the suburb has been in existence also directly influences tree cover because in younger suburbs insufficient time would have elapsed for trees to be planted and become mature (Greene, Millward, & Ceh, 2011).

There is also a range of other factors that can discourage planting of new vegetation, or even encourage removal of existing vegetation. For example, in some locations the fear of assisting the spread of bushfires in hot and dry conditions can discourage planting around the home (Gilbert & Brack, 2007). Furthermore, the presence of dense urban vegetation is often associated with increased fear of crime (Gobster & Westphal, 2004; Nasar & Jones, 1997). Tree maintenance requires time, effort, and knowledge, as well as space, which is a scarce commodity in densely populated areas (Kirkpatrick *et al*., 2011; Summit & McPherson, 1998). Large trees around homes or near roads can cause damage or threaten foundations and other infrastructure due to the spread of heavy roots while large overhanging branches can also create safety issues (Head & Muir, 2005; Nowak & Dwyer, 2007). Pondering this range of possibilities and the barriers against planting and maintaining vegetation around the home, a growing body of research shows that socioeconomic and demographic factors are correlated with tree cover and species diversity within yards (Clarke, Jenerette, & Davila, 2013; Kirkpatrick, Daniels, & Zagorski, 2007; Shanahan *et al*., 2014; van Heezik, Freeman, Porter, & Dickinson, 2013).

Furthermore, considerable evidence now shows that socio-demographic factors (including gender, age, education, income and nature orientation) influence to the maintain a private green spaces (Ho *et al*., 2005; Lin, Fuller, Bush, Gaston, & Shanahan, 2014; Zanon, Doucouliagos, Hall, & Lockstone-Binney, 2013).

Table 1 summarized all the factors influences to the presence and size of residential gardens in an urban area. Table 2 shows the selected socio demographic variables for this research study.

When review the scientific literature on residential green space, most of the research have done in the context of community gardening, urban agriculture and home gardening. These researches gathered evidence of the benefits of gardening and food growing in relation to specific health and wellbeing issue.

They have used various methods to identify factors influencing participation in edible gardening and/or urban agriculture. The method such as descriptive case studies, comparative studies, surveys of participants and typology studies have been used to identify many types of influential factors including economic, institutional, cultural, social, and demographic factors.

Table 1. Summary of factors influencing the residential gardens

Factor Associated With Function of Residential Garden	Determining Factor	Authors
Presence and size of yards	History and types of urban development	Conway & Hackworth, 2007; Gill, Handley, Ennos, Pauleit, Theuray, & Lindley, 2008; Smith, Gaston, Warren, & Thompson, 2005
Proportion of green space available	Housing type and density	Whitford *et al*., 2001
Extent and type of vegetation cover in private gardens	Socioeconomic variables e.g. population and housing density, education, home ownership	Luck *et al*., 2009
	Biological variables e.g. rainfall, soil fertility, solar radiation	Luck *et al*., 2009
Abundance of vegetation	Physical characteristics of cities	Kirkpatrick, Davison, & Daniels, 2012; Loram *et al*., 2007; Shanahan *et al*., 2014; Smith *et al*., 2006
Decision to plant and maintain vegetation in private green spaces	Cultural background, demographics, housing type and ownership	Grove *et al*., 2006; Perkins, Heynen, & Wilson, 2004; Troy, Grove, O'Neil-Dunne, Pickett, & Cadenasso, 2007
Invest in tree cover to save money on heating and cooling and to enhance privacy	Home ownership	Bowler *et al*., 2010; McPherson *et al*,1998
Factors that discourage the planting and maintenance of vegetation	Fear of increased potential for bushfires in hot and dry conditions	Gilbert & Brack, 2007
	Presence of dense vegetation cover likely to instill fear of crime	Gobster & Westphal, 2004; Nasar & Jones, 1997
	Tree maintenance requires time, effort, and knowledge, as well as space that is a scarce commodity in densely populated areas	Kirkpatrick *et al*., 2012; Summit & McPherson, 1998
	Vegetation with heavy roots around homes or near roads can cause damage or threaten infrastructure; large overhanging branches can create safety issues	Head & Muir, 2005; Nowak & Dwyer, 2007
Tree cover and species diversity within yards	Socioeconomic and demographic factors	Clarke, Jenerette, & Davila, 2013; Kirkpatrick, Daniels, & Zagorski, 2007; Shanahan *et al*., 2014; van Heezik, Freeman, Porter, & Dickinson, 2013
Amount of time that people spend in green spaces	Nature orientation	Lin *et al*., 2014
What induces people to spend more time in their private yards	The vegetation content of private yards and socio-demographic factors	Arnold & Lang, 2007; Graesch, Broege, Arnold, Owens, & Schneider, 2006

Source: Developed by Author,2019

Some researchers have conducted case studies in which they created a profile of edible gardeners in an area. For example, Miura et al. (2003) profiled 152 urban edible gardeners in Davao City, in the Philippines, noting their age, education, family size, family income, household food consumption

