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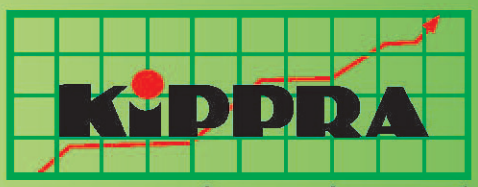

The KENYA INSTITUTE for PUBLIC
POLICY RESEARCH and ANALYSIS

Analysis of the Housing Status and Access to Basic Infrastructure in Nairobi City County: Disparities and Level of Deprivation

Charity Mbaka
Humphrey Njogu

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THE KENYA INSTITUTE FOR PUBLIC POLICY
RESEARCH AND ANALYSIS (KIPPRA)

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Abstract

Access to basic infrastructure is a key constituent and a prerequisite for affordable housing. Nairobi City County accounts for the highest affordable housing deficit in the country, with roughly 60 per cent of residents living in informal settlements. Therefore, an in-depth empirical analysis of the current housing status at a disaggregated level is key for targeted affordable housing policy interventions. This study analyzed intra-county disparities in housing conditions and access to basic infrastructure and designed a Multidimensional Housing Deprivation Index (MHDI) to serve as a policy-prescriptive tool in addressing housing deprivation in all its dimensions. MHDI framework involved defining dimensions, indicators, deprivation cutoffs and weights. The analysis involved computation of the housing deprivation incidence, intensity, and decomposition of MHDI by sub-groups. The results indicate that there is distinctive intra-county disparities and pockets of deprivation in access to basic infrastructure and housing conditions. The sub-counties dominated by informal settlements recorded higher levels of deprivation. MHDI score (0.195) indicates that 19.5 per cent of households are multidimensional housing deprived in at least 33.0 per cent of the weighted indicators. The incidence (0.407) of housing deprivation indicates that 40.7 per cent of households are multidimensional deprived, suggesting that 4 out of 10 households were deprived. Further Intensity (0.48) showed that, on average, multidimensional deprived households were deprived in 48 per cent of weighted indicators. The indicators that contribute highest to MHDI includes cooking fuel (26.7%), internet (18.8%), garbage collection (18.7%), and handwashing facility (12.2%). The study recommends a multisectoral approach in planning and developing affordable housing projects to ensure seamless execution of the plans. In addition, Nairobi County Development Plans should allocate adequate resources and identify appropriate strategies to reduce deprivation, with more emphasis on indicators contributing the most to MHDI.

Abbreviations and Acronyms

SDGs	Sustainable Development Goals
OECD	Organization for Economic Cooperation and Development
MHDI	Multidimensional Housing Deprivation Index
UNDAF	United Nations Development Assistant Framework
NUA	New Urban Agenda
GIS	Geographical Information Systems
CSFs	Critical Success Factors
CSC	Critical Success Criteria
NGOs	Non-Governmental Organizations
SSI	Slum Severity Index
KNBS	Kenya National Bureau of Statistics
KIHBS	Kenya Integrated Household Survey
UNDP	United Nations Development Programme
AF	Alkire Foster
UN	United Nations
KPHC	Kenya Population and Housing Census
LPG	Liquefied Petroleum Gas

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1. Introduction

1.1 Background

Access to basic infrastructure is an integral component in the provision affordable housing in the formal housing sector (Bah et al., 2018). According to the World Economic Forum (2019), access to basic urban infrastructure and services, including safe drinking water, sanitation, clean energy sources for cooking and lighting, solid waste disposal, and Internet access is vital in making affordable housing a reality. The provision of basic functional infrastructure immensely contributes to overall sustainable development, well-being and decent quality of life, enabling households to use their time productively (Gaal and Afraah, 2017).

Article 43(1)(b) of the Constitution of Kenya 2010 stipulates that access to adequate housing and reasonable sanitation standards is a right for all citizens. Kenya's Vision 2030 also places the urban sector at the top of the development agenda to provide universal infrastructure for inclusive and sustainable development. Further, provision of affordable housing as one of the National government's pillars of growth under the "Big Four" agenda targets to provide 500,000 decent houses alongside basic infrastructure to address the housing deficit (Kenya Affordable Housing Development Framework, 2018). The importance of access to infrastructure as a prerequisite for affordable housing is entrenched in the global, regional, national, and local development plans and strategies, including the Sustainable Development Goals (SGDs).

Access to basic services is essential to meeting basic human needs, eradicating poverty, and ensuring people's healthy lives. However, in an increasingly urbanized world, there is an enormous backlog in the provision of urban basic (UN-Habitat, 2018). According to Granath (2017), a critical step in ensuring access to affordable housing is taking stock of the housing statistics on the status, challenges, and opportunities to address the existing gaps effectively.

Globally, over 4.2 billion people, which translates to 55 per cent of the global population, live in the cities (SDG Report, 2019) and projections indicate an upward trajectory by 2050, with the urban population more than doubling its current size. With more than 80 per cent of global GDP generated in cities, urbanization can contribute to sustainable growth and an incredible opportunity to develop local economies (Papakonstantinou, 2019). However, the speed and scale of urbanization brings challenges, including meeting accelerated demand for affordable housing, well-connected transport systems, other infrastructure, basic services. Adequate housing is a human right, and its absence negatively affects urban equity and inclusion, health and safety, and livelihood opportunities (United Nations Statistics Division, 2019). Renewed policy attention and increased investments are vital in ensuring affordable and adequate housing for all by 2030 (United Nations Statistics Division, 2019).

According to the Africa Union (2015), access to affordable and quality basic services, including safe and improved water, improved sanitation, efficient transport, high-speed broadband Internet connectivity, is no longer a luxury for a few but a right for all citizens. In most developing countries, housing deprivation is quantitative

and quantitative (UN-Habitat, 2015; Olotuah, 2016). The qualitative dimension entails low housing quality and insufficient supply of affordable/social housing, among the major obstacles to affordable housing (Organization for Economic Cooperation and Development - OECD, 2018). According to Van Noppen (2012), lack of quality housing translates to a lack of access to clean water and sanitation, unreliable and unhealthy energy sources, increased exposure to disease, and low levels of financial security. Therefore, adequate housing contributes to attaining a good quality of life and a high standard of living. However, most of the polemics in the literature on affordable housing tend to focus mainly on the housing market's price affordability dimension, with little regard to housing quality and prerequisite basic infrastructure access (Kampamba et al., 2018).

Nairobi County hosts Kenya's capital city and contributes close to 60 percent of the Gross Domestic Product share. However, due to rapid urbanization, the county faces the challenge of meeting the growing demand for affordable housing units, limiting the economy's expansion, and creating pervasive urban inequality. Nairobi City County records the highest housing deficit mainly attributable to the perpetual mushrooming of slums and informal settlements characterized by dilapidated housing conditions that lack of essential infrastructural services (World Bank, 2016). Kenya's urbanization rates are expected to remain high, with at least 50 per cent of the population living in urban areas by 2050 and continue to pose a challenge in access to basic infrastructure, hence stagnated socio-economic progress and well-being of the population. According to Yung and Lee (2012), two critical intertwined dimensions to consider in closing the housing deficit include affordability and adequacy. Understanding the status of housing is vital for implementing affordable housing programmes (Zealand, 2015). Brkanić (2017) empathize that housing quality assessment provides the necessary information on the current state of the housing stock, input for future projects, and insight into its users' present needs.

