# SUSTAINABLE URBAN GREEN INFRASTRUCTURES AS A REMEDIATION TOOL FOR ENHANCED ENVIRONMENT AND LOCAL AIR QUALITY FOR METROPOLITAN LAGOS

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Adopting a new paradigm in the urban planning process helps to create a resilient metropolitan city and functional urban open spaces. Lagos State Government is worried about the increasing volume of greenhouse gases emission in the metropolis, hence there is need to remedy the degrading settlements. Mitigation measures traceable to over reliance on hydrocarbon based facilities and equipment call for the redevelopment of the green corridors and wetlands. These green corridors are the existing thin strip of land within Lagos Mainland which are habitats for few wildlife and biodiversity. They include wetlands and canal routes which fall within the setbacks of Agidingbi, Opebi, Oregun, Maryland, Yaba and Iwaya rivers flood plain with a distance of about 17km. Urban development in the past has not articulated these sustainable components in the environmental design but this paper is guided by the use of afforestation and urban greening solutions. The study examine and identified the various land-uses existing in the study area with a view to evaluating their level of compliant to the Global Climate Change policies that addresses low carbon emissions through eco-friendly green infrastructures that enhances the environmental air quality for a more sustainable Lagos City. The study is underpinned by the ecological urbanism dictum. Following the qualitative and descriptive analysis of the on-site data collection, observations and evaluations, the developmental and adaptive strategies were mapped out through GIS based network mapping. The land use data were obtained from various analysis conducted by the use of Geographic Information Systems (GIS), used to take twenty six (26) Points at about 500m intervals along the green corridors and wetlands. The socioeconomic information and details were gotten through various observations, interviews and personal deductions. The wellbeing of a city cannot be separated from the wellbeing of its environment therefore the study recognised the role of a healthy ecosystem and a reduced reliance on fossil fuel, increased green open spaces, restoration of habitats, water and air purity. The study proposed carbon sequestration through restoration, conservation of existing wetlands and other strategic adaptive solutions toward a sustainable and resilient city development in the form of; urban green infrastructures, non-motorized transportation mode, urban agriculture along the wetlands, restoration of the wetlands and water ways, conservation and inclusive landscape regeneration of the open spaces and concludes by stressing the reality of sustainable low carbon philosophy within the landscape and built environment pedagogy.

Keywords: climate change; greenhouse gases; green corridors; landscape regeneration; urban green infrastructures

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## INTRODUCTION

Liveable landscapes are designed as public spaces that allow people to get from point A to B, but also support and encourage the activities people pursue in public spaces. Such habitats are resilient, inclusive, multicultural, socially cohesive, economically vibrant, and full of life (UNEP, 2017). The Lagos State Government has commenced some environmental measure to curb the increasing volume of greenhouse gases within the metropolis. An estimate of about 40% of all new vehicle registration in Nigeria are in Lagos and accounts for 40% of the total national petroleum products consumptions (Loricamp, 2007). Loricamp (2007) further states that about 95% of these motorised architecture were manufactured over ten years ago and without catalytic converters to minimize noxious and toxic carbon effluents. Vehicular density is estimated at 220 vehicles per kilometre compare to national average of 1.1 vehicles per kilometre (LSG, 2006). Sustainable Urban Green Infrastructures are needed as remediation and restoration tools for enhancing the environment and the primary local air quality in the Lagos Metropolis (LASEPA, 2001). Commuters need adequate infrastructure in the forms of slow-speed shared walkways, vegetated walls (green walls), roof garden/green roofs, natures walkway, footpaths, cycling routes and green—on which to travel. In accordance to the Lagos state government NMT policies which involves two simple methods; Systematic traffic calming to ensure that smaller streets are safe places for the mixing of pedestrians and other modes -shared lanes; and pedestrian and cycle infrastructure that is physically separated from motor vehicle traffic (by raised medians, vehicle parking lanes, bollards, landscaping, etc.) on larger streets (Lagos NMT Policy, 2017). Streets are public spaces for socialisation and commerce as well as mobility. The slow zone—whether the entire right-of-way of a small street or a separate space on a larger thoroughfare—is space for liveability for people to walk, talk, and interact, for doing business, for children to play. The provision of an adequate slow zone recognizes that street are destinations. It also enables streets to provide safe and uninterrupted mobility for all users regardless of their travelling speed (Lagos NMT Policy, 2017).

