Rajapaksha.U, et al (eds), 2015, "Making built environments responsive"*: Proceedings of the 8th International Conference of Faculty of Architecture Research Unit (FARU), University of Moratuwa, Sri Lanka,* pp. 462–476. ©

AN ANALYTICAL STUDY OF THE VALUE OF URBAN OPEN SPACES IN PROMOTING ENVIRONMENTAL IMPROVEMENT AND SOCIAL WELLBEING

CHANDANA KALUPAHANA[1], D. K. WEERAKOON[2] & M. I. M MAHEES[3]
[1]Urban Development Authority, Sri Lanka
[2]Department of Zoology, University of Colombo, Colombo 3
[3]Department of Sociology, University of Colombo, Colombo 3
chankalu@gmail.com

Abstract

According to current projections, more than 75% of the human population will live in cities and urban areas by 2050. This will lead to overcrowding of the cities that will lead to conversion of much needed open spaces to meet infrastructure needs. Loss of urban spaces will contribute to physical inactivity which together with unhealthy diets will contribute to a rapid increase in the non-communicable diseases among the urban populace. Therefore modern cities must incorporate urban parks to provide aesthetic, social, physiological and psychological benefits to urban societies. In Sri Lanka, an initiative has been taken to create urban parks, multi use trails and wetland nature parks to encourage active and passive recreation as well as social gathering. This research project was formulated to test the hypothesis that *"created parks have generated improvement in physical environment such as quality of air and aesthetics and has made an impact on sociological wellbeing of the user community".* The research focused on four open spaces created in Sri Jayewardenepura Kotte, Diyatha Uyana, Parliament green, Japanese friendship road walk path and model paddy field walk path. One environmental parameter, air quality and visitation patterns to these parks were investigated with the aim of identifying level of exposure of the visitors while spending time at these sites and visitor preferences. The air quality of the four sites is well within National air quality standards, especially during the peak use hours of these sites by general public. The parks attract a multitude of users mainly between 29 and 49 years of age. The users show site tenacity based on the type of activity they engage in while using these parks. These parks have positively contributed to social and physical well being of park users.

Keywords : *Urban open spaces, urban health, environment improvement, social well being*

1. INTRODUCTION

The world is undergoing an unprecedented urban expansion and according to current projections more than 75% of the human population will move to the cities and urban areas by 2050 (UN, 2012, UNFPA, 2011). This will be accompanied by an ever increasing demand for urban public services. Further, this will lead to overcrowding in the cities forcing city dwellers to become restricted to minimal spaces for living. In most Third World cities, the enormous pressure for shelter and services has resulted in the conversion of much needed open spaces of the city to dwellings or other facilities. Loss of urban spaces in turn has contributed to physical inactivity of people. Lack of exercise and unhealthy diets are considered to be the main drivers that are contributing to a rapid increase in the non-communicable diseases (Lee et al., 2012), especially among the urban populace.

There is mounting evidence that urban parks provide important aesthetic, social and psychological benefits to urban societies, which enrich human life with meaning and emotions (Arnberger, 2006; Chiesura, 2004; Sugiyama *et al*., 2008; Takano, *et al*., 2002). As emphasized by McRobie (2000) and Christiansen, *et al*., (2001), urban parks, designed primarily for recreation can provide enormous benefits to the community by improving health, social well-being and enhancing enjoyment of the local environment. Similarly, benefits of leisure also cover physical health, psychosocial well-being, self actualization, spirituality, self-identity, family bonding, child development, environmental education and social skills development (Veal and Lynch, 2001). Therefore, multifaceted services of urban open spaces and urban greenery are of crucial significance for the livability of modern cities and the well being of urban dwellers. Also due to its capacity in controlling the effects of Climate change, the role of urban open spaces is been greatly valued and appreciated in the global cities today. Considering these factors, urban regeneration, retrofitting parks and open spaces into cities have come into the forefront of city agendas to promote healthy living and creating healthy cities.

