

IMPACT OF FLORA ON SENSE OF SAFETY: A STUDY OF INDEPENDENCE SQUARE, COLOMBO

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Abstract

Sri Lanka as a developing country, urban green spaces are important to physical and psychological well-being of the urbanites. These spaces play a vital role in balancing the green of the urban areas as well. Many natural and manmade elements are compromised in the aforementioned urban green spaces. Many researches have proven the importance of these elements in assuring psychological safety while inhabiting the urban public spaces. Among these elements flora plays a crucial role as it has many benefits to the human as well as for the environmental system.

This study investigates the relationship between the flora and the sense of safety in the urban public spaces. For the identification of the parameters of the physical and psychological safety, Prospect Refuge Theory, concept of eyes on the street, information processing theory and many other related theories were analyzed. Through this literature survey; visibility, environmental satisfaction and wayfinding were selected as the parameters for the study. Independence Square, Colombo was selected as the case study as it is a functional public urban space which consists with plenty of flora. Primarily observations were done for the proper selection of the spaces and further validation was obtained through the supervisors and the peers. Thirty visitors to the premises were selected randomly for the questionnaire and the open-ended interviews. The results show that the moderately dense areas feel safer than highly dense areas and low dense areas. Darker places were rejected from the users while more visible spaces were selected as safer space. According to the findings visibility of the space is more important and flora density is more impacted on this parameter. Besides, Wayfinding and environmental satisfaction shows insignificant impacts on safety when compared with visibility.

Keywords: Vegetation density, sense of safety, urban public spaces

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Introduction

As the commercial capital of the country, Colombo has higher rise buildings being built in the city which makes the city to a concrete forest. In order to prevent this chaos and from the perspective on well-being of city dwellers, it is more important to have urban public spaces as much as possible within the context which brings more green into the city. "Access to natural open spaces is a central value in modern society". Moreover, urban outdoor spaces are associated with personal and social meanings. They provide a context for social interaction (Burgess, Harrison, & Limb, 1988), and offer "gateways" or opportunities for people to escape for a while from the stress of urban life (Burgess et al., 1988).

Therefore, urban green spaces are more beneficial for both city dwellers and the environment. As the main element will be flora, in enhancing the aesthetic value of an urban green space, it will also help to keep thermal comfort of the space. Even though we need as much as flora to reduce environmental issues and to enhance the aesthetic beauty, it must not lead the space to be criminal friendly, or a space favourable for anti-social activities such as vandalism which can be often seen in most urban public spaces.

Objectives of the Study

The main objective of the study is to investigate the most important environmental factor on sense of safety in reference to flora in an urban public space in local context.

Scope and Limitations

- In this study only an urban public outdoor green space was considered. The sense of safety in urban public spaces is beyond the scope of this study.
- Individual tree canopies or their leaf density were not measured. Only an approximate opportunistic analyze has been done to classify areas by considering flora. Therefore, overall impact at the space was studied on sense of safety in classified spaces.
- The impacts of ethnicity, social class, gender, age, education level, marital status, religion and familiarity were not considered in this study. To prevent from deviations of final result study due to those factors being applied, some precautions were taken whilst collecting data. When analyzing the collected data from questionnaire responses, samples were selected using a systematic sampling system to represent the users of the space to gain more accurate result of the study and to conduct the study more statistically.

Sense of safety and landscape:

Some previous research and studies shows that there is no relationship between the natural environment and the sense of security. But there are more previous research and studies, journals and theories that explain the relationship between the natural environment and the sense of security in urban outdoor spaces.

The safeties of urban parks in regards to natural elements have been considered in these studies. The vegetation density of landscape had been categorized into three types of complexity levels as; high, moderate and low complexity and several theories such as; Information-processing theory (Kaplan and Kaplan's theory), Appleton's prospect-refuge theory, Arousal theory, Broken windows theory (Kelling & Wilson) and Optimization theory have been used. CPTED (Crime Prevention through Environmental Design) has been considered as well when conducting the research which implies that the visibility should be considered in regards to safety(Hami & Emami, 2015).