Table 2. Selected variables for the study

No.	Variable	Description	Unit of Measurement
1	Land extent	Total lot size	Perch
2	Vegetation cover of yard	Percentage of area used as residential garden out of the total land space available for gardening	%
3	Year in which the home was built	House build year	Year
4	Housing type	Type of house	Single house - single story Single house - two story Single story - out of multi-story Attached house/ annex Raw house/ line house Hut/ shanty
5	Ownership of home	Land Tenure	Owned/ Rented/ Leased/ Encroached
6	Household size	Total number of people living in the home	Number
7	Children in the home	Number of children living in the home	Number
8	Occupation	Employment details of the person who maintains the home garden	Dual career/ only husband works/ only wife works/ both are non-occupied
9	Householder's income	Householder's average income	Rs.
10	Educational background	Highest formal educational qualification	Lower than O/L, O/L pass, A/L pass/ degree/ higher than degree
11	Cultural background	Cultural background	Buddhism/ Hinduism/ Islam/ Christianity
12	Nature orientation	The affective, cognitive, and experiential relationship individuals have with the natural world	Asked participants to respond to statements concerning their nature orientation. Items can then be averaged to produce a nature relatedness score.
13	Time spent in the home	The total time spent in the home per day for maintaining the home garden	hours
14	Perception about advantages of residential gardening	Consider the benefits that residents can gain from residential gardening	Asked participants to respond to statements concerning the benefits of residential greenery. The items can then be averaged to find their perceptions regarding advantages received from residential garden.
15	Perception about disadvantages of residential gardening	Consider the factors that can discourage residents from planting new vegetation, or even encourage them to remove old vegetation.	Asked participants to respond to statements concerning the factors that can discourage residents from planting new vegetation. Items can then be averaged to produce Index of Socioeconomic Disadvantage.

costs, yard size, number of varieties of fruits and vegetables planted, and body mass index. This research approach cannot determine the relative influence of different factors on gardening behavior.

A few studies (Maxwell, 1995; Mazereeuw, 2005; Mwangi, 1995) have compared the demographic characteristics of gardeners with non-gardeners in urban settings. For example, a telephone survey of urban residents of the Waterloo region in Canada found that the proportion of residents who grew food on their private, residential properties was found to be the same across gender, age and income

groups (Mazereeuw, 2005). However, residents who had lived in Canada for more than 10 years were more likely to grow their own food than those who had lived in Canada for less than 10 years. Mwangi (1995) and Maxwell (1995) also found that length of stay affected the probability of participation in urban agriculture in Nairobi (Kenya) and Kampala (Uganda), respectively. Additionally, Maxwell found that larger households were more likely to grow food.

Another strategy for explaining the factors that influence urban agriculture is to create typologies. Typologies are used as a means to explain clusters of factors influencing an activity or behaviour. Moustier and Moustier, P., & Danso (2006) created four types: home subsistence farmers, family-type commercial farmers, entrepreneurial farmers and multicropping peri urban farmers. Whereas, Kortright (2007) observed Toronto residents with edible backyards who did not fit into any of Moustier and Danso's four types and created another five types: cook gardeners, teaching gardeners, environmental gardeners, hobby gardeners, and aesthetic gardeners. Neither of these studies used empirical methods to create the typologies.

Although numerous studies have identified possible factors influencing gardening behaviors, none have measured the relative influence of socio demographic variables on the extent of size and presence of residential garden. To determine the relative influence of variables on participation in edible gardening, one would need to test a predictive model. For example, Blaylock and Gallo (1993) used a predictive model to determine the factors influencing the decision to produce vegetables at home in the USA. However, they restricted their model to external factors. To date, no studies have sought to determine the relative influence of socio demographic determinants on the size and presence of residential gardening.

In order to fill this gap in the literature, this research will determine which socio-demographic factors have the greatest influence on size and presence of residential gardening. Filling this research gap will contribute to a greater understanding of function of residential green spaces which can then be used to promote it. Understanding and promoting residential gardening in is important because gardening has numerous benefits.

By go through with the literature, we identified 14 socio demographic variables (Table 2)which are influencing to the size and presence of residential green space and then use multiple regression analysis to study the relationship between independent and dependent variable. Regression analysis can provide insights that few other techniques can. The key benefits of using regression analysis are that it can: Indicate if independent variables have a significant relationship with a dependent variable, indicate the relative strength of different independent variables' effects on a dependent variable and Make predictions (Eric Mool, 2014).