The focus on Nairobi County is instigated by the need to demystify the aggregated statistics in relation to housing status and access to basic infrastructure. Further, this study's findings are expected to assist the housing sector stakeholders in designing appropriate strategies and policy interventions towards universal access to basic infrastructure, which will equally boost the implementation of the affordable housing project. The multidimensional housing deprivation index intends to serve as a policy-prescriptive tool in addressing housing deprivation in all its dimensions. Therefore, there is need for an area-based development approach to derive a broader and in-depth outlook for an appropriate action plan in providing basic infrastructure. Against this backdrop, the study seeks to provide an in-depth analysis of housing status and level of access to basic infrastructure in Nairobi County and design a Multidimensional Housing Deprivation Index (MHDI).

1.2 Problem Statement

One of the government's aspirations under the "Big Four" agenda and the Kenya Vision 2030 is to close the annual deficit of 200,000 by delivering affordable housing in major cities and towns across various counties in Kenya. Under the affordable housing project, Nairobi City County is among the priority counties targeted for the first phase of the affordable project. Notably, Nairobi City County accounts for the highest housing deficit, with roughly 60 per cent of urban dwellers lacking access to affordable housing. One of the critical constituents for affordable housing is access to basic infrastructure and quality housing, often left out while planning and implementing affordable housing projects. Therefore, assessing the current housing status, particularly on housing quality, access to basic infrastructure, and defining the housing deprivation index provides critical input to the ongoing projects and provides insights into the key areas of policy intervention. Past studies mainly focus on physical access to basic services without disjointing the aspect of deprivation and how various indicators of housing contribute to deprivation. Therefore, this study aims to establish housing status and access to basic infrastructure disparities and level of deprivation in access to basic infrastructure in Nairobi City County.

1.3 Study Objectives

Specifically, this study seeks to:

(i) Establish the status of housing and access to basic infrastructure in Nairobi City County.

(ii) Establish the intra-county disparities in housing conditions and access to basic infrastructure.

(iii) Establish multidimensional Household Deprivation Index in Nairobi City County.

1.4 Research Questions

This study seeks to answer the following research questions:

(i) How is the status of housing and access to basic infrastructure in Nairobi County?

(ii) How are the intra-county disparities in housing conditions and access to basic infrastructure?

(iii) What is the level of housing deprivation in Nairobi City County?

1.5 Outline of the Paper

The other sections of the paper are organized as follows. Section 2 of the paper presents key policy and legal frameworks, and section 3 presents an overview of empirical and theoretical literature. In section 4, the data sources and description and methodology for the MHDI are provided. Section 5 lays out the status of housing and access to basic infrastructure results. Section 6 presents and discusses the intra-regional disparities. Section 7 presents the MHDI results and discussions. Section 8 provides the conclusion and policy implications of the study. In the appendix, the definition of operational terms and percentage of total population and density are presented.

2. Key Policy and Legal Frameworks Supportive of Provision of Affordable Housing and Access to Basic Infrastructure in Kenya

Supportive policy and legal frameworks pertinent to affordable housing and basic infrastructure are vital in creating an enabling environment for implementing affordable housing agenda (Table 1). Kenya is a signatory to global and regional policy frameworks that directly or indirectly provide key action areas on affordable housing and critical prerequisites for livable communities. The provision of adequate housing is also at the centre of the national development plan, entrenched in various national and local policies and development plans.

According to Table 1, the key policy and legal frameworks adequately encompass the provisions key in advancing and achieving the agenda on affordable housing. The policy and legal frameworks adequately identify the targets and planning and development frameworks. Notably, the National and County governments, and other key stakeholders have localized the targets comprised in various policies and legal frameworks into the medium-term plans, county development plans, and other development plans to fast-track the provision of affordable housing projects. However, the key policy and legal instruments, including United Nations Development Assistance Framework for Kenya (UNDAF) New Urban Agenda (NUA) are adequate in addressing the aspects of Internet access and connectivity. Access to the Internet has increasingly become an essential service for the population as countries migrate to digital platforms and economies, hence incorporating the Internet in planning as a key prerequisite for affordable housing.

Table 1: Policy and legal frameworks supportive of provision of various aspects of affordable housing and access to basic infrastructure

Global and regional policy frameworks	Year adopted	Broad objective	Water and sanitation	Energy	Internet	Waste management	Provision of affordable housing
United Nations 2030 Agenda for Sustainable Development Goals (SDGs)	2015	Universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. Pledge: "Leave No One Behind".	Goal 6: Ensure universal and equitable access to safe and affordable drinking water for all.	Goal 7: Ensure universal access to affordable, reliable and modern energy services	Goal 9.c, Significantly increase access to ICT and strive to provide universal and affordable access to the Internet in least developed countries by 2020.	Goal 11 Target 11.6.1 Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities.	Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

The New Urban Agenda (NUA)	2018	Outlines interventions required by governments to ensure effective planning, development, and management of cities and human settlements in sustainable ways in supporting the implementation of the 2030 Agenda.	NUA 120: Equip public water and sanitation utilities with the capacity to Sustainable to ensure universal and equitable access to safe and affordable drinking water, adequate and equitable sanitation and hygiene for all.	NUA 75: Develop sustainable, renewable and affordable energy and energy-efficient buildings and construction modes and to promoting energy conservation and efficiency, which are essential to enable the reduction of greenhouse gas and black carbon emissions.	No specific provisions on internet access	NUA 119: Integrate sustainable waste management and material reuse principles into urban waste disposal and metabolic systems.	NUA 31: Formulate national legislation forbidding discrimination in housing, access to public and encouraging the development of a multitude of housing types for the diverse needs of a city's inhabitants. Provide affordable, multi-generational housing for elderly residents. Housing and the provision of affordable housing must be key components of integrated spatial planning efforts.

The United Nations Development Assistance Framework for Kenya (UNDAF) (2018-2022)	2018	UNDAF is anchored on the country's, the Kenya Vision 2030, Medium-Term Plan III, "Big Four" agenda and SDGs. There priority areas are: Strategic Priority I: Transformative Governance. Strategic Priority II: Human capital development Strategic Priority III: Sustainable and inclusive growth	Strategic priority II: Promote access to safe water and sanitation	Strategic Priority III: Enhance institutional (both public and private) and community capacity for increased access to cost-effective and clean energy.	No specific provisions on Internet access.	Strategic priority II: Strengthen government capacity to deliver equitable and sustainable basic drinking water and sanitation services, improve solid waste management.	Strategic priority II: Promote access to adequate housing
Africa Agenda 2063	2015	Agenda 2063 is Africa's blueprint and strategic framework to deliver on its goal for inclusive and sustainable development.	Develop and improve the regulatory framework, expand infrastructure, build the capacity of the citizenry for enhanced affordable access to the necessities of life including water and sanitation.	Provide affordable and sustainable access to energy and electricity by all households	Expand access of ICT Develop/ improve and promote policies to ensure access to internet services. Target: All citizens have access to a high-speed internet connectivity and voice communication facilities by 2025	Develop/ implement policies for the growth of urban waste recycling industries Target: 100 per cent of urban waste is recycled by 2063	Develop policies and programmes to facilitate the provision of affordable housing including financing and the elimination of slums

