Contemporary issues in the GEOGRAPHY of Urban & Regional Planning in Nigeria

(A FESTSCHRIFT IN HONOUR OF PROF. A. S. AGUDA)

Editors

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CONTEMPORARY ISSUES IN THE GEOGRAPHY OF URBAN AND REGIONAL PLANNING IN NIGERIA

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CONTENTS

FORWARD

This book is a collection of research-based articles written in honour of Professor Akinola Samuel Aguda, to mark his retirement from the Obafemi Awolowo University, Ile-Ife, Nigeria. The focus of Professor Aguda's research in the fields of Urban, Industrial and Development Geography has been on housing problems and spatial growth of cities in Nigeria, Crime, Communal Conflict and Violence on Urban Residential Segregation, Community Development (Home Town Associations and Government Efforts), Urban Growth and Problems in Nigerian Cities, Spatial Pattern of Manufacturing Industries in Nigeria. He also researched extensively on Spatial Distribution and Locational Efficiency of infrastructure and social services as well as Consumer Behaviour regarding social services accessibility in Nigerian Urban Centre. His work also reflected the role of informal Sector in employment generation in the Urban Setting and proffer strategies of achieving, reliable and sustainable infrastructural services in Nigeria's Urban Areas. Most of the studies presented in this book are in the same sub discipline of Geography as Professor Aguda's research.
The fact that the book is dedicated to a guru of urban and Industrial Geography in Nigeria underscore the importance of Geography in planning and development. The articles contained in this book have been contributed by scholars and academics many of whom have passed through the tutelage of Professor Aguda. The topics are carefully selected and the book is structured in such a way that contemporary issues in Geography of Urban and Regional Planning are well laid out and discussed.

The book would be of immense value to research students, academics and planners in Nigeria and elsewhere in sub–Saharan Africa in formulating research questions and policies. To the general readers with interest in the urban geography and planning, this book provides a rich source of data and information.

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August, 2023.

PREFACE

In recent years, Geographers have been writing papers and books in honour of retiring erudite professors. The theme of such papers and books often reflects the retiring scholar field of specialization and in which they have contributed meaningfully to extend the frontier of knowledge while in active service. Consequently, the retirement of Professor Akinola Sam Aguda from the Department of Geography, Obafemi Awolowo University, Ile-Ife, Nigeria affords scholars and his academic sons and daughters (Masters and PhDs graduates) the opportunity to celebrate the erudite urban geographer by contributing papers on different themes in the Geography of Urban and Regional Planning that led to the publication of the book.

The book is in 8 sections and 25 chapters. **Section 1** focuses on the biography and career of Professor Akinola Samuel Aguda. **Section 2** is on Urbanisation. In this section Olabamiji and Ajala examined subjective poverty in selected cities of Osun State, Nigeria using geospatial techniques, while Okpuvwie et al, also using geospatial techniques investigated crimes committed against persons in Ughelli Metropolis, Delta State, Nigeria. Areola looked at urban beautification projects in Ibadan Metropolis, Nigeria. While Eludoyin examined domestic water quality and the discriminatory influence of socio-economic stratification on accessibility to safe water in Olorunda local government area in Osun State, Nigeria.

Section 3 focused on transportation and transport planning. Olawole et al, using Lagos -Accra transport corridor to examined service quality of cross-border road transport in West Africa. Aboyeji considered the impact of transport on farmers' accessibility to Agricultural Extension in Kwara South Senatorial District, Nigeria. Ale in his contribution assessed mobility and quality of life or rural elderly in Ondo North Senatorial District, Ondo State, Nigeria. While Yoade and Atoyebi looked at the effects of road expansion and highway development in South-West, Nigeria. Oladepo et al. classified driving behaviour of taxi drivers in Ibadan to include reckless driving, risky driving, distracted driving, self-willed/emotional driving and cautious driving behaviour and found that taxi drivers in the city drive aggressively most of the times. Significant similarity in reckless driving behaviour was observed among taxi drivers in the eleven local government areas in the city.

Section 4 is on urban industrial location dynamics. Abba examined locational pattern and physical forms of gated communities in Kano Metropolis Nigeria. In terms of distribution, Abba found that the gated developments in the city have a cluster spatial pattern. While Olugbamila et al, raised issues the location of Base Transceiver Stations

in Ile-Ife, Nigeria and revealed that availability of power and increased in property value, attraction of other industries, financial gain and population increase are minor economic impact derived from the erection of BTS in a location.

Section 5 is on urban management. Adeniyi and Olayiwola evaluated traders' participation in weekly environmental sanitation in Osogbo and concluded that ignorance on the part of space users and ineffective environmental laws are the reasons for the poor participation of space users in weekly environmental sanitation. Dankani, Dankani, Dankani and Mustapha explored the nature and challenges of urban agricultural practices in Kano Metropolis, Nigeria. The study found out that urban agriculture is bedevilled with challenges ranging from lack of support, non-recognition by the state, small land holding and insecurity of tenure, pressure from land owners and developers which requires serious policy change and concludes that government need to recognize and give legitimacy to urban agricultural practices in metropolitan Kano as it is now commonly adopted in many countries of the world in line with the goals, targets and indicators of Sustainable Development Goals. Odunjo, contribution is on urbanisation and sustainable housing provision in Nigeria. Oladimeji. Abubakar-Kamar, Odunjo and Adeoye examined mass housing schemes delivery strategies and the challenges of maintenance in Nigeria. Olaniyan, Medayese and Kasim look at green city interventions for sustainable urban ecology in Nigeria. Olawuni, Popoola and Adeyemi examined hazard reduction strategies in flood prone area of Ibadan Oyo State, Nigeria. The study recommends flood control and management policies, that incorporate public participation among other mitigation measure.