The open spaces are for public use. Therefore, their design must not discriminate against users by their age, ability, gender, income, race, ethnicity, or religion. An equity-based approach to NMT policy must ensure that providing services and infrastructure meet the needs of all users. Nigeria's Intended Nationally Dependent Contributions (INDC) as a part of the agreement signed by the federal government of Nigeria in Paris during COP 21 to reduce greenhouse gas emission by 20% conditional and 45% unconditional is key to achieving environment sustainability through low carbon transportation mode (Puncher et al, 2008). Environmental benefits of walking and cycling are achieved through reduced motor vehicle use leading to reduced congestion and vehicle emissions, improved local air quality and reduced carbon emissions into the atmosphere. The urban dwellers are in dire need for safe and pleasing places to walk, cycle, jog and connect to nature within Lagos metropolis, this study proposes the integration of the available green corridors and wetlands with all the inherent ecosystem services and biodiversity to include the stretch of river wetlands and canal routes which fall within the setbacks of Agidingbi, Opebi, Oregun, Maryland, Yaba and Iwaya rivers flood plain from Awolowo Way in Ikeja through Maryland to the Iwaya Community across the

16.6km (17km approximated distance) close to the communities, providing ecological and recreational facilities such as skating board, basketball court, lawn tennis, football field, board walk, children play area, nature sky walk and bicycle training tracks. Establishing bike corridors all through the city enables both residents and visitors to enjoy local parks and nature scenes. Within the context of this study, open space includes: green spaces (or green field developments) such as regional and local parks and reserves, sports fields, and other recreation areas, blue spaces such as the region's waterways and harbors, grey spaces such as civic squares, streets and transport corridors.

The aim of this study is to assess the extent to which Urban Green Infrasrtructures can be used as a tool to remediate and enhance the environmental air quality for a more sustainable Lagos City. The following are the objectives of this study: To explore the restoration of the wetlands and transforming it into productive and attractive green space for ecotourism, encouraging urban agriculture through food production in a sustainable way is more nutritious and less toxic, benefiting consumers and farm workers; To address Sustainable urban farming methods to help regenerate and restore rather than contaminate the soil; To determine if bio-remediated green spaces in urban areas improves air quality, reduces polluted water run-off from paved areas, can moderate the atmospheric temperatures thus reducing energy costs, restores biodiversity and healthy habitats and reduces soil erosion; and to explore the Introduction of plants for phytoremediation, with the ability to remove some toxins from contaminated soil and water adhering to every planning process towards the implementation of the Global Climate Change policies that addresses low carbon emissions through eco-friendly infrastructures while also focusing on the United Nation's Sustainable Development Goal 11- Sustainable Cities and Communities on the metropolitan scale so as to reduce the effects and menace of Climate Change.

## LITERATURE REVIEW: SUSTAINABLE ENVIRONMENTAL AND GREEN INFRASTRUCTURE PRINCIPLES

Green Infrastructure refers to a strategically planned and delivered network comprising the broadest range of high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering those ecological services and quality of life benefits required by the communities it serves and needed to underpin sustainability (Natural England, 2009). Its design and management should also respect and enhance the character and distinctiveness of an area with regard to habitats and landscape types (Natural England, 2009). Green Infrastructure includes established green spaces and new sites and should thread through and surround the built environment and connect the urban area to its wider rural hinterland. Consequently it needs to be delivered at all spatial scales from sub-regional to local neighbourhood levels, accommodating both accessible natural green spaces within local communities and often much larger sites in the urban fringe and wider countryside (Beer, 2010).

