

## **Assessment of Metropolitan Urban Forms and City Geo-spatial Configurations using Green Infrastructure Framework: The Case Study of Lagos Island, Lagos State, Nigeria**

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### **1 ABSTRACT**

For over three decades, the economic and commercial activities of both local and foreign organizations, firms, industries and institutions have been moving to the Lagos Island in search for a reputable business atmosphere and this has led to the emergence of vertical urbanizations of the area thereby turning it into a foremost Central Business District (CBD). The Lagos metropolis is the economic hub of West Africa and the Lagos Island has the bulk of the economic activities. Most of the ill-controlled infrastructural developments are along the major streets and the Island districts are supposed to have certain spatial configurations expected of a metropolitan city like Lagos. The basic urban form design policies and theories had been neglected long time ago thereby making the streets faced with chaotic smart growths, worrisome urban resilience and harsh biophilic architecture with little or no consideration to green landscapes. This study is situated upon the Urban Morphological Theory which investigates the relationships between urban design spatial configurations, landscape and ecological urbanism and some other green city conceptual frameworks. Scholars in the field of landscape urbanism had made divergent or opposed theoretical, conceptual and methodological choices, opportunities in the metamorphosis of a city forms and streetscapes. The normative, descriptive and the critical analysis of the theories were holistically investigated and assessed which informed the study objectives. How do we conceptualize the spatial order of contemporary Lagos Island? What models can best describe its emergent urban forms almost without any green innovations and infrastructures? Land use and detailed geodetic data were obtained from various analysis conducted by the use of Geographic Information Systems (GIS), interviews and personal deductions. This study identifies the different barriers, green innovative strategies for achieving sustainable urban morphology, exploring relationships between quality of life in cities, wellbeing of citizens and mobility, exploring relationships between spatial configurations and equity, exploring implications of emerging technologies for urban development and dynamics, exploring implications of emerging lifestyles and/or business practice for dwellers. This paper demonstrates and evaluates the present upheavals in the urban spatial configurations and geomorphology, social development framework and socioeconomic masterplans for Africa's business districts.

Keywords: metropolitan; urban sprawl; spatial configurations; resilience; urban morphology.

### **2 INTRODUCTION**

The rapid influx of commercial activities into the Lagos Island has led to the increase in the Lagos's population in both absolute and relative terms which has also naturally been accompanied by the expansion of existing built-up areas and the upsurge of Central Business District (CBD) has some common identifiable metropolitan settlement patterns with little or no concern for urban green infrastructures. The dominant nucleated commercial centre has four major building types with little or inadequate car parking spaces and there are no open space for greenery and recreational parks. Lagos has been identified as the seventh fastest growing economy and urban city centre in the world. The average annual growth rate between 2006 to 2020 is 4.44 % behind Bamako (Mali) that is 4.45% (UNDP, Urban Strategy, 2016). The Marina stretch in Lagos Island has some of the tallest buildings in Nigeria, some of which are owned by the Commercial Bank Headquartes and Multinational Corporate Buildings. Transportation hub at Lagos Island Central Business District (CBD) has witness tremendous improvement in the traffic situation always caused by the high commercial activities going on within the area and the government intervention through the implementation of a strategic plan to improve traffic situation on the Island by the Lagos State Government has led to a drastic reduction in traffic gridlock at Broad Street, Apongbon Street and Nnamdi Azikwe Street. The landuse zones are residential, commercial, administrative, recreational and few industrial zones. Overall, the physical development of the high rise buildings and the evasive built-up areas is expected to continue in the

coming years if not properly controlled especially along the Marina Street and there is considerable uncertainty about how much expansion will take place in the coming years.

The key issues are that the population growth, economic upsurge and demanding residential spaces are critical for an emerging Africa's commercial hub and it has increased the population density. The growth of Lagos Island physical developments is accompanied by the expansion of existing built-up areas and the physical expansion of built-up areas is expected to continue in the coming decades, although there is considerable uncertainty about how much expansion will take place. The key issues are the spatial designs and unidentifiable urban configuration. This assessment acts as an outset for the Urban Change Processes theme of the Urbanisation Research Nigeria (URN) programme – and thus as a foundation for later, targeted and more detailed research in the years 2015 to 2017 (Robin Bloch et al, 2015). The study analyses urbanisation and urban expansion in Nigeria. In portraying the dynamics and drivers of urban population growth and the spatial expansion process, it presents an integrated analysis incorporating: An overview of the spatial-demographic dynamics of Nigeria's urban transition. While the information available is at times problematic and ambiguous, by combining and summarising data from multiple sources, credible facts are identified on the dynamics of the urban transition. The analysis points to an expected persistence in rapid urbanisation, urban population growth and urban expansion. As the country's cities have expanded in terms of land cover, their physical organisation has been transformed. Through a historical overview of the evolution of urban structures and the linkages with demographic changes, spatial patterns characteristic of contemporary Nigerian urbanism and landscape are identified (Robin Bloch et al, 2015). It is intended that the findings and conclusions established in this study could advance the development of strategic spatial planning in Nigeria. The following are some of the research questions: What are the general perception about the integration of nature within the urban form context? What makes us epitomizes social and economic activities against the liveability of a city? How can the love for nature start at our doorstep especially in our urbanized cities? How is the landscape designed to be resilient in the face of increasing urbanization?

The aim of the study is to assess the extent to which we have achieved a climatic resilient Urban Forms, Metropolitan City Geo-Spatial Designs and Urban Configurations using the Lagos Island as a case study to ensure a Sustainable Lagos Metropolis. To achieve this the following objectives are to be pursued:

- (1) Determining the ill-controlled infrastructural developments are along Lagos Marina Street and the Island districts are supposed to have certain spatial configuration expected of a metropolitan city.
- (2) Have understanding of the perpetual changes of spatial expansion and the physical configuration and structural characteristics of the city.
- (3) Promoting integrated spatial planning by identifying multi-functional zones or by incorporating habitat restoration measures and other connectivity elements into various land-use plans and policies.
- (4) Contributing to developing a greener and more sustainable economy by investing in ecosystem services and not only technological solutions, and mitigating adverse effects of transport and energy infrastructure.