The sense of safety in regard to the surrounding environment is much of an individual preference depending on the factors they consider. “Daniel defined “Landscape preference” as an individual’s degree of like or dislike for the visual appearance of a place as compared to another.” (Hami & Emami, 2015) A familiar space, a space with the surrounding of one’s a favourable elements such as favourite flowers and water features as well as the planting patterns may result in making that individual feel safer in that space rather than in other spaces. A conclusion had been made that the moderate complexity level is considered as more secured by people. And also the presence of a water feature in such places enhances the secure feeling of users even at high complexity landscape. A readable environment is created when designed with less variety of plants and more repetition of plants. Also the low density of understory plants which shows open character with a positive effect on secureness without reducing other benefits of urban parks. (Hami & Emami, 2015)

Factors such as area covered by the vegetation including the understory as well as the canopy coverage, planting pattern and the lighting of a space are also considered by users in order to feel safe. A case study in Tabriz, Iran has been done in order to determine how the planting patterns affect the safety in urban parks mainly using Routine Activity (RA) theory. It shows that the planting pattern may either create a crime-friendly surrounding or support anti-social activities (Misuse of public space, Disregard for community/personal well-being, Acts directed at people, Environmental damage (Maulan, 2014)(Harradine, Kodz, Lemetti, & Jones, 2004). A research has been conducted mainly on how both natural and artificial lighting condition effect the safety by using Prospect and Refugee theory, Figure-Ground theory (Kevin Lynch), Concept of Eyes on the Streets (Jane Jacobs), Broken windows theory (Kelling & Wilson) and Sense of ‘Enclosure’ theory (Chris Haile). The user preference of a space depending on the research conducted on whether vegetation reduces crime had shown that high-canopy trees, widely spaced trees, low growing shrubs, and grass may actually reduce crime in poor inner-city neighborhoods while low visibility vegetation forms such as large shrubs and dense woods are crime-friendly. (Kuo & Sullivan, 2007). Here also, the visibility has been considered as a measurable factor which impacts the safety of urban parks depending on the user. (Jayasinghe, 2016). Another case study has shown that way-finding anxiety, legibility, and visibility are mainly considered in regard to the safety of environmental designs. Reduce the height of shrubs and enclosing walls, Raising the tree canopy, Grass or smooth ground together with water elements as well as Decrease tree density are concluded ways of improving the visibility. It also concludes that the well maintained, manicured parks feel much safer than natural looking urban parks. (Dogrusoy, 2017)

Environmental parameters impact on sense of safety in urban public spaces

The factors that effect on sense of safety in urban public spaces were identified through the literatures reviewed. The environmental factors visibility, wayfinding anxiety and environmental satisfaction were identified as factors with most impact on sense of safety in an urban public space.

According to the previous researches any object obstructing the user’s depth of visibility reduces the sense of safety of the space. Most of the users are afraid of enclosed places and places where the outside cannot be seen from the place they are relaxing. Therefore, visibility is also a more important environmental factor in an urban public design as flora can be an object to block the user’s view. According to literature review way-finding anxiety encourage the feeling of unsafe in users. Uneasiness to find out the way to exit or where to go within the space will enhance the way-finding anxiety. This will lead for users to feel that he or she is not safe due to confusion occur during finding the way.

Environmental satisfaction is an another parameter to measure the sense of safety of an urban public space. Many researches states that users are more satisfied and tend enjoy the space when the space is felt much safer to them. They may also recommend the space to their friends and other people if they are satisfied of the space and if they feel safer at the space.

Theoretical Background

This study mostly depends on recent studies and journal articles which already done in regard to this research area. Theories that have been applied to those studies and journals have taken as supportive theories to confirm the safety dimensions and parameters which are more important in this study.

Several theories have been used as supportive theories such as Information-processing theory (Kaplan and Kaplan’s theory), Appleton’s prospect-refuge theory, Routing activity theory, broken windows theory (Kelling & Wilson) and sense of enclosure theory, figure-ground theory and also the concept of Eyes on the street. Alongside, CPTED (Crime Prevention through Environmental Design) has been considered when conducting the studies which imply that the visibility should be considered in regards to safety.