Section 6 focusses on urban and regional planning strategies. Omolade and Agun examined grassroots participation as a veritable pathway to sustainable national development using Ondo Development Committee (ODC) as a case study. While Ajila. and Farinde examined the contributions of textile extension services in rural development in Nigeria. While Akinloye examined the effect of land acquisition on peasantry in Ifelodun Local Government Area, Osun State Nigeria

Section 7 is on urban ecology. Sylvanus, Ajibuah, and Akinwumi looked at the role of armed banditry on land use and Land cover changes in Chikun LGA, Kaduna State, Nigeria and study concludes that the incidence of armed banditry in the LGA poses a threat to human habitation and agricultural productivity and therefore, call for a concerted effort by the government and relevant stakeholders in taking back the spaces occupied by armed bandits and also stop the bandits from further destruction of Land use and Land cover in Chikun LGA. Ismaila, Sirajo and Yusuf looked at land values and spatial structure in Sokoto Metropolis

Section 8 concludes on geospatial applications in urban and regional planning. Nwaezeigwe evaluated the application of Radar and Optical Sensors in road feature extraction in Ikorodu Urban, Lagos State, Nigeria and linear features especially road network can be extracted with ease without the rigour of digitization from Radar and Optical imageries. The study also showed that Radar image provided more efficiency than the optical image. While, Makinde and Abdul explore the use of machine learning for feature detection and land cover dynamics assessment using Ohafia Abia, Abia State, Nigeria and a case study.

Given the coverage of the papers, the simple ways the issues of urban space were treated, this book would be an invaluable resource to both undergraduate and graduate students in Universities and consultants interested in all the major sections addressed in the book.

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CHAPTER 17

Green City Interventions for Sustainable Urban Ecology in Nigeria

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INTRODUCTION

A cultural landscape, an urban region is distinguished by its high population density and substantial impervious surface, with various land use and land cover types coming together to produce a dynamic patch mosaic (Odume et al., 2022). The form, function, and dynamics of an urban system are thus influenced by interactions between humans and their surroundings (Wu, 2014). In addition to influencing human behaviour, community structure, and social organisation, urbanisation also modifies the composition and spatial arrangement of natural landscape elements and ecosystems (Jiboye, 2011; UN-Habitat, 2012; Wu, 2014; Nilon et al., 2017; Zhou et al., 2022).

Protecting the natural biological resources on which humanity and all life depend fundamentally is a challenge that has fallen on the shoulders of urban planners and academics (Odume et al., 2022). Since people's livelihoods are based on the principles and practises of sustainability, it is widely agreed that healthy ecosystems are essential to human survival (Jiboye, 2011). Durability, independence, autonomy, and changeability are the hallmarks of a sustainable environment. Despite external stresses, healthy ecosystems keep their unique functional variety, productivity, and fertility (Cepeliauskaite & Stasiskiene, 2020). Ecological techniques centred on the green paradigm are at the forefront of the movement towards a more sustainable urban ecology.

Green cities are the modern term for communities that prioritise ecological, economic, and social sustainability in their planning and growth. The concept of a "green city" is nebulous, but it may be distilled to a few key features. Energy efficiency and decreasing reliance on nonrenewable energy sources, low-carbon transportation systems, green and resilient infrastructure, waste reduction and management, expanded green

spaces, water cycle management, and integrated planning are all topics that fall under this category (Kennet, 2010; Kirmanto et al., 2012). Rather than causing harm to the environment, green cities look for ways to improve and sustain their natural urban ecology. In order for urban ecosystems to thrive, sustainable practises like "green city" planning are essential.

Green city, from one point of view, is a metaphor for a city that has achieved its ecological sustainability goals. Good urban governance is at the core of the concept, which aims to create a city that is both environmentally and socially sustainable (Kirmanto et al., 2012). Within the limitations and quirks of the Nigerian urban setting, this article examines the numerous intervention areas of the green city method that can be implemented for sustainable urban ecology.

The Green City Concept

Since the beginning of urban planning, professionals have looked for ways to protect natural habitats while also incorporating them into urban areas (UCD, 2008). Reasons for doing so have ranged from concerns with beauty and health to those of recreation and amenity. Nonetheless, conservation-related incentives have been studied for an unexpectedly long time. For instance, Utopian thinker Patrick Geddes stressed the importance of conserving a city's biological resources and incorporating nature into urban planning (Geddes, 1915; Hough, 2004).

There was a push to incorporate more green space into quickly expanding towns around the end of the nineteenth century. The goal of many of the earliest landscape planners, including Fredrick Law Olmsted (1822–1903), was to protect the natural environment while also improving the quality of life for the city's dense population by designing parks and other green spaces (Hough, 2004). Greenways, as we know them today, may be traced back to his ideas (Fabos, 1995; Ahern, 2000). The influential Garden Cities of Tomorrow (1902) by Ebenezer Howard (1850-1928) outlined a model of a self-sustaining town in which planned satellite communities are surrounded by greenbelts, containing carefully balanced areas of residences, industry, and agriculture; and this berthed the greenbelt concept, which had been developed by Olmsted to bring nature into the city. Greenbelts were planned to serve multiple purposes, including delineating municipal bounds, protecting rural areas, and providing recreational and open space for residents. Later on, greenbelts were developed as a method to limit urban growth and maintain a balance between city and country life (UCD, 2008).

Beyond the concept of a greenbelt, other ideas have developed, such as the strategic gap and green wedges ideologies, which provide axes of protected land that penetrate urban areas and can be used to preserve landscape and wildlife links between towns and the country, as well as to provide recreational facilities and promote positive land management (UCD, 2008). Connected patches and linear strips of habitat with an innate ecological use such as hedgerows, woodlands, wetlands, and manmade corridors like roadways, railway lines, road margins, and streetscapes make up greenways and green networks in addition to greenbelts (Girling and Kellett, 2005).

In light of the foregoing, the concept of the "green city" has expanded beyond the initial goal of creating greenbelts, green wedges, greenways, and green networks to include encouraging environmental assets for the achievement of sustainable urban development and ecological goals to promote an eco-friendly city that strikes a balance between social, economic, and environmental aspects. The term "green city" is defined succinctly as "carbon neutral and fully sustainable" (Birch and Wachter, 2008:3). De Roo (2010) argues that green planning, a green economy, green open spaces, and a green network are the four pillars of the green city concept, which centres green space at the hub of development and regeneration. The primary idea behind the green city movement is to strike a balance between the natural and manmade worlds.