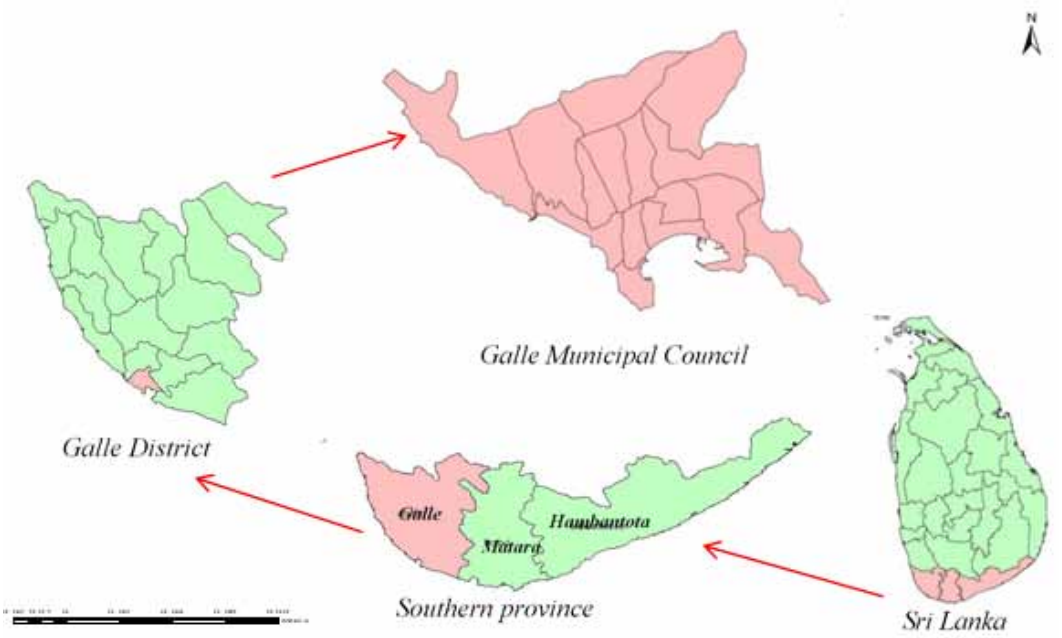
3. MATERIALS AND METHOD

3.1. Study Area

The City of Galle is located at Latitude 6.01^0 N and Longitude 80.13E in the Wet Zone, which is the most urbanized region in Sri Lanka. It is the largest town in the Southern Province and functions as the District and Provincial capital of the Southern Region. This town is located in the wet zone receives rain from South-West Monsoon with an annual rainfall of 2377.9 mm. Annual average temperature is 26.7 0 C and the humidity ranges from 80-88%. The Galle Municipal Council area covers an extent of 1742.4 hectares, and consists of 15 wards (Figure 1).

This urban area was first established as a municipality on 01.01.1867 according to the gazette notification no. 3571 issued by the Governor on 24.11.1866 under the Urban Council Ordinance of 1865. More recently, it had been recognized that there was a necessity to have planned development due to the population growth and other urban issues. Therefore, this town had been declared as an urban development area under Section 3 of the UDA Act No 41 of 1978 by Gazette Extraordinary notification No. 38/16 of 01.06.1979 for the purpose of formalizing the urban diversity arising with the population growth in the town.

Figure 1. Location map of Galle Municipal Council (MC)



Proposed Zoning Plan was prepared based on the development requirements of the town up to the planned period of 2025. Accordingly, the town was divided into 11 zones (Figure 2).

According to the proposed zoning plan (2008-2025) of the Urban Development Authority, eight primary residential zones have been demarcated within the Galle MC (Figure 3).According to the analysis done by C. Jayasinghe et all,2018 by measuring the suitability levels using GIS based weighted overlay analysis based on four key criteria such as level of infrastructure, land value, road accessibility, and proximity to town center the "Primary residential zone 6" is the best residential zone in Galle MC region(Figure 4). Therefore this zone is selected as the case study for this research; there are 280 housing units and represent 4% housing units from all residential zone (Table 3).

There are 280 housing units in the selected sample and 14322 population. There are 112 house owners are Buddhists,162 are Islamic and 6 are Christians. When concern about the detail of housing, 189 houses are single story, 63 are two story,14 are more than 2 storied houses. There are 2 annex type houses and 6 shanties. 264 houses are owned by themselves and 16 houses are rented houses.

76 households have less than 6 perch land lot,83 have 6-10 perch land, 68 have 10-15 perch land, 27 have 15-20 land extent and 26 householders have more than 20 perch land extent.

3.2. Data Collection

Survey was conducted on 280 housing units using the questionnaire survey method as the data collection technique and Participants were the owners of the housing units. There were 16 questions (Appendix A) covering three sub-topics: a) basic information regarding the residents, condition of house and land, b) green coverage, and c) peoples' attitudes towards green coverage. 5-point Likert scale-style questions used to get the details on nature orientation and participant's perception about advantages and disadvantages resulting from gardening. The data analysis of this study was performed using a multiple regression model. In this study 14 variables were used (Figures 5).

