

REGENERATING URBAN LANDSCAPES THROUGH WETLANDS RESTORATION AND OUTDOOR OPEN SPACE CONNECTIVITY: OFF-ROAD BICYCLE LANE PLANNING PRINCIPLES FOR TOURISM DEVELOPMENT

REGENERAÇÃO DE PAISAGENS URBANAS POR MEIO DA RESTAURAÇÃO DE ÁREAS ÚMIDAS E
CONECTIVIDADE DE ESPAÇOS ABERTOS AO AR LIVRE: PRINCÍPIOS DE PLANEJAMENTO DE
CICLOVIAS OFF-ROAD PARA O DESENVOLVIMENTO DO TURISMO

REGENERACIÓN DE PAISAJES URBANOS MEDIANTE LA RESTAURACIÓN DE HUMEDALES Y LA
CONECTIVIDAD DE ESPACIOS ABIERTOS AL AIRE LIBRE: PRINCIPIOS DE PLANIFICACIÓN DE
CARRILES BICI TODOTERRENO PARA EL DESARROLLO TURÍSTICO

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Abstract: Sustainable tourism development and outdoor activities are linked to the effective utilization of open spaces and green corridors within the city. The regeneration and revitalization of this landscape are vital for the emergence of a smart, resilient, and biophilic city for the health and well-being of both the residents and the tourists. This area is part of the urban fabric and is essential for the transportation network development and interconnectivity within the metropolitan space. The wetland and green corridor comprise marshes and canal drainage routes located within the setbacks of the Ikeja, Ojodu, Agidingbi, Opebi, Oregun, Maryland, Yaba, and Iwaya rivers floodplain. Qualitative and descriptive analysis of the on-site data collection, observations, and evaluations, Geographic Information Systems (GIS) were utilized to map out the developmental and adaptive strategies through GIS-based network mapping. This involved randomly selecting twenty-six (26) points that are landmarks and notable hubs within the city at approximately 750m intervals aligned within the 20km corridor of the waterways and wetlands of the selected study area. Through a variety of on-site observations, assessments, interviews, and inferential methods, people's perceptions of the use of off-road bike lanes, and its economic and social information were gathered. A healthy ecosystem, less reliance on fossil fuels, more green space, habitat restoration, clean water and air, and increased green space are all important for a city's overall well-being. This study suggested off-road non-motorized transportation connectivity, and other strategically adapted alternatives for resilient and sustainable city growth, in addition to carbon sequestration through restoration and preservation of already-existing wetlands. The restoration of urban desolate spaces, improvement of sanitation, governance of floodplains, recreation, and cultural values within metropolitan areas.

Keywords: desolate spaces; floodplains; open spaces; well-being; tourism development.

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Resumo: O desenvolvimento sustentável do turismo e as atividades ao ar livre estão ligados à utilização efetiva de espaços abertos e corredores verdes dentro da cidade. A regeneração e revitalização desta paisagem são vitais para o surgimento de uma cidade inteligente, resiliente e biofílica para a saúde e bem-estar dos moradores e turistas. Esta área faz parte do tecido urbano e é essencial para o desenvolvimento da rede de transporte e interconectividade dentro do espaço metropolitano. O pântano e o corredor verde compreendem pântanos e rotas de drenagem de canais localizados dentro dos recuos da planície de inundação dos rios Ikeja, Ojodu, Agidingbi, Opebi, Oregon, Maryland, Yaba e Iwaya. Análise qualitativa e descritiva da coleta de dados no local, observações e avaliações, Sistemas de Informação Geográfica (GIS) foram utilizados para mapear as estratégias de desenvolvimento e adaptação por meio do mapeamento de rede baseado em GIS. Isso envolveu a seleção aleatória de vinte e seis (26) pontos que são marcos e centros notáveis dentro da cidade em intervalos de aproximadamente 750 m alinhados dentro do corredor de 20 km das hidrovias e pântanos da área de estudo selecionada. Por meio de uma variedade de observações no local, avaliações, entrevistas e métodos inferenciais, as percepções das pessoas sobre o uso de ciclovias off-road e suas informações econômicas e sociais foram coletadas. Um ecossistema saudável, menos dependência de combustíveis fósseis, mais espaço verde, restauração de habitat, água e ar limpos e mais espaço verde são todos importantes para o bem-estar geral de uma cidade. Este estudo sugeriu conectividade de transporte não motorizado off-road e outras alternativas estrategicamente adaptadas para o crescimento resiliente e sustentável da cidade, além do sequestro de carbono por meio da restauração e preservação de pântanos já existentes. A restauração de espaços urbanos desolados, melhoria do saneamento, governança de várzeas, recreação e valores culturais em áreas metropolitanas.

Palavras-chave: espaços desolados; planícies de inundação; espaços abertos; bem-estar; desenvolvimento turístico.

Resumen: El desarrollo del turismo sostenible y las actividades al aire libre están vinculados a la utilización eficaz de los espacios abiertos y los corredores verdes de la ciudad. La regeneración y revitalización de este paisaje son vitales para el surgimiento de una ciudad inteligente, resiliente y biofílica para la salud y el bienestar tanto de los residentes como de los turistas. Esta zona forma parte del tejido urbano y es esencial para el desarrollo de la red de transporte y la interconectividad dentro del espacio metropolitano. El humedal y el corredor verde comprenden pantanos y rutas de drenaje de canales ubicados dentro de los retranqueos de las llanuras aluviales de los ríos Ikeja, Ojodu, Agidingbi, Opebi, Oregon, Maryland, Yaba e Iwaya. Se utilizaron análisis cualitativos y descriptivos de la recopilación de datos in situ, observaciones y evaluaciones, y sistemas de información geográfica (SIG) para trazar las estrategias de desarrollo y adaptación a través del mapeo de redes basado en SIG. Esto implicó seleccionar al azar veintiséis (26) puntos que son puntos de referencia y centros notables dentro de la ciudad a intervalos de aproximadamente 750 m alineados dentro del corredor de 20 km de vías fluviales y humedales del área de estudio seleccionada. A través de una variedad de observaciones in situ, evaluaciones, entrevistas y métodos inferenciales, se recopilaron las percepciones de las personas sobre el uso de carriles para bicicletas fuera de la carretera y su información económica y social. Un ecosistema saludable, una menor dependencia de los combustibles fósiles, más espacios verdes, la restauración del hábitat, agua y aire limpios y un mayor espacio verde son todos importantes para el bienestar general de una ciudad. Este estudio sugirió la conectividad del transporte no motorizado fuera de la carretera y otras alternativas adaptadas estratégicamente para el crecimiento resiliente y sostenible de la ciudad, además del secuestro de carbono a través de la restauración y preservación de humedales ya existentes. La restauración de espacios urbanos desolados, la mejora del saneamiento, la gobernanza de las llanuras aluviales, la recreación y los valores culturales dentro de las áreas metropolitanas.

Palabras Clave: espacios desolados; llanuras de inundación; espacios abiertos; bienestar; desarrollo turístico.

INTRODUCTION

Practically all riding occurs in outdoor places for transit purposes, urban planning initiatives and infrastructure are an absolute must for metropolitan biking (Murgante, Trabace, & Vespe, 2023). The social and economic environments of cities are fundamentally shaped by their transportation infrastructure (Whitford, & Brearley, 2024). Facilitating inexpensive pragmatic transportation, such as commuting to the workplace, regular grocery excursions, or the movement of commodities within the metropolis, bicycling connectivity can support the economy and likewise boost the tourism sector of the city. Understanding the variables influencing the utilization of urban green-blue habitats is essential to ensuring that city dwellers share equally from any potential salutogenic wellness purposes (Zielinska-Dabkowska, & Bobkowska, 2022; Westphal, 2022). Regenerative cities are dynamic hubs of productivity that promote reciprocal benefits between metropolitan regions and their surrounding regions, as well as the regeneration of resources and the supplies needed (Flink, 2020). Design features and urban layout characteristics influence the adoption of off-road bicycle facilities, however, most districts in Lagos state do not have these characteristics hence the reason why most tourist who would prefer commuting to the city for sightseeing finds it rather difficult to commute. While designing a bicycle lane infrastructure, the most important factors to take into account are security, ease, simplicity, cohesiveness, and aesthetic appeal. Several bike-related casualties and significant injuries were reported in traffic accidents along major roads within the metropolis, which connects the city's main neighborhoods. One common excuse given for not riding a bicycle is fear of traffic, especially by older men, women, and little children. Separated bike lanes increase safety by reducing collisions between riders and other drivers. Increasing

bike safety also involves lowering clashing paths and implementing basic urban planning principles and traffic management techniques (Masoud, 2021).