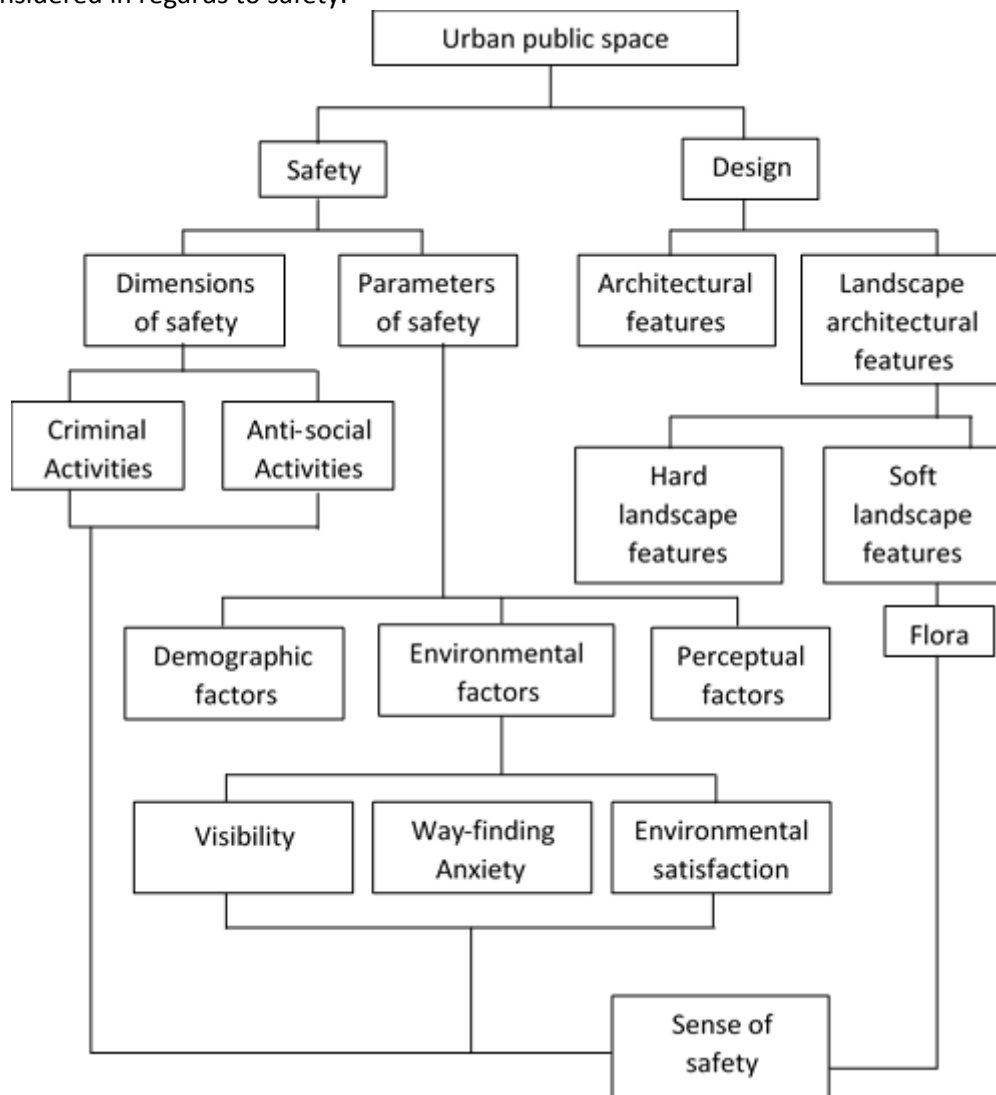


Figure 1: Sense of safety and flora in an urban public space
 Source: the author

The framework of the study was formulated through a literature review and the dependent variable and independent variables were identified by after going through recent studies and journal articles.

Dependent Variable

According to the study, the sense of safety has become the dependent variable. Therefore, when considering dimensions of sense of safety, it is divided into two categories criminal activities and anti-social activities according to the literatures reviewed. Criminal activities and anti-social activities are both increase the fear of crime or feeling of unsafe at the space. The routine activity theory explains about three conditions to be met before a crime can occur such as the potential of crime, the potential of the victim and lack of effective authority and control power to observe and respond to a crime (Maulan, 2014). Although, the theory explains people feel fear of crime or feel unsafe of the space due to situations they are facing within the space.