The Constitution of Kenya	2010	This Constitution is the supreme law of the Republic and binds all persons and all State organs at both levels of government	Article 43 1(b) of Kenya's constitution recognizes that every person has the right to accessible and adequate housing of reasonable sanitation standards. Progressive implementation of the right to housing includes other basic infrastructure, such as water supply, sanitation, waste management, and quality housing units. Further, the constitution creates two levels of government: national and county governments. It assigns functions and allocates funds for addressing urban development challenges including affordable housing					
The Kenya Vision 2030	2008	Vision 2030 is the government's long-term development blueprint that cuts across various sectors. The vision also targets the installation of physical and social infrastructure in slums and informal settlements	Targets to reduce water deficit in the country.	Achieve universal access to clean and modern energy sources for all	Upgrade national ICT infrastructure to enable universal access to ICT services	Develop waste management and pollution control programme.	Increase annual affordable housing production by 200,000 units to meet the growing demand especially in urban areas.
The Urban Areas and Cities (Amendment) Act, 2019	2018	The Act gives effect to Article 184 of the Constitution, which provides for the classification, governance, and management of urban areas and cities. It also provides for the criteria of establishing urban areas, the principle of governance and participation of residents, and for connected purposes	Provides for cities and municipalities to have functional if water and sanitation services and infrastructure	Provides for cities and municipalities to have access to electricity and energy provision (gas, kerosene, biomass	No specific provisions on internet access	Provides for cities and municipalities, town and market centres to have functional solid waste management systems	Provides for an integrated planning framework within which all county governments must operate, among other functions, incorporate planning and delivery of affordable housing and basic infrastructure.

The Sessional Paper No1. of 2017 on National Land Use Policy	2017	The Policy seeks to set out long term goals for land use management.	Provides for an integrated approach that brings together infrastructure and service providers at the planning stage of development including water and sanitation	Promote energy saving technology and encourage the use of alternative/ renewable energy sources	No specific provisions on internet access	To address the issues of population growth and distribution, national and county governments are required to encourage waste management programmes that are environmentally sustainable	Development of appropriate building technologies to encourage people to develop housing in a more economical. The policy also gives guidelines for preparing physical development plans at the county level.
The County Government Act 2012	2012	Give effect to the objects and principles of devolution as set out in Articles 174 and 175 of the Constitution	The county planning framework shall integrate economic, physical, social, environmental and spatial planning. Section 110 of the Act provides the development of county spatial plans, ten-year county GIS based database system spatial plan for each county which elaborates suitable sites for public and private land developments and infrastructural investments, including physical infrastructure and housing				

The County Government Act, 2012 Article (110) provides that counties shall develop a ten-year county GIS-based database system spatial plan that provides strategic guidance regarding the location and nature of development within the county, including the development of housing and basic amenities. Following the development of the Kenya National Spatial Plan 2015-2045, which guides in developing county spatial and sector plans, a few counties have developed spatial plans, which is a setback in implementing the affordable housing projects. Lack of adequate provision of infrastructure such as safe water, sanitation, drainage, and solid waste disposal services is associated with poor planning, inadequate enforcement and implementation of the plans, and urban sprawl, which negatively affects the quality of the environment and life in human settlements (Sessional Paper No. 1 on National Land Use Policy, 2017). Therefore, counties need to fast-track the spatial plans' development to inform housing projects and infrastructure development. In addition, planning and development of urban areas should take basic infrastructure and services into cognizance as guided by spatial plans. There is also need to promote an integrated approach that brings together infrastructure and service providers at the planning stage of the housing development to ensure adequate provision of infrastructure and services in human settlements.

3. Literature Review

3.1 Introduction

This section provides an overview of theoretical frameworks and empirical knowledge closely linked to access to quality housing and basic infrastructure as prerequisites for affordable housing. The chapter explores the existing theories pertinent to adequate and affordable housing.

3.2 Theories Underpinning the Nexus between Affordable Housing, Access to Basic Infrastructure and Housing Conditions

The housing sector research is multidisciplinary, ranging from sociology, psychology, economics, anthropology, history, planning, architecture, philosophy, and other academic and professional disciplines (Ruonavaara, 2018). Similarly, theoretical perspectives that advance the concept of the provision of affordable housing are multifaceted. The "housing and social theory" advanced by Kemeny (1992) in studying the nature of housing research concerning social theory states that having housing is disjointed from the social aspects. Therefore, housing studies need to explore the nature of housing phenomena within the social realm. However, King (2009) contests this argument by stating that even though housing is embedded and linked to other phenomena, this should not diminish housing as an isolated case for study. King (2009) also alludes to the need to reconceptualize housing according to the theories and concepts prevalent in various disciplines.

Morris and Winter's (1978) theory of "family housing adjustment and adaptation" was developed from human behaviour's sociological model. The theory indicates that individuals have expectations regarding the type, size, quality of adequate housing, and home ownership preference. However, economic, political, and social structural factors constrain access to adequate housing. The inability to quickly overcome the constraints that impede the resolution of normative housing deficits, in turn, may affect socio-economic development, certainly in the short-run and also in the long-run.

The theory of "distributive justice" (Cohen, 1987) is concerned with the question 'who gets what'. The theory argues that common resources should be distributed reasonably, which guarantees every individual a fair share of the allocated resource. Theoretical perspectives of distributive justice in the provision of affordable housing include equity (Cohen, 1987), utility (Feldman, 1995), sufficiency (Frankfurt, 1987), and priority (Casal, 2007). While equity and utility are central for social housing, sufficiency refers to providing adequate housing and prioritizing eligible beneficiaries (Jonkman, 2020). However, goods are distributed equally among all persons, giving each person the same resources with the equity criterion. Therefore, people with different needs get the same amount of resources, resulting in an unfair distributive outcome. Yung and Lee (2012) purport that affordability and adequate housing are intertwined. Affordable housing without adequacy would mean securing basic human needs. Therefore, affordable housing projects should also focus on physical adequacy. Therefore, the

distributive justice model can assess the distribution of basic good for individuals and households to identify inequalities and the flexibility to explicitly apply different moral judgments (Yung and Lee, 2012). The distributive justice theory supports the case for government intervention in facilitating access to adequate and affordable housing by all social-economic groups in society.

The theory of "critical success factors" was first introduced by Rockart (1978), highlighting the importance of organizations controlling their CSFs to complete their projects successfully. The concept is still evolving and widely adopted from a multidisciplinary perspective. CSF emphasizes that a successful project should be completed on time, within budget, and with the desired quality (Rockart, 1980). The CSF concept introduction clarified the five critical sources of CSFs: the industry, competitive strategy and industry position, environmental factors, temporal factors, and managerial position (Rockart and Bullen, 1981; Rockart 1980; Sanvido et al., 1992).