Sustainable Urban Ecology

The term "Urban" might mean different things to different people. Most of these definitions are based on one or more of the three basic factors: total population number, population density, and impervious surface area or constructed structures (Wu, 2014), although they all emphasise various features of urban systems. High human density, an abundance of built buildings, a large number of impervious surfaces, changed climatic and hydrological conditions, air pollution, and altered ecosystem function and services are only some of the things that urban regions have in common. A single definition of urban areas that encompasses all their fundamental parts and features is neither possible nor necessary. All key ecological and environmental characteristics of urban systems can be related to these two parameters, either directly or indirectly, making high human population density and wide impervious surface area the two conspicuous factors that sufficiently define what is urban.

Ecology is a term borrowed from the natural sciences that refers to the study of biological patterns and environmental processes in any ecosystem, be it a forest, farm, rural community, or city. Research and studies in the field of ecology have been undertaken in two distinct approaches. The natural sciences team steers the first one,

which puts more emphasis on connections between the plant and animal kingdoms and how those connections are affected by environmental conditions. The second definition of ecology prioritises human well-being by using a multidisciplinary approach to bettering urban residents' quality of life and access to resources. The issues, habitats, and difficulties of urban ecosystems are the primary focus.

Given the multiplicity of connotations inherent in the words "ecology" and "urban," the field of urban ecology is broad and multifaceted. Urban ecology can be defined simply as ecological research in an urban setting, but its many subfields attest to its breadth. Urban ecological studies typically aim for specific applications of research in the development and administration of urban green areas, in addition to a scientific component. As such, it may be said that urban ecology is an applied science. What this means is that urban ecology is now seen as a hybrid field that requires and incorporates the concerns, concepts, and procedures of social sciences in order to fully address the unique challenges of urban environments. Individual species, populations, communities, and landscapes are all components of urban ecological systems. The urban ecosystem is viewed as a combination of natural and manmade features in the field of urban studies (Cepeliauskaite and Stasiskiene, 2020).

In a larger sense, urban ecology is the study of ecosystems that include city dwellers and the built environment of urbanising landscapes (Pataki, 2015). Ecosystem services, which are intrinsically connected to urbanisation trends, are the focus of this study. As such, urban ecology is an interdisciplinary study that backs up the efforts to make cities greener. Geography, sociology, urban planning, landscape design, engineering, economics, anthropology, climatology, public health, and ecology are just some of the fields from which it draws inspiration. Urban ecology has been used to refer to the study of humans in cities, the study of nature in cities, and the study of the coupled relationships between humans and nature. This is due to urban ecology's interdisciplinary character and its particular focus on humans and natural systems inside urbanised environments.

In the 1920s, a group of sociologists at the University of Chicago (the Chicago School of Sociology or Human Ecology) developed urban ecology as a subfield of human ecology (Park et al., 1925; Wilson, 1984; Wu, 2014). Robert E. Park (1864-1944), Ernest W. Burgess (1886-1966), Roderick D. McKenzie (1885-1940), and Amos H. Hawley (1910-2009) were all influential members of the Chicago school. After the development of urban ecology, the terms "ecosystem ecology" and "landscape ecology" were coined in 1935 and 1939, respectively (Wu, 2014). An early bio-ecology approach to urban ecology, sometimes called "the Berlin school" (Weiland and Richter, 2011), was conducted mostly by botanists and zoologists. Human ecology and ecosystem or landscape ecology provided

the foundation for the development of modern urban ecology. Increased "interdisciplinarity" and "transdisciplinarity" in its primary research issues and key players characterises this new urban ecology paradigm.

According to Wu (2014) and Lepczyk et al. (2017), urban ecology can be understood either as "ecology in cities," which focuses on non-human organisms in the urban environment, or as "ecology of cities," which views the entire city as an ecosystem. The sustainability of cities has emerged as a third category or perspective of urban ecology in light of current, cutting-edge advancements in urban studies (Connop et al., 2016). Different yet related urban ecological techniques can be recognised using this wide classification. Figure 17.1 shows their timeline and connections. The first theme, urban sociology or human ecology, looks into urban human behaviour and social organisation through the lens of established ecological theory and notions. Second, the bio-ecological method looks at the variety and density of wildlife in urban areas. Third, there is the human ecosystem approach or the urban systems approach, both of which view cities as complex ecosystems made up of both "natural" and "social" elements. Fourth, the urban landscape method views cities as multi-scaled patch dynamic systems with spatially varying characteristics. This method, which draws on landscape ecological ideas and techniques, centres on the interplay between human development patterns and natural systems. The fifth is the growing emphasis on the connection between environmental services and human well-being in urban environments, which is central to the evolving urban sustainability strategy.