### 3 LITERATURE REVIEW

The theory and practice of ecological urbanism has a long history, a foundation of knowledge to support it, and built works that demonstrate its benefits (Spirn, 1985). The roots of this tradition in Western culture are deep: from Hippocrates' treatise of *Airs, Waters, and Places* to contemporary authors (Spirn, 1985). The world is rapidly approaching a situation in which most people live in urban settlements sometimes megacities like Lagos. The pioneering environmental writer George Perkins Marsh stated this warning several years ago when he proposed that "human improvidence" was depleting the earth "to such a condition of impoverished productiveness, of shattered surface, of climatic excess" as to threaten the "extinction of the living species" (Marsh 1865). Marsh proposed that "in reclaiming and reoccupying lands laid waste by human improvidence or malice the task is to become a co-worker with nature in the reconstruction of the damaged urban fabrics and urban landscape mosaics." It is surprising, therefore, that in the burgeoning literature on the theories of environmental sustainability and environmental politics, the urban environment is often neglected or forgotten as attention is now focused on "global" problems like; landscape degradations, climate change, deforestation, desertification, and the likes. Similarly, much of the urban studies literature is symptomatically silent about the physical-environmental foundations on which the urbanization process rests. By the beginning of the twentieth century, some scholars disagreed over whether

the task was to rebuild existing cities or to build a new “garden cities” in the countryside, such as those advocated by the author Ebenezer Howard, whose book, *Garden Cities for To-Morrow*, influenced the garden city and new town movements in England and the US (Howard 1902). Geographer and planner Patrick Geddes opposed Howard’s approach in His book “Here or nowhere is our Utopia,” he argued (Geddes, 1915). Geddes, who was educated as a biologist, viewed each city and its surrounding countryside as an evolving organic whole whose future plan should be based on an understanding of its natural and cultural history and its “life processes in the present” (Geddes, 1915). For Kelvin Lynch, the city is first and foremost a human habitat, and he judged “good city form” by how well it sustains human life and existence (Lynch, 1981).

Lynch stressed the importance of how people perceive the city, proceeding from human perception to understanding the sense of place. He explored the role that natural features play in enhancing the identity, legibility, coherence, and immediacy of urban forms and open spaces from the scale of the streets, cities to that of the regions. His last book, *Wasting Away*, takes an ecological approach to managing resources and waste (Lynch, 1990). McHarg’s professional practice was devoted predominantly to the planning of suburbs and metropolitan regions as opposed to downtown and inner-city districts. His approach is valuable for ecological urbanism, even though he viewed the city as a pathological environment (McHarg, 1969). The state of ecological urban design and planning in the present day in comparison to 1984 and about the foundations that make advance possible was deeply explored in her book; *The Granite Garden: Urban Nature and Human Design*. The award winning book is credited with launching a movement that provided the foundation for current strands of practice such as landscape urbanism and ecological urbanism (Spirn, 1985). The key achievement of professional practices stating categorically how and why they advanced the state of the art of ecological urban design and planning.

Various advances in landscape architecture education and urban design theories reflecting the promises that they hold for the practice of ecological urban design and planning. There are discovered and important new knowledge and areas of opportunity for urbanist yet to be recognised and are yet unexploited. Spirn stated in *The Granite Garden* in sections and details on “What Every City Should Do” at the scale of a street corner and the scale of the city as a whole. Assess how well that agenda has been met and identified areas of opportunity for landscape architects. New knowledge about urban nature and identify areas of opportunity for landscape architects, which are currently under recognized and under exploited. Climate and air quality in relation to urban form. Opportunities for designed experiments in collaboration with scientists and environmental justice. The city is part of nature, a fact that has profound implications for how cities are designed, built, and managed. City designers have exploited nature to promote human purposes. The roots of this tradition are as diverse as the many ways in which nature contributes to human health, safety, and welfare. An overview of that tradition is also well outlined, along with an assessment of existing knowledge and prospects for city designed in line with urban morphological configurations and Human Designs (Spirn, 1985). Emerging literature on political ecology (Walker, 2005), little attention has been paid so far to the urban as a process of socio-ecological change, while discussions about global environmental problems and the possibilities for a “sustainable” future customarily ignored the urban origin of many of these problems. Similarly, the growing literature on the technical aspects of urban environments, geared primarily to designers and environmental policy makers, fails to acknowledge the intimate relationship between the antinomies of capitalist urbanization processes and socio-environmental injustices (Whitehead, 2003). This book seeks to address this gap and to chart the contours of a critical academic and political project that foregrounds the urban condition as fundamentally a socio-environmental process. The technology to control urban changes in the form of geospatial datasets comprised of updated satellite imagery and population density through census count (Leonard et al, 2013). Stating that satellite imagery of built-up areas “is a more precise, consistent and comparable definition of an urban area than notions such as population thresholds or administrative boundaries” (Leonard et al, 2013). Sustainable development has been commonly defined as “Economic and Social Development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs” (WCED, 1987).

This definition brought together what is now known as the three pillars of sustainable development; economic development, social development and ecological development under one societal goal of sustainability. Per continent, Copenhagen is the top green city in Europe, Vancouver in North America, Auckland in Oceania, Tokyo in Asia, Curitiba in South America and Cape Town in Africa. Moscow,

Shanghai and Sao Paulo, important BRICS Cities (Brazil, Russia, India, China and South Africa) have medium green performances. Per country, two Dutch and two Canadian cities are among the top 10 green city performances. All studied African and Indian cities such as Cape Town, Nairobi, Johannesburg, Accra, Lagos, Mumbai, Bengaluru and Delhi are in Cluster 3 with low green performances. Lagos is the city with the lowest green performance (17.27 points) in this ranking (UNDP, 2016). Environmentalists are typically well aware of the potential of urban green spaces to contribute to human health and wellbeing, to species protection or provision of wildlife habitats and for contributing to climate change adaptation. However, policy makers also need to be aware of other social and economic trends and emerging challenges, since these can be some of the important drivers and risks for investing in Urban Green Infrastructure (UGI). (Ulrich, 1974).