In recent years, CSF has been applied in the housing discourse to focus on sustainable, affordable housing (Adabre and Chan, 2019; Kwofie et al., 2016; Mukhtar et al., 2017). Oyebanji et al. (2017) identified adequate funding, affordability, efficient economic planning, appropriate construction technology, environmental protection, use of environmentally friendly materials, effective land use planning, suitable design, the security of lives and property, provision of social services, and ensuring social cohesion as key in implementing the affordable housing projects. Chan and Adabre (2019) identify household satisfaction, stakeholders' satisfaction CSC, house operation cost, time measurement, location affordability cost, and quality of housing provision and infrastructure services components for sustainable, affordable housing. The use of success criteria (CSF) for sustainable, affordable housing projects is limited but has started to gain traction recently. CSC serves as a guide for assessing the performance of affordable housing projects and serving as a guide to developers, NGOs, and government agencies in allocating resources to provide sustainable, affordable housing (Chan and Adabre, 2019).

The theories mentioned above are vital in advancing research towards policy intervention in affordable housing from affordability as the individuals/ household's purchasing power, reflected through the income patterns (Cai and Lu, 2015). However, the theory of critical success factors for providing affordable housing is embedded in economic, environmental, and social domains pivotal in providing adequate and decent housing. Particularly, CSC exemplifies the centrality of quality and adequate housing, including access to basic infrastructure, which is the focus of this study. Moreover, successfully implementing these CSFs will ensure a holistic, sustainable, affordable housing market (Chan and Adabre, 2019).

3.3 Empirical literature

3.3.1 Nexus between affordable housing, access to basic infrastructure and housing conditions

Research on housing quality and access to basic infrastructure has gained ground in developed and developing countries since the mid-20th century. Quality housing and access to basic infrastructure are critical components in implementing affordable housing projects (Adabre and Chan, 2019). Dixon and Woodcraft (2016) emphasize providing the proper infrastructure to support a healthy social and cultural life. Notably, housing, and essential infrastructural services are interconnected and create an over-arching framework for planning and delivering affordable housing (Hingorani and Tiwari, 2012). According to the World Economic Forum (2019), affordable housing is inseparable from the quality housing dimension. Affordable housing has a direct impact on the population's health and well-being (Olotuah, 2016). This section explores the past research and the gaps in quality housing and access to basic infrastructure in the delivery of affordable housing.

Zainal et al. (2012) identify housing conditions as physical conditions of dwellings, type of dwelling unit, house tenure, surrounding environment, and amenities availability. Further, Zealand (2015) mentions that housing quality indicators should measure the dwelling's physical characteristics and the area's broader environmental factors. Cai and Lu (2015) indicate that housing affordability is beyond income and includes accessibility, amenities, and housing adequacy.

The past studies in the housing quality discourse focused on appraisal of structures and apartments, evaluating environmental factors, assessing the physical neighbourhood environment qualitative and quantitative dimensions of housing quality (Solow, 1946; Twichell, 1948; Kain and Quigley, 1970). In recent years, quality assessment research has remained within a similar framework but has diversified on the indicators and approaches (Brkanić, 2017). Recent studies tend to focus on tenant housing conditions and the level of satisfaction on health conditions (Kang et al., 2014; Bennett et al., 2016), security (Grum and Kobal, 2014; Bennett et al., 2016), and measures of housing satisfaction (Mridha, 2015; Choi and Cho, 2014; Lea and Dang, 2016). Also, quantitative approaches to housing quality have advanced by applying quantitative methods other than housing and neighbourhood quality (Ilesanmi, 2012). A study by Islam and Khan (2013) examined the determinants of satisfaction level of water and sanitation, waste management, and electricity among slum and non-slum dwellers in Dhaka city. The findings show that most households' satisfaction level for the services mentioned above is lower irrespective of slum and non-slum consumers.

Similarly, the approaches applied in examining housing quality in the developed and developing economies differ. Developed economies mainly focus on the value or price of a dwelling unit, tenure, and dwelling size (Ilesanmi, 2012). For most developing countries, the economic measure focuses on property-market evaluation while non-economic approaches focus on the quality evaluation techniques to assess residents' satisfaction with housing (Byun and Ha, 2016;

Jun and Jeong, 2018). Normative evaluation techniques for appraisal of housing quality involve identifying minimum quality standards (Brkanić, 2017). Streimikiene (2015) identifies the characteristics or properties of a physical environment and its users' characteristics as a criterion for assessing housing conditions. The qualitative dimensions of assessing housing quality focus on housing and neighborhood quality and the residential environment, which are vital determinants of quality-of-life and well-being. Sengupta and Tipple (2007) identify four significant indicator variables to analyze quality: dwelling size and occupancy rates; connection to services: levels of mains infrastructure such as water, sanitation, waste disposal, neighbourhood/site characteristics. Ilesanmi (2012) applied penalty scoring to assess housing and neighbourhood quality of public housing using quality indicators. The results indicate that approximately 34 per cent of all the housing blocks surveyed were categorized as low quality and dilapidated. Ibem (2012) demonstrates that lack of access to housing services, infrastructure, and neighbourhood facilities account for low public housing quality.

Studies also link housing quality indicators to the health status of communities. Streimikiene (2015) purports that decent housing includes other fundamental aspects of housing conditions, such as the quality of the roofs, floors, doors, and window frames, which may also adversely affect people's health conditions and comfort. Similarly, a study by Adeoye (2016) acknowledges that adequate housing is a crucial requirement for an efficient and satisfying labour force and the foundation of moderate community life. The study established linkages between poor housing conditions and their detrimental health effects, emphasizing mental health. Aribigbola (2011) purports that the quality of housing within any neighbourhood should be such that satisfies minimum health standards and good living standards across all income levels.

Other studies recognize the locational aspect as key to understanding the critical challenges in providing quality housing and basic amenities. Tusting et al. (2019) portray housing transformation in urban and rural areas in Sub-Saharan Africa between 2000 and 2015. The prevalence of improved housing (with improved water and sanitation, sufficient living area, and durable construction) doubled from 11 per cent to 23 per cent. However, the findings also indicate that about 53 per cent million urban dwellers were still living in unimproved housing by 2015.

Further, Ilesanmi (2012) suggests that housing quality is a composite concept comprising several characteristics, and is expressed differently according to urban/rural, formal/ informal housing, developed/developing. A study by Zainal et al. (2012) explores the relationship between housing conditions and the quality of life among Malaysia's urban poor using a participatory approach. The results indicate a significant relationship between housing conditions and quality of life. Patel et al. (2020) applied Slum Severity Index (SSI), a household-level measure that captures multiple housing deprivations. Bird et al. (2019) used spatially disaggregated data to reveal the status of slums in urban Africa. The results indicate that slum areas are very dense with poor-quality buildings, lacking access to vital sewage disposal and electricity services. Paddison (2012) shows that urban disparities in housing persist in some regions, with some urban

population living in shanty or slum settlements in which housing can lack basic amenities. Similarly, Al Mamun et al. (2011) revealed a significant association between quality of housing, quality of water supply, safety conditions, and daily living needs associated with respondent's location (urban and rural areas).

However, Patel and Beauregard (2020) propose that measuring deprivation by sectoral domains (e.g., water and sanitation deprivation) can help tailor sectoral policies instead of the dichotomous slum/non-slum approach. The housing deprivations approach could also be used as eligibility criteria to target beneficiaries for affordable housing programmes. Therefore, a household-based approach also provides a means to understand systemic inequalities that manifest in developmental outcomes (Patel and Beauregard, 2020).

