

LOSS OR GAINED? AN ANALYSIS OF GREEN SPACES IN CITY OF COLOMBO BETWEEN 2010-2015

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Abstract

Green spaces are an essential component in urban infrastructure and their heterogeneity influence the services they provide to mankind. During the last five year period a significant change in the landscape of City of Colombo was observed as many improvements were incorporated into various components of its infrastructure. We mapped vegetation cover of green spaces in 47 wards in the City of Colombo in 2010 and 2015 using Google Earth, ArcGIS 10.3 and ArcMap software and assessed their change in extent. In 2015 street trees, and vegetation in residential and commercial areas covered 86.06% of the city area while amenity and green open areas (such as lawns and playgrounds) covered 5.50 %. Cinnamon Gardens exhibited the highest cover for both these vegetation types. Patchy mix vegetation cover of the City was 4.49% and the highest extent was observed in Fort. Mattakkuliya had the highest extent of lake and canals, and associated wetlands which showed a city wide cover of 3.3%. Scattered patches of abandoned paddy fields and related marsh cover were highest in Kirullapone ward. Between 2010-2015 the total extent of green spaces in Colombo City has not been significantly changed, instead changes among vegetation types were identified. These included a 1.5% decrease in open green areas, patchy mixed vegetation, marshlands and a slight increase (>0.5% %) in vegetation at roadside, residential, commercial and amenity areas. A remarkable reduction of 13.26% in green spaces was reported from Modara while 3-6% decrease was reported from Thimbrigasyaya, Bambalapitiya, and Kirullapone wards. A 5-25% improvement of green spaces was reported in Panchikawatte, Pamankada, Kotahena West and East, Lunupokuna and Bloemendhal wards. While reflecting the recent changes in landscape in Colombo wards, this paper also highlights the need of strategic improvement of different vegetation types to receive optimum services and values from city's green spaces. Thus, it is expected that findings of this work will be used for planning of further modifications to the existing landscape in the City of Colombo.

Keywords: green-spaces, green-cover, Colombo, vegetation

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Introduction

We are now entering into a period of where the cities and nature are being integrated not only for the purpose of beautification but also to receive the optimum services and functions provided by the herbs, shrubs and trees in land, semi-aquatic and aquatic habitats of the non built open environment. The regulatory and provisioning services they provide, such as climate amelioration, carbon sequestration and storage, flood water storage, air and water purification exhibit the capacity of a city to be resilient against today's concerns on urban heat island effect, air and noise pollution, increased soil erosion and flash floods (Heywood, 1996). Urban green spaces fulfil the environmental and recreational function similar to larger natural areas although exist on a small scale. It is commonly accepted that urban green spaces are essential for the health and well-being of citizens, thus intended to support urban population's quality of life (Mambretti, 2011). Sociological studies highlight the importance of natural environments as determinants of the choice of residential location. For example, in a study of the city of Leuven the lack of public green spaces and children's playgrounds seemed to be a main reason why people left the city (Herzele and Wiedemann, 2002). Therefore green spaces have become an essential component in the urban infrastructure and their structure, composition, location and configuration is said to play a vital role in maximizing the ecological services they provide (Gaston, 2010).

The green spaces in the city of Colombo have been our focus in this study. Colombo is the largest city of Sri Lanka, located within the Western Province. It is the main commercial and business centre of Sri Lanka and as a consequence many people are drawn in to the city daily. The central Colombo, which comprises of Fort and Pettah areas provides more than 100,000 jobs for people. It is estimated to have a daytime population of more than 650,000 in 2003 (Chandrasiri, 2003) and after a decade increased to approximately 2,300,000 (Department of Census and Statistics, 2012). In this context understanding of the importance of the role played by urban green spaces towards creating a healthy and sustainable, disaster free environment is vital.

Recently studies have identified the change in vegetation cover in 47 wards of the Colombo city from the years 1956-2010 using landuse maps (Liyakath and Ranwala, 2013), aerial photographs and IKONOS satellite maps (Wickramasinghe *et. al.*, 2016). According to the resultant maps, a gradual decline of green cover percentage was depicted. The total green vegetation cover of the Colombo city has been changed from 35.7%, to 22.2% from 1956- 2010. Thus in order to identify the changes thereafter, we carry out a fine scale analysis of urban green spaces in the city between the years 2010- 2015.