Figure 2. Proposed zoning plan of Galle MC

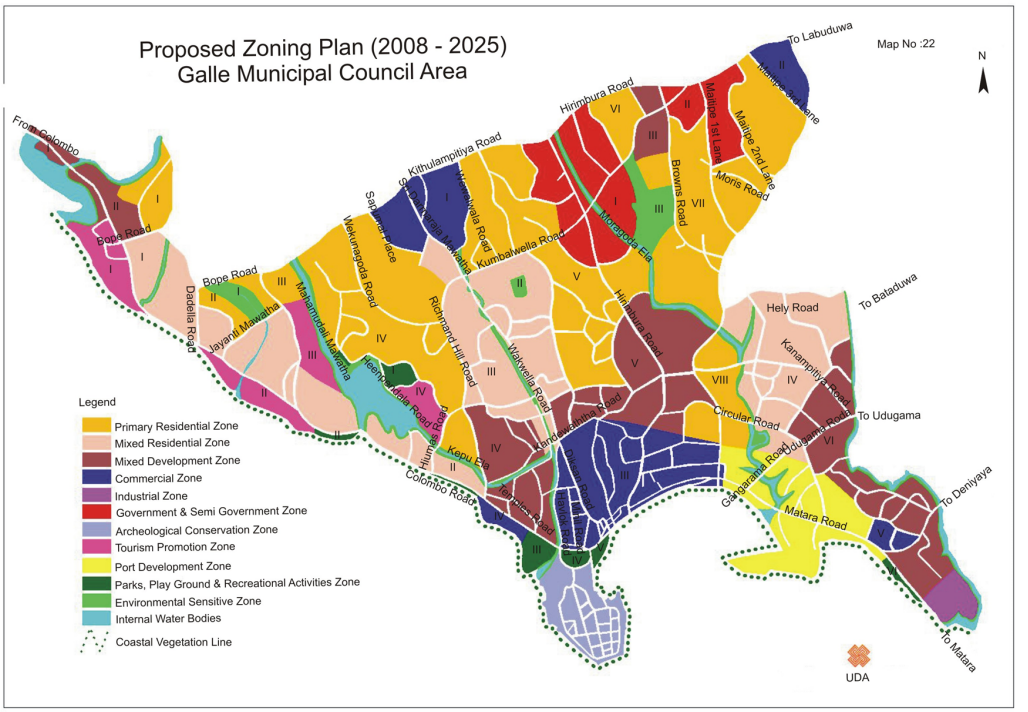


Figure 3. Primary residential zones of Galle MC

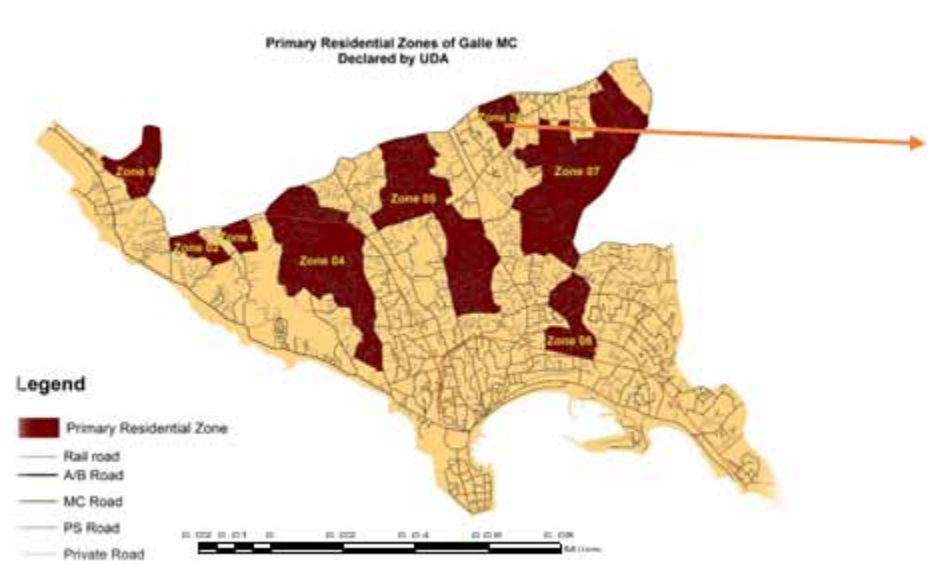


Figure 4. Primary residential zone 06

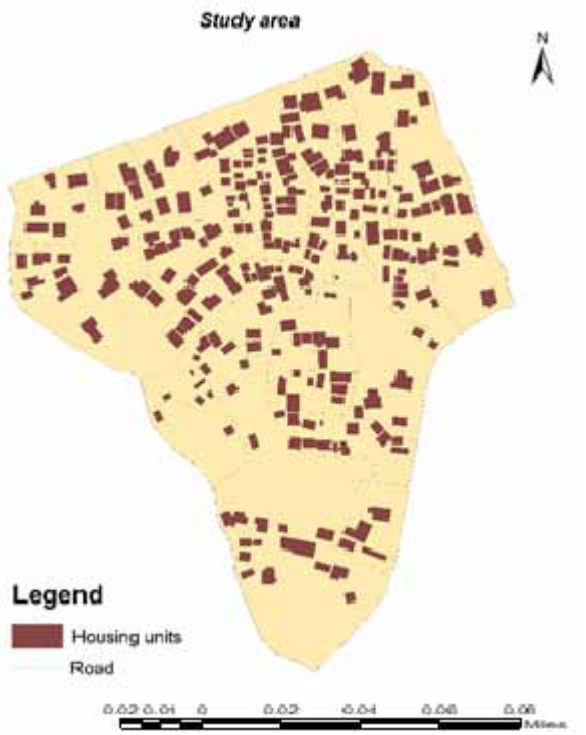


Table 3. Detail of each residential zone

Primary residential Zone	Extent (Acres)	%	No. of Housing Units	%
Zone 01	598	5	176**76**	3
Zone 02	34	3	214	3
Zone 03	25	2	122	2
Zone 04	306	25	1620	26
Zone 05	291	24	1542	24
Zone 06	41	3	280	4
Zone 07	371	31	1252	20
Zone 08	87	7	1126	18
Total	1214		6332	

3.2.1. Independent Variables

See Figure 5.

3.2.2. Dependent Variable

Extent of the residential green space maintain by the respondents was measured as follows:

Figure 5. Relationship between independent and dependent variable

$$SRG = \frac{AEG \times 100}{TUSG}$$

where:

SRG = % of space using for residential garden
AEG = Available Extent of greenery area
TUSG = Total usable space for gardening

4. ANALYSIS

Missing data can critically bias the conclusions of a research (Barbara G.Tabachnick & Fidell, 2001). Therefore, the issue of missing data should be addressed and treated before the analysis. There are no missing values in this study (Appendix B).

4.1. Reliability and Validity Analysis

Reliability and validity analysis were done for the three multiple respondent questions of the prepared questionnaire. This research tested reliability using Cronbach's Alpha value, which ranged from 0.70 to 0.95. In the validation process of the research two basic survey instruments, namely content and construct validity were assessed to get the uniqueness of the measures.