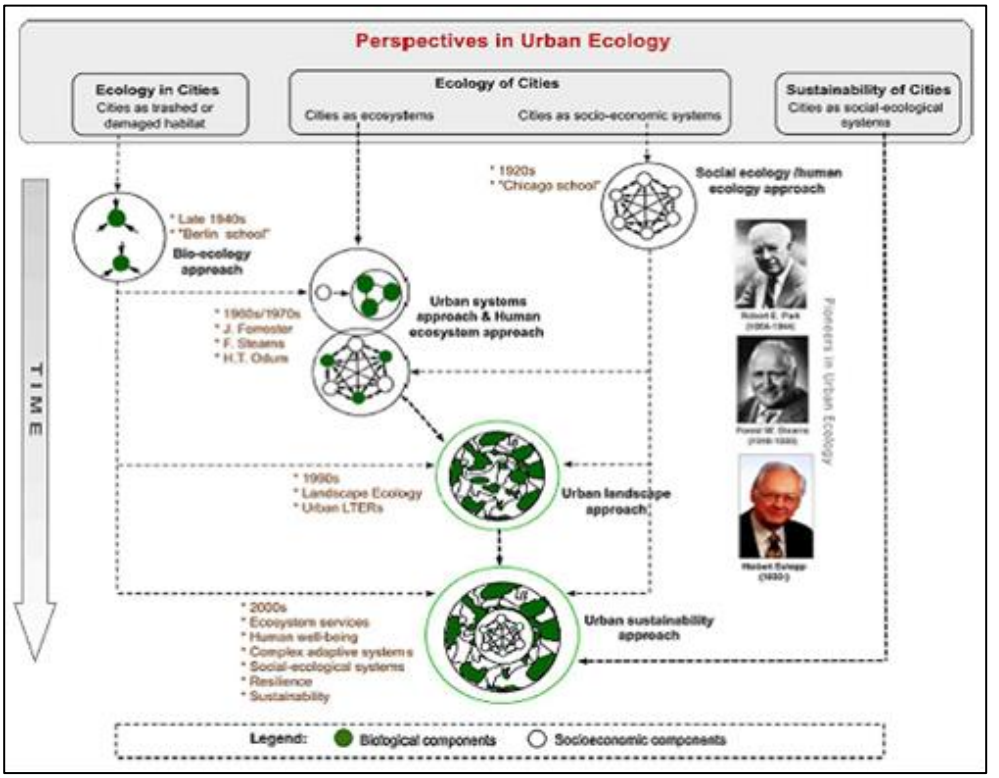

Figure 17.1: Evolving perspectives and approaches in urban ecology
Source: Wu (2014)

Ecological studies that focus on large-scale issues in actual landscapes should address the issue of sustainability as soon as possible (Constanza et al., 2014). Sustainability in the city is gaining popularity among academics studying cities. An idea or vision like sustainability, as described by Loucks (1994) and mentioned by Wu (2014), can sweep over a culture like a tidal wave. The concepts of "sustainable urban development" and "urban sustainability" are synonymous in the academic literature, and the two terms are commonly used interchangeably. The term "urban sustainability" is used to describe "a desirable state or set of conditions that persists over time" in cities, while "sustainable urban development" suggests "a process by which sustainability can be attained." According to the Brundtland Report, "sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development; and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations" (WCED, 1987). In a nutshell, urban sustainability is a continual adaptive process of establishing and

sustaining a set of dynamic conditions that meet the needs of current and future generations in an urban region.

In light of the foregoing, we can define sustainable urban ecology as the process of coordinating ecological, economic, and social responses to local and global shifts in order to foster and sustain a positive feedback loop between ecosystem services and human well-being. Focusing on biodiversity, ecological processes, and ecosystem services, this iterative method examines spatial and temporal patterns, environmental repercussions, and the sustainability of urbanisation. The concepts of "ecology in cities," "ecology of cities," and "sustainability of cities" are all included in this all-encompassing term.

Ecological Dimensions of the Green City Index

In 2012, Kirmanto et al. highlighted eight areas where the Green City idea may use intervention. Figure 17.2 depicts these green practises, which include green community planning and design, green open spaces, green waste management, green transportation, green water and energy use, green construction, and green living. Each of these avenues for change is distinct from the others, but they all work together to make a green city. Key intervention areas for sustainable urban environment based on the green city idea, these characteristics can also be categorised as the green city index.

Figure 17.2: Attributes of Green City
Source: Kirmanto et al. (2012)

Green Planning and Design

The efficiency of a city is heavily dependent on its physical layout. Green city facilitation is influenced by a number of factors, including the shape of urban spatial organisation. In order to develop resilient cities of the future, green planning and design provide a comprehensive foundation for planning in the present. The monocentric city, the polycentric city, and its variants in the form of a conurbation of "urban villages" are the three main types of urban planning schemes that have been developed so far. The composite model, the fourth model, is a hybrid of the three main models (shown in Figure 17.3). Urban spatial structure models such as these define city morphology and provide a foundation for environmentally responsible city planning and design (Lindfield and Steinberg, 2012).

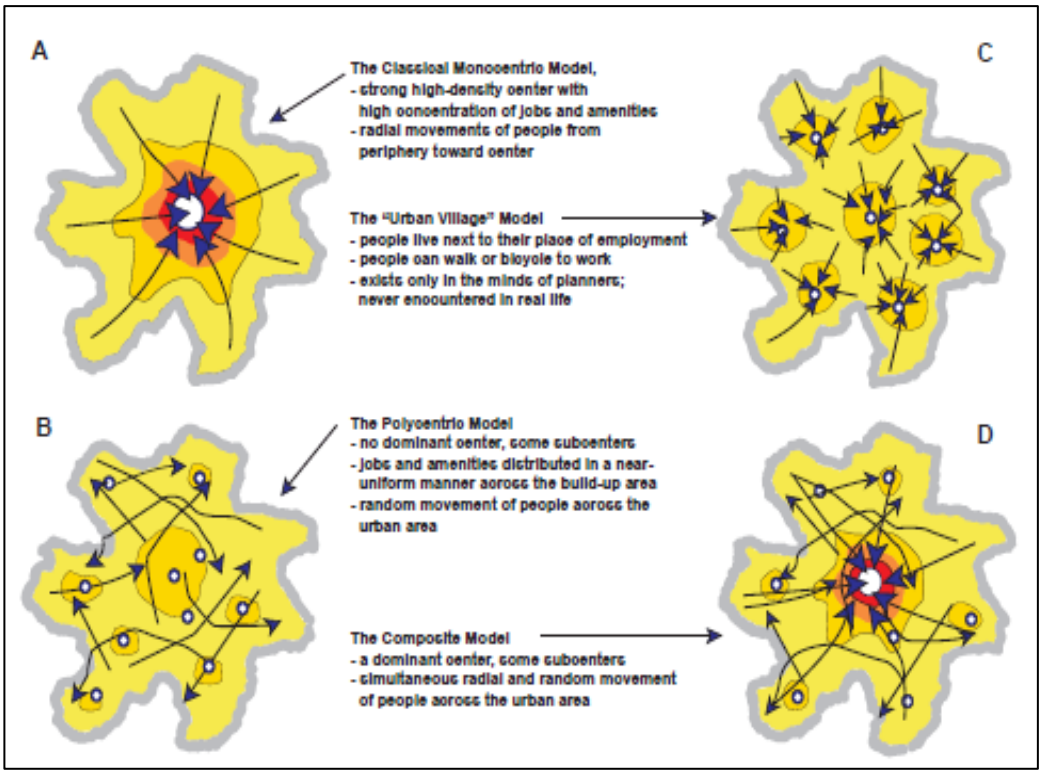

Figure 17.3: Common Urban Spatial Structures
Source: Lindfield and Steinberg (2012)

Achieving efficiency in the utilisation of space and the provision of services necessitates spatial planning and the proactive application of land use models when the building of green cities becomes the overall goal. Sustainability is affected by how

efficiently land is used. Thus, the green city strategy relies heavily on urban planning and design. With an eye towards preserving land resources and conserving the natural urban ecology, "green" urban planning and design prioritises compact land-use models, mixed land-use, and smart city growth (Lindfield & Steinberg, 2012; UN-Habitat, 2012).

