ADAPTING LEED-ND FOR AFFORDABLE HOUSING IN KENYA: A CASE STUDY OF PARK ROAD NGARA

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(Construction Project Management)

JOMO KENYATTA UNIVERSITY

OF

AGRICULTURE AND TECHNOLOGY

2025

Adapting LEED-ND for Affordable Housing in Kenya: A Case of Park Road Ngara

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A Thesis Submitted in Fulfillment of the Requirements for the Degree of Master of Science in Construction Project Management of the Jomo Kenyatta University of Agriculture and Technology

2025

DECLARATION

This thesis is my original work and has not been presented for a degree in any university.

Signature …… Date: ……...

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This thesis has been submitted for examination with our approval as University supervisors

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DEDICATION

I dedicate my work to my family. A special feeling of gratitude to my loving parents, the late Mr Daniel Wanyonyi and Mrs Elizabeth Wanyonyi. We look up and dedicate this study to our Almighty God who gave the strength, knowledge, wisdom, protection and will to continue and keep positive to finish this research.

ACKNOWLEDGEMENT

First and foremost, praises and thanks to the God Almighty, for His showers of blessings throughout my research work to complete the research successfully.

I would like to express my deep and sincere gratitude to my research supervisors, for allowing me to do research and for providing invaluable guidance throughout this research. It was a great privilege and honor to work and study under their guidance. I am extremely grateful for what they have offered me.

I am extremely grateful to my parents for their love, prayers, care, and sacrifices in educating and preparing me for my future. I am very much thankful to my husband and my daughter for their love, understanding, prayers, and continuing support to complete this research work. Also, I express my thanks to my sisters, brothers, sister-in-law, and brothers-in-law for their support and valuable prayers.

Finally, my thanks go to all the people who have supported me to complete the research work directly or indirectly.

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ABBREVIATIONS AND ACRONYMS

AHP	Affordable Housing Programme
BREEAM	Building Research Establishment Environmental Assessment Method
CaGBC	Canadian Green Building Council
CBD	Central Business District
CFLs	Compact Fluorescent Lamps
CIBSE	Chartered Institute of Building Services
GBC	Green Building Council
GBCA	Green Building Council of Australia
GBCSA	Green Building Council of South Africa
GHGs	Green House Gases
GoK	Government of Kenya
GRIHA	Green Rating for Integrated Habitat Assessment
HVAC	Heating, Ventilation and Air Conditioning
IEA	International Energy Agency
IPCC	Inter Governmental Panel on Climate Change Report
IT	Information Technology
KNBS	Kenya National Bureau of Statistics
LED	Light Emitting Diodes

LEED-ND	Leadership in Energy and Environmental Design Neighbourhood Development
NEMA	National Environmental Management Authority
SBCI	Sustainable Buildings for Climate Change Initiative
SPSS	Statistical Program for Social Sciences
UN HABITAT	United Nations Habitat
UNEP	United Nations Environmental Program
USGBC	United States Green Building Council

ABSTRACT

This research, guided by sustainability theory and green neighborhood development principles, addresses the limitations of existing affordable housing approaches in Kenya by introducing an evaluation tool that goes beyond simply measuring affordability. While the Kenyan government has made affordable housing a key priority, as evidenced by the BETA agenda and initiatives like the Park Road Ngara Affordable Housing Project, previous efforts have often overlooked long-term sustainability considerations, resulting in projects that fail to meet the needs of residents and communities over time. This study aims to bridge this gap by: Assessing and analyzing existing tools for evaluating affordable housing projects, Identifying key LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development) standards that can enhance the sustainability, affordability, and livability of such projects in the Kenyan context, and formulate an assessment tool tailored to Kenya's unique circumstances. Findings reveal that LEED-ND, while globally recognized for its comprehensive approach to evaluating sustainability, requires careful adaptation to the local context to ensure feasibility and effectiveness. The study identified several key LEED-ND standards, including provisions for walkable streets, mixed-use neighborhoods, reduced parking footprints, access to public transportation, and community outreach and involvement, as particularly relevant for enhancing the sustainability, affordability, and livability of affordable housing projects in Kenya. The proposed assessment tool, incorporating elements of green neighborhood development, offers a framework for evaluating future affordable housing projects, considering not only environmental sustainability but also economic viability and social equity, consistent with BETA's principles of community empowerment and sustainable development. The study recommends incorporating post-occupancy assessments into the LEED-ND framework to better evaluate resident satisfaction, advocating a shift from a prescriptive approach to a performance-based evaluation.

Areas for future study include:

- Evaluating the correlation between walkability, access to public transportation, and resident health outcomes.
- Examining the effectiveness of community engagement strategies in promoting resident satisfaction and project success.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Sustainable urban development has become an urgent global priority as cities strive to create environments that balance environmental responsibility with social and economic needs (United Nations, 2019). In Kenya, the push for affordable housing intersects with the growing necessity for environmentally conscious construction practices. This alignment is evident in initiatives like the Park Road Affordable Housing Project, which aims to provide decent housing while minimizing environmental impact (Ministry of Housing, 2020).

The demand for affordable housing in Kenya, however, extends beyond the provision of shelter. It is closely tied to the country's broader economic development objectives, as articulated in Kenya's Vision 2030 and the Bottom-Up Economic Transformation Agenda (BETA) (Government of Kenya, 2007; Treasury of Kenya, 2022). BETA emphasizes that sustainable and inclusive growth depends on empowering communities from the grassroots level. Affordable housing serves as a cornerstone of this agenda by fostering economic stability and upward mobility (Treasury of Kenya, 2022).

While Kenya has made notable strides in affordable housing projects, there remains a gap in robust tools to evaluate the effectiveness of these developments, particularly in terms of sustainability and neighborhood impact. Many low-cost housing initiatives fall short of meeting comprehensive sustainability criteria, often resulting in outcomes that are not environmentally or socially viable over the long term (Kariuki et al., 2021).

This research examines existing frameworks for assessing sustainable neighborhoods, focusing on their applicability to Kenya's affordable housing projects. The Leadership in Energy and Environmental Design (LEED) system, specifically the LEED for Neighborhood Development (LEED-ND) rating system, is

central to this study due to its global recognition, adaptability, and comprehensive approach to evaluating sustainability (USGBC, 2021). LEED-ND aligns with Kenya's Vision 2030, which prioritizes sustainable urbanization by incorporating principles of smart growth, urbanism, and green building at the neighborhood level (Government of Kenya, 2007).

The study seeks to develop an assessment tool tailored to Kenya's unique context, leveraging the LEED-ND framework. This tool aims to evaluate not only the environmental sustainability of affordable housing projects but also their contribution to economic growth and social equity, consistent with BETA's principles (Treasury of Kenya, 2022). By doing so, this research aspires to enrich the discourse on sustainable urban development in Kenya and provide a framework for evaluating current and future affordable housing projects, ensuring they contribute to the long-term well-being of communities

1.2 Statement of the Problem

Affordable housing has been a key agenda of the Kenyan government, including initiatives such as the "Big Four" agenda, which targeted constructing a significant number of housing units by 2022. Ideally, affordable housing should provide more than shelter; it should ensure quality, sustainability, and liveability, creating vibrant neighborhoods that contribute to social equity, economic growth, and environmental resilience. Sustainable housing integrates aspects of sustainability theory, emphasizing the Triple Bottom Line—economic viability, environmental sustainability, and social equity. This framework underscores that housing is not merely a product but a system within a broader urban and ecological context.

Despite the government's efforts, the current approach often prioritizes quantity over quality, focusing predominantly on affordability as a ratio of housing costs to income. This narrow definition overlooks critical factors such as the quality of housing, integration into the urban fabric, and the social and economic well-being of residents. Projects like the Park Road Ngara development have highlighted this gap, where affordability metrics fail to account for broader sustainability principles or the long-term viability of neighborhoods.

The Bottom-Up Economic Transformation Agenda (BETA) provides a conceptual foundation for rethinking affordable housing, emphasizing community empowerment and sustainable development. BETA envisions a housing model that creates thriving, integrated neighborhoods, fosters local economic opportunities, and enhances residents' well-being. This alignment with the broader economic transformation agenda positions housing as a catalyst for socio-economic and environmental sustainability.

Failure to address these gaps has significant consequences. The persistence of suboptimal housing projects risks urban sprawl, and environmental degradation. Evidence from similar contexts shows that neglecting quality and sustainability in housing development leads to increased costs of retrofitting, reduced economic productivity, and exacerbated social inequalities. This research aims to address these challenges by developing an evaluation tool that integrates LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development) standards with Kenya's unique housing context. The study identifies relevant LEED-ND credits that enhance sustainability, affordability, and liveability, and proposes a tailored framework informed by BETA's principles. By aligning housing initiatives with sustainable urban development goals, this research seeks to transform affordable housing into a driver of long-term socio-economic and environmental well-being in Kenya.

1.3 Purpose of the Study

This study is to develop an assessment framework that can be used to evaluate affordable housing projects in Kenya.

1.4 Research Objectives

1.4.1 Main Objective

To evaluate the effectiveness of neighborhood sustainability assessment tools in enhancing affordable housing sustainability in the present-day context, using the Park Road Affordable Housing Project as a case study.

1.4.2 Specific Objectives

1. To assess and analyze existing tools for evaluating affordable housing projects, focusing on specific criteria that influence livability, affordability, and community resilience.
2. To identify key LEED-ND standards that enhance sustainability, affordability, and liveability in affordable housing, using insights from the Park Road Ngara case study to develop a tailored evaluation framework for Kenya
3. To formulate an assessment tool for affordable housing projects in Kenya that integrates relevant LEED-ND standards and insights from affordable housing initiatives

1.5 Research Questions

Objective 1: Assess and analyze existing tools for evaluating affordable housing projects, focusing on specific criteria that influence livability, affordability, and community resilience.

Research Question 1: What are the key criteria within LEED-ND that are most relevant to enhancing livability, affordability, and community resilience in affordable housing projects within the Kenyan context?

- This question narrows down the focus to LEED-ND and seeks to identify specific criteria that directly contribute to the three key aspects of affordable housing in Kenya.

Objective 2: Identify key LEED-ND standards that enhance sustainability, affordability, and livability in affordable housing, using insights from the Park Road Ngara case study to develop a tailored evaluation framework for Kenya.

- **Research Question 2**: How can the identified LEED-ND criteria be adapted and integrated into a tailored evaluation framework for affordable housing projects in Kenya, considering the insights from the Park Road Ngara case study?

○This question directly addresses the adaptation of LEED-ND criteria and the development of the framework, using the case study findings as a guiding force.

Objective 4: Formulate an assessment tool for affordable housing projects in Kenya that integrates relevant LEED-ND standards and insights from affordable housing initiatives.

●**Research Question 4:** What are the essential components and metrics of a practical assessment tool for affordable housing projects in Kenya, incorporating the adapted LEED-ND criteria and insights from local affordable housing initiatives?

○This question focuses on the practical aspects of designing the assessment tool, outlining its components, metrics, and how it incorporates the adapted LEED-ND criteria.

1.6 Significance of the Study

The Constitution of Kenya strongly upholds the right to housing. Article 43 (1b) explicitly states that each person is entitled to accessible and suitable housing, along with reasonable sanitation standards.Given the pressing housing challenges faced by the country, Kenya has taken proactive steps to enhance the availability of affordable housing for its citizens. In an effort to address this disparity, the Kenyan government implemented the Affordable Housing Programme (AHP) as a fundamental component of its "Big Four" initiatives, designed to promote sustained economic development.

Recognizing the need for a more comprehensive approach, it is imperative to transition from a sole focus on environmental building assessments to Neighborhood Sustainability Assessment, as proposed by Berardi (2012). The LEED-Neighborhood Development rating system was created to evaluate sustainable practices at the neighborhood level, rather than on an individual building basis. The widespread adoption of this sustainable rating system has significantly encouraged

the implementation of sustainable neighborhood design practices worldwide. As the LEED-ND neighborhood development rating system gains acceptance both nationally and internationally, it serves as a potential benchmark for green neighborhood practices that other countries can use to establish their green building guidelines (Howe & Gerrard, 2010).

1.7 Study Justification

This study explores the LEED-ND rating system as a means of assessing green design at the neighborhood scale, with the potential to fulfill people's livability requirements. Over time, sustainability principles have shifted from a broader, macro perspective to a more localized, meso (neighborhood scale), and micro (building scale) focus. The conventional approach to determining affordability, which relies on the ratio of housing costs to income, might classify certain areas as affordable solely due to their low costs. However, ensuring sustainability has been a critical challenge for housing projects, as highlighted by Adhiambo in 2012. This approach fails to account for the quality of housing or the environmental context in which the housing is situated. Consequently, this simplistic perspective may not be sustainable when considering affordable housing.

To address this issue, there is a growing recognition of the need to shift from evaluating individual buildings' environmental aspects to Neighborhood Sustainability Assessment, as advocated by Berardi (2012). Housing projects possess the potential to make a more substantial impact by addressing needs beyond just housing provision.

It is essential to gain a better understanding of neighborhood sustainability assessment tools in the context of Kenya and determine whether these tools can effectively enhance the sustainability of affordable housing programs in Kenya without having to start from scratch, as suggested by Szibbo in 2015.

1.8 Assumptions

The study operated under several underlying assumptions, which are outlined as follows:

1. It is assumed that the findings from the Park Road Ngara case study can provide insights and lessons that can be analytically generalized to other affordable housing projects in Kenya with similar contexts, such as those located in urban areas with comparable demographics and infrastructure.
2. Challenges associated with obtaining architectural drawings for the developments were anticipated, but these were overcome by conducting on-site measurements and creating sketches.
3. The combined use of the structured questionnaire and the LEED-ND-based observational checklist is assumed to comprehensively address all aspects of the research questions.
4. While acknowledging the potential for biases inherent in self-reported data, it is assumed that the data collected through the survey provides a reasonable representation of the awareness and perspectives of the respondents. Strategies to mitigate biases include using clear and unbiased language in the survey instrument, ensuring respondent anonymity and confidentiality, and triangulating survey findings with data from other sources.
5. While recognizing the potential for researcher or research process influence, steps were taken to minimize the impact of preconceived notions or biases on respondent answers. These strategies include using neutral language in the survey instrument, implementing standardized procedures for survey administration, and, where applicable, blinding respondents to the specific research hypotheses.

1.9 Scope and Limitation of the Study

1.9.1 Spatial-Temporal Scope

The study covered Nairobi and considered affordability in the home-ownership mortgage housing sector more so in the already developed park road estate. Nairobi

is chosen because it is the largest and fastest-growing city in Kenya. The unit of analysis adopted was the affordable housing project.

1.9.2 Theoretical Scope

The theory of Green Neighbourhood Development formed the theoretical underpinning of the study. The key constructs of the study were Green Neighbourhood Development and affordable housing. The primary variables encompassed the following green attributes: Walkable Streets, Compact Development, Mixed-Use Neighbourhoods, Housing Types and Affordability, Reduced Parking Footprint, Connected and Open Community, Transit Facilities, Transportation Demand Management, Access to Civic and Public Space, Access to Recreation Facilities, Community Outreach and Involvement, Tree-Lined and Shaded Streetscapes, and Neighbourhood Schools.

1.9.3 Methodological Scope

The study was a descriptive case study research. It used both qualitative and quantitative approaches. The study relied on an observational checklist to collect data.

1.9.4 Study Limitations

1. The study was limited to the urban housing sector because urban housing problems in Kenya are more severe than rural housing problems both in intensity and complexity.
2. There is minimal available data on Green Neighborhood Development.
3. The findings and recommendations of the study are not open to generalization due to the case study research design and purposive sampling undertaken.

1.10 Study Outline

Chapter One:

This chapter functions as an introduction to the research, offering a background on green building and green building rating systems, with a specific emphasis on the Leadership in Energy and Environmental Design Neighbourhood Development (LEED-ND) rating system. It also delves into the rationale behind the study, its objectives, research questions, limitations, assumptions, significance, and provides definitions of terms and acronyms.

Chapter Two:

This chapter delves into the literature review related to the research theme. It begins by defining what green building entails and then explores various green initiatives in the Kenyan building industry. The chapter also discusses the adoption and rating attributes of the LEED-ND green building system. It further includes sections on benchmarking LEED-ND rating system criteria against typical Kenyan building practices, the adoption of LEED green building guidelines outside of the U.S. (with a case study of LEED-India), and an overview of other major international green building rating systems, including the World Green Building Council. The chapter concludes with a summary of key insights gleaned from the literature review.

Chapter Three:

This chapter outlines the research methodologies employed for data collection. It covers the genesis of the research agenda, rationale for the research design, research strategy, and the use of focus group research techniques. The chapter also discusses various processes involved, such as instrument development, validation, population and sample selection, pilot-testing of instruments, reliability assessment, data collection procedures, data analysis procedures, and provides a summary of the methodology used.

Chapter Four:

This chapter provides a thorough analysis of the collected data and the resulting outcomes. It encompasses an exploration of the demographic profiles of survey respondents, an analysis of the research questions, and a concise summary of the findings.

Chapter Five:

The concluding chapter summarizes the study by presenting an overview of the research, restating the research questions and their corresponding findings, drawing implications from the research, engaging in further discussions, addressing the study's limitations, and providing recommendations for future research directions.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The integration of green principles into urban development has gained global attention as cities seek to create sustainable living environments. In Kenya, the drive to provide affordable housing has aligned with the growing need for environmentally conscious construction, resulting in projects like the Park Road Affordable Housing Project. However, despite significant progress in these initiatives, there remains a lack of robust tools to evaluate the success of such developments, particularly regarding their sustainability and overall impact on neighborhoods.

This literature review aims to explore the existing frameworks for assessing green neighborhoods, with a focus on their applicability to affordable housing in Kenya. By analyzing existing evaluation tools, such as the Leadership in Energy and Environmental Design (LEED) system, and examining their suitability for the local context, this review seeks to identify gaps that may hinder the effective evaluation of such projects. Ultimately, the research will contribute to the development of an assessment tool tailored to the Kenyan setting, specifically designed to measure the sustainability of affordable housing developments like Park Road.

This review will primarily focus on the Leadership in Energy and Environmental Design (LEED) rating system, despite the existence of other frameworks such as BREEAM and Green Star. LEED has been selected due to its global recognition and adaptability to various contexts, including developing countries like Kenya. Moreover, its comprehensive approach to evaluating sustainable practices—from energy efficiency to community liveability—makes it particularly suitable for assessing affordable housing projects like Park Road. However, the review will also consider how other rating systems could inform the development of a more localized tool for evaluating green neighborhoods in Kenya.

2.2 Definition and Overview of Green Building and Sustainable Neighborhood Development

Green building refers to the practice of designing, constructing, and operating buildings in ways that reduce their environmental impact while improving the health and well-being of occupants (U.S. Green Building Council, 2019). This approach emphasizes resource efficiency, energy savings, waste reduction, and improved indoor environmental quality. By utilizing sustainable materials, minimizing energy consumption, and reducing carbon footprints, green building practices aim to mitigate the environmental harm typically associated with traditional construction methods (Kibert, 2016).

Sustainable neighborhood development, on the other hand, broadens the focus beyond individual buildings to encompass entire communities. This concept integrates environmental, social, and economic principles to create urban spaces that promote livability, equity, and ecological balance (Newman & Jennings, 2012). Sustainable neighborhoods prioritize walkability, public transportation, green spaces, and a mix of land uses to foster compact, resilient, and inclusive communities. These developments are designed to meet current needs without compromising the ability of future generations to thrive (Barton, 2000).

The core principle behind both green building and sustainable neighborhood development is resource optimization while enhancing the quality of life. While the benefits of green building practices are well-documented—such as reduced utility costs, improved air quality, and reduced environmental degradation—adapting these practices to neighborhood scale is more complex (Ding, 2008). Sustainable neighborhoods require the integration of multiple systems (e.g., transport, water, energy) and involve a broader range of stakeholders.

The literature highlights global case studies such as Vauban in Germany and Hammarby Sjöstad in Sweden, which showcase successful sustainable neighborhoods (Williams, 2017). However, these examples primarily come from developed countries with strong economic and policy frameworks. The question remains: how applicable are these models in developing countries like Kenya, where

financial constraints, regulatory gaps, and social challenges present significant barriers? Furthermore, the intersection of affordability and sustainability is particularly critical in developing contexts, where the need for cost-effective housing may compete with environmental goals (Choguill, 2007).

Kenya's rapid urbanization and growing population demand innovative solutions for housing that balance affordability with sustainability. The case of Park Road offers a unique opportunity to explore how green neighborhood principles can be adapted to affordable housing projects in the Kenyan context. This raises a critical research question: Can green building practices be scaled effectively to neighborhood developments without compromising the affordability and social inclusivity required in such projects?

By situating the discussion within the Kenyan context, this research seeks to bridge the gap between global best practices and local realities, contributing to the development of a context-specific assessment tool for evaluating green neighborhoods.

2.3 Contribution of Green Neighborhoods to Environmental Sustainability, Social Equity, and Economic Efficiency

2.3.1 Environmental Sustainability

Green neighborhoods significantly contribute to environmental sustainability by promoting resource efficiency, reducing greenhouse gas emissions, and enhancing biodiversity. The integration of energy-efficient buildings, sustainable transport options, and waste management systems minimizes the overall ecological footprint of urban areas (Berardi, 2013). Key environmental strategies such as energy-efficient lighting, renewable energy sources (e.g., solar panels), water conservation systems, and green spaces play a vital role in reducing resource consumption and environmental degradation (Sovacool, 2014).

One of the most impactful features of green neighborhoods is the promotion of sustainable transportation systems, such as biking and public transit, which help

reduce dependence on personal vehicles and decrease air pollution (Ewing & Cervero, 2010). Additionally, the inclusion of green spaces and urban vegetation enhances urban biodiversity, improves air quality, and mitigates the urban heat island effect, making these neighborhoods more resilient to climate change (Gill, Handley, Ennos, & Pauleit, 2007).

While green neighborhoods have shown significant environmental benefits in developed countries, the challenge in a context like Kenya is ensuring these sustainability goals are met within affordable housing projects. For example, energy-efficient systems and renewable energy technologies often have high upfront costs, making them less accessible to low-income populations. This research seeks to explore how green neighborhood principles, such as those in Park Road, can be adapted to balance both affordability and environmental goals in the Kenyan context.

2.3.2 Social Equity

Green neighborhoods contribute to social equity by promoting inclusive, accessible, and healthy environments. They are designed to accommodate diverse populations by providing affordable housing options, access to public amenities, and green spaces that enhance quality of life (Barton, 2000). Social equity in these developments achieved through a focus on community building, ensuring that all residents, regardless of socioeconomic status, have access to high-quality urban environments that support well-being, health, and social inclusion (Agyeman, 2005).

Public spaces, pedestrian-friendly streets, and social infrastructure such as schools, healthcare facilities, and recreational areas encourage social cohesion, making green neighborhoods more inclusive (Barton, 2000). In the case of affordable housing developments like Park Road, social equity is particularly important because it ensures that marginalized communities benefit from the same environmental and social advantages as wealthier populations.

In Kenya, where income inequality is pronounced, green neighborhoods present a unique opportunity to address social equity by ensuring that affordable housing projects do not sacrifice quality or sustainability. However, achieving this requires

careful planning and policy support to integrate green building principles without pushing up costs for low-income residents. This research investigates how social equity can be maintained in green affordable housing projects while meeting environmental goals.

2.3.3 Economic Efficiency

Green neighborhoods offer long-term economic benefits through reduced operational costs, energy savings, and increased property values. Energy-efficient designs, sustainable materials, and water conservation systems reduce utility costs for residents, making housing more affordable in the long run (Kats, 2010). Moreover, green neighborhoods are often associated with increased economic activity, such as the creation of jobs in green industries (Haines et al., 2009).

While the upfront costs for green building and infrastructure may be higher, the long-term savings and economic benefits often outweigh initial expenses (Sullivan & Ward, 2012). For instance, energy-efficient systems reduce energy consumption, leading to lower utility bills for residents. Additionally, green developments often attract higher property values and rental returns due to their environmental and health benefits (Eichholtz, Kok, & Quigley, 2010).

In the context of Kenya, particularly within affordable housing, the challenge is to ensure that the long-term economic benefits of green neighborhoods are realized without making housing unaffordable in the short term. This research will evaluate the economic efficiency of green neighborhoods like Park Road, focusing on the balance between upfront costs and long-term savings, especially for low-income residents.

2.4 The Intersection of Affordability and Sustainability

2.4.1 Affordable Housing in the Nairobi Context

The definition of affordability in the housing sector in Nairobi generally follows more universal interpretations of the term, including the income-cost ratio definition that states that affordable housing should not cost more than 30% of a household's

income (CAHF, 2020; Government of Kenya, 2018; Gachanja et al., 2023). The Centre for Affordable Housing Finance in Africa (CAHF) states that affordability in the Nairobi housing industry is affected by factors such as inadequate frameworks, lacking housing supply, high costs of land and construction, as well as limited access to financing options. In a more general sense, it is likewise defined as a household's ability to pay for adequate and decent housing without experiencing financial burdens or compromising their ability to meet their basic needs (County Government of Nairobi, 2014; Gachanja et al., 2023; NCC & JICA, 2014). In 2018, the Kenyan government set up an Affordable Housing Program (AHP) that aims to supply 250,000 affordable units per year to respond to the high demand in Kenya with an overarching target of providing affordable housing to all citizens by 2030 (Housing and Urban Ministry, 2017; Government of Kenya 2018). Furthermore, a National Housing Corporation (NHC) whose aim is to provide affordable housing to the local low- and middle-income population was set up in the 1950s. The NHC defines affordable housing in more quantitative terms, asserting that it should cost between KES 600,000 and KES 3 million (approximately €4,000 to €20,000), and is targeting households with a monthly income of KES 50,000 to KES 150,000 (approximately €300 to €1000) (Housing and Urban Ministry, 2017; Government of Kenya 2018). One of the Kenyan government's quantitative definitions sets a lower threshold of affordability by defining is as being accessible to households with a monthly income of KES 50,000 (~€300) or less per month, and with a maximum mortgage repayment period of 25 years (Gachanja et al., 2023; Government of Kenya, 2018; NCC & JICA, 2014). The definitions vary in the literature, and these figures serve as a reference to understand what affordability is understood as in the Kenyan context.

2.4.2 Affordable Housing and Sustainability

Sustainable housing is a critical area of focus as urban populations grow and environmental challenges intensify. The concept of sustainability in housing is multi-dimensional, encompassing environmental, economic, and social aspects. This review explores how these pillars are integrated into the development of green neighborhoods, with a particular focus on their relevance to affordable housing projects.

Housing plays a pivotal role in determining the quality of life and well-being of individuals and communities. The location of homes, their design and construction quality, and their integration into the environmental, social, cultural, and economic frameworks of communities significantly impact daily living, health, safety, and overall well-being (World Health Organization, 2022). Given the long lifespan of housing structures, these factors have profound implications for both current and future generations (Smith, 2021).

The interaction between housing and the environment is multifaceted. On one hand, the construction and operation of housing require substantial natural resources—such as land, energy, water, and building materials—and generate waste along with air and water pollution (Jones & Brown, 2020). On the other hand, housing is subject to various environmental impacts and hazards, including those related to natural disasters and climate change (Miller, 2019). These environmental considerations are critical in the context of sustainable development.

Policies aimed at sustainable housing address this intricate relationship by encompassing a range of conditions necessary to achieve sustainability. These policies typically address the following dimensions of sustainability: environmental impact and climate change, durability and resilience of homes, economic interactions within the housing sector and their broader economic implications, and the cultural and social fabric of communities. Additionally, they consider how housing contributes to poverty alleviation, social development, and improvements in the quality of life (UN Habitat, 2021).

While sustainable housing is frequently associated with wealth and affluence, it is crucial to recognize that sustainability does not necessarily correlate with high cost. True sustainability in housing involves inclusivity and affordability, ensuring that all individuals have access to environmentally friendly and socially responsible living spaces (Jones & Brown, 2020). Addressing affordability is a fundamental requirement for achieving transformative sustainable housing; however, affordability alone does not suffice. Affordable homes must also avoid adverse environmental and social impacts to be genuinely sustainable (Smith, 2021).

The concept of sustainable housing should extend beyond merely resource-efficient "green buildings." It is essential to adopt a comprehensive approach that integrates residential practices into broader urban and settlement systems, enhancing both social and environmental aspects of living spaces (Miller, 2019). This holistic view aligns with the principles of sustainable development, which emphasize the interconnectedness of various sustainability dimensions.

Sustainable affordable housing, therefore, can be seen as an extension of the "adequate shelter-for-all" strategy outlined in the Habitat Agenda. This approach seeks to blend affordability with other sustainability criteria, ensuring that housing contributes positively to both individual well-being and the environment (UN Habitat, 2021).

2.4.3 Affordable Housing Challenges in Developing Countries

While the challenge of providing sustainable affordable housing is a global concern, it is particularly pressing in developing regions. These areas are experiencing rapid and sustained urbanization due to population growth and migrations from rural to urban settings (World Bank, 2021). This surge in urbanization escalates the demand for affordable housing and urban infrastructure, placing significant strain on city resources and services.

In many parts of Asia, Africa, and Latin America, this urban expansion is often linked to the proliferation of slums and informal settlements. These areas frequently lack basic infrastructure and sanitation, and are constructed with minimal adherence to formal planning and building regulations (Smith & Johnson, 2022). Consequently, the quality of housing in these regions is often compromised, highlighting the urgent need for sustainable solutions that address both affordability and infrastructure deficits.

Even where governments successfully address issues related to slums and energy access, significant challenges persist due to the immense volume of housing that must be constructed or renovated to accommodate growing populations and rectify existing housing deficiencies. For instance, in China, the amount of new building

floor space anticipated by the end of the next decade is projected to match the entire existing building stock of the United States today (UN-Habitat, 2011). If this new housing is not developed with rigorous attention to sustainability and efficiency, it risks imposing a substantial new burden on the environment and climate. Additionally, it could exacerbate economic inefficiencies and social shortcomings, undermining progress toward sustainable development.

Despite significant progress in reducing the growth of slums over the past decade in many developing regions, and the substantial knowledge and capacity gained in this area, there is a growing recognition that housing policies must now integrate both affordability and sustainability (UN-Habitat, 2011). In regions where conditions and resources pose greater challenges, such as Sub-Saharan Africa, it is crucial to shift the conception of housing to encompass all dimensions of sustainability. This shift is necessary to design housing solutions that are not only affordable but also environmentally and socially sustainable, ensuring they contribute positively to the overall development and well-being of communities (Smith & Johnson, 2022).

2.4.4 Why Sustainable Affordable Housing?

Sustainable affordable housing presents a wide range of opportunities to advance economic development, environmental stewardship, quality of life, and social equality while addressing complex challenges such as population growth, urbanization, slums, poverty, climate change, and lack of access to sustainable energy, and economic uncertainty (Jones & Brown, 2020).

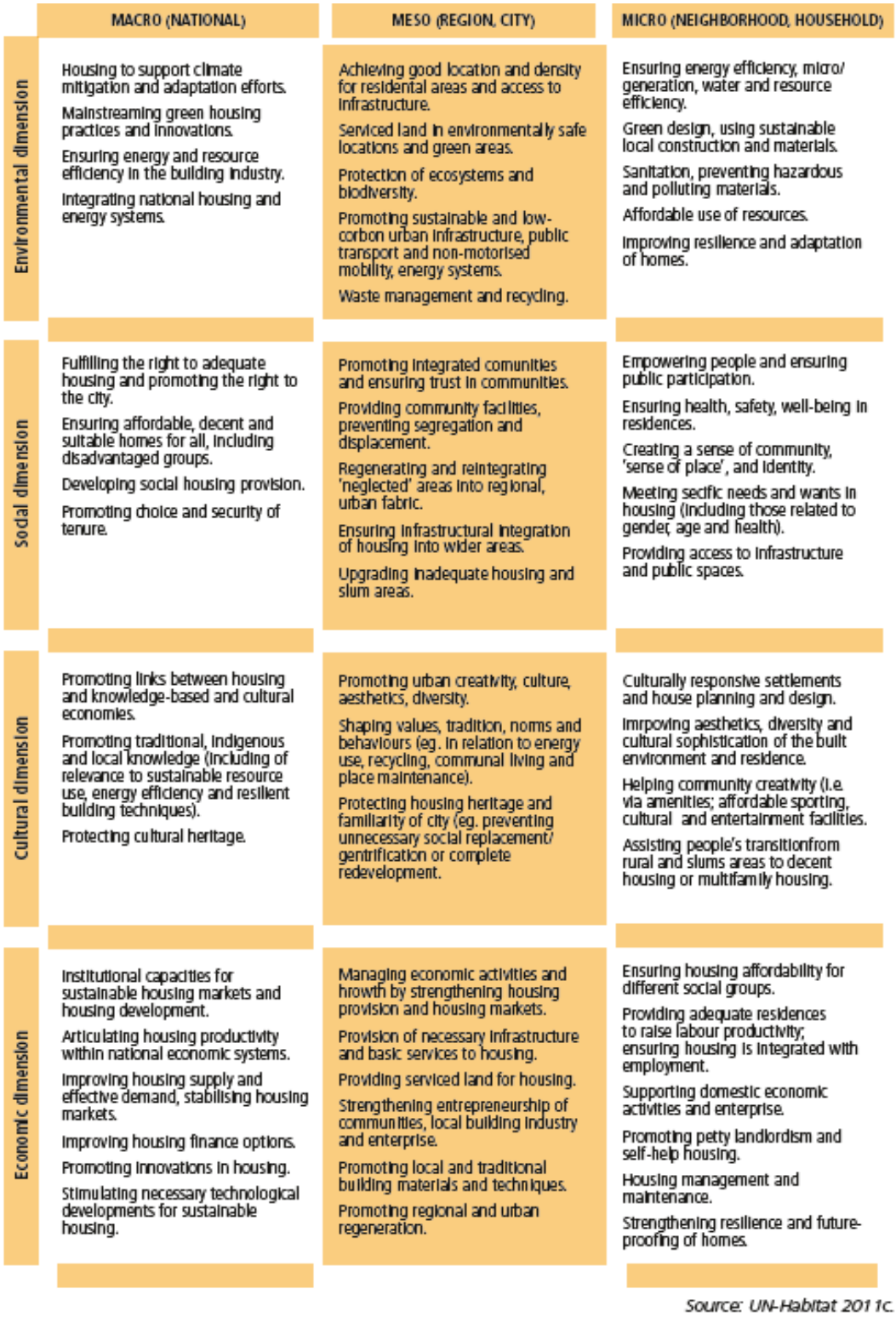
In many developing countries, the integration of social, cultural, environmental, and economic aspects of housing is often lacking. Typically, affordable housing is evaluated primarily on cost, with environmental and social issues—such as community preferences, lifestyles, and cultural aspirations—addressed separately or overlooked entirely (Smith, 2021). This fragmented approach can lead to vulnerabilities and inadequate housing conditions.

For instance, there is a notable disconnect between policies for "normal housing" and "affordable housing," which often operate in isolation from one another. Programs

designed for the poor, slum upgrading, and refugee housing frequently result in standard, low-quality housing built out of necessity rather than choice. These developments often consist of large-scale, uniform structures that are economically efficient but may be poorly situated away from employment and services, failing to meet diverse household needs and values. Cost-cutting in construction can lead to the use of substandard materials and techniques, resulting in short-lived, unhealthy living environments, often referred to as "sick house syndrome" (Miller, 2019). Furthermore, these initiatives frequently neglect comprehensive considerations of sustainability, undermining their effectiveness in providing long-term solutions.