Table 4. Reliability and validity analysis

Variable	No. of Items	Cronbach's Alpha	KMO	Bartlett's Test		Initial Eigenvalue	AVE
				Chi Square Value	Sig.		
1. Nature Orientation	3	0.806	0.706	273.766	0.000	2.163	72.101%
2. Perception about advantages received from residential garden	9	0.864	0.915	964.487	0.000	4.494	49.929%
3. Perception about disadvantages resulting from residential garden	4	0.495	0.678	200.210	0.000	2.012	-
4. Perception about disadvantages resulting from residential garden after removing Q1	3	0.749	0.683	194.478	0.000	1.998	66.589%

Content validity is the subjective assessment of the measures affiliated with the face validity, and this is somewhat informal. All questions in the developed questionnaire were adopted from previous studies. By doing so, content validity was assured.

Researcher tested content validity by using Kaiser-Meyer-Olkin (KMO) measure, Bartlett's test of sphericity, Initial Eigenvalue and Average Variance Extracted (AVE). The value of Kaiser-Meyer-Olkin (KMO) should be greater than 0.5 if the sample is adequate (Field, 2005). If Bartlett's test is significant, factor analysis is appropriate to test construct validity (Field, 2005). If the Eigenvalue is greater than 1.00 then the data will support the assumption of unidimensionality (McGill M.T., 2009). The value of AVE for each construct should be at least 0.50 for the construct validity to be accepted (Zait & Bertea, 2011).

According to Table 4, Cronbach's Alpha values of all variables range from 0.70 to 0.95 except in the case of variable No. 04 – Perception about disadvantages resulting from residential garden. All KMO values are greater than 0.5. Likewise, all Sig values of Bartlett's Test also consistently maintain the condition of values that are less than 0.05 and Initial Eigenvalue as greater than 1. The AVE values are also above 0.5 except variable No. 04 – Perception about disadvantages resulting from residential garden. Researcher is able to state that all variables are reliable and valid after removing Q1 from Perception about disadvantages resulting from residential garden. Hence, the researcher could safely conclude that the reliability and validity of this research attained a higher position after the elimination of unsuitable questions.

4.2. Regression Analysis

Regression analysis is a powerful statistical method that allows one to examine the relationship between two or more variables of interest. In this research, the dependent variable is the extent of green area maintained by the resident. There are altogether 14 independent variables including a few dummy variables.

As shown in Table 5, the P value of the variable such as land extent, nature orientation, perception about advantages and disadvantages associated with residential greenery, occupational level of husband and wife, and their educational level is greater than 0.05. Then at 95% confidence level researcher can say that those factors have an effect on Extent of the green area. Based on the result of analysis the following model is formulated to illustrate the relationship between socio demographic factors influencing to the extent of green space maintain by the urban residence.

4.3. Developed Regression Model

$$EGA = 0.091 + 0.003LE + 0.060NO + 0.030PA - 0.040PDA + 0.198D_1 + 0.240D_2$$

EGA = Extent of the green area

Table 5. Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.091	0.173		0.525	0.600
Land extent (Perches)	0.003	0.001	0.127	2.685	0.008
Age of the home	0.000	0.001	0.015	0.337	0.736
Household size	0.008	0.010	0.060	0.854	0.394
Number of children at home	-0.004	0.013	-0.019	-0.281	0.779
Average income	1.204E-009	0.000	0.000	0.008	0.994
Total number of hours spent at home	-0.002	0.001	-0.064	-1.255	0.211
Nature Orientation	0.060	0.011	0.344	5.680	0.000
Perception about advantages received from residential garden	0.030	0.014	0.115	2.087	0.038
Perception about disadvantages resulting from residential garden	-0.040	0.015	-0.139	-2.579	0.010
Housing type- single storey	-0.064	0.056	-0.144	-1.134	0.258
Housing type- two storey	-0.086	0.058	-0.172	-1.477	0.141
Housing type- more than two storeys	-0.092	0.065	-0.096	-1.406	0.161
Housing type- attached house/ annex	-0.086	0.118	-0.035	-0.726	0.468
Housing type- hut/ shanty	-0.024	0.084	-0.016	-0.281	0.779
Land ownership- owned by member	-0.009	0.039	-0.010	-0.223	0.823
Dual career	0.129	0.080	0.271	1.611	0.108
Only husband works	0.115	0.078	0.263	1.468	0.143
Only wife works	0.071	0.088	0.074	0.809	0.419
Both are non-occupied	0.198	0.084	0.176	2.363	0.019
Lower than O/L	-0.042	0.075	-0.091	-0.568	0.571
O/L pass	-0.058	0.075	-0.132	-0.770	0.442
A/L pass	-0.047	0.074	-0.098	-0.630	0.529
Degree	-0.071	0.079	-0.083	-0.897	0.370
Higher than degree	0.240	0.089	0.224	2.701	0.007
Culture- Buddhism	-0.007	0.113	-0.017	-0.063	0.950
Culture- Islam	-0.026	0.114	-0.062	-0.230	0.818
Culture- Christian	0.010	0.130	0.007	0.074	0.941

LE = Land extent (Perches)
NO = Nature Orientation
PA = Perception about advantages received from residential garden
PDA = Perception about disadvantages resulting from residential garden
D_1 = Occupation (Both are non-occupied)
D_2 = Education level (Higher than degree)

Table 6. Overall model significance

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.833	27	0.253	11.976	0.000[b]
	Residual	5.325	252	0.021		
	Total	12.158	279			

a. Dependent Variable: Extent of the green area (Source: Author, 2019)

b. Predictors: (Constant), Cultural-Christian, Only husband works, A/L pass, Land ownership- owned by member, Housing type- attached house/ annex, Housing type- two storey, Degree, Perception about disadvantages resulting from residential garden, Housing type- hut/ shanty, Age of the home, Both are non-occupied, Housing type- more than two storey, Number of children at home, Average income, Land extent, Total number of hours spent at home, Perception about advantages received from residential garden, Only wife works, Cultural-Buddhism, Higher than degree, Lower than O/L, Nature Oriented, Household size, Housing type- single storey, Dual career, O/L pass, Cultural-Islam.