The most common characteristics used to characterize safety include the number of users, pace, pathway, sidewalks, kind of junctions, and frequency of fatalities. The green area which is a narrow strip of land inside Lagos Mainland that serves as a home for various animal species and biodiversity is known as “Eko green corridors.” The utilization of urban greening strategies in conjunction with the off-road bicycle infrastructure planning principles in the metropolis serves as the foundation for this research. Historically, urban development has not explicitly stated these sustainable elements in the environmental design. Analyzing qualitative interviews with random individuals who actively use the access along the water channels and wetlands in Lagos State allowed for the development of a system map of parameters impacting utilization. This research also evaluates the potential of urban green infrastructure like the green corridor with the introduction of off-road bicycle pathways as a remediation and improvement strategy for environmental air quality to create a more sustainable Lagos City.

The goals of this investigation are as follows; investigating the possibility of restoring the wetlands and turning them into a useful and alluring tourist destination; promoting sustainable urban agriculture by producing healthier food; addressing the use of sustainable urban farming techniques to aid in soil regeneration and restoration as opposed to soil contamination; to ascertain if bio-remediated green spaces in urban settings enhance air quality, lessen the amount of dirty water that runs off from paved areas, can regulate air temperatures, which lowers energy costs, and restore biodiversity. Along with developing suggestions for improving accommodations for cyclists, this research offers a thorough worldwide assessment of the guidelines for cycling infrastructure for tourism development in the metropolis. The findings in this study offer contextual details to enhance comprehension of cycling conduct and residents’ access to modern linear park facilities.

The results encourage urban designers and planners in their endeavors to enhance advisory materials and encourage cycling (Boychev, 2021; Smith, Georgiou, King, Tiegies, & Chastin, 2022). Depending on the city’s master plans and urban policies, cyclists may ride on the sidewalk or the street, and they may or may not share space with other user groups (Smith, et al., 2022; Mendes, & Panza, 2024). The criteria used to choose the different kinds of cycling facilities varied even more between nations than the landscape features like width, setbacks, buffer zones, etc. (Khadour, Fekete, & Sárospataki, 2023; Mendes, & Panza, 2024). The ultimate goal of this study is to demonstrate the viability of carbon-free, ecological ethical concepts in both man-made (designed) and natural environments, preserving and all-encompassing renewing communal outdoor-based landscapes while simultaneously reviving marshes and streams to enhance socio-economic and communal activities in the neighborhoods.

THEORETICAL REVIEW

Although there are not many clear reasons to limit independent bicycling participation, biking relies upon a bike-friendly urban environment and infrastructure for the entirety of its trips, therefore the social fabric and public space investments are necessary at the local, surrounding area, and municipal tiers (Sobhani, Esmaeilzadeh, Barghjelveh, Sadeghi, & Marcu, 2021). Sobhani, et al. (2021) stated that the development of standards for the application of “green” and sustainable development concepts to the road and transport networks and there are various techniques available from around the globe for evaluating how sustainable and environmentally friendly transportation infrastructure development is, these systems cannot be used universally and require modification in urban areas (de Oliveira, Misato, & da Costa Morcelli, 2024; De Ferrari, Oceppek, Travis, & Armony, 2024). One essential component of the continued popularity of biking as a means of transportation is the provision of smooth, safe, and accessible infrastructure for cyclists (Cai, & Pei, 2021). Many countries around the world have quite different cycling infrastructures and planning ideas, but there isn’t a comprehensive list of parallels and differences (Sobhani, et al. 2021; Cai, & Pei, 2021). Although age has less of an impact in cities with high cycling rates since riding is a popular activity for people of all ages, cycling is more common among younger individuals in beginning cities (De Ferrari, et al., 2024). For older demographics, riding is less appealing due to the perceived security and physical exertion involved in pedaling. According to other research, women tend to pedal less than men do and are more restricted by traffic dangers; yet, cycling is associated with greater levels of education (Sobhani, et al. 2021; Cai, & Pei, 2021; Jedliński, & Sosik-Filipiak, 2022).

Within or near urban regions, there is great potential for ecosystem-based climate interventions related to five different landscape types in cities and one organic natural resource management system (Autelitano, & Giuliani, 2021). This study, however, considered six design strategies for urban regeneration and off-road transportation network development of

these riparian green open spaces for socio-cultural cohesion in the parks and gardens and urban open spaces and wetlands connectivity (see Figure 1 below) amongst which are the management of organic substances and ecological infrastructure created by urban forests and tree populations that use the organic “waste” of a city as a resource as opposed to sending it to a landfill (Kazemzadeh, Lareshyn, Winslott Hiselius, & Ronchi, 2020).

Figure 1 - Study's strategies for urban regeneration and ecotourism development.



The research is also motivated by some global tourism institutional frameworks (rules, strategies, initiatives, and activities) in Brazil that support the implementation of diplomatic guidelines in regulating tourism (Silva, Grechi, & Carneiro, 2024). The effective use of transboundary riparian corridors is one area where Silva et al. (2024) stressed the significance of an institutional structure on sustainability for tourist administration in border territories. The following tourism policies were examined: MS Tourism Law (2018), National Tourism Policy (Law No. 11.771/2008), Latin American Integration Route (RILA), Tourism Regionalization Program - PRT (2003-2022), and PRT (2003-2022).

Analyzing the social context and administration situations shown here can aid in comprehending the intricate framework of interactions that exist in the area under consideration and in assessing the likelihood of countries' diplomatic involvement. In the context of tourist regulation in a cross-border area, the societal matrix (the surroundings and structure) can serve as a guide for the creation of diplomatic measures (Silva, et al., 2024; Santos, & Brilha, 2024). Global tourist development will be aided by the implementation of these landscape urbanism strategies by nations around the globe (Raihan, 2024).

The control of greenways and riparian places and places are managed for leisure activities, heritage significance, agricultural purposes, wetlands control, ecosystem preservation, and improved overall water quality. These waterways, coastlines, and marshlands are examples composed of water networks that play important sponge functions and engage in the recycling of carbon. In terms of cropping networks, there are urban ones such as community vegetable gardens and municipally managed agricultural land, and then there are parks and grasslands that are managed to conserve and safeguard ecosystems, watersheds, recreational opportunities, drainage area management, and aesthetically pleasing qualities for tourist (Kazemzadeh, et al., 2020).

Kazemzadeh, et al., (2020), stated that cities may investigate how metropolitan greening and environmental preservation overlap. A major rise in bicycle engagement may be achieved via smart management; model communities have observed a dramatic increase in urban riding as a result of persistently coordinating several non-motorized transportation interconnectivity initiatives (Masoud, Idris, & Lovegrove, 2021). Even with declared legislative commitments, several other cities have failed to achieve notable growth in cycling. All too often, initiatives to promote cycling in urban areas fall short of producing significant rises in the number of people who cycle for various types of trips and socioeconomic classifications (Masoud, et al., 2021; Santos, de Assis Cabral, dos Santos Lima, & de Andrade Santos, 2024).