The open space requirement stipulated for Sri Lankan Cities to maintain a healthy environment is 1.4ha per 1000 population. However, majority of the cities fail to meet this requirement. Therefore, an initiative has been taken to transform cities into much more environmentally friendly entities. The pockets of greenery in cities are turned in to urban parks, water front developments, streetscape improvements, multi use trails and wetland nature parks to encourage urban dwellers to engage in active and passive recreation and also social gathering. A study conducted by Marawila and Thibbotuwawa (2010) has estimated that such a newly created urban park,

Diyatha Uyana alone attracts more than 100,000 visitors per year with a recreational value of 3,890 million Rupees (UDS 35 million) per anum.

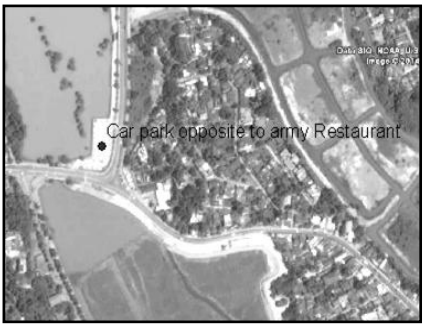
Although these created urban open spaces seems to be successful in attracting large number of visitors with a high recreational value, an attempt has not been made to ascertain whether the anticipated objectives are achieved in the fields of environmental improvement and social wellbeing. While these urban parks encourage people to engage in physical activity, due to their proximity to busy roadways the users may get exposed to air that carries high loads of vehicle emissions. Further, since physical exercise enhance the respiratory rate that may further increase the exposure rate. Accordingly, this research project was formulated to test the hypothesis that ***"created parks have generated improvement in physical environment such as quality of air and aesthetics and has made an impact on sociological wellbeing of the user community".*** The research has focused on the open spaces created in and around Sri Jayewardenepura Kotte at the fringes of Diyawanna Lake. The issues investigated included the quality of air in newly created open spaces, people's perception regarding these urban parks, the emotional dimension involved in the experience of nature and its importance for *people's* general well being.

2. METHOD

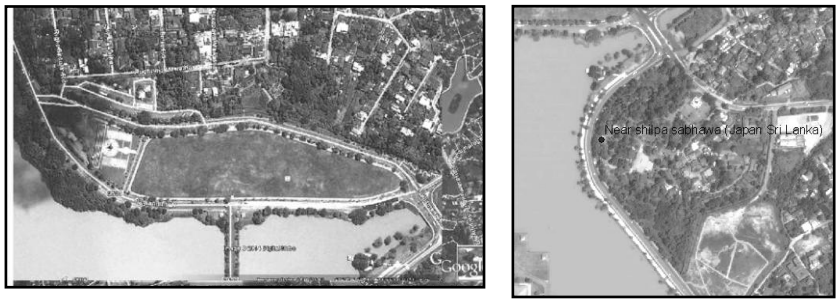
2.1 *Description of the study area*

Altogether four sites, Diyatha Uyana Park, Model farm Parkway, Parliament Green and Japanese Friendship Road Parkway were selected for this study within the Kotte Municipal Council area. All 4 sites are located in the vicinity of the New Parliament Complex and are waterfront developments. Out of the four sites selected, three have physical links with the water mass of Diyawanna Lake while the other has only a visual connection. Each site contains facilities and picturesque setting which has contributed to their popularity.

Diyatha Uyana Park



Model farm Parkway



Parliament Green Japanese Friendship Road Parkway

Figure 1: An aerial view of the four sites selected for the study

***Diyatha Uyana Park*:** The land area once belonged to the Water's Edge premises and was not open to general public. Since September 2012 the edge of water and a substantial area was opened to the general public. The long paved walkway along the edge of Diyawanna Lake is used by the joggers while ample seating is provided for family outings. The interior section of the wetland accommodates the nature lovers and the artists. The park also has food court, an aquarium and sales centers. Therefore, it can be describes as park that offers a multitude of recreational opportunities.

***Model farm Parkway*:** The site contains logging path along the outer periphery of a paddy field. The jogging path is purposefully designed with a level difference to the busy road so that the walkers are relaxed in their own entity. The exercise area opposite the path equipped with colorful exercise equipment is used by all age groups.

***Parliament Green*:** The 13 acre area in front of the Parliament Complex is developed as a parade ground as well as a public open space. The Jogging track along the periphery of the green is approximately 2km long. The boundary of the jogging track is made into tiers so that people could sit and relax under a row of shady trees. A food court is provided across the park along with a parking area.