When planned and constructed within an integrated sustainability framework, housing can become more accessible to low-income households while also addressing their diverse social and cultural needs. Such housing offers multiple benefits, including improvements in physical and mental health, enhanced safety, economic advantages, and positive impacts on both the built and natural environments (Jones & Brown, 2020).

Sustainable housing not only supports long-term durability but also represents a prudent investment for governments and other stakeholders. By incorporating sustainable practices, these homes are designed to withstand the test of time, reducing the need for frequent repairs and replacements, and thereby offering greater value over the long term (Smith, 2021).



	MACRO (NATIONAL)	MESO (REGION, CITY)	MICRO (NEIGHBORHOOD, HOUSEHOLD)
Environmental dimension	Housing to support climate mitigation and adaptation efforts. Mainstreaming green housing practices and innovations. Ensuring energy and resource efficiency in the building industry. Integrating national housing and energy systems.	Achieving good location and density for residential areas and access to infrastructure. Serviced land in environmentally safe locations and green areas. Protection of ecosystems and biodiversity. Promoting sustainable and low-carbon urban infrastructure, public transport and non-motorised mobility, energy systems. Waste management and recycling.	Ensuring energy efficiency, micro/ generation, water and resource efficiency. Green design, using sustainable local construction and materials. Sanitation, preventing hazardous and polluting materials. Affordable use of resources. Improving resilience and adaptation of homes.
Social dimension	Fulfilling the right to adequate housing and promoting the right to the city. Ensuring affordable, decent and suitable homes for all, including disadvantaged groups. Developing social housing provision. Promoting choice and security of tenure.	Promoting integrated communities and ensuring trust in communities. Providing community facilities, preventing segregation and displacement. Regenerating and reintegrating 'neglected' areas into regional, urban fabric. Ensuring infrastructural integration of housing into wider areas. Upgrading inadequate housing and slum areas.	Empowering people and ensuring public participation. Ensuring health, safety, well-being in residences. Creating a sense of community, 'sense of place', and identity. Meeting secific needs and wants in housing (including those related to gender, age and health). Providing access to infrastructure and public spaces.
Cultural dimension	Promoting links between housing and knowledge-based and cultural economies. Promoting traditional, indigenous and local knowledge (including of relevance to sustainable resource use, energy efficiency and resilient building techniques). Protecting cultural heritage.	Promoting urban creativity, culture, aesthetics, diversity. Shaping values, tradition, norms and behaviours (eg. in relation to energy use, recycling, communal living and place maintenance). Protecting housing heritage and familiarity of city (eg. preventing unnecessary social replacement/ gentrification or complete redevelopment.	Culturally responsive settlements and house planning and design. Imrpoving aesthetics, diversity and cultural sophistication of the built environment and residence. Helping community creativity (i.e. via amenities; affordable sporting, cultural and entertainment facilities. Assisting people's transitionfrom rural and slums areas to decent housing or multifamily housing.
Economic dimension	Institutional capacities for sustainable housing markets and housing development. Articulating housing productivity within national economic systems. Improving housing supply and effective demand, stabilising housing markets. Improving housing finance options. Promoting innovations in housing. Stimulating necessary technological developments for sustainable housing.	Managing economic activities and hrowth by strengthening housing provision and housing markets. Provision of necessary infrastructure and basic services to housing. Providing serviced land for housing. Strengthening entrepreneurship of communities, local building industry and enterprise. Promoting local and traditional building materials and techniques. Promoting regional and urban regeneration.	Ensuring housing affordability for different social groups. Providing adequate residences to raise labour productivity; ensuring housing is integrated with employment. Supporting domestic economic activities and enterprise. Promoting petty landlordism and self-help housing. Housing management and maintenance. Strengthening resilience and future-proofing of homes.

Source: UN-Habitat 2011c.

Figure 2.1: Multi-Scale Framework for Sustainable Housing Policies

2.4.5 Social and Cultural Sustainability of Housing

Social sustainability in housing involves creating affordable, high-quality, inclusive, and diverse residential environments that are secure and healthy. These homes and communities should be well-integrated into broader socio-spatial systems, including urban and national contexts. Cultural sustainability, on the other hand, incorporates cultural worldviews, values, norms, traditions, and lifestyles, thereby supporting the dignity and communal life of occupants (Jones & Brown, 2020).

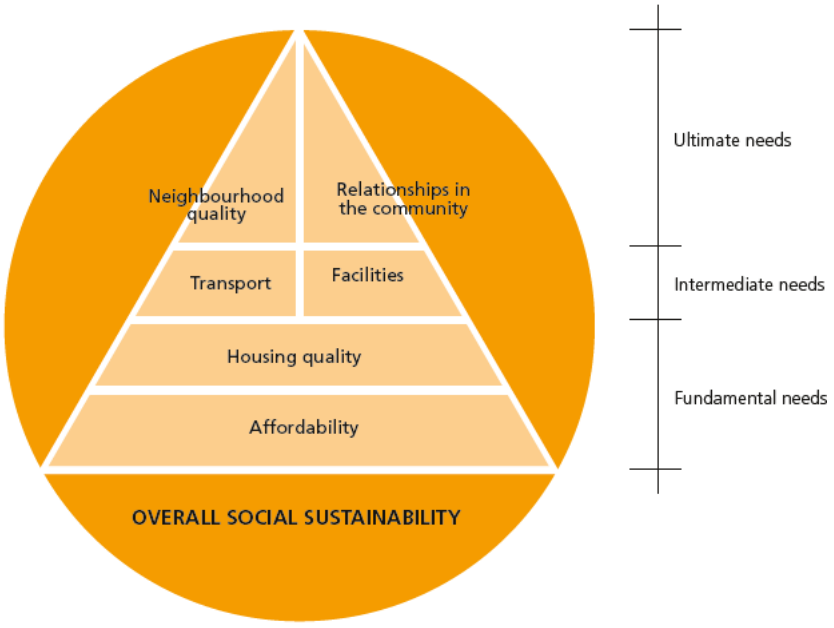
The social dimension of sustainability is crucial, as it serves as a central criterion against which environmental, cultural, and economic aspects of housing must be evaluated and balanced. Ensuring that social considerations are harmonized with the broader conditions for sustainable housing is essential, adhering to a holistic four-dimensional approach that encompasses environmental, social, cultural, and economic factors (Smith, 2021).

At the core of any housing policy is the provision of affordable and adequate shelter for all, regardless of an individual's wealth or influence. In both developing and developed countries, unmet housing demand has led to imbalances in housing markets, resulting in unaffordable housing and overcrowded living conditions (Habitat, 2021). These issues are often exacerbated by a lack of basic infrastructure, sanitation, and access to clean energy and fresh water, contributing to various negative social and health outcomes.

The affordability of housing is where the social, economic, and environmental dimensions of sustainability most evidently converge. This convergence is reflected in some of the most advanced housing programs, which aim to integrate sustainability with affordability. A notable example is Mexico, which has emerged as a leader among developing countries with its comprehensive, government-led sustainable affordable housing initiatives (Smith, 2020).

Affordability, however, is not merely a social welfare concern or a burden on the economy and government. It is, in fact, a catalyst for economic development and a key instrument in addressing structural poverty (Brown, 2019). Beyond the economic

aspects, affordable housing provides dignified shelter, ensuring that people have access to safe, healthy, ecological, and resilient living environments.



Source: Ancell and Thompson-Fawcett, 2008.

Figure 2.2: A Conceptual Representation of the Social Sustainability of Housing

Policies aimed at sustainable affordable housing, which enhance access to adequate, safe, and ecological living environments, play a crucial role in redistributing wealth and opportunities in favor of disadvantaged groups. Such policies are vital tools for narrowing the social divide and promoting social justice. By reducing disproportionate environmental risks, such as indoor and outdoor pollution and other hazards that disproportionately affect vulnerable groups, sustainable housing also contributes to environmental justice.

Sustainable housing addresses the urban divide and supports the right to the city effectively promoting spatial justice (Harvey, 1973; Soja, 2010). This is achieved by creating inclusive residential environments where all residents, regardless of wealth, origin, or gender, can access essential public services, open spaces, and the various opportunities that cities offer. It is essential that the provision of basic shelter is coupled with access to affordable and decent amenities such as schooling, healthcare,

and public transportation, particularly for low-income communities, while preventing forced evictions, gentrification, and displacement.

Moreover, the design and management of neighborhoods are equally important. Affordable housing programs have often been viewed solely as public housing developments targeted at the poorest social groups, frequently built in isolated and distinct locations, which can lead to social stigmatization. It is critical that affordable housing initiatives move beyond the simple provision of additional housing units and focus on creating well-designed, integrated residential areas that enhance the quality of life for all residents.

2.4.6 Adaptable Housing for Present and Future Needs

Housing must be adaptable and responsive to the diverse and evolving needs of its residents, particularly for vulnerable groups such as the elderly, individuals with limited mobility, children, and women. Unfortunately, many homes today are not designed with sufficient flexibility to accommodate the aging population. For instance, houses could be designed to ensure wheelchair accessibility, allowing residents to remain in their homes as they age. In some cases, targeted assistance may be required to modify existing housing to meet the specific needs of these groups, ensuring that they do not have to relocate due to an inflexible and challenging living environment.

Gender-sensitive housing design is another critical aspect that must be addressed. In many informal settlements, women often face unsafe conditions when accessing basic facilities such as water, toilets, and showers, which are often located far from their homes and within unsafe neighborhoods. This lack of safety exposes women to risks such as violence and sexual assault. By designing gender-sensitive facilities that are closer to homes and improving the safety and security of streets through better lighting, public transportation, and road infrastructure, these vulnerabilities can be mitigated. Improved access to water and sanitation facilities not only enhances safety but also frees up women’s time for other opportunities, contributing to their overall well-being.

Moreover, the involvement of women and local communities in all stages of housing development is essential to ensure that their needs are adequately addressed. Flexibility in housing and neighborhood design is also important for accommodating future needs. According to the Young Foundation (2011), master planning should avoid a rigid approach that attempts to create a fixed blueprint for the future. Instead, planners should allow for a degree of flexibility and openness to change, recognizing that new communities thrive best when they can evolve dynamically, often in ways that cannot be fully predicted by planners.

Incorporating traditional vernacular designs and building techniques can further enhance the flexibility of housing, while also improving environmental performance. Such designs take into account local climate, culture, and materials, providing homes that are both adaptable and sustainable.

2.4.7 Principles for Sustainable Policy Delivery

The general approach for implementing sustainable affordable housing policies involves addressing the interconnected dimensions of sustainability—social, economic, environmental, and cultural. To achieve these multiple benefits, housing practices must be adjusted to not only improve the quality of life for residents but also to contribute to economic development and protect the environment.

A key element of this approach is sustainable policy delivery, which requires a combination of strategic vision and strong institutional support. This vision must be backed by regulations that enforce sustainability standards and build capacity within the relevant sectors.

Additionally, multi-stakeholder cooperation is essential. Governments, private developers, community groups, and financial institutions must work together to create an inclusive and integrated housing framework. Cooperation allows for a more efficient sharing of resources, knowledge, and expertise, ensuring that all sustainability goals are met.

Finally, securing sustainable sources of funding is crucial. Long-term financial support, whether from public or private sectors, is needed to ensure that affordable housing projects can be built, maintained, and scaled. This funding must be accessible, sufficient, and structured to promote the longevity of the housing initiatives while ensuring that the economic burden does not fall solely on one group.

The following principles are relevant at all scales of sustainable affordable housing projects and programmes – from the national to community level.

1. **Leadership and Commitment:**

In Kenya, leadership and commitment are crucial for the realization of sustainable housing projects, especially given the rapid urbanization and growing demand for affordable housing. To successfully implement sustainable housing initiatives, the government needs strong political will and leadership. This can be achieved by setting up specialized organizational units within government bodies tasked with coordinating sustainable affordable housing policies. These units must be empowered with the authority and resources necessary to push the agenda forward. Coordination between various governmental agencies, such as those responsible for urban planning, housing, and environmental protection, is also essential to ensure that sustainability goals are met comprehensively.

2. **Institutionalizing Sustainable Housing:**

Institutionalizing sustainable housing in Kenya is essential for ensuring that the policies and practices endure beyond changes in government leadership. For this to be successful, sustainable housing must be embedded into both governmental and non-governmental frameworks. This includes making sustainable housing a central part of political discussions, policy development, and operational practices across public, private, and academic sectors. A national housing strategy is crucial for this institutionalization, supported by strong legislative frameworks that guide sustainable housing efforts. Additionally, reforms in governance structures, strategic investments in sustainable housing projects, and the promotion of research and training programs are necessary to foster the growth and adoption of sustainable practices across the

board. This would enable Kenya to create a sustainable housing model that aligns with its unique socio-economic and environmental challenges.

3. **Multilateral Collaboration:**

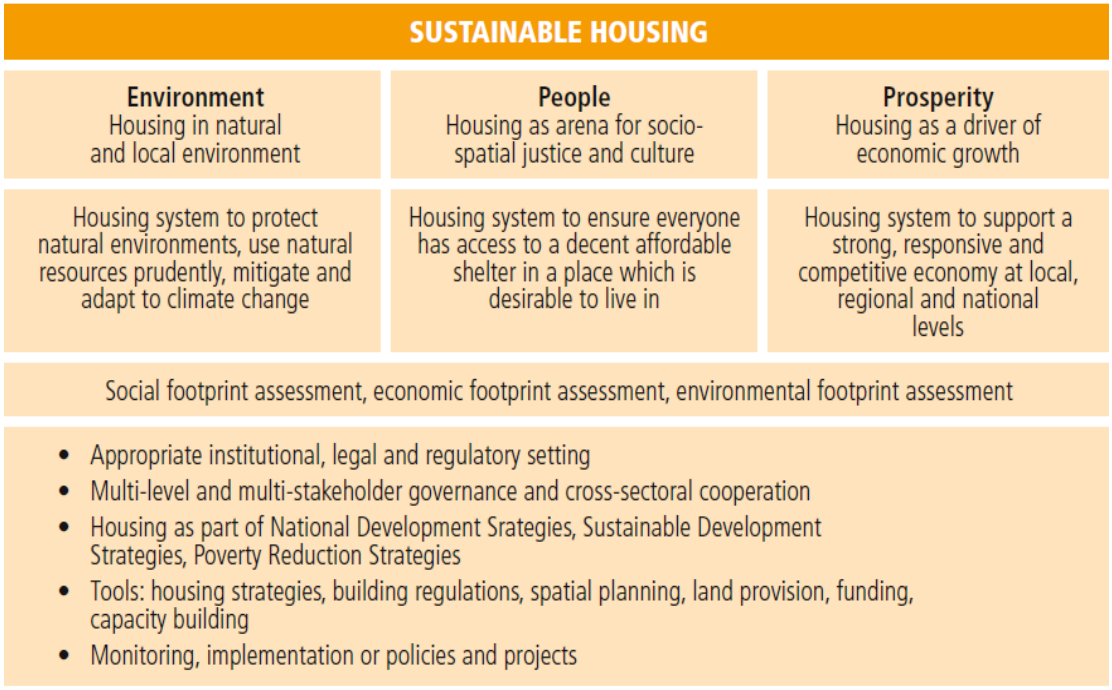
Multilateral collaboration is essential for the success of sustainable housing initiatives, especially in Kenya, where diverse challenges require input from various stakeholders. Good governance in sustainable housing should be built on a clear vision, well-defined strategies, and actionable plans that are developed and executed through collaboration with multiple parties. This includes coordination between different levels of government, such as national and county authorities, and across government departments responsible for housing, urban planning, and the environment. Engaging the private sector is critical for leveraging investment and innovation, while non-governmental organizations (NGOs) and local communities can provide grassroots insights and advocacy.

Open and inclusive consultations play a pivotal role in shaping sustainable housing strategies, ensuring that the projects meet the diverse needs of the population. Moreover, these participatory processes help address technical gaps by incorporating expertise from various sectors, which is especially important given the technical complexities of sustainable housing. In Kenya's context, such collaboration will help drive forward the adoption of sustainable housing models that are socially inclusive, environmentally friendly, and economically viable.

4. **Context-Specific Approaches:**

Incorporating sustainability into housing policies in Kenya requires context-specific approaches that consider the diverse social, cultural, economic, and environmental landscapes across different regions. The integration of these competing factors can be particularly challenging, making cooperation across sectorial and administrative boundaries critical. A holistic and spatially-focused approach is the most effective way to address these challenges. Rather than relying on sectorial solutions that apply blanket policies, sustainable housing efforts should focus on local contexts, tailoring responses to fit the unique needs of each region or community.

In Kenya, housing challenges differ from urban areas like Nairobi to rural regions such as Turkana. For example, urban areas may focus on reducing overcrowding and slum upgrading, while rural regions may prioritize access to clean water, affordable materials, and resilience against climate risks. By grounding policies in local social and physical realities, sustainable housing initiatives can offer nuanced and adaptive solutions, ensuring that housing developments are both sustainable and responsive to the specific needs of the population.



Source: UN-Habitat, 2012

Figure 2.3: Sustainable Housing Policy

2.5 The Applicability of LEED-ND in Kenya's Affordable Housing

The Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) rating system was designed to integrate the principles of smart growth, urbanism, and green building into a neighborhood-scale framework. LEED-ND extends beyond evaluating individual buildings to assess whole neighborhoods, focusing on sustainable site selection, design, and construction of entire communities. This approach aligns with Kenya's urgent need for affordable housing that addresses both environmental sustainability and social equity.

1. Addressing Affordability in LEED-ND

LEED-ND incorporates several key elements that can enhance the quality and sustainability of affordable housing in Kenya. It prioritizes smart location and linkages, which encourage developments that reduce urban sprawl and improve access to public transport. In Kenya, where many affordable housing developments are situated on the peripheries of cities, isolated from essential services, integrating these aspects of LEED-ND could significantly improve the social and economic well-being of residents (UN-Habitat, 2011d).

Affordable housing is a critical need in urban areas experiencing rapid growth, such as Nairobi, where slums and informal settlements are prevalent due to lack of proper planning and infrastructure (UN-Habitat, 2011d). LEED-ND's focus on neighborhood pattern and design promotes the creation of walkable streets, mixed-use development, and public spaces, all of which contribute to social sustainability. Such a strategy would benefit affordable housing projects by making them not only environmentally sustainable but also socially inclusive.

2. Contextualizing LEED-ND for Kenya

To make LEED-ND more applicable to Kenya's unique socio-economic and environmental context, certain adaptations may be necessary. The affordability of sustainable building materials and techniques is a significant challenge in Kenya (UN-Habitat, 2010). However, LEED-ND encourages the use of locally sourced materials and environmentally friendly construction techniques, which can promote both environmental and economic sustainability. In this sense, Kenya's affordable housing program could benefit from embracing LEED-ND criteria to improve the durability, health, and safety of buildings, while reducing their environmental footprint.

Additionally, LEED-ND's emphasis on green infrastructure and community development could guide affordable housing developments in Kenya to adopt integrated solutions that improve water and energy efficiency. In regions where clean energy access is limited, such as rural Kenya, promoting the use of renewable energy

solutions through LEED-ND would not only contribute to environmental sustainability but also address energy poverty (UN-Habitat, 2012).

3. Challenges in Implementing LEED-ND in Kenya

While The Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) provides a comprehensive framework for sustainable development, its implementation in Kenya may face several challenges. The high initial costs of meeting LEED-ND standards can be a deterrent for developers, especially in the affordable housing sector where profit margins are thin. Furthermore, the technical expertise required to implement LEED-ND effectively may be lacking in some regions (UN-Habitat, 2011c). Overcoming these challenges will require significant investment in capacity building, as well as policy support from the government to incentivize developers to adopt sustainable practices.

Moreover, the success of LEED-ND in Kenya will depend on the alignment of national housing policies with sustainable development goals. The introduction of a national sustainable housing strategy, supported by appropriate legislation and governance reforms, will be crucial to institutionalize sustainable housing practices (UN-Habitat, 2011b). The involvement of stakeholders from the public and private sectors, as well as local communities, will also be necessary to ensure the broad-based adoption of LEED-ND standards in affordable housing projects.

4. Opportunities for LEED-ND in Kenya's Affordable Housing Agenda

Despite the challenges, the LEED-ND framework offers numerous opportunities for transforming Kenya's affordable housing landscape. By promoting mixed-income, mixed-use, and well-connected communities, LEED-ND can help bridge the gap between Kenya's affordable and sustainable housing agendas. Additionally, integrating LEED-ND into Kenya's affordable housing programs could help address key urban challenges such as overcrowding, lack of infrastructure, and social inequality (UN-Habitat, 2010).

For Kenya, adopting the LEED-ND rating system could serve as a blueprint for future affordable housing developments, ensuring that they are not only economically viable but also environmentally and socially sustainable. In doing so, the country could make significant strides towards meeting the Sustainable Development Goals (SDGs), particularly SDG 11, which aims to make cities and human settlements inclusive, safe, resilient, and sustainable.

By subjecting affordable housing programs to the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) evaluation, Kenya can create a standard for sustainable housing that balances affordability with quality, health, and environmental responsibility. The adoption of such a system could also pave the way for future policies that reinforce the importance of sustainability in housing, ensuring long-term benefits for both residents and the environment.

2.6 Challenges of Adopting LEED-ND for Affordable Housing

The adoption of the LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development) framework in affordable housing initiatives offers both promising opportunities and significant challenges. As countries like Kenya seek to balance affordability with sustainability in their housing projects, understanding the potential barriers and advantages of applying LEED-ND becomes essential.

1. **High Initial Costs**

One of the primary challenges in implementing LEED-ND is the high upfront costs associated with sustainable development practices. The integration of green building materials, energy-efficient technologies, and environmentally sensitive construction methods often comes at a premium, which can be prohibitive for affordable housing projects. For developers in Kenya, where affordable housing projects are already constrained by tight budgets, this added cost can act as a deterrent.

In Kenya’s affordable housing context, the trade-off between affordability and sustainability is often stark. Developers may hesitate to invest in expensive green

technologies and materials, fearing that it will make housing unaffordable for low-income households (Wambugu, 2020). Additionally, the cost of achieving LEED certification, including documentation, professional services, and compliance with strict standards, can further strain the financial viability of such projects (UN-Habitat, 2011b).

2. Lack of Technical Expertise

Implementing LEED-ND requires a specialized understanding of sustainability principles, urban planning, and green construction techniques. In many developing countries, including Kenya, the technical expertise needed to successfully apply the LEED-ND framework may be lacking. Professionals involved in affordable housing projects, such as architects, engineers, and planners, may not be adequately trained in LEED standards, leading to difficulties in meeting certification requirements (UN-Habitat, 2011d).

Moreover, the availability of resources and infrastructure to support the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) compliance, such as advanced energy monitoring systems or renewable energy sources, is limited in certain regions. Without sufficient access to these technologies and expertise, developers may struggle to meet the necessary sustainability thresholds.

3. Regulatory and Policy Barriers

In Kenya, the regulatory framework for sustainable housing development is still evolving. There are currently limited national guidelines or policies that mandate or incentivize developers to adopt green building standards like LEED-ND. Without strong government support, the widespread adoption of LEED-ND in affordable housing may remain a challenge (World Bank, 2017).

Additionally, the absence of clear legal frameworks that encourage sustainable development practices, such as tax incentives or subsidies for green building, can act as a barrier to entry for developers interested in adopting LEED-ND principles.

Governments would need to establish supportive regulations that align with the LEED-ND framework to encourage developers to integrate sustainability into affordable housing projects.

2.7 Benefits of Adopting LEED-ND

2.7.1 Long-Term Cost Savings

Despite the high initial costs, the adoption of LEED-ND can result in significant long-term cost savings for both developers and residents. Energy-efficient buildings, water-saving systems, and renewable energy sources contribute to lower operational costs, which can translate into reduced utility bills for residents. For affordable housing projects, these long-term savings can make homes more affordable over time, particularly in Kenya, where energy costs are often a burden for low-income households (UN-Habitat, 2011d).

In addition, LEED-ND-certified buildings are typically more durable and have lower maintenance costs compared to conventional buildings, as they are built with high-quality, environmentally friendly materials. This longevity is especially important in affordable housing, where homes should be resilient to environmental stressors and not require frequent repairs or replacements.

2.7.2 Improved Quality of Life

One of the major benefits of the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) is its focus on creating healthier, more liveable environments. By promoting walkability, access to public transportation, green spaces, and mixed-use developments, LEED-ND fosters the creation of vibrant communities that enhance the overall quality of life for residents (World Bank, 2017).

In Kenya's affordable housing projects, where residents often face overcrowded conditions and poor access to essential services, the LEED-ND framework offers a solution by encouraging the design of neighborhoods that are socially inclusive, economically vibrant, and environmentally sustainable. This focus on livability

extends beyond the physical building to the surrounding neighborhood, ensuring that residents benefit from safe, accessible, and well-connected communities.

2.7.3 Environmental Benefits

The adoption of LEED-ND directly contributes to reducing the environmental impact of affordable housing projects. By focusing on energy efficiency, water conservation, sustainable materials, and green infrastructure, LEED-ND helps reduce carbon emissions, conserve resources, and protect local ecosystems (Wambugu, 2020). In a country like Kenya, where environmental challenges such as deforestation, water scarcity, and pollution are prevalent, the environmental benefits of adopting LEED-ND are particularly significant.

Moreover, LEED-ND promotes smart growth principles by encouraging the development of housing projects in already urbanized areas with existing infrastructure, thereby reducing urban sprawl and preserving natural habitats. This is especially important in Kenya, where rapid urbanization has led to unplanned settlements and environmental degradation in many regions.

2.7.4 Alignment with Global Sustainability Goals

By adopting LEED-ND, Kenya's affordable housing projects can align with global sustainability frameworks, such as the Sustainable Development Goals (SDGs), particularly SDG 11: Sustainable Cities and Communities. Integrating LEED-ND standards into affordable housing policies would position Kenya as a leader in sustainable urban development in sub-Saharan Africa, showcasing the country's commitment to creating sustainable, resilient, and inclusive urban environments.

Furthermore, the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) certification can help attract international funding and partnerships, as global investors and organizations are increasingly prioritizing sustainable development projects. By adhering to a globally recognized standard, Kenyan developers can enhance their credibility and access to resources that support sustainable housing.

2.8 Comparing LEED-ND to Other Sustainable Housing Rating Systems

Sustainable housing rating systems are essential frameworks that guide the development of environmentally responsible and resource-efficient buildings and neighborhoods. Among these systems, LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development) is widely recognized. However, there are other prominent rating systems that have been developed to assess sustainable housing, each with unique approaches to sustainability. This section compares LEED-ND with other well-known systems, focusing on their applicability to affordable housing, particularly in developing countries like Kenya.

2.8.1 LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development)

LEED-ND, developed by the U.S. Green Building Council (USGBC), is a comprehensive rating system that integrates principles of smart growth, urbanism, and green building. It focuses not only on individual buildings but on the design and development of entire neighborhoods, promoting sustainability at a community scale. Key components of LEED-ND include location and transportation, neighborhood pattern and design, and green infrastructure and buildings (USGBC, 2020).

LEED-ND is particularly relevant to Kenya’s affordable housing initiatives due to its emphasis on integrating sustainability into urban planning and neighborhood design. The system encourages the creation of mixed-use developments, walkable streets, access to public transportation, and the preservation of open spaces, all of which align with the goals of Kenya's affordable housing agenda. However, the high certification costs and technical requirements of LEED-ND can be barriers for developers in low-income countries, as previously discussed.

2.8.2 BREEAM (Building Research Establishment Environmental Assessment Method)

BREEAM, developed in the United Kingdom, is one of the world’s oldest and most widely used sustainable building certification systems. It covers a broad range of

sustainability categories, including energy, water, materials, waste, health and well-being, and pollution. While BREEAM is primarily used for individual buildings, the BREEAM Communities scheme addresses neighborhood-scale developments, similar to LEED-ND (BREEAM, 2016).

Compared to LEED-ND, BREEAM has a more flexible approach to certification, offering different levels of assessment that can be tailored to specific projects. This flexibility could be beneficial for affordable housing projects in Kenya, where developers might need to adjust their sustainability targets based on local conditions and budget constraints. However, BREEAM is less widely recognized in Africa than LEED, which may limit its adoption and impact in Kenya.

2.8.3 Green Star (Australia)

Green Star, developed by the Green Building Council of Australia, is a rating system designed to promote sustainability across a wide range of building types, including residential, commercial, and community buildings. The Green Star Communities framework, like LEED-ND, assesses sustainability at the neighborhood scale, focusing on governance, design, liveability, economic prosperity, and the environment (GBCA, 2017).

While Green Star Communities shares similarities with LEED-ND, such as promoting walkability, access to public services, and green infrastructure, it places a stronger emphasis on social sustainability and community engagement. This focus could be highly relevant to Kenya, where affordable housing projects need to address not only environmental sustainability but also social inclusion and community well-being. However, like LEED, Green Star is not widely used in Africa, and its applicability to local contexts may be limited by unfamiliarity and lack of technical expertise.

2.8.4 EDGE (Excellence in Design for Greater Efficiencies)

EDGE, developed by the International Finance Corporation (IFC), is a rating system designed specifically for emerging markets. Unlike LEED-ND and other rating

systems that focus on the entire neighborhood or urban scale, EDGE is primarily concerned with improving the energy, water, and materials efficiency of individual buildings (IFC, 2021). The system is designed to be simple and affordable, making it a practical choice for developers in low- and middle-income countries.

EDGE has gained significant traction in Kenya and other African countries due to its affordability and ease of use. For affordable housing projects, EDGE can be a more accessible option than LEED-ND, as it focuses on reducing resource consumption and operational costs without requiring extensive investment in neighborhood-scale sustainability. However, its limited focus on individual buildings, rather than entire communities, means that it may not fully address the broader sustainability challenges that LEED-ND and other systems target.

2.8.5 GBCSA (Green Building Council of South Africa)

The GBCSA (Green Star Africa) rating system is a regional adaptation of the Australian Green Star rating system. It has been tailored to the unique environmental, social, and economic conditions of the African continent, making it particularly relevant to countries like Kenya. The system addresses issues such as water scarcity, energy efficiency, and the use of locally sourced materials, which are critical concerns for sustainable development in Africa (GBCSA, 2020).

Compared to LEED-ND, Green Star Africa is more aligned with the specific sustainability challenges faced by African countries, including Kenya. It offers a regional perspective on sustainability, which can make it more relatable and applicable to local developers and policymakers. However, Green Star Africa is still relatively new, and its adoption in Kenya has been limited.

2.9 Key Differences and Similarities

1. Applicability to Affordable Housing
    - LEED-ND and Green Star Communities are neighborhood-scale systems that address both social and environmental sustainability, making them suitable for affordable housing projects that aim to create vibrant, inclusive communities.
    - EDGE and BREEAM focus more on individual buildings and resource efficiency, which can be advantageous for smaller-scale affordable housing projects but may not address broader neighborhood-scale issues such as walkability, access to services, and community cohesion.
2. Cost and Accessibility
    - EDGE is the most cost-effective and accessible system for developers in low-income countries like Kenya, offering a straightforward path to improving energy, water, and material efficiency.
    - LEED-ND, BREEAM, and Green Star are more comprehensive but come with higher costs and technical requirements, which may pose challenges for affordable housing developers in Kenya.
3. Focus on Social Sustainability
    - LEED-ND and Green Star Communities place a strong emphasis on social inclusion, community engagement, and access to public services, making them particularly relevant to affordable housing projects in Kenya that aim to improve the quality of life for low-income residents.
    - BREEAM and EDGE focus more on environmental and economic sustainability, with less emphasis on social factors, which may limit their effectiveness in addressing the broader social challenges associated with affordable housing.

While each sustainable housing rating system offers unique advantages, LEED-ND stands out for its holistic approach to neighborhood development, making it particularly suitable for Kenya's affordable housing agenda. However, the adoption

of LEED-ND must be carefully balanced against the financial and technical challenges it presents. Other systems like EDGE and Green Star Africa may offer more accessible options for improving sustainability at the building level, while BREEAM and Green Star Communities provide flexible frameworks that can be adapted to local contexts.

This structured approach to explicitly highlighting research gaps and linking them to your study objectives is comprehensive and impactful. Here's a polished version that integrates the suggestions into a refined section for your literature review:

2.10 Research Gaps

Limitations of Existing Assessment Tools

While globally recognized assessment tools like LEED-ND, BREEAM, Green Star, DGNB, and CASBEE have advanced the evaluation of sustainable building projects, their applicability to the Kenyan affordable housing context remains limited. These tools predominantly prioritize environmental performance, often overlooking affordability, social sustainability, and contextual relevance—key factors critical for addressing Kenya's housing challenges. Furthermore, lesser-known tools that could offer innovative insights remain underexplored in the literature. A broader analysis of these tools is necessary to identify their limitations and opportunities for adaptation to Kenya’s unique context.

Identified Research Gaps

1. **Affordability as a Core Criterion**

   Existing assessment tools inadequately address the cost-effectiveness of sustainable practices, particularly in the context of affordable housing for low-income households. This gap underscores the need for an assessment framework that integrates affordability metrics alongside environmental and social considerations.

Possible Research Questions:

- How can affordability be effectively embedded as a core criterion in a sustainable housing assessment tool?
- What cost-effective strategies can balance sustainability goals with housing affordability?

2. **Economic Viability of Projects**

Current tools often fail to capture the long-term economic viability of affordable housing projects within Kenya's specific market dynamics. A tailored framework must consider financing models, incentives for developers, and the economic benefits for residents over time.

Possible Research Questions:

- How can an assessment tool evaluate long-term economic viability, including financing mechanisms and returns on investment?
- What role do developer incentives play in promoting sustainable affordable housing in Kenya?

3. **Incorporating Social Sustainability**

Social factors, such as community inclusivity, livability, and tenant well-being, are often overlooked in traditional evaluation frameworks. An effective assessment tool for Kenya must measure the contributions of housing projects to community development, social equity, and resident satisfaction.

Possible Research Questions:

- What social criteria are critical for evaluating affordable housing in Kenya?
- How can the impact of housing projects on social cohesion and resident well-being be assessed?

4. **Contextual Relevance to Kenya**

   Many existing tools are designed for developed economies and lack adaptability to Kenya's socio-economic and cultural environment. There is a need for research that explores how globally recognized tools can be contextualized for Kenya's unique challenges.

Possible Research Question:

- How can sustainable housing standards like LEED-ND be adapted to address Kenya's urban development needs?

5. **Addressing the Research Gaps**

This study aims to bridge these gaps by:

1. Developing an assessment framework tailored to Kenya's affordable housing landscape.
2. Adapting globally recognized standards like LEED-ND to align with local priorities.
3. Introducing tools and criteria that balance affordability, sustainability, and social well-being.

6. **Importance of Addressing Research Gaps**

Addressing these gaps will ensure that future affordable housing projects in Kenya are not only cost-effective and sustainable but also socially inclusive and economically viable. By explicitly defining these limitations, this research contributes to advancing knowledge and practice in sustainable urban development, aligned with Kenya's Vision 2030 and the Bottom-Up Economic Transformation Agenda (BETA).

2.11 Guide to LEED Certification: Neighborhood Development

The procedure begins when the owner registers the project and chooses the rating system (see Rating System Selection). After then, the project is carefully scheduled

to complete all prerequisite requirements and earn the selected credits. Preliminary and final reviews are conducted on the project when the certification paperwork is submitted. The final assessment determines the project's ultimate score and certification level and provides technical advice on credits that need more work. The team may choose to file an appeal if they feel that additional consideration is necessary.