The transport system in Lagos is predominantly road-based, and the available road infrastructure is greatly overstretched. Lagos residents rely heavily on informal paratransit modes such as danfos as well as taxi services such as kekes (three-

wheelers) and okadas (motorcycle taxis). A smaller number of commuters travel on buses run by Lagos Metropolitan Area Transport Authority (LAMATA) and Lagos Bus Asset Management Limited (LAGBUS). According to recent mode split data, 70 per cent of motorised trips are by paratransit public transport modes (Lagos Urban Transport Master Plan, 2014). Recent data on walking and cycling are not available, but non-motorised modes likely account for upwards of a third of all trips in the city. Walking is a component of almost all public transport trips, so almost all commuters walk as a part of their daily trips. Lagos' concerning transport situation has spurred numerous interventions over the years. In 2002, the Lagos Urban Transport Project (LUTP), a World Bank funded initiative, was launched to revamp and modernise public transport (LUTMP, 2014).

The quality of life for NMT users is much deteriorated; they can never relax when they are at or close to a street. Mobility induced city air pollution is evident in the metropolis where governments annual budgets emphasized road transportation and car ownership at the detriment of ferry, rapid and light rail transit systems (World Bank, 2016). Alternative mobility frame work advocates for circulatory facilities including sidewalks, walkways, paths and bike lanes. These facilities minimally impact cityscape, rely on renewable energy, use less urban space, reduce traffic congestion, improve physical fitness and are cheaper (Adejumo, 2010). Leisure cycling is compatible with non-motorized and car free planning philosophy. Non-motorized modes are either developed along roadways or off road trails along urban natural corridors including parks and urban wilds. Uduma-Olugu et al, (2018) opined that the university's open spaces need to better meet the psychological comfort of the students, staffs and visitors through the use of available spaces to experience plants and trees in a more biophilic manner. She went further to state that open space networks should encourage more active lifestyles by offering a variety of safe and attractive spaces that are well distributed throughout a neighbourhood and are accessible, catering for the sporting, recreational needs of the students within the university's community and preferably public open space should attempt to cater for multiple users (Uduma-Olugu et al, 2018).

There is no single agreed definition of open space nationally or internationally. There is agreement however, that there are many types of urban public open space. Our regions' open space network is not just about playgrounds, parks and reserves, but incorporates diverse aspects of our wider environment, for example, neighbourhood streets, city centres, walkways, greenery, waterways, structures and views. For the purposes of this study we will use a broad understanding of open space. It also includes the open vistas and views that surround the city (RPH, 2010). Open space is also often referred to by the narrower term 'green space'. Green spaces can be defined as 'any vegetated land or water. This includes natural habitats, green corridors such as paths and rivers, parks, gardens, playing fields, children's play areas, cemeteries, and countryside immediately adjoining a town. Open spaces also include contaminated or vacant land, often called "brown fields", which can be developed into green spaces or parks. Undeveloped or poorly developed brown fields are not considered to be quality open spaces and can have a negative impact on health and wellbeing. Under the Local Government Act 2002, local authorities are required to 'promote the social, economic, environmental and cultural wellbeing of communities', commonly called the "four wellbeing". Social,

economic, environmental and cultural factors are the four cornerstones of the sustainability framework. They also represent the four major factors that influence health (Percival, 2017).

The green corridors which serves as a riparian buffer zone in some part of the metropolis is thin and sometimes used as linear parks and converted to recreational use within the urban setting that is substantially longer than it is wide and this area are often described as greenways (Kennedy, 2003). While others uses of the strips of public land next to canal, streams, extended defensive wall, electrical power lines, highway and shorelines in some urbanised cases. Some scholars also often describe this greenways as Riparian Forest or Riparian woodland. It is a forested woodland area of land adjacent to body of water such as river, streams, swamps, pond and lake (Kennedy, 2003). There is a strong incentive to manage and protect riparian land because disproportionally large benefits can be gained by repairing a relatively small tract of land, and because many restoration actions, such as revegetation, are simple and affordable (Wong et al, 2009). The ecological composition predominant here provides critical habitat for different species of butterflies, birds, reptiles and mammals. The forest are natural bodies of water sometimes serve the purpose of a riparian buffer zones for residential neighbourhoods and the forest is important in preserving air and water quality, maintaining stream integrity and purity, acts as filters for the sediments and other toxic pollutants. The buffer zone can be made up through restoration and revitalization of the wetlands which are made up of trees, shrubs and grass plantings (Kennedy, 2003). Sustainability is one the newest degree subjects that attempts to bridge social science with civic engineering and environmental science with the technology of the future. When we hear the word "sustainability" we tend to think of renewable fuel sources, reducing carbon emissions, protecting environments and a way of keeping the delicate ecosystems of our planet in balance (Percival, 2017). Sustainability looks to protect our natural environment, human and ecological health, while driving innovation and not compromising our way of life (Kennedy, 2003).