Fear of crime has been considered in many work of literature which also means the sense of safety, and the fear of crime is leading to feeling unsafe in a space. When considering the overall concept of environmental criminology 'Routing activity theory' can be defined as the central part (Wikström, 2019). Anti-social activities in urban public spaces can be discussed in four main parts such as misuse of public space, disregard for community/personal well-being, acts directed at people and environmental damage (Harradine, Kodz, Lemetti, & Jones, 2004).

Independent variables

According to the literatures reviewed, flora playing a major role to enhance or decrease the sense of safety. Sense of safety of urban public space can be measured through socio-demographic factors, environmental factors, perceptual factors and park use. As this study only focuses on the impact of flora on the sense of safety, the environmental factor has been considered. When it comes to environmental factors there are more variables to consider such as visibility, way-finding anxiety, legibility, maintaining, and environmental satisfaction. Amongst those factors; visibility, way-finding anxiety and environmental satisfaction have been selected as variables to this study as most effective to the local context while this study only considering soft landscape features.

Methodology of the study

The entire methodology of the study will mainly conduct based on the literature by going through much research which is previously done and journal articles in this study area.

The densities of vegetation have been categorized into three sections as Low density, Moderate density, and High density after photographic survey and discussions with the supervisor and colleagues. The process of categorizing vegetation densities was followed by previous research done in the same study area.

Data collection

Data collections were done through the pilot study and the field study. The analysis of the study was done by processing of the collected data. Firstly, the data was analyzed to investigate the relationship between the sense of safety and impact of the flora of the space by using Independent Variables (IV) and Dependent variable (DV). Pearson's Regression analysis was done and discovered that there is a relationship between sense of safety and flora of the urban public space by considering the value of R. Secondly, investigated the most important independent variable of environmental factors by considering R square, which is more important to know than just knowing that flora has an impact on the sense of safety. The unobtrusive observations were used to state that the overall space is a space with the feeling of safety. It helps to explain the impact of flora on the sense of safety when some places of this urban public space were reluctant by its users whilst overall space stated as safe space.

Case study in Independence Square:

There are no any shrubs that create any hiding places at the site and there are no boundary walls except in the pathway area. When it comes to flora, the space has only trees and lawn covers as soft landscape elements. Hard landscape enhances the value of the space and it provides more comfortable feeling for visitors except during the noon hours. Pathways are well-defined by hard landscape.

Park maintenance was excellent. There are no litters or any broken elements which can be seen within the site. Lawn areas were well maintained. Above factors were considered in previous research and studies and explained by the theory of broken windows, which is argued vandalism, litter and less maintaining lawn areas enhance the fear of crime of the user.

Unobtrusive observations by author

Three separate places were identified after the pilot study by interviewing visitors and observing their preference to stay longer in those spaces for the easiness to study the impact of flora on the sense of safety. It also concerned about the vegetation density differentiation of those three spaces. According to other studies, the densities of vegetation have been divided into three sections as Low density, Moderate density, and High density. Low density; is where a lawn area and the vegetation with same species of flora. Moderate density; where different species of flora present with a lawn and there is more than three-meter gap between trees with high canopies enabling to see more area through voids. High density is the area where there are huge varieties of species and consist of trees with trunks of a larger diameter (DBH-Diameter of Breast Height) and the canopy height is lower than the eye level. Those were categorized after photographic survey and discussions with the supervisor and colleagues.

In the Independence square, the Space 01 shows the moderate dense character as there are many species of flora with a lawn and averagely there is more than three-meter gap between trees and averagely trunks are not obstructing the views.



Figure 2: Map of three different spaces in the study area
Source: author



Figure 3: The selected spaces on their density
 Source: author

Unobtrusive observations by colleagues

This unobtrusive observation was done according to two sections. The first section is to find out if there are any other reasons to feel unsafe within the study area and the second section is to find out the contribution of flora on the final result. The colleagues were asked to examine the three different spaces in relevant to above two sections and to rate those spaces accordingly using 5-point Likert scale 1 = very low, 5 = very high.