Green Open Spaces

Most people don't think of parks and other green areas in cities as essential for things like air quality and recreation. If a city is well-designed, however, one-fourth of its land area can be set aside for parks and other open spaces. These open areas absorb rain and wastewater while also filtering the air we breathe. Sustainable urban ecology benefits from parks, gardens, street greenery, and trees due to their ability to store carbon, regulate water flow, and filter pollutants.

Therefore, parks and other open green areas play a crucial role in keeping urban ecological systems healthy. Environmental and ecological benefits, improved economic and aesthetic assets, facilitated social and psychological wellbeing, food and agricultural benefit, pollution control, biodiversity and nature conservation, energy savings, recreation and health benefits; all are provided by green open spaces, an important indicator of the green city. Large, interconnected green networks, river corridors, flood plains, coastal zones, parks, gardens, recreational and leisure areas, home gardens, and green patches in road medians and road sides are all examples of green open spaces.

Green Waste

The goal of a zero-waste city model is central to the green city movement. The elimination of waste and landfill is the result of optimising all material movements in metropolitan areas. To achieve zero waste, the full product and building life cycle must be taken into account, and the necessity for life cycle-based industrial and societal systems and construction processes must be articulated. To achieve this goal, garbage is kept out of landfills, which can have a harmful effect on the urban ecosystem, and products, structures, and urban areas are created so that all resources can be recovered without harming the environment.

Polluting the natural ecosystem, which includes the air, rivers, landscape, and soil, is a result of modern raw material extraction and processing, as things not directly beneficial to a production become undesired trash. The goal of the green waste strategy is to eliminate waste altogether by constructing closed-loop systems in which the waste

products of one industry are used as the raw materials for another. Figure 17.4 is a schematic of the zero-waste concepts at the heart of the green city concept. Avoiding, reducing, reusing, recycling, recovering, and finally treating and disposing of garbage is the preferred path to creating environmentally friendly cities, in that order (Lindfield & Steinberg, 2012).

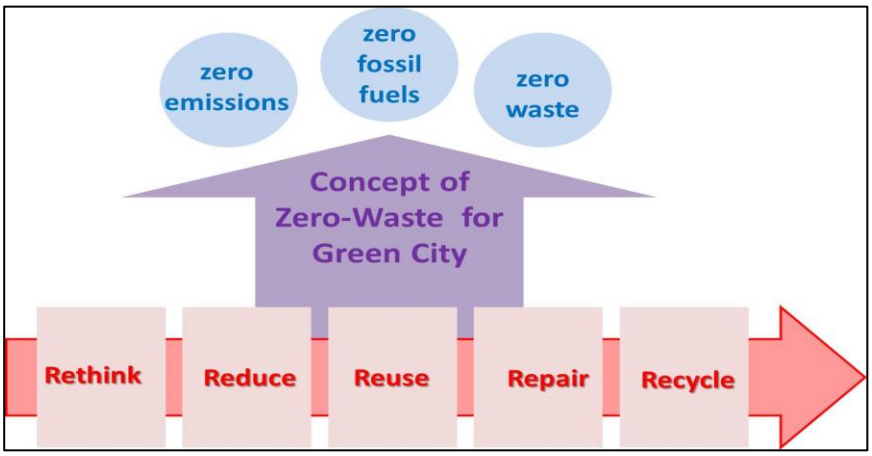

Figure 17.4: Zero-Waste Concept for the Green City
Source: Adapted from Lindfield and Steinberg (2012)

Green Transportation

Transport is important because it facilitates trade. Improvements in accessibility and mobility go hand in hand with progress. Contrary to expectations, transport problems tend to intensify alongside rising prosperity. Congestion, air pollution, and the emission of greenhouse gases are all made worse by the rising usage of automobiles and motorcycles as the middle class expands its disposable money. Increases in the use of automobiles tend to lead to unsustainable growth, which is harmful to eco-friendly urban planning.

Wright (2005), looking at the bright side, offered a model of a spectrum of potential transport alternatives for an optimal green city, which anticipates possibilities ranging from relatively "car-lite" cities to entirely "car-free" cities (Figure 17.5). In this view, a green city will place limits on the number of private automobiles allowed on its streets, while also providing resources and policies that encourage the use of public transit and modes of transportation other than private automobiles. A city that fully bans motorised cars, essentially producing a zero-emission city, is on the greenest end of this range, while "traffic-calmed" or "car-lite" zones, which discourage vehicle use without an absolute ban, are on the other end.