## RESEARCH DESIGN / METHODS

The study pursued a descriptive and qualitative analysis of the information gathered during the research and deductive approach, building on the available literature on green city, 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. Some landmarks, open spaces and commercial hubs were identified and there geospatial locations gotten and the points were taken after every calculated distances of 500m along the wetland/green corridor during the survey. The land use was classified into Administrative, Commercial, Educational, Health, Public, Recreational, Religious and Transportation. The second set of data was gotten from the Physical Planning Development Control Department of the State and through various interviews were conducted with some environmental enthusiasts and stakeholders. Information of statutory setbacks and minimum requirement 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 the incorporation of green infrastructure into the urban forms and geospatial configurations will enhance the environment. This study employed descriptive survey design of the existing site conditions in which the existing status of the independent situations were gotten during data collection without any manipulation of the variables.To achieve this, stratified random sampling technique was used to identify and phase the green corridors and the neighboring street roads within the proximate Five Local Government Areas of Lagos State. There are five predominant land use typologies namely; Commercial, Educational, Residential, Public, Recreational and Religious land use which are further categorized into three zones– High, Medium and Low Density.

**The Study Area**
The study area covers the green corridors and wetlands through a distance of 17km along the Agindingbi-Obafemi Awolowo Road at Ikeja through the Opebi and Oregun link bridges connecting Ojota-Maryland and continuing through Bariga and ending at Iwaya where the University of Lagos is located. The green corridor connects different neighborhoods, communities and districts in Lagos State such as; Yaba, Bariga Gbagada, Anthony, Maryland, Mende, Somolu, Oworonshoki, Ogudu, Ifako, Ojota, and Ikeja. These areas cut across five different central local government area and Local Council Development areas (LCDA) of the Metropolitan Lagos in Nigeria. The site was selected after careful analysis of a set down criteria based on the literature review and the relevant guidelines for the establishment of a 'Biophilic Ecosystem' in the selected wetlands within Lagos metropolis using the following parameters set down as site selection criteria: Location and accessibility to the users; The ease of ingress and egress to and out of the site for vehicles, cyclist and pedestrians. Size of site and possibility for future expansion potentials; enough land to accommodate the various functions as well as give room for future development and expansion. Land use compliance; the site has to be within the land use for recreational development on the States' Master Plan. Environmental features; like land forms, rocks, crops, hills, valleys, stream/river, natural vegetation and any other special character that makes the site unique and can be utilized for the intended project. General study of the site microclimatic conditions and its features considering its potentials and treats in an attempt to utilise the advantages.
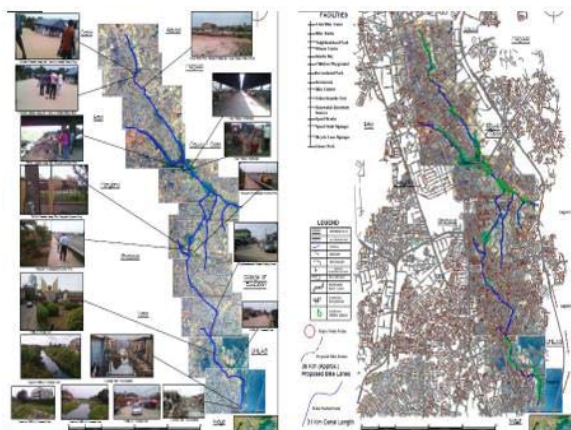