To encourage both tourists and residents of every city to appreciate the health benefits of cycling, the government in developing cities is trying to get more people to ride their bikes to connect places as against the constant use of cars especially for prospective tourists whose focus is to connect with places with the city without any hassle or stress (Zhao, Zhang, Zhang, Wong, Zhou, & Meng, 2021). Planners who want to mainstream cycling for everyday transportation in cities frequently encounter institutional and structural obstacles to advancement, notwithstanding an increase in studies on bicycle usage and an expanding body of scientific documentation for bike infrastructure development (Zhao, et al., 2021; Ovi, 2020).

Historically, cycling has been marginalized in many places, which has made it difficult for advocates hoping to see a rise in riding across various user groups and for various modes of transportation (Zhao, et al., 2021). To assist activists and practitioners who are working to promote metropolitan cycling, this page attempts to compile and synthesize the available research (Zhao, et al., 2021; Ovi, 2020; Masoud, et al., 2021). Increasing walking and cycling rates is a major goal for cities all around the world in their efforts to achieve greater ecological connectivity (Ahmed, Pirdavani, Janssens, & Wets, 2023). Ahmed et al (2023), stated that walking and cycling are two very economical as well as space-efficient modes of transportation that also significantly improve users' health and well-being. They are also essential for using buses and trains and have few negative effects due to the emission of gas into the atmosphere (Ahmed, et al, 2023). In particular, difficulties with atmospheric emissions, gridlock, parking, noise from vehicles, highway trauma, a lack of exercise, emotional disorders, and social isolation can all be addressed by using active means of transportation (Corben, 2022).

Characteristics and Impact of Off-road Bicycle Lane Planning in Tourism Development

Conversely, measurements primarily rely on impartial assessments of a range of characteristics that impact riding or the creation of bikeability indices (Schröter, Hantschel, Koszowski, Buehler, Schepers, Weber, & Gerike, 2021). The majority of attribute evaluations have been conducted using geographic data analysis with multicriteria techniques including maps. Developing bike lanes, the creation of geographical representations showing riding appropriateness for mountainous towns, and the selection of secure and feasible cyclist paths and within the subsequent scenario, indices and composite measurements of several built environment characteristics are used to assess bikeability. Here, a balanced blend of several features and values is used to provide an overall rating that categorizes the riding circumstances (Schröter, et al., 2021). These ratings include for illustration, the bicycle suitability rating and the bike quality of performance. Numerous more cycling-ability indices were developed and created in recent years to assess biking appropriateness and construct transportation networks. Bicyclists' ability to pedal across their starting point and goal is reflected in urban/city cohesiveness. Corben, (2022) opined that for a bicycle network to be considered cohesive, it must have consistent routes and circumstances that make it easy for cyclists to follow, have few stop-needed disruptions like traffic signals and crossings, and have convenient access to public transportation. Connectivity is characterized by a variety of factors, including the number of breaks in a path, the existence of consistent road surfaces, and directions (Corben, 2022; Schröter, et al., 2021).

An appealing cycling infrastructure additionally becomes necessary (Montella, Chiaradonna, Mihiel, Lovegrove, Nunziante, & Rella Riccardi, 2022). Although it has been defined alternatively, aesthetics is an essential quality for commuting and researchers have connected it with the existence of vibrant and diverse uses like grocery shops, eateries, and cafés with enticing qualities as well as the architectural and aesthetic elements of the built landscape (Montella, et al., 2022). Montella, et al., (2022), defined desirability as the availability of services as well as infrastructure for bicyclists or, more generally, as the presence of safe, well-lit roads with even, smooth, slope-gradients, and appropriate spacing.

Thus, features of biking facilities and construction sites have been used to characterize appeal. Some characteristics that are used to define beauty are the number of trees along the routes, the distance of the cycling pathways, and the existence of amenities for bicyclists (Wang, Gong, Wang, Jia, & Kyo, 2022). Apart from the characteristics of the natural setting, population considerations should also be taken into account. Individual mobility and cycling are shaped by characteristics such as a background in society, a person's age, gender, and the density of residents (Wang, et al., 2022; Moore, Evans, Lau, Riley,

Erickson, & Taylor-Davenport, 2023). For instance, data from earlier research suggests a relationship between increased cycling rates and the density of the population (Paiva, Ahad, Tripathi, Feroz, & Casalino, 2021; Reggiani, Salomons, Sterk, Yuan, O'Hern, Daamen, & Hoogendoorn, 2022). The most crucial factor in determining which demographic groups are more likely to engage in cycling is their chronological age.

Figure 2 - Typical off-road Bicycle and Pedestrian Corridor.



Source: Martin Gol Architects. <https://martingoldarchitects.com/archerbraid-a-multi-use-path/> (Accessed on June 2024).

This study therefore examines the practical application of off-road bike lanes as a novel means of facilitating transportation and commercial activity and lessening the strain on urban transportation networks as shown typically in Figure 2. This study further revealed that hands-on involvement has beneficial outcomes and that cycling is actively spreading in the majority of communities worldwide (Fang, Hassan, & Horng, 2024).

Regenerating Developing Countries: Lagos in focus

The majority of the world's countries especially developing ones are witnessing an increase in their urban population due to both natural population growth and the ongoing migration of individuals from rural to urban regions (Reggiani, et al., 2022). Since then, the global population has increased more quickly in urban areas compared to rural ones, and by 2030, it is predicted that more people will live in metropolitan areas. New challenges affecting the tourism sector in fast-developing cities, such as growing property costs, a shortage of housing, inadequate infrastructure, a lack of green space, and uncontrolled city growth at the expense of the surrounding ecosystem, arise when cities try to satisfy growing demand while providing excellent amenities.

As a result, ecological or farmlands are often being absorbed by urbanization (Reggiani, et al., 2022; Ribeiro, Santos, De Moura, Montenegro, & Freitas, 2024). A city's future shape is largely determined by its strategic off-road plan of action, which is a fundamental component of urban government. As per the definition, a master plan is a flexible and long-range planning document that offers a conceptual structure to direct future expansion and advancement. Reggiani, et al., (2022) affirmed that the process of connecting structures, relationships, and their immediate surroundings is known as strategic thinking. Assessment, suggestions, and plans for a site's populace, economics, living conditions, transportation, public amenities, and land use are all included in a master plan. Community feedback, inquiries, initiatives for planning, the present state of affairs physical attributes, and social and economic circumstances all form part of its foundation (Salimbene, & Wiggins, 2020; Moore, et al., 2023; Ribeiro, et al., 2024).

As a guide to potential urban regeneration and tourism boost, the comprehensive initiative provides a precise course for foreseeable growth that is suited to the needs of the city today and in the years ahead. However, because urban environments are changing, the development plan ought to be reviewed and amended regularly by the town implementing agencies (Paiva, et al., 2021; Cox, & Natali, 2024). These revisions make the plan adaptable to new conditions and specifications, so it remains relevant and useful over time. If trends in city growth or explosive growth in cities occur, the town planning agency may even mandate the formulation of an entirely fresh strategy periodically to accommodate the shifting landscape cityscape and the assessment of previous strategies for urban redevelopment and regeneration. The creation of a precise and binding legal framework is a crucial component supporting the effective execution of the off-road bike model and strategy (Reggiani, et al., 2022; Paiva, et al., 2021). The comprehensive off-road bicycle lane design strategy, the city's tourism sector repositioning, and a well-established urban masterplan and regulatory structure are combined, urban development gains legitimacy and effectiveness and the metropolis moves towards its objectives for the future in an environmentally friendly, sustainable, and integrated manner.