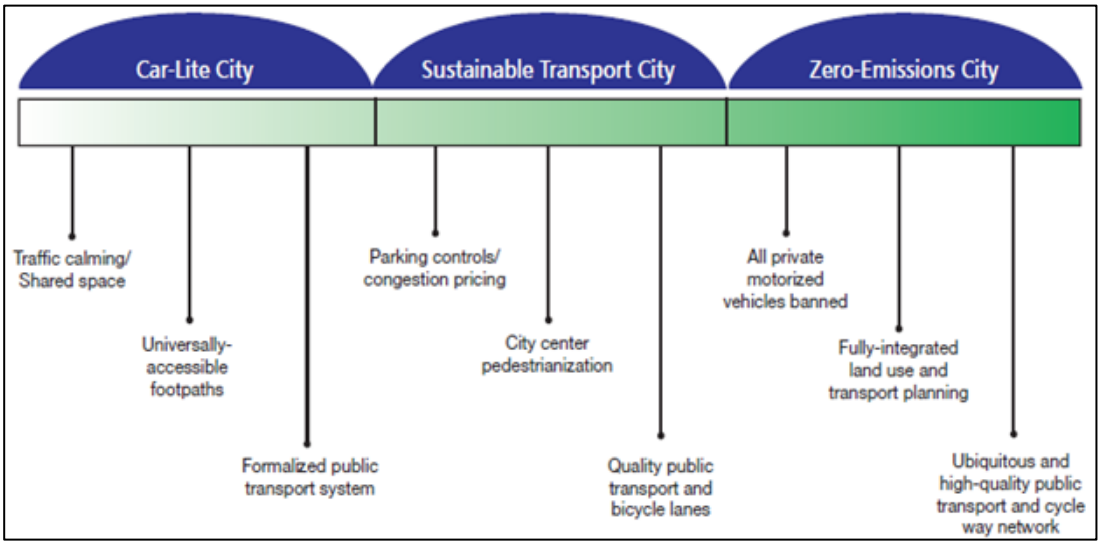

Figure 17.5: The Spectrum of Possibilities for Transport in a Green City
Source: Wright (2005)

Green Water

The promotion of the green city concept relies heavily on the efficient management of the river basins surrounding urban centres. Water resources are scarce, technical and administrative capacities are low, and institutions are shaky in most developing world cities (Langer and McNamara, 2011). Green water denotes a water-sensitive city, which is essentially synonymous with a livable city where environmental restoration and protection, supply security, flood management, public health, and economic sustainability are all properly integrated. The five pillars of green water are (i) meeting the water and sanitation needs of all people, (ii) bolstering agricultural and industrial output, (iii) creating vibrant, livable cities and towns, (iv) reviving rivers and ecosystems, and (v) constructing communities that can adapt to new circumstances.

Figure 17.6 depicts the green city water secure model proposed by Lindfield and Steinberg (2012), which incorporates the ADB's (2012) key dimensions of green water as well as the following: making technology count; promoting waste water management; improving production efficiencies; reducing wastages; decreasing consumption levels; decreasing energy for water provision.

Figure 17.6: Green City Water Secure Model
Source: Adapted from Lindfield and Steinberg (2012)

Green Energy

When people figured out how to collect, store, and utilise energy on a grand scale, it sped up the progress of civilization. Energy's luxuries may have come at a high price to society and the environment, though, in the form of things like global warming, water and air pollution, acid rain, and deforestation. Therefore, the goal of green energy is to provide the necessary energy for development while having minimal negative effects on the natural environment. The idea of a "green city" promotes efficient use of resources and a shift towards renewable power sources.

The developing world is currently years behind the developed world in terms of smart energy development and the use of renewable energy sources (Langer and McNamara, 2011). Lindfield and Steinberg (2012) report that less than 10% of worldwide energy smart projects are located in Africa, the Middle East, and Latin America combined, and that in 2010, less than 10% of Africa's energy generation came from non-hydro and renewable sources. This demonstrates a reliance on energy sources that are harmful to the environment.

Energy supply, building retrofits, solid waste, new construction, smart solutions, and transportation are the six main sectors where Lindfield and Steinberg (2012) advise taking action to promote green energy. Figure 17.7 is a visual representation of the many renewable urban energy sources listed by Langer and McNamara (2011), which can contribute to achieving green energy and, more broadly, promoting green cities.

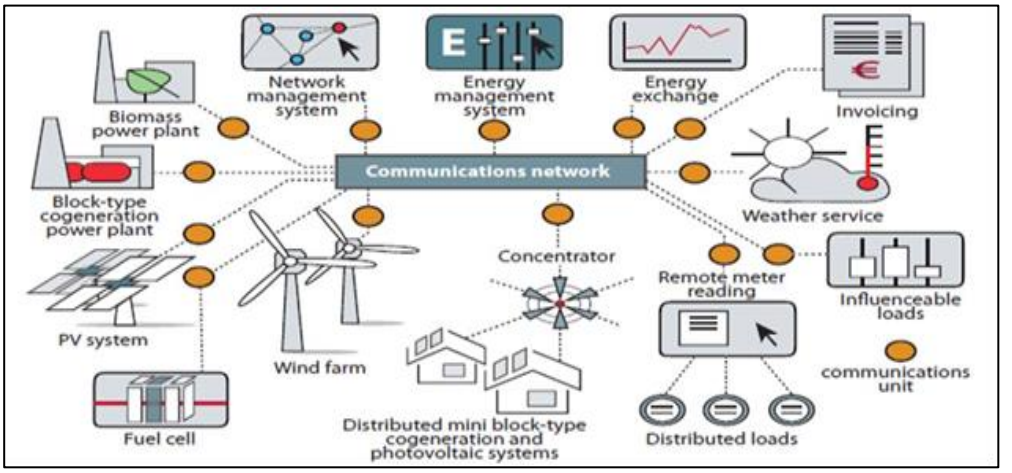

Figure 17.7: Renewable Urban Energy Options
Source: Langer and McNamara (2011)

Green Building

About half of all carbon emissions in cities come from buildings. This is due to a number of factors, including the materials used in their construction, the carbon consumed in their manufacture, the need for cooling or heating during construction, the energy requirements of services like water supply, wastewater treatment, and solid waste disposal, and general inefficiency in these areas. Changes to the internal infrastructure of a building, including its water supply, cooling and heating systems, and treatment of wastewater and solid wastes, follow the initial conversion to greener building materials. Green roofs (and facades), water harvesting systems, and sustainable urban drainage systems are all integral parts of an energy-efficient building's design.

The Environmental Protection Agency (2014) defines green building as "the process of developing, designing, constructing, operating, maintaining, renovating, and deconstructing a building in a way that minimises its negative impacts on the environment and maximises its positive impacts on its occupants and the community at large." The traditional considerations of economy, usability, durability, and comfort in architectural design are augmented and supplemented by this practise. Figure 17.8 depicts how plants are often integrated onto the outside of green buildings (Drew Gangnes, 2008; De Lotto et al., 2015). (EPA, 2014) Green buildings have positive effects on the environment, the economy, and society as a whole. Sustainable site design, water conservation and quality, energy and environment, indoor environmental quality, and resource conservation are the

five main components of green building design, as highlighted by Enterprise Green Communities (2010) and World Bank (2012).