***Japanese Friendship Road Parkway*:** This parkway is created along the newly constructed Sri Lanka Japan friendship road. The walk path with shady trees is constructed a level below the highway and it has created a much needed buffer from the busy road. This parkway also contains a parking area and the seating and a rest area built on stilts. A restaurant is made available across the parking area.

2.2 Methodology of the study

Two main methods were used, one for the environmental study and the other for the sociological study. The environmental study focused on the air quality of the environment in parks and neighborhoods located adjacent to the park to ascertain the level of exposure of park users to vehicular emissions. Three main parameters, concentrations of SO_2 (Sulphur Dioxide), NO_2 (Nitrogen Oxide) and fine particulate matter (PM_{10}) were measured (Atkinson and Anderson, 2001). A total of 10 permanent sampling locations were selected for the study. These 10 locations were selected based on the level of park usage and the difference in environmental settings. Approximately, a quarter-mile (approx. 0.4km) distance from the edge of each site was designated as the adjacent neighborhoods. This is the widely used distance criteria in the urban park literature to define urban park

catchment areas, based on behavioral studies. On site sampling and air quality testing was carried out by the National Building Research Organization (NBRO). The samples were collected weekly and tested in the laboratory of the NBRO.

Active and Passive sampling techniques were used to collect the sampling. At each site passive air sampling devices were installed to measure long term exposure levels. Active monitoring was also conducted at critical locations for short term (1 hr, 8hr and 24hr) sampling to cover peak traffic hours and maximum visitation hours in the parks.

At each location passive sampling apparatuses were installed in an open area with a minimum distance of 3m from ay permanent structure and at a 3m height from the ground level using holding clips. The sealed end caps were removed on site before installing in the samplers. Each set of passive samplers, installed at selected sampling points were collected at weekly intervals for testing. They were sealed with the end caps and were taken to the laboratory for analysis. Samples for the following week were installed at the time of collecting the previous set of samplers. The measurements were carried out during calm wind and cloudless conditions. There were no rains during the sampling period. The sampling was carried out for 24 hrs to ascertain the quality of air with respect to Sulphur Dioxide (SO_2), Nitrogen Oxide (NO_2) and PM_{10} concentrations in a daily basis. Eight hours in the morning, eight hours in the evening and the peak traffic hour were considered.

The results were compared with National Ambient Air Quality Standards stipulated by the Central Environment Authority, of Sri Lanka which is considered as the national air quality standards to ascertain the quality of air in the parks.

For the sociological study a questionnaire survey method was used on a randomly selected sample from all 4 parks. More in depth interviews were done with a selective group of park users through personalized interviews.

In order to get a representative sample of users, 200 questionnaires were distributed among the selected users in each of the locations. Most of them were completed through a face-to-face discussion made between the user and the data collector, and some were filled by the users and was returned later. The questionnaire targeted users on weekdays and weekends as well as mornings, afternoons and evenings to capture temporal variations. Data was directly entered from the questionnaire into the SPSS database for analysis.

The questionnaire contained a series of questions designed to capture the current use of the green space, perceived quality of green space, attitudes to potential green space interventions and finally how these initiatives have influenced their health and wellbeing. Validated existing scales (for health and wellbeing) and questions that have been cognitively tested and demonstrated in the world to conduct such surveys in parks and open spaces were also referenced as a guideline.

The sampling was done using a selective method. The sample was selected to cover all age groups, gender balance and also to obtain a cross section of activities happening in these parks. The survey was conducted among a mix category of respondents from ages 15- 19, 20-24, 25- 34, 35-44, 45-54 and smaller percentage of persons that are more than 55 years of age. *Apart from the semi- structured questionnaire survey, in depth interviews were conducted for a selected group of users to ensure that different age groups, professionals and vendors are captured in the sample.*

3. RESULTS AND DISCUSSION

3.*1* *Air quality of the four selected urban parks*

Four locations (L1 - L4) were selected to for the active sampling to ascertain the concentrations of NO_2, SO_2 and PM_{10} on a daily basis. They were strategically located within the parks and within the neighborhood of parks.