4.3.1. Regression Model Requirement

Overall model significance was tested by ANOVA Statistic, and it gave a P value of 0.000, which is less than 0.05. Researcher can say that this was the overall model significance at 95% confidence level. Overall model significance means that independent variables in the developed model jointly affected Extent of the green area (Table 6).

4.3.2. Model Adequacy

R-squared is 0.562. It means that 56.2% of the variation in Extent of the green area can be explained by the following six independent variables: Land extent, Nature Orientation, Perception about advantages received from residential garden, Perception about disadvantages resulting from residential garden, Occupation and Educational level. Therefore, researcher can say that the model is adequate.

Then researcher check regression model assumptions as follows.

4.3.3. Residual Should Not be Auto Correlation Error

Residual should not be Auto correlation error, and this can be tested by using Durbin-Watson statistic. According to the model summary (Table 7), Durbin-Watson statistic is 1.854, which is close to 2. Therefore, there is no Auto correlation error and the model is appropriate.

4.3.4. Residual Should Be Normal Distribution

Residuals are normality or not can be check by using histogram and P-P plot. Histogram has bell shape (Figure 6) and P-P plot's plots closed to the diagonal line (Figure 7). Then researcher can say that residuals are normally distributed.

Table 7. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.750[a]	0.562	0.515	0.14537	1.854

a. Predictors: (Constant), Cultural-Christian, Only husband works, A/L pass, Land ownership- owned by member, Housing type- attached house/ annex, Housing type- two storey, Degree, Perception about disadvantages resulting from residential garden, Housing type- hut/ shanty, Age of the home, Both are non-occupied, Housing type- more than two storey, Number of children at home, Average income, Land extent, Total Number of hours spent at home, Perception about advantages received from residential garden, Only wife works, Cultural-Buddhism, Higher than degree, Lower than O/L, Nature Oriented, Household size, Housing type- single storey, Dual career, O/L pass, Cultural-Islam

b. Dependent Variable: Extent of the green area (Source: Author, 2019)

Figure 6. Regression Standardized Residual

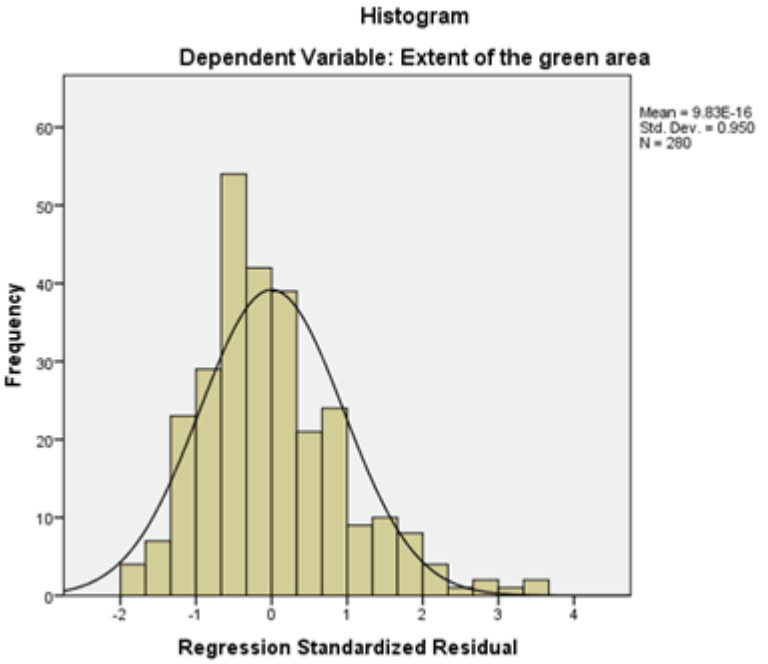
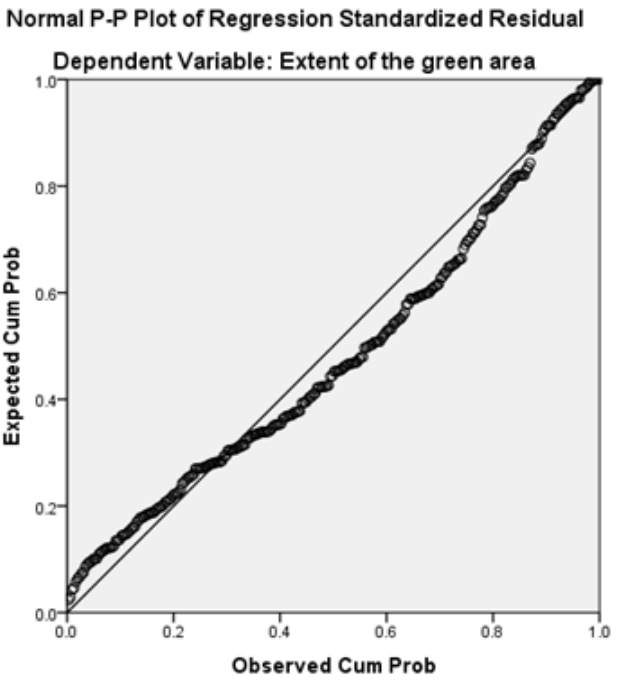


Figure 7. Normal P-P plot of Regression standardized residual



4.3.5. Residual Are in Homoscedasticity Distribution

The error lies on systematic pattern says the inadmissible of the model. Thereby, variance of the error is not constant. Hence, if the model is good fit, it should be homoscedasticity. Accordingly, Figure 8 It has not been distributed on systematic pattern. Thus, errors are in homoscedasticity distribution (Residual mean zero and constant variance). Therefore, the regression model is acceptable.