Methodology

The landuse and related vegetation cover changes due to either natural causes or human activities can be monitored using current and archived remotely sensed data spatially and temporally in a cost effective manner. The study was confined to City of Colombo /Municipal Council Area (60 56' N, 790 49'E) which consisted of 47 municipal wards spread over a total of 37 sq. km extent.

The green spaces within the Colombo city limits were mapped based on information available in Google Earth maps available for 2010 and 2015, which were uploaded separately by Google Earth Pro on 31/6/2015. Cover of green spaces were digitized using polygons coming under

different green space categories as reflected by the main vegetation types (see below) using ArcGIS 10.3 software. The ward map of Colombo was overlaid on maps prepared for each year and zoomed into a level where green spaces were clearly visible. Ground truthing was followed for verification of vegetation in green spaces. The selection of green space categories were based on the classification by Freeman and Buck (2003), and modified to suite local situations in order to reflect habitat heterogeneity and diversity of local vegetation. Therefore the green space categories of different vegetation types identified in this study were: i) vegetation in amenity and open spaces [including lawns and playgrounds] ii) street trees, and vegetation in residential and commercial areas iii) vegetation in lakes and canals and associated wetlands, iv) scattered abandoned paddy fields or marshlands v) patchy mixed vegetation, and vegetation on bare lands.

Using the shape files obtained after digitizing the vegetation cover, the total extent of each category was determined as km² and as a percentage of the total area of the City.

Results and Discussion

In 2015, among the different green space categories, the highest percentage (86.06%, 6.05 km²) was reported by the street trees, vegetation in residential and commercial areas. Such vegetation cover was highest in the Cinnamon Garden ward. The green space cover of the amenity and open green areas was 5.50 % (0.32 km²), and the highest cover was also observed in Cinnamon Gardens ward.

Cover of patchy mix vegetation and bare lands was 4.49% (0.39 km²) of the city, and the highest cover was reported in Fort. Lakes, canal and associated vegetation was about 3.3.% (0.24 km²) of the city area and Mattakkuliya ward had the highest cover of such aquatic vegetation. The Kirulapone ward reported the highest extent (0.04 km²) of abandoned paddy lands (Table 1).

Table 1. Extent of green spaces in 47 wards in Colombo city as at 31st June 2015. The highest extent reported for each green space category is in bold font.

| Ward name | Green space Category (km ²) | | | | | Total |
|------------------|---|---------------------|---------------------------------------|-------------------------|------------------------|--------|
| | Patchy /mix veg & bare lands | Amenity open spaces | Residential, industrial/ Street trees | Wetland / Lakes/ Canals | Abandoned Paddy Fields | |
| Mattakuliya | 0.0207 | 0.0123 | 0.3070 | 0.0229 | 0.0000 | 0.3629 |
| Mahawatta | 0.0280 | 0.0081 | 0.0148 | 0.0065 | 0.0000 | 0.0574 |
| Modara | 0.0000 | 0.0015 | 0.1787 | 0.0013 | 0.0000 | 0.1815 |
| Aluthkade East | 0.0132 | 0.0000 | 0.0097 | 0.0184 | 0.0000 | 0.0413 |
| Aluth Mawatha | 0.0220 | 0.0048 | 0.1885 | 0.0000 | 0.0000 | 0.2154 |
| Wellawatta South | 0.0078 | 0.0186 | 0.1058 | 0.0126 | 0.0000 | 0.1449 |
| Pamankada East | 0.0252 | 0.0082 | 0.2855 | 0.0088 | 0.0000 | 0.3277 |
| Pamankada West | 0.0000 | 0.0000 | 0.1274 | 0.0090 | 0.0000 | 0.1363 |
| Wellawatta North | 0.0343 | 0.0035 | 0.1443 | 0.0061 | 0.0000 | 0.1882 |
| Kirullapone | 0.0195 | 0.0133 | 0.4270 | 0.0053 | 0.0198 | 0.4850 |