Table 1: Results of the active sampling for air quality

Locations	**SO_2 Conc. µgm/m^3**		**NO_2 Conc. µgm/m^3**		**PM_{10} (µgm/m^3)**
	Observed	Standard	Observed	Standard	
L1 Day 8Hr	23	120	21	150	0.021
L1 Peak 1Hr	82	200	100	250	
L1 Night 8Hr	24	120	23	150	
L2 Day 8Hr	13	120	13	150	0.007
L2 Peak 1Hr	66	200	58	250	
L2 Night 8Hr	8	120	10	150	
L3 Day 8Hr	21	120	25	150	0.027
L3 Peak 1Hr	102	200	149	250	
L3 Night 8Hr	14	120	14	150	
L4 Day 8Hr	7	120	12	150	0.016
L4 Peak 1Hr	43	200	40	250	
L4 Night 8Hr	5	120	15	150	

Sampling locations**:** L1 - Diyatha Uyana (near Min Medura); L2 - Diyatha Uyana (Near the boundary towards Waters edge); L3 - Japanese Friendship road park (Near the Parking area); L4 - Model farm park (Near the Temple)

The results of active sampling indicate that the concentrations of SO_2 and NO_2 are not higher than the values stipulated in the National Environmental (Ambient Air Quality) Regulations as declared in the Sri Lanka gazette No 1562/22, which are the Standard guidelines for Sri Lanka under the Ministry of Environment. At each location peak values were much higher compared to morning and evening hours. Further, SO_2 and NO_2 levels are lowest at the Model Farm park and the section of the Diyatha Uyana facing away from the traffic. The location L3 had the highest values compared to the other three sites as it is located next to a busy intersection (Kimbulawala Junction) which receives a very high traffic flow during peak traffic period. However, the peak time concentrations are still less than the standard concentrations. Active sampling done throughout a period of 24 hours in the four parks and their surroundings, demonstrates that the morning and the evenings had very low concentrations of SO_2 and NO_2 and therefore, the most visited hours to the parks are safe and healthier to use.

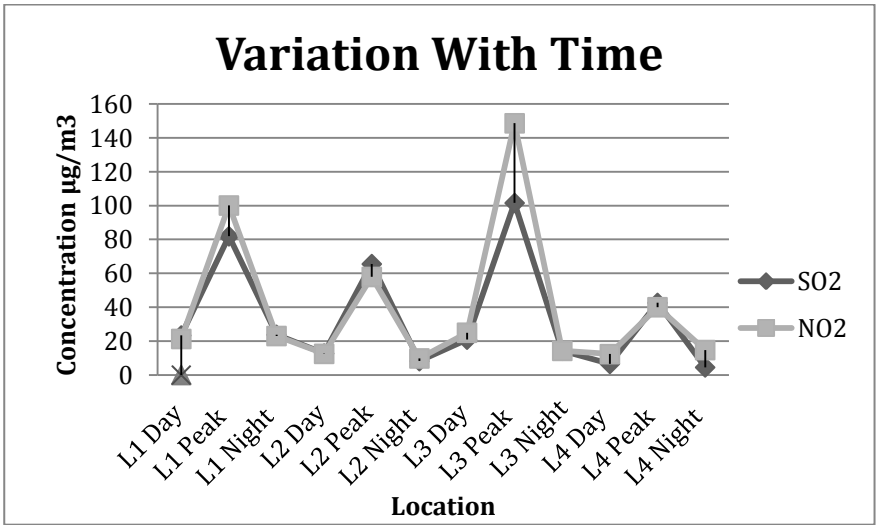


Figure 2: Daily average SO_2 and NO_2 levels (µgm/m^3) observed at the 4 sampling locations.

Passive sampling was conducted at 10 locations in the 4 parks for six weeks continuously to ascertain the weekly concentrations of NO_2 and SO_2 levels. Weekly exposure levels of SO_2 and NO_2 were analyzed to obtain trends and spatial variations. Figures 3 indicates the concentrations of NO_2 and SO_2 at each of the ten sampling location. Each concentration was

compared with the ambient air quality standards published by CEA to ascertain the quality of air at the 10 different locations.

Other than the site L3, L7 and L8 the weekly average NO_2 levels were below the permissible air quality standard throughout the study period (Figure 3). Average NO_2 levels showed temporal fluctuations during the study period with some weeks yielding high values. The fluctuations were consistent across the 10 sampling locations. At site L3 and L7 the standard value was exceeded only during one out of the six weeks during which measurements were taken. However the average NO_2 levels at site 8 exceeded the permissible value 50% of the time. All three sites showing high values were located in close proximity to the road while site 8 is located at the Kimbulawala junction where traffic stalls considerably, especially during peak hours resulting in high level of emissions.