METHODOLOGY

This study employed several methodologies, such as quantitative evaluation, qualitative assessment, and on-site inspection of the selected schools combined with interviews. To determine the main needs of the people living along the wetland and water channels, a quantitative survey was carried out at different nodes using established metrics from the body of previously published research and information from discussions with city planners, landscape architects, architects, and logistics and transportation specialists. The physical examination that was done on the spot, the pictures that were obtained, and a careful geographical analysis of the satellite images served as the primary data sources for this study. For the secondary source of data, relevant literature in the fields of tourism, ecotourism, urban landscapes, and urban planning principles was reviewed (Minohara, Zucco, de Cravalho Soares, & dos Santos, 2024; Santos, de Assis Cabral, dos Santos Lima, & de Andrade Santos, 2024; Silva, et al., 2024). The study technique encompasses a thorough examination of the urban development methods seen in master plans worldwide.

Urban planning, urban growth, and organizational plans for cities have been studied and examined by a large number of local and international experts and professionals. Within the framework of global master planning principles, this research seeks to evaluate how well the Lagos model master plan promotes livable urban growth. Questions were asked according to the design strategies as shown in Figure 1; How do wetlands restoration and urban connectivity enhance tourism development? What are the benefits of urban forests and trees? Do the greenways and riparian corridors boost urban connectivity? Are the aquatic ecosystems conserved within the worldview or urban air quality? What are the principles of nature conservation and management in the context of city development? How does the inclusion of off-road bicycle routes and urban parks & gardens enhance socio-cultural cohesion? (see Table 3&4). To better comprehend the cities' urban problems, the first step is taking a brief historical look at the growth patterns and dynamics of the cities.

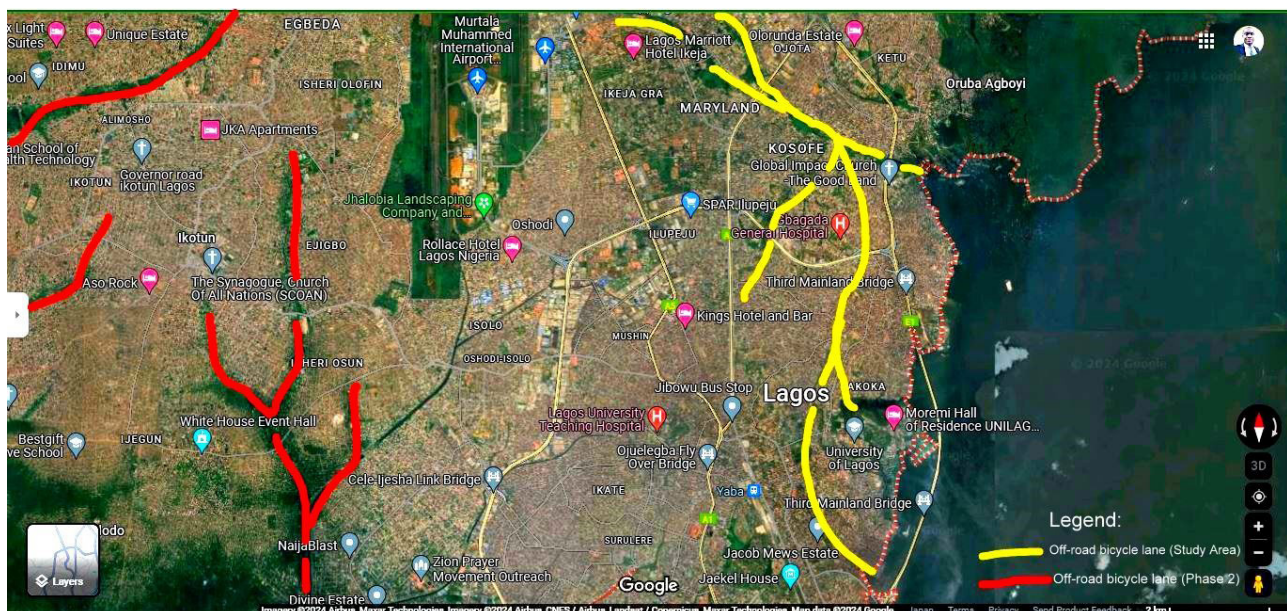
Our research's second phase entails a careful examination of the urban development methods described in Lagos Mainland master plans. Using the Global Positioning System (GPS) and Geographic Information System for mapping, database analysis, and presentation purposes, direct survey methods were used to perform reconnaissance surveys to gather this information. Along the wetland/green corridor, points were recorded after every selected landmark. This involved randomly selecting twenty-six (26) points that are landmarks and notable hubs within the city at approximately 750m intervals aligned within the 20km corridor of the waterways and wetlands of the selected study area. Through a variety of on-site observations, assessments, interviews, and inferential methods, people's perceptions of the use of off-road bike lanes, and its economic and social information were gathered.

During the study, a few parks, gardens, open spaces, and commercial centers were identified along with their geographic positions. Administration, commerce, education, health, public, recreational, religious, and transportation were the categories assigned to the existing land use. Interviews with residents, stakeholders, and environmental enthusiasts were performed to gather the second piece of data, which was gathered from the State's Physical Planning and Development Control Department. Figures 4,5 and 6 show the area and the data was gathered and analyzed using all known descriptive and inferential statistical techniques. This study used a descriptive survey design of the current site circumstances, meaning that no variables were changed during data collection to determine the current state of the independent scenarios. The nearby five Local Government Areas of Lagos State's green corridors and nearby street roadways were identified and phased using a stratified random sample approach to accomplish this. Land use typologies are classified into three zones: high, medium, and low density. These five typologies include commercial, educational, residential, public, recreational, and religious land use.

The Study Area

The research area spans 20 km along the Agidingbi-Obafemi Awolowo Road in Ikeja, passing across the Opebi and Ore-gun link bridges that connect Ojota and Maryland, then via Bariga and ends at Iwaya, home of the University of Lagos. The Lagos State neighborhoods, localities, and districts that are connected by the green corridor include Yaba, Bariga Gbagada, Anthony, Maryland, Mende, Somolu, Oworonshoki, Ogudu, Ifako, Ojota, and Ikeja (see Figure 3 below).

Figure 3 - Aerial Imagery showing the possible off-road bike lane corridors.



In Lagos metropolis, looking at the proposed master plan, the yellow line forms phase one while the red line is phase two for future studies because it combines both the on-road and off-road bicycle lanes within the metropolis. These areas are divided among the Local Council Development Areas (LCDA) and five distinct core local government areas of Nigeria's Metropolitan Lagos. In Table 1, the following elements were established as site selection criteria at various locations, and they were carefully examined after consulting the literature study and pertinent recommendations for the creation of a "Biophilic Ecosystem" for tourism sector development in the chosen wetlands inside Lagos City. The site's location and user-friendliness, including automobile, bicycle, and pedestrian entry and egress, are important considerations.

The size of the site and its potential for future growth; should be enough acreage to support the different uses and provide space for future growth and development. Compliance with land use regulations: the location must fall into the State's Master Plan's category for recreational development. Landforms, rocks, crops, hills, valleys, streams, rivers, natural flora, and any other distinctive characteristic that distinguishes the location and lends itself to the planned project are examples of environmental elements. A comprehensive examination of the site's characteristics and microclimate to identify opportunities and risks to maximize the benefits.

Table 1 - Table showing the Geographical Coordinates of Selected Landmarks.

S/N	Classification of the Landmarks	Use	Street/Area Name	Eastings	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 Oworoshoki 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 Mosque	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 Headquarters	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

Figure 4 - Section of the wetland corridor (20km) along Bariga and Iwaya Communities.