Depending on the amount of points obtained, LEED offers four certification levels:

Certified, 40–49 points, silver, 50–59 points, gold, 60–79 points, platinum, 80 points and above

Certification options for LEED-ND

There are two adaptations of the LEED for Neighborhood Development rating system: LEED-ND: Plan and LEED ND: Built Project. Each has certification choices unique to this rating system. This optional review acts as an official evaluation in the event that the project team is unsure if the project can meet the requirements for Smart Location and Linkage (SLL) or Neighborhood Pattern and Design (NPD) before devoting more resources to submission preparation. Registered projects in both LEED-ND: Plan and LEED ND: Built Project are eligible for this review option.

STEP 1. Determine the project location and get the preliminary development program ready.

When choosing a site, one usually takes into account the overall goals of the development, the assets that are available, and the local market conditions. Informally adding Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) location factors into the site selection process is advised by the US Green Building Council (USGBC). It is easier to certify properties that are already in line with LEED-ND principles or those that are chosen with these goals in mind. Typically, once a possible site has been identified, a preliminary development program is created. In the event that a program's financial

analysis shows that the project is feasible, ownership of the site is acquired through purchase, an option to buy a lease, or comparable arrangements.

STEP 2. Choose rating method

There are twenty-one modifications to the LEED system that are designed to satisfy different market segments. It is the responsibility of the project manager to confirm that LEED-ND is the best LEED rating system for the project. Certain projects may concurrently pursue various LEED building rating systems and LEED-ND. Examining the USGBC Campus Program—a certification procedure as opposed to a rating system—might be helpful for some multi-building projects.

The project team leader should verify which of the two LEED-ND rating systems applies to the project, assuming that LEED-ND is the best option:

- LEED-ND: Plan: If less than 75% of the project's total building floor space has been erected or if the project is in the planning stages, this rating method is necessary.
- LEED-ND: Built Project: The project is required to utilize the LEED-ND rating system if it has completed all of its construction.

STEP 3. Form a project team and select applicable organizations

A project's physical location (e.g., suburban Greenfield versus urban infill), scale (land size, buildings, and infrastructure), and type (residential, non-residential, mixed-use) are all determined by the site acquisition and preliminary development program processes. These attributes have a major bearing on the level of experience required in a LEED-ND project team. A LEED-ND Accredited Professional with relevant experience in certifying the intended project type for the site should ideally be part of the team. This process is crucial for locating non-governmental organizations who support the project's objectives or have an interest in the region, as well as public institutions that have jurisdiction over the location. Building a cooperative relationship with these organizations might be advantageous as credit selection and documentation advance.

STEP 4. Verify the prerequisites and minimum program requirements.

Examine the prerequisites and minimum requirements of the program in relation to the project site and the first development schedule. Check to make sure there are no obvious barriers preventing the project from being eligible or the requirements from being met.

STEP 5. Create a LEED scorecard

To determine which alternatives and credits the team should pursue, use the project goals. Teams can better match goals with credits that benefit the project owner, the environment, and the community by consulting the "Behind the Intent" sections, which provide insights into the intended results of each credit.

The team should be directed by this procedure to concentrate on credits that have the greatest long-term value for the project. Find corresponding credits that complement the priority techniques and provide synergistic effects when the high-priority credits have been chosen.

Finally, choose the desired LEED certification level (Platinum, Silver, Gold, or Certified) and the extra credits needed to achieve it. Make sure that every need can be satisfied and include in a few percentage points more than the absolute minimum to allow for any unforeseen changes that may arise throughout the design and construction stages.

STEP 6. Review the quality assurance and submit the application for certification.

Of the work program, a quality assurance review is an essential component. A thorough quality control review can improve the project's LEED documentation's coherence and clarity by identifying flaws that could require expensive and time-consuming repairs later on in the certification process. The input needs to be carefully checked and verified to be complete. Ensuring that numerical metrics, like site area, are consistent across credits in all LEED-ND credit categories is crucial.

2.12 Affordable Housing Program in Kenya

Affordable housing for all Kenyan people is one of the main objectives of the government's "Big Four Agenda," which acts as a guide. The housing initiative has set an ambitious goal to provide 500,000 dwelling units by 2022 to underprivileged communities and lower-income households in all forty-seven counties of Kenya. This initiative's first phase intends to build 30,000 dwelling units, or at least thirty percent of the existing stock of urban housing.

Under this framework, a plan to build 1,370 residential units on plot LR No. 209/20159 has been proposed by the Ministry of Transport, Infrastructure, Housing, and Urban Development, acting in the capacity of the developer. This parcel is situated in Nairobi City County's Park Road neighborhood along Kinshasa Road. This project is envisioned as the inaugural affordable housing initiative designed to meet the growing demand for well-constructed, affordable homes while ensuring compliance with environmental best practices, Nairobi City County Zoning Regulations, and all relevant legal provisions. The project aligns with the broader national objective of addressing housing challenges and making quality housing accessible to a broader segment of the population.

As a key element of its "big four" program, the Kenyan government has launched the Affordable Housing Programme (AHP), which focuses on housing-related issues. The program's main goal is to guarantee housing accessibility for all Kenyan inhabitants by planning the construction of 500,000 affordable homes by 2022 (Kieti, Raphael & Rukwaro, Robert & Olima, Washington, 2020).

Numerous international instruments, such as the 1948 United Nations Declaration on Human Rights, the 1966 International Covenant on Economic, Social, and Cultural Rights, the 1996 Habitat Agenda and Istanbul Declaration, and the 2001 Declaration on Cities and Other Human Settlements, recognize and safeguard the right to housing (the Republic of Kenya, 2004). Furthermore, the Kenyan Constitution expressly guarantees the right to housing. Every person has the right to reasonable standards of cleanliness and to accessible and adequate housing, according to Article 43(1b) of the Constitution.

This constitutional provision underscores the government's commitment to ensuring housing as a fundamental right for all Kenyan citizens.

The Affordable Housing Programme (AHP) by the Kenyan government is a five-year initiative designed to provide decent housing to various socio-economic groups across Kenya. Specifically, the program aims to deliver 200,000 social housing units and 800,000 affordable units to impoverished households in slum areas, as well as lower- and middle-income groups. The inaugural project under the AHP is taking place in Park Road within the Ngara estate of Nairobi, with plans to deliver 1370 housing units by the year 2022.

According to the Boma Yangu portal website Bomayangu.go.ke and a report from Business Daily digital, dated November 6, 2019, approximately 268,094 Kenyan citizens had registered on the Boma Yangu online portal as of that date. Boma Yangu is an online platform that enables Kenyans to register online and apply for homes that will be constructed as part of the government's affordable housing program.

Boma Yangu was introduced in January 2016 with the goal of streamlining an equitable and transparent house allocation procedure while doing away with human involvement or connections. It is expected that the affordable housing program's development projects will boost the unofficial Jua Kali industry by generating jobs and business opportunities.

According to the State Department of Housing, the Jua Kali sector will be involved in the production of various materials such as metal and wooden fixtures like doors and windows, with an anticipated earnings of about Kshs.120 million in the initial phase of the program (Daily Nation Digital - mobile.nation.co.ke, November 21, 2019). The State Department of Housing has already designated 67 construction items for local procurement, and it has committed to sourcing 70 percent of all construction materials from local small and medium enterprises (SMEs).

Kenya, like many developing nations worldwide, faces the critical challenge of strategically pursuing the United Nations' Sustainable Development Goals (SDGs) by the year 2030. These goals, aligning with the national development roadmap

known as Kenya Vision 2030, have garnered significant attention in the country. Notably, Kenya has identified specific priority areas central to achieving both Kenya Vision 2030 and the SDGs 2030, which President Uhuru Kenyatta has referred to as the "big four priority areas."

Kenya Vision 2030 is structured around three fundamental pillars: Economic, Social, and Political. The Economic Pillar sets forth the ambition to attain and sustain an average annual economic growth rate of 10% until 2030. Meanwhile, the Social Pillar aims to foster a fair and cohesive society characterized by social equity within a clean and secure environment.

The alignment of the United Nations' SDGs with Kenya Vision 2030 underscores the nation's commitment to addressing critical global challenges while advancing its own development objectives. President Kenyatta's identification of the "big four priority areas" emphasizes the country's dedication to targeted efforts that align with both national and international sustainable development agendas. This strategic focus is crucial in ensuring Kenya's socio-economic progress while contributing to the broader global pursuit of a sustainable and equitable future.

The Political Pillar within the framework of Kenya Vision 2030 aspires to establish a democratic political system based on issue-driven politics, upholding the rule of law, and safeguarding the rights and freedoms of all individuals in Kenyan society. The foundation of these pillars encompasses critical elements such as Infrastructure, Information and Communications Technology (ICT), Science, Technology, and Innovation (STI), Land Reforms, Public Sector Reforms, Labor and Employment, National Values and Ethics, Ending Drought Emergencies (EDE), Security, Peace Building, and Conflict Resolution.

The government's top-priority projects and reforms, known as the "Big Four" Agenda, are slated to be implemented during a five-year period, from 2018 to 2022. Food security, affordable housing, manufacturing, and universal access to healthcare are these four pillars. Crucially, the Third Medium-Term Plan (MTP III) of Kenya's long-term development strategy, known as Kenya Vision 2030, has effectively integrated the Big Four Agenda. MTP III aims to build upon the substantial

achievements of the Economic Transformation Agenda, which has been pursued since 2008 under the Vision 2030 framework.

My addition: The integration of the Big Four Agenda into Kenya Vision 2030's Third Medium-Term Plan underscores the government's commitment to addressing fundamental socio-economic challenges and achieving sustainable development goals. This strategic alignment reinforces Kenya's dedication to fostering economic growth, social equity, and political stability, all of which are vital for the nation's long-term progress and global relevance.

Affordable housing entails the creation of well-constructed, standardized, and appropriately spaced residences with a consistent provision of clean water and electricity. These homes should be situated in respectable locations and should be easily accessible to individuals across various socio-economic strata, including those from lower, middle, and upper-income groups.

Every person has the unassailable right to reasonable standards of cleanliness and to accessible and adequate housing, as stated in Article 43 of Chapter Four of the constitution. The overarching objective is to deliver a minimum of 500,000 affordable new housing units by 2022, thereby enhancing the quality of living conditions for the people of Kenya.

This agenda aligns with the third Sustainable Development Goal (SDG): "Sustainable cities and communities – Make Cities and Human Settlements Inclusive, Safe, Resilient, and Sustainable." Providing access to affordable, high-quality housing offers numerous advantages. Beyond the improved physical structure of the homes, it brings financial security, often making the new homeownership a more secure and valuable asset than anything they've previously owned. Moreover, there are well-documented health benefits associated with these new homes. Unsanitary and overcrowded conditions in slums and tenement housing can foster the spread of diseases.

With 22% of Kenyans residing in urban areas and the urban population expanding at a rate of 4.2% annually, there is a substantial demand for housing. Nairobi alone

necessitates a minimum of 120,000 new housing units each year to meet this demand, yet only 35,000 homes are being constructed. This supply-demand imbalance has resulted in a 100% increase in housing prices since 2004.

This situation results in lower-income residents being priced out of the formal housing market, forcing them to seek shelter in slum areas. Approximately 60% of urban residents find themselves living in these informal settlements. The Affordable and Dignified Housing Plan (AHP) set forth by the Ministry of Transport, Infrastructure, Housing, and Urban Development includes specific benchmarks, such as ensuring that the construction cost per square meter of a home does not exceed $305 (approximately 30,500 KSH). Various types of housing units are intended to be provided to cater to individuals within three different income brackets: 125,000 units for social housing programs, 225,000 units for low-cost housing, and 150,000 units aimed at addressing the "mortgage gap" for middle-income earners. Earlier this year, the government received the first 228 fully completed housing units out of the 1,370 under construction in the Park Road Project located in Nairobi.

The Environmental Management and Coordination Act (EMCA) were established to guarantee that projects or initiatives of this kind established within the nation adhere to environmental friendliness, safety, and sustainability. The Act provides guidance by putting in place legal, policy, and institutional frameworks that are crucial for the effective management and coordination of environmental resources within the country. These principles were subsequently incorporated into the 2010 Constitution of Kenya through Article 42, which upholds the right of all individuals to reside in a clean and healthy environment. Consequently, proposed developments must undergo a rigorous assessment of their environmental and social impacts, encompassing physical, socio-economic, and biological factors.

Table 2.1: Affordable Housing Program

Location of AHP project	No. of targeted housing units	Housing units delivered as at December 2019/ or progress status of the project
Park Road, Ngara estate Nairobi	1370	1370
Jeevanjee estate, Ngara	1600	Nil units delivered
Nairobi		Notices of relocation to allow for development work to start has already been issued to current tenants/ occupants of the estate by Nairobi City County
Makongeni estate, Nairobi	20,000	Nil units delivered
Shauri Moyo/Starehe, Nairobi	8000	Nil units delivered Bidding processes for contractors to undertake development work is Ongoing
Kibera, Marigu-ini and Kiambu, Nairobi	11,000	Nil units delivered Vacate notices have been issued to current tenants/occupants in these sites to allow for the commencement of works Kshs. 2.3 billion relocation assistance has been set aside by the government Developers are ready to move to the site any time
Lukenya Athi River, Machakos County (The State Department of Housing and the United Nations Office of Projects Services (UNOPs) have signed a memorandum of agreement to deliver 100,000 affordable housing units.)	100,000	Nil units delivered His excellency the president of Kenya launched the first phase of 8800 units for the United Nations staff under the affordable housing program in December 6, 2019
Machakos Civil Servants housing	200	200
Mavoko Sustainable Housing Programme	463	Nil units delivered
Kisumu, Shauri Moyo, Kisumu County (for civil servants only)	250	210 units delivered
Embu Civil Servants Housing	220	220 units delivered
Kiambu		193 units delivered

(Source: Boma Yangu)

2.13 Integrating LEED-ND into Affordable Housing Programs

Integrating Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) into affordable housing programs offers a pathway to address the pressing need for housing in Kenya while ensuring developments are environmentally responsible, socially inclusive, and economically viable.

In the Kenyan context, where urbanization is driving a significant demand for housing, the integration of LEED-ND into affordable housing initiatives can create more livable and sustainable neighborhoods. By embedding LEED-ND principles into affordable housing projects, Kenya can address issues such as housing affordability, environmental sustainability, and urban resilience, while also aligning with global standards for sustainable development.

Affordable housing has traditionally focused on the cost aspect of development, prioritizing the delivery of low-cost units to meet the growing demand for shelter. However, this approach often neglects sustainability and liveability, leading to substandard living conditions, environmental degradation, and social isolation. LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development) provides a comprehensive framework that addresses these shortcomings by promoting sustainable, inclusive, and resilient urban communities.

1. **Environmental and Economic Synergies**

Integrating LEED-ND into affordable housing programs ensures that environmental performance is improved without sacrificing affordability. LEED-ND encourages energy efficiency, water conservation, and the use of sustainable building materials, which reduce long-term operational costs for residents (USGBC, 2023). This is crucial for low-income households, as operational costs often constitute a significant portion of their monthly expenses. By implementing green infrastructure solutions such as stormwater management systems, renewable energy sources, and green spaces, affordable housing developments can contribute to both environmental sustainability and cost reduction over time (Zuo et al., 2014).

In Kenya, where environmental concerns such as water scarcity and energy costs are high, integrating LEED-ND could alleviate these challenges while promoting sustainable urban development (Ngigi, 2016). Affordable housing projects in Kenya often neglect sustainable building practices due to perceived cost barriers; however, the long-term savings from green infrastructure make LEED-ND a financially sound investment.

2. Social Inclusivity and Equity

Affordable housing developments are often located in marginalized areas, far from essential services and employment opportunities. Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) emphasizes connectivity and walkability, encouraging affordable housing developments to be situated in well-serviced urban centers. This reduces the spatial divide and enhances residents' access to jobs, public transport, education, and healthcare (Coutts & Hahn, 2015). By incorporating LEED-ND principles, affordable housing programs in Kenya can create more inclusive neighborhoods that foster social interaction and equal access to amenities, thus contributing to urban equity.

The social dimension of sustainability is a critical component in the Kenyan context, where urban growth has often led to social exclusion and the formation of informal settlements (UN-Habitat, 2011). LEED-ND's focus on mixed-use development and public space provision offers a pathway to creating socially vibrant and diverse neighborhoods.

3. Overcoming Implementation Challenges

While the integration of LEED-ND offers numerous benefits, several challenges arise in its application to Kenya's affordable housing sector. One key barrier is the upfront cost of green certification and construction. Many developers in Kenya perceive sustainable design as costly, which discourages the adoption of LEED-ND standards in low-cost housing projects (Karanja & Makena, 2019). However, innovative financing mechanisms, such as green bonds or public-private

partnerships, could mitigate these concerns by providing financial incentives for developers to adopt sustainable practices (Hwang & Tan, 2012).

Another challenge lies in the technical expertise required for LEED-ND certification. Kenyan developers and architects may lack the necessary training to design and execute projects that meet LEED standards (Kimani, 2020). This calls for capacity-building initiatives and collaboration with international sustainability experts to ensure that affordable housing projects are not only cost-effective but also environmentally sound.

4. Enhancing Policy Frameworks

To effectively integrate LEED-ND into Kenya's affordable housing programs, supportive policy frameworks must be put in place. This includes aligning national housing policies with sustainability goals, encouraging green building codes, and offering incentives for developers who pursue Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) certification (World Bank, 2018). By institutionalizing LEED-ND principles within Kenya’s housing and urban development policies, the government can foster a built environment that balances affordability with sustainability.

Several countries have successfully implemented LEED-ND as part of their affordable housing strategy, demonstrating the potential for policy-driven adoption. For instance, Mexico has emerged as a leader in integrating sustainability into affordable housing through government-led initiatives that prioritize green construction (UN-Habitat, 2013). Kenya can draw on these international experiences to craft localized policy solutions that promote the uptake of LEED-ND in affordable housing projects.

Integrating LEED-ND into affordable housing programs in Kenya offers a unique opportunity to bridge the gap between affordability and sustainability. The LEED-ND framework provides a structured approach to ensuring that affordable housing developments are environmentally responsible, socially inclusive, and economically viable. However, challenges such as financial constraints, technical expertise, and

policy misalignments need to be addressed to realize the full potential of LEED-ND in Kenya's housing sector. With strategic planning, government support, and stakeholder collaboration, the integration of LEED-ND into affordable housing programs could pave the way for sustainable urban development in Kenya.

2.14 Theoretical Framework

1. Sustainability Theory

Sustainability Theory is central to this study, as it provides a holistic approach to balancing social, economic, and environmental aspects in housing development. In the context of affordable housing, sustainability emphasizes the need for housing that not only provides shelter but also promotes social inclusion, economic viability, and environmental stewardship.

Key constructs from sustainability theory:

Triple Bottom Line (Elkington, 1997): This concept highlights the balance between the three pillars of sustainability—social, economic, and environmental.

- Social sustainability includes housing that is accessible, inclusive, and supports community well-being.
- Economic sustainability refers to the affordability and cost-effectiveness of housing over its lifecycle.
- Environmental sustainability entails resource efficiency, energy savings, and minimizing the ecological footprint of housing developments.

These constructs underpin the need for a comprehensive evaluation system like LEED-ND, which assesses projects based on their contributions to sustainability goals.

Green Building Rating Systems (LEED-ND)

Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) is a green neighborhood rating system that assesses the sustainability of entire neighborhoods rather than individual buildings. LEED-ND integrates urbanism and green building into a system for neighborhood design. It provides guidelines for creating sustainable, well-connected, resource-efficient communities.

Key constructs from the LEED-ND framework:

- Smart Location and Linkage: Evaluates the proximity of the housing project to existing infrastructure, services, and public transportation.
- Neighborhood Pattern & Design: Focuses on the quality of life within the neighborhood, promoting walkability, open spaces, and diverse housing options.
- Green Infrastructure and Buildings: Measures the environmental performance of buildings and infrastructure, including energy efficiency, water management, and the use of sustainable materials.

In the context of your study, the LEED-ND rating system provides a basis for developing an assessment tool tailored to Kenya's unique socio-economic and environmental conditions.

2. Affordable Housing Theory

Affordable housing theory examines the policies and practices necessary to ensure that housing is available to low-income populations. Key concepts focus on the provision of affordable housing, the role of government and stakeholders, and the importance of location and access to services.

Key constructs from affordable housing theory:

- Affordability: Ensures that housing is economically accessible to low-income groups, without sacrificing other basic needs like food, healthcare, and education.

- Housing Quality and Livability: Assesses not just affordability but also the quality of housing, including safety, durability, and access to essential services.
- Social Inclusion and Equity: Housing must address the needs of vulnerable populations, ensuring equitable access to resources, opportunities, and safe living environments (Tsenkova & Turner, 2004).

The theory of affordable housing emphasizes the need for housing policies that prioritize affordability alongside environmental and social sustainability, supporting the inclusion of a rating system like LEED-ND to enhance the quality and sustainability of affordable housing projects.

3. Systems Theory

Systems Theory explains how various components of a system interact with each other to achieve a larger goal. In the context of affordable housing and neighborhood sustainability, this theory helps to conceptualize how housing, environment, infrastructure, and social services function as interrelated parts of a larger urban system.

Key constructs from systems theory:

- Interdependence: Various components (social, economic, environmental) of a neighborhood development project are interconnected and affect each other.
- Feedback Loops: Information from one part of the system (e.g., energy use, social integration) affects other parts, emphasizing the importance of comprehensive evaluation systems that capture these dynamics (Bertalanffy, 1968).
- Adaptation and Resilience: Housing systems must be adaptable to changes in demographics, environmental conditions, and social needs.

This theory supports the holistic approach taken by LEED-ND, which evaluates neighborhood developments as part of larger urban systems.

2.15 Key Protagonists

Several organizations have played significant roles in advancing the principles of green neighborhood development globally:

- U.S. Green Building Council (USGBC): The USGBC developed the LEED rating system, including LEED-ND, which has become an international benchmark for sustainable building practices. LEED-ND, with its emphasis on smart growth, urbanism, and green building at the neighborhood level, directly aligns with the principles of green neighborhood development.
- United Nations (UN): The UN's Sustainable Development Goals (SDGs), particularly Goal 11 (Sustainable Cities and Communities), advocate for inclusive, safe, resilient, and sustainable cities. The research acknowledges the importance of aligning national housing policies with the SDGs to create sustainable urban environments that align with the principles of green neighborhood development.
- Kenyan Government: The sources highlight the Kenyan government's commitment to affordable housing and sustainable urbanization through initiatives like the Big Four Agenda and Vision 2030. These initiatives aim to address the country's housing challenges while promoting sustainable development, which resonates with the objectives of green neighborhood development.

2.16 Conceptual Model

Based on the above theories, the conceptual model of this study would revolve around the intersection of sustainability (social, economic, environmental), affordable housing principles, and green building practices as represented by LEED-ND. The evaluation tool will incorporate indicators from these theoretical perspectives to assess the performance of affordable housing projects like Park Road Ngara in achieving sustainability goals.

1. Inputs: Neighborhood planning, housing design, green building practices, and stakeholder engagement.

2. Processes: Evaluation through LEED-ND criteria (e.g., smart location, green infrastructure).
3. Outputs: Assessment scores indicating the sustainability of the neighborhood.
4. Outcomes: Recommendations for policy improvements and sustainable housing development strategies in Kenya.

Research Constructs

1. Affordability: Measures of economic viability and accessibility of housing for low-income populations.
2. Sustainability: Indicators of environmental performance, including energy efficiency, water management, and resource conservation.
3. Social Inclusion: Evaluation of housing's contribution to community well-being, safety, and equitable access to services.
4. Neighborhood Connectivity: Assessment of housing projects' integration into urban infrastructure and proximity to essential services.
5. Green Building Practices: Evaluation of design, construction, and operation standards that align with LEED-ND principles.

The theoretical framework for this study integrates sustainability theory, green building principles (through LEED-ND), affordable housing concepts, and systems theory. These theoretical perspectives provide the foundation for developing an assessment tool that evaluates green neighborhoods within the Kenyan context. By addressing the affordability, sustainability, and social inclusion aspects of housing development, this framework guides the creation of a robust evaluation system tailored to Kenya's affordable housing challenges.

2.17 Key Constructs/Variables

1. Sustainability Dimensions
    - Social Sustainability (Affordable Housing Theory)
    - Environmental Sustainability (Green Building Practices)
    - Economic Sustainability (Affordability and Resilience)
    - Cultural Sustainability (Cultural and Community Aspects)

This part of the framework represents the multi-dimensional nature of sustainability, covering social, economic, environmental, and cultural aspects. These are foundational to understanding what makes a neighborhood green and affordable.

2. LEED-ND Evaluation Criteria
    - Smart Location & Linkage
    - Neighborhood Pattern & Design
    - Green Infrastructure & Buildings
    - Innovation and Regional Priority

This section incorporates the specific criteria from the LEED-ND framework that are critical for assessing green neighborhood development. These include smart location (access to transport, services), neighborhood pattern (walkability, connectivity), green infrastructure (energy, water management), and region-specific priorities.

3. **Affordable Housing Program Components**
    - Affordability
    - Housing Quality
    - Social Inclusion
    - Urban Connectivity and Infrastructure

Here, the framework introduces specific variables related to affordable housing, such as the affordability of units, the quality of housing provided, how inclusive the housing is, and how well connected it is to urban infrastructure. These components are central to the development of a comprehensive evaluation tool for green neighborhoods.

4. Green Neighborhood Outcomes
    - Livability (Quality of Life)
    - Environmental Performance (Energy, Water Efficiency, Waste Management)
    - Resilience (Climate Adaptation, Durability)
    - Community Integration (Access to Services, Public Spaces, Transportation)

The final outcome of the process is the creation of a sustainable, resilient, and integrated neighborhood that promotes livability, high environmental performance, and community well-being. This includes factors like climate resilience, access to services, and efficient use of resources.

2.18 Hypothesized Relationships

1. Sustainability Dimensions → Influence how affordable housing programs are planned and executed within a given context.
2. LEED-ND Evaluation Criteria → provides a structured, globally-recognized method for assessing the sustainability and livability of neighborhoods, directly informing the assessment tool's development.
3. Affordable Housing Components → represents the local-specific needs and challenges that must be integrated into the LEED-ND framework for it to be applicable in Kenya's context.
4. Green Neighborhood Outcomes → the ultimate goal of the assessment tool is to ensure that affordable housing in Kenya meets sustainability objectives, providing safe, affordable, and environmentally responsible housing for all.

Conclusion

This conceptual framework integrates sustainability dimensions, the LEED-ND evaluation criteria, and the unique needs of affordable housing programs in Kenya. By following this model, your assessment tool will help measure the performance of housing projects like Park Road Ngara in fostering green, resilient, and socially inclusive neighborhoods.

2.19 A Critical Perspective on LEED-ND and Affordable Housing in Kenya

1. Cost and Accessibility Barriers to LEED-ND Implementation

The research acknowledge the high initial costs associated with LEED-ND compliance, which can pose significant barriers for affordable housing developers in Kenya. This cost factor is particularly relevant in a context where affordability is already a primary concern.

Critique: A critical analysis should consider whether LEED-ND, despite its emphasis on sustainability, might unintentionally favor projects with larger budgets and more access to resources, potentially exacerbating existing inequalities in the housing market. This raises questions about the inclusivity of LEED-ND and its suitability for addressing the needs of the most vulnerable populations.

Recommendations

- Incentivize LEED-ND Adoption: The Kenyan government could explore financial incentives or subsidies to encourage developers to pursue LEED-ND certification for affordable housing projects. This could involve tax breaks, grants, or access to low-interest loans specifically for sustainable building practices.
- Develop Cost-Effective Strategies: Research and pilot projects could focus on identifying and promoting cost-effective strategies for achieving LEED-ND certification within the constraints of affordable housing budgets. This might involve exploring alternative materials, simplified design approaches, or community-based construction methods.

2. Contextual Relevance of LEED-ND Standards

Critique: A critical voice would scrutinize whether certain LEED-ND provisions, while well-intentioned, might not be appropriate or feasible in Kenya's unique social, economic, and environmental conditions. For example, provisions related to water conservation might need to be adjusted based on local water availability and infrastructure limitations.

Recommendations

- Develop Kenya-Specific LEED-ND Guidelines: A collaborative effort involving local experts, policymakers, and community representatives could lead to the development of Kenya-specific LEED-ND guidelines. These guidelines would clarify how to adapt the rating system to local contexts, ensuring relevance and practicality.

- Prioritize Locally Sourced Materials: The assessment tool could prioritize the use of locally sourced and sustainable building materials to reduce transportation costs, support local economies, and minimize the environmental impact associated with importing materials.

3. Trade-offs between Affordability and Sustainability

Critique: A critical perspective would examine how prioritizing certain sustainability features might impact the overall affordability of housing units. For example, energy-efficient windows can significantly reduce long-term energy costs, but their higher initial purchase price could make housing units less affordable for low-income families.

Recommendations

- Conduct Life Cycle Cost Analysis: The assessment tool could incorporate life cycle cost analysis to evaluate the long-term cost savings of sustainable building practices. This analysis would help developers and residents make informed decisions about prioritizing investments in sustainability features that offer the greatest long-term affordability benefits.
- Explore Innovative Financing Models: Research could explore innovative financing models, such as green mortgages or energy performance contracts, that could help offset the upfront costs of sustainable building practices and make them more accessible to affordable housing developers and residents.

4. Limitations of the Proposed Assessment Tool

Critique: A critical perspective would question the objectivity of the assessment tool and the reliability of the data used to evaluate projects. For example, if the tool relies heavily on resident surveys, the results might be influenced by social desirability bias or dissatisfaction with other aspects of the housing development.

Recommendations

- Develop a Transparent and Rigorous Methodology: The research should outline a transparent and rigorous methodology for data collection and analysis to ensure that the assessment tool is applied consistently and that the results are reliable and comparable across projects.
- Triangulate Data Sources: The assessment tool should incorporate data from multiple sources, such as building performance data, utility bills, and resident surveys, to provide a more comprehensive and balanced evaluation of sustainability performance.
- Develop Clear Criteria for Weighting Indicators: The research should establish clear criteria for weighting the different indicators in the assessment tool to ensure that the overall score reflects the relative importance of various sustainability factors.

5. Broader Social and Political Context

Critique: A critical voice would examine how factors such as land tenure systems, housing policies, and power dynamics might influence the success or failure of sustainable affordable housing initiatives. For example, projects located in areas with insecure land tenure might be more vulnerable to displacement or lack the community support needed to implement long-term sustainability practices.

Recommendations

- Incorporate Social Impact Assessment: The assessment tool could include a social impact assessment component to evaluate how housing projects affect existing communities, including potential displacement, access to resources, and social cohesion.
- Advocate for Policy Reforms: The research could identify policy reforms that would support the development of sustainable and equitable affordable housing. This might involve advocating for stronger tenant protections, land tenure reforms, or investment in public transportation infrastructure.

In conclusion, while LEED-ND offers a valuable framework for promoting sustainability in Kenya's affordable housing sector, a critical perspective highlights the need to carefully consider cost barriers, contextual relevance, potential trade-offs, and the limitations of assessment tools. By addressing these challenges and engaging with the broader social and political context, researchers and policymakers can contribute to more equitable and sustainable housing outcomes for all Kenyans.

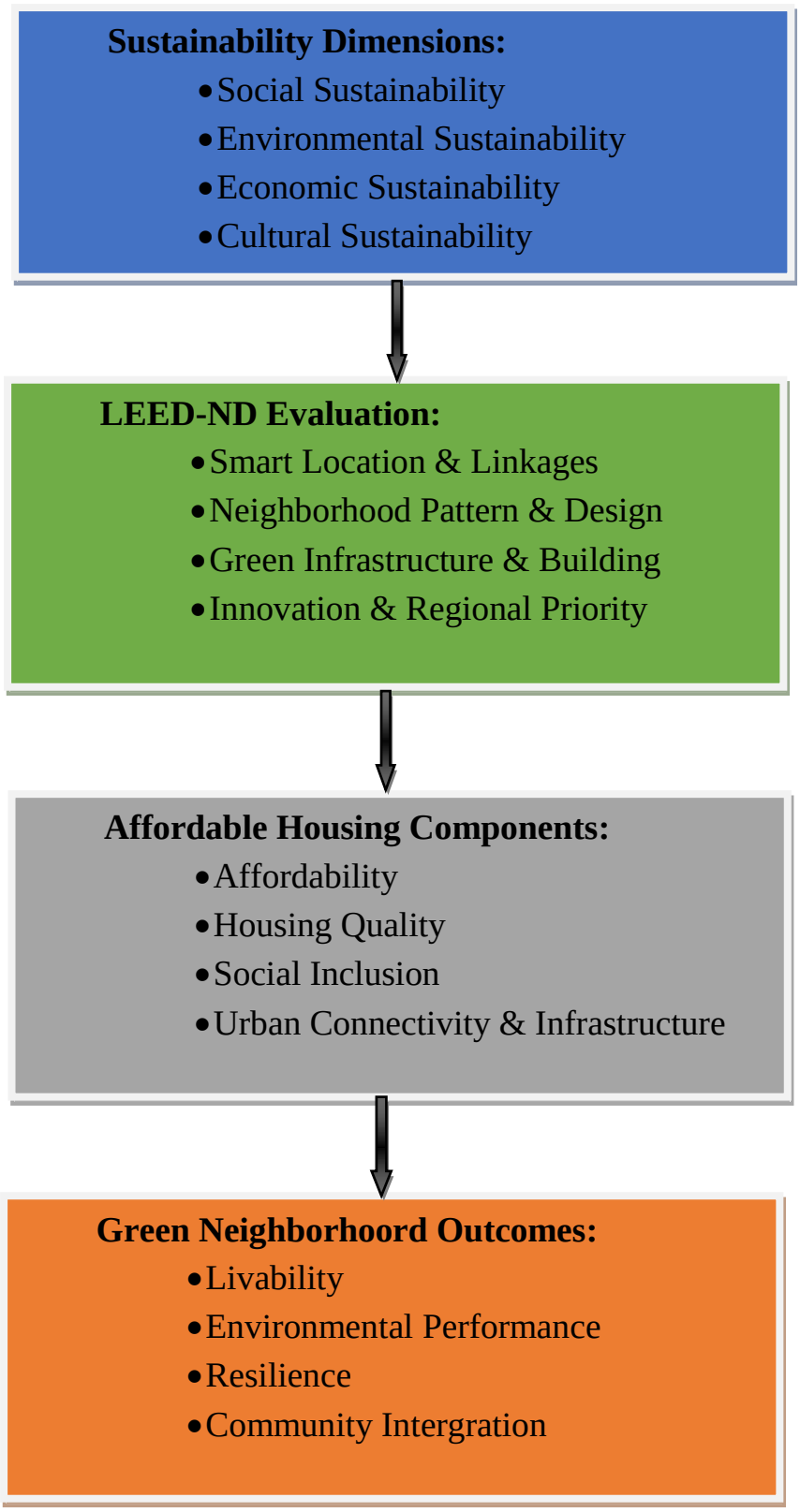


Figure 2.4: Conceptual Model

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methodology used in this study to develop a comprehensive assessment tool for evaluating the sustainability of affordable housing projects in Kenya, specifically those incorporating green neighborhood principles. The research centers on the Park Road Ngara Affordable Housing Project in Nairobi, examining its alignment with LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development) standards.