Likewise, there is a large body of empirical research on housing quality in Kenya, focusing on housing quality and basic infrastructure access. It is evident that deficiency in housing quality varies widely across the country and is more pronounced in urban areas than rural areas, and has unique living conditions that require tailored solutions to the deprivations (Simiyu et al., 2019). The study by Gulyani et al. (2018) indicates that only 18 per cent of urban Kenyans live in a self-contained unit with a toilet, kitchen, electricity, and private water connection. The World Bank (2016) indicates that 84 per cent of formal households in Nairobi City have access to a piped water connection within the house, with only 36 per cent for informal settlements. Simiyu et al. (2019) adopted the living conditions framework and the multidimensional poverty index to describe households' living conditions. The study indicates deprivation in access to infrastructural services such as water, sanitation, and solid waste disposal. Similarly, a study by Trevor and Lodene (2017) conducted in Mathare slums revealed that residents prioritize sanitation, waste management, and access to water, electricity, education, and healthcare as the essential services for adding quality to their lives.

Although the existing studies in Kenya have addressed quality housing access to basic services, they focus more on the users' perception and satisfactory index. Besides, research concentrates mainly on slums and does not consider that access to basic services is also challenging for formal set-ups. Therefore, this study adopts a multidimensional measure of deprivation to assess households' housing conditions and access to basic amenities infrastructure. A vivid understanding of housing quality provides the necessary information on the current state of the housing stock, important information as an input for future projects, and insight into its users' current wishes and needs (Brkanić, 2017).

4. Methodology

4.1 Introduction

This section describes the methodology adopted to undertake this study, particularly on the study area, data sources, empirical model and analysis, and key indicators considered by the study.

4.2 Study Area

The area of focus for the study is Nairobi City County, which is the capital city of Kenya. Over the past years, Nairobi County has experienced rapid urbanization with an estimated population of 4.4 million (KNBS, 2019). Nairobi City County is projected to be inhabited by more than 6 million residents by 2030 (World Bank, 2015). On land-use type, residential areas take up the largest share of land use of about 25.2 per cent followed by industrial/commercial/service centres at 4.6 per cent. The percentage share of the population across the sub-counties differs from distinct disparities in the density of persons per sq. km (Appendix 1). Similarly, the precise selection of the study area is premised on the fact that since the inception of devolution, counties are mandated to deliver affordable housing projects and provide the basic infrastructure that is unique and address the needs of the residents of a specific county. Furthermore, housing projects are successful when consistent with the local economy, geo-climatic conditions, available resources, and suitable capital investments. The study only focused on Nairobi County to allow for in-depth investigation and analysis of the key policy issues.

4.3 Data Sources

The study used the Kenya Integrated Household Budget Survey (KIHBS (2015/16) Nairobi sub-set comprising 550 urban households, consisting of the critical indicators and the unit of analysis required for modelling the multidimensional housing deprivation index. The study used the Kenya Integrated Household Budget Survey (2015/16) and the Kenya Population and Housing Census (2019), which comprised of credible county-level indicators on housing status and access to basic amenities. According to UNDP (2020), the first fundamental requirement for any multidimensional index is that all the information for the household must come from the same survey to identify simultaneous deprivation. The unit of analysis is the household, where specific household characteristics form a critical basis for identifying housing deprivation indicators. Secondary data from the Kenya population and housing census (2019) analyzed the intra-county disparities in access to basic infrastructure and housing conditions. Both data sets comprised key information relevant to policy intervention and gives more insights into access to housing and basic infrastructure among regions. It is also worth noting that Nairobi City County is categorized as purely urban, and hosts the highest proportion of the urban population in the country. The data was reorganized prior to data analysis by merging various data sub-sets, filtering,

variable transformation, and computing the interest indicators. Quantitative data analysis was applied by use of cross-tabulations and descriptive statistics to address the study objectives. Regression analysis was applied in computing the Multidimensional Housing Deprivation Index (MHDI).

4.4 Multidimensional Housing Deprivation Index Design

4.4.1 Introduction

The Multidimensional Housing Deprivation Index was guided by Alkire Foster (AF) methodology to describe its properties and the measurement design and model specifications (Alkire et al., 2015). Alkire-Foster analysis allows identifying deprived households in each indicator, deprivation count, and deprivation in multiple dimensions at a given threshold. Minimum level of satisfaction, which is based on international consensus (such as the Sustainable Development Goals or SDGs). Therefore, MHDI provides a framework to capture and evaluate a set of housing deprivations by measuring the incidence and intensity of multidimensional deprivations defined over a set of pre-selected indicators critical for policy intervention.

4.4.2 Methodology steps

The methodology involves two steps: identification and aggregation. Identification is based on a dual cut-off and involves identifying deprivation on each indicator by a defined cut-off and comparing deprivation scores to a specified threshold to determine the multidimensional deprivation. Aggregation focuses on the multidimensionally deprived and describes the overall level deprivation profiles of different indicators.

I. Identification

(a) Selection of dimensions and indicators

Fundamentally, the MHDI captures the set of housing deprivations that may affect a household. The MHDI comprises seven dimensions and ten indicators representing access to basic amenities and housing materials/condition. The indicators include access to modern cooking fuel; access to light (grid electricity); access to clean and safe drinking water; toilet facility; solid waste management; housing conditions including material of the floor, the material of the roof, and material of (exterior) walls; and access to household conveniences such as the Internet.

(b) Selection of the indicators' deprivation cut-offs

A deprivation cut-off is assigned to each of the indicators. A household is deprived in a particular indicator if the household characteristic matches the deprivation cut-off. Usually, the indicators' deprivation cut-offs are noted as z_i so that

household *i* is considered deprived if achievement in that indicator x_i is below the cut-off, that is if $x_i<z_i$. Clearly, well-founded reasons are needed to determine each cut-off (Alkire et al., 2015). In this study, the deprivation cut-offs are based on the internationally agreed upon SDGs' standards and current policy priorities in the country as underlined in the Kenya Vision 2030.

(c) Indicators weights

Following the selection of indicators and their corresponding cut-offs, the next step was to define the weights each indicator will have in the measure. Following the Alkire and Fang (2018) normative weighting strategy, the MHDI dimensions are equally weighted, so that each of them receives a 1/7 weight. The indicators within each dimension are also equally weighted. Thus, each indicator within the cooking, lighting, water, waste management and ICT dimension receives a 1/7 weight and each indicator within sanitation and housing composition dimensions receives a 1/14 weight and 1/21 weight, respectively. The total weights for all the dimensions and indicators add up to 1 as indicated in Table 2.