| | | | | | | |
|-------------------|---------------|---------------|-----------------|---------------|---------------|---------------|
| Milagiriya | 0.0194 | 0.0092 | 0.1275 | 0.0000 | 0.0000 | 0.1561 |
| Havelock town | 0.0161 | 0.0167 | 0.3057 | 0.0086 | 0.0000 | 0.3471 |
| Kirula | 0.0400 | 0.0216 | 0.2846 | 0.0114 | 0.0117 | 0.3693 |
| Thimbrigasyaya | 0.0001 | 0.0280 | 0.2307 | 0.0000 | 0.0028 | 0.2616 |
| Narahenpita | 0.0072 | 0.0413 | 0.2540 | 0.0018 | 0.0000 | 0.3043 |
| Borella South | 0.0000 | 0.0000 | 0.2936 | 0.0000 | 0.0000 | 0.2936 |
| Borella North | 0.0173 | 0.0176 | 0.3920 | 0.0123 | 0.0000 | 0.4392 |
| Kuppiyawatta West | 0.0029 | 0.0000 | 0.0312 | 0.0000 | 0.0000 | 0.0341 |
| Cinnamon Garden | 0.0000 | 0.0451 | 0.4598 | 0.0000 | 0.0000 | 0.5050 |
| Wekanda | 0.0011 | 0.0113 | 0.0680 | 0.0051 | 0.0000 | 0.0856 |
| Bambalapitiya | 0.0000 | 0.0112 | 0.2845 | 0.0000 | 0.0000 | 0.2957 |
| Kollupitiya | 0.0000 | 0.0000 | 0.1879 | 0.0194 | 0.0000 | 0.2073 |
| Kompannawidiya | 0.0015 | 0.0026 | 0.0682 | 0.0190 | 0.0000 | 0.0912 |
| Hunupitiya | 0.0000 | 0.0045 | 0.0780 | 0.0201 | 0.0000 | 0.1026 |
| Suduwella | 0.0079 | 0.0056 | 0.1682 | 0.0029 | 0.0000 | 0.1846 |
| Maradana | 0.0000 | 0.0025 | 0.0196 | 0.0000 | 0.0000 | 0.0220 |
| Maligakanda | 0.0000 | 0.0000 | 0.0377 | 0.0000 | 0.0000 | 0.0377 |
| Kuppiyawatta East | 0.0145 | 0.0000 | 0.0057 | 0.0000 | 0.0000 | 0.0202 |
| Wanathamulla | 0.0035 | 0.0000 | 0.0957 | 0.0050 | 0.0052 | 0.1094 |
| Maligawatta West | 0.0000 | 0.0021 | 0.0879 | 0.0000 | 0.0000 | 0.0900 |
| Panchikawatte | 0.0000 | 0.0000 | 0.0730 | 0.0000 | 0.0000 | 0.0730 |
| Kehelwatta | 0.0058 | 0.0000 | 0.0231 | 0.0076 | 0.0000 | 0.0365 |
| Fort | 0.0416 | 0.0024 | 0.0986 | 0.0159 | 0.0000 | 0.1585 |
| Kochchikade South | 0.0058 | 0.0025 | 0.0019 | 0.0000 | 0.0000 | 0.0101 |
| Aluthkade West | 0.0000 | 0.0000 | 0.0216 | 0.0000 | 0.0000 | 0.0216 |
| Maligawatta East | 0.0014 | 0.0000 | 0.0202 | 0.0000 | 0.0000 | 0.0216 |
| Dematagoda | 0.0000 | 0.0000 | 0.0714 | 0.0141 | 0.0000 | 0.0855 |
| Grandpass South | 0.0000 | 0.0024 | 0.0477 | 0.0000 | 0.0000 | 0.0501 |
| New Bazar | 0.0088 | 0.0066 | 0.0274 | 0.0000 | 0.0000 | 0.0429 |
| Masangasweediya | 0.0017 | 0.0000 | 0.0027 | 0.0000 | 0.0000 | 0.0045 |
| Gintupitiya | 0.0000 | 0.0000 | 0.0058 | 0.0000 | 0.0000 | 0.0058 |
| Grandpass North | 0.0000 | 0.0000 | 0.0340 | 0.0000 | 0.0000 | 0.0340 |
| Bioemendhal | 0.0159 | 0.0095 | 0.0816 | 0.0032 | 0.0000 | 0.1103 |
| Kotahena East | 0.0012 | 0.0032 | 0.0582 | 0.0000 | 0.0000 | 0.0626 |
| Kochchikade North | 0.0000 | 0.0000 | 0.0061 | 0.0000 | 0.0000 | 0.0061 |
| Kotahena West | 0.0000 | 0.0000 | 0.0767 | 0.0000 | 0.0000 | 0.0767 |
| Lunupokuna | 0.0024 | 0.0000 | 0.1319 | 0.0000 | 0.0000 | 0.1343 |
| Total | 0.3868 | 0.3163 | 6.051305 | 0.2375 | 0.0394 | 7.0313 |