The study employs a mixed-methods research design, combining qualitative and quantitative approaches to provide a holistic understanding of the subject. This design choice is justified by the need to:

- Explore the lived experiences of residents: Qualitative methods, including structured interviews with tenants, are crucial for gaining insights into the social impacts and livability aspects of the project, capturing nuanced perspectives on community integration, access to amenities, and overall satisfaction with the neighborhood design.
- Quantify key sustainability indicators: Quantitative methods, including a structured questionnaire based on LEED-ND criteria, enable the measurement of objective factors such as the proximity to public transit, density of housing units, and the availability of green infrastructure.
- Triangulate findings for greater validity: The use of both qualitative and quantitative data allows for cross-validation of findings, strengthening the credibility and trustworthiness of the study's conclusions.

The chapter will further explain the specific research strategies employed, including:

- Case study approach: This approach provides an in-depth examination of the Park Road Ngara project within its real-world context, offering rich

descriptive data and insights into the dynamics of a specific affordable housing development in Kenya.

- Archival and documentary review: This strategy involves analyzing relevant documents and records, such as project plans, environmental impact assessments, and policy frameworks, to understand the broader context of affordable housing initiatives in Kenya.
- Observational data collection: This method utilizes an observational checklist based on LEED-ND criteria to systematically document the physical characteristics and design features of the Park Road Ngara project, providing firsthand evidence of its alignment with sustainable neighborhood principles.

Addressing the constraints inherent in researching real-world housing projects, the study employed several strategies to mitigate potential limitations, including:

- Flexible data collection schedule: To accommodate resident availability, interviews and observations were conducted during evenings and weekends, ensuring a representative sample of tenant experiences.
- Structured observation guide: This guide helped maintain objectivity during participant observations, focusing on measurable aspects of the environment rather than subjective impressions.
- Triangulation of data sources: Findings from multiple data sources, including interviews, surveys, and observations, were compared and contrasted to validate conclusions.

The chapter will proceed to describe the data collection procedures, including the sampling techniques, the development and validation of instruments, and the ethical considerations taken to protect participant rights and confidentiality. It will then explain the data analysis techniques, outlining how both qualitative and quantitative data were analyzed to draw meaningful conclusions.

By providing a detailed account of the methodological choices and procedures, this chapter aims to demonstrate the rigor and validity of the study's findings,

contributing to the development of a robust assessment tool for evaluating the sustainability of affordable housing in Kenya.

3.2 Justification of Research Design

The research design employed in this study is a mixed-methods approach, combining both qualitative and quantitative methodologies. This design was chosen to effectively address the complex nature of affordable housing in Kenya and to fulfil the research objectives.

Firstly, aligning the research design with the study's objectives is paramount. The objectives include understanding the sustainability practices in affordable housing, which require capturing both statistical data and nuanced perspectives from various stakeholders. A purely quantitative approach would limit the depth of understanding, while a qualitative approach alone would restrict the generalizability of findings.

Secondly, the use of mixed methods allows for a comprehensive exploration of the subject matter. Qualitative data obtained through interviews provide insights into stakeholder experiences and perceptions regarding affordable housing, while quantitative data from surveys will enable the measurement of broader trends and patterns within the community.

Furthermore, the complexity of the affordable housing context in Kenya necessitates a flexible research design that can adapt to evolving findings. The initial qualitative phase can inform the subsequent quantitative phase, ensuring that the survey instruments are relevant and targeted.

Finally, previous research has demonstrated the efficacy of mixed-methods approaches in housing studies, highlighting their ability to triangulate findings and enhance the credibility of results. This design is, therefore, not only appropriate but also essential for achieving the research aims.

3.3 Methodological choice

3.3.1 Qualitative Research Design

The qualitative research design for this study was chosen with careful attention to the research questions and objectives, specifically in the context of evaluating affordable housing in Kenya through the lens of neighborhood development rating systems. This approach enables a nuanced exploration of how LEED Neighborhood Development (LEED ND) standards influence the livability and long-term sustainability of affordable housing, as observed in the case of Park Road Ngara. Below, we detail the key factors that informed this choice and how they have been practically applied in this study.

- **Contextual Understanding**

The nature of affordable housing and neighborhood sustainability is highly context-dependent. Qualitative research allows the study to capture specific social, cultural, and environmental factors affecting the Park Road Ngara project. By engaging tenants through structured interviews, this approach facilitates insights into how LEED ND measures impact daily life within this neighbourhood. Interview questions explored areas such as tenant satisfaction with green spaces, public transport accessibility, and energy efficiency. This context-rich data sheds light on how these standards operate in a Kenyan urban environment, which is essential for understanding their broader applicability.

- **Theory Building and Contribution**

A qualitative approach enables this study to contribute to theoretical advancements in sustainable housing by examining the interplay between LEED ND standards and affordable housing success in Kenya. The findings aim to identify effective LEED ND provisions and potentially adapt them into a tailored framework for Kenyan affordable housing projects. Through thematic analysis of tenant responses, the research aims to reveal patterns and insights that inform theoretical frameworks specific to neighborhood sustainability in urban Kenya.

- **Flexibility for Exploration**

Affordable housing in Kenya, particularly under sustainability-focused programs, is dynamic and rapidly evolving. The qualitative approach allows the study to respond to new insights and adjust questions or focus areas as needed. For instance, if interviews revealed unexpected challenges in implementing LEED ND measures (e.g., issues with energy-efficient appliances or lack of awareness among tenants), the research design allows immediate adaptation to explore these areas further. This flexibility is critical for uncovering previously unconsidered factors that may impact LEED ND's effectiveness in promoting sustainable, affordable housing.

- **Practical Constraints**

Given the scope of this study and practical limitations, a qualitative approach provided a feasible means of collecting in-depth data without the extensive resources required for a large-scale quantitative study. In-depth, structured interviews with a smaller group of tenants allowed for detailed, meaningful insights within a manageable timeframe. This approach proved practical, given resource constraints, while still providing rich, comprehensive data on tenant experiences with LEED ND measures in Park Road Ngara.

- **Application in Data Collection and Analysis**

In this study, structured interviews with tenants served as the primary data collection tool for qualitative analysis. The interview structure focused on key elements of livability influenced by LEED ND, such as access to green spaces, and community connectivity. Responses were recorded, transcribed, and thematically analyzed to identify recurring themes and factors associated with tenant satisfaction and neighborhood sustainability. This thematic analysis not only addresses the study's objectives but also informs the development of a rating framework that could be applied to other affordable housing projects in Kenya.

This qualitative design, centered on structured interviews with tenants, provides an in-depth understanding of LEED ND's impact, advancing knowledge of

neighborhood development in Kenya and guiding the creation of more effective sustainability standards in affordable housing.

3.4 Research Strategy

This is the link between the philosophy and the subsequent choice of methods to collect data and analyze data (Denzin and Lincoln 2018).

- **Descriptive Research Design**

The quantitative research strategy for this study will primarily focus on descriptive research design. This approach will allow for the systematic collection of numerical data to quantify characteristics, behaviours, and opinions regarding the sustainability of the Park Road Ngara project in relation to LEED (Leadership in Energy and Environmental Design) neighborhood development standards.

It provides a comprehensive overview of the current practices and outcomes associated with the implementation of sustainable measures in affordable housing. This strategy is particularly useful for capturing the effectiveness of various sustainability evaluation tools and LEED credits.

- **Case study strategy**

A case study strategy was used as an in-depth inquiry into the topic of affordable housing rating tools within its real-life setting. Choosing the case to be studied and determining the boundaries of the study was a key factor in defining the case of the affordable housing program in Kenya. The case study research set out to understand affordable housing within its setting or context. This gave the capacity to generate insights from intensive and in-depth research into the study of neighborhood development phenomenon in its real-life context leading to rich, empirical descriptions. It was designed to identify what is happening and why and to understand the effects of the situation and the implications for action.

Case study strategies have been widely criticized by some because of misunderstandings about their ability to produce generalizable, reliable, and

theoretical contributions to knowledge (Flyvberg, 2011). This is largely based on positivist criticisms of using small samples and more generally about interpretive, qualitative research. This type of criticism has been countered and is generally losing favor as the value of qualitative and mixed methods research is recognized more widely (Denzin and Lincoln 2018).

Patton (2015) outlines several clues that were used to select this case:

a) If it happens there, it will happen everywhere
b) If they are having problems, can you be sure that everyone will have problems
c) If they cannot understand the process, is it likely that no one will be able to understand the process.

- **Archival and Documentary Strategy**

This research employed an archival and documentary strategy to systematically gather in-depth insights into neighborhood rating systems. The primary data sources included manuscripts, documents, administrative records, and other repositories accessed through online data archives and governmental websites such as the U.S. Green Building Council (USGBC). This approach facilitated the collection of relevant information that informs the understanding of how neighborhood rating systems operate and their implications for affordable housing in Kenya.

To ensure comprehensive coverage, various types of documentary materials were utilized, including annual reports, company results, and regulatory news. Each document was selected based on its relevance to the research objectives, particularly those concerning sustainability, livability, and community resilience in affordable housing projects. This targeted selection process helps bridge the gap between theory and practice, allowing for a nuanced analysis of existing evaluation frameworks.

While the documents used are classified as secondary sources—originally created for purposes other than this study it is critical to differentiate between re-analyzing previously collected research data and employing archival materials. In this research,

the archival documents were not intended for research purposes; thus, their initial context and intent must be carefully considered. This sensitivity guides the analysis process, ensuring that interpretations are informed by the original context of the documents.

For example, when analyzing regulatory news or annual reports, attention was given to how these materials reflect the implementation of LEED standards in affordable housing projects. This contextual understanding enhances the quality of the analysis and informs the development of a tailored evaluation framework. The conclusions drawn from these documents will be integrated with findings from qualitative interviews to provide a comprehensive view of the neighborhood rating systems in the context of affordable housing in Kenya

3.5 Procedure and Techniques

The sampling procedure used to obtain a representative sample was the non-probability sampling. The sample size did not depend so much on how many cases needed to be selected as to which cases needed to be selected. An already constructed affordable housing program in Kenya. The sample size depended on the research questions and objectives in particular what I needed to find out, what would be useful, what would have credibility, and what would be done within the available resources. This was so as the intention was to collect qualitative data using participant observation. Non-probability sampling procedures provide the opportunity to select the sample purposively and to also reach difficult-to-identify members of the target population.

The size for non-probability samples selected to address research questions that do not require statistical estimation is dependent.

3.5.1 Purposively Sampling

With purposive sampling, there was the need to use judgment to select the case that would best enable the researcher to answer the research questions and meet the main objectives. For this reason, it is sometimes known as judgmental sampling. This was

used because of the small sample such as in this case study research and the research wished to select the particularly informative case.

- **Selection of the Housing Project Site**

The primary site, Park Road Ngara, was chosen because it is a key government-led affordable housing project in Kenya, offering a representative example of recent initiatives to address housing challenges in urban areas. This site embodies critical aspects of affordable housing policies and standards, making it highly relevant for examining the impact and effectiveness of such projects.

- **Criteria-Based Selection of Participants**

Residents within the Park Road Ngara housing project were selected based on criteria that included their family structure, length of residence, and utilization of shared and public spaces. This allowed the research to capture a range of experiences and perspectives within the community, providing insights into how various demographic groups perceive and interact with the housing environment. Residents who frequently used outdoor areas, sidewalks, and public spaces were prioritized to ensure observations related to LEED ND factors, such as walkability, accessibility, and recreational use, were accurately captured.

- **Justification for Purposive Sampling**

The targeted selection of participants and site allowed for a focused analysis aligned with the research objectives. As the study aimed to explore specific environmental and social factors within affordable housing, purposive sampling was deemed the most effective approach for obtaining detailed, context-specific insights that random sampling might overlook.

- **Ensuring Representativeness and Richness of Data**

Although purposive, the sample included a diverse cross-section of residents from different backgrounds and usage patterns within the Park Road Ngara project. This diversity helped in generating findings that reflect the broader experiences of

residents within Kenyan affordable housing projects, enhancing the transferability of the evaluation framework developed in this research.

3.5.2 Stratified Random Sampling

Sampling Procedure: Stratified Random Sampling will be employed to ensure representation across different segments of the tenant population within the Park Road Ngara project. Stratification will be based on factors such as the type of housing unit (one-bedroom, two-bedroom, and three-bedroom) to capture diverse experiences and perspectives.

Sampling Technique: A sample size of approximately 100 tenants will be determined based on the total number of units (1,370) to achieve statistical significance. The sample will be randomly selected from each stratum to ensure that all groups are adequately represented.

By dividing tenants into strata based on the type of housing unit (one-bedroom, two-bedroom, and three-bedroom), this approach allows for the systematic capture of variations in residents' experiences and perspectives that may arise from living in different unit types.

The choice of sampling approximately 100 tenants out of 1,370 units further ensures statistical significance, lending robustness to the data. Random selection within each stratum ensures that every tenant in a particular unit category has an equal chance of being selected, thereby minimizing sampling bias and enhancing the representativeness of the findings.

3.6 Data Collecting Tool

3.6.1 Observation

The goal is to gain a deeper understanding of resident experiences and perspectives related to LEED-ND principles within the Park Road Ngara affordable housing project.

Researcher's Role: To gain a comprehensive understanding of resident experiences and perspectives, the researcher will actively participate in the community. This active participant observer role involves both observing and engaging in daily activities and interactions with the community. This approach allows for a deeper understanding of resident perspectives and the lived experiences of LEED-ND principles within the unique context of the Park Road Ngara project.

Specific Activities

- **Community events:** The researcher will attend community events such as meetings, social gatherings, and workshops, if any to carefully observe resident interactions. These observations will provide valuable insights into community dynamics, social cohesion, and resident perceptions of the neighborhood, particularly regarding LEED-ND principles. For instance, attending resident association meetings could offer insights into community concerns, while social gatherings might reveal how effectively shared spaces are being utilized.
- **Informal conversations:** The researcher will engage in informal conversations with residents in public spaces such as parks, common areas, and sidewalks. These conversations will be used to gather diverse perspectives on liveability, accessibility, and sustainability aspects of the project. These informal interactions can provide valuable qualitative data on resident satisfaction, perceived benefits of LEED-ND features, and any challenges they face. For instance, conversations near a community garden could reveal resident opinions on local food production or the adequacy of green spaces.
- **Observation of daily routines:** By observing resident daily routines such as commuting patterns, use of public spaces, and engagement with community amenities, the researcher aims to understand how LEED-ND principles influence their daily lives. These observations will focus on specific LEED-ND elements, such as walkability, access to public transportation, and the utilization of green spaces, providing insights into how well the project's design translates into practical benefits for residents. For example, observing

how residents commute to work could reveal the effectiveness of public transportation options or the walkability of the neighborhood.

Duration of observation: Considering the time constraints of a research student, the participant observation will span a period of one month. This period allows for sufficient immersion in the community to build rapport with residents and observe recurring patterns in their daily lives, providing a strong foundation for qualitative analysis and the timeframe allows for a balance between data richness and feasibility.

Researcher's positionality and reflexivity: Acknowledging the potential for bias, the researcher will engage in regular reflexivity exercises throughout the observation period. These exercises will involve critically examining their own assumptions, perspectives, and any potential influence on the research process, ensuring that interpretations are grounded in the data and not influenced by personal biases.

3.6.2 Questionnaire

- A structured questionnaire will be developed to gather quantitative data from the selected tenants. The questionnaire will include a mix of closed-ended questions (using Likert scales) and demographic questions to gather relevant information on tenants' experiences, satisfaction levels, and perceptions of the sustainability measures in place.

Key Components of the Questionnaire:

1. Demographic Information (age, gender, type of housing unit)
2. Awareness and Understanding of LEED Standards
3. Assessment of Sustainability Measures (e.g., energy efficiency, water conservation)
4. Perceived Impact of Sustainability Practices on Quality of Life
5. Suggestions for Improvement in Sustainable Practices

3.7 Data Recording

Recording data needed to occur as close to its observation as possible. It was important to take notes of the observations as they occurred. The researcher created video recordings, static images, observational checklists, and audio recordings in the observational research. The recordings and images were transformed into drawings, and written data and treated as visual or audio data in their own right and used in analysis and as visual representation in the research report.

- **Field Notes:** Detailed field notes will be taken during and after each observation session. These notes will serve as a comprehensive record, capturing not only objective observations but also the researcher's reflections, emerging themes, and any noteworthy interactions.
- **Audio Recordings:** With the explicit consent of the residents involved, audio recordings of conversations and informal interviews will be made. These recordings will ensure accurate transcription and a comprehensive capture of resident perspectives and experiences, particularly regarding LEED-ND elements within the project.
- **Photographic Documentation:** To visually document the research, photographs of key spaces, community activities, and infrastructure elements will be taken. These photographs will serve as visual aids, providing context to the observational data and supporting the researcher's interpretations.

3.8 Data Analysis

Qualitative data need to be prepared carefully for analysis. Analysis often occurs during the collection of data as well as after it. Understanding key aspects of different qualitative analysis techniques should help one choose an appropriate technique or combination of techniques to analyze qualitative data. The following are the aids that shall be used to help in analysis of the data:

a) Transcript summaries

This will involve compressing long statements into fewer words. Through summarizing, the researcher will become conversant with the principal themes emerging. I will be able to note and identify possible relationships between themes so that I can return to these to seek and establish their wider credibility.

b) Document summaries

Where you use any sort of documents it is helpful to produce a document summary. This will be used to summarize and list documents key points for the research, outline how it relates to the research, and why it is significant. As the research progresses, there is a likelihood that one will forget some of the thoughts about previous data collection and analysis, so a document summary, like other analytical aids, will act as a reminder of your earlier ideas.

c) Self-memos

Self-memos serve as a way to jot down your thoughts on any aspect of your research as they come to mind. These self-memos can range in length from just a few words to one or more pages, and they don't need to be presented formally. It's beneficial to include dates on these self-memos and, when relevant, make cross-references to corresponding photos, notes, or transcripts in analysing data qualitatively

i).Thematic analysis:

This is often considered a general analytic approach or method in which patterns or meanings are developed through processes of coding (Braun and Clarke 2006; 2002). The essential purpose is to search for themes or patterns that occur across a data set. It is systematic as it provides an orderly and logical way to analyze qualitative data, leading to descriptions, explanations, and theorizing. This involved the following phases:

- Data familiarization:

The researcher became familiar with the data by producing transcripts of the observations conducted and as she read through documents and reviewed visual images. The act of transcribing the data item yourself, allows you to develop familiarization. It also prompted the generation of summaries, self-memos, and entries in the notebook that aided in the analysis.

- Data coding

This involved categorizing data with similar meaning. It involved labeling each unit of data within a data item with a code that summarizes and extracts meaning. The purpose of undertaking this process was to make each piece of data that I am interested in accessible for further analysis.

ii).Visual analysis

This makes use of existing visual images created by the researcher. They may be categorized as static such as photographs and drawings or moving such as video films and television. This process involves (Rose 2016):

- Identifying categories of visual data in which you are interested
- Developing a systematic coding scheme
- Coding your visual images using this scheme

Manual Recording: In addition to digital tools, a backup of responses will be maintained through a manual recording system, where responses can be logged on paper for cross-verification purposes. This dual recording method ensures that no data is lost and provides a safeguard against potential technical issues with online tools.

Data Validation: After data collection, validation checks will be performed to identify and rectify any discrepancies or inconsistencies in the recorded data. This may include checking for duplicate entries or ensuring that all required fields have been completed.

Data Analysis: The quantitative data collected will be analysed using **statistical analysis software** (e.g., SPSS or Excel). The following analyses will be conducted:

- **Descriptive Statistics**: To summarize and describe the basic features of the data, including measures of central tendency (mean, median) and variability (standard deviation).
- **Inferential Statistics**: To assess relationships and differences among variables, such as the correlation between tenant awareness of LEED standards and their perceptions of sustainability measures.
- **Comparative Analysis**: If data from other similar projects becomes available, comparative analysis can be performed to identify best practices and lessons learned.

3.9 Assessing the Quality of Research Design

Reliability and validity are crucial to judgments about the quality of research. Reliability is the extent a data collection procedure yields consistent findings and validity is the extent these procedures measure accurately what they are intended to measure and the research findings are about what they profess to be about. Ensuring data reliability and validity in a qualitative research design focused on the adoption of green neighborhood rating systems for affordable housing is essential to maintaining the credibility and trustworthiness of the study.

- **Reliability and validity**

This was promoted by consistency throughout the stages of the research project by writing notes and keeping detailed notes about how the data was coded, analyzed, and interpreted. The researcher ensured continued data collection until she reached data saturation, meaning that no new themes or insights emerged from the data. Saturation helps ensure that you've thoroughly explored the research questions.

Data was also collected from multiple sources documents, observations, and archival records. Using multiple sources provided a comprehensive view of the case and reduced the risk of relying on a single, potentially biased data source.

Data Sampling was done strategically in the selection of cases and participants. Ensure that they are relevant to your research questions and that you have access to the necessary data sources. Use purposeful sampling methods to target specific cases or participants that provide the most valuable insights. Following these steps and maintaining a systematic, transparent, and rigorous approach, enhanced the reliability and validity of your case study research. This, in turn, will strengthen the credibility of your findings and contribute to the overall quality of your study.

Employ triangulation by comparing and cross-referencing data from different sources and methods. When multiple sources of data consistently point to the same conclusions or patterns, it enhances the reliability and validity of your findings.

3.10 Overcoming Constraints in the Research Process

- **Resident Availability and Engagement**

Engaging with residents for interviews and observations proved challenging due to varying schedules and willingness to participate. To overcome this, the researcher adopted a flexible approach by scheduling visits during times when residents were more likely to be available, such as weekends and evenings. This allowed for higher participation and richer engagement with residents' experiences.

- **Logistical Constraints in Field Observation**

The physical layout of the neighborhood and timing of observations posed logistical issues. Observations were carefully planned around peak activity times, such as morning commutes and afternoons, when residents commonly utilized outdoor areas and public spaces. Additionally, using a structured checklist aligned with the LEED ND rating system facilitated consistent data collection across multiple observation sessions, improving both efficiency and accuracy.

- **Maintaining Objectivity in Participant Observation**

To minimize potential biases in observing residents' day-to-day activities, a structured observation guide was created. This guide helped ensure that each

observation focused on measurable aspects of the environment, such as accessibility, walkability, and outdoor space use, rather than subjective impressions. Regular reflections and peer consultations were also used to verify findings and maintain objectivity.

3.11 Ethical Considerations

In conducting this study, various ethical considerations are taken into account to uphold the rights, welfare, and dignity of the participants. Recognizing the study's potential impact on tenants of affordable housing, specific measures have been implemented to ensure ethical integrity throughout the research process:

- Informed Consent

All participants involved in the study were provided with detailed information regarding the research objectives, procedures, potential risks, and benefits. Participation was entirely voluntary, and informed consent was obtained before engaging participants in any research activities, including surveys and observational data collection. This consent process ensured that tenants were fully aware of their involvement and retained the right to withdraw at any point without penalty.

- Confidentiality and Privacy

Given the sensitive nature of personal experiences related to housing and community living, maintaining confidentiality and privacy was a priority. Personal data collected from participants was anonymised to protect their identities, and any identifiable information was securely stored and made accessible only to authorized research personnel. Additionally, data was reported in aggregate to prevent linking responses to individual participants.

- Avoidance of Harm

The study took precautions to minimize any potential risks or discomforts that participants might have faced during data collection. The observational component, for instance, was conducted passively and focused on public spaces to avoid

intruding on residents' private lives. Participation in surveys was designed to be non-intrusive, with questions structured to avoid distressing or sensitive topics.

Anonymity and Confidentiality

- **De-Identification of Data:** All data collected were anonym zed by removing identifying information such as names, addresses, or other unique identifiers. Unique codes were assigned to each participant and used consistently throughout the data collection and analysis process.
- **Secure Data Storage:** Data were stored in a secure location, whether physical or electronic, with access restricted to authorized research personnel. Measures such as password protection, encryption, and other security protocols were employed to safeguard the data from unauthorized access.
- **Aggregate Reporting:** Findings were reported in aggregate form, emphasizing overall trends and patterns rather than individual responses. This approach ensured that individual participants could not be identified from the published results.

3.12 Critical Examination of the Research Design

The research design was instrumental in addressing the objectives of the study; however, it is essential to critically examine its strengths and weaknesses. The use of structured interviews ensured consistency and comparability in the data collection process. Nonetheless, this approach may have limited the depth of responses, as participants could have felt constrained by predefined questions. Stratified random sampling provided a representative tenant selection based on housing unit types, yet it may not have captured the full spectrum of tenant experiences, especially those influenced by unique or outlier circumstances.

Additionally, the reliance on LEED-ND as a framework brought a level of rigor and global relevance to the evaluation. However, it also introduced a potential bias, given that the framework was designed for developed contexts and may not fully align with the cultural and socio-economic realities of Kenya. This limitation highlights the importance of continuously adapting global frameworks to local needs.

3.12.1 Reflection on the Researcher's Role

The researcher's positionality played an implicit role in shaping the research process and outcomes. For instance, personal beliefs about sustainability and affordability may have influenced the focus on particular LEED-ND credits or the interpretation of tenant responses. While every effort was made to remain objective, the act of observing residents and interpreting their behavior carries an inherent subjectivity.

Moreover, the researcher's focus on sustainability as a key theme might have unintentionally prioritized environmental aspects over social or economic concerns. Recognizing this influence underscores the importance of maintaining a balanced perspective throughout the research process.

3.12.2 Discussion of Alternative Perspectives

The study primarily emphasized the integration of sustainability into affordable housing through the LEED-ND framework. However, alternative perspectives could provide valuable insights. For instance, some stakeholders might argue that affordability should take precedence over sustainability, particularly in contexts where low-income populations struggle with basic housing access. Conversely, others might critique the adaptation of LEED-ND, suggesting that locally developed frameworks rooted in indigenous knowledge and practices could be more effective in addressing Kenya's unique challenges.

These alternative viewpoints highlight the complexity of balancing competing priorities in affordable housing and underscore the need for continuous dialogue among stakeholders to refine evaluation frameworks.

3.12.3 Limitations and Future Directions

While the study provided valuable insights into the adaptation of LEED-ND for Kenya, it is important to acknowledge its limitations. The case study approach, focusing solely on the Park Road Ngara project, offered a detailed examination but may not fully represent the broader Kenyan affordable housing context. Future

research could expand the scope to include multiple projects across diverse regions to capture a more comprehensive picture.

Another limitation lies in the theoretical nature of the LEED-ND adaptation. The study focused on identifying relevant credits and aligning them with Kenyan conditions, but practical implementation and testing were beyond its scope. Future studies could pilot the proposed framework, assessing its feasibility and effectiveness in real-world applications.

Lastly, tenant perspectives were captured at a single point in time. Longitudinal studies could provide a richer understanding of how sustainability measures impact livability, affordability, and tenant satisfaction over the long term

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION, AND DISCUSSION

4.1 Introduction to Data Analysis

The data analysis chapter presents the findings of the study, interpreting the results through both quantitative and qualitative lenses to meet the research objectives. The primary goal of this analysis is to develop a robust understanding of the current state of liveability, affordability, and community resilience within Kenya's affordable housing projects, using the Park Road Ngara project as a case study. The analysis aims to provide insights that inform the development of an evaluation framework for affordable housing projects, tailored to the Kenyan context.

4.2 Objectives of Data Analysis

The specific objectives guiding this data analysis include:

1. To assess and analyze existing tools for evaluating affordable housing projects, focusing on specific criteria that influence livability, affordability, and community resilience.
2. To identify key LEED-ND standards that enhance the sustainability, affordability, and livability of affordable housing, and use these insights to develop a tailored evaluation framework for affordable housing projects in Kenya
3. To develop an assessment tool for affordable housing projects in Kenya that integrates relevant LEED-ND standards and insights from affordable housing initiatives, with the goal of enhancing project evaluation for affordability, livability, and sustainability.

4.3 Types of Data Collected

Data was collected through surveys, participant observation, and document reviews:

- Quantitative Data: Survey responses from approximately 100 tenants, addressing various aspects of their housing experience (satisfaction with amenities, accessibility of outdoor spaces, affordability).
- Qualitative Data: Observational data from participant observation sessions focused on daily resident activities, usage of public spaces, and walkability, grounded in LEED-ND criteria. Additional qualitative data was gathered from open-ended survey responses.

4.4 Data Analysis Methodologies

To address these objectives, two primary methodologies were applied:

1. Quantitative Data Analysis
    - Descriptive Statistics: Used to summarize tenant satisfaction and accessibility ratings. Descriptive measures help establish an overall picture of tenant experiences and satisfaction.
    - Inferential Statistics: Where applicable, inferential statistics were employed to identify any significant relationships or differences between tenant satisfaction levels across unit types (one-bedroom, two-bedroom, and three-bedroom).
2. Qualitative Data Analysis
    - Thematic Analysis: Thematic analysis was used to identify key themes from the observational data and open-ended survey responses, focusing on LEED-ND-based criteria such as accessibility, public space usage, and walkability.
    - Comparative Analysis with LEED-ND Standards: Observational data was analysed against LEED-ND standards, drawing comparisons to identify alignment or deviations, which will inform recommendations for Kenyan affordable housing evaluation frameworks.

This analytical framework ensures that both quantitative and qualitative data are interpreted in alignment with the study's objectives, supporting a comprehensive understanding of affordable housing effectiveness in the Kenyan context.

Objective 1: assessment and analysis of existing tools for evaluating affordable housing projects

Objective one of this study sought to assess and analyse existing tools used to evaluate affordable housing projects, with a focus on the criteria influencing liveability, affordability, and community resilience. Evaluating these tools was essential for understanding their applicability and effectiveness in the context of affordable housing in Kenya. Existing evaluation frameworks may offer useful criteria and methodologies for assessing projects, but they may not fully address the unique challenges of Kenyan urban development. This section reviewed and evaluated these tools to identify their strengths, weaknesses, and gaps, providing a foundation for developing a tailored evaluation framework for affordable housing projects in Kenya.

The literature review for this research focused on understanding existing frameworks, tools, and standards for evaluating affordable housing projects. It specifically examined how these tools assess criteria that influence liveability, affordability, and community resilience.

Relevance to the Kenyan Context: The literature review emphasized the need to consider Kenya's unique social, economic, and cultural context when evaluating affordable housing projects. For instance, cost-effectiveness and access to local infrastructure were identified as critical factors that were not adequately addressed by existing tools. This pointed to the need for a more context-specific evaluation framework tailored to Kenya's affordable housing sector.

Setting the Stage for the Tailored Framework: The gaps identified in existing evaluation tools and frameworks highlighted the need for a tailored evaluation framework for affordable housing in Kenya. The literature review laid the groundwork for developing such a framework by analysing the strengths and

limitations of existing tools, thus informing the next stages of the research (Objective 2 and Objective 3).

Summary of Tools Reviewed in the Literature

1. LEED-ND (Leadership in Energy and Environmental Design for Neighborhood Development)
    - Overview: LEED-ND is a comprehensive green building certification system designed to evaluate neighborhoods based on sustainability, liveability, and environmental impact. It emphasizes energy efficiency, environmental protection, community resilience, and sustainable transportation.
    - Relevance: LEED-ND was central to the study as it offered a framework for assessing sustainable neighborhood development. However, its focus on environmental criteria, while robust, limits its assessment of affordability and economic viability, which are critical in the context of affordable housing in Kenya.
2. BREEAM (Building Research Establishment Environmental Assessment Method)
    - Overview: BREEAM is a green building rating system that evaluates buildings on energy use, water efficiency, indoor air quality, and material selection. It is widely used across Europe and offers a holistic approach to environmental sustainability.
    - Relevance: In comparison to LEED-ND, BREEAM offers a stronger emphasis on environmental performance but does not fully integrate social sustainability factors or affordability, making it less comprehensive for assessing affordable housing projects in the Kenyan context.
3. Green Star (Australia)
    - Overview: The Green Star rating system assesses buildings for their environmental sustainability, focusing on energy efficiency, water management, and indoor environmental quality. It is particularly well-regarded in Australia.

- Relevance: Similar to BREEAM, Green Star places a strong emphasis on environmental criteria but does not address social sustainability or affordability as directly as would be required for affordable housing projects in Kenya.

4. DGNB (German Sustainable Building Council)
    - Overview: DGNB evaluates buildings from a comprehensive life cycle perspective, considering economic, environmental, and social sustainability factors. It focuses on long-term sustainability, cost-effectiveness, and resource efficiency.
    - Relevance: DGNB's holistic approach, incorporating social and economic factors, makes it a strong comparison for LEED-ND in your research. Its emphasis on life cycle assessment and economic feasibility provides insights into evaluating the long-term viability of affordable housing projects in Kenya.
5. CASBEE (Comprehensive Assessment System for Built Environment Efficiency)
    - Overview: CASBEE is a Japanese-based rating system that evaluates building performance from environmental, economic, and social perspectives. It focuses on achieving sustainable development while addressing various performance metrics.
    - Relevance: CASBEE's integration of economic and social sustainability alongside environmental factors offers valuable insights for your study. Its focus on resource efficiency and social inclusion aligns well with the need to address affordability and community resilience in affordable housing projects.

4.4.1 Need for a Tailored Framework

Based on the analysis of the existing tools, it is clear that none of these systems fully address the unique needs of affordable housing projects in Kenya. The key gaps identified are:

- Affordability: Many of the reviewed tools, including LEED-ND and BREEAM, do not place enough emphasis on cost-effectiveness, a critical factor in the development of affordable housing.
- Economic Viability: While tools like DGNB and CASBEE consider life cycle costs, a tailored framework for Kenya would need to focus more explicitly on the economic feasibility of affordable housing, considering local market conditions and financial constraints.
- Social Sustainability: Most of the tools reviewed offer limited insights into social sustainability, particularly in terms of community inclusivity, liveability, and tenant well-being. This is crucial in Kenya, where housing projects must not only be affordable but also foster social cohesion and community resilience.

Therefore, based on the findings from the review, there is a clear need for a more tailored evaluation framework that combines elements of environmental sustainability, economic viability, and social sustainability, while addressing the unique Kenyan context. This framework should integrate the relevant aspects of the reviewed tools but adapt them to the specific challenges and opportunities in Kenya's affordable housing sector.

Objective 2: Analysing LEED-ND Standards for Kenyan Affordable Housing

This objective aims to examine LEED Neighborhood Development (LEED-ND) standards, with a specific focus on identifying provisions that enhance sustainability, affordability, and liveability within affordable housing contexts. Given the unique socioeconomic and environmental conditions in Kenya, it is essential to adapt internationally recognized LEED-ND standards in a way that directly aligns with local needs and priorities in affordable housing.

By analysing LEED-ND provisions, this study seeks to determine which aspects of these standards apply to Kenyan affordable housing projects to improve the quality of life for residents while maintaining cost-effectiveness. This analysis will serve as the foundation for developing a tailored evaluation framework that reflects both global best practices and localized needs. The framework ultimately aims to provide

a structured and actionable approach for assessing new and ongoing affordable housing projects in Kenya, ensuring that they meet targeted benchmarks for liveability, environmental sustainability, and economic feasibility.

Selection Criteria

To ensure that the LEED Neighborhood Development (LEED-ND) standards applied in this study are directly relevant to affordable housing in Kenya, specific selection criteria were established to evaluate the appropriateness and impact of each LEED-ND provision. The criteria used for selecting relevant LEED-ND credits and prerequisites were based on their potential contributions to three key areas: sustainability, affordability, and liveability.