(d) Deprivation cut-off (to identify the deprived households)

For the first cut-off, each household is assigned a deprivation score according to their deprivations in the indicators. The deprivation score for each household is calculated by taking a weighted sum of the deprivations experienced. The deprivation score for each household lies between 0 and 1 or else between 0 per cent to 100 per cent. The score increases as the number of deprivations increases and reaches its maximum of 1 when the household is deprived in all ten indicators. A household not deprived in any indicator receives a score equal to 0. Expressed formally as:

$$c_{(i)} = I_1\ w_1 + I_2\ w_2 + I_3\ w_3 + \ldots\ldots\ldots + I_4\ w_4 \qquad 1$$

Where:

$c_{(i)}$ =Total score for a household (household deprivation score) =(sum of each deprivation multiplied by its weight)

I_1 =1 if household is deprived in indicator i and I_1 =0 otherwise,

w_1 - weights attached to the indicator *i*

A second cut-off or threshold is used to identify only the multidimensionally deprived herein referred as housing deprivation cut-off and defined as the share of (weighted) deprivations a household must have to be considered deprived, and denoted with *k*. Therefore, a household is considered deprived if the deprivation score is equal or greater than the deprivation cut-off. Formally, a household is deprived if $c_i \geq k$. In this study, we follow Nussbaumer et al. (2012 and define a household as multidimensional housing deprived if the deprivation score is higher than or equal to 0.33 (k = 0.33 or 33%). Alkire and Santos (2014) indicate that a deprivation cut-off of 0.33 is normatively justified because it provides a wide distribution of results and captures the acutely deprived. The cut (k =33%)

means that we identify a household as multidimensionally deprived if deprived in 33 per cent or more of the weighted indicators. Therefore, a specific household's multidimensional housing deprivation index occurs if the deprivation score is equal or greater than the cut-off. To differentiate between the original deprivation score $c_{(i)}$ from the censored one, we use for the censored deprivation score the notation $c_i(k)$. For instance, a household is identified as multidimensional deprived of housing if the deprivation score is equal or greater than cut-off of 0.33 as shown in equation 2.

if $c_i \geq k = c_i \geq 0.333$.

Therefore, a household is multidimensionally deprived when:

$$c_i(k) = (w_1 I_1 + w_2 I_2 + w_2 I_{(2)} + \ldots\ldots\ldots + w_d I_d) \; 0.333 \qquad 2$$

II. Aggregations

a) Headcount

It is worth noting that MHDI is a product of two aspects of deprivation: incidence and intensity. Incidence of multidimensionally deprived or headcount ratio measures the proportion of households that are multidimensional housing deprived (equation 3). These multidimensional housing deprived households are aggregated over the entire sample of households or respective sub-samples to compute the multidimensional housing deprivation headcount ratio.

The multidimensional housing deprived headcount (H) is computed as:

$$H = q/n \qquad 3$$

Where q is the number of multidimensionally deprived households and n is the total number of households.

b) Intensity

The second component is called the intensity of housing depriviation (A). The intensity or severity of housing deprivation indicates the average proportion of indicators in which households are multidimensionally deprived. This entails computing the average share of weighted indicators in which households are deprived by adding up the deprivation scores of the deprived and dividing them by the total number of deprived households (equation 4).

Therefore, the intensity (A) of multidimensional housing deprivation is the average deprivation score of multidimensionally deprived households expressed as:

$$A = c_i(k)/q \qquad 4$$

where $c_i(k)$ is the total censored deprivation scores of household(s) i and q is the total number of households multidimensionally deprived of housing.

Conclusively, Multidimensional Housing Deprivation Index (Mo) is the product of a headcount ratio (proportion of households that are multidimensional housing deprived) and the intensity of housing deprivation as shown in equation (5).

$$MHDI = H*A \qquad 5$$

c) Decomposition of MHDI by sub-groups

One key feature of the MHDI is that it can be decomposed by sub-group characteristics. When analysing country-level estimates, the question here is which population sub-groups are relevant to the study and in further explaining the dynamics in MHDI. This study decomposed the MHDI by poverty status, amount of rent paid and housing ownership status. At aggregate level of analysis, MHDI condenses a lot of information. Decomposing gives high resolution lens on deprivation, and is therefore used to identify the most prevalent deprivations. Notably, each sub-group is the total households over which the MHDI is computed. For example, decomposition of poverty status (poor and non-poor) would take all (and only) the poor households and compute the MHDI in the same way as for the total households and follow the same for the non-poor households. Once this is done, we have the MHDI for poor and non-poor. From the poor and non-poor MHDI, we can obtain the overall MHDI. This can be verified by computing a weighted sum of the MHDI of the poor and the non-poor households using the household shares as weights, and obtain the MHDI (equation 6). The formula for this is as follows:

$$MHDI = \frac{n_U}{n} MHDI_U + \frac{n_R}{n} MHDI_R \qquad 6$$

According to equation 6, U denotes "poor" and R denotes "non-poor" and $n_{U/n}$ is the number of poor households divided by the total households, and similarly for $n_{R/n}$ is the number of non-poor households divided by the total households (assuming that $n_{U/n}+n_{R/n}= n$). It is worth noting that this relationship holds for as many groups as identified in the study, if they all add up to the total population. Following the above expression, one can easily compute the contribution of various sub-groups to overall housing deprivation.

Given the above expression the contribution of each group to MHDI is computed as illustrated in equation 7.

$$\frac{\frac{n_U}{n} MHDI_U}{MHDI} * 100 \qquad 7$$

Table 2 presents the dimensions, indicators, deprivation cut-offs, and weights employed to estimate the multidimensional housing deprivation index for Nairobi City County. As aforementioned, the indicators and deprivations cut-offs are selected to reflect the critical components relevant for affordable and adequate housing. Further equal weighting of dimensions and indicators was aligned to the methodology by Alkire et al. (2015). Nevertheless, future studies are given a free hand to adjust the weighting accordingly with respect to spatial aspects,

availability of data, study objectives and importance of the indicator or dimension to the overall multidimensional index (Alkire et al., 2015).

Table 2: Multidimensional housing deprivation index, dimensions, indicators and cut off

Dimension	Indicators	Deprivation cut-off (household deprived if . . .)	Weights
Cooking (1/7)	Cooking fuel	Households use cooking fuel other than LPG, electricity or biogas	0.1428 (1/7)
Lighting (1/7)	Source of lighting	Household have no access to electricity through grid /solar	0.1428 (1/7)
Water (1/7)	Safe and improved drinking water	Household have no access to safe and improved drinking water from piped supplies with tap water in their dwelling, yard or plot; or public standposts) and non-piped supplies (such as boreholes, protected wells and springs, rainwater and packaged or delivered water)	0.1428 (1/7)
Sanitation (1/7)	Improved sanitation	Household have no access to safely managed sanitation from improved non-public toilet facility (flush to piped sewer and septic tanks)	0.0714 (1/14)
	Hand washing facility	Households have no access to a hand washing facility	0.0714 (1/14)

Waste management (1/7)	Solid waste disposal arrangement	Household has no organized arrangements for garbage collection, which includes collection arrangements including private, community and public	0.1428 (1/7)
Housing composition (1/7)	Housing roofing material	Household main dwelling unit with natural/ rudimentary roof including Grass/Twigs/ MakutiThatch/ Bamboo/Wood/ Mud/Plastic/ Polythene/Dung / Mud/Tin cans/ Canvas/ Tents/ Nylon/ Cartons/ Cardboard and Shingles	0.0476 (1/21)
	Type of housing wall material	Household main dwelling unit with natural/ rudimentary wall material including cane/ palm/ trunks grass/ reeds mud/ cow dung stone with mud covered adobe uncovered adobe plywood/ cardboard off cuts/ reused wood/ wood planks, iron sheets, canvas/ tents nylon/ cartons. timber	0.0476 (1/21)
	Housing floor material	Household main dwelling unit floor material is grass / thatch / makuti; dung/mud	0.0476 (1/21)
Information Communication Technology (1/7)	Access to Internet	Household with no access to Internet in their home	0.1428 (1/7)