When the total extent of green spaces is taken into consideration it was evident that it has not significantly changed over the last five years (Figure 1). However it is visible that the amenity and open green spaces and the patchy mix vegetation and bare lands have been increased in

the year 2015 with a reduction in street trees, vegetation in residential and commercial areas. Nevertheless, these differences in respective vegetation did not seem to be a significant change in urban green spaces of Colombo from 2010 to 2015 (Figure 2).

An in depth analysis of the green spaces in the 47 wards of City of Colombo from 2010 to 2015 (Table 2) identified that the highest negative change (-17.59%) was shown in ward Panchikawatte followed by Kotahena West and Kotahena East. The highest positive change was shown by ward Modara (10% increase in green spaces) followed by Pamankada East. Ward Lunupokuna and Bioemendhal also showed relatively high negative change and ward Maligawatta East, Maligawatta West, Bambalapitiya, Thimbrigasyaya and Kirullopone also showed relatively high positive changes in percent green cover from 2010 to 2015. These could reflect either the clearing of trees and vegetation or planting of trees, home gardening or landscaping practices occurred with recent developments.

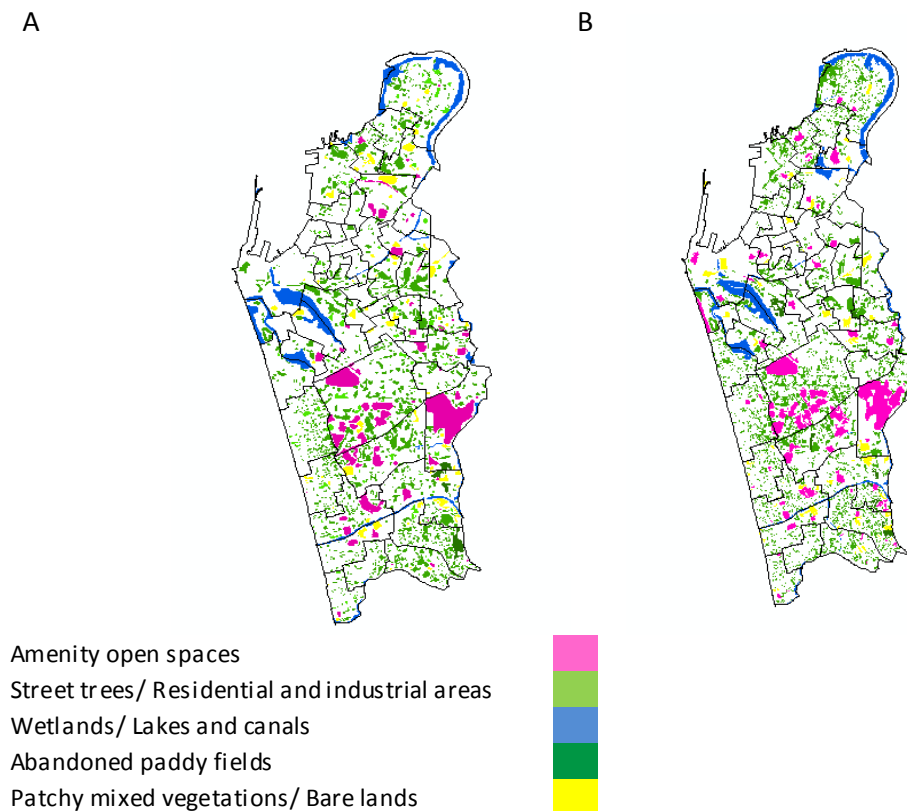


Fig 1. Spatial distribution of green spaces in Colombo city, (A) year 2010; (B) year 2015