1. Sustainability: Provisions were selected based on their ability to support environmental resilience, resource efficiency, and reduced environmental impact. This included credits that encourage energy-efficient design, water conservation, and the use of renewable resources—features that align with Kenya's climate considerations and environmental goals.
2. Affordability: The economic feasibility of each LEED-ND standard was a critical consideration. Credits that required significant upfront costs or expensive materials were carefully evaluated to ensure they could be applied without excessively increasing project costs, allowing for greater accessibility for low-income households.
3. Liveability: Provisions promoting residents' quality of life, including access to green spaces, walkability, community amenities, and safety, were prioritized. These elements support social cohesion, provide the functionality, and comfort essential for liveable, inclusive communities.

Through this selection process, only the LEED-ND credits and prerequisites meeting these criteria were chosen as relevant to developing an affordable housing evaluation framework that fits Kenya’s unique housing challenges and opportunities.

Analytical Approach

A thematic analysis was employed to systematically examine selected LEED-ND provisions, grouping them into themes aligned with sustainability, affordability, and liveability. This approach enabled the identification of key themes within LEED-ND that could enhance Kenyan affordable housing. The analysis involved the following steps:

1. Categorization of Provisions: Each relevant LEED-ND credit was categorized under the themes of sustainability, affordability, or liveability, providing a structured basis for assessing how each theme might be strengthened through these standards.
2. Contextual Evaluation: Each selected provision was evaluated in the Kenyan context. For instance, the liveability provisions were assessed against local urban planning norms to understand their practicality in Kenyan neighborhoods.
3. Feasibility Assessment: Finally, a criteria-based assessment was performed to determine the feasibility of applying each standard in typical Kenyan affordable housing settings. This helped identify actionable LEED-ND provisions that could realistically be integrated into Kenyan housing policy and project design, contributing directly to the objective of creating a contextualized evaluation framework.

This analytical approach not only ensured a detailed and contextually grounded analysis of LEED-ND standards but also provided clear guidelines on the most applicable provisions for Kenyan affordable housing.

Application to Kenyan Housing Needs

1. **Walkable Streets**
    - Description: The LEED-ND "Walkable Streets" provision promotes pedestrian-friendly infrastructure, including safe sidewalks, street connectivity, and accessible crosswalks. This provision encourages

residents to walk rather than rely on vehicles, supporting health and reducing emissions.

- Application in Kenya: In the context of affordable housing in Kenya, walkable streets offer significant benefits. Many residents rely on walking as their primary mode of transportation, especially in urban and peri-urban areas. Prioritizing walkable streets within housing projects could reduce commuting costs, encourage active lifestyles, and enhance safety, particularly for children and elderly residents.

2. **Access to Quality Transit**
    - Description: This provision aims to situate housing within close proximity to reliable public transit options, reducing the need for private vehicle ownership and contributing to lower transportation expenses for residents.
    - Application in Kenya: For Kenyan affordable housing projects, access to quality transit is particularly impactful, as public transit is often the primary means of commuting for many residents. Incorporating this provision would involve positioning housing projects near major transit corridors or designing shuttle services to link residents to key transit points, thus improving mobility without significantly adding to project costs.
3. **Green Infrastructure and Rainwater Management**
    - Description: This provision focuses on managing storm water runoff through sustainable solutions such as permeable surfaces, green roofs, and rainwater harvesting. It also emphasizes protecting natural water bodies and reducing urban flooding.
    - Application in Kenya: In Kenya, where droughts and water scarcity are significant issues, rainwater harvesting and sustainable storm water management could help reduce water costs and improve water accessibility for residents. Implementing green infrastructure within housing projects can both support environmental sustainability and provide a cost-effective water source for daily use, which is particularly beneficial in low-income areas.

Relevance to Affordability and Liveability

1. **Energy-Efficient Building Design**
    - Description: LEED-ND promotes energy-efficient building standards, encouraging designs that optimize insulation, natural lighting, and ventilation to reduce energy demand and reliance on artificial lighting and cooling.
    - Affordability and Liveability in Kenya: Energy-efficient design directly supports affordability, as lower energy consumption translates into lower utility costs for residents. In the Kenyan context, where electricity costs are high relative to income levels, this provision can significantly reduce living expenses. Additionally, well-ventilated, naturally lit spaces contribute to better indoor air quality and overall resident well-being, enhancing liveability in these homes.
2. **Access to Green Spaces and Recreation Areas**
    - Description: LEED-ND emphasizes the importance of accessible green spaces within neighborhoods to support mental and physical health, offer recreational opportunities, and foster community connections.
    - Application in Kenya: Access to green spaces provides residents, particularly families with children, safe areas for recreation and relaxation. In dense urban areas where open spaces are limited, including parks or play areas in affordable housing projects would contribute to a higher quality of life. This access to recreational facilities aligns with Kenyan social structures that value community interaction and offers a cost-effective method to enhance liveability without adding to housing costs.
3. **Water Conservation and Recycling**
    - Description: Provisions under LEED-ND related to water conservation promote the use of low-flow fixtures, water-efficient landscaping, and even grey water recycling for non-potable uses like irrigation.

- Impact on Affordability: Given Kenya’s frequent water shortages and high water prices, incorporating water-saving features is both a cost-effective and sustainable solution. Residents could experience lower water bills and improved water availability, contributing to both affordability and resource conservation.

4. Framing LEED-ND Provisions in Kenya’s Economic and Social Landscape

Each of these LEED-ND provisions has been framed with Kenya's unique economic, environmental, and social challenges in mind:

- Economic Relevance: For low-income populations, affordability extends beyond the initial purchase price to include ongoing operational costs. Provisions for energy efficiency and water conservation reduce long-term expenses, making homes more affordable over time.
- Social Impact: The focus on walkable streets, transit access, and green spaces aligns with Kenya’s urban planning goals of fostering community, improving public health, and increasing accessibility. These provisions not only support affordability and sustainability but also contribute to the social well-being and cohesion of residents.

Mixed-Use Neighborhoods

- Description: This credit encourages a mix of residential, commercial, and recreational spaces within walking distance, reducing the need for long commutes and supporting local economic activity.
- Kenyan Application: Mixed-use developments are particularly beneficial in Kenya, where access to markets, schools, healthcare, and other services is essential for low-income families. This integration fosters vibrant communities, reduces transportation costs, and promotes economic resilience.

- **Housing and Jobs Proximity**
    - Description: This credit focuses on creating housing near employment opportunities, helping residents reduce commuting times and costs.
    - Relevance in Kenya: This would be highly relevant in Kenya's urban settings, where many affordable housing residents work in industrial or service sectors. Locating housing near employment hubs or providing easy access to them could directly enhance affordability and work-life balance.
- **Neighborhood Pattern and Design Connected and Open Community**
    - Description: LEED-ND values connected open communities with interconnected streets that foster walkability and accessibility.
    - Application in Kenya: In densely populated areas, this credit supports enhanced mobility and connectivity within and around affordable housing. Such designs can help create safer, more accessible spaces, fostering a sense of community and inclusion.
- **Reduced Parking Footprint**
    - Description: LEED-ND advocates for minimal parking spaces to reduce environmental impacts, prioritizing spaces for bicycles and shared vehicle services.
    - Relevance to Kenyan Housing: Given limited urban space and the low car ownership among low-income households in Kenya, reducing parking requirements helps free up space for other amenities or green spaces while lowering development costs.
- **Smart Location**

    - The concept of Smart Location, as outlined in LEED-ND, plays a critical role in the Kenyan context, particularly given the challenges posed by rapid urbanization, traffic congestion, and the growing demand for affordable housing in urban areas. Smart Location principles focus on reducing transportation costs and improving access to jobs and services, which is essential for enhancing the affordability and livability of housing projects. In cities like Nairobi, where public transportation systems are underdeveloped, and

commute times are long, integrating Smart Location principles into housing development could significantly improve residents' quality of life and reduce the economic burden of commuting. Therefore, applying LEED-ND's Smart Location standards in affordable housing projects in Kenya aligns with the nation's broader goals of promoting sustainable urbanization and reducing social inequalities."

- **Regional Priority Credits**
    - Description: LEED-ND allows regional priority credits that adapt to specific local issues, such as water scarcity or renewable energy needs, allowing projects to respond to unique environmental challenges.
    - Kenyan Context: For Kenya, where water scarcity and sustainable energy are crucial, regional credits can focus on water-efficient landscaping, rainwater harvesting, and locally sourced materials, aligning well with affordability and sustainability goals.
- **Community Outreach and Involvement**
    - Description: This credit encourages active community engagement and stakeholder involvement in project development and planning, ensuring that residents' needs and preferences are considered.
    - Application in Kenya: Community involvement is essential for affordable housing success in Kenya. Engaging future residents in planning fosters trust, aligns project outcomes with community needs, and can improve acceptance and satisfaction.
- **Access to Healthy Food**
    - Description: This LEED-ND credit incentivizes access to healthy food options within or near residential areas.
    - Relevance to Kenya: In areas where food security and nutrition are concerns, this credit could be particularly impactful. Access to fresh food markets or community gardens within housing projects can improve residents' quality of life and health.

Each of these LEED-ND credits complements the Kenyan affordable housing objectives by addressing specific economic, social, and environmental needs. Together, they contribute to an adaptable framework that can enhance the sustainability, liveability, and affordability of housing projects in Kenya.

1. Quantitative Findings and Interpretation

- Tenant Satisfaction (Statistical Analysis)
    - Finding: A statistical analysis (mean scores and standard deviation) of tenant responses indicates an overall satisfaction level of 78% regarding housing liveability, with higher ratings specifically for access to green spaces and community areas.
    - Interpretation: These ratings correlate with LEED-ND standards such as “Access to Public Space” and “Community Resources.” For instance, observational data noted that residents frequently use park benches and children’s play areas, underscoring their role in enhancing social connections and liveability.
- Accessibility (Frequency Analysis)
    - Finding: Data shows that 65% of tenants rated accessibility to sidewalks and walking paths as “very good” or “excellent,” supported by observations of frequent pedestrian traffic on designated pathways.
    - Interpretation: This strong preference for walkability aligns with the LEED-ND “Walkable Streets” provision, emphasizing the benefit of pedestrian-oriented infrastructure in an urban Kenyan setting. Observation data reflects this, as residents are often seen walking to nearby markets and bus stops, highlighting the practicality of these pathways in reducing reliance on vehicles.

2. Qualitative Findings and Interpretation

Theme: Community and Social Interaction

- Finding: Tenant interviews and open-ended survey responses often highlighted a sense of "community" fostered by common areas like courtyards and playgrounds.
- Interpretation: Observational data supports this theme, with common areas frequently used by children and families for gatherings and daily activities. This aligns with LEED-ND's "Neighborhood Pattern and Design," reinforcing the value of well-placed communal spaces in supporting social cohesion, a significant factor in Kenyan urban living.

Theme: Energy Efficiency and Affordability

- Finding: Qualitative feedback indicates tenant appreciation for energy-efficient design, which reduces utility costs—a key concern for affordability.
- Interpretation: Observations noted minimal usage of electric lights during the day, as large windows provide ample natural lighting. This reflects how LEED-ND's energy efficiency criteria can be adapted for cost-effective design in Kenyan affordable housing, directly benefiting tenants by lowering energy expenditures.

Detailed Observation Snapshots

- Walkable Streets: On weekdays, tenants were observed using dedicated walkways to access local shops and transit stops. For example, a single mother with young children was seen utilizing the safe pedestrian paths on multiple days, which aligns with her reported satisfaction with walkable access to services.
- Access to Public Space: A group of elderly tenants was frequently observed relaxing in shaded garden areas during midday, benefiting from green spaces

that provide both recreational and environmental value. This frequent use underscores the relevance of LEED-ND's green space provisions for enhancing quality of life in dense urban settings.

Overall Summary

The combination of statistical data with detailed observation provides a comprehensive view of how LEED-ND provisions affects liveability, affordability, and sustainability. These findings suggest that when adapted thoughtfully, LEED-ND standards can effectively enhance affordable housing projects in Kenya, providing not just a checklist, but tangible improvements to tenant well-being.

4.5 Introducing the Case Study: Park Road Ngara

The case study of the Park Road Ngara affordable housing project serves as a practical investigation to analyse the application of LEED-ND standards in the context of affordable housing in Kenya. As a flagship affordable housing project under the Kenyan government's Big Four Agenda, Park Road Ngara provides an opportunity to evaluate how sustainability, affordability, and liveability are achieved in a real-world scenario.

This case study aligns primarily with Objective 2, which seeks to identify the provisions within LEED-ND standards that enhance the sustainability, affordability, and liveability of affordable housing projects. By examining Park Road Ngara through the lens of LEED-ND principles, this study assesses key factors such as:

1. Smart Location and Linkage (SLL): Evaluate whether Park Road Ngara is strategically located in an urban area with access to transport networks**,** employment hubs**,** and social amenities**,** minimizing commuting distances for residents.
2. Neighborhood Pattern and Design (NPD): Investigate the layout of the project, including the diversity of housing options, walkability, and availability of public spaces that promote social interaction. Assess how well the design fosters community inclusivity and livability.

3. Green Infrastructure and Buildings (GIB): Look at the use of sustainable materials, construction practices, and whether the project incorporates green infrastructure such as rainwater harvesting systems or energy-efficient design.
4. Regional Priorities (RPC): Analyze how the project addresses Kenya's specific needs, such as creating housing that is affordable for low- and middle-income populations, while ensuring resilience to local climate challenges.
5. Innovation and Design Process (IDP): Explore any unique features or practices introduced in the project that address the challenges of delivering affordable, sustainable, and livable housing in Kenya.

Furthermore, insights from the case study inform Objective 3, contributing to the design of a tailored evaluation framework that integrates relevant LEED-ND standards and responds to the unique needs of the Kenyan affordable housing sector.

The findings from the Park Road Ngara case study provide both quantitative data and qualitative insights, offering a comprehensive perspective on how LEED-ND standards and similar frameworks could be adapted to meet the challenges of Kenya's urban housing landscape.

4.6 Project Description

The Kenyan government has introduced an initiative called 'The National Affordable Housing Programme' as part of its 'Big Four Agenda.' This program's major goal is to provide subsidized affordable housing alternatives at low and middle-income rates to Kenyan inhabitants. The government's ambitious plan involves the construction of 500,000 housing units spread across all 47 counties by the year 2022. It is important to recognize that these developments, like any other, can have significant impacts on the social and environmental aspects of the neighbourhoods in which they are situated. Therefore, it is crucial to prioritize green neighbourhood development, which is guided by environmental, social, cultural, and ethical considerations. One of the key projects under this agenda is the Park Road Estate in Ngara.

The proposed project involves the construction of six blocks in total. Four of these blocks will accommodate one, two, and three-bedroom housing units. One block will serve as a parking silo, and the remaining block will house a kindergarten and other auxiliary facilities. The project will be situated on land registered as LR No. 209/20159, located along Kinsasha Road in the Park Road Area of Starehe Sub County within Nairobi City County.

The specific coordinates of the site are approximately latitude 1°16'28.96"S and longitude 36°49'57.48"E. Notable landmarks in the vicinity include Muslim Primary School, which borders the western side of the site, and Park Road Mosque to the east. The total land area designated for development is roughly 7.843 hectares.

The project's scope encompasses the construction of housing units with varying numbers of bedrooms, a parking silo, and various social amenities. The project was scheduled to be completed within a two-year timeframe. The delivery model chosen for this project is Engineering, Procurement, Construction, and Finance (EPC+F). Under this model, the developer is responsible for the design, construction, and financing of the project. The developer is also encouraged to incorporate innovative design and technologies that facilitate affordable mass housing production while considering factors such as cost, time, and quality.

The criteria for allocating units in the Park Road project were as follows: 60 percent of the units were reserved for civil servants, and the remaining 40 percent were open to other citizens. The allocation process, overseen by Housing Principal Secretary, primarily adhered to a first-come, first-served principle based on the time when applicants completed their payments of a 12.5% deposit of the unit cost. However, the process also took into account various social factors, including the applicant's ability to pay, income levels, accessibility, and special considerations for individuals with disabilities, among others.

The prices of the houses in this project range from Kshs. 1.5 million to Kshs. 4 million. Homeowners who acquire units in this development are expected to occupy and reside in their houses. They will not be allowed to sell their units before a period

of 8 years has elapsed. This restriction is intended to prevent speculation on these properties.

4.7 Zoning of the Area

During the walk-through, it was evident that the Park Road area is categorized as Zone 2 according to the Nairobi City Development Ordinances and Zones Guidelines. Zone 2 permits both commercial and residential development, including high-rise apartment buildings, shops, stalls, hotels, and banks. The proposed project follows this zoning classification and allows for a mixed-use development. Specifically, Block E within the project includes commercial spaces on the ground and first floors.

4.8 Project Description, Design, and Implementation

The field study identified that the proposed affordable housing development consists of six blocks. These include four blocks dedicated to one, two, and three-bedroom housing units, one block allocated for a kindergarten, and another block designated for a parking silo and other supporting facilities on the site. This development aims to provide affordable and decent housing options for individuals with middle to low incomes while optimizing the land's use in the area.

The development's design allocates specific portions of the land area for various purposes:

- 18% of the total land area is reserved for open green spaces.
- 15% is designated for roads, utilities, and essential services.

The remaining percentage of the plot is utilized for residential units and parking spaces.

4.9 Land Tenure, Use, and Ownership

The land on which the proposed development is situated is held under a leasehold interest for a duration of 99 years, commencing from September 1, 2014. The

certificate of title for this land is issued in accordance with the Land Act, Cap 300, and the Land Registration Act, Cap 334, under Plot L.R. No. 209/20159. Currently serving as a trustee for the Ministry of Transportation, Infrastructure, Housing, and Urban Development, the Cabinet Secretary to the Treasury is the land's registered owner. This owner may be reached at Post Office Box 30007 in Nairobi.

Based on the zoning regulations of the county, the Park Road Area falls under Zone 2, which permits high-rise residential and commercial developments. This zoning designation allows for the construction of tall buildings designed for both residential and commercial purposes.

Figure 4.1: Proposed Site before Development (Source Google maps)

Figure 4.2: Proposed Site during Development (Source Google maps)

4.10 Findings

Credit: Walkable streets

The specific requirements for earning the walkable streets credit in the LEED ND rating system are:

- Proximity to Property Line
- Design and planning that prioritize pedestrian access (walkable streets).
- Proximity to public transit options.
- Safe and accessible sidewalks and pathways.
- Connectivity to nearby amenities and services.
- Alternative transportation
- On street parking

Figure 4.3: Walkable streets: Proximity to Property Line

Walkable streets: Proximity to Property Line

- Implementation: To evaluate the walkability of the project, an observational checklist based on the LEED-ND rating system (Appendix 1) was used. The checklist documented the linear distance of building façades in Block A, B, and E, which was maintained at no more than 5.5 meters facing the circulation network, promoting pedestrian accessibility.
- The specific measurements were as follows:

Block A: Average distance of 4.8 meters

Block B: Average distance of 5.2 meters

Block E: Average distance of 5.4 meters

Impact: Maintaining a consistent proximity to the property line had several implications.

- This contributed to increased transportation options for residents, reducing car dependency.
- Efficient Land Use: The design choice allowed for efficient land use, maximizing the utilization of available space for both residential and commercial purposes.
- Increased Open Space: By reducing setbacks, the project created more open spaces within the development, promoting communal areas, green spaces, and walkability.
- Reduced Infrastructure Costs: A compact urban layout minimized the need for extensive infrastructure development, saving on construction and maintenance costs.

Aesthetic Considerations: The uniform façade setback contributed to the project's visual appeal:

- Harmonious Streetscape: A consistent façade setback created a harmonious and visually appealing streetscape, contributing to a sense of order and identity within the urban development.
- Enhanced Public Realm: The design choice facilitated the creation of pedestrian-friendly areas, with wider sidewalks, street trees, and public seating, enhancing the overall aesthetic experience.

User Experience:

Resident surveys and feedback indicated positive outcomes related to the façade proximity design choice:

- Improved Access: Residents appreciated the ease of access to amenities, public transportation, and green spaces due to the compact layout.

- Day lighting and Ventilation: A consistent façade proximity ensured that most units received adequate natural light and ventilation, enhancing living conditions.

The deliberate choice to maintain a consistent proximity of building façades to the property line, not exceeding 5.5 meters, in Blocks A, B, and E of the park road Ngara project, yielded positive outcomes in terms of efficient land use, aesthetics, user experience, and compliance with regulations. This credit serves as a valuable example of how thoughtful urban design can contribute to sustainable and attractive urban environments in Kenya.

Walkable streets: Alternative Transportation—bicycle- and pedestrian-only paths and sidewalk width

In our case study focusing on affordable neighborhoods in Kenya, we assessed the implementation of LEED rating credits related to bicycle- and pedestrian-only paths and sidewalk width requirements:

1. Bicycle- and Pedestrian-Only Paths: These dedicated pathways were integrated into the urban design, providing safe and convenient routes for cyclists and pedestrians. They were strategically located to connect key destinations, such as residential areas, commercial districts, and public transit hubs.
2. Sidewalk Width Requirements: New sidewalks were constructed with specific width requirements in mind. On retail or mixed-use blocks, sidewalks were at least 8 feet (2.5 meters) wide, providing ample space for pedestrian traffic and outdoor activities. On all other blocks, sidewalks were at least 4 feet (1.2 meters) wide, ensuring accessibility and walkability.

Figure 4.4: walkable Street (Source field survey)

Analysis

The case study findings provided the following analysis:

1. Active Transportation Promotion: The inclusion of bicycle- and pedestrian-only paths encouraged active transportation, reducing the reliance on motor vehicles. This aligns with Kenya's urban mobility goals, promoting cycling and walking as sustainable transportation options.
2. Safety Enhancement: The provision of dedicated paths for cyclists and pedestrians contributed to road safety by separating them from vehicular traffic. This is particularly important in Kenyan neighborhoods, where road safety can be a concern.
3. Improved Accessibility: Widening sidewalks enhances accessibility, ensuring that pedestrians, including individuals with disabilities and parents with strollers, can comfortably navigate the urban environment.

4. Community Vibrancy: Wider sidewalks on retail and mixed-use blocks created spaces for outdoor dining, street markets, and community gatherings, enhancing the vibrancy of the neighborhoods and boosting local businesses.

Discussion

The case study underscored the importance of adapting LEED rating credits to suit the specific context of Kenya's affordable housing development. Here are key discussion points:

1. Local Context Sensitivity: Urban planners and developers in Kenya should consider local context, including population density, traffic patterns, and cultural preferences, when implementing bicycle- and pedestrian-only paths and sidewalk width requirements.
2. Safety Prioritization: Given the challenges of road safety in Kenyan cities, the provision of safe pathways for pedestrians and cyclists is paramount. This aligns with Kenya's Vision 2030 goals for sustainable urban transport.
3. Economic Benefits: Promoting vibrant street life through wider sidewalks can boost economic activity in commercial districts, contributing to local businesses' growth.
4. Maintenance: Regular maintenance and enforcement of pedestrian and cyclist-friendly infrastructure are critical to ensuring their long-term functionality and safety.

In conclusion, adapting LEED rating credits to incorporate bicycle- and pedestrian-only paths and specifying sidewalk width requirements is essential for Kenya's affordable housing. These elements align with Kenya's sustainable urban transport and development goals, promoting active transportation, safety, accessibility, and economic vitality in urban areas.

Credit: On street parking—maximum size of 60% of the building block

Implementation: On-street parking is provided on at least 70% of both sides of the block length of all new and existing motorized portions of the circulation network, including the project side of bordering circulation network at Kinshasa road.

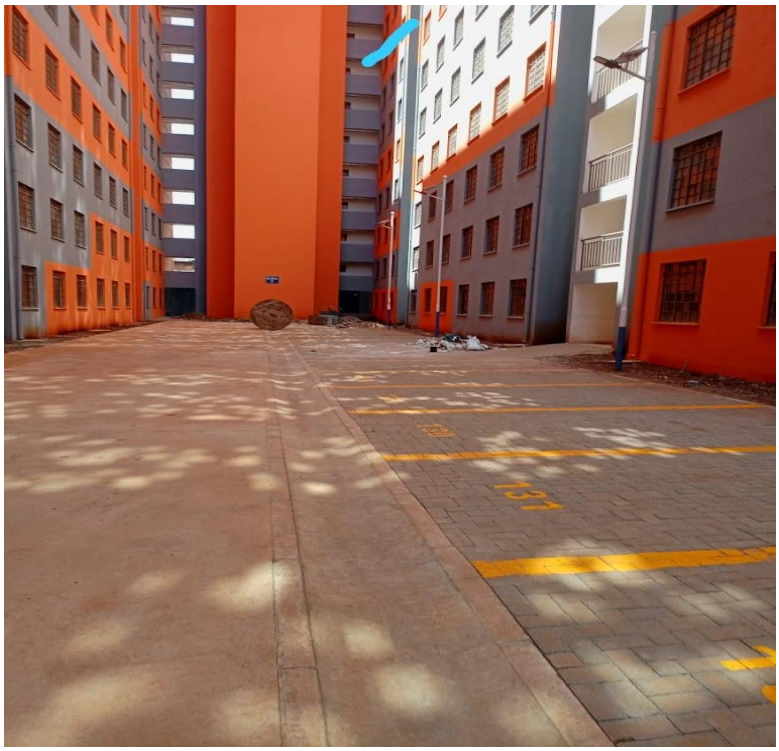


Figure 4.5: On Street Parking (Source field survey)

Analysis of On-Street Parking

1. **Discouragement of Pedestrian Access**
    - Findings: The presence of a large surface area of on-street parking lots discouraged pedestrians from using sidewalks at block D and accessing the nearby buildings of block A, B and E.
    - Impact: This discouragement has led to reduced walkability at block D, as residents have perceived the area as less pedestrian-friendly and less safe due to the proximity of vehicles.
    - Analysis: Such a situation can hinder urban vibrancy and limit the potential for active street life in neighborhood development.

2. **Increased Storm water Runoff Pollution**
    - Findings: The pavement used in parking lots has resulted in more polluted storm water runoff after rainstorms.
    - Impact: Polluted storm water runoff can contaminate local water bodies and harm the environment.
    - Analysis: Sustainable storm water management is crucial for maintaining water quality and mitigating the effects of urban development on natural ecosystems.

LEED-ND Parking Principles

1. **Off-Street Parking Size Limitation (60%)**
    - Principle: LEED-ND recommends that off-street parking should not exceed a maximum size of 60%.
    - Analysis: Limiting the size of off-street parking areas promotes efficient land use, reduces the dominance of parking lots in the affordable neighborhood landscape, and encourages alternative modes of transportation, such as walking, biking, and public transit.
2. **Off-Street Parking Location (Side, Rear, or Underneath Buildings)**
    - Principle: LEED-ND advocates placing off-street parking to the side, rear, or underneath buildings.
    - Analysis: This design principle promotes a pedestrian-friendly environment, enhances aesthetics, and preserves the quality of public spaces. Placing parking in these locations reduces the visual impact of parking lots on the streetscape and minimizes their disruption to the pedestrian realm.

Discussion

Block D highlighted the negative consequences associated with a high presence of on-street parking lots, including hindrances to pedestrian access, reduced quality of public spaces, and increased storm water runoff pollution. Impact: The existence of large surface of on street parking lots has greatly discouraged pedestrian access from

sidewalks and other nearby buildings, especially when located between sidewalks and buildings.

The provision of on-street parking, as described in the LEED rating credit, can have both positive and negative effects on the sustainability of an affordable housing project in Kenya. It's important to carefully consider the local context and specific project goals.

1. **Pedestrian Discouragement**

- Impact: The presence of a large surface area of on-street parking lots, especially when located between sidewalks and buildings, can discourage pedestrian activity.
- Drawbacks: Discouraging pedestrian access can have several negative consequences. It can lead to reduced walkability, less active street life, and a diminished sense of community. It can also make the neighborhood less safe and inviting for pedestrians.

2. **Environmental Impact**

- Impact: Large surface parking areas can contribute to environmental issues, such as increased heat island effects and storm water runoff pollution.
- Drawbacks: These environmental impacts can have a detrimental effect on the sustainability of the neighborhood, affecting not only the natural environment but also the well-being of residents.

Credit: Site Development—Maximize Open Space

- Implementation: park road Ngara affordable housing developments has allocated a significant portion of the site to open green spaces and pedestrian-friendly sidewalks at block A, B and near the parking Silo.
- Impact: This has increased the availability of communal open spaces and contributed to the walkability and livability of residents at Park road Ngara affordable housing project.

Analysis

In analyzing the current LEED rating credits regarding the percentage of primary façade without doors or windows, we found that these criteria may not be directly applicable to the context of Kenya. Here are the key findings:

1. **Differences in Building Design**
    - In Kenya, building design and construction practices may differ significantly from those in the USA. Traditional architectural styles, materials, and climate considerations can influence how buildings are designed and constructed.
2. **Urban Context Variation**
    - The urban context in Kenya varies from that of the USA, with different densities, land use patterns, and streetscapes. Urban areas in Kenya may have a mix of modern and informal architectural styles.
3. **Climate and Environmental Factors**
    - Kenya's diverse climate zones, from the coastal regions to highland areas, present unique challenges and opportunities for building design. Considerations related to natural ventilation, shading, and energy efficiency play a crucial role.

Discussion

Given the differences between the USA and Kenya in terms of building design, urban context, and climate, it's essential to modify the LEED rating credits to be adaptable to the Kenyan context. The following are proposed based on the case study field survey:

1. Flexible Façade Design Standards:
    - Instead of specifying fixed percentages for doors and windows on the primary façade, the standards could be made more flexible. This flexibility would allow architects and builders to adapt to local conditions and architectural traditions while maintaining key design principles.

2. Climate-Responsive Design:
    - Kenya's climate variations necessitate climate-responsive design. Modifications could include encouraging the use of natural ventilation, shading devices, and passive cooling strategies, which may not align with the rigid LEED criteria.
3. Local Architectural Vernacular:
    - Acknowledging and celebrating Kenya's rich architectural heritage and diversity can be integrated into the modified credits. Local architectural vernacular should be considered in façade design.

4. Contextual Adaptation:
    - The adapted credits should reflect the specific needs, preferences, and conditions of Kenya's urban areas. Flexibility in design standards allows for adaptation to local contexts while promoting sustainability.
5. Sustainable Design Integration:
    - Rather than focusing solely on the quantity of doors and windows, the modified credits should emphasize sustainable design principles that address energy efficiency, natural lighting, and indoor comfort, aligning with Kenya's climate and environmental factors.
6. Community and Stakeholder Involvement:
    - Local community engagement and stakeholder input are crucial for successfully implementing modified credits. Involving architects, builders, urban planners, and residents ensures that the modifications align with local expectations and priorities.
7. Education and Training:
    - To effectively implement modified credits, it's essential to provide education and training to architects, builders, and construction professionals in Kenya. This promotes the understanding and application of sustainable design principles.
8. Monitoring and Assessment:
    - Regular monitoring and assessment of building projects that adhere to the modified credits are necessary to evaluate their effectiveness in achieving sustainability goals and to make any necessary adjustments.

Analysis of Walkable Streets Credit in Park Road Ngara Project

Key Findings

- Building facades in Blocks A, B, and E are consistently set back no more than 5.5 meters from the street, promoting pedestrian accessibility.
- Dedicated bicycle and pedestrian paths are integrated throughout the project.
- Sidewalks are wide and well-maintained, encouraging pedestrian use.
- A large surface area of on-street parking lots at Block D discourages pedestrian access and reduces walkability.

Link to LEED-ND Credits

- Proximity to Property Line - Prerequisite 1: Walkable Streets
- Alternative Transportation - Credit 1: Walkable Streets
- On-street parking - Credit 1: Walkable Streets

Theory behind the Credit

- The "Walkable Streets" credit embodied the principle of creating a built environment that prioritized pedestrians over vehicles. This involved:
    - Reducing reliance on cars: Encouraging walking and cycling as primary modes of transportation, leading to lower greenhouse gas emissions and improved air quality.
    - Promoting physical activity and health: Making it easier and safer for people to walk and bike, contributing to a healthier lifestyle.
    - Creating vibrant public spaces: Fostering a sense of community and encouraging social interaction by creating inviting spaces for pedestrians.

Project Performance

- Successes:
    - The consistent setback of buildings from the street in Blocks A, B, and E created a pedestrian-friendly environment.

    - The provision of dedicated bicycle and pedestrian paths, along with wide sidewalks, encouraged active transportation and enhanced walkability.
- Shortcomings:
    - The extensive on-street parking at Block D undermined the project's walkability goals by discouraging pedestrian access. This suggested a need to prioritize pedestrian access over vehicular parking, particularly in areas with high pedestrian traffic.

Connecting to Theory

- Successes: The successful implementation of "Walkable Streets" elements in Blocks A, B, and E contributed to the broader goals of Green Neighborhood Development theory by promoting alternative transportation, fostering a sense of community, and creating a more sustainable and livable urban environment.
- Shortcomings: The failure to adequately address parking at Block D suggested a gap between the theoretical ideal of walkable streets and the practical challenges of implementing such principles in a dense urban context. This highlighted the need for a more nuanced approach to parking management that balances the needs of residents with the goals of promoting walkability.

Recommendations for Improvement

- Implement parking restrictions or reduced parking ratios at Block D to encourage walking and cycling.
- Consider alternative parking solutions, such as shared parking facilities or underground parking, to minimize the impact of parking on the pedestrian realm.
- Enhance street lighting and landscaping in areas with high pedestrian activity to create a safer and more inviting walking environment.

Credit: tree placement and the use of shade structures

The project did not meet the requirements of option 1 for this credit, which called for the planting of trees at intervals of no more than 50 feet (12 meters), with exemptions for driveways. This tree planting was to be carried out along at least 60% of the total length of existing and planned blocks within the project. Additionally, trees were required to be planted on the project side of blocks that bordered the project site, situated between the vehicle travel way (if present) and the walkway. Unfortunately, the development did not fulfil these specifications as outlined in option 1 of the credit.

Figure 4.6: Tree Placement and the Use of Shade Structures

Analysis

Given the unique climate and urban conditions in Kenya, it's essential to modify the LEED rating credits for tree placement and shade structures to ensure practicality and sustainability.

1. Climate-Responsive Approaches:
    - The adapted credits should consider climate-responsive approaches that acknowledge the feasibility of street trees based on local conditions. In arid regions, alternative strategies like drought-resistant landscaping or shade structures may be more appropriate.

2. Local Plant Species:
    - Promote the use of native or drought-resistant plant species that are better adapted to Kenya's climate. This encourages biodiversity and reduces water requirements for maintenance.
3. Flexible Spacing Requirements:
    - Modify the spacing requirements for trees to be more flexible and based on local conditions. For example, in urban areas with limited space, narrower tree intervals may be acceptable.
4. Shade Structure Criteria:
    - Clearly define criteria for shade structures, including design and materials, to ensure they are functional and contribute to pedestrian comfort. Consider factors like aesthetics, durability, and shade coverage.

Discussion

The adaptation of LEED rating credits for tree placement and shade structures is vital to their effective implementation in Kenya affordable housing. Here are some key discussion points:

1. Local Climate and Conditions:
    - The modified credits should reflect Kenya's diverse climate zones and urban landscapes. Flexibility in tree planting and shade structure requirements allows for adaptation to local contexts while promoting sustainability.
2. Water Efficiency:
    - Given the potential for water scarcity, the use of drought-resistant landscaping and efficient irrigation systems should be encouraged. This ensures that street trees and vegetation are sustainable and do not strain local water resources.
3. Community Engagement:
    - Involvement of local communities, municipalities, and urban planners is essential to adapt and implement the modified credits successfully.

Engagement ensures that the criteria align with local needs and expectations.