The findings have a number of implications for environmental planning and design. At the most general level, the results suggest that outdoor visual environments can influence individuals' psychological wellbeing, and therefore should be given explicit attention in planning and design decisions. Most planners have some sensitivity for aesthetic aspects of environments, and in fact there exists some direct empirical evidence showing that aesthetic benefits can be of considerable importance (Shafer and Mietz, 1969). The findings here imply that the importance of strategic urban greening is by no means limited to aesthetics only but also includes a range of influences on emotional and psychological state of the users. It also shows how it helps the environment to reduce atmospheric heat. Urban parks and gardens play a critical role in cooling cities and provide safe routes for walking and cycling as well as sites for physical activities, social interactions and recreations. Recent estimates emerged showing that lack of access to green open spaces and physical inactivities linked to poor walkability accounts for 3.3% of global death (WHO, HSD, 2012). Green spaces are very important to mental health. Having access to green spaces can reduce health inequalities, improve wellbeing and aid the treatment of mental illness. Studies also suggest that physical activities in a natural environment can help remedy mild depression and reduce physiological stress indicators. (WHO, 2001). Urban morphological elements, degradation and loss of urban connectivity are caused mainly by the development of grey infrastructure such as roads, urban settlements, and hydropower plants, dams, car parks poses significant threats to ecosystem coherence. The Urban Green Infrastructure (UGI) decisions will determine Africa's cities landscapes and urban forms for the next ten decades.

The conventional infrastructure planning arrangements put in place by the government of Lagos State through the Ministry of Environment (MoE) and Lagos State Parks and Garden Agency (LASPARK) given the mandate to build neighbourhood parks in all the available open spaces within the metropolis cannot cope with the new challenges and need to integrate other aspects of urban green like green wall, green roofs/gardens, urban agriculture which are some of the sustainable ecological urbanism. While grey infrastructure refers to the technical interconnected structures that support a society, such as roads, railways, water supply, sewers, power grids, telecommunications, green infrastructure is an interconnected network of green space that conserves ecosystem values and functions and provides associated benefits to society (Rees, 1991). It is clear that we need all the types of infrastructure for us to have a balanced ecosystem and have to find ways of making the three types of infrastructure complement each other. Sometimes, certain types of grey infrastructure measures are needed to support green infrastructure, for example hard structures to protect a valuable coastal habitat from erosion or a sluice to regulate the water regime in a wetland. The added value of green infrastructure arises from its multifunctional use (Rees, 1991). Blue infrastructures are elements that can be linked to water. They are pools, ponds, artificial basins, water courses, blue roofs (Vlaanderen, 2016). Blue roofs help to store and harvest annual precipitation, reduce storm water runoff, increase available water supply and improve air quality (Winkelman, 2017). Winkelman argued that while green, blue and grey infrastructure are all important, green seems unabatedly to be cheaper than grey. He went further to state that Green and Green-Grey blends increase Economic Benefits (Winkelman, 2017).

There is a need for green, grey and blue infrastructures functions together within the same microclimate of the megacity. Nature can provide services for free, that in other cases grey infrastructure can provide only after large investments. Green infrastructure measures, such as habitat restoration and maintenance, also create jobs and fuel the economy, just as grey infrastructure activities do, but in a more sustainable manner. The concept, which helps to understand the various impacts of city's food requirements on the landscape termed as ecological footprint (Rees, 1991).

An ecological footprint is a measure of the impact that a given population exerts on nature. It represents the land area necessary to sustain current level of resource consumption and waste disposed of a specific population. Urban Greening Synergies (UGS) as discussed in this study will help decision makers in planning and designing, pushing the boundaries of greening for urban architecture, ecology, urban public spaces and the design of the streetscape for all users which is one of the determining factors in the success of a balanced ecosystem and providing comfortable and sheltered conditions (Rees, 1991). Developing a conceptual masterplan and framework for the green city and using it to develop a method to measure a city's green performance is a difficult and time-draining task, as has been pointed out throughout this research work. Behind the basic parameters that define how cities perform in terms of green and other related issues there are, for example, different and sometimes complex patterns of city planning and development. These have diverse spatial, cultural, environmental, social and economic characteristics that are almost impossible to capture using a small set of thematic areas and indicators (Ogenis B. and Jannes K., 2018).

#### 4 THE STUDY AREA

Lagos Island is the Principal and Central Local Government Area (LGA) of the Metropolitan Lagos in Nigeria. It is part of the Lagos Division. The LGA only covers the western half of Lagos Island; the eastern half is under the jurisdiction of the LGA of Eti-Osa. The Lagos Island is in Eti-Osa Local government in Lagos State, Nigeria. It is popularly regarded as "Eko" which trade activities is usually carried out. It has an estimated population of 212,700 as at 2006-03-21 (A Population Projection of 292,900 by 2016-03-21 2016:- National Population Commission of Nigeria; National Bureau of Statistics). The metropolis is located on the sandy barrier-lagoon complex of Western Nigeria coastline. It is framed by Longitudes 3°23'32.97" of the Greenwich Meridian and Latitudes 6°27'19.99" of the Equator (Wikipedia, 2018).



Plate 1: Detailed Map of Lagos Island as at 1962. Source: Retrieved from Wikipedia, 2018. Plate 2: Updated Satellite Imagery Showing Lagos Island, Lagos State. Source: Lagos ER Mapper, 2018



Plate 3&4: Lagos Island Map Showing the (a) Zoning (b) Wards Source: Positive Reference Limited, 2018

Its ward jurisdiction encompasses an area of about 3.5km X 3km (10.5sq/km). Lagos Island is divided into two main parts which are: Lagos Island East and Lagos Island West, and also subdivided into various wards titled with alphabets 'A' to 'J'. However the micro-climatic condition of the area is influenced by climatic seasons; dry season and wet season. The major water body in the local government is the Lagoon and the Atlantic Ocean where the area is environmentally friendly. Lying on Lagos Lagoon, a large protected harbour on the coast of Africa, the island was home to the Yoruba fishing village of Eko, which grew into the modern city of Lagos. The city has now spread out to cover the neighbouring islands as well as the adjoining Mainland. Lagos Island is connected to the mainland by three large bridges which cross Lagos Lagoon to the district of Ebute Metta.

It is also linked to the neighbouring island of Ikoyi and to the Victoria Island. The Lagos harbour district of Apapa faces the western side of the island. Forming the main commercial district of Lagos, Lagos Island plays host to the main government buildings, shops and offices. The Catholic and Anglican Cathedrals as well as the Central Mosque are located here. Historically, Lagos Island (Isale Eko) was home to the Brazilian Quarters of Lagos where the majority of the slave trade returnees from Brazil settled. Broad Street now has so many administrative, commercial and residential facilities within the area in the Marina district.

## 5 METHODOLOGY

The research adopted a deductive approach, building on the state of the art literature on green city and the authors' knowledge and experience with the environment, infrastructure, sustainability and green city. Primary data formed the basic source of information used in this study. This was obtained through conduct of reconnaissance survey through direct survey techniques using Global Positioning System (GPS) and Geographic Information System for the both the mapping, database analysis and presentations. Physical observations and face to face interviews were also conducted.