Section one:

- Litter management
- Presence of vandalism activities

Section two:

- The gap between trees (more than 3m or less)
- Canopy levels of trees (above eye level)
- The density of canopy leaves (Canopy thickness)
- Diameter at breast height (DBH) of tree trunks

The results of section one show litter management are high and vandalism activities are very low in the study area. Those parameters can positively impact the sense of safety as the broken window theory explain that the user feels an unsafe feeling due to vandalism activities and poor litter management in urban public spaces. Therefore, the final results of the impact of flora on the sense of safety will become more accurate as there are no other conflicts at the site.

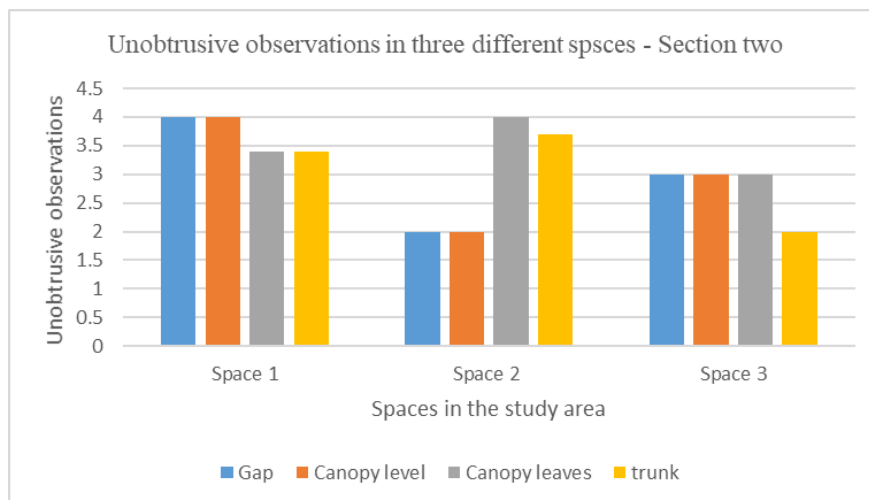


Figure 4: contribution of flora on sense of safety of spaces
 Source: author

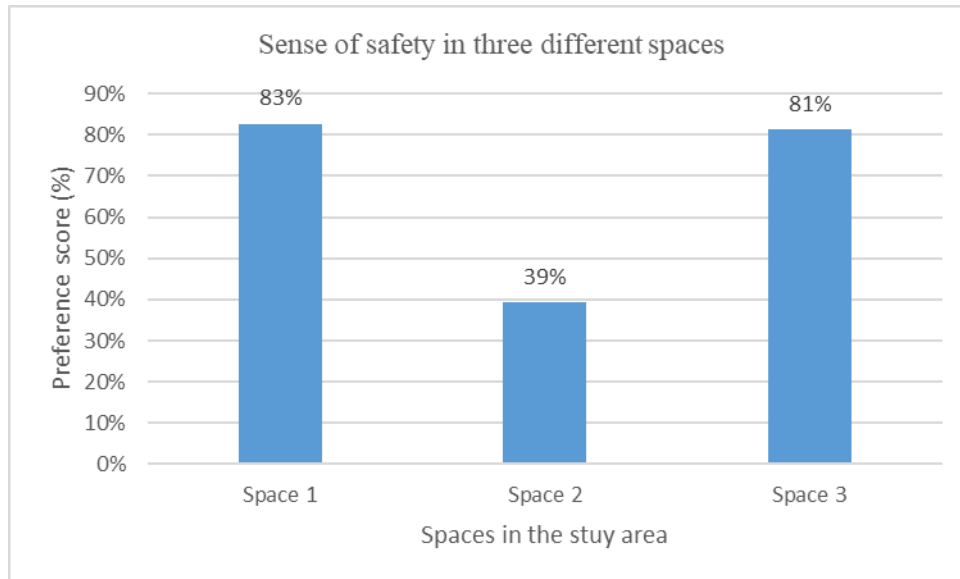


Figure 5: Sense of safety in three different spaces
Source: author

The figure shows the sense of safety of the three different spaces in the study area. It clearly shows the sense of safety in space 2 (High dense area) is very low. Sense of safety in space 1 (Moderate dense area) and space 3 (Low dense area) is slightly varied as 83% and 81% percent of sense of safety in the area.