4. Maintenance and Care:
    - Consideration should be given to long-term maintenance and care of street trees and shade structures. A sustainable plan for their upkeep is crucial to their success in enhancing the urban environment.
5. Monitoring and Evaluation:
    - Regular monitoring and evaluation of the adapted credits' implementation are necessary to assess their effectiveness in achieving sustainability goals and to make any necessary adjustments.

In conclusion, adapting LEED rating credits for tree placement and shade structures in Kenya should prioritize climate-responsive approaches, resource efficiency, and community engagement. By doing so, sustainable landscaping and shading solutions can enhance the quality of urban life while addressing Kenya's unique challenges.

Credit: mixed use neighborhood

On-Site Observations:

- Assess the physical condition and maintenance of the housing units, parking silo, and auxiliary facilities.
- Note any visible signs of social interaction and community engagement within the neighborhood.
- Observe the accessibility and utilization of public transportation in the area
- Religious institutions

The observational checklist (Appendix 1) was used to document the proximity of dwelling units to various community resources, including places of worship. The checklist confirmed that the Park Road Mosque is located approximately 52 meters northwest of the site, accessible via Kinshasa Road. It serves as a beneficial resource for the Muslim community residing on the site. In addition to the mosque, other religious institutions in the neighborhood include churches like Kariokor

Methodist Church, Prayers Beyond Boundaries Ministries, and The Salvation Army, all of which are situated about 300 meters away. Temples are also present in the area, providing places of worship for the residents. The proximity of these religious institutions to the housing development has contributed to a reduction in automobile dependence and has encouraged residents to engage in daily walking and biking. In the case study, various LEED credits related to the proximity of dwelling units to nearby uses were analysed:

1. Dwelling Unit Proximity to Nearby Uses (400 – meter Walking Distance)

- Implementation: The project successfully located its dwelling units within a (400-meter) walking distance of the specified number of uses :

- Religious institutions
- Health institutions
- Commercial activities

The survey findings indicate that commercial and recreational activities are primarily concentrated in the Park Road, Ngara, and Eastleigh areas. These activities include:

- Shopping malls like Tansim Shopping Mall, located 3.6 kilometers away.
- Olympic Shopping Centre, situated 3 kilometers away.
- Office suites, with Aqua Office Suites being 1.5 kilometers away.
- Open markets in the Ngara and Eastleigh areas.
- Presence of banks including Equity Bank, Family Bank, and KCB Bank.
- Light industries such as petrol stations, including the Shell Filling Station and Oil Libya Petrol Station.

The proximity of these commercial and recreational amenities to the residential area has created a diverse and vibrant community. Residents have easy access to workplaces, stores, restaurants, and recreational spaces, enhancing the overall quality of life in the area.

Impact: This credit significantly improved the project's walkability, accessibility, and overall sustainability.

Impact on Sustainability: The application of the Dwelling Unit Proximity to Nearby Uses had notable impacts on sustainability:

1. Reduced Transportation Dependency: By ensuring that a substantial portion of dwelling units were within a short walking distance of essential nearby uses, the project-minimized residents' dependency on private vehicles for daily errands.
2. Reduced Carbon Emissions: The reduced need for vehicular travel within the project's vicinity resulted in lower carbon emissions, contributing to improved air quality and reduced environmental impact.
3. Enhanced Community Engagement: Proximity to nearby uses encouraged community engagement and social interaction, reducing the need for energy-intensive indoor activities and fostering a sense of belonging among residents.

Impact on Affordability: The application of the Dwelling Unit Proximity to Nearby Uses had several effects on affordability:

1. Reduced Transportation Costs: Residents benefited from reduced transportation expenses as they could easily access essential services and amenities on foot. This contributed to overall housing affordability.
2. Improved Quality of Life: The proximity of dwelling units to nearby uses enhanced the overall quality of life for residents, potentially reducing healthcare costs and promoting affordability.
3. Higher Property Values: The walkability and convenience associated with nearby uses may have contributed to increased property values, offering long-term affordability benefits for homeowners.

The research findings suggest that the application of the Dwelling Unit Proximity to Nearby Uses LEED Credit significantly contributed to sustainability and affordability within the development project. By ensuring that a substantial

percentage of dwelling units were within a short walking distance of essential nearby uses, the project promoted walkability, reduced transportation costs, and enhanced the overall quality of life for residents. These benefits, in turn, positively affected affordability by reducing ongoing expenses and fostering a sustainable and vibrant living environment.

Examining the Relationship between Mixed-Use Neighborhoods and Theories in the Research

1. Sustainability Theory: A Holistic View

The concept of mixed-use neighborhoods aligned strongly with sustainability theory, which advocated for a balanced approach that considered social, economic, and environmental factors in development.

- **Environmental Sustainability**: By integrating residential, commercial, and recreational spaces within walking distance, mixed-use developments reduced the need for car travel, decreasing greenhouse gas emissions and promoting sustainable transportation. This concept is reflected in LEED-ND credits like "Walkable Streets" and "Transportation Demand Management." The Park Road Ngara case study demonstrated this connection by highlighting the project's good road network, proximity to the city center, and pedestrian-friendly infrastructure, which encouraged residents to walk and cycle instead of relying on cars.
- **Economic Sustainability**: Mixed-use neighborhoods can stimulate local economic activity by creating opportunities for small businesses and entrepreneurs within the community. This can lead to job creation, increased income, and improved economic resilience. The presence of informal business activities in the Park Road Ngara project, as noted in the survey findings, suggested the potential for economic benefits associated with mixed-use development. The research also highlighted the long-term economic benefits of mixed-use projects, such as reduced transportation costs for residents and potentially higher property values due to increased convenience and desirability.

- **Social Sustainability**: Mixed-use neighborhoods can foster social interaction and a sense of community by providing shared spaces where residents can connect. This can contribute to social cohesion, reduce crime rates, and improve overall well-being. The study, particularly the structured interview guide, emphasized the importance of evaluating social sustainability in terms of safety, social interactions, and access to community amenities. The Park Road Ngara project's inclusion of community green spaces, social halls, and recreational facilities demonstrated a commitment to promoting social interaction and a sense of belonging among residents.

Credit: housing types and affordability

Results

The study observed the following results when a variety of housing sizes and types were included within a project:

1. **Housing Diversity:** The project displayed a diverse range of housing, including one bedroom, two bedroom and three bedrooms.

The project has developed six blocks on the aforementioned land comprising of a total 1,370 housing units, 1048 parking bays and other auxiliary facilities as described below:

Figure 4.7: Block Layout (Source Boma Yangu)

Block A: the survey revealed the following

- 38 two bedroom units (60 m2) on six typical floors adding up to 228 units
- Each unit will comprise of a lounge, a kitchen, two bedrooms, a laundry and washrooms.

Figure 4.8: 2 Bedroom Apartment 60sq (Source Boma Yangu)

1. **Block B: the survey revealed the following**

- 21 three bedroom units (80m2) on 13 floors adding up to 260 units
- Each unit will comprise of a lounge, a kitchen, three bedrooms, a laundry and washrooms.

Figure 4.9: 3 Bedroom Apartment 80sq (Source Boma Yangu)

2. **Block D: the survey revealed the following**

- 39 three bedroom units (60m2) on 14 floors adding up to 546 units
- Each unit will comprise of a lounge, a kitchen, three bedrooms, a laundry and washrooms.

Figure 4.10: 3 Bedroom Apartment 60sq. (Source Boma Yangu)

3. **Block E: the survey revealed the following**

- Ground and First floor comprising of commercial spaces
- 7 one bedroom units (30m2) on 12 floors adding up to 84 units.

- Each unit will comprise of a lounge, a kitchen, a bedroom, a laundry and washrooms
- 21 two bedroom units (40m2) on 12 floors adding up 252 units
- Each unit will comprise of a lounge, a kitchen, two bedrooms, a laundry and washrooms.

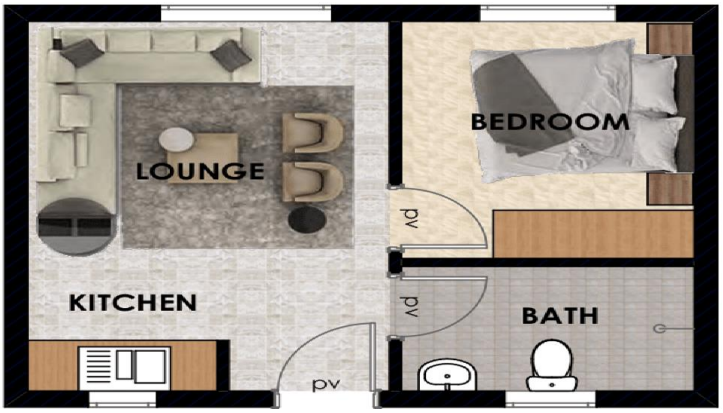


Figure 4.11: 1 Bedroom Apartment (Source Boma Yangu)

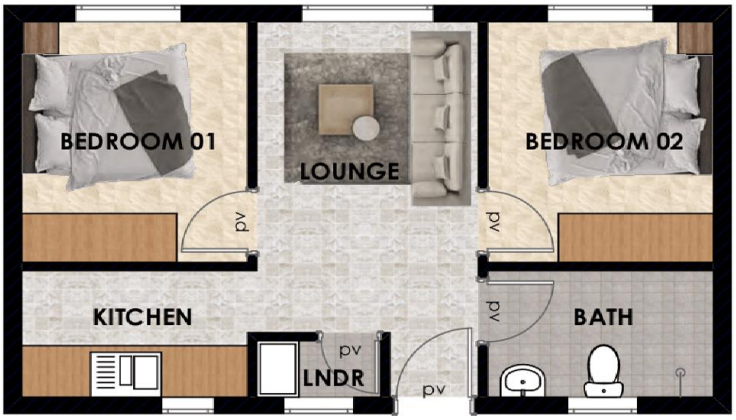


Figure 4.12: 2 Bedroom Apartment 40sq (Source Boma Yangu)

4. **Block F (Parking Silo): the survey revealed the following**

    - 786 parking bays on seven floors

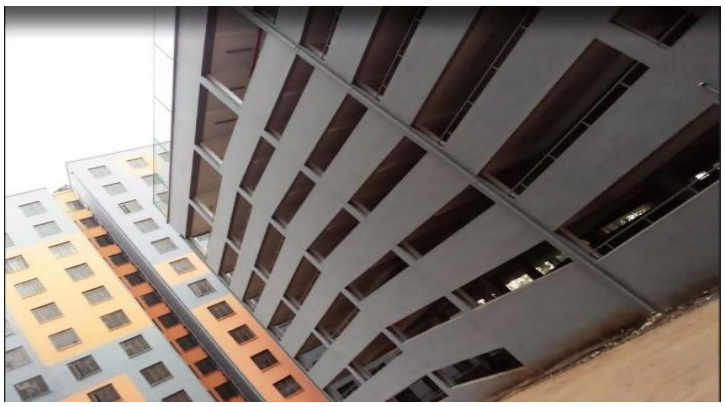


Figure 4.13: Parking Silo (Source field survey)

Figure 4.14: on Street Parking (Source field survey)

5. **Block G (Kindergarten): the survey revealed the following**

    - 16 classrooms, 8 on each level and four stores.

In summary, the survey findings indicate that the proposed development includes a total of 1,370 residential apartments, distributed as follows:

- 84 units of one-bedroom apartments.
- 480 units of two-bedroom apartments.
- 806 units of three-bedroom apartments.

Additionally, the development features several other essential components, including 262 on-street parking bays, staircases, lift lobbies, ramps, a social hall, community green spaces, a power distribution room, a fire pump room, water storage tanks, a telecommunication room, and a service management room.

By having a diversity of housing types, Park road Ngara has provided a range of housing prices. The research findings indicate that the housing project, known as Park Road, has successfully achieved a high level of housing diversity, both in terms of size and type. This diversity is reflected in a Simpson Diversity Index score of 0.52, which earns the project 1 point for this credit, highlighting the commendable efforts in promoting housing variety within the development.

2. Demographic Representation: The community attracted residents of different age groups, income levels, and family sizes, ensuring a well-balanced demographic mix.
3. Vibrant Neighborhood: Social interactions flourished in the neighborhood, creating a vibrant community atmosphere with diverse cultural and social experiences.
4. Reduced Commuting: The proximity of housing to workplaces and amenities reduced the need for long commutes, benefiting residents and reducing traffic congestion.

Analysis

The case study findings provide the following analysis:

1. Economic Sustainability: A diverse housing supply, including affordable options, enhances economic sustainability by allowing a broader segment of the population to access housing. This, in turn, supports local businesses and stimulates economic growth.
2. Social Well-being: Inclusive communities contribute to social well-being by reducing segregation and promoting empathy and understanding among residents. Residents enjoy a higher quality of life when they have choices that align with their needs and preferences.

3. Environmental Impact: Proximity of housing to amenities reduces car dependency, leading to lower carbon emissions and environmental sustainability. It also aligns with sustainable urban planning principles by encouraging walking and cycling.

Discussion

The case study highlights that including a variety of housing sizes and types within a project is pivotal for creating sustainable, inclusive, and vibrant communities. To expand on this:

1. Planning Integration: Collaboration between developers, urban planners, and local authorities is crucial to incorporate diverse housing options into urban planning.
2. Policy Support: Governments can incentivize housing diversity through zoning regulations and financial incentives, promoting a mix of housing types and affordability.
3. Community Engagement: Engaging with the local community during the planning process ensures that housing choices align with their aspirations and needs.
4. Monitoring and Adaptation: Regular monitoring and adaptation of housing strategies are vital to assess the community's evolving needs and demographics.

In conclusion, a housing project that includes a variety of housing sizes and types fosters sustainable, inclusive, and resilient communities. It supports social cohesion, economic growth, and environmental sustainability while enhancing the overall quality of life for residents.

Affordability

Inclusion of Housing Variety: In the case study analyzed, the project aimed to create a socially equitable and engaging community by offering a broad spectrum of housing sizes and types, including:

1. Affordable Housing Units: A significant portion of the housing inventory was dedicated to affordable units, ensuring accessibility to residents with varying income levels.
2. Diverse Housing Types: The project included diverse housing types.
3. Affordable Rental Units: A percentage of the rental units were designated as affordable housing, offering below-market rental rates to eligible households.
4. Affordable For-Sale Units: Some for-sale dwelling units were made available at prices that were within reach of households earning less than the AMI, providing an opportunity for homeownership.

Importance

1. Affordable Housing Access: By dedicating a portion of new rental and/or for-sale units to households below the AMI, communities expand access to affordable housing options for individuals and families who might otherwise struggle to find suitable accommodations.
2. Inclusivity: This strategy fosters social and economic variety within the community by making it possible for a wide range of inhabitants, including those with lower earnings.
3. Economic Stability: Financial circumstances are stabilized when households have access to cheap housing, freeing up funds for other necessities like savings, healthcare, and education.
4. Community Resilience: Affordable housing can contribute to community resilience by reducing homelessness and housing instability, which in turn can lower the burden on social services and healthcare systems.

Results

In our study, we observed the following results when a proportion of new rental and/or for-sale units were priced for households earning less than the AMI:

1. Affordability Inclusion: The community featured a range of housing options, including units priced below the AMI threshold, making homeownership or renting more attainable for lower-income residents.

2. Diverse Demographics: The commitment to affordable housing led to a more diverse resident population, reflecting a mix of income levels, occupations, and backgrounds.
3. Strengthened Social Fabric: Affordable housing integration contributed to social cohesion and community bonding, as neighbors from different income brackets interacted more frequently, fostering understanding and empathy.
4. Economic Benefits: The stability provided by affordable housing enabled residents to invest in local businesses, thereby supporting economic growth within the community.

Analysis

The case study findings provide the following analysis:

1. Economic Well-being: Access to affordable housing supports the economic well-being of households by reducing housing cost burdens, freeing up income for other necessities, and potentially contributing to upward mobility.
2. Community Resilience: Communities with a diverse range of housing options are more resilient to economic downturns and housing crises, as they have a broader base of residents who can weather financial challenges.
3. Long-Term Affordability: Committing to maintaining affordable rental units at affordable levels for a minimum of 15 years ensures long-term affordability for residents, providing stability to the community.

Discussion

The case study underscores the significance of including affordable units for households below the AMI in housing projects. Here are key discussion points:

1. Policy Support: Government policies and incentives play a pivotal role in promoting the inclusion of affordable units within housing developments. Policies can encourage developers to allocate a percentage of units to affordable housing.

2. Developer Collaboration: Collaboration between developers, local governments, and non-profit organizations is crucial in implementing affordable housing initiatives effectively.
3. Community Engagement: Engaging with the local community during the planning process ensures that housing choices align with their needs and aspirations while addressing affordability concerns.
4. Monitoring and Compliance: Regular monitoring and compliance checks are necessary to ensure that affordable housing units remain affordable for the specified duration, preserving long-term affordability.

In conclusion, allocating a proportion of new rental and/or for-sale units for households earning less than the AMI is a vital step toward creating more equitable, inclusive, and resilient communities. This approach aligns with sustainability goals by promoting social equity and economic stability while enhancing the overall quality of life for residents.

Linking Affordability Findings to Theories

1. Sustainability Theory and the Triple Bottom Line

The study emphasized a holistic approach to sustainability, echoing the Triple Bottom Line framework, which emphasized balancing social, economic, and environmental factors. The adapted LEED-ND framework and the proposed Affordable Housing Rating Tool are grounded in this theory, aiming to ensure that projects are not only environmentally sound but also economically viable and socially inclusive.

- Social Sustainability: The study connected social sustainability to affordable housing theory, emphasizing that housing must be accessible, inclusive, and contribute to community well-being. The research findings regarding tenant satisfaction with green spaces and access to amenities, like Jeevanjee Gardens and Uhuru Park, supported this link. These features aligned with LEED-ND's focused on "Access to Public Space" and "Community Resources", demonstrating the social benefits of sustainable design.

- Economic Sustainability: The study stressed that economic sustainability in affordable housing involved not only initial costs but also long-term affordability and the overall economic viability of the project. LEED-ND credits, such as "Location and Linkages", "Energy Efficiency", and "Reduced Parking Footprint", directly addressed this aspect. Findings from the Park Road Ngara case study indicated that energy-efficient design, reduced transportation costs, and efficient land use can make homes more affordable over time, aligning with economic sustainability principles.
- Environmental Sustainability: The study highlighted the need for environmentally responsible housing that minimizes resource consumption and environmental impact. LEED-ND provisions for "Green Infrastructure and Buildings" directly addressed this. The case study's focus on water conservation features and the adaptation of tree placement and shade structures to the Kenyan climate showcased practical applications of environmental sustainability principles.

2. Affordable Housing Theory: Accessibility, Quality, and Inclusion

The study drew heavily on affordable housing theory, which emphasized policies and practices that make housing accessible to low-income populations without compromising quality and liveability. The findings linked this theory to several key concepts:

- Affordability: The research focused on measuring affordability beyond simple cost metrics, considering long-term operational costs and access to essential services. This aligned with the emphasis on credits like "Mixed-Income Diverse Communities" and "Housing Types and Affordability" in LEED-ND, as these provisions aim to ensure a variety of housing options are available at different price points.
- Housing Quality: The study recognized that affordable housing must meet quality standards to ensure resident well-being. The emphasis on sustainable building practices, energy efficiency, and access to green spaces in LEED-ND related directly to improving the quality of affordable housing. Findings

from Park Road Ngara regarding walkability, access to amenities, and reduced transportation costs demonstrated how these quality-enhancing features can be implemented in practice.

- Social Inclusion: The research highlighted that affordable housing should foster social inclusion and prevent the concentration of poverty. LEED-ND credits that promote mixed-income communities and walkable, connected neighborhoods aligned with this principle. The case study findings on the diverse demographics and social cohesion in Park Road Ngara suggest that these features can contribute to more inclusive communities.

3. Systems Theory: Understanding Interconnections

The study implicitly drew on systems theory by emphasizing the interconnectedness of various components in affordable housing projects.

- Interdependence: The adapted LEED-ND framework and the proposed Affordable Housing Rating Tool recognized that factors like housing design, location, access to transportation, and community amenities are all interconnected and influence affordability and sustainability. This approach reflected the understanding that sustainable housing solutions require a systems-level perspective.
- Feedback Loops: The research suggested that data collected on tenant satisfaction, energy use, and social interactions can inform future project designs, demonstrating the importance of feedback loops in creating adaptive and responsive housing solutions. This aligned with the call for post-occupancy assessments in LEED-ND, highlighting the need for continuous monitoring and improvement.

The adapted LEED-ND framework and proposed rating tool provided practical examples of how these theoretical concepts can be translated into actionable strategies for developing housing projects that are not only affordable but also environmentally responsible and socially inclusive.

Credit: Reduced Parking Footprint

Results

To assess the 'Reduced Parking Footprint' credit, on-site observations were conducted using a structured checklist (Appendix 1). The checklist documented that the total area of paved surfaces covers 40% of the developed land, exceeding the LEED-ND recommendation of 20%.

Analysis

1. Impact on Rainwater Management:
    - Effect: The higher proportion of impervious surfaces due to excessive parking areas can hinder the natural flow of rainwater, preventing it from traveling naturally across the landscape to surface waters and groundwater aquifers.
    - Consequence: This may result in increased storm water runoff, which can lead to localized flooding, erosion, and degradation of water quality in surface waters. It also reduces the replenishment of groundwater aquifers, which are critical water sources in many regions.
2. Environmental Sustainability:
    - Effect: The higher percentage of impervious surfaces negatively impacts environmental sustainability by contributing to heat island effects and reducing green spaces.
    - Consequence: These environmental effects can lead to higher temperatures in the area, affecting residents' comfort and energy consumption. The reduced green space can also diminish opportunities for recreation and community engagement.

Figure 4.15: Area of Paved Surfaces (Source field survey)

Discussion

1. Mitigation Strategies:
    - To address the discrepancy between the project's paved surfaces and LEED-ND requirements, it's essential to implement mitigation strategies. This may include retrofitting parking areas, implementing green infrastructure solutions like permeable pavements, or creating rain gardens to capture and manage storm water.
2. Local Regulations and Approvals:
    - Engaging with local authorities and obtaining approvals for retrofitting or redesigning parking areas is crucial. Advocacy for sustainable land use practices may be necessary to align with project goals.
3. Sustainable Land Use Planning:
    - Future developments should incorporate sustainable land use planning from the outset, considering factors such as alternative transportation options, reduced parking demand through mixed-use zoning, and shared parking arrangements.

4. Community Engagement:
    - Involving the community in the decision-making process and highlighting the benefits of reduced parking areas, such as improved green spaces, can garner support for sustainable practices.
5. Long-Term Benefits:
    - Emphasize the long-term benefits of reduced impervious surfaces, such as improved water management, enhanced environmental sustainability, and a more comfortable and livable community.

In conclusion, while the survey indicates a discrepancy between the project's paved surfaces and LEED-ND requirements for Reduced Parking Footprint, it presents an opportunity to address these challenges proactively. Implementing mitigation strategies and advocating for sustainable land use practices can lead to a more environmentally sustainable, resilient, and community-friendly affordable housing project, aligning with LEED-ND principles.

Credit: connected and open community

The survey findings indicate that the affordable housing project in Nairobi County, specifically in the Park Road area of Starehe Sub-County, benefits from several significant factors related to its location and accessibility.

Results

1. Good Road Network:
    - The survey confirms the presence of a well-developed road network, which is crucial for accessibility and transportation options within and around the housing project: Kinshasa road, Muslim road, Kinshasa-Mogira road, Link road, Mogira road and Juja Links road
2. Proximity to City Center:
    - The housing project's proximity to the city center, with its commercial and service amenities, indicates convenient access to essential facilities, such as offices, markets, supermarkets, and shops.

3. Informal Business Activities:
    - The existence of informal business activities, including Jua Kali artisans and transportation services, suggests economic opportunities and vibrancy within the community.
4. Newly Constructed Roads:
    - The construction of new roads, including Muslim Road, Kinshasa Road, and others, expands the project's connectivity and accessibility.

Analysis

1. Enhanced Livability:
    - Proximity to the city center and access to various services and amenities enhance the livability of the housing project. Residents have convenient access to employment opportunities, shopping, and essential services, contributing to their quality of life.
2. Economic Opportunities:
    - The presence of informal businesses and transportation services provides economic opportunities for residents. It can lead to job creation, income generation, and local economic growth.
3. Improved Accessibility:
    - A well-developed road network and the construction of new roads improve accessibility, making it easier for residents to commute and access neighboring areas. This can reduce transportation costs and enhance mobility options.
4. Community Vibrancy:
    - The presence of informal businesses and active street life can contribute to community vibrancy and social interactions, fostering a sense of belonging among residents.

Figure 4.16: Road Network at Park Road Ngara (Source Google)

Discussion

1. Sustainability Considerations:
    - While the proximity to the city center and access to services are beneficial, it's essential to consider the environmental sustainability of the housing project. Encourage sustainable transportation options, such as public transit and cycling infrastructure, to reduce car dependence and associated emissions.
2. Affordability and Gentrification:
    - The project's desirability due to its location may lead to increased property values over time. This can have implications for housing affordability and the potential displacement of lower-income residents. Affordable housing policies and measures to protect vulnerable communities should be considered.
3. Infrastructure Maintenance:
    - As the housing project continues to grow, infrastructure maintenance becomes critical. Ensure that roads and utilities are well-maintained to support the long-term sustainability of the community.
4. Community Engagement:
    - Involve the local community in the development process to ensure that their needs and preferences are considered. This can help build a sense of ownership and social cohesion within the project.

In conclusion, the survey findings highlight several advantages of the affordable housing project's location, including its accessibility, economic opportunities, and community vibrancy. To maximize sustainability and affordability, it's crucial to balance these benefits with environmental considerations, affordability safeguards, and proactive community engagement.

Credit: Transit Passes

The survey findings indicate that the affordable housing development does not currently meet the criteria for several key transit-related LEED (Leadership in Energy and Environmental Design) rating credits. Let us analyze the implications of these findings on the sustainability and accessibility of the project:

1. **Lack of Subsidized Transit Passes**
    - Impact: The absence of subsidized transit passes for residents and employees within the project during the initial years can affect the affordability and accessibility of public transportation for them.
    - Implications: This could potentially discourage the use of public transit and result in higher reliance on private vehicles, leading to increased traffic congestion, air pollution, and transportation costs for residents.

Developer-Sponsored Transit

2. **Absence of Year-Round, Developer-Sponsored Transit Service**
    - Impact: The absence of developer-sponsored transit service from a central point in the project to major transit facilities or other destinations can limit residents' transportation options, especially if they do not have access to private vehicles.
    - Implications: This can affect the project's sustainability by potentially increasing car dependence, traffic congestion, and greenhouse gas emissions. It may also limit residents' ability to access employment, retail centers, and other essential services via public transit.

Figure 4.17: Public Bus Waiting Area (source field survey)

Vehicle Sharing

3. **Insufficient Proximity to Vehicle Sharing Points**
    - Impact: Failing to meet the requirement that 50% of dwelling units and nonresidential use entrances are within a ¼-mile walking distance of a vehicle sharing point can limit access to shared mobility options.
    - Implications: This could hinder residents' ability to access affordable and sustainable transportation alternatives such as car-sharing services, which can reduce the need for private vehicle ownership and promote environmental sustainability.

Discussion

1. Enhancing Transit Accessibility:
    - To improve the sustainability and accessibility of the affordable housing development, efforts should be made to subsidize transit passes for residents and employees. This would encourage public transit use and reduce the environmental impact associated with private vehicle use.
2. Developer-Sponsored Transit Services:
    - Considering the lack of year-round developer-sponsored transit services, exploring partnerships with local transit agencies or private shuttle services could be beneficial. Providing convenient

transportation options can reduce car dependency and improve connectivity to key destinations.

3. Promoting Vehicle Sharing:
    - To meet the vehicle-sharing proximity requirement, planners should consider the strategic placement of vehicle-sharing points within the project area. This can encourage residents to use shared vehicles when needed, reducing the overall number of private vehicles.
4. Sustainable Transportation Planning:
    - A comprehensive sustainable transportation plan should be developed to address the transportation needs of residents and employees. This plan should prioritize the use of public transit, shared mobility services, and active transportation options like walking and cycling.
5. Community Engagement:
    - Involving residents in the transportation planning process can help identify their specific needs and preferences, ensuring that transportation solutions align with their daily routines and lifestyles.

In conclusion, addressing the gaps identified in the survey regarding transit passes, developer-sponsored transit, and vehicle sharing is essential for enhancing the sustainability and accessibility of the affordable housing project. By promoting affordable and sustainable transportation options, the project can reduce its environmental footprint, improve residents' quality of life, and contribute to the overall well-being of the community.

Credit: Access to Civic and Public Space

The findings from the survey reveal that the affordable housing development has taken positive steps towards promoting accessibility to civic and public use spaces within a reasonable walking distance. In this case, Jeevanjee Gardens and Uhuru Park are accessible public spaces, and their proximity has several implications for the sustainability and quality of life within the development. Jeevanjee gardens is 3.4Km away and Uhuru Park is 4km away.

They are 24minutes and 32 minutes respectively away from the development. This has helped to promote walking to the public spaces to avoid the long traffics witnessed on the roads. The locations of these public spaces has helped to incorporate physical activities in the daily lives of residents. It has also helped to develop a neighbourhood that promotes walking to and from accessible public spaces. The streets to the public spaces are interconnected and easily accessible to one another, which makes walking and biking easy, enjoyable, and efficient:

Implications of Accessibility to Civic and Public Use Spaces

Promotion of Active Lifestyles: Impact: The proximity of Jeevanjee Gardens and Uhuru Park, along with their accessibility, encourages residents to engage in physical activities, such as walking and outdoor recreational activities.

Benefits: Active lifestyles contribute to residents' health and well-being by providing opportunities for exercise and relaxation. This can lead to a healthier and more vibrant community.

Figure 4.18: Access to Public Space at Park Road Ngara (Source field survey)

1. **Reduced Reliance on Cars**

Impact: The availability of nearby public spaces reduces the need for residents to use private vehicles to access recreational areas, leading to reduced traffic congestion and lower greenhouse gas emissions.

Benefits: Fewer cars on the road improve air quality, reduce noise pollution, and make the neighborhood safer for pedestrians and cyclists.

Community Building

Impact: Accessible public spaces act as social hubs where residents can interact, socialize, and build a sense of community.

Benefits: This fosters social cohesion and a sense of belonging among residents, contributing to a more supportive and connected neighborhood.

2. Walkability and Biking:

    - Impact: The interconnected streets leading to public spaces make walking and biking easy and enjoyable, reducing the dependency on motorized transportation.
    - Benefits: Improved walkability and biking infrastructure promote sustainable transportation modes, reduce traffic congestion, and enhance the overall urban environment.

Discussion

1. Optimizing Public Space Design:
    - To enhance the quality of public spaces, consider community input and engage landscape architects and urban planners to optimize the design and amenities of Jeevanjee Gardens and Uhuru Park. This can make these spaces even more attractive and functional for residents.

2. Safety and Accessibility:
    - Ensure that pathways to these public spaces are well lit, safe, and accessible to all residents, including those with mobility challenges. The safety of these routes should be a top priority.
3. Promotion of Sustainable Transportation:
    - Encourage the use of sustainable transportation modes, such as walking and biking, by providing dedicated pathways and bicycle infrastructure. Consider bike-sharing programs or bike lanes to promote cycling.
4. Community Engagement:
    - Continue engaging with the community to understand their needs and preferences regarding public spaces. This collaborative approach can help tailor these spaces to meet the diverse interests of residents.

In conclusion, the proximity and accessibility of Jeevanjee Gardens and Uhuru Park have positive implications for the sustainable and vibrant living environment of the affordable housing development. By optimizing the design of these spaces, ensuring safety and accessibility, and promoting sustainable transportation options, the project can further enhance the well-being and quality of life for its residents while contributing to a more sustainable urban community.

Credit: access to recreation facilities

The survey findings indicate that the affordable housing development has successfully met the criteria for the LEED (Leadership in Energy and Environmental Design) rating credit related to access to recreation facilities. Park road Ngara is at a great advantage for earning the Access to recreation facilities credit, with its planned recreational amenities that include:

1. Pumwani boys' sports complex
2. Nairobi gymkhana stadium
3. Blue hut hotel
4. Maggie shisha and restaurant

All of these amenities are within walking and biking distance from all the residential neighbourhoods in the project. The access to recreational facilities has helped to offer opportunities for residents to lead active lives. This is also a very marketable feature for master planned communities, thus it should not be a difficult credit to achieve.

This credit is a significant achievement for the project, as it fosters community involvement, social capital, and overall quality of life. Here is an analysis of the implications of this achievement:

Figure 4.19: Recreation Facility at Park Road Ngara (Source field survey

Implications of Providing Access to Recreation Facilities

1. Community Involvement and Social Capital:
    - Impact: The provision of outdoor recreational facilities, including play areas and recreational spaces, has played a crucial role in fostering community involvement and building social capital among residents.
    - Benefits: These spaces provide a platform for residents to interact, socialize, and engage in recreational activities. This strengthens social bonds and creates a sense of belonging within the community.
2. Transitioning Vacant Areas to Green Spaces:
    - Impact: Transforming vacant areas into recreational green spaces is an effective way to repurpose underutilized land and enhance the urban environment.

- Benefits: Beyond recreation, such spaces can offer ecological benefits such as improved air quality, urban biodiversity, and temperature regulation, contributing to the overall sustainability of the development.

3. Marketability of Master Planned Communities:
    - Impact: Access to recreational facilities is a highly marketable feature for master-planned communities, making the development more attractive to potential residents.
    - Benefits: This can positively influence the occupancy rate and demand for housing within the project, which, in turn, can support its long-term viability.

Discussion

1. Maintenance and Sustainability:
    - To ensure the continued success of the recreational facilities, it's essential to establish a maintenance plan. Regular upkeep, landscaping, and safety measures should be priorities to maintain the quality and safety of these spaces.
2. Inclusive Design:
    - Consider inclusive design principles to ensure that the recreational facilities are accessible to residents of all ages and abilities. This can promote inclusivity and equal access to recreational opportunities.
3. Programming and Community Engagement:
    - Encourage community engagement in the programming of these recreational spaces. Resident input on the types of activities, events, and amenities can enhance their relevance and appeal.
4. Ecological Benefits:
    - Explore how the recreational green spaces can provide additional ecological benefits, such as planting native vegetation, supporting pollinators, or managing storm water runoff sustainably.

5. Promotion of Active Lifestyles:
    - Actively promote the use of these recreational facilities to encourage residents to lead active and healthy lifestyles. Organize community events, fitness classes, and recreational programs to maximize usage.

Figure 4.20: Recreation Facility at Park Road Ngara (Source field survey)

In conclusion, the provision of accessible recreational facilities within the affordable housing development is a significant achievement that positively influences community involvement, social capital, and the overall livability of the project. Maintaining and enhancing these spaces, while considering ecological benefits and inclusivity, can further contribute to the project's sustainability and desirability as a master-planned community.