Data needs in the questionnaire and interviews were targeted at households, commercial complexes, shopping malls, office complexes and financial institutions in each districts and geo-locations and it is centered on the dwellers and commuters socio cultural and economic backgrounds, shanty settlements, their waste disposal systems and the manner of their environmental awareness on greening, cleanliness and environmental sanitations. Major streets were identified, they include: Marina Street, Broad Street, Akpongbon Street, Church Street and TBS Street. The other streets were also taken as independent entities from physical planning perspective in this study. Some landmarks and iconic locations some of which are monumental bulidings and parks were identified and there geo-spatial locations gotten during the survey.

The land use was classified into Administrative, Commercial, Educational, Health, Public, Recreational, Residential, Mixed-used, Religious and Transportation Zones. The second set of data were gotten from the Physical Planning Development Control Department of the State and Local Government Secretariat and through various interviews that were conducted with some environmental enthusiasts and stakeholders. Information of statutory setbacks and minimum requirements for greening before building development approvals. The available descriptive and inferential statistical techniques were used in the collation and analysis of the data. The main hypothesis in this study is that there is need for the incorporation of Urban Green Infrastructure (UGI) into the urban forms and the geo-spatial configurations of the urban open spaces.

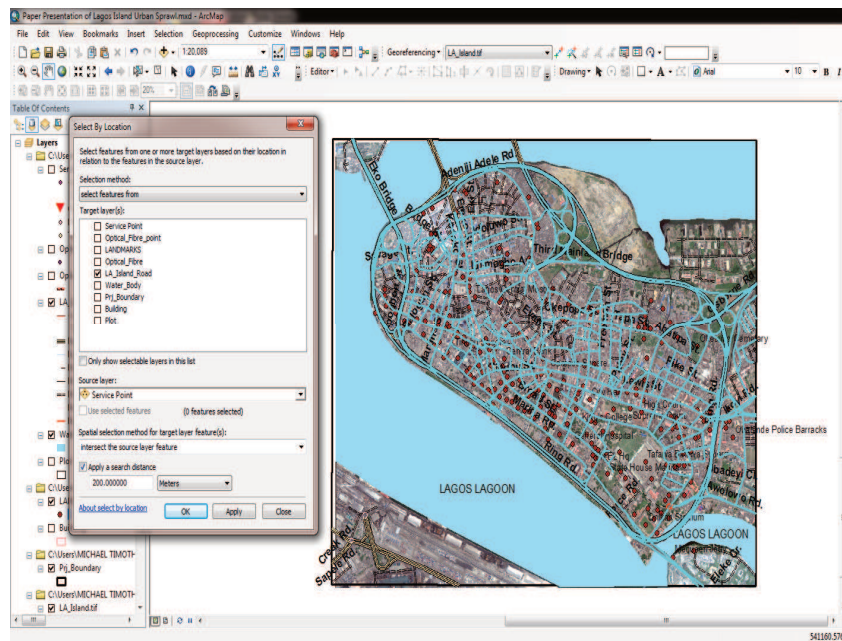


Plate 5: Map Showing the Network Analysis of Road Networks to various Open Spaces and Landmarks

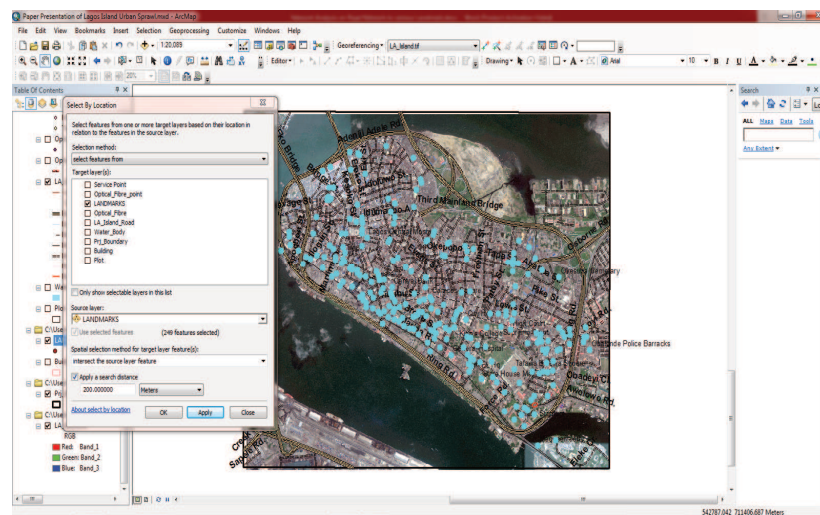


Plate 6: Map Showing the Spatial Analysis at the Open Spaces and Landmark Points (264 Points)

S/N	CLASSIFICATION	USE	NAME	EASTINGS	NORTHINGS
A	ADMINISTRATIVE				
1	Administrative	Office Block	Savannah Bank House	543276.934	713212.270
2	Administrative	Office Block	NITEL Headquatre	544074.528	712456.270
3	Administrative	Office Block	Group House	545263.845	712762.555
4	Administrative	Office Block	ECOWAS Office Complex	544748.443	712073.323
5	Administrative	Office Block	Nigerian Institute of Architects	544679.843	712110.741
6	Administrative	Office Block	United State Information Services	544113.231	712561.537
7	Administrative	Office Block	NCR House	544087.395	712578.464
8	Administrative	Office Block	Western House	544055.322	712608.754
9	Administrative	Office Block	Independence Building	544156.885	712691.608
10	Administrative	Office Block	Nal Towers	543642.836	712715.662
11	Administrative	Office Block	Shell Petroleum House	543547.509	712789.607
12	Administrative	Office Block	UAC Niger House	543189.587	712993.400
13	Administrative	Office Block	Co-op Bank Plc HQ	543155.276	712973.012
14	Administrative	Office Block	Royal Excahnage Assurance Plc	543132.899	712990.913
15	Administrative	Post Office	General Post Office Marina	543075.713	713024.230
16	Administrative	Office Block	CSS Book Shop House	543303.461	713084.897
17	Administrative	Office Block	Investment House	543246.275	713041.634
18	Administrative	Office Block	Nitel Exchange	543413.356	713062.022
19	Administrative	Office Block	Niger Insurance Plc	543604.803	713103.295
20	Administrative	Office Block	St. Peter's House	543494.907	712946.657
21	Administrative	Fire Service	Federal Fire Service	543624.195	712952.281
22	Administrative	Office Block	Eleganza Plaza	543724.516	712866.499
23	Administrative	Office Block		543839.486	712747.680
24	Administrative	Office Block	Knight Frank Building	543584.637	712991.374
25	Administrative	Police Station	Adeniji Adele Police Station	544052.237	713542.605
26	Administrative	Bank		544801.657	712440.363
27	Administrative	Embassy	Ghana High Commission	544938.081	712464.969
28	Administrative	Bank		544884.371	712448.049
29	Administrative	Office Block	Young Women Christian Association of Nig.	544874.290	712535.746
30	Administrative	Court	Chief Magistrate Court	544771.157	712801.315
31	Administrative	Office Block	Lapal House	544817.499	712790.043
32	Administrative	Office Block	Hospital	545042.533	712803.820
33	Administrative	Police Station	Ebute Ero Police Station	542832.608	714434.882