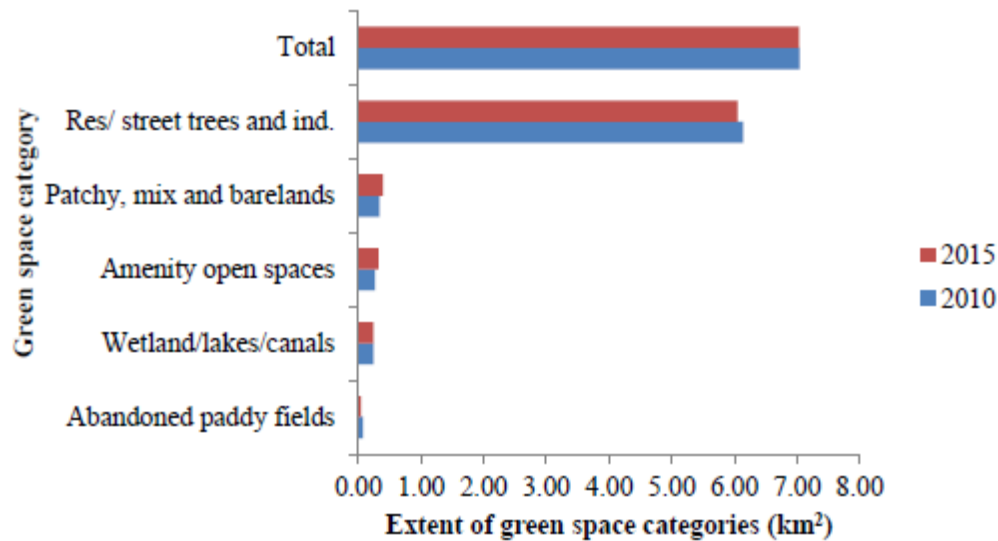


Fig2. Comparison of green spaces categories in Colombo city from years 2010- 2015

Table 2. Change in green cover in 47wards in Colombo City over the period from 2010-2015. Note: reduction of green spaces are given with a negative value

| Ward name | Ward area (km ²) | % Green cover/spaces | | % change in green cover/spaces |
|-------------------|------------------------------|----------------------|-------|--------------------------------|
| | | 2010 | 2015 | |
| Mattakuliya | 2.74 | 12.12 | 13.25 | -1.12 |
| Mahawatta | 0.79 | 6.22 | 7.26 | -1.04 |
| Modara | 0.68 | 39.95 | 26.69 | 13.26 |
| Aluthkade East | 0.27 | 14.92 | 15.29 | -0.37 |
| Aluth Mawatha | 0.67 | 32.83 | 32.15 | 0.68 |
| Wellawatta South | 0.67 | 19.89 | 21.62 | -1.73 |
| Pamankada East | 0.99 | 43.20 | 33.10 | 10.10 |
| Pamankada West | 0.63 | 19.74 | 21.64 | -1.90 |
| Wellawatta North | 0.94 | 20.71 | 20.03 | 0.68 |
| Kirullapone | 1.39 | 38.22 | 34.89 | 3.33 |
| Milagiriya | 0.96 | 17.30 | 16.26 | 1.04 |
| Havelock town | 1.31 | 26.47 | 26.49 | -0.02 |
| Kirula | 1.83 | 21.48 | 20.18 | 1.30 |
| Thimbirigasyaya | 1.88 | 20.61 | 13.91 | 6.69 |
| Narahrenpita | 1.89 | 16.69 | 16.10 | 0.58 |
| Borella South | 0.65 | 43.65 | 45.16 | -1.51 |
| Borella North | 1.02 | 43.65 | 43.06 | 0.59 |
| Kuppiyawatta West | 0.38 | 8.98 | 8.98 | 0.00 |
| Cinnamon Garden | 3.68 | 12.59 | 13.72 | -1.14 |