*Figures 1&2: Location map showing Ikeja - Iwaya Townships (16.6km), the connecting streets and transit hubs. Source: Google Earth Pro 2018.*
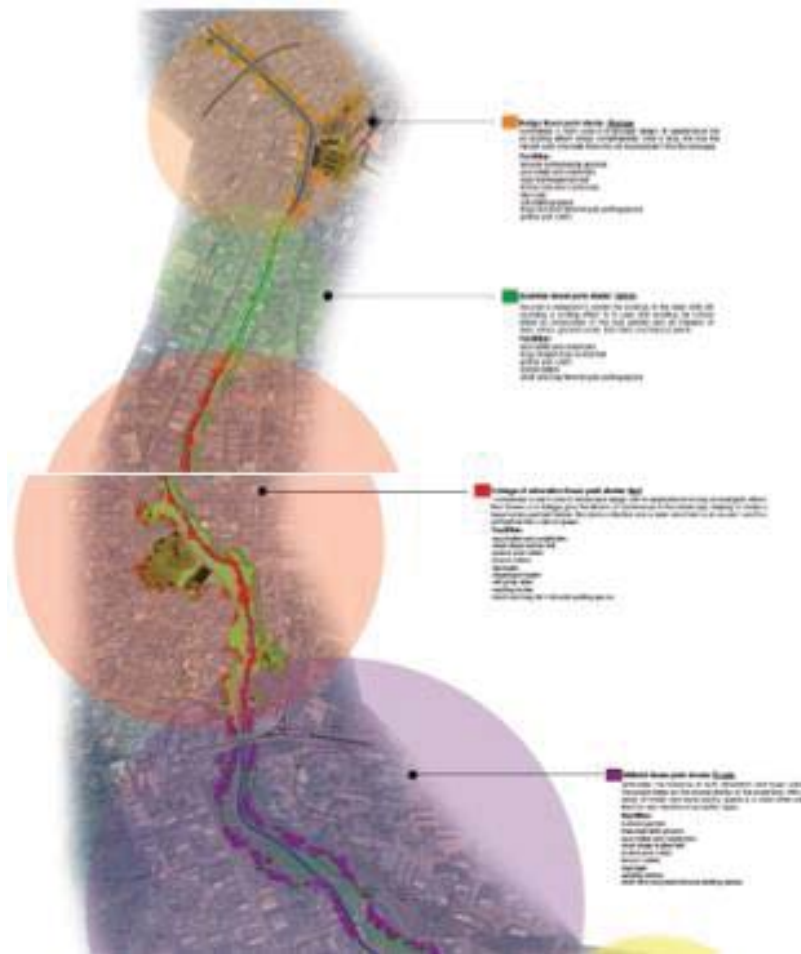
*Figure 3&4: Map showing the proposed green infrastructural facilities at the 2.7km first phase (three zones) and the 1.5km second phase (two zones).*



**UNILAG Conservation centre linear park: Yellow**
:considered a warm color in landscape design. Its appearance in the landscape has a stimulating effect. Yellow flowers come forward in the landscape, helping to make a large landscape feel cooler. Yellow's complimentary color in the garden is purple.
**Facilities:**
-cycling fitness centre
-rock garden
-Botanical garden
-eco-toilets and waste bins
-short steep incline trail
-police post cabin
-Snack cabins
-signages
-seating niches
-short and long term bicycle parking space

**Facilities:**
-picnic pavilion
-cycle polo sport
-jump trail grounds
-eco-toilets and waste bins
-short steep incline trail
-police post cabin
-Snack cabins
-signages
-car parking space
-short and long term bicycle parking space
-cultural garden
-free style BMX grounds and dirt jumping grounds

**UNILAG staff quarters linear park shade: White**
:a neutral colour, it can brighten up the landscape. This type of Landscape gives the illusion of glowing in the moonlight, making them a good choice for areas you spend time in during the evening. That is, white and pale flowers are more strongly scented than their darker counterparts.