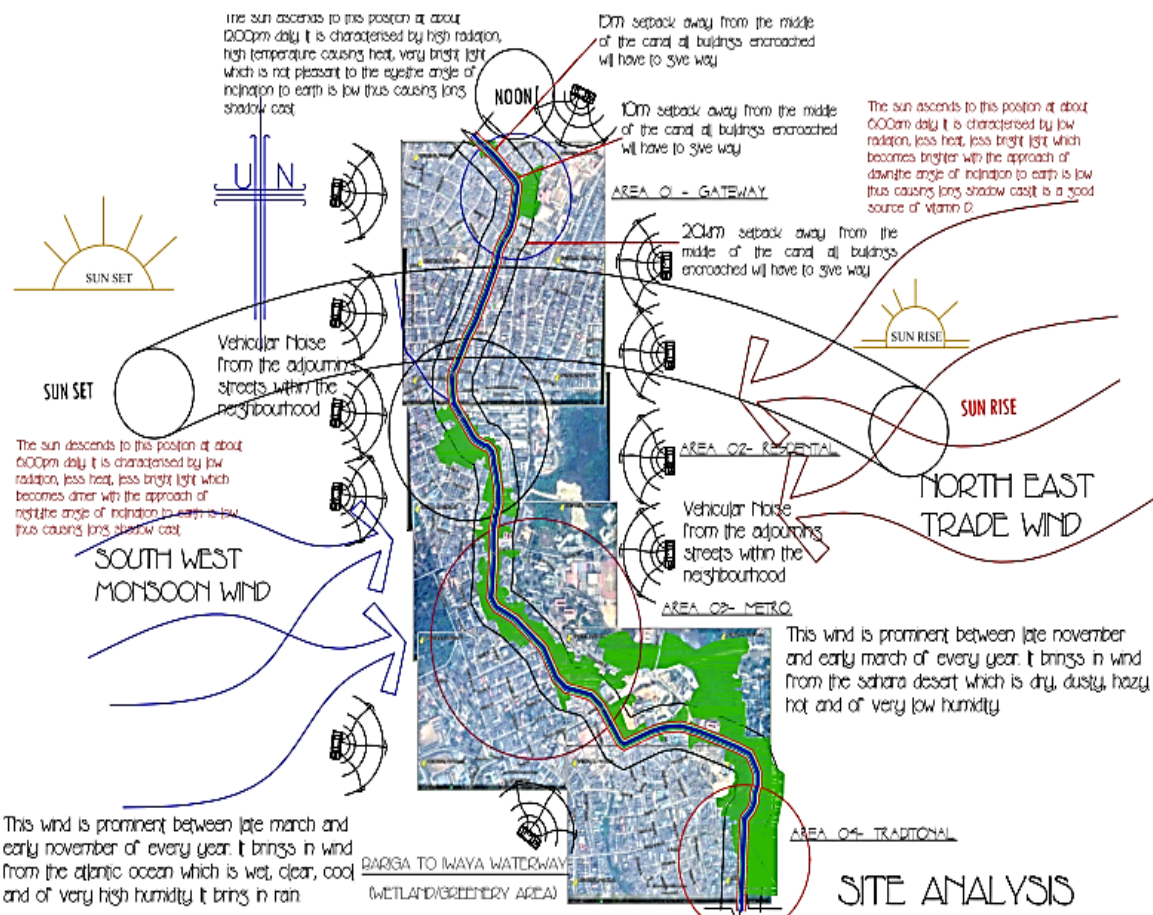
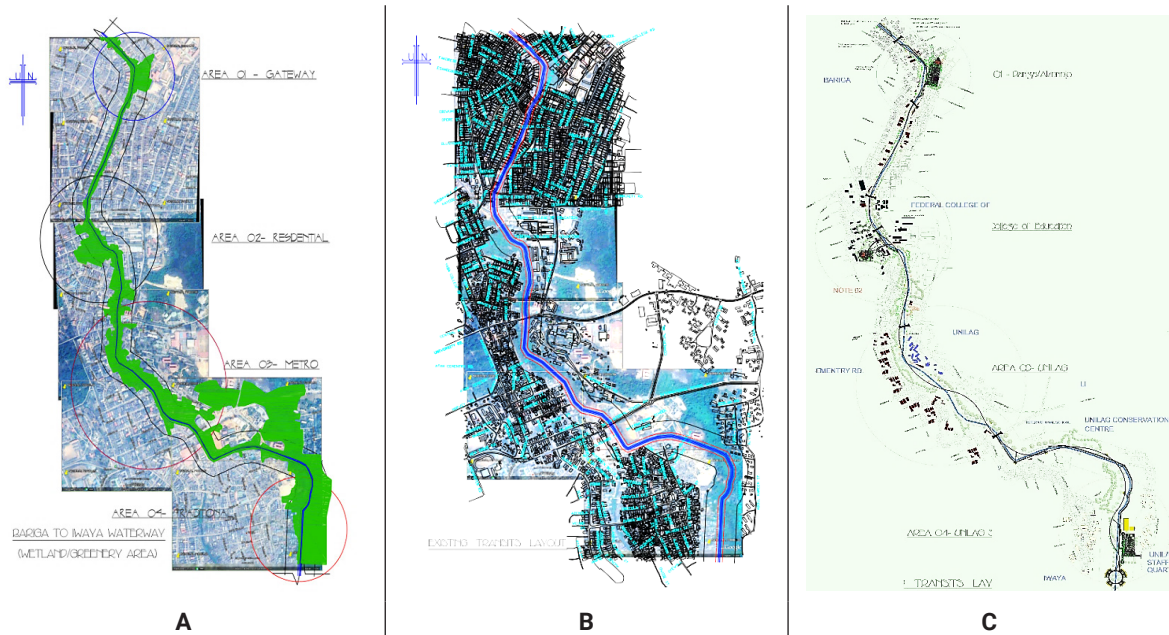


Figure 5 - Pictorial analysis along the 20km corridor of Bariga and Iwaya Communities.



Figure 6 - a) Analysis of the green area coverage b) Existing building/development footprints c) Horizontal alignment of the off-road bicycle lane possible along the green corridor.



**Figure 7 - a) Adequate setback and concretized canal channel behind the University of Lagos.
b) Encroached canal setback by a religious organization (the yellow building) just behind the canal.**



A



B

**Figure 8 - a) V-section of the concretized canal channel at the University of Lagos.
b) Open drained canal inwards Akoka community lacking maintenance and habitat to reptiles.**



A



B

Figures 7 and 8 show the existing condition of the green corridor and the level of degradation and abuse (see Figure 7b) of how this corridor has encroached and houses are built to obstruct the free flow of water along the channels in some places and some places, the channels have been narrowed down to nothing which is not adequate for the easy passage and flow of water during rain peak seasons. While some parts of the canal have been concretized (just about 45%) a large amount of the waterway has not been concretized and this has given ecological habitat for dangerous amphibians and reptiles even within the city (see Figure 8b). This onsite assessment noted that some of the animals identified such as snakes, frogs, alligators, monitor lizards and crocodiles are dangerous for tourism development hence the need for adequate nature restoration and conservation of the natural habitats.

RESULTS AND DISCUSSIONS

Driven by the tourism development principles and framework, the study combined maps and geographic information system (GIS) technology, a transportation or cycle chart is created especially for bikers in the area. A pilot study, data gathering, data processing, and data visualization were all steps of operations used in this investigation. Although no particular elements or concepts were used in the creation of the perfect city bicycling route map, the initial result indicated the main criteria and features of the map. The criteria encompass the fundamental components of mapping, the optimal layout of cartographic features and concepts, and pertinent characteristics seen in a typical bicycle map. A graphic representation of suggested cycling routes was made, complete with important elements such as dedicated bike paths, land use and signage, points of passion, and directions.

Statistical Analysis

Based on the good response from the respondents, the terrain assessment demonstrated the practicality inherent in the suggested tourism model. A good cycling map can help tourists who enjoy cycling become more prevalent as a means of transportation in urban areas. Using the spectrum of frequency tables of data, demographic data about the respondents is shown in this section. Additionally, it disclosed how the respondents' demographic details were presented in the research area. The researcher's request, a prompt invitation, and the respondents' availability during the onsite field survey all went into the selection process. Table 2 below shows that 10 (45.3%) respondents were between the ages of 61 and above, 7 (32%) interviewees were between the ages of 31 and 60, and 5 (22.7%) interviewees belonged between the ages of 15 and 30. This table demonstrates that whereas elderly residents who were aware of the city's circumstances forty-three years ago (43 years) gave the most interviews, young persons between the ages of fifteen and thirty gave the fewest interviews.