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34	Administrative	Office Block	LSDPC House	542901.615	713809.437
35	Administrative	Office Block	Great Nigeria House	542790.199	713701.438
36	Administrative	Office Block	Elephant House	542210.327	713721.218
37	Administrative	Office Block	A & G House	542209.057	713676.648
38	Administrative	Office Block	Ebani House	542218.750	713600.157
39	Administrative	Office Block	UBA House	542424.060	713475.448
40	Administrative	Office Block	Hallmark Plaza	542383.649	713490.570
41	Administrative	Office Block	Wema Towers	542553.636	713389.673
42	Administrative	Office Block	PZ Industries Plc House	542568.497	713489.005
43	Administrative	Office Block	Financial Trust House	542627.077	713598.863
44	Administrative	Office Block	Anambra House	542764.744	713578.919
45	Administrative	Office Block	Reinsurance House	542764.034	713260.903
46	Administrative	Office Block		542765.686	713467.915
47	Administrative	Office Block	Abibu Oki Court	542864.006	713374.381
48	Administrative	Office Block	Mandilas Hose	542938.834	713318.912
49	Administrative	Office Block	Africa Continental Bank Plc HQ	542916.429	713341.535
50	Administrative	Office Block	Bank Industries House	542916.212	713370.030
51	Administrative	Office Block	Afribank Nig. Plc HQ Afribank Plaza	542998.871	713310.429
52	Administrative	Office Block	Bull Plaza	542939.450	713126.039
53	Administrative	Office Block	Nicon Insurance Corporation HQ	542966.738	713144.125
54	Administrative	Office Block	Union Bank Plc HQ	542974.671	713095.260
55	Administrative	Office Block	First Bank Plc HQ	543006.719	713072.097
56	Administrative	Office Block	Medife House	543260.564	713161.895
57	Administrative	Office Block	Africa Petroleum House	543277.381	713120.962
58	Administrative	Office Block	Nigeria Stock Exchange	543157.234	713164.392
59	Administrative	Hall	Glover Memorial Hall	543078.218	713117.149
60	Administrative	Post Office	Nipost Head Quarters	545116.671	712836.126
61	Administrative	Office Block	National Bank of Nigeria HQ	543057.590	713263.213
<b>B</b>	<b>COMMERCIAL</b>				
1	Commercial	Shopping Center	Napex Complex	544969.381	711839.800
2	Commercial	Petrol Station	Conoil Petrol Station	545281.810	712850.382
3	Commercial	Petrol Station	Conoil Petrol Station	543670.454	712636.372
4	Commercial	Petrol Station	Total Petrol Station	543559.055	713088.875
5	Commercial	Restaurant	Mr. Biggs	543698.830	712815.369
6	Commercial	Petrol Station	AP Petrol Station	543685.740	713095.282
7	Commercial	Petrol Station	Texaco Petrol Station	543806.213	713055.393
8	Commercial	Petrol Station	AP Petrol Station	543504.332	713156.382
9	Commercial	Market	Ita Faji Market	543336.084	713482.591
10	Commercial	Market	Simpson Street Market	544458.221	712995.939
11	Commercial	Petrol Station	Oando Petrol Station	544539.062	712980.814
12	Commercial	Car Shop	Mandilas House	544552.623	713218.644
13	Commercial	Petrol Station	Total Petrol Station	544685.098	713331.300
14	Commercial	Shopping Center	Sura Shopping Complex	544828.005	713370.417
15	Commercial	Market	Sura Market	544760.202	713480.465
16	Commercial	Petrol Station	Total Petrol Station	544454.111	712960.286
17	Commercial	Market	Sand Grouse Market	544529.225	713060.263
18	Commercial	Petrol Station	Texaco Petrol Station	544838.838	712454.559
19	Commercial	Petrol Station	Texaco Petrol Station	544808.732	712754.555
20	Commercial	Petrol Station	AP Petrol Station	544880.125	712654.355
21	Commercial	Petrol Station	Mobil Petrol Station	544863.425	712624.294
22	Commercial	Market	Anikantamo Plank Market	543626.874	713633.017
23	Commercial	Petrol Station	Oando Petrol Station	543703.591	713690.296
24	Commercial	Market	Jankara Market	543304.044	713853.897
25	Commercial	Market	Pelewura Market	543500.859	713943.369
26	Commercial	Shopping Center	Model Market Oja Oba	543491.578	714380.903
27	Commercial	Market	Oja Oba Market	543568.543	714191.831
28	Commercial	Market	Maborete Market	543580.843	714160.904
29	Commercial	Petrol Station	Bovas Petrol Station	543526.370	714097.646
30	Commercial	Market	Alakoro Market	542622.481	714117.550
31	Commercial	Petrol Station	Conoil Petrol Station	542665.642	714117.096
32	Commercial	Market	Ebute Ero Market	542630.347	714301.785
33	Commercial	Shopping Center	Abibatu Mogaji Shopping Complex	542550.643	714268.464
34	Commercial	Market	Idumota Market	542913.133	713964.089
35	Commercial	Market	Oke Arin Market	542600.809	714005.310
36	Commercial	Market	Balogun Market	542835.178	713836.075
37	Commercial	Shopping Center	Union Homes Complex	542959.904	713741.747
38	Commercial	Market	Tom Jones Markets	542965.143	713799.827
39	Commercial	Shopping Center	Lagos Central Mosque Plaza	542964.684	713700.968
40	Commercial	Market	Apongbon Market	542456.155	713704.937
41	Commercial	Restaurant	Mr. Biggs	542303.429	713550.573
42	Commercial	Restaurant	Eatrite Fast Food	542496.279	713508.038
43	Commercial	Shopping Center	Ebudola Eko Central Makert	542662.785	713566.117
44	Commercial	Market	Mandilas Market	542786.137	713525.314
45	Commercial	Market	Oluwole Market	542960.490	713589.959
46	Commercial	Shopping Center	Kinsway Shopping Hall	542651.262	713310.947
47	Commercial	Petrol Station	Oando Petrol Station	542734.055	713223.302
48	Commercial	Restaurant	Tastee Fried Chicken	542697.978	713337.122
49	Commercial	Petrol Station	Oando Petrol Station	542781.130	713449.208
50	Commercial	Restaurant	Tetrazzini Restaurant	542749.154	713432.894
51	Commercial	Restaurant	Sweet Sensation fast food	542836.381	713386.562
52	Commercial	Restaurant	Tantalizers	542854.870	713400.918
53	Commercial	Shopping Center	Timubu Shopping Complex	543131.616	713322.070
54	Commercial	Market	Timubu Market	543113.625	713357.736
55	Commercial	Market	Marina New Market	542861.076	713216.788
<b>C</b>	<b>EDUCATIONAL</b>				
1	Educational	School	King's College	544253.339	712851.704
2	Educational	School	Nigerian Army College of Logistics	543500.641	712838.321
3	Educational	Library	Central Library	543351.198	713034.176
4	Educational	School	Eko Akete Grammar School	543678.355	713023.112
5	Educational	School	Holy Cross Catholic School	543913.726	712923.972
6	Educational	School	Ebute Elefun Pry School	543943.174	712989.796
7	Educational	School	Timubu Methodist Primary School	543933.646	712964.390
8	Educational	School	St. John Primary School	543251.695	713649.042
9	Educational	School	Christ Church Cathedral School	543381.888	712939.865
10	Educational	School	St. Peter's Primary School	543551.028	712988.087
11	Educational	School	St. Mary's Private School	543525.091	712961.053
12	Educational	School	Lagos Island Handicraft Centre	544527.066	713422.573
13	Educational	School	Fazz+Omar Ahmadiyya School	544537.498	713435.611
14	Educational	School	Lagos Island Nur/Pry School	544532.804	713471.077
15	Educational	School	Dolphin High School	544581.830	713431.961