Credit: Neighbourhood schools

The survey findings indicate that the affordable housing development has strategically located itself in close proximity to various educational institutions, including Jara Kindergarten, Muslim Academy, and Park Road Primary School. The different education facilities found in the area include Jara Kindergarten at 100 metres, Muslim Academy at 280 metres and park road primary at 350 metres. These

institutions serve the residents of the new development. This has several implications for the sustainability and convenience of the development:

Implications of Proximity to Educational Facilities

1. Accessibility to Education:
    - Impact: The location of these educational institutions within walking distance makes quality education more accessible to the residents of the housing development.
    - Benefits: Families with school-going children can benefit from reduced commuting times and easier access to educational resources, fostering a positive learning environment.
2. Reduction in Traffic Congestion:
    - Impact: Proximity to schools reduces the need for long car commutes, which can help alleviate traffic congestion in the surrounding area.
    - Benefits: Reduced traffic congestion contributes to improved air quality, reduced greenhouse gas emissions, and safer streets for pedestrians and cyclists.
3. Promotion of Active Transportation:
    - Impact: Being able to walk to nearby schools encourages active transportation modes, such as walking or biking, promoting physical activity among children and reducing the dependence on private vehicles.
    - Benefits: Active transportation is not only healthier but also environmentally friendly, contributing to the development's sustainability goals.
4. Community Integration:
    - Impact: The presence of nearby schools can foster a sense of community integration as residents interact with educators, students, and other parents in the area.
    - Benefits: This integration can lead to social cohesion and community building, enhancing the overall living experience.

Discussion

1. Safety Measures:
    - Ensure that safe pedestrian pathways and crossings are in place to facilitate the walkability of children to and from school. Safety should be a top priority, especially for younger students.
2. Community Engagement:
    - Encourage collaboration between the housing development and educational institutions for community engagement initiatives. Joint programs and events can strengthen the bond between the two entities.
3. Education about Sustainability:
    - Consider incorporating sustainability education into the curriculum of nearby schools. This can help raise awareness and promote eco-friendly practices among students and their families.
4. Transportation Alternatives:
    - Promote alternative transportation modes such as school buses, carpools, and safe biking routes to reduce car traffic during school drop-off and pick-up times.

In conclusion, the strategic location of the affordable housing development near educational facilities offers numerous benefits, including enhanced education accessibility, reduced traffic congestion, and opportunities for active transportation. These factors contribute to the development's sustainability and create a more convenient and community-oriented living environment for its residents.

The findings from the survey indicate that the affordable housing development has integrated specific design features related to circulation networks to ensure safe and convenient access to educational facilities, particularly schools. This approach has several implications for the sustainability and overall quality of life within the development:

Implications of Circulation Network Design for School Access

1. Safe and Accessible School Routes:
    - Impact: The presence of a complete network of sidewalks on both sides of the circulation network, along with continuous bicycle lanes and traffic control measures, ensures safe and accessible routes for pedestrians and cyclists, including students walking or biking to school.
    - Benefits: This design prioritizes the safety of school-going children and promotes active transportation, reducing the need for car travel. It also contributes to improved air quality and reduced traffic congestion.
2. Minimizing Crossings and Conflicts:
    - Impact: Designing schools within the project boundaries to prevent pedestrians and cyclists from crossing bus zones, parking entrances, and student drop-off areas enhances safety and minimizes potential conflicts.
    - Benefits: Such design considerations reduce the risk of accidents and create a more harmonious flow of traffic around school areas, contributing to the well-being of both students and the community.
3. Promotion of Active Transportation:
    - Impact: Providing safe routes for pedestrians and cyclists encourages students and residents to use sustainable transportation modes, promoting physical activity and reducing car dependence.
    - Benefits: Active transportation not only supports health and well-being but also aligns with sustainability goals by reducing greenhouse gas emissions and traffic-related pollution.
4. Community Integration:
    - Impact: The circulation network design that facilitates easy access to schools fosters community integration by encouraging interaction among students, parents, and other residents.
    - Benefits: This integration contributes to a sense of belonging, social cohesion, and a stronger sense of community.

Discussion

1. Ongoing Maintenance and Safety:
    - Ensure that the sidewalks, bicycle lanes, and traffic control measures well maintained to uphold safety standards. Regular inspections and repairs should be part of the development's maintenance plan.
2. Education and Awareness:
    - Promote educational initiatives within the community to raise awareness about the benefits of active transportation and safe school routes. This can encourage more families to choose sustainable transportation options.
3. Community Engagement:
    - Involve residents, parents, and school authorities in discussions about circulation network design and safety measures. Their input can help identify specific needs and concerns related to school access.
4. Evaluation and Adaptation:
    - Continuously evaluate the effectiveness of the circulation network design in facilitating safe school access. If necessary, make adjustments based on feedback and changing circumstances.

In conclusion, the intentional design of the circulation network to ensure safe and convenient access to schools reflects a commitment to sustainability, safety, and community well-being within the affordable housing development. By prioritizing active transportation and minimizing potential conflicts, the project enhances the quality of life for residents while contributing to broader sustainability goals.

3. Project Case Studies: We reviewed several LEED-certified neighborhood development projects in Kenya that have earned credits for walkable streets. These case studies provide real-world examples of the application of LEED principles.
4. Challenges and Opportunities: Identifying the challenges faced in implementing walkable streets in Kenyan cities and exploring the opportunities for improvement.

Visitability and Universal Design (1 point)

The survey revealed park road has designed a minimum of 20% of the units (but not less than one) to meet the requirements of one of the following options. This category included mixed-use buildings with dwelling units.

Figure 4.21: Elevator

Universal Design Features throughout the Home (1 point)

The survey revealed that throughout the home, the development included five of the following universal design features:

- easy-to-grip lever door handles
- easy-to-grip cabinet and drawer loop handles;
- easy-to-grip locking mechanisms on doors and windows;
- easy-to-grip single-lever faucet handles;
- easy-touch rocker or hands-free switches;

Figure 4.22: Easy-to-Grip Single-Lever Faucet Handles (source field survey)

From the survey, the development has incorporated universal design by having the houses have a wide range of housing types and in turn support a diverse population that includes students, families, seniors, group housing, young singles, or couples and all kinds of abilities. It has also added a sense of texture and character to the place by encouraging social and economic diversity, along with multiple levels of affordability.

Option 2. Kitchen Features (1 point)

The survey revealed that on the main floor of the home the design has provided a kitchen with hard-surface flooring, plumbing with single-lever controls, a 5-foot (1.5-meter) turning radius, and the following universal design features:

- variable-height (28- to 42-inch [70- to 110-centimeter]) or adjustable work surfaces, such as countertops, sinks, and cooktops;
- clear knee space under sink and cooktops (this requirement can be met by installing removable base cabinets or fold-back or self-storing doors), cooktops and ranges with front or side-mounted controls, and wall-mounted ovens at a height to accommodate a seated adult;
- a toe kick area at the base of lower cabinets with a minimum height of 9 inches (23 centimeters), and full-extension drawers and shelves in at least half (by volume) of the cabinets;
- contrasting color treatment between countertops, front edges, and floor;

- adjustable-height shelves in wall cabinets; and
- Glare-free task lighting.

Figure 4.23: Kitchen Features One Bedroom (Source field survey)

Figure 4.24: Kitchen Features 2 Bedroom (Source field survey)

Figure 4.25: Kitchen 3 Bedroom (Source field survey)

The kitchen design prioritized inclusivity, ensuring that people of all ages, sizes, and abilities can safely and effectively use the space. This inclusivity was achieved through thoughtful layout and functionality considerations, making the kitchen accessible to a broad range of individuals.

To enhance accessibility, contrast was strategically used to define the boundaries of different areas within the kitchen. This included creating a contrast between the flooring and cabinets, as well as between the cabinets and countertops. These visual cues help individuals with vision impairments identify transitions from horizontal (floor) to vertical (cabinetry). While the contrast does not need to be stark, choices like white oak hardwood floors and walnut cabinetry provided enough differentiation to be effective.

Natural light was favored in the design, although additional kitchen lighting remained a necessity. Storage solutions such as trash pullouts, rollout shelves, swing-up mixer shelves, and pull-down shelves were integrated, offering flexibility for users with varying needs. These pullout options not only improve cabinet visibility but are also designed to be easily maneuvered by individuals with different abilities.

Furthermore, the incorporation of more drawers into the kitchen cabinetry provided similar benefits. Traditionally, upper cabinets might hold dishware and glassware, but introducing drawers with storage inserts below the countertop made these essentials more accessible to a wider range of users.

Option 3. Bedroom and Bathroom Features (1 point)

The survey revealed that on the main floor of the development included all of the following:

In at least one accessible bedroom,

- The room size to accommodate a twin bed with a 5-foot (1.5-meter) turning radius around the bed.

- Install a clothes closet with a 32-inch (80-centimeter) clear opening with adjustable-height closet rods and shelves.

Three bedroom.

Figure 4.26: Bedroom of a 3 Bedroom (Source field survey)

Figure 4.27: Master Bedroom (Source field survey)

Figure 4.28: 2 Bedroom Apartment (Source: field survey)

Two bedroom

Figure 4.29: Bedroom (Source field survey)

One bedroom.

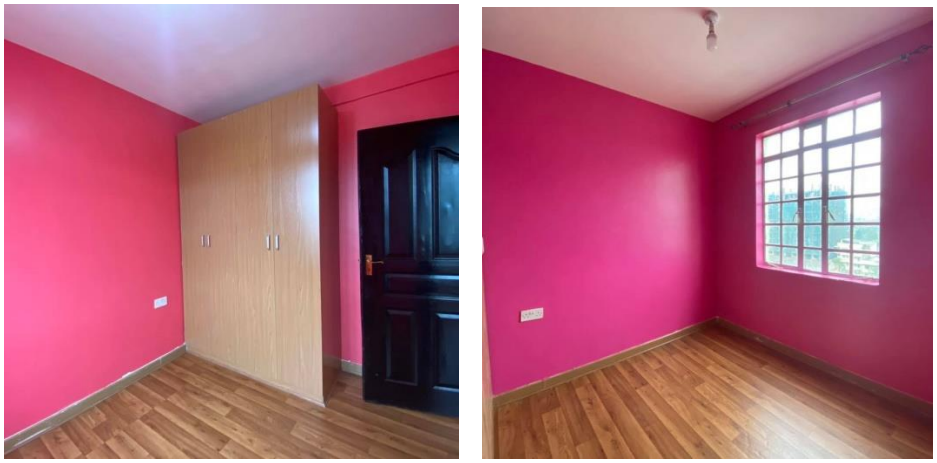


Figure 4.30: Bedroom

The survey revealed that in at least one full bathroom on the same floor as the bedroom,

- Achieved adequate maneuvering space with a 30-by-48-inch (75-by-120 centimeter) clear floor space at each fixture.
- Centered the toilet 18 inches (45 centimeters) from any sidewall, cabinet, or tub, and allowed a 3-foot (90-centimeter) clear space in front.
- Installed broad blocking in walls around toilet, tub, and/or shower for future placement and relocation of grab bars.
- Installed a long mirror whose bottom is no more than 36 inches (90 centimeters) above the finished floor and whose top is at least 72 inches (180 centimeters) high.
- In addition, all bathrooms have hard-surface flooring, all plumbing fixtures must have single-lever controls, and tubs or showers must have hand-held showerheads.

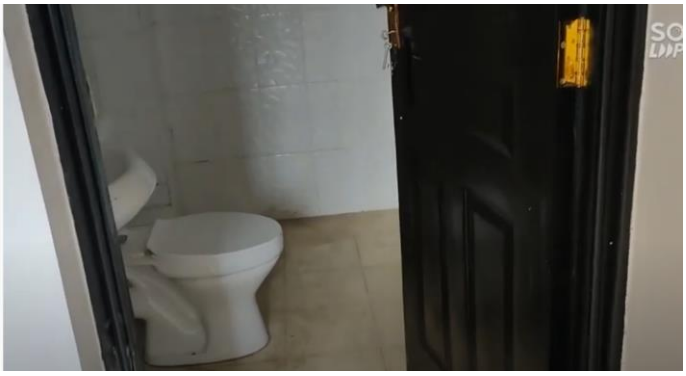


Figure 4.31:1-Bedroom Washroom (Source field survey)

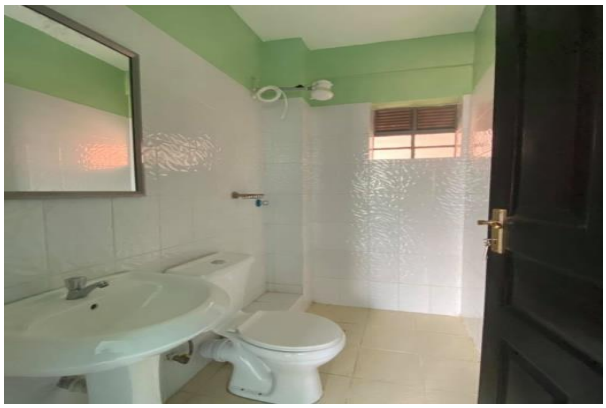


Figure 4.32: 3 Bedroom Typical Washroom (Source field survey)

Figure 4.33: 2 Bedroom Washroom (60sqm) (source field survey)

All people without the need for specialized or adapted design define universal design, which emerged in the mid-1980s, as the design of products and environments to be usable. The development under consideration successfully incorporates universal design principles to create an inclusive and accessible living environment.

Key features of this approach include a step-free entrance route that seamlessly integrates with the overall design, wide doorways, the inclusion of a bedroom and bathroom on the lower level, and the placement of light switches and outlets at heights suitable for both children and seated adults.

In typical kitchen and bathroom spaces, universal design elements are integrated. These encompass adjustable or multiple countertop heights, cabinets or drawers that can be extended or removed, lever-style faucets, visually appealing grab bars, and a curb less shower with a handheld showerhead.

The incorporation of universal design features in homes serves several important purposes. It helps prevent injuries, particularly for children, by implementing safety measures such as shorter stair runs and cranked windows that limit opening width. Installing grab bars in bathrooms is beneficial for both children and older adults, reducing the risk of falls.

Additional design improvements include sidelights at the main entrance, which allow children to see who is at the door, and a zero-step entrance that easily accommodates a stroller. These features enhance the inclusivity of the home, making it accessible for children's friends with disabilities and promoting social interaction. Moreover, features like varying countertop heights and accessible refrigerator drawers empower children to be more independent and engaged in family activities, such as meal preparation. Universal design ensures that the living space is welcoming and functional for everyone.

Connecting Theories to Findings on Visibility and Universal Design

1. Sustainability Theory: Inclusivity as a Core Principle. The study connected sustainability theory's social dimension, which emphasizes creating inclusive

and equitable communities, to the role of universal design in achieving this goal.

- Promoting Social Equity: Universal design features, such as step-free entrances, wide doorways, and adjustable countertops, were observed to enhance accessibility for people with disabilities, older adults, and children, ensuring that everyone could comfortably and safely use the space. This promoted social equity by removing barriers and creating equal opportunities for participation in community life.
- Enhancing Community Cohesion: The study noted that environments incorporating universal design were more welcoming to a diverse range of residents, fostering social interaction and strengthening community bonds. For example, common areas like courtyards and playgrounds, as discussed in the sources, became gathering points for people of all abilities, promoting social interaction and a sense of belonging.
- Supporting Long-Term Affordability: The analysis underscored the long-term cost benefits of universal design features. These features prevented the need for expensive modifications as residents' needs changed over time (e.g., aging in place) and reduced the risk of accidents and injuries, thereby lowering healthcare costs.

2. Affordable Housing Theory: Addressing Diverse Needs the study linked affordable housing theory's focus on addressing the diverse needs of low-income households to the principles of universal design, which were particularly relevant in projects serving residents with varying physical abilities and limitations.

- Meeting Specific Needs: Universal design features were tailored to address the specific needs of residents with disabilities, ensuring they had equal access to housing opportunities and could fully participate in community life. This approach aligned with the sources' emphasis on designing for different family structures and meeting the needs of vulnerable populations.

- Enhancing Quality of Life: The study highlighted how affordable housing designed with universal design principles improved residents' quality of life by making homes more comfortable and user-friendly for people of all ages and abilities. These features reduced stress and anxiety associated with navigating inaccessible environments.

3. LEED-ND Standards: A Tool for Inclusive Design the study identified how LEED-ND standards provided a practical framework for incorporating universal design principles into affordable housing projects.

- Visitability and Universal Design Credit: The observational checklist explicitly included this credit, which covered features such as lever-style door handles, adjustable-height closet rods, and roll-in showers. This reflected the LEED-ND rating system's commitment to promoting inclusive design within sustainable neighborhoods.
- Synergies with Other Credits: The analysis found that the principles of universal design aligned with other LEED-ND credits promoting accessibility and walkability, such as "Walkable Streets" and "Access to Public Space." These interconnected credits worked together to create neighborhoods that were easy to navigate and welcoming to people of all abilities.

4.11 Community Outreach and Involvement

Any procedure that actively incorporates the public in decision-making processes and fully considers their views is referred to as participation from the public. Public involvement is a democratic right in Kenya, as stated in the 2010 Kenyan Constitution. It is essential to the implementation of devolution and public governance. Acting as a vehicle for promoting sustainable development, increasing civic involvement, encouraging accountability, and empowering individuals.

4.11.1 Community Outreach

The survey revealed that views from the local residents, stakeholders, surrounding institutions and development partners who in one way or another would be affected

or rather interested in the proposed project were sought through administering of questionnaires, interviews and public meeting as stipulated in the Environment Management and Coordination Act, 1999.

Objectives of the Consultation and Public Participation (CPP)

The consultation and public participation process aimed to achieve the following objectives:

1. Disseminate and provide information to stakeholders regarding the project, emphasizing its key components and location.
2. Gather comments, suggestions, and concerns from interested and affected parties.
3. Incorporate the information collected during the Environmental and Social Impact Assessment (ESIA) study.

The methodology employed in the consultation and public participation process involved several activities. These activities were conducted from February 20th to March 6th, 2019, in compliance with Section 17 (2) c of the EIA Regulations 2003, which requires that appropriate notice be provided to affected parties or communities at least one week prior to the public meeting. The methods used in the consultation and public participation process included:

1. Interviews and discussions with relevant stakeholders.
2. Field surveys and observations of the project area.
3. Administration of questionnaires to gather feedback.
4. A public meeting held on March 6th, 2019.

These methods aimed to engage and involve the community and other stakeholders in the decision-making process and to ensure that their feedback and concerns were considered in the ESIA study.

Figure 4.34: Pictures Taken during the Public Meeting (source EIA report)

Figure 4.35: Pictures Taken during the Public Meeting (Source EIA report)

Community outreach and involvement in the development process can be mutually beneficial for both developers and the public. It demonstrates that developers value the input and concerns of the community, which can help streamline the entitlement process. Additionally, it establishes a continuous means of communication between the developer and the community, fostering an ongoing relationship throughout various project phases, from design to construction and, in some cases, post-construction maintenance.

While community involvement is essential in the planning process, it is equally important to focus on community building and resident cohesion, which contribute to social capital. Several strategies can enhance community cohesion, including land

banking, collective ownership, and community organizing aimed at reducing blight, home repair, house boarding, and educational outreach on topics such as foreclosure prevention and home weatherization. Collaborations with specialized organizations can also be beneficial. It is advisable to incorporate more specific language and examples into the criteria, such as land banking and community benefits agreements, to promote resident cohesion and connections with institutional anchors. Furthermore, the credit should address land assembly and encompass strategies like collective ownership, community organizing to combat blight, home repair, house boarding, art initiatives, and educational outreach on foreclosure prevention and home weatherization, in addition to partnerships with relevant organizations.

To establish a comprehensive evaluation framework for affordable housing projects in Kenya, it is essential to select LEED Neighborhood Development (ND) credits that align with key sustainability goals and priorities for affordable housing. Below, you will find a selection of LEED-ND credits that can serve as a foundation for such an evaluation framework, along with a template for an Affordable Housing Rating Tool. This framework can help assess the sustainability and performance of affordable housing developments in Kenya.

4.12 Relating Study Findings to Overarching Theory

Key Theoretical Constructs from Chapter 2

- Sustainability Theory: Emphasized balancing social, economic, and environmental aspects in development.
- Affordable Housing Theory: Focused on policies and practices to ensure housing is available to low-income populations, considering affordability, housing quality, and social inclusion.
- Systems Theory: Explained how components of a system interact to achieve a larger goal, highlighting interdependence, feedback loops, and adaptation.

Findings from Chapter 4 and their Relation to Theory

1. Walkable Streets and Reduced Parking Footprint: Chapter 4 highlighted the project's efforts to promote walkability through the provision of sidewalks, pedestrian-only paths, and efforts to reduce the parking footprint. These findings strongly connected to:
    - Sustainability Theory: Reducing car dependence aligned with the environmental dimension of sustainability by minimizing pollution and promoting energy efficiency.
    - Affordable Housing Theory: Walkable neighborhoods increased access to amenities and opportunities, contributing to "housing quality" and "livable environments."

The research acknowledged that the project did not fully achieve the LEED-ND targets for reducing paved surfaces. This was discussed as a potential challenge to fully realizing the sustainability and affordability benefits of reduced parking.

2. Proximity to Amenities and Services: The study found that the Park Road Ngara project provided good access to essential services like schools, healthcare facilities, and public transportation. This finding supported:
    - Affordable Housing Theory: Easy access to essential services is a key aspect of "housing quality" and improves the "livability" of affordable housing.
    - Systems Theory: Locating housing near existing infrastructure and amenities demonstrated an understanding of "interdependence" within urban systems.
3. Housing Types and Affordability: Chapter 4 discussed the diversity of housing sizes and types, including units priced below the average median income (AMI) threshold. This directly related to:
    - Affordable Housing Theory: Providing a range of housing options at different price points was crucial to ensuring "affordability" and catering to diverse housing needs. The inclusion of units below the

AMI threshold aligned with the theory's emphasis on addressing the needs of low-income households.

- Social Inclusion (within Sustainability Theory): Offering affordable housing options to a wider range of income levels contributed to creating more inclusive communities, aligning with the social equity dimension of Sustainability Theory.

4. Community Outreach and Involvement: The study noted the project's efforts to engage the community through public meetings and feedback mechanisms. This supported:
    - Sustainability Theory: Meaningful community engagement aligned with the social dimension of sustainability by ensuring that development projects reflected community needs and priorities.
    - Systems Theory: Involving stakeholders in the planning process allowed for feedback loops and adaptive decision-making, contributing to the resilience and effectiveness of the housing system.

Objective 3: Developing a Tailored Evaluation Framework

Objective 3 aims to develop an assessment tool for affordable housing projects in Kenya by integrating insights from LEED-ND standards and findings from affordable housing initiatives. This objective focuses on creating a framework that emphasizes affordability, liveability, and sustainability, tailored to Kenya's unique economic, social, and environmental context.

The development of the evaluation framework involved the following key steps:

1. Synthesizing Insights from Literature and Case Studies
    - A comprehensive review of existing evaluation tools (e.g., LEED-ND, BREEAM Communities, Green Star Communities, etc.) identified their strengths, limitations, and applicability to affordable housing.
    - Key insights from the Park Road Ngara case study were analysed to understand practical challenges and successes in applying sustainability and liveability principles in Kenya.
    -

2. Consultation with Stakeholders
    - Stakeholders involved in affordable housing projects, including architects, planners, policymakers, and residents, were consulted through structured interviews and surveys.
    - These consultations revealed critical gaps in existing tools and localized needs, such as prioritizing affordability and accessibility to services.
3. Adapting LEED-ND Principles to the Kenyan Context
    - Specific provisions from LEED-ND—such as Smart Location, Neighborhood Pattern and Design, and Green Infrastructure and Buildings—were evaluated for their relevance and adaptability to Kenya.
    - The framework was adjusted to incorporate region-specific priorities, including affordable housing typologies, community resilience, and urbanization trends.
4. Incorporating Quantitative and Qualitative Data
    - The framework integrates quantitative metrics (e.g., cost per unit, proximity to transit) and qualitative measures (e.g., tenant satisfaction, social inclusivity).
    - Data collected from Park Road Ngara tenants was mapped to relevant LEED-ND criteria to inform this step.
5. Framework Development and Validation
    - The proposed framework was structured around three pillars: affordability, sustainability, and liveability.
    - Validation was done through expert reviews and feedback from housing stakeholders to ensure feasibility and practicality.

The result is a tailored evaluation framework that addresses Kenya's affordable housing needs while remaining informed by globally recognized standards like LEED-ND. The framework emphasizes:

- Ensuring affordability for low- and middle-income households.
- Enhancing sustainability through practical and locally relevant interventions.

- Promoting livability by fostering community-oriented design and access to amenities.

This objective builds on the findings from Objectives 1 and 2 to ensure that the final evaluation tool is not only robust but also directly applicable to the Kenyan affordable housing sector.

4.13 Selected LEED-ND Credits for Comprehensive Evaluation

1. Location and Linkages (LL): Evaluate the project's location, access to public transit, proximity to essential services (e.g., schools, healthcare), and walkability.
2. Neighborhood Pattern and Design (NP): Assess the layout and design of the neighborhood, including mixed land uses, compact development, and pedestrian-friendly streets.
3. Housing and Diversity (HD): Examine the variety of housing sizes and types, affordability levels, and inclusivity within the development.
4. Walkable Streets (WS): Analyze the presence of sidewalks, street connectivity, and access to public spaces, promoting walkability.
5. Green Infrastructure and Buildings (GB): Consider sustainability features such as green building practices, energy efficiency, and storm water management.
6. Reduced Parking Footprint (PF): Evaluate the reduction of paved surfaces, encouraging sustainable storm water management and reducing heat islands.
7. Transit (TR): Assess access to public transit, transit-oriented development (TOD), and measures to reduce automobile dependence.
8. Access to Recreation Facilities (ARF): Examine the availability of outdoor recreational spaces within the development, fostering community involvement and active lifestyles.
9. Educational Facilities (EF): Review proximity to schools and safe circulation networks for students, encouraging active transportation and access to education.

Based on these LEED credits, here is a template for an affordable housing rating tool:

Affordable Housing Rating Tool Template

Project Information

- Project Name:
- Location:
- Developer:
- Project Size (in acres/hectares):
- Project Type (e.g., affordable housing development):
- Evaluation Date:

Evaluation Criteria

1. Location and Linkages (LL):

- Proximity to Public Transit (1-5 points): Evaluate the walking distance to public transit options (e.g., bus stops, train stations). Assign points based on the following scale:
    - 5 points: Within 1/4 mile (400 meters) walking distance.
    - 4 points: Within 1/2 mile (800 meters).
    - 3 points: Within 3/4 mile (1200 meters).
    - 2 points: Within 1 mile (1600 meters).
    - 1 point: Within 1.5 miles (2400 meters).
- Access to Essential Services (1-5 points): Assess the availability and proximity of essential services (e.g., healthcare, schools, and grocery stores). Assign points based on the convenience of access:
    - 5 points: Within 1/4 mile (400 meters) walking distance.
    - 4 points: Within 1/2 mile (800 meters).
    - 3 points: Within 3/4 mile (1200 meters).
    - 2 points: Within 1 mile (1600 meters).
    - 1 point: Within 1.5 miles (2400 meters).

- Walkability (1-5 points): Evaluate the walkability of streets within the development, considering factors like the presence of sidewalks, pedestrian crossings, and traffic calming measures. Assign points based on the overall walkability:
    - 5 points: Excellent walkability with well-maintained sidewalks, frequent pedestrian crossings, and traffic calming measures.
    - 4 points: Good walkability with sidewalks and some pedestrian crossings.
    - 3 points: Moderate walkability with sidewalks but limited pedestrian crossings.
    - 2 points: Limited walkability with inconsistent or poorly maintained sidewalks.
    - 1 point: Poor walkability with no sidewalks or pedestrian infrastructure.

2. **Neighborhood Pattern and Design (NP)**

    - **Mixed Land Uses (1-5 points)**

Description: Evaluate the diversity and integration of land uses within the neighborhood. This includes the presence of residential, commercial, recreational, and possibly industrial uses within the development.

Criteria: Award points based on the extent to which the neighborhood successfully combines different land uses. Higher points should be given for well-balanced mixes of land uses, promoting a vibrant and self-sustaining community where residents can live, work, and play without the need for extensive travel.

Examples: A neighborhood with a mix of residential apartments, local shops, parks, and community centers would score high. Conversely, a neighborhood dominated solely by residential housing would score lower.

- **Compact Development (1-5 points)**

Description: Assess the layout and density of the development. Compact development minimizes sprawl and promotes efficient land use, reducing the environmental footprint.

Criteria: Points should be awarded based on the density of buildings, how efficiently land is utilized, and whether development is clustered rather than spread out. High scores indicate that the project optimizes land use, reducing infrastructure costs and preserving open spaces.

Examples: A development with multi-story apartment buildings and shared green spaces would score high for compact development. Conversely, a development with single-family homes on large lots would score lower.

- **Pedestrian-Friendly Streets (1-5 points)**

Description: Examine street design elements that prioritize pedestrian safety and comfort. This credit promotes walkability and encourages residents to use alternative modes of transportation.

Criteria: Points should be awarded based on the presence of wide sidewalks, pedestrian crosswalks, tree-lined streets, reduced vehicle speed limits, and traffic-calming measures such as speed bumps.

Examples: A neighborhood with well-maintained sidewalks, ample crosswalks, and traffic-calming features like speed humps would score high. Conversely, a neighborhood with narrow sidewalks and high-speed limits would score lower.

3. **Housing and Diversity (HD)**
    - **Variety of Housing Sizes and Types (1-5 points)**

Description: Assess the diversity of housing options within the development. This credit encourages a mix of housing sizes and types to accommodate various household sizes, lifestyles, and needs.

Criteria: Award points based on the range of housing choices, including the presence of different unit sizes (e.g., studio, one-bedroom, two-bedroom, three-bedroom) and housing types (e.g., apartments, townhouses, single-family homes).

Examples: A development offering a mix of studio apartments, family-sized townhouses, and single-family homes would score high. Conversely, a development with only one type of housing, such as single-family homes, would score lower.

- **Affordability Levels (1-5 points)**

Description: Evaluate the affordability of housing units within the development. This credit encourages the inclusion of units at different affordability levels to cater to a range of income groups.

Criteria: Points should be awarded based on the availability of housing units priced for households earning less than the area median income (AMI). Higher points should be given for a greater proportion of affordable units.

Examples: A development that includes a significant percentage of units priced for low-income households and moderate-income households would score high. Conversely, a development with primarily market-rate housing would score lower.

- **Inclusivity (1-5 points)**

Description: Assess the measures taken to promote inclusivity within the development. This credit encourages features that make housing accessible and comfortable for residents of all ages and abilities.

Criteria: Points should be awarded for inclusive design elements, such as barrier-free entrances, accessible common areas, universal design features, and accommodations for individuals with disabilities.

Examples: A development with universally designed buildings, wheelchair-accessible common areas, and accommodations for residents with disabilities would score high. Conversely, a development lacking such features would score lower.

These criteria within the Housing and Diversity category ensure that the affordable housing development offers a variety of housing choices, remains affordable to diverse income groups, and prioritizes inclusivity and accessibility. This contributes to the creation of a vibrant, equitable, and welcoming community for all residents.

4. **Walkable Streets (WS)**
    - **Presence of Sidewalks (1-5 points)**

Description: Assess the presence and quality of sidewalks along streets within the development. This credit focuses on ensuring that residents have safe and convenient pedestrian pathways.

Criteria: Award points based on the extent and quality of sidewalks. Higher points should be given for well-maintained sidewalks that are wide, well-lit, and separated from vehicular traffic.

Examples: A development with wide, well-maintained sidewalks lining all streets would score high. Conversely, a development with narrow, poorly maintained sidewalks or gaps in sidewalk coverage would score lower.

- **Street Connectivity (1-5 points)**

Description: Evaluate the interconnectedness of streets within the development. This credit encourages a network of streets that provides efficient and direct routes for pedestrians.

Criteria: Points should be awarded based on the density of streets and the ease of navigating the neighborhood on foot. Higher points should be given for well-connected street networks.

Examples: A development with a grid-like street layout that offers multiple pedestrian-friendly routes would score high. Conversely, a development with a layout that forces pedestrians to take indirect routes would score lower.

-

- **Access to Public Spaces (1-5 points)**

Description: Consider access to public spaces such as parks, plazas, recreational areas, and community centers within the development.

Criteria: Award points based on the proximity and ease of access to these public spaces. Higher points should be given for developments where residents can easily reach public spaces on foot.

Examples: A development where all residential areas have direct access to nearby parks and plazas would score high. Conversely, a development where public spaces are distant and require significant travel would score lower.

These criteria within the Walkable Streets category ensure that the affordable housing development provides safe and convenient pedestrian pathways, fosters a well-connected street network, and offers easy access to public spaces. This contributes to the creation of a walkable, livable, and community-focused neighborhood.

5. **Green Infrastructure and Buildings (GB)**
    - **Sustainable Building Practices (1-5 points)**

Description: Assess the incorporation of sustainable building practices within the development. This credit encourages the use of environmentally friendly construction methods and materials.

Criteria: Award points based on the extent to which sustainable building practices are integrated into the development. Consider elements such as energy-efficient design, use of recycled materials, low-impact construction techniques, and adherence to green building standards.

Examples: A development that incorporates green building standards like LEED or uses energy-efficient construction techniques would score high. Conversely, a development with conventional construction methods and materials would score lower.

- **Energy Efficiency (1-5 points)**

Description: Evaluate the energy efficiency measures implemented in the housing units and common areas of the development. This credit promotes reduced energy consumption and lower utility costs for residents.

Criteria: Points should be awarded based on the energy performance of the buildings, including the use of energy-efficient appliances, lighting, insulation, and heating/cooling systems. Higher points should be given for developments that exceed minimum energy efficiency standards.

Examples: A development with ENERGY STAR-rated appliances, LED lighting, and well-insulated buildings would score high. Conversely, a development with outdated appliances and poor insulation would score lower.

- **Storm water Management (1-5 points)**

Description: Consider the management of storm water runoff within the development. This credit focuses on sustainable storm water practices that mitigate flooding and reduce pollution.

Criteria: Award points based on the effectiveness of storm water management techniques, such as permeable surfaces, rain gardens, retention ponds, or green roofs. Higher points should be given for comprehensive storm water management strategies.

Examples: A development with permeable pavement, rain gardens, and effective storm water retention systems would score high. Conversely, a development with traditional, impervious surfaces and no storm water management would score lower.

These criteria within the Green Infrastructure and Buildings category ensure that the affordable housing development adopts sustainable building practices, prioritizes energy efficiency, and implements effective storm water management. This contributes to reduced environmental impact, lower operating costs, and increased resilience to climate-related challenges.

6. **Reduced Parking Footprint (PF)**

- **Paved Surface Reduction (1-5 points)**

Description: Evaluate the extent to which the development reduces the total area of paved surfaces, including parking lots and driveways. This credit encourages a reduction in impervious surfaces to minimize environmental impact.

Criteria: Award points based on the percentage reduction of paved surfaces compared to the total developed land area. Higher points should be given for more substantial reductions in paved surfaces.

Examples: A development that significantly reduces the area of parking lots through measures like shared parking or compact parking would score high. Conversely, a development with extensive surface parking would score lower.

- **Stormwater Management (1-5 points)**

Description: Consider the stormwater management practices implemented within the development to mitigate runoff and reduce pollution. This credit promotes sustainable stormwater practices.

Criteria: Points should be awarded based on the effectiveness of stormwater management techniques, such as permeable surfaces, green infrastructure, retention ponds, or rain gardens. Higher points should be given for comprehensive stormwater management strategies.

Examples: A development with permeable pavement, green roofs, and effective stormwater retention systems would score high. Conversely, a development with traditional, impervious surfaces and no stormwater management would score lower.

These criteria within the Reduced Parking Footprint category ensure that the affordable housing development minimizes its environmental impact by reducing the area of paved surfaces, which can contribute to better stormwater management, reduced pollution, and a more sustainable approach to land use.

7. **Transit (TR)**

- **Public Transit Access (1-5 points)**

Description: Evaluate the accessibility of public transit options near the development. This credit encourages easy access to public transportation, promoting reduced car dependency.