Comparison between sense of safety and environmental factors

($R^2 = .93$) Environmental factors explain 93% of the variance in sense of safety which means 93% of the sense of safety can be explained by knowing environmental factors of the urban public space.

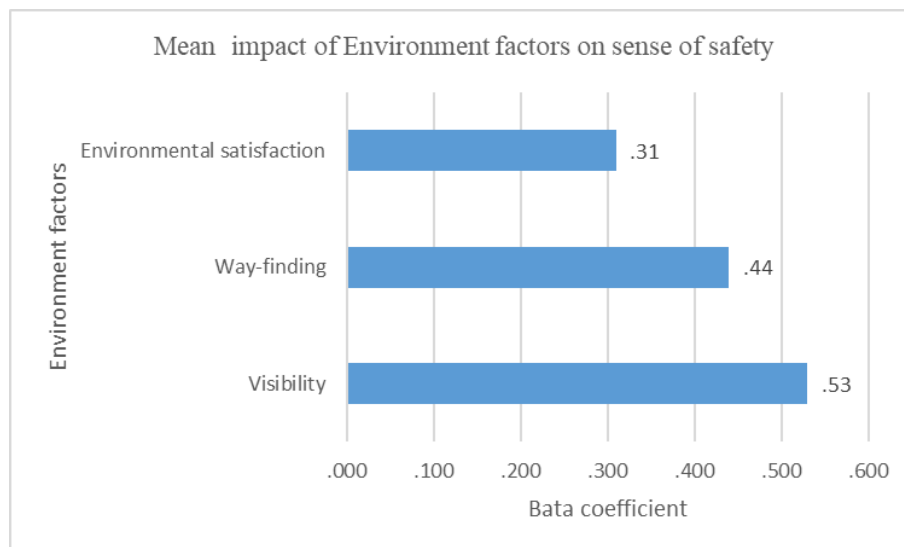


Figure 6: Mean impact of environment factors on sense of safety in three different spaces
Source: author

The figure shows the mean impact of visibility, way-finding and environmental satisfaction. According to the figure visibility ($\beta = .53$) is more impacted on sense of safety, then the way-finding ($\beta = .44$) and last is environmental satisfaction ($\beta = .31$).

The relation between sense of safety and visibility

Regression results - Visibility

A simple linear regression was calculated to predict visibility based on sense of safety. Visibility was a significant predictor of Sense of safety, $\beta = .86$, $t(28) = 8.96$, $p = .000$, $R^2 = .74$.

Table 1: Regression results summary of visibility

Independent variable - Visibility

Dependent variable – Sense of safety

Model	Sense of safety		Standardized Coefficients	t	Sig.
	R	R ²	Beta		
Visibility	.861	.741	.861	8.956	.000

When considering the impact of flora on sense of safety in urban public space, visibility is significantly impacted on sense of safety and it explains 74% of sense of safety in urban public spaces relevant to flora.