16	Educational	School	Epetedo High School	544693.886	713580.284
17	Educational	School	Araromi Baptist School	544984.918	712647.675
18	Educational	School	St. Stephen's Wase School	543850.963	713613.688
19	Educational	School	King Ado High School	543301.327	713975.015
20	Educational	School	Holy trinity School	542933.610	714411.516
21	Educational	School	Ansar Ud-Deen Primary School	542639.538	714013.971
22	Educational	School	St. Paul School	542684.701	713488.498
<b>D</b>	<b>HEALTH</b>				
1	Health	Hospital	General Hospital	543889.609	712603.589
2	Health	Hospital	Onikan Health Centre & Maternity	544884.750	712235.467
3	Health	Hospital	NAF Medical Centre	544947.113	712331.684
4	Health	Health	Lagos Island Maternity Hospital	544013.450	712671.117
5	Health	Hospital	St. Nicolas Hospital	544054.432	712765.553
6	Health	Hospital	Osagie Medical Centre	544090.068	712755.753
7	Health	Hospital	Federal Dental Clinic	544096.304	712502.737
8	Health	Hospital	Lagos State Dental Centre	544066.904	712522.337
9	Health	Hospital	Juli Sam Clinic	544081.512	713174.140
10	Health	Hospital	Beta Clinic	543627.576	713298.184
11	Health	Hospital	Massey Street Children's Hospital	543413.743	713392.006
12	Health	Mosque	Laguda Central Mosque	543473.534	713358.190
13	Health	Cemetery	Abari Cemetery	544527.066	713357.899
14	Health	Hospital	Victory Hospital & Maternity Home	544293.423	712977.310
15	Health	Hospital	The Health Arena	544782.847	712714.057
16	Health	Hospital	Penta Medical Centre	544889.310	712729.087
17	Health	Hospital	Tiwadola Clinic	544839.210	712653.102
18	Health	Hospital	Maja Hospital (Glaucoma Unity)	545063.408	712764.993
19	Health	Hospital	Cottage Medical Clinic	543797.703	713506.218
<b>E</b>	<b>PUBLIC</b>				
1	Public	Court	High Court	544506.064	712828.651
2	Public	Court	Supreme Court	544404.462	712855.973
3	Public	Govt. Office	City Hall	544039.889	712920.008
4	Public	Cemetery	Okesuna Cemetery	545002.887	713302.758
5	Public	Police Station	Obalende Police Barracks	545324.792	712648.176
6	Public	Govt. Office	State House Marina	544201.423	712392.436
7	Public	Police Station	Obalende Police Barracks	545256.360	712719.141
8	Public	Police Station	Onikan Police Station	544642.425	711964.634
9	Public	Govt. Office	National Assembly Complex (Lagos Office)	544595.208	712352.175
10	Public	Court	High Court of Lagos	544725.279	712454.629
11	Public	Govt. Office	Fed. Min. of Justice (Lagos Office)	543768.453	712670.226
12	Public	Cemetery	Remembrance Arcade	544244.193	712677.354
13	Public	Govt. Office	NEPA Eko Distributor Zonal HQ	543398.729	712865.333
14	Public	Govt. Office	Mamman Kontangora House	543455.747	712843.061
15	Public	Govt. Office	Federal Office of Statistics	543599.830	712870.575
16	Public	Govt. Office	Nigerian Port Authority House	543345.728	712904.389
17	Public	Hall	St. Georges Hall	543678.960	712827.970
18	Public	Police Station	Nig. Police Area AHQ Lion Building	543864.765	712825.282
19	Public	Govt. Office	Office of the Auditor Gen. of the Federation	543829.421	712847.886
20	Public	Court	Chief Magistrate Court	544475.432	713443.956
21	Public	Refuse Dump	Refuse Transfer & Loading Station	544590.699	713636.641
22	Public	Govt. Office	Police Work Dept. Barack Okesuna	544378.957	712973.573
23	Public	Govt. Office	Fed. Min. of works & Housing	544677.272	712708.738
24	Public	Police Station	Omo Awo Police Post	543261.838	713898.601
25	Public	Hall	Tom Jones Memorial Hall & Library	542964.818	713845.896
26	Public	Govt. Office	Central bank of Nigeria	543047.325	713168.354
27	Public	Govt. Office	Federal Government Press	543711.282	712752.694
28	Public	Police Station	Kam Selem House Zonal Police HQ	545114.729	712702.752
<b>F</b>	<b>RECREATIONAL</b>				
1	Recreational	Recreational	Tinubu Square	543142.887	713277.597
2	Recreational	Recreational	Tafawa Balewa Square	544538.832	712474.675
3	Recreational	Stadium	Onikan Stadium	544541.891	712022.170
4	Recreational	Recreational	Campos Square	543671.572	713124.843
5	Recreational	Boat Club	Mequeen Jetty	544783.349	711791.526
6	Recreational	Recreational Club	Island Club	544617.480	712067.978
7	Recreational	Swimming Pool	J.K Randle Swimming Pool	544564.917	712141.923
8	Recreational	Theatre	Muson Centre	544438.409	712100.050
9	Recreational	Recreational Club	Local Govt. Staff Recreation Club	544648.662	712131.232
10	Recreational	Museum	National Museum Onikan	544717.261	712199.831
11	Recreational	Recreational Club	Yoruba Tennis Club	544750.224	712237.249
12	Recreational	Restaurant	Lagos Toast Fast Foods	544318.138	712403.847
13	Recreational	Recreational Club	Lagos Lawn Tennis Club	544362.683	712356.630
14	Recreational	Recreational Centre	Tafawa Balewa Square Cricket Oval	544308.338	712545.500
15	Recreational	Restaurant	Mama Cass Cafeteria	543002.615	713032.186
16	Recreational	Restaurant	Tantalizers Fast Food	543296.002	713014.782
17	Recreational	Playground	Ajere Playground	543746.617	712992.949
18	Recreational	Hotel	J30 Guest House	543618.956	713212.955
19	Recreational	Cinema	Corona Cinema	543286.615	713458.729
20	Recreational	Hotel	Ritz Hotel	544945.031	712551.384
21	Recreational	Hotel	Famoss Guest House	544822.510	712723.242
22	Recreational	Recreational Centre	Hospital	545005.891	712849.291
<b>G</b>	<b>RELIGIOUS</b>				
1	Religious	Church	Christ Church Cathedral	543234.963	712945.004
2	Religious	Mosque	Lagos Central Mosque	543013.794	713665.691
3	Religious	Church	Our Saviour's Church	544187.109	712540.996
4	Religious	Church	Methodist Church of Nigeria	545289.295	712765.549
5	Religious	Church	Catholic Secretariat	544441.082	712266.649
6	Religious	Church	The Diocese of Lagos Anglican Communion	543296.996	712920.799
7	Religious	Church	Cathedral House	543285.062	712990.913
8	Religious	Church	4 Square Gospel Church LI HQ	543981.207	713014.684
9	Religious	Mosque	Juma At-UI Islamiyya of Nig. Central Mosque	543994.643	713165.631
10	Religious	Mosque	Brazilian Oloro Mosque	543619.204	713305.002
11	Religious	Church	St. John's Anglican Church	543231.325	713626.053
12	Religious	Church	St. Peter's Church	543543.357	712969.090
13	Religious	Church	Ebenezer Baptist Church	543762.910	712883.242
14	Religious	Church	Holy Cross Cathedral	543920.726	712853.286
15	Religious	Church	Christ Apostolic Church	544535.933	713525.319
16	Religious	Church	Cherubim & Seraphim Ifelodun Aladura	544115.006	713565.461
17	Religious	Church	St. Andrew's Anglican Church	544032.792	713590.364
18	Religious	Mosque	Istijabah Muslim Forum Of Nig. Mumuni Oloro Mosque	544047.461	713474.036
19	Religious	Mosque	Imam Salu (Hadji Onirakunmi) Mosque	544522.206	712917.104