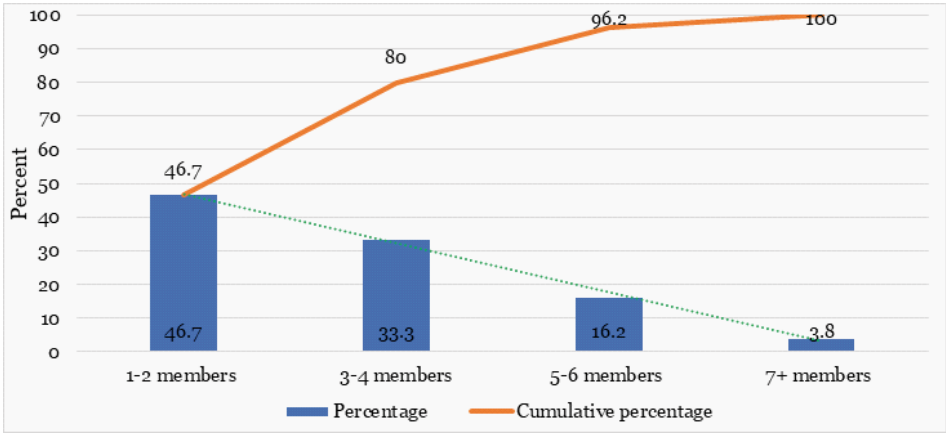
Source: Adopted from the Kenya Vision 2030 and UN, SDG global indicators

5. Analysis of Status of Housing and Access to Basic Infrastructure in Nairobi City County

5.1 Household Characteristics

This section analyses the household and housing characteristics of the sample used to generate the MHDI. According to KIHBS (2015), a household size refers to the number of persons living in the household. The average household size was 3 members below the national average of 4 members and 3.3 members for urban areas. Households with 1-2 and members cumulatively accounted for almost half (46.7%) of the households (Figure 1). Also, households with up to four members accounted for 80 per cent of households. This indicates that most households in Nairobi County comprise small family units, which is a pivotal factor in implementing affordable housing units. Understanding the household size of the targeted beneficiaries is critical when defining the designs applicable to the affordable housing project. For instance, a higher proportion of smaller-sized households is likely to increase demand for housing units (Menon et al., 2019).

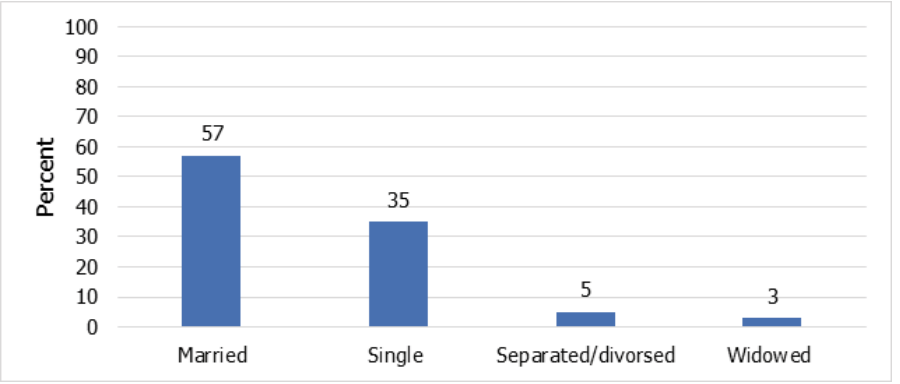
Figure 1: Percentage distribution of households by size



Computed from Kenya Integrated Household Budget Survey, 2015/16

For the household headship, most households were headed by males (76%) while females headed households stood at 24 per cent. The diversity indicates that most of the households in Kenya culturally embrace a patriarchal system although females are also central to household decision-making. Therefore, both male and female-headed households should be centrally involved in the affordable housing programmes. Notably, households with a married couple stood at 57 per cent and singles at 35 per cent (Figure 2). The results indicate that housing projects should also consider the single persons housing units such as affordable bedsitters and studio apartments. The single category comprises students from various higher learning institutions and graduates residing in the city, hence integrating into the affordable housing project.

Figure 2: Marital status of the household head



Computed from Kenya Integrated Household Budget Survey, 2015/16

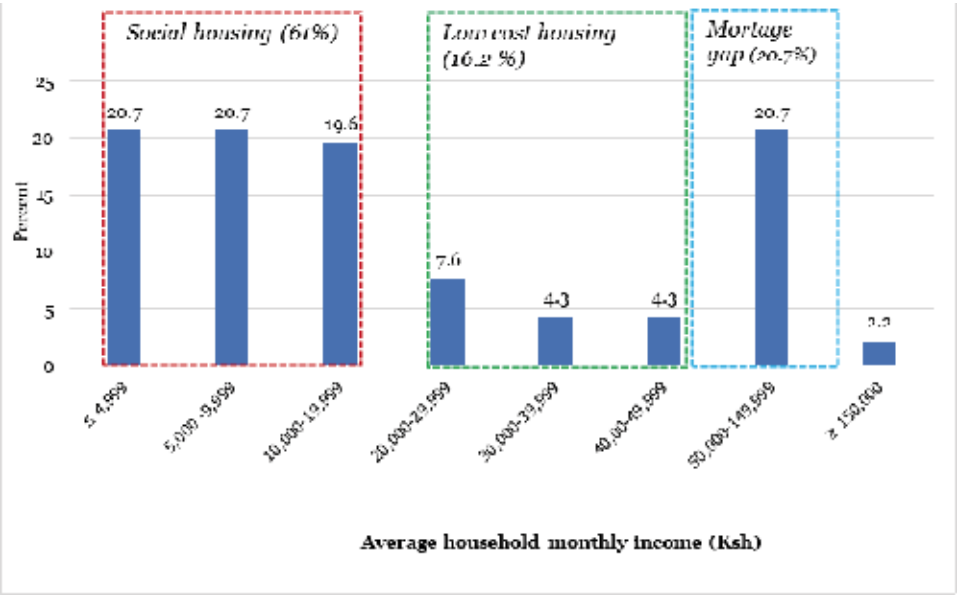
Age and the dependency ratio is also essential in understanding the target groups for the affordable housing project. In terms of distribution by broad age group, most of the Nairobi residents (67.4%) are aged 15-64 years, while 31.4 per cent is reported across age group 0-14 years. The age group comprising persons aged above 65 years was the lowest at 1.1 per cent. Similarly, urban areas' low old-age dependency[1] ratio stood at 1.6 compared to 6.9 nationally. The low old-age dependency ratio in urban areas and especially in Nairobi County is mainly attributed to urban-rural migration after retirement. Therefore, housing programmes should consider the youthful population's interests and preferences living in the city.