Figure 17.8: A Typical Green Building Design
Source: Drew Gangnes (2008)

Green Community

The concept of a "green community" extends far beyond mere environmental considerations. It includes means of subsistence, livelihood, and way of life. Safe and peaceful living can be found in environmentally conscious areas. The idea of brotherhood underpins all aspects of daily life. Households work together to ensure one other's safety. Green neighbourhoods are warm and welcoming places where segregation is not enforced.

Greener communities can be encouraged by prioritising the following measures: (i) preserving and restoring open space, natural beauty, and critical environmental areas; (ii) creating parks, community gardens, and other public green spaces; (iii) focusing development on preexisting communities; (iv) developing in a compact, mixed-use fashion; (v) constructing neighbourhood streets and trails that promote walking and biking; and (vi) cultivating a strong sense of community.

Strategic Framework for Integrating Green City in Urban Ecological Policy and Development in Nigeria

High environmental performance relative to established benchmarks critical to sustainable urban ecological considerations is the foundation of the Green City Concept. These benchmarks include: i) quality of environmental assets; ii) efficient use of resources; and iii) mitigation and adaptation to risks derived from climate change. Key intervention areas for a sustainable urban ecology in Nigeria can be found in the environmental facets of the green city concept.

Table 17.1: Environmental Dimensions of Green City Approach

General environmental dimension	Targeted environmental dimension
Quality of environmental assets	Air quality
	Water quality
	Land/soil quality
Stock of resources	Water resources availability
	Green space availability
	Biodiversity and eco systems
Climate change risks	Mitigation (greenhouse gas emission)
	Adaptation (resilience to climate change risks)

Source: EBRD (2016)

The ADB (2015) conceptual model depicts the evolution of cities from "basic" to "eco-friendly" to "carbon neutral," with each stage revolving around urban design, infrastructure, and environmental policy. This green city transition model can be used as a tool in the city planning and management processes of Nigerian municipalities. As can be seen in Figure 17.9, the framework is flexible, and some cities may find that their experience and progress fall across multiple categories.

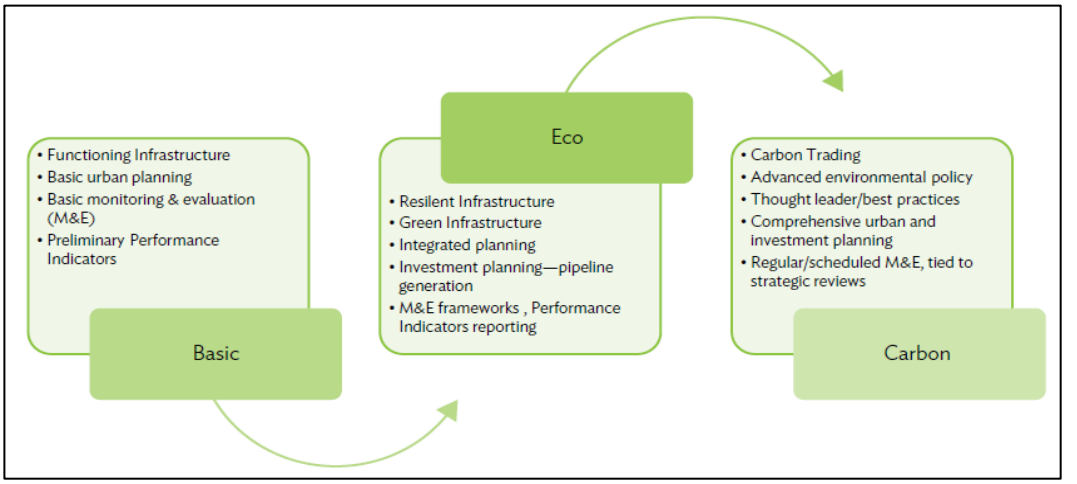

Figure 17.9: Green City Transitions
Source: ADB (2015)

To create a sustainable urban ecosystem, important enablers for green city development include a supportive legislative and regulatory framework, strategic planning, and access to funding. Together, this method and the supporting activities it requires help a city make the shift towards being a green, sustainable community. These facilitative aspects of the green city concept are highly pertinent to ecologically sound city planning. Several different aspects of urban ecology and green city planning are intertwined in this effort. Sustainable urban ecology is a central concern of the green city strategy, which focuses on six core strategic action areas. Consequently, greener, integrated, and sustainable urban growth can be achieved by the widespread adoption of green city techniques as more people gain an appreciation for the value of the green city approach to improving sustainable urban ecology. Table 17.2 provides an overview of the most important strategic green action areas, together with some of the most important considerations and benefits in terms of achieving a sustainable urban ecosystem.

Table 17.2: Key Strategic Action Areas: Major Considerations and Benefits

Key Considerations	Benefits
Low Carbon Transport	
• Integrated urban transport planning • Transit oriented development • Multimodal transport • Low- carbon public transport • Intelligent transport system (ITS) • City greening and green infrastructure	• Livable cities • Reduced emissions • Reduced carbon footprints • Increased quality of life • Increased productivity • Reduced reliance on automobiles
Green Industry Complex	
• Government and institutional capacity • Involvement of producers, community groups, the industry sector • Spatial planning • Monitoring and evaluation frameworks • Training/development and community awareness	• Reduced waste output • Improved operative efficiency • Improved environmental conditions • Potential additional revenue streams • Increased awareness of waste management acts • Improved urban environmental conditions
Energy Efficient Buildings	
• Building design standards • Rating systems/Renewable energy • Planning and building enforcement capacity • Sustainable building materials • Financial incentives	• Reduced energy and water consumption • Healthy buildings/Reduced operating costs • Reduced emissions • Less waste generation • Increased marketing potential
City Greening	
• Urban farming • Heat island • Passive cooling and Green roofs • Living walls/Habitat banking or offset • Ecosystem service • Landscape level planning	• Improved urban environment • Improved air and water quality • Cooler urban centers/Improved visual amenity • Alternative public spaces/Increased biodiversity • Increased connection with natural environment • Reduced disaster risk
Green, Resilient Infrastructure	
• Multifunctional spaces and engineering solutions • Natural processes system-based approach • Short, medium and long-term time horizons • Integrated urban planning/Future expansion needs	• Improved service delivery • Multifunctional spaces • Adaptable and resilient urban spaces • Adaptation of climate change • Improved visual amenity