Survey dimensions on visibility

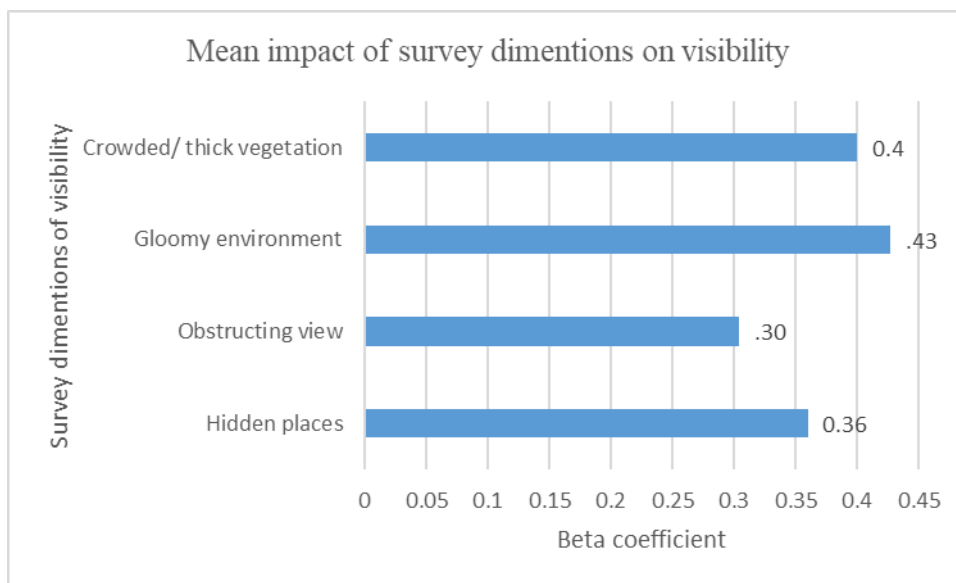


Figure 7: Survey dimensions on visibility
Source: author

When comparing the survey dimensions on visibility, mostly impacted one is gloominess ($\beta = .43$) of the space. When it comes to sense of safety it has not that much of impact on sense of safety in urban public spaces. Hidden places ($\beta = .36$) are not that much of impact on visibility when comparing to gloomy environment.

According to the results, the gloomy environment is mostly impacting visibility among other factors. Therefore, the impact of flora on gloominess is mostly impacted by the sense of safety of the space which is more concern about when adding trees in urban public space.

when comparing canopy thickness and canopy level which is involved to create the gloominess, the results show the canopy thickness ($\beta = .61$) has more impacted on gloominess than canopy height ($\beta = .48$) which creating the gloomy the environment at the space.

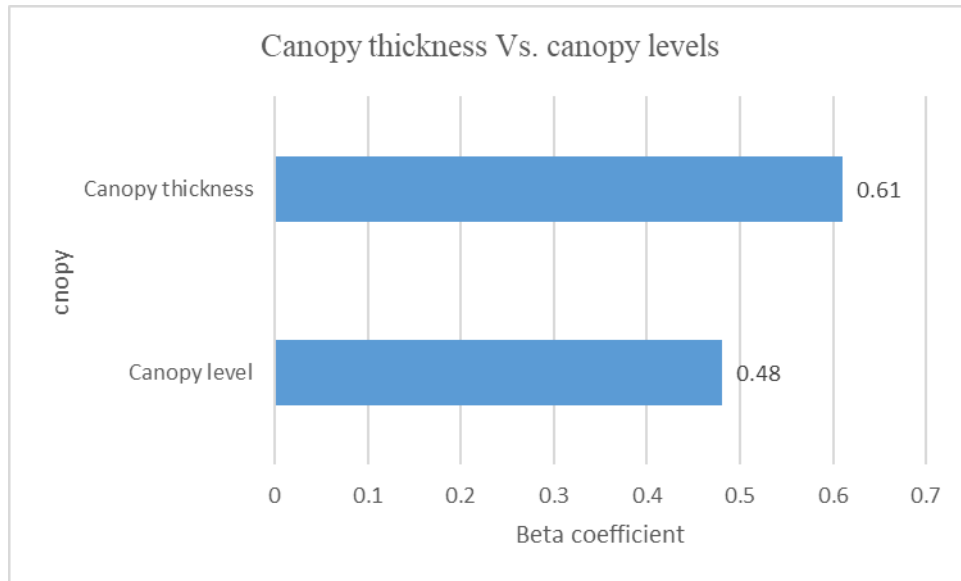


Figure 8: Canopy thickness Vs. canopy levels on safety
Source: author

Discussion

The environmental factors were identified such as “visibility”, “way-finding anxiety” and “environmental satisfaction” to investigate the most impacted factor among the sense of safety in urban public spaces regarding flora. according to the analysis, visibility is explaining 74% of the variance in sense of safety, way-finding is explaining 57% of the variance in sense of safety and the environmental satisfaction in explaining 24% of the variance in sense of safety. The results show visibility is more impacted by the sense of safety in urban public spaces. Then the most important environmental factor is the visibility which; 74% of sense of safety can explain by knowing the visibility in urban public space.