Regression model requirements and assumptions are fulfilled and it means that this model is valid.

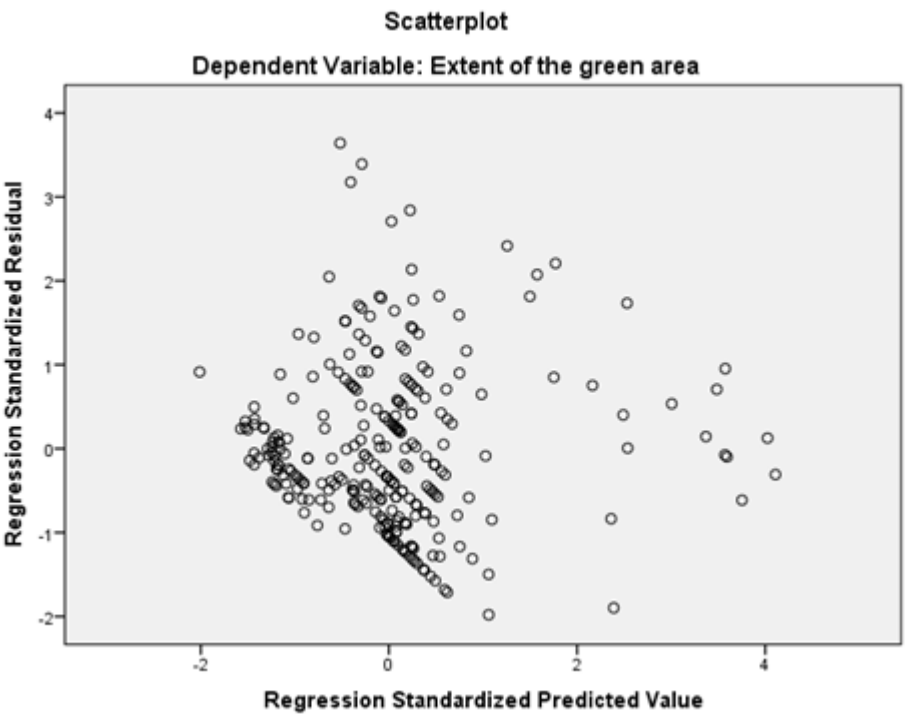
5. RESULTS

Residential gardens constitute a substantial proportion of the green spaces in Galle City. However, not all residents choose to have, or are able to keep a residential garden. Generally, householders who have less than 6 perches of land are unable to maintain an adequate plot of greenery. Mean extent of the green area maintained by land owners who own less than 6 perches is 18.80%, while 6-10 perch land owners maintain 21.36%, 10-15 perch land owners maintain 30%, 15-20 perch land owners maintain 28% and those who own more than 20 perches maintain 38%. Land extent had a significant positive effect on the Extent of green area maintained by the residents.

Nature Orientation had a significant positive effect on Extent of the green area ($p < 0.05$, $\beta = 0.060$). This indicates that when the Nature Orientation increases, Extent of the green area will also increase. Mean Extent of the green area maintained by the Nature Oriented People is 33.5% and Mean Extent of the green area maintain by the non-Nature Oriented People is 16.6%.

Regression beta value for Perception about advantages received from residential garden is 0.038. This indicates that when Perception about the advantages received from residential gardens increases,

Figure 8. Scatterplot



Extent of the green area will also increase. Mean Extent of the green area of people who perceived the advantages received from residential gardens is 27.15% and Mean Extent of the green area of people who did not perceive the advantages received from residential gardens is 18.05%.

Cameron *et al*. (2012) found that perceptions of private gardens are not always positive. However, most participants (27.15%) of this study enjoyed gardening and found it a therapeutic activity. Residents' benefit from gardens is mostly related to the extent of their gardening practices.

Mean Extent of the green area of people who perceived that disadvantages result from residential gardens is 21.43% and Mean Extent of the green area of people who did not perceive that disadvantages resulted from residential gardens is 47.8%. Regression beta value for Perception about disadvantages resulting from residential garden is –0.040. This indicates that when Perception about disadvantages resulting from residential garden increase, Extent of the green area will decrease.

As shown in Table 5, Occupation has a significant effect on Extent of the green area ($p < 0.05$). Beta value when both husband and wife are non-occupied is 0.198. This indicates that when husband and wife are non-occupied, Extent of the green area will increase by 19.8%.

According to the Regression Coefficients, P value of Educational level (higher than degree) is 0.007, which value is less than 0.05. Then at 95% confidence level researcher can say that Educational qualification has an effect on Extent of the green area. Mean Extent of the green area maintained by people whose educational level is higher than a degree is 75.9%.

Findings from our quantitative study indicated that land extent, nature orientation, perception about advantages and disadvantages associated with residential greenery, occupational level of husband and wife, and their educational level significantly affect the extent of green area maintained in urban residences.

Age of the home, housing type, ownership, household size, number of children at home, average income, number of hours spent at home and cultural background do not seem to have any effect on the extent of residential greenery in the study area.