• Use of technology/Building materials • Eco system services	• Increased biodiversity
Intelligent Systems and Smart Cities	
• Financial /Institutional/Technological capacity • Operation and management • Public safety monitoring • Early warning system (disaster risk management) • Urban service reporting	• Responsive infrastructure/Responsive government • Efficient provision of services • Resilient infrastructure • Improved disaster risk reduction • Improved transparency(government)

Source: ADB (2015)

Community links, such as walkable streets, connections to public amenities and open space, access to recreational facilities, and alternatives to driving, such as bicycling and public transport, are all examples of how green city standards have been incorporating city elements that are beneficial to occupant health. Promoting local food production and economic benefits, both of which are important considerations from a human ecological perspective, is one of the main goals of green city standards that encourage community gardens and other outdoor improvements. Green and healthy physical urban developments can reap greater ecological and sustainability benefits if they are planned and implemented holistically, which can be achieved through continued collaboration between environmental professionals. Therefore, the concept of green city should serve as a central pivot point in advancing and protecting a sustainable urban ecosystem in Nigeria and beyond.

Impediments to the Implementation of the Green City Interventions in Nigeria

The financial and environmental benefits of green cities might be difficult to assess. This is due to the fact that the subjective and psychological values connected to aesthetics, health, wellness, and environmental sustainability that green cities provide cannot be assessed within the confines of existing metrics and parameters, despite having long term life cycle economic benefits. Consequently, urban planners and decision makers in Nigeria may be deterred to prioritise green investments within local, state, and federal budgetary provisions and allocations due to the initial start-up cost of green developments, which may seem higher than conventional techniques. It appears that political leaders in government circles are less enthusiastic about green city initiatives due to the possibility of greater initial expenditures associated with green city initiatives compared to conventional city initiatives. Green practises and investments may be seen as an unpopular

policy direction, but in the long run, their benefits will outweigh those of traditional infrastructure, such as the "stomach infrastructure" that some argue needs more attention.

Furthermore, many Nigerian cities lack master plans or any physical development plan to direct and control urban physical development, which makes it difficult to reap the benefits of green investments through their management and planning. There is a dearth of technical help and training for public agencies, which is crucial so that employees can carry out review and approval obligations and effectively guide development teams navigating new green practices. Staff technical assistance and training, necessary to mainstream the application of green mechanisms and strategies in urban planning and management, is rarely undertaken by many government ministries, departments, and agencies in Nigeria.

Green cities are often advocated for because of the positive environmental impacts they have on the environment through reduced resource and energy consumption, enhanced air quality, reduced ecological footprint in material usage and construction, decreased greenhouse gas emissions, and increased integration of natural elements. However, the political and urban governance structure in Ni makes it difficult to make the careful and continuous investments necessary to put green city plans into acti Implementing the green city method to create sustainable urban ecology is hindered by the lack of continuity in governance that has been found. This is because green city planning is an ongoing cycle that benefits from regular assessment and adjustment.

Human settlements are one of the few ecosystems that are significantly expanding in extent as Nigeria advances further towards urbanized life and settlements. The pace of deforestation and the destruction of urban ecosystems in Nigeria as a result of this growth is extremely high. However, human actions, both deliberate and accidental, have a much greater impact on the function of urban ecosystems than they do on their natural counterparts. Despite recent advances in our understanding of how complex, human-dominated ecosystems function thanks to the field of urban ecology, Nigeria's institutions and lack of a suitable regulatory, policy, and legal framework severely limit the country's ability to put these discoveries into practice.

CONCLUSION

The green city movement should be led by urban planners who are responsible for its promotion, integration, and execution. This calls for environmentally friendly methods to be incorporated into urban land use planning and resource distribution. Only through the deliberate actions of urban development professionals can the benefits of green cities be

realised through the design and intentional execution of green development plans. The green city concepts present a multi-sectoral approach to mitigating the challenges of the twenty-first century city, at a time when the globe is contending with a wide range of problems, from climate change to rapid, unrestrained urbanisation. To better prepare urban development experts, municipal administrators, and decision makers for the innovations and challenges of the future, it is necessary for them to understand and prioritise the green city notion as an important construct of sustainable urban ecology.

Green initiatives, once implemented, can have substantial financial and environmental benefits. It can facilitate the growth of sustainable cities by improving the efficiency with which ecological resources are used and allocated. The urban setting is ideal for the creation, testing, and eventual deployment of groundbreaking environmentally friendly innovations and procedures. These aid the development of specialised groups within green producing industries that rely heavily on specialised knowledge. Because of the economies of scale afforded by urbanisation, cities may make the most of green investments to create a sustainable urban ecosystem. While many nations have begun adopting the green city concept, Nigeria has yet to realise its many advantages. Cities with more green space are better able to withstand the stresses and dangers posed by climate change and other types of natural and man-made calamities. In addition to its many positive effects on the environment, the green city concept also opens up new avenues for social and economic progress and the pursuit of more equitable urban environments. It's an all-around strategy that allows for multiple entry points for intervention. Instead of merely referring to physically greener towns, the term "green city" embraces an eco-friendly and sustainable way of life in all elements of human existence.

For these reasons, the green city concept ought to be incorporated into urban and regional planning curricula, policies, and practises in order to ensure a sustainable urban environment. Moving forward, the green city concept should be ingrained in the undergraduate and graduate curricula of urban professionals, in addition to other areas of professional training. Setting green objectives, green building criteria, and green building codes are all necessary to put the green city concept into action. Green building standards can be harmonised across jurisdictions if local governments use their planning authority to update their building codes. Sustainable urban ecology in Nigeria can be driven by a comprehensive evaluation of existing local, state, and national codes and laws, which would yield a range of policy choices for code change to facilitate the shift towards eco-friendly and carbon neutral urban environments.

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