*Figure 5: Map showing the proposed green infrastructural facilities at the 2.0km third phase (three zones).*

**Table 1: Table showing the geographical coordinates of selected transit hubs and landmark points (26 Points)**

| S/N | Classification of the Landmarks | Use | Street/Area Name | Easthings | Northings |
|---|---|---|---|---|---|
| 1 | Commercial | Hotel | De Ritz Deluxe Hotel | 3°21'10.36"E | 6°35'38.70"N |
| 2 | Commercial | Hotel | Westown Hotel | 3°21'36.73"E | 6°35'0.05"N |
| 3 | Public | Transportation | Sheraton Link Bridge | 3°21'46.44"E | 6°35'7.11"N |
| 4 | Residential Estate | Housing Estate, Onigbongbo | Ajanaku Steet | 3°21'57.77"E | 6°35'8.81"N |
| 5 | Public | Transportation | Maryland Cane Village | 3°22'19.47"E | 6°34'42.32"N |
| 6 | Religious | Church | Our Lady Queen of Peace Catholic Church | 3°23'20.46"E | 6°34'0.49"N |
| 7 | Public | Transportation | Lagos –Ibadan Expressway-Third Axial Link Road | 3°21'55.72"E | 6°34'0.83"N |
| 8 | Residential | Housing Estate, Kosofe | Folarangba Street | 3°23'28.00"E | 6°34'1.87"N |
| 9 | Residential | Housing Estate, Kosofe | Adewale Kuku Street | 3°22'33.92"E | 6°33'24.29"N |
| 10 | Public | Transportation | Apapa Oworonshoki Expressway | 3°22'21.94"E | 6°33'16.54"N |
| 11 | Religious | Church | TREM Church | 3°22'20.31"E | 6°33'10.80"N |
| 12 | Residential | Obanikoro | Buraimoh Street | 3°22'18.08"E | 6°32'53.69"N |
| 13 | Residential | Bariga | Bariga Road | 3°23'0.16"E | 6°31'59.92"N |
| 14 | Recreational | Neighbourhood Park | Ojo Square | 3°23'2.29"E | 6°31'38.34"N |
| 15 | Religious | Mosque | Akoka Central Moque | 3°23'6.73"E | 6°31'38.57"N |
| 16 | Educational | Federal College Of Education (Technical), Akoka | Abule Ijesha | 3°23'4.69"E | 6°31'22.09"N |
| 17 | Educational | St Finbarr's College | Abule Ijesha | 3°23'9.37"E | 6°31'22.30"N |
| 18 | Educational | Akpka High School | Abule Ijesha | 3°23'9.81"E | 6°31'16.00"N |
| 19 | Educational | University of Lagos | Akoka | 3°23'7.06"E | 6°31'3.64"N |
| 20 | Residential | Housing Estate | Johnson's Street | 3°23'8.59"E | 6°30'43.00"N |
| 21 | Religious | Church | MFM Headquatres | 3°23'16.92"E | 6°30'37.27"N |
| 22 | Educational | University of Lagos | UNILAG Distance Learning Institute (DLI) | 3°23'37.95"E | 6°30'38.34"N |
| 23 | Residential | Iwaya Community | Owodunni Street | 3°23'35.11"E | 6°30'22.86"N |
| 24 | Residential | UNILAG Staff Quatres' | UNILAG High Rise | 3°23'48.27"E | 6°30'19.17"N |
| 25 | Public | Water Corporation, Iwaya | Lagos State Water Corporation | 3°23'31.29"E | 6°30'7.29"N |
| 26 | Residential | Makoko Slums | Makoko | 3°23'39.02"E | 6°29'44.23"N |