Table 2 - Respondent's Age, Respondent's Gender, and Respondent's Physical Ability Demography.

Ages		
Ages	Frequency	Percentage (%)
15-30	5	22.7
31-60	7	32.0
61-Above	10	45.3
Total	22	100
Gender		
Gender	Frequency	Percentage (%)
Male	13	59
Female	9	41
Total	22	100
Physical Ability		
Gender	Frequency	Percentage (%)
Physically fit	19	86
Physically disabled	3	14
Total	22	100

The number of those surveyed by gender is shown in Table 2 above; 59% of those surveyed were male, and 41% were female. This indicates that the male-dominated population uses transportation facilities more frequently than the female population, as evidenced by the fact that most of the cyclists seen are male. In addition, the respondents' looks were taken into consideration about their physical capabilities and disabilities, which in turn determined their ability to commute within the town. Physical disabilities included blindness, handicaps, and age-related diseases (e.g., stroke, arthritis, dementia, Parkinson's disease, etc.); only 3 respondents (14%) were physically disabled.

This demonstrates even further how the structure of roads has to be linked with the mobility needs of the elderly and disabled in the context of both urban settlements and communities. Following the collection, processing, and analysis of the data and interviews, Table 3 below illustrates how half of the respondents experienced disorderly community street accessibility, with frequent accidents and social crimes occurring virtually daily (no records). The majority of impacted individuals seemed to be older adults with physical limitations, indicating that more research and policy-making by the local government may be necessary to reinvigorate the current mobility infrastructure. The road networks and street connection issues may be resolved in a thorough, safe, and rational manner by using the sustainable mobility paradigm.

The opinions of the locals about the infrastructure and street quality are displayed in Tables 3 and 4, respectively. In terms of aesthetics, tranquility, traffic safety, criminal safety, and social risks, the town received a very low grade of (0) because of the numerous subpar amenities that were not only outdated but also in disrepair, as well as the daily rise in crime rates which are red flags and turn-offs (negative signs) for prospective tourist. Since none of the neighborhoods had any provisions for walking (pedestrian) or recreational facilities, Table 4 above gave both walking (pedestrians) and recreational facilities a low rating (1*).

Table 3 - User's perceptions of the neighborhood streets infrastructure for tourism.

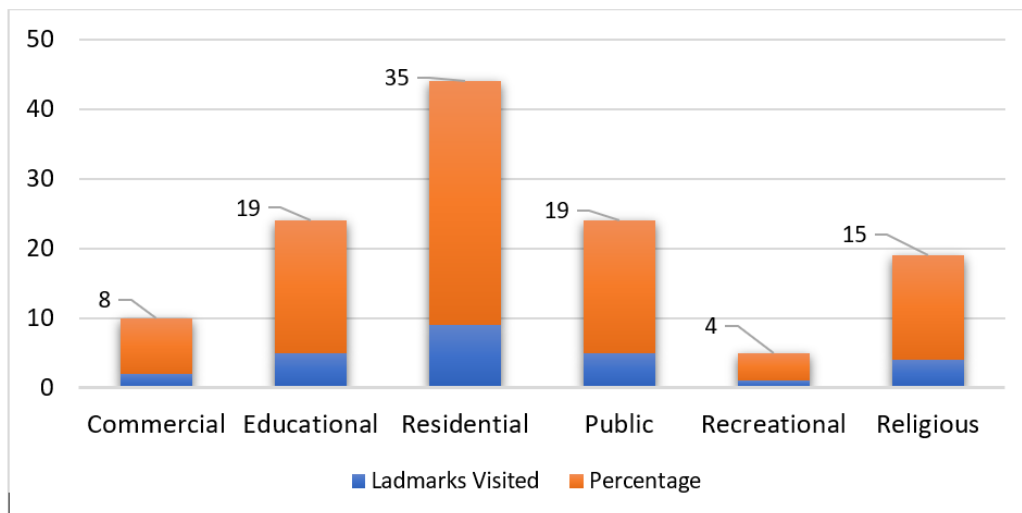
S/N	Activities	Description	Locations visited	Remarks
1	Shopping destinations	Availability of corner shops, services, groceries, and food outlets.	5	Inadequate
2	Recreation facilities	Availability of fitness centers, parks, gyms, and recreation centers.	10	Inadequate
3	Residential density	Proportion of different dwelling types and housing density.	15	Mixed-use
4	Commercial activities	Accessibility of different places for commercial activities.	21	Mixed-use
5	Streets/road connectivity signage	Existing street network typology (e.g., cul-de-sacs, block size, route availability).	22	Inadequate
6	Walking facilities	Pedestrian access infrastructure and road quality.	18	Inadequate
7	Availability of cycling facilities	Cyclist environment quality and the state of the existing bike lanes	0	None
8	Streetscape aesthetics	The attractiveness of the neighborhood (e.g., street trees, road infrastructure, and nice building architecture).	15	Inadequate
9	Traffic safety	Safety from traffic (e.g., slow speeds/speed breakers, lighting, crosswalks)	15	Inadequate
10	Mobility crime safety	Stranger danger along the streets and neighborhood?	12	No records
11	Social danger perception	Presence of social incivilities and micro-crimes (e.g., illicit drug use, robberies, hoodlums).	15	No records
12	Neighbourhood social relations	Any neighborhood social cohesion?	26	Inadequate

Table 4 - Description of expert's and user's perceptions of the neighborhood streets' quality.

S/N	Activities	Description	Avenue visited	Rating
1	Tourism Destinations and Commercial Hubs	Quality of shops, services, and food outlets.	All Avenues	**
2	Recreation Facilities	Quality of parks, gyms, and recreation centers.	All Avenues	*
3	Residential Density	Proportion of different dwelling types and housing density.	All Avenues	**
4	Land-use Mix Access	Accessibility of different places	All Avenues	****
5	Street Connectivity	Street network typology (e.g., cul-de-sacs, block size, route availability).	All Avenues	**
6	Pedestrian Facilities	Pedestrian environment quality.	All Avenues	*
7	Cycling Facilities	Cyclist environment quality	All Avenues	**
8	Aesthetics	Streetscape attractiveness of neighborhood (e.g., trees, road infrastructure).	All Avenues	0
9	Traffic Safety	Safety from traffic (e.g., slow speeds, lighting, crosswalks).	All Avenues	***
10	Crime Safety	Community road users' danger.	All Avenues	**
11	Social Danger Perception	Presence of social incivilities and micro-crimes (e.g., illicit drug use, robberies, strange people).	All Avenues	**
12	Neighbourhood Social Relations	Neighborhood cohesion (e.g., stopping to talk to neighbors, social exchange with neighbors).	All Avenues	*

Remarks from on-site interviews inventories and assessment of the sites. Note: 4* (extreme impact), 3* (critical impact), 2* (moderate impact), 1* (fair impact), 0 (no impact).

Figure 9 - Chart showing the current land use dominant and along the green corridor.



The limited number of tourist attractions, residential density, mixed-use activities, street connection, evident bike facilities, and the strong sense of community among neighbors are all given a fair rating. The aforementioned figure (Figure 9) shows that the following land use analyses were obtained for the 26 transit hub sites and landmarks that were chosen by random sampling: business (8%), religious (15%), residential (35%), public (19%), educational (19%), recreational (4%) and residential (35%). This table also demonstrates that, in the Lagos Mainland, residential use makes up the majority of the land use, followed by public and educational uses. Since recreation accounts for only 4% of overall land use, there aren't many open spaces in the study region designated for vegetation. The region is also known for religious activities to the tune of 15%. Data from the respondents revealed that there are businesses, churches, and mosques on every street in the area, with little to no consideration for open spaces for recreational purposes and flora.