20	Religious	Church	Araromi Baptist Church	545014.143	712654.355
21	Religious	Church	The Holy Flock of Christ Church	543824.959	713500.799
22	Religious	Church	St. Stephen's Cathedral Church	543868.073	713622.069
23	Religious	Church	Kingdom Hall of Jehovah Witnesses	543645.113	713644.402
24	Religious	Mosque	Olorunsola Mosque	543712.440	713721.683
25	Religious	Mosque	Ahadiyya Muslim Jamat Central Mosque	543290.797	713792.886
26	Religious	Mosque	Anwar- Ul- Islam Mosque	543234.076	714018.638
27	Religious	Church	Holy Trinity Anglican Church	542917.736	714425.758
28	Religious	Church	Obun-Eko Methodist Church	542993.868	714238.499
29	Religious	Church	United African Methodist Church	542624.831	714006.944
30	Religious	Mosque	Ansar Ud-Deen Society of Nig. Mosque	542613.882	714033.745
31	Religious	Mosque	Alaso Oke Mosque	542490.412	713852.076
32	Religious	Mosque	Shitta Abbey Mosque	542749.549	713704.274
33	Religious	Church	St Paul Church	542688.522	713464.093
34	Religious	Church	Methodist Church of the Trinity	543180.285	713204.731
35	Religious	Church	First Baptist Church	543729.300	712801.427
1	Residential	Palace	Iga Idunganran	543212.441	714488.039
<b>H</b>	<b>TRANSPORTATION</b>				
1	Transportation	Bus Stop	CMS Bus Stop	543174.172	712885.991
2	Transportation	Bus Stop	Leventis Bus Stop	542122.109	713549.664
3	Transportation	Bus Stop	Apongbon Bus Stop	542352.143	713424.826
4	Transportation	Bus Stop	Tinubu Bus Stop	543192.215	713281.040
5	Transportation	Bus Stop	Obalende Bus stop	545118.614	712784.330
6	Transportation	Bus Stop	Idumota Bus Stop	542848.026	714279.475

Source: Field Survey, 2018

The table above shows that Administrative use is 61 (20%), Commercial use is 55 (18%), Educational use is 22 (7%), Residential/Mixed-used is 50 (17%), Transport use is 12 (4%), Health use is 19 (6%), Public use is 28 (9%), Recreational use is 22 (7%). The total land use locations of the various points captured in this study is 264 (100%). This table shows that most of the land use are for administrative uses followed by commercial activities and residential/mixed-used facilities that the Lagos Island has limited open spaces that are specifically for greenery. The 17% of both the residential and mixed-use are now prevalent as most of the buildings that were originally residential are now being partly or fully converted into commercial shops, complexes, stores and ware houses while still maintaining the upper floors for residential purposes.