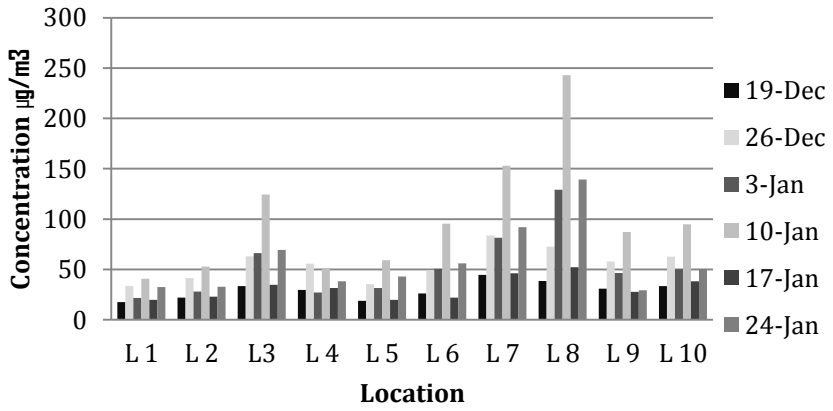
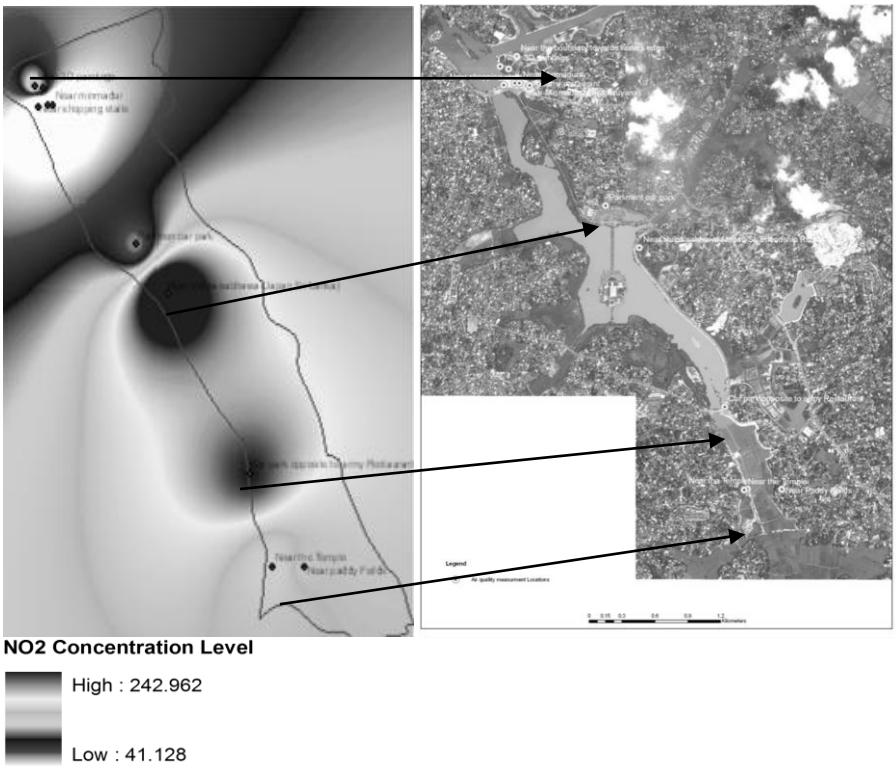


Figure 3: Weekly average NO_2 levels ($\mu gm/m^3$) recorded at the 10 sample locations.

A value greater than 100 $\mu gm/m^3$ will provide a SLAQI (Sri Lanka Air Quality Index) value greater than 100 and therefore will be considered unhealthy. Sampling locations: L1 - Diyatha Uyana shopping area; L2 - Diyatha Uyana boundary with Waters edge; L3 - Diyatha Uyana 3D painted area; L4 - Diyatha Uyana children's play area; L5 - Diyatha Uyana Min Medura; L6 - Parliament car park; L7 - Japanese Friendship Road; L8 - Car Park at the Kimbulawala Junction; L9 - Near the temple along Kimbulawala-Pamunuwa Road; L10 - Kimbulawala Paddy Field.