As a result of the high level of abuse, disuse, and misuse of the green corridors—which have over time led to various land/wetlands encroachment, ecosystem degradation through air and water pollution, burning of refuse at various dump sites, loss of biodiversity, and blockages of road drainages—the study established that the wetlands and green corridors are vast areas of land, covering an area of approximately 20 km², and are primarily populated by land uses that are not planned. According to this study, sustainable urban green infrastructures are not currently utilized or in existence in these locations. As a result, it is recommended that green infrastructures be employed as a remediation tool to improve the local air quality and ecological condition in metropolitan Lagos. The frameworks for urban ecological farming, garden allotments, and urban carbon sequestration were also noted as important components of green infrastructure. Further information obtained from the interviewees was that not much is being done by the planning authority, which is in charge of overseeing the region. Due to continuous commercial store construction, particularly along the statutory residential setbacks, which impair commuter view and may result in auto accidents, there is evidence of extremely inadequate physical development regulation and management.

To enhance the tourism potential of a city by using this technique, there is a need to determine the possible impact of green cover on surface temperature and, in turn, prioritize areas of improvement for green infrastructure development to enhance the local temperature control function. Deciles were used to rank the findings. We developed an approach that takes into account the various conditions of public green spaces that coexist in the city when estimating spatial priority areas for green infrastructure planning and management. These areas are then estimated about the population's proximity to these public spaces. Consequently, even though every public green area has been taken into account, we anticipated that their relative value might be taken into consideration. This study finds that being close to parks and public gardens is more valuable than being close to semi-public gardens, which offer various forms of controlled public access. Being close to public squares with trees, which reduces the sense of greenness, is also more valuable than being close to public gardens and parks.

DISCUSSIONS

The significance of urban regeneration for sustainable tourism development cannot be overemphasized even though the goal of the city is to reduce the number of privately owned vehicles used to commute from the suburbs to the city center by encouraging the use of public transit and non-motorized forms of transportation, especially cycling, as viable substitutes for automobiles because of its aforementioned benefits. It is decided that the creation of an effective public transportation system is required to handle the increasing amount of commuter traffic between home and workplace locations. The revival of public places and the regeneration of urban spaces are made possible by the implementation of a tram system as a solution. Soft patterns that favor non-motorized means of transport, such as walking and cycling, are given precedence at both the local and agglomeration levels to lessen the effect of traffic in the city and preserve the natural link inside the city. By maintaining natural spaces running across the city centers, these blood vessels demonstrate Lagos's soft circulation masterplan and offer a true link between the many natural habitats. A concrete demonstration of Lagos state's dedication to urban green initiatives, as stated by the Lagos State Park and Garden Agency (LASPARK), is provided by the introduction of urban agriculture techniques on wetlands as a strategy for wetlands conservation to increase the city's potentials towards tourism development. The production, processing, and marketing of food should be moved into cities, closer to population centers and neighborhoods that frequently experience food insecurity due to a lack of access to wholesome food.

Landscape Design and Urban Greenery Approach

Carbon released by industry and vehicles into the atmosphere is taken up and stored by vegetation. It is crucial to wake up and determine how much CO₂ would be stored by trees and bushes on the wetlands over a year to create a climate-resilient Lagos through the preservation, restoration, and protection of Lagos Wetland. The suggested urban green infrastructure master plan for the city must include a detailed count of the number, kind, area, and girth of trees to calculate the value of CO₂ collected for environmental advantages. Given that, a city's health is inextricably linked to the health of its peaceful and livable surroundings. An environment damaged by pollution, contamination, and the effects of climate change is brought back to health by a redesigned local food system. The production, distribution, and consumption of food now contribute one-third of greenhouse gas emissions caused by human activity. With the use of renewable resources and a steer clear of practices and materials that pollute the environment or the food, a sustainable food system produces food near the customers it serves (de Santana Ribeiro, de Carvalho, Lopes, & de Sousa Filho, 2024).

Reclaiming Urban Spaces for the People through Landscape Design

Even if the number of individuals using cars has unavoidably grown recently, many people still work from home, at least in part. There will be a decrease in the number of automobiles entering our metropolitan areas when low-emission zones are implemented. Reduced traffic, reduced need for on-street parking, less pollution, and fewer road-related signs all result from fewer automobiles. Streets can no longer be seen as networks for automobiles; instead, they should be seen as areas where people live, work, and play.

Landscape and urban design approaches and models as presented in Figures 10(a&b) and 11(a&b) can only be effectively executed if it is thoughtfully and carefully planned and constructed. Outdoor areas are rarely static; they can shift with the seasons and overflow with life's erratic rhythms as people pass by, cross paths, and spend time together. A well-planned, adaptable urban area can serve a variety of purposes all year long and contribute to the development of a city center that stands alone as a destination. It can be used for winter markets, big-screen sporting events, annual performances, civic gatherings, and even the addition of a summer beach. Thus, effective landscape design is essential to revitalization projects and may assist unleash the potential offered by building architecture. As shown in Figure 11(a&b), a public realm that is appealing, easily accessible, and conducive to foot traffic will draw more users, lengthen their stays, and guarantee future visits. When properly executed, it may guarantee the long-term socioeconomic viability of our metropolitan areas by generating lively areas where certain kinds of commerce and other economic activities might flourish once more.

Creating a network of interconnected off-road bike trails and on-road riding pathways throughout the state of Lagos is the goal of the comprehensive linear park, social, health, and fitness impact off-road cycling trail. Given that it links to several districts, villages, and suburbs in Lagos state, such as Gbagada, Anthony, Mende, Somolu, Oworoshoki, Ogudu, Ifako, Ojota, and Ikeja, the Anthony to Maryland off-road bicycle path system is considered a top priority for this feasibility study. In addition, the plan serves as a guide for fostering an environment that is both active and healthy, enticing people to cycle for sports, leisure, wildlife observation, low-carbon transit, and peaceful landscapes.

A 20-kilometer cycling route is available at the linear park for travel, sightseeing, leisure, and tourism activities. Bike riding and walking are two of the many methods to go to work and other locations in a desirable environment to live and work. Carbon sequestration via remediation, preservation of the existing wetlands, and other tactically sound adaptable options for resilient and environmentally friendly urban development, such as non-motorized transportation, urban agriculture beside wetlands, restoration of wetland ecosystem and rivers and streams, preservation and inclusive landscape regeneration of open spaces, and concluding with a focus on the realities of sustainable low-carbon philosophy in the built environment and landscape. Among the advantages of urban green infrastructure.

Figure 10 - The proposed landscape design for the off-road bicycle lane (color black) along the corridor. (a) Onike(UNILAG)-Iwaya, (b) Bariga-Akoka.