| | | | | |
|-------------------|------|-------|-------|--------|
| Wekanda | 0.55 | 15.94 | 15.56 | 0.38 |
| Bambalapitiya | 1.48 | 23.01 | 19.98 | 3.03 |
| Kollupitiya | 0.97 | 20.40 | 21.37 | -0.97 |
| Kompannawidiya | 0.62 | 13.88 | 14.71 | -0.83 |
| Hunupitiya | 0.66 | 15.94 | 15.55 | 0.39 |
| Suduwella | 1.32 | 14.65 | 13.99 | 0.66 |
| Maradana | 0.27 | 8.06 | 8.16 | -0.11 |
| Maligakanda | 0.18 | 19.15 | 20.92 | -1.77 |
| Kuppiyawatta East | 0.59 | 3.46 | 3.43 | 0.03 |
| Wanathamulla | 0.59 | 19.15 | 18.54 | 0.61 |
| Maligawatta West | 0.38 | 27.05 | 23.69 | 3.36 |
| Panchikawatte | 0.26 | 1.15 | 28.07 | -26.92 |
| Kehelwatta | 0.31 | 12.10 | 11.78 | 0.32 |
| Fort | 2.13 | 6.20 | 7.44 | -1.24 |
| Kochchikade South | 0.23 | 4.45 | 4.40 | 0.06 |
| Aluthkade West | 0.15 | 14.52 | 14.43 | 0.09 |
| Maligawatta East | 0.60 | 6.77 | 3.60 | 3.17 |
| Dematagoda | 0.73 | 11.79 | 11.71 | 0.08 |
| Grandpass South | 0.6 | 8.42 | 8.35 | 0.06 |
| New Bazar | 0.54 | 7.26 | 7.94 | -0.67 |
| Masangasweediya | 0.24 | 1.71 | 1.86 | -0.14 |
| Gintupitiya | 0.19 | 3.11 | 3.05 | 0.06 |
| Grandpass North | 0.45 | 6.50 | 7.55 | -1.05 |
| Bioemendhal | 1.01 | 4.88 | 10.92 | -6.03 |
| Kotahena East | 0.3 | 6.85 | 20.87 | -14.01 |
| Kochchikade North | 0.33 | 2.19 | 1.85 | 0.33 |
| Kotahena West | 0.4 | 1.59 | 19.18 | -17.59 |
| Lunupokuna | 1.17 | 2.99 | 11.48 | -8.49 |

The concept of sustainability has become an important paradigm in urban planning in order to minimize the negative impacts on environment which may arise as a result of urbanization. In this context urban green spaces play a major role in making the cities green and comfortable for inhabitants via ameliorating the local weather conditions, encouraging wildlife, providing fresh air and shade. Therefore it is important to identify the changes of vegetation cover or the green spaces of a city, and quantify the losses or gains. This study provided basic, but vital information for urban planners reflecting the impacts of recent landscape practices to the green spaces in Colombo. It is sceptical whether urban planning and landscaping activities have understood the real social, economic and physiological benefits of green spaces in a city rather than to increase the aesthetic beauty. It is evident that very few research studies have been done to reveal the changes in vegetation of cities of Sri Lanka.. Nevertheless, time has come to pay more attention towards the urban greening of Colombo along with sustainable urban planning activities for a better green future .

Conclusion

It was clear from the study that rapid urbanization, land use changes and recent landscape practices has transformed the spatial patterns of urban green spaces in city of Colombo from 2010-2015. It is recommended that urban planners should more focus to improve the green spaces and manage them strategically for a sustainable future. In this regard the wards with less green spaces could be supported with tree planting. If space has become a limitation due to the built up area, alternative landscaping practices such as vertical gardens could be developed. We hope that the information provided in this study will be used by decision makers in identifying strategies to manage them in order to obtain the maximum ecological benefit from green vegetation cover.

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