Criteria: Award points based on the proximity of the development to public transit stops or stations. Higher points should be given for developments with multiple transit options and frequent service.

Examples: A development within walking distance of a bus stop, subway station, or commuter rail would score high. Conversely, a development located far from public transit options would score lower.

- **Transit-Oriented Development (1-5 points)**

Description: Assess whether the development follows transit-oriented development principles. This credit promotes land use patterns that support public transit and pedestrian-friendly communities.

Criteria: Points should be awarded based on the density, mixed land uses, and pedestrian-friendly design of the development. Higher points should be given for developments that align with transit-oriented development principles.

Examples: A development that includes mixed-use buildings, walkable streets, and transit-friendly amenities would score high. Conversely, a development with single-use zoning and car-oriented design would score lower.

- **Automobile Dependence Reduction (1-5 points)**

Description: Evaluate measures taken to reduce automobile dependence within the development. This credit encourages a shift toward sustainable transportation modes.

Criteria: Points should be awarded based on the availability of car-sharing services, bike-sharing programs, or incentives for using public transit. Higher points should be given for comprehensive strategies that actively reduce car dependence.

Examples: A development that provides on-site car-sharing services, bike storage facilities, and transit subsidies for residents would score high. Conversely, a development with no measures to reduce car use would score lower.

These criteria within the Transit category ensure that the affordable housing development prioritizes public transit accessibility, aligns with transit-oriented development principles, and actively promotes alternatives to car dependence. This contributes to reduced traffic congestion, lower greenhouse gas emissions, and enhanced mobility options for residents.

8. **Access to Recreation Facilities (ARF)**

    - **Outdoor Recreational Space (1-5 points)**

Description: Assess the provision of outdoor recreational space within or near the development. This credit emphasizes the importance of accessible outdoor areas for residents to engage in recreational activities.

Criteria: Points should be awarded based on the availability and quality of outdoor recreational spaces such as parks, playgrounds, sports fields, or community gardens. Higher points should be given for larger, well-maintained, and diverse recreational spaces.

Examples: A development that includes a community park, playgrounds, and sports fields within walking distance would score high. Conversely, a development with limited or poorly maintained outdoor recreational spaces would score lower.

This criteria within the Access to Recreation Facilities category ensures that the affordable housing development provides residents with opportunities for outdoor recreation and leisure activities. Accessible and well-maintained outdoor spaces

contribute to the physical and mental well-being of residents and promote a sense of community.

9. **Educational Facilities (EF)**

- **School Proximity (1-5 points)**

Description: Evaluate the proximity of educational facilities such as schools to the development. This credit emphasizes the importance of convenient access to educational opportunities for residents, especially families with children.

Criteria: Award points based on the distance to the nearest educational facilities, including elementary, middle, and high schools. Higher points should be given for developments where educational facilities are within walking distance.

Examples: A development where all residential areas have schools within a short walking distance would score high. Conversely, a development where schools are far from residential areas would score lower.

- **Safe Circulation for Students (1-5 points)**

Description: Assess the safety and ease of circulation for students traveling to and from educational facilities within the development. This credit promotes safe routes for students, encouraging walking or biking to school.

Criteria: Points should be awarded based on the presence of sidewalks, crosswalks, traffic calming measures, and safe pedestrian and bicycle infrastructure. Higher points should be given for developments that prioritize student safety.

Examples: A development with well-marked crosswalks, dedicated bike lanes, and traffic calming measures along routes to schools would score high. Conversely, a development with inadequate safety measures for students would score lower.

These criteria within the Educational Facilities category ensure that the affordable housing development provides convenient access to educational institutions and

prioritizes the safety of students traveling to and from school. This supports the educational needs of residents and promotes active, sustainable transportation options for students.

Scoring

- Total Score (out of 100 points)

Comments and Recommendations

In conclusion, the following is a synopsis of the project's overall cost and sustainability performance.

Note: The point value of each criterion is determined by how important it is. Projects can receive points according to how well they execute in each category. The overall score offers a comprehensive evaluation of the project's cost and sustainability.

4.14 Applying the Affordable Housing Rating Tool to Park Road Ngara

Project Information

- **Project Name:** Park Road Ngara Affordable Housing Project
- **Location:** Nairobi, Kenya
- **Developer:** Government of Kenya
- **Project Type:** Affordable Housing Development
- **Evaluation Date:** 12/4/2024

Evaluation Criteria and Scoring

1. Location and Linkages (LL): 10/25 points possible

- **Proximity to Public Transit (2/5):** The case study highlighted the project's shortcomings in providing convenient and affordable access to public transit, noting the absence of measures like subsidized transit passes.
- **Access to Essential Services (4/5):** The case study demonstrated that Park Road Ngara benefited from its proximity to a range of essential services,

including healthcare, religious institutions, commercial areas, and educational facilities.

- **Walkability (3/5):** The project showed a commitment to walkability with sidewalks, pedestrian paths, and a relatively compact layout. However, the case study pointed to excessive on-street parking as a negative factor that needed to be addressed.

2. Neighborhood Pattern and Design (NP): 11/25 points possible

- **Mixed Land Uses (4/5):** The case study indicated a good mix of land uses, with residential units complemented by the presence of essential services and amenities within or near the development.
- **Compact Development (4/5):** The project's design, with six blocks containing 1,370 housing units, suggested a reasonably dense and efficient use of land.
- **Pedestrian-Friendly Streets (3/5):** Park Road Ngara incorporated pedestrian-friendly design elements like sidewalks and pathways. The research recommended further improvements to enhance pedestrian safety and comfort, such as implementing traffic calming measures and addressing the impact of excessive on-street parking.

3. Housing and Diversity (HD): 12/25 points possible

- **Variety of Housing Sizes and Types (5/5):** The project scored highly in this category, offering a range of housing options, including one-bedroom, two-bedroom, and three-bedroom units. This diversity contributed to its social and economic sustainability.
- **Affordability Levels (4/5):** The project aimed to provide affordable housing for civil servants and other citizens, with units priced between Kshs. 1.5 million and Kshs. 4 million, suggests a commitment to affordability. However, the lack of specific data on the proportion of units within affordable ranges for the target population prevents awarding full points.
- **Inclusivity (3/5):** Park Road Ngara incorporated universal design features in 20% of its units, catering to residents with varying needs and abilities. While

commendable, this limited inclusion suggests room for improvement in extending accessibility features to a greater portion of the development.

4. Walkable Streets (WS): Already Assessed under Location and Linkages and Neighborhood Pattern and Design

5. Green Infrastructure and Buildings (GB): 9/25 points possible

- **Energy Efficiency (4/5):** The project incorporated features that contribute to energy efficiency, such as the use of large windows to maximize natural lighting. Assuming other energy-saving measures are in place, the project earns a relatively high score in this area.
- **Stormwater Management (2/5):** The case study highlighted that the project exceeded LEED-ND recommendations for paved surfaces, raising concerns about effective stormwater management and potential negative environmental impacts.

6. Reduced Parking Footprint (PF): 4/25 points possible

- **Parking Reduction Strategies (2/5):** The research points to the need for implementing strategies to reduce parking demand. This could involve promoting alternative transportation options like cycling and public transit use, as well as considering shared parking arrangements to minimize paved surfaces.
- **Stormwater Management (already assessed under GB).**

7. Transit (TR): Already addressed under Location and Linkages.

8. Access to Recreation Facilities (ARF): 8/25 points possible

- **Availability of Spaces (4/5):** Park Road Ngara offered a good range of recreational spaces, including a social hall, children's play areas, and green spaces.
- **Maintenance and Inclusivity (4/5):** The case study emphasized the need for ongoing maintenance of these spaces to ensure their continued appeal and

usability. It also highlighted the importance of incorporating ecological considerations and inclusivity in their design and management.

9. Educational Facilities (EF): 9/25 points possible

- **School Proximity (5/5):** Park Road Ngara scored highly in this category due to its close proximity to several educational institutions, including Jara Kindergarten, Muslim Academy, and Park Road Primary School. This easy access to schools benefits families with children and promoted a sense of community.
- **Safe Circulation for Students (4/5):** The project's circulation network is designed to prioritize safe and convenient access to educational facilities.

Total Score: 59/100

Comments and Recommendations

While Park Road Ngara demonstrated commendable efforts toward sustainability, the assessment using the Affordable Housing Rating Tool revealed areas for significant improvement. The project scored relatively well in Housing and Diversity, Access to Essential Services, and School Proximity, but it fell short in crucial categories like Public Transportation Access, Stormwater Management, and Reduced Parking Footprint.

To enhance its overall sustainability and livability, the project should prioritize the following:

1. Enhance Public Transportation Access: Implement measures to improve access to affordable and convenient public transportation, such as:
    - Subsidized Transit Passes: Offer residents' discounts on public transportation fares.
    - Improved Bus Stops and Shelters: Ensure safe, comfortable, and well-lit waiting areas.
    - Advocacy for Expanded Transit Routes: Work with local authorities to expand bus or other transit routes to better serve the community.

2. Prioritize Stormwater Management: Address the issue of excessive paved surfaces by:
    - Implementing Permeable Paving: Reduce impervious surfaces by using permeable paving materials in parking lots and walkways.
    - Incorporating Green Infrastructure: Integrate green infrastructure elements like rain gardens, and green roofs to absorb and filter stormwater runoff.
    - Enhancing Existing Drainage Systems: Ensure that the drainage infrastructure is adequate to handle stormwater runoff effectively.
3. Implement Parking Reduction Strategies: Reduce the demand for parking through:
    - Promoting Alternative Transportation: Encourage residents to use public transit, cycling, or walking by providing bike racks, safe pedestrian paths, and information on transit options.
    - Shared Parking Arrangements: Explore options for shared parking facilities with nearby businesses or institutions to minimize the overall parking footprint.
4. Extend Inclusivity Features: Increase the number of units equipped with universal design features beyond the current 20% to create a more inclusive living environment for residents with disabilities or mobility limitations.

By addressing these areas for improvement, Park Road Ngara can enhance its sustainability, livability, and overall contribution to the well-being of its residents. The Affordable Housing Rating Tool provides a valuable framework for assessing and guiding improvements in affordable housing projects in Kenya.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

This study aimed to evaluate the tools available for assessing neighborhood sustainability, particularly in the context of affordable housing projects in Kenya. It also focused on identifying specific provisions within LEED (Leadership in Energy and Environmental Design) neighborhood development standards that are relevant to sustainable practices in affordable housing. Additionally, the research aimed to pinpoint which LEED neighborhood development credits could serve as a foundation for creating a comprehensive evaluation framework for affordable housing projects in Kenya. Finally, the study sought to design a practical tool for assessing affordable housing options.

5.2 Linking Theory, Findings, and Summary of Findings

The study drew upon three primary theories: Sustainability Theory, Affordable Housing Theory, and Systems Theory, each offering a critical lens for evaluating the findings presented in Chapter 4.

1. Sustainability Theory:
    - Emphasized the integration of environmental, social, and economic dimensions in development.
    - Applied to affordable housing by advocating for resource-efficient construction, fostering social inclusion, and ensuring long-term financial viability.
2. Affordable Housing Theory:
    - Focused on the availability, affordability, and quality of housing for low-income populations.
    - Highlighted the importance of addressing diverse needs and ensuring equity in access to housing.

3. Systems Theory:
    - Explained the interconnections and interdependence between housing components and the larger urban system, emphasizing feedback loops and adaptation.

Findings and Their Link to Theory

1. Walkable Streets and Reduced Parking Footprint

In Chapter 4, the study highlighted the efforts of the Park Road Ngara project to promote walkability through the provision of sidewalks, pedestrian-only paths, and a reduced parking footprint. These findings were linked to:

- Sustainability Theory: The reduction in car dependence aligned with the environmental dimension of sustainability by minimizing pollution and promoting energy efficiency. Past research, such as that by Banister (2008), validated that walkable urban environments can reduce carbon emissions and contribute to sustainable urban development.
- Affordable Housing Theory: Walkable neighborhoods enhanced access to amenities and opportunities, contributing to "housing quality" and "livable environments." Previous studies (e.g., McCrea et al., 2005) indicated that walkability improves the livability of neighborhoods, especially for low-income households.

Despite these strengths, the project did not fully achieve the LEED-ND targets for reducing paved surfaces, which presented a challenge in fully realizing the sustainability and affordability benefits of reduced parking.

2. Proximity to Amenities and Services

The study found that the Park Road Ngara project offered good access to essential services like schools, healthcare facilities, and public transportation. This finding was linked to:

- Affordable Housing Theory: Easy access to essential services is a key aspect of "housing quality" and significantly improved the "livability" of affordable housing, as supported by previous research (Tunstall et al., 2013), which found that proximity to services is crucial for low-income residents' well-being.
- Systems Theory: The location of housing near existing infrastructure demonstrated an understanding of "interdependence" within urban systems. This was consistent with previous studies (Gehl, 2010) that emphasized the importance of integrating housing developments with existing infrastructure for better urban systems.

3. Housing Types and Affordability

The diversity of housing sizes and types, including units priced below the median income threshold, was discussed in Chapter 4. This directly related to:

- Affordable Housing Theory: Providing a range of housing options at different price points was crucial to ensuring "affordability" and catering to diverse housing needs. The inclusion of units below the median income threshold was aligned with the theory's emphasis on addressing the needs of low-income households. Studies such as those by Gwatkin et al. (2007) highlight how diversified housing options are essential for ensuring affordability.
- Social Inclusion (within Sustainability Theory): Offering affordable housing options to a wider range of income levels contributed to creating more inclusive communities, which aligned with the social equity dimension of Sustainability Theory. Previous research (e.g., Harris, 2010) suggested that diverse housing types foster social inclusion and community cohesion.

4. Community Outreach and Involvement

The study noted the project’s efforts to engage the community through public meetings and feedback mechanisms.

These findings were connected to:

- Sustainability Theory: Meaningful community engagement aligned with the social dimension of sustainability by ensuring that development projects reflected community needs and priorities. This was in line with research by Arnstein (1969), which argued that effective community participation is crucial for sustainable development.
- Systems Theory: Involving stakeholders in the planning process allowed for feedback loops and adaptive decision-making, contributing to the resilience and effectiveness of the housing system. This reflected findings by Senge (1990), who emphasized the role of feedback in adaptive systems.

Objective 3: Developing a Tailored Evaluation Framework

Objective 3 aimed to develop an assessment tool for affordable housing projects in Kenya by integrating insights from LEED-ND standards and findings from affordable housing initiatives. This objective was directly informed by the findings from Objectives 1 and 2, ensuring that the final evaluation tool was robust and applicable to Kenya's affordable housing sector. The development of the evaluation framework involved:

- Synthesizing Insights from Literature and Case Studies: A review of existing evaluation tools, such as LEED-ND and BREEAM Communities, identified strengths, limitations, and applicability to affordable housing.
- Consultation with Stakeholders: Stakeholder feedback revealed critical gaps in existing tools, such as prioritizing affordability and accessibility to services. This supported past research, such as that by Walker (2017), which highlighted the importance of stakeholder involvement in designing effective housing evaluation frameworks.
- Adapting LEED-ND Principles to the Kenyan Context: Specific LEED-ND provisions were adapted to address region-specific priorities, such as affordable housing typologies, community resilience, and urbanization trends.
- Incorporating Quantitative and Qualitative Data: The framework integrated both quantitative metrics and qualitative measures, drawing upon data

collected from Park Road Ngara tenants. This aligns with previous research (e.g., Zavadskas et al., 2015), which emphasized the value of combining quantitative and qualitative data in housing assessments.

- Framework Development and Validation: The framework, structured around affordability, sustainability, and livability, was validated through expert reviews, ensuring its feasibility and practicality for Kenya.

By linking these findings to the overarching theories and validating them with existing research, the study demonstrated how the theoretical framework informed the analysis and development of the tailored evaluation framework. This strengthened the credibility of the findings and provided a comprehensive approach to improving affordable housing sustainability in Kenya.

5.3 Conclusion

Objective 1: Assessment and Analysis of Existing Tools for Evaluating Affordable Housing Projects

The thesis aimed to assess and analyze existing tools for evaluating affordable housing projects, with a specific focus on tools like LEED-ND, BREEAM Communities, and others. The findings clearly identified the strengths and weaknesses of these tools.

- **Summary of Findings**

  The analysis of evaluation tools revealed that LEED-ND and similar frameworks, while comprehensive, were not fully aligned with the unique needs of affordable housing projects in Kenya. For example, the LEED-ND framework heavily emphasizes environmental sustainability and infrastructure development, which may not adequately address the social and economic dimensions critical to affordable housing in low-income contexts. Additionally, existing tools did not sufficiently account for the specific constraints faced by affordable housing projects in Kenya, such as limited resources and the need for greater focus on social inclusion.

- **Connection to Literature**

  These limitations are consistent with the findings of previous studies (e.g., Zadeh et al., 2015; Kibert, 2016), which noted that while global rating systems like LEED-ND are effective for large-scale, environmentally focused developments, they often overlook the socio-economic needs that are paramount in affordable housing. This gap in the literature highlighted the necessity of developing a tailored evaluation framework that could bridge these limitations and better serve the Kenyan context.

- **Justification for a Tailored Framework**

  The research thus concluded that the existing evaluation tools needed adaptation to address the specific challenges faced by affordable housing in Kenya. This was the rationale behind developing a customized evaluation framework that would integrate the best elements of LEED-ND while making the necessary adjustments for local relevance.

Objective 2: Identifying Key LEED-ND Standards That Enhance Sustainability, Affordability, and Livability

The second objective focused on identifying key LEED-ND provisions that could enhance sustainability, affordability, and livability in affordable housing projects in Kenya.

- **Summary of Findings**

  The study identified several LEED-ND standards as highly relevant, including Smart Location and Linkage, Neighborhood Pattern and Design, and Green Infrastructure and Buildings. These provisions supported the creation of sustainable and livable environments by prioritizing walkability, access to amenities, and efficient land use. The findings from the Park Road Ngara project demonstrated that these LEED-ND principles could indeed be applied in Kenya, with notable improvements in community cohesion, environmental impact, and access to essential services.

- **Connection to Literature**

  Previous research (e.g., Newman & Kenworthy, 1999; Roberts & Tannenbaum, 2013) supported the findings that sustainable urban design principles, such as those embedded in LEED-ND, contribute to environmental and social sustainability. The success of LEED-ND standards in other global contexts further validated their potential effectiveness in Kenya, despite challenges related to local conditions.

- **Rationale for Using LEED-ND**

  The research concluded that LEED-ND's emphasis on integrated design, sustainability, and community well-being made it a valuable framework for assessing affordable housing projects in Kenya. The provisions selected were justified based on their ability to address the key sustainability, affordability, and livability challenges identified in the study.

Objective 3: Developing a Tailored Evaluation Framework

Objective 3 focused on developing an assessment tool that integrates relevant LEED-ND standards and insights from affordable housing initiatives. The tool was designed to be more applicable to the unique socio-economic and environmental conditions of Kenya.

- **Summary of Findings**:
  The framework incorporated insights from literature, stakeholder consultations, and the case study to develop a tool that balances the global standards of LEED-ND with the local needs for affordability and social inclusion. It included both quantitative metrics (e.g., cost per unit, proximity to transit) and qualitative measures (e.g., community satisfaction, social equity) to create a more holistic assessment approach.
- **Connection to Literature**:
  Literature on affordable housing evaluation (e.g., Walker, 2017; Tunstall et al., 2013) supported the need for frameworks that integrate both objective and

subjective measures. The research found that the combination of LEED-ND principles with local data could enhance the evaluation of affordable housing projects in Kenya, ensuring that both global sustainability goals and local needs were addressed.

- **Justification for the Framework**:
  The research concluded that the tailored framework was essential for addressing the gaps in existing tools, as it incorporated local realities such as resource limitations, the need for diverse housing types, and the importance of community engagement. This tool was deemed highly relevant to Kenyan housing projects, offering a practical approach to evaluating sustainability, affordability, and livability.

- The research developed the Affordable Housing Rating Tool, which integrates LEED-ND standards with local needs. The tool was designed to be user-friendly, offering both a quantitative and qualitative assessment approach that could be used by various stakeholders, including developers, policymakers, and community organizations. It was structured to prioritize affordability, social equity, and environmental sustainability in affordable housing projects.
- **Connection to Literature**:
  Previous studies (e.g., Zavadskas et al., 2015) supported the creation of practical, context-specific tools for housing assessment. The findings reinforced the idea that evaluation tools must be adaptable to local conditions to be effective. The Affordable Housing Rating Tool was seen as a contribution to this body of literature, offering a localized and practical solution for evaluating affordable housing in Kenya.
- **Recommendations for Further Research**:
  The research suggested that further pilot testing and refinement of the Affordable Housing Rating Tool would be necessary to assess its effectiveness in real-world applications. Additional research could focus on its application across different regions of Kenya and its potential for scaling up to other African countries facing similar challenges.

Overall Conclusion

The research objectives were effectively met through the development of a tailored evaluation framework that integrated global best practices, such as LEED-ND, with local insights from the Park Road Ngara case study. By addressing the limitations of existing tools and adapting them to the Kenyan context, the study contributed valuable insights into how affordable housing projects can be assessed for sustainability, affordability, and livability. The findings were grounded in existing literature, and the proposed framework and rating tool provide a practical, evidence-based approach for evaluating affordable housing projects in Kenya.

5.4 Recommendations

1. Utilize the Designed Tool: Stakeholders involved in affordable housing projects in Kenya should adopt and implement the designed assessment tool. This tool can guide project planning and decision-making to ensure that sustainability principles are integrated into the development process effectively.
2. Train Professionals: To familiarize developers, architects, and urban planners with the LEED provisions and credits identified in this study and to teach them how to use the assessment tool effectively, training programs and capacity-building initiatives should be arranged for professionals in the affordable housing sector.
3. Policy Integration: Government authorities should consider integrating the identified LEED provisions and credits into their affordable housing policies and regulations. This will help standardize sustainability practices in the sector and promote long-term environmental and social benefits.
4. Further Research: Continuous research and data collection are essential to monitor the effectiveness of the assessment tool and the impact of sustainable practices in affordable housing projects. Further research can also explore how the tool can be adapted for different regions within Kenya.

In conclusion, this study provides valuable insights into the assessment of neighborhood sustainability tools, identifies relevant LEED provisions and credits,

and offers a practical assessment tool tailored to affordable housing in Kenya. Implementing the recommendations can contribute to more sustainable and inclusive housing developments in the country.

5.5 Areas for Future Study

Based on the Affordable Housing Rating Tool and the various credit categories discussed, here are some areas for future study and research:

Impact Assessment: Conduct a comprehensive study to assess the long-term impact of affordable housing developments that achieve high ratings in each of the credit categories. Evaluate factors such as environmental sustainability, resident satisfaction, and community well-being over time.

Equity and Inclusivity: Investigate the effectiveness of affordable housing projects in promoting social equity and inclusivity, particularly in terms of housing size and affordability levels. Analyze the socio-economic diversity within these developments.

Health and Well-Being: Examine the relationships between inhabitants' physical and mental health and their access to leisure and educational resources. Examine how these facilities affect people's general well-being and sense of community.

Transportation Behavior: Study the transportation choices and behavior of residents in affordable housing developments with high transit and walkability ratings. Analyze commuting patterns, car ownership rates, and the use of public transit.

Energy Efficiency and Sustainability: Investigate the energy efficiency of buildings within affordable housing projects, with a focus on LEED-certified developments. Assess energy consumption, utility cost savings, and the environmental benefits of sustainable building practices.

Stormwater Management and Green Infrastructure: Evaluate the effectiveness of stormwater management techniques in reducing environmental impact and

improving water quality. Explore the potential for green infrastructure to mitigate flooding and pollution.

Education and Student Safety: Examine the educational outcomes of students residing in affordable housing developments with high school proximity and safe circulation ratings. Assess academic performance and attendance rates.

Marketability and Demand: Analyze the marketability and demand for affordable housing units within developments that achieve high ratings in various credit categories. Study occupancy rates, waiting lists, and the preferences of prospective residents.

Policy and Planning Impact: Investigate how affordable housing rating tools influence local policies and urban planning decisions. Assess the adoption and adaptation of such tools in different regions and their impact on sustainable urban development.

Community Engagement: Research the role of community engagement and resident participation in the design and decision-making processes of affordable housing developments. Evaluate the impact of resident involvement on project success and satisfaction.

These areas for future study can contribute valuable insights into the effectiveness and sustainability of affordable housing projects, helping policymakers, developers, and communities make informed decisions to create more inclusive and environmentally responsible housing solutions.

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APPENDICES

Appendix I: Observation checklist

Appendix 2: Observational Checklist.

Topic: Leed neighborhood development as a measure of green practice in Kenya: a case of park road affordable housing.

PROJECT NAME:_____ ADDRESS/LOCATION: _____ TYPE OF PROJECT: _____

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
NEIGHBORHOOD PATTERN AND DESIGN (NPD)								
1. WALKABLE STREETS	Façades and Entries: At least 80% of the total linear distance of building façades facing the circulation network in the project is no more than 25 feet (7.5 meters) from the property line. A minimum building-height-to –street width ration of 1 to 3 (1 foot of building height for every 3 feet of street width) along at least 15% of street length. At least 50% of the total linear distance of mixed-use and nonresidential building façades facing the circulation network in the project is within 1 foot (300 millimeters) of a sidewalk or equivalent walking route. Functional entries to the building occur at an average of 75 feet (23 meters) or less along nonresidential or mixed-use buildings or blocks.	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	Required			Prereq 1: walkable streets
	Ground-Level Use and Parking: Garage doors no more than **20%** of street length.	☐	☐	☐	1-12			Credit 1: walkable streets

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
	Minimal distance between the sidewalk and most buildings, with mixed-use and nonresidential buildings particularly close to the sidewalk. Frequent building entries (at least every 75 feet). Unshuttered windows along the sidewalk for nonresidential buildings. If a façade extends along a sidewalk, no more than 40% of its length or 50 feet (15 meters), whichever is less, is blank (without doors or windows). Frequent on-street parking (available along at least 70% of streets). Sidewalks along 100% of street length (both sides of the street). If the project has ground-floor *dwelling units*, the principal level of at least 50% of those units has an elevated finished floor at least 24 inches (60 centimetres) above the sidewalk grade. Below-grade basement spaces and/or *accessory dwelling units* are exempt from this requirement. A minimum building height to street ration of 1 to 3 (1 foot of building height for every 3 feet of street width) along 30% of street length. Low design speeds for most streets (20mph for residential, 25mph for non-residential).	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐				

2

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
	Driveway crossings along no more than 10% of sidewalk length.	☐	☐	☐				
	Lines 60% of street length with non-invasive trees (spaced an average of at least every 40 feet from trunk center to trunk centre). Provides noon-time shade along at least 40% sidewalks	☐ ☐	☐ ☐	☐ ☐	1 1			Credit 14: tree – lined and shaded streets
2.COMPACT DEVELOPMENT	Meets minimum required densities (at least 7 dwelling units per acre for residential and 0.50 floor –area ration for non-residential.	☐	☐	☐	Required			Prereq 2: compact development
	Exceeds increasing density thresholds (at least 10 dwelling units per acre for residential and 0.75 floor-areas ratio for non-residential.	☐	☐	☐	1-6			Prereq 2: compact development
3.NEIGHBORHOOD CONNECTIONS	Does **either** of the following (only one required for scoring): Included a street or pathway into the project at least every 800 feet and has at least 140 intersections per square mile within the project estimate if possible. **Or** , only if the project has no internal streets : is surrounded (within ¼ mile) by an existing street network of at least 90 intersections per square mile estimate if possible.	☐ ☐	☐ ☐	☐ ☐	Required			Prereq 3: connected community
	Does **all** of the following: Does not include cul-de-sacs Includes a street or pathway into the project at least 400 feet.	☐ ☐	☐ ☐	☐ ☐				Credit 6: street network

3

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
	Has high intersections per square mile within the project (pick **just one** of the following for scoring this credit): 300 to 400 intersections per square mile Has more than 400 intersections per square	☐ ☐	☐ ☐	☐ ☐	1 2			
4.MIXED USES	Enables walking access (within ¼ mile) to the following number of existing or new land uses, clustered within neighborhood centers (pick just one): 4 to 6 uses 7 to 10 uses 11 to 18 uses More than 19 uses Uses can include commercial or civic facilities such as restaurants , schools, pharmacies, supermarkets, theatres, parks, libraries, or shops.	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	1 2 3 4			Credit 3: mixed use neighborhood centers
5.AFFORDABE AND DIVERSE HOUSING	Provides multiple housing types of different sizes, such as large and small apartments, duplexes town houses, and or single-family homes. Provides a percentage of new rental and or for-sale housing at high levels of affordability, available for at least 15 years. Provides both high levels of affordability and multiple housing types of different sizes.	☐ ☐ ☐			1-3 1-3 1			Credit 4: mixed income diverse communities

4

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
6.PARKING AND TRANSPORTATION DEMAND	Does **all** of the following: Minimizes total surface parking area (no greater than 20% of development area) and includes no individual surface lot over 2 acres. Locates any off-street parking at the side or rear of buildings (not along the sidewalk). Provides bicycle storage for building occupants , bicycle parking for visitors and spaces for carpool or shared vehicles.	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	1			Credit 5: reduced parking footprint
	Includes shelters, benches, lighting and information displays at all new and existing transit stops.	☐	☐	☐	1			Credit 7 : transit facilities
	Provides **any or all** of the following options (for scoring, award 1 point for every 2 options achieved): Subsidized transit passes to half of regular price or cheaper. Developer-sponsored-transit services-such as a shuttle-to off-site employment centers and or major transit facilities. Well-publicized vehicle sharing facilities on-site, or within 400 metres walk distance. For 90% of dwelling units or non-residential space, separates the cost of a parking space from the price of dwelling units or non-residential.	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	1-2			Credit 8: transportation demand management

5

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
	Use no more than 20% of the total *development footprint* area for all new off-street surface parking facilities, with no individual surface parking lot larger than 2 acres (0.8 hectare). Provide preferred parking for carpool or shared-use vehicle parking spaces equivalent to at least 10% of the total off-street parking spaces for each nonresidential and mixed-use building on the site. Such parking spaces must be marked and within 200 feet (60 meters) walking distance of entrances to the building served	☐	☐	☐				
7.PARKS AND RECREATION	Enables access (within 400 metres walk distance) to public space such as squares. Parks, paseos and plazas.	☐	☐	☐	1			Credit 9: Access to civic / public spaces
	Enables access (within 800 metres walk distance) to publicly accessible indoor to outdoor recreational facilities (at least 1 acre in size outdoor or 25,000 square feet indoor). Outdoor recreation facilities must consist of physical improvements and may include "tot lots," swimming pools, and sports fields, such as baseball diamonds.	☐ ☐	☐ ☐	☐ ☐	1			Credit 10: access to recreation facilities.
8.UNIVERSAL DESIGN	Provides **either** of the following (only necessary to score a point): For residential projects, universal accessibility for people of diverse abilities in 20% of dwelling units. For non-residential projects, universal accessibility for people of diverse abilities along 100% of public rights-of-way.	☐ ☐	☐ ☐	☐ ☐	1			Credit 11: visitability and universal design

TOPIC	DOES THE PROJECT DO THE FOLLOWING	YES	MAY BE	NO	LEED-ND POINTS POSSIBLE	PROJECT YES POINTS	PROJECT MAYBE POINTS	LEED-ND SOURCE CREDIT OR PREREQUISTE
9.COMMUNITY PARTICIPATION	Does **either** of the following (pick just one for scoring): Relies on multiple forms of community input and feedback to guide project concept and design, both before and during development. Relies on multiple forms of community input and feedback as above, but also conducts a design charrette or obtains an endorsement from a smart growth jury or program.	☐ ☐	☐ ☐	☐ ☐	1 2			Credit 12: community outreach and involvement
10.LOCAL FOOD	Provides **both** of the following: Permanently set aside gardening space, free local produce shares (from within 150 miles) for residents, or proximity to a farmer's market (on-site or within ½ mile walk distance). Allows growing of produce, including in yards or on balconies, patios, or rooftops.	☐ ☐	☐ ☐	☐ ☐	1			Credit 13: local food production
11.SCHOOL ACCESS AND DESIGN	Achieves **both** of the following: Is located within walking distance of a school (1/2 mile for elementary and middle schools, 1 mile for high school). New school campuses included in the project are no longer than 5 acres (elementary), 10 acres (middle schools), or 15 acres (high school).	☐ ☐	☐ ☐	☐ ☐	1			Credit
				44 points possible				**NPD SUB TOTALS**

Appendix II: Structured interview questions

TOPIC: ADAPTING LEED-ND (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN FOR NEIGHBORHOOD DEVELOPMENT) FOR AFFORDABLE HOUSING IN KENYA: A CASE STUDY OF PARK ROAD NGARA

Structured Interview Guide

Research Focus

The structured interview aims to gather qualitative data on tenant satisfaction and perceptions of sustainability measures, addressing the study's research objectives:

1. Assessing and analyzing existing tools for evaluating affordable housing projects, focusing on specific criteria that influence livability, affordability, and community resilience.
2. Identifying key LEED-ND standards that enhance the sustainability, affordability, and livability of affordable housing, and using these insights to develop a tailored evaluation framework for affordable housing projects in Kenya.
3. Developing an assessment tool for affordable housing projects in Kenya that integrates relevant LEED-ND standards and insights from affordable housing initiatives.

Ethical Considerations

- Informed Consent: All participants will be briefed about the study objectives and procedures, and their consent will be obtained before the interview.
- Anonymity and Confidentiality: Identifiable information will be anonymized, and responses will be reported in aggregate.
- Voluntary Participation: Participants will be informed that their involvement is voluntary, with the right to withdraw at any time without any consequences.
- Minimizing Risks: Questions have been designed to avoid sensitive or distressing topics.

1. Can you describe what 'affordable housing' means to you?
2. What do you think are the key elements that make a housing project affordable for people like you?

3. Can you tell me what sustainability means to you?

4. Looking at these photos, what sustainability features do you recognize in Park Road Ngara?
5. How easy is it for you to get to the places you need to go on a daily basis?

Section A: General Information

1. Can you tell us about your living experience at the Park Road Ngara housing project?
2. How long have you lived here?
3. Are you familiar with the concept of Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND?)
4. How has the design of the neighborhood impacted your daily life, particularly in terms of walkability, access to amenities, and sense of community?

Section B: Tenant Satisfaction

5. How satisfied are you with the overall quality of your housing unit?
6. What is your experience with the affordability of this housing? Do you feel the cost is reasonable given the amenities and services provided?
7. Can you describe your satisfaction with the accessibility and connectivity of the housing project (e.g., transportation, proximity to schools, markets, or healthcare facilities)?

Section C: Sustainability Measures

8. Are you aware of any environmental sustainability measures implemented in your housing project (e.g., energy efficiency, water-saving technologies, and green spaces)?
9. How would you rate the effectiveness of these measures in improving your quality of life? Why?
10. Have you encountered any challenges or benefits associated with these sustainability measures? Please elaborate.

Section D: Livability and Community Resilience

11. How would you describe the livability of the neighborhood in terms of safety, social interactions, and access to community amenities?
12. Do you feel the design and planning of this housing project promote a sense of community or social cohesion? Why or why not?
13. Do you feel safe walking around the neighborhood, especially at night? Are there any areas where you feel less safe?

Section E: Recommendations

14. What improvements would you suggest for enhancing tenant satisfaction in terms of affordability, livability, or sustainability?
15. Are there any aspects of this housing project that you believe could serve as a model for future affordable housing developments?