*Source: Field survey, 2018.*

**Table 2: Table showing the various land-uses**

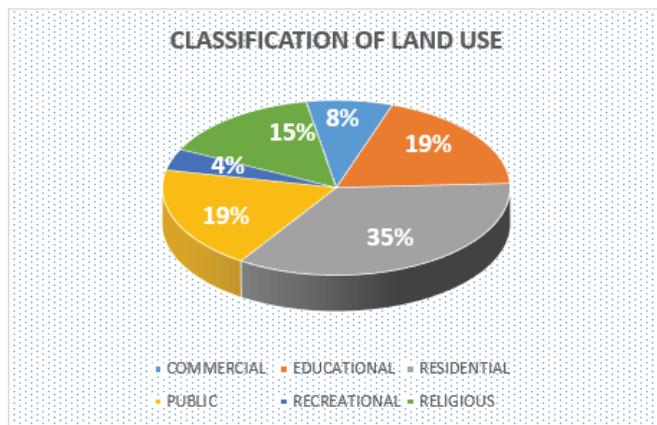| Land Use | Commercial | Educational | Residential | Public | Recreational | Religious | Total |
|---|---|---|---|---|---|---|---|
| | 2 | 5 | 9 | 5 | 1 | 4 | 26 |
| | 8% | 19% | 35% | 19% | 4% | 15% | 100% |

*Source: Field survey, 2018*

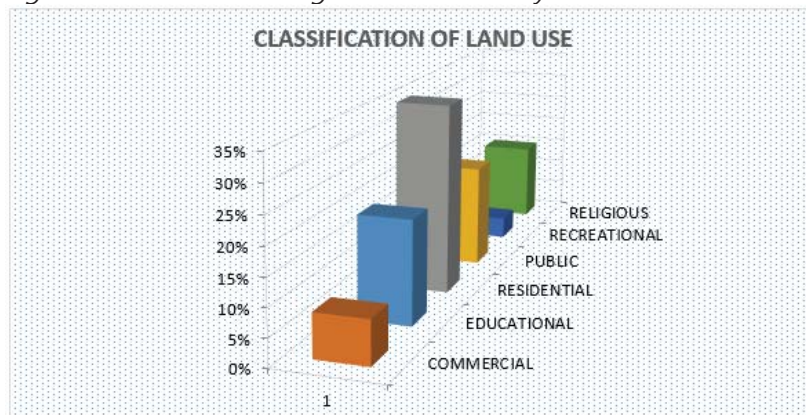Figure 6: Pie Chart showing the land use analysis. Source: Field survey, 2018.



Figure 7: Bar Chart showing the land use analysis. Source: Field survey, 2018.

Table 1&2 above indicates that of the 26 transit hubs location and landmarks selected through random sampling the following analysis were obtainable: commercial (8%), educational (19%), residential (35%), public (19%), recreational (4%) and Religious (15%). This table further shows that most of the land use are for residential use followed by educational and public activities around the Lagos Mainland. Recreation has about 4% of the total land use which means that the study area has limited open spaces that are specifically for greenery. Religious activities occupies about 15% of the area. The studies identifies that there are commercials shops, Churches and Mosques at every streets within the neighbourhood with little or no regard for greenery and open spaces for recreational activities.

## FINDINGS AND DISCUSSIONS

The study established that the green corridors and wetlands are vast land of an area of about 30km2 and it is mostly populated by land uses that are not planned hence the high level of abuse, disuse and misuse of the green corridors which have over the years led to the various land/wetlands encroachment, ecosystem degradation through air and water pollution, burning of refuses at the various dump sites, loss of biodiversity, blockages of road drainages. This study confirmed that sustainable urban green infrastructures were not currently in place and use in these areas and therefore suggest the use of green infrastructures as a remediation

tool for enhancing the environment and local air quality for Metropolitan Lagos. It was also observed that the following green infrastructure frameworks should be considered: Urban Ecological Farming, Garden Allotments and Urban Carbon Sequestration.

Introducing urban agricultural practices on wetland as an approach of conserving wetlands in Lagos state offers tangible evidence of Lagos state commitment to urban green initiatives as outlined by Lagos State Park and Garden Agency (LASPARK). Urban agriculture is a growing movement to bring the production, processing, and marketing of food into cities, closer to population centers and communities that often suffer from food insecurity through limited access to healthy food.