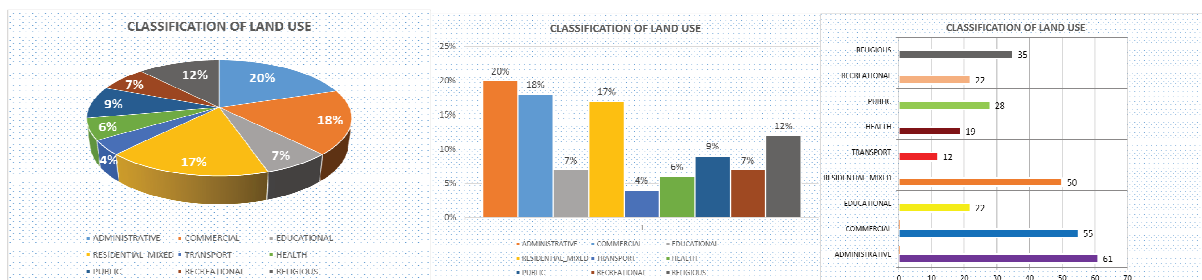


Figure 1, 2 & 3: Pie Chart and Bar Charts Showing the Land Use Analysis. Source: Field Survey, 2018

## 6 FINDINGS AND DISCUSSIONS

This study was conducted to assess the Urban Forms and Metropolitan City Spatial Designs and Configurations of the constantly Changing Urban Spaces to enhance the green rating, Wellbeing and the Depleting Urban Spaces, the social relation based on psycho-social climate, psychological wellbeing components of the Lagos Metropolitan city. Over two Hundred Landmarks were identified within the CBD and It was found out that there are various landscape features at all the zones assessed and there are no provisions for greenery. The 7% of the recreation area comprises of the open spaces at some school and few residential buildings. This suggest neglect and lack of appropriate planning in the allocation of recreation spaces. The Administrative buildings had about 20% of the total land use but the and the roof tops were used for the air conditioning chillers and outdoor units which also suggest that there are limited technology for the installation of roof gardens and green walls that can make the facilities biophilic and conducive for human habitation. Plate 1 revealed that as at 1962 the Carter Bridge was the only Bridge connecting the Island. But in the early 1980's the Eko Bridge and Third Mainland Bridge were constructed to meet the demand for more road networks due to the increasing population of Lagos Island.

### 6.1 Basic Features of the Open Spaces and Landmarks Locations

The factor influencing CBD was originally earmarked for administrative and residential estate development not until about three decades ago when commercial activities bewildered the area and most of the originally built residential apartment are now converted to commercial store outrightly while some of the building still maintain a dual status of a mixed-used building meaning that it still serve both commercial and residential

purposes. The original layout as designed in 1967 made provisions for Recreation, sport complex, golf course, horse race course cemetery and many other open spaces which has either been relocated or redeveloped for other purposes thereby creating a vacuum in the ecosystem and altering the natural biodiversities. The urban planning barriers majorly is over population and traffic congestions which has affected the green innovative strategies for achieving sustainable urban morphology, relationships between quality of life in cities, wellbeing of citizens and mobility, relationships between spatial configurations and equity, implications of emerging technologies for urban development and dynamics, exploring implications of emerging lifestyles and/or business practice for dwellers. Further findings revealed and evaluates the present upheavals in the urban spatial configurations and geomorphology, social development frameworks and socio-economic masterplans.

## **6.2 Geo-Spatial Characteristics of the Non-Motorized Transportation Networks**

Urban design configurations of Lagos Island were originally designed with cycling route in some areas but further development in the three decades has not given priority to walking, cycling, jogging, and eco-friendly motorized rapid transit vehicles like the electric cars with low or zero amount of carbon emission and other forms of renewable energy technologies. A further studies shows that this area has been no proper reference to energy efficient practice in the public service and solid waste discharge and collections. The quality of air, water and soil has been overly saturated and they need quick improvement so as to attain the global standard.

## **6.3 Challenges to Achieving a High Green Rating**

The building industry is one of the most energy consuming industry of the city. The Lagos Island as the area of study focused on the extensive use of energy and resources efficiency in combination with the increment of the production and use of renewable energy in the industry. Key elements of this study area which are just emerging includes the use of low development impact practices in the construction of new buildings and in the remodeling of the existing facilities, the use of building energy green ratings and performance rating as to energy improvement and efficiency. The construction technology adopted for construction of road, parks, and building are still obsolete since there are quicker and better approaches which should be as a matter of policy be adopted in both local, state and national level.

## **7 CONCLUSION**

For Lagos to attain the vision of becoming a smart city, sustainable city and also main her position as the economic and financial hub of Africa that is safe, secure, functional and productive, the Lagos State government embarked on the implementation of various urban planning and development regulatory and policy frameworks as well as urban development projects. This paper, however, demonstrated that urban neglect of green infrastructures like green transportation networks, urban agriculture and urban greening solutions like green roofs, vertical farming, green walls, green ICT and technologies, green public services. Lagos metropolis is in dire need of green urban space to sustain the growing population and to reduce the increase atmospheric temperature. Open spaces are now very scarce. An interest in urban green infrastructure (UGI) must look in the direction of already built up spaces and central business districts and commercial hubs. Above all Lagos State Parks and Gardens (LASPARK) must come up with sustainable greening guidelines and effective policies that will encourage the placement of value on the urban and residential landscapes for a better, healthier, serene and greener city. The people now know the importance of greening, social cohesion and the need to restore our habitat so it can keep thriving and withstand the pertinent commercialization of the city. The use of both government setbacks and private residence land areas requires a detail understanding of the long-term urban greening goals and objectives of the primary urban space. Applying a comprehensive urban green infrastructure is an important approach to mitigate urban heat island happened during the urbanization, construction, and development process. Development of a conceptual framework of research on urban greening masterplan. This study summarizes and integrates the main findings which are presented in the urban greening. This includes debates around which benefits are provided by UGI and how these benefits can be articulated in ecological, social and economic terms. Furthermore, we scrutinize the relationship between green spaces and social cohesion and discuss links between biological and cultural diversity. Hence, UGI is perceived as a comprehensive landscape approach acknowledging services and benefits from a coherent green, grey and blue network at different urban spatial configuration and levels, linking up neighbourhoods, districts and cities.

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