Map 9 : Air Quality testing locations in four parks and neighbourhoods

Other than the site L6 and L8 the weekly average SO_2 levels were below the permissible air quality standard throughout the study period (Figure 4). As in the case of NO_2, average SO_2 levels showed temporal fluctuations during the study period with some weeks yielding high values. At site L6 the standard value was exceeded only during one out of the six weeks during which measurements were taken. However the average SO_2 levels at site 8 exceeded the permissible value 50% of the time. Both sites showing high values are parking areas, which are also located in close proximity to the road.

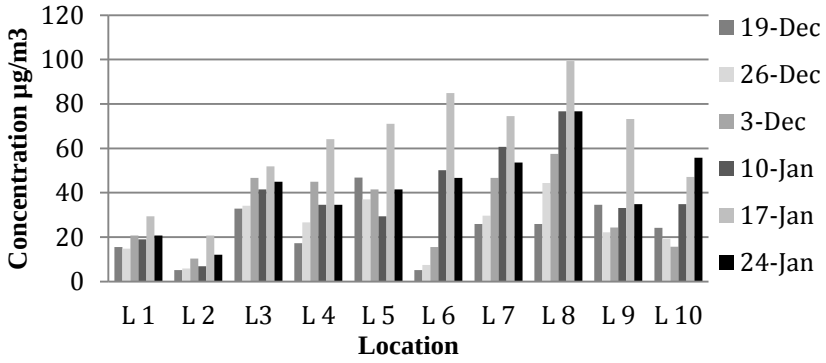


Figure 4: Weekly average SO_2 levels (µgm/m^3) recorded in the 10 sample locations. A value greater than 80 µgm/m^3 will provide a SLAQI (Sri Lanka Air Quality Index) value greater than 100 and therefore will be considered unhealthy. Sampling locations: L1 - Diyatha Uyana shopping area; L2 - Diyatha Uyana boundary with Waters edge; L3 - Diyatha Uyana 3D painted area; L4 - Diyatha Uyana children's play area; L5 - Diyatha Uyana Min Medura; L6 - Parliament car park; L7 - Japanese Friendship Road; L8 - Car Park at the Kimbulawala Junction; L9 - Near the temple along Kimbulawala-Pamunuwa Road; L10 - Kimbulawala Paddy Field.

The SO_2 and NO_2 concentrations at locations which are used heavily are well within the standard concentrations stipulated by the CEA which ensures good air quality for the users. The NO_2 concentration was also mapped graphically to highlight the range of weekly concentrations that persist at the four study sites (Figure 5), which once again shows that Kimbulawala Junction and Japanese Friendship Road park has the lowest air quality with respect to NO_2 concentration.

3.2 Visitation Patterns

This visitor survey indicated that more than 66% of the park users are between 29 and 49 yrs of age (Figure 6). The younger age groups (20 to 29) showed a higher preference towards Diyatha Uyana while the older age groups (40-49) showed a higher preference to the Model Paddy field walk path (Figure 7). This preference was related to the activities they perform during their visitation to these sites. The younger age groups use the urban parks mainly as a meeting place and hence prefers Diyatha Uyana which provides conditions conducive for social gathering while the middle aged group use the urban parks mainly for physical exercise and hence shows a higher preference towards the model paddy field walk path which is ideally suited for this purpose. The Parliament Green is more popular with the adult age groups of 30-39, 40-49 and above 50 (57%). The senior

citizens sowed a higher preference to this site as the design of parliament green creates an environment with quiet privacy where they feel safe and content. They also have the ability to interact with their piers while walking slowly along the path or sitting on the stepped tiers when tired. The 50+ group least preferred the Japanese friendship road pathway as it was bordering a road with heavy traffic and a lake on the other side. The visitor survey also indicated that usage of these urban parks by children is very low which may indicate that their participation in physical activity is declining as they are spending their leisure time more on sedentary activities such as watching television or playing computer games.