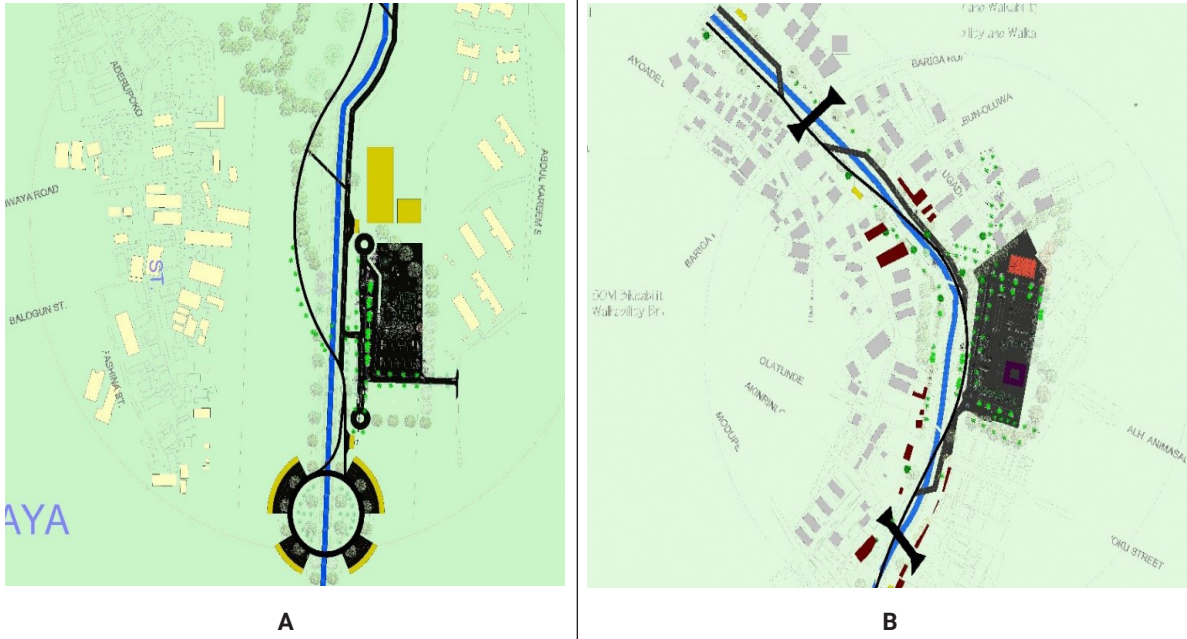
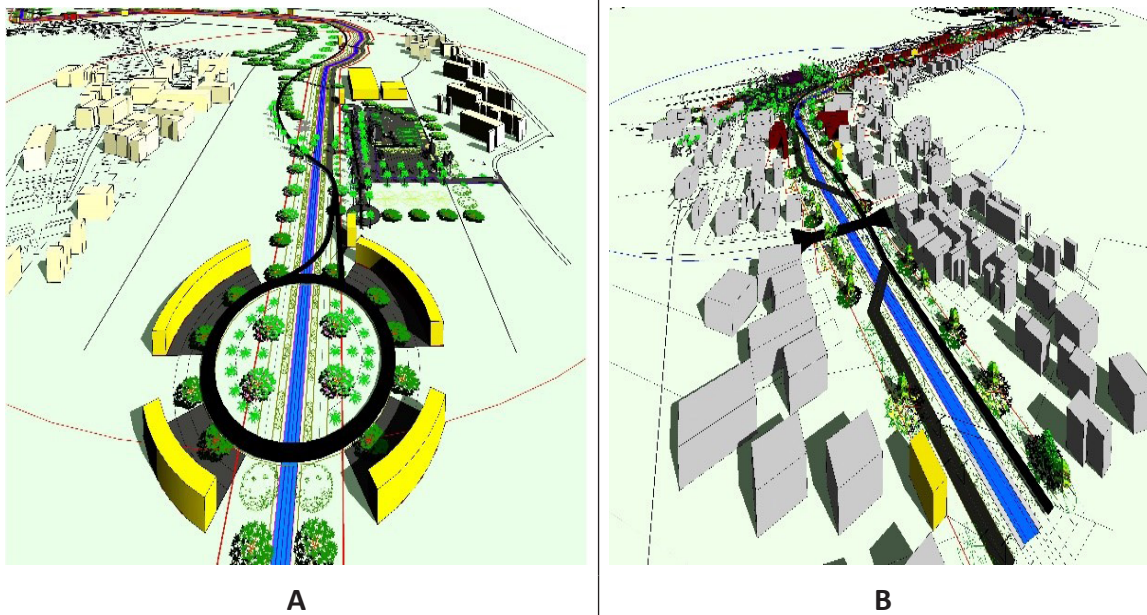


Figure 11 - The proposed landscape design (3D views) for the off-road bicycle lane (color black) along the corridor. (a) Onike(UNILAG)-Iwaya, (b) Bariga-Akoka.



Urban Carbon Reduction and Sequestration

By absorbing CO₂ from the atmosphere as they develop, well-planned green walls, green roofs, bio-retention/rain gardens, and street trees help reduce carbon emissions. According to recent studies, more than 12 million tons of dust, dirt, and other particle matter are captured and purified by open spaces, and the high prevalence of air pollution and the absorption of carcinogenic compounds that pose a risk to the health and well-being of the population, this is especially crucial in metropolitan areas. Numerous investigations looked into the relationship involving the urban atmosphere and metropolitan vegetation.

FINAL CONSIDERATIONS

The key conclusions from tourism development, urban greening initiatives, regeneration, and open space connectivity are elucidated in this study, along with an explanation of how the advantages might be expressed in ecological, social, and economic terms. The study also explored connections between biological and cultural variety and examined the relationship between social cohesiveness and green places towards a resilient community for tourism development.

On the other hand, tourism, ecotourism, and biophilic design approaches are viewed as complete landscape design and planning strategies that connect neighborhoods, districts, and cities while understanding the distinct ecological services and benefits from a cohesive green, grey, and blue network at different urban spatial configurations and levels. Securing the entire services necessitates participatory synergy and green strategy planning to address the range of issues related to local sustainable projects and strategies for advancing Lagos's social and economic well-being.

1. By reducing reliance on fossil fuels, increasing green open spaces, restoring habitats, and improving soil, water, and air purity, a city can become environmentally conscious. Suitable government authorities and private institutions should understand the role green infrastructures play in restoring a healthy ecosystem. Collaboration between the environment and agriculture ministries is necessary to encourage the application of sustainable farming methods in urban agricultural environments. To turn plant waste from farms and gardens into compost that may be utilized in nearby farms and gardens, waste treatment facilities should be supported. The amount and type of open space that is available in a community may have a major and long-lasting effect on the health and well-being of that community, as this article has demonstrated.
2. It is crucial to highlight to decision-makers the importance of open spaces in forming our communities both today and in the future. This includes promoting health and social advantages as well as those associated with sustainability and economic growth.
3. Make the most of the space that is already available and employ strategies that fund pocket parks, neighborhood gardens, and multipurpose areas intended for a variety of communities.
4. Take into account prospects for land rationalization to augment the number of open space locations.
5. The development of green and open spaces in urban environments takes precedence over areas designated for parking, for instance.
6. Employ local and cultural organizations in the design of places to make them relevant.
7. Pay special attention to locations that are most in need of open space upgrades, such as certain regions with lower incomes and places where there is already subpar open space.
8. Take into account efforts to green the streets as well as upgrades to road layout, traffic control, and street connection that will make the areas more walkable.

Recognizing the contributions that these such as physically active lives, psychological wellness, a sense of community, and connected communities make to the general health and well-being of individuals and the environment at large is imperative for the private sector and local, state, and federal agencies.

When designing for tourism purposes, there is much more to consider than only the aesthetic appeal when evaluating the health, social justice, and sustainability benefits of landscape design in city centers. The management of health and social care expenses, as well as public health, may be significantly impacted by the enhanced public realm in urban regions for municipal governments. In addition, it can assist achieve borough-wide environmental goals and enhance socioeconomic fairness. Additionally, important to preserving good psychological conditions are recreational areas; in fact, a growing number of medical experts increasingly advocate daily, continuous interaction with the environment. Consequently, is believed that providing well-designed open areas is essential to promoting civic wellness and good health.

The findings from this research presented an even stronger argument for a better metropolitan environment by exposing the "bloated deprivation" that a lot of municipalities experience, with countless impoverished neighborhoods, landlords/homeowners, visitors, and tourists having much fewer chances of finding lush vegetation for social cohesion, meetings, recreation, and relaxation. If properly planned, establishing vegetation and implementing environmentally friendly urban drainage systems can not only strengthen the aesthetics of our urban areas but also enhance the natural world, reduce the effects of city heat islands, and offer efficient irrigation alternatives to handle variations in precipitation and climate conditions without adding to the burden on our currently overburdened waterways.

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