Plant life captures and stores carbon found in the environment from sources like automobiles and industries. To achieve a climate resilient Lagos through preservation, restoration and conservation of Lagos wetland, it is therefore paramount to activate and calculate the amount of $CO_2$ that would be sequestered by trees and shrubs over a year on the wetland. In order to populate the value of $CO_2$ captured for environmental benefits, there is need for close enumeration of trees, type of trees, trees area and trees girth in the proposed urban green infrastructure master plan for the metropolis.

Since the wellbeing of a city cannot be separated from the wellbeing of its serene and habitable environments. A re-envisioned local food system restores health to an ecosystem degraded by pollution, contamination, and threats from climate change. Food production, distribution, and consumption now account for one-third of man-made greenhouse gas emissions. A sustainable food system produces food close to the consumers it serves, using renewable resources and avoiding methods and materials that contaminate the environment and the food.

The Integrated Linear Park, Social, Health and Fitness Impact is an off-road bike trail is aim to create connected on-road cycling routes and an off-road trail network across Lagos state. Anthony to Maryland off-road bicycle trail system is seen as a high priority for this feasibility study as it connects to different neighborhoods, communities and districts in Lagos state such includes Gbagada, Anthony, Mende, Somolu, Oworonshoki, Ogudu, Ifako, Ojota, and Ikeja. The plan is also a blueprint for creating a healthy and active environment encouraging people to participate in cycling for healthy living, cycling for low carbon transportation, sports, nature watch, play and relaxing parks. The Linear Park provides bicycle path for transportation, tour and recreation through 16.6 kilometers. A desirable place to live and work includes walking and bicycling among the options for ways to get to work and other destinations.

## CONCLUSION

This study summarizes and integrates the main findings which are presented in the urban greening strategies and technological innovations and how the benefits can be articulated in ecological, social and economic terms. Furthermore, the study scrutinized the relationship between green spaces, social cohesion and discussed links between biological and cultural diversity. Hence, UGI is perceived as a

comprehensive landscape approach acknowledging the various ecological services and benefits from a coherent green, grey and blue network at different urban spatial configurations and levels, linking up neighbourhoods, districts and cities.

Securing the full services and benefits of UGI requires both green strategic planning as well as participatory synergies in order to address the variety of challenges associated with local sustainable developments and approaches so as to promoting the social and economic wellbeing of urban residents. Appropriate government authorities and private institutions should recognize the role green infrastructures plays in restoring a healthy ecosystem and in creating a more sustainable city through reduced reliance on fossil fuel, increased green open spaces, restoration of habitats, increased soil, water and air purity.

Ministry of Agriculture and that of Environment should synergize to support the use of sustainable farming practices in urban agricultural settings. Support should be given to the establishment of waste treatment facilities to transform plant waste from gardens and farms into compost to be used in local gardens and farms.

This paper has illustrated that the quality and type of open space provided within communities can have a significant and sustained impact on community health and wellbeing. Adopting the following strategies will help to enhance the air quality:

1. The promotion of health and social benefits, as well as those related to the environment and the economy are important in commending to decision makers the significance of open spaces in shaping our communities now and in the future.
2. Maximize the use of existing space and use approaches that invest in community gardens, pocket parks, and multifunctional spaces designed for diverse communities.
3. Consider opportunities for rationalization of land as a way to increase the number of open space destinations.
4. Priorities green and open space development within urban settings over space for vehicle parking for example.
5. Involve communities in the design of spaces making them culturally and locally relevant. Focus on those areas most in need of open space improvements e.g. some lower socio economic areas, areas with existing poor quality open space.
6. Consider street greening initiatives and improvements to street connectivity, road design and traffic management that will increase the neighborhoods' walkability.

Private Organizations, Local, State and Federal Government must also play a key role in recognizing the contributions that these make to public health outcomes of individuals and the environment at large such as physically active lives, good mental health, cohesive and connected communities.

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