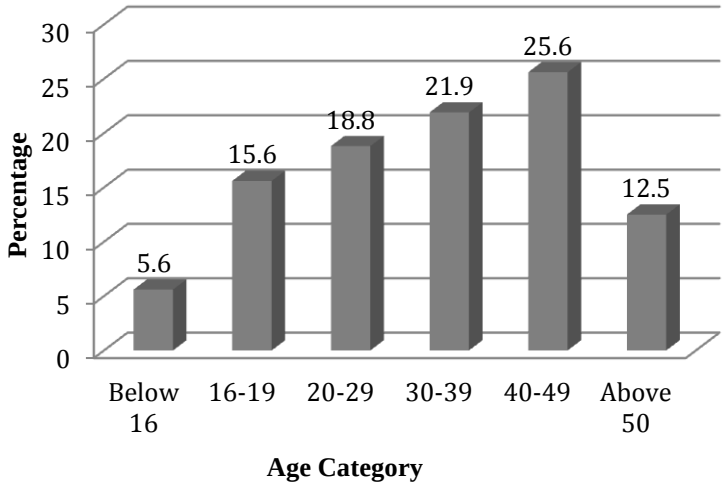


Figure 6: Usage of parks and open spaces by different age groups

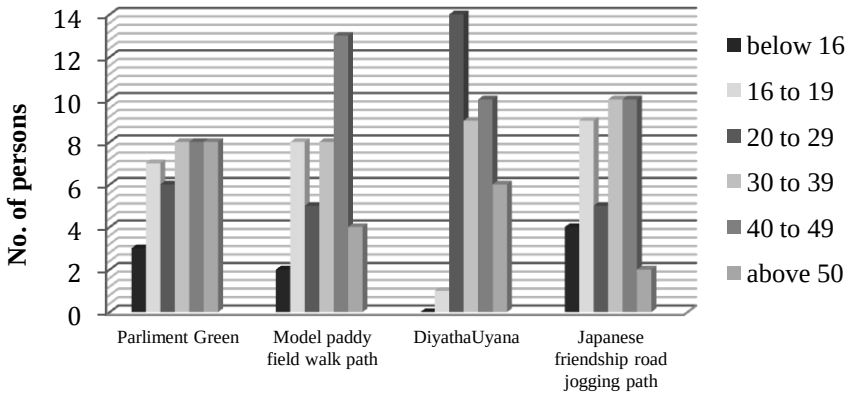


Figure 7: Usage of the four selected parks by different age groups

The visitor survey also indicated that majority of the persons (97%) visiting these urban parks showed a preference towards a specific site while a 3% of the visitors indicated that they use more than one park. The Parliament Green, Diyatha Uyana and Model farm jogging path were equal in preference. Japanese friendship Road park received a lower preference. Japanese friendship park had fewer facilities compared to the other three parks that have food courts, seating etc., facilitating a range of choices which may have contributed to the lower preference shown by visitors towards Japanese friendship road park (Figure 8).

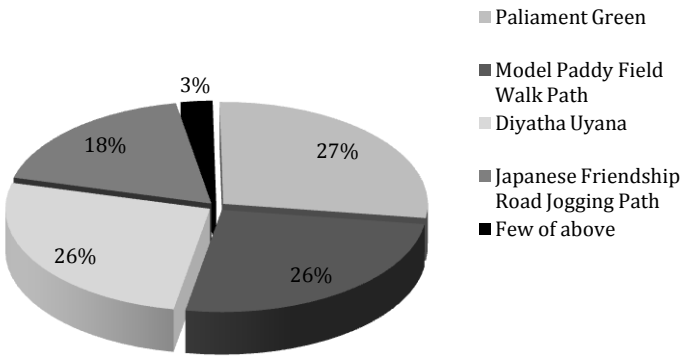


Figure 8: Visitation to parks

Majority of the users choose to visit these parks with friends, followed by children or the spouse. They highlight the fact that the parks have created an environment conducive for people to gather and spend their leisure time (Figure 9).