6. CONCLUSION AND DISCUSSION

As the world's cities continue to grow, continuing to value green space in cities is vital, but is also a challenge, particularly in developing nations where there is pressure for space, resources and development. Therefore, it is necessary to draw attention on this area and find innovative solutions in this domain.

Urban green spaces are considered a key solution to problems associated with increasing urbanization, such as pollution and urban 'heat island' effect (Kendal *et al*., 2016; Smith *et al*., 2006). The green infrastructure of cities includes both public and private green spaces. This paper investigated the socio demographic factors that most influence the size and presence of residential green spaces in an urban environment. The analysis showed that factors such as land extent, nature orientation, and perceptions about advantages and disadvantages of growing residential greenery, occupational status and their educational level significantly affect to the extent of green area maintained by an urban residence.

The present study has some limitations that provide directions for future research. First, the present sample represent the householders living in best residential zone of Galle city and represent only 4% housing units from all residential zone. Replication of this study in other residential zones is necessary in more representative samples to establish generalization.

Second, the results of this study have shown that it is possible to develop a model that describes the socio demographic factors influence on the size of a residential garden in an urban city. The model can be further improved by considering another variables mentioned in the literature review section of this article. We considered only 14 variables and there are few other variables such as history and types of urban development (Conway & Hackworth, 2007; Gill, Handley, Ennos, Pauleit, Theuray, & Lindley, 2008; Smith, Gaston, Warren, & Thompson, 2005), housing density (Whitford

et al., 2001) and physical characteristics of cities (Kirkpatrick, Davison, & Daniels, 2012; Loram *et al*., 2007; Shanahan *et al*., 2014; Smith *et al*., 2005) that influence the size of a residential garden in an urban city. The extent and type of vegetation cover in private gardens vary in accordance with the biological variables such as rail fall, soil fertility, solar radiation (Luck et al,2009). These variables can be used to further develop this research study.

The results of this study can support public authorities and urban planners as they strive to effectively design and manage urban green spaces. The presence of private gardens reduces the need for public green spaces therefore future greening initiatives should focus on residential green spaces. Under the present circumstance, there are no planning guidelines and standards to encourage greenery in residential lands in Sri Lanka. From the results, we proposed that regulations for green coverage with proportion to the lot size is needed to sustain the urban greenery in Sri Lanka.

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APPENDIX A. IDENTIFICATION OF SOCIO DEMOGRAPHIC FACTORS INFLUENCE TO THE FUNCTIONS OF RESIDENTIAL GARDENS

1. Land extent:
2. Extent of the greenery area:
3. % of area using as residential garden as a proportion to the total land space can be used as gardening?

$$\frac{Extent\ of\ greenery\ area}{Total\ usable\ space\ for\ gardening} \times 100 =$$

4. Age of the house:
5. Housing types:

Single house- Single story	Single house- Two story	Single story- more than two story	Attached house/annex	Raw house/line house	Hut/shanty

6. Land ownership:

Owned by a member of the household	Rent	Leased	Encroached

7. Householder's size:
8. Number of children in the home:
9. Occupation:

Dual carrier	Only husband work	Only wife work	Both are non-occupied

10. Householders average income per month:
11. Educational background:

Less than O/L	O/L pass	A/L pass	degree	Above degree

12. Cultural background:

Buddhism	Hinduism	Islam	Christianity

13. Time spent at home (6.00 am to 6.00 pm):

husband	
wife	
Others	
Total	

14. Are you nature oriented?

	SA	A	N	D	SD
a) I would prefer to visit nature related places during my free time					
b) I prefer to gardening as my hobby					
c) I never approve the cutting of trees					

15. What is your perception about advantages receiving from residential garden?

	SA	A	N	D	SD
a) Contact with nature					
b) Leisure activities with family, friends					
c) Provide opportunities to improve mental health & physical fitness					
d) Provide habitat for wildlife, aiding biodiversity					
e) Help to stabilize urban temperature & humidity					
f) Absorb pollutants in air & ground water					
g) Slow storm water runoff and reduce drainage infrastructure					
h) Receiving Food & medicine					
i) Increase the house value					

16. What is your perception about the disadvantages of a residential garden?

	SA	A	N	D	SD
a) Presence of urban vegetation will create fear of crime					
b) Tree maintenance require time, effort, knowledge & space					
c) it will reduce the space for other activities					
d) vegetation around home can cause root damage or threaten other infrastructure with fallen limbs creating safety issues					

APPENDIX B. UNIVARIATE STATISTICS

Table 8. Univariate Statistics

	N	Mean	Std. Deviation	Missing	
				Count	Percent
M5kQ1	280	2.75	1.464	0	.0
M5kQ2	280	2.55	1.354	0	.0
M5kQ3	280	3.36	1.410	0	.0
M5lQ1	280	3.79	1.190	0	.0
M5lQ2	280	3.42	1.281	0	.0
M5lQ3	280	2.95	1.355	0	.0
M5lQ4	280	3.81	1.065	0	.0
M5lQ5	280	3.30	1.165	0	.0
M5lQ6	280	3.12	.958	0	.0
M5lQ7	280	3.39	1.177	0	.0
M5lQ8	280	3.84	.941	0	.0
M5lQ9	280	2.58	1.158	0	.0
M5mQ1	280	3.39	1.263	0	.0
M5mQ2	280	3.90	1.109	0	.0
M5mQ3	280	3.79	1.121	0	.0
M5mQ4	280	3.91	1.119	0	.0

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