A household income bracket is critical in targeting affordable housing beneficiaries. Average household monthly income[2] is the total average earnings of all household members. A high proportion (61%) of the households earn below Ksh 20,000 (Figure 3). This indicates that the largest population of households in Nairobi County will require formal social housing as defined in the National Housing Development Fund regulations 2020. Currently, formal housing is inaccessible to most low-income earners due to the low purchasing power. The mortgage gap comprises 20.7 per cent of households, while the low-cost housing category stands at 16.2 per cent. The middle to high-income segment comprises only 2.2 per cent of the households. Therefore, the government's plan for social, low-cost and mortgage gap housing under the affordable housing project will go a long way in supporting most households in Nairobi City County.

1 Defined as the population aged 65 years and above relative to the total number of persons aged 15-64 years.

2 It includes all forms of income arising from regular income such as income from rent, pension, savings and interest and non-regular income which includes one off payments and windfalls like gratuity payments or winning a lottery.

Figure 3: Household's average monthly income and affordable housing category[3]



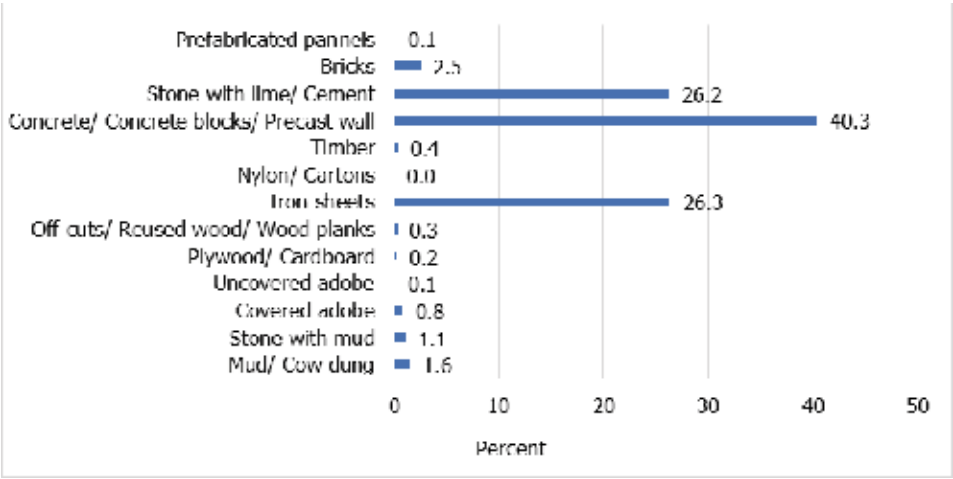
Computed from Kenya Integrated Household Budget Survey, 2015/16

5.2 Status of Housing

The results indicate that majority (69.2%) of households in Nairobi County have dwelling units with walls made of finished and durable material, including concrete/concrete blocks/precast (40.3%) followed by stone with lime/cement at 26.2 per cent, bricks, and prefabricated panels at 2.5 per cent and 0.1 per cent, respectively. Cumulatively, more than one quarter (30.8%) of households were deprived of the housing wall material (Figure 4). Low-quality building materials are predominant in the slums and informal settlements.

3 a) Social housing designated for monthly income earners earning up to 19,999 shillings.
b) Low cost housing designated for monthly income earners earning between Ksh 20,000 to Ksh 49, 999 shillings.
c) mortgage gap housing designated for monthly income earners earning between 50, 000 to 149, 999 shillings.
d) middle to high income housing designated for monthly income earners earning 150,000 shillings and above:

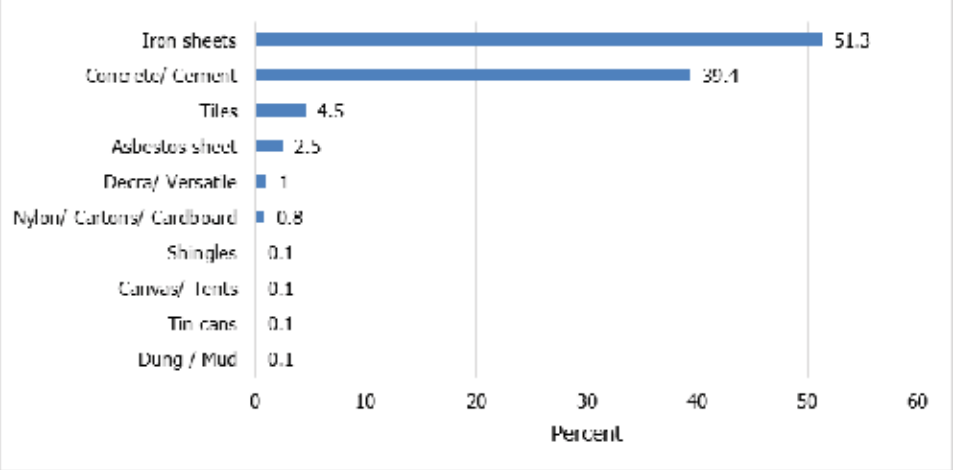
Figure 4: Predominant wall material of main dwelling unit



Computed from Kenya Population and Housing Census (2019)

Further, about 1.2 per cent of households had dwelling units with roofing of low-quality, including dung/mud; tents; tin cans; shingles and nylon. This indicates that despite the county's high urbanization level, a significant proportion of the population still resides in low-quality dwelling units, especially in slums, and therefore the need for affordable and decent housing units. On the other hand, 98.7 per cent of households live in dwelling units with finished and modern roofing material. Iron sheets make up the predominant (51.3%) roofing material, followed by concrete/cement, tiles (4.5%) and asbestos and decra/versatile at 2.5 per cent and 1 per cent, respectively (Figure 5).

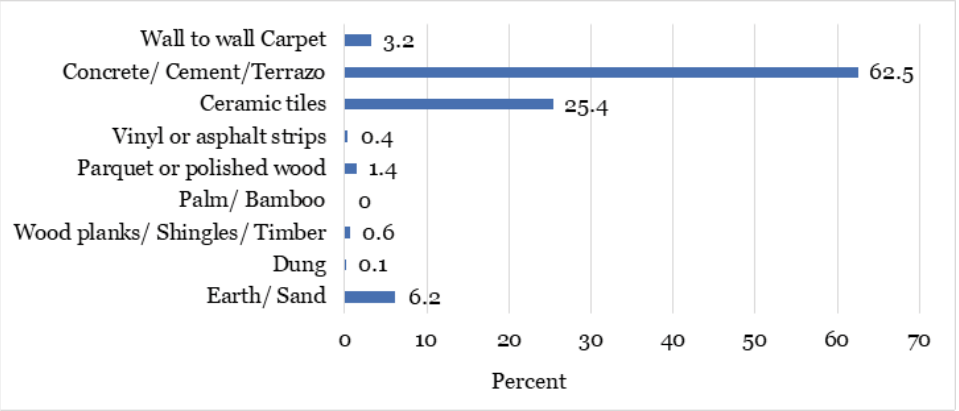
Figure 5: Predominant roof material of main dwelling unit



Computed from Kenya Population and Housing Census (2019)

Distribution of households by predominant floor material of the primary dwelling unit shows that majority (92.2%) of dwelling units are constructed using the recommendable quality material. The highest proportion of households used concrete/cement/terrazzo at 25.4 per cent, followed by ceramic tiles at 25.4 per cent and about 6.9 per cent of the households had low-quality housing materials, including earth/sand (6.2%); dung (0.1%) and wood planks at 0.6 per cent (Figure 6).