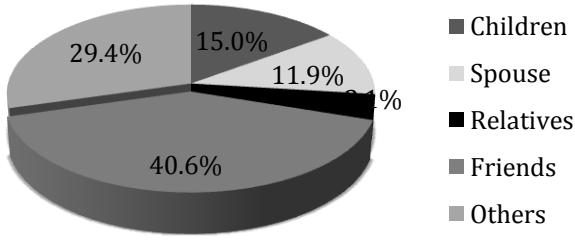


Figure 9: Relationships between park users

4. CONCLUSION

Although the urban open spaces in and around the city of Colombo have been transformed to provide more opportunities for recreation for the urban dwellers, there has not been any concerted effort to evaluate the merits and demerits of this transformation. This study was undertaken to address this knowledge gap and to act as a precedent study to promote similar initiatives in future. Furthermore, it was understood that because of the multifaceted character in these improvements they should be revisited in a multidisciplinary manner to ascertain its success or drawbacks. Although it is needed to investigate on different environmental conditions such as air quality, thermal comfort in the parks to obtain a thorough knowledge on the aspect, the limitations such as the period of study and security constrains the parameter was limited to air quality. Furthermore when considering the type of usage of the open spaces and the segment of population, it was decided that ascertaining the quality of air is the most important parameter when obtaining an idea on the quality of environment.

The air quality data generated from this study indicates that the parks design has taken into consideration the health aspects by constructing car parks adjacent to the roadways and locating the public use areas away from the busy roadways ensuring better quality environment to the user. The urban regeneration efforts commenced recently, focusing on this aspect of maximizing the open spaces and strengthening the green blue integration, has created a sustainable and healthy environment within cities. In these endeavors cities which are blessed with natural environments, rich in biodiversity has an advantage over those who do not. The discussed study area could be considered as a catalyst in such initiatives. The spectacular environment created within the city has not only preserved the pristine habitats, generated more recreational opportunities, but most importantly, has provided a healthier environment for the user community.

The analysis of the results revealed that the senior citizen group of 50+ preferred parliament green mostly, followed by Diyatha Uyana and Model farm walk path while the younger age groups preferred Diyatha Uyana that provides conducive for gathering. This indicates that park design should also take into consider many uses of an urban open space and provide many use opportunities to meet different needs of the user community. All in all the hypothesis tested that the parks have improved the environment and there by uplifted the social well being is supported by the findings of this study. It can be stated that the urban regeneration efforts have been successful in achieving their objectives. The efforts have created a healthy environment and attracted a user population for active and passive use and the user's have given a validity to the regeneration initiatives.

Overall the results of this study will assist in identifying important parameters that needs to be considered at the design stage of open spaces. The findings will also assist the design of open arenas responsive to urban issues such as health and social wellbeing. Therefore, this knowledge can contribute to the sustainable development of cities of the future.

References:

Arnberger, A. (2006). Recreation use of urban forest: An inter-area comparison. *Urban Forestry & Urban Greening*, **4**:135-144.

Atkinson, R.W., Anderson, H.R., 2001. Acute effects of particulate air pollution on respiratory admissions: results from APHEA 2 project. Air pollution and health: a European approach. *Am. J. Respire. Crit. Care Med.* **164**:1860–1866

Chiesura, A. 2004. The role of urban parks for the sustainable city. *Landscape and Urban Planning*, **68**:129- 138

Christiansen, G., Conner, N., & McCrudden, M. (2001). The value of public open space for community service provision, (No. 0731363973). Sydney: Sydney Urban Parks Education and Research Group, SUPER Group technical report series.

Lee, I-M., Shiroma E.J., Puska, P., Blair, S.N. and Katzmarzyk, P.T. (2012). Impact of Physical Inactivity on the World's Major Non-Communicable Diseases/ *Lancet* **380(9838):** 219-229.

Marawila, T. D. and Thibbotuwawa, M. (2010) To Develop or to Conserve? The Case of the Diyawanna Oya Wetlands in Sri Lanka. *SANDEE Working Paper* 52-10, 49pp.

McRobie, L. (2000) 'A new set of priorities: English Heritage' In The Regeneration of Public Parks, (Eds, Woudstra, J. and Fieldhouse, K.), The Garden History Society & Landscape Design Trust, E & FN Spoon & English Heritage, London, p. 3.

Sugiyama, T., Leslie, E., Giles-Corti, B., Owen, N., 2008. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships?

Takano, T., Nakamura, K., Watanabe, M., 2002. Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *J. Epidemiol. Commun.* H **56 (12)**, 913–918

Veal, A. J. and Lynch, R. (2001) Australian Leisure, Longman, Frenchs Forest N.S.W.