Knowing the visibility in urban public spaces is the most important factor on the sense of safety which is useful when designing urban public spaces. When including flora into urban public spaces, it is a necessity to possess a proper knowledge of the factors which are to be considered in order to enhance the sense of safety as users often visit and enjoy the spaces more in where the safety provided by flora is high. As gloominess has more impact on the visibility which created by flora in urban public spaces, by the unobtrusive observations it can explain the factors which create gloominess and darkness at the space. As it shows canopy thickness ($\beta = .61$) has more impact on the sense of safety than canopy height ($\beta = .48$). Considering the sense of safety in urban public spaces, the findings are predicting that the canopy thicknesses are more important to consider whilst designing urban public spaces.

The thickness of each canopy was not calculated in this study as this study is to find out the impact of flora on the sense of safety in urban public spaces. The canopy thickness is a support to have gloomier and darkness effect of the space by reducing the amount of daylight received by the ground. Therefore, it is better to apply flora which do not reduce the amount of sunlight received by the floor that provides a safer feeling to users in urban public spaces. Even though it is providing a sense of safety, the comfortable level of the shade of users in urban public spaces should be considered.

CONCLUSION

Sri Lanka as a developing country which is going through many developments after the civil war, it is becoming more urbanized over time. The population density is getting higher in urban areas as population shifting into urban area from suburbs and rural areas of the country. The majority of the public is now living in urban areas with a stressful lifestyle without much interaction with the nature. For most of them, the urban public spaces are the only spaces where they can interact with nature which is beneficial for their well-being. Therefore, it is essential to keep urban public spaces as natural as possible. When it comes to urban outdoor spaces which provide nature related experiences to the users, flora is playing a major role. In order to sustain a healthy outdoor lifestyle, it is necessary to make outdoor urban spaces comfortable for urban public so that they can spend with the nature without feeling unsafe. Therefore, applying flora in urban public spaces to enhance the sense of safety is more beneficial to the urban public.

This study was conducted to find out the impact of flora on the sense of safety in urban public spaces with most relevant environmental factors which impact on the sense of safety of users. The study did not consider other parameters that impacted on the sense of safety in urban public spaces such as demographic parameters and perceptual parameters which are included in some previous studies. With referring to previous studies and through the theoretical framework, survey dimensions and theories were identified which are suitable for the local context. The study was mainly focused on visibility, way-finding anxiety and environmental satisfaction. The study found that visibility has more impact on the sense of safety in urban public spaces, then way-finding anxiety and least impact is from environmental satisfaction. The results show some deviations from previous studies whilst some results are supporting. The research found that the environmental factors have more impact on sense of safety. The urban public spaces with more safety feeling were most preferred by the users, which also confirms the Kaplan and Kaplan's information processing theory and it is the idea implied by some other previous studies (Hami & Emami, 2015).

The Appleton explains that perceived safety is related to environmental satisfaction. Even though it shows a relation, it is not showing a strong relationship between use of space and the sense of safety whilst the study reveals the environmental satisfaction do not have much impact on sense of safety. There are studies which stated that the environmental satisfaction of the user in the urban public spaces have more impact on the sense of safety; which is not showing that much of a relationship from this study.

The study found a strong relationship between the sense of safety and visibility in urban public space with regard to flora. Appleton's prospect refuge theory also gives this idea which states that the visibility of the space has an impact on the sense of safety. Most of the previous studies confirmed this idea. Although some studies found that vegetation density has more impact on the sense of safety, which does not show much impact according to this study. But, according to the study moderately dense area provides a safer feeling to users than low and high dense areas as stated in previous studies as well. The study found that the gloomy spaces were more reluctant by users due to the feeling of unsafe.

As the study found that the gloomy spaces were more reluctant by users due to poor visibility which reduces the sense of safety, this study will support further research on the impact of canopy thickness (sunlight received by the ground through the spaces between leaves) on sense of safety or shade levels of flora on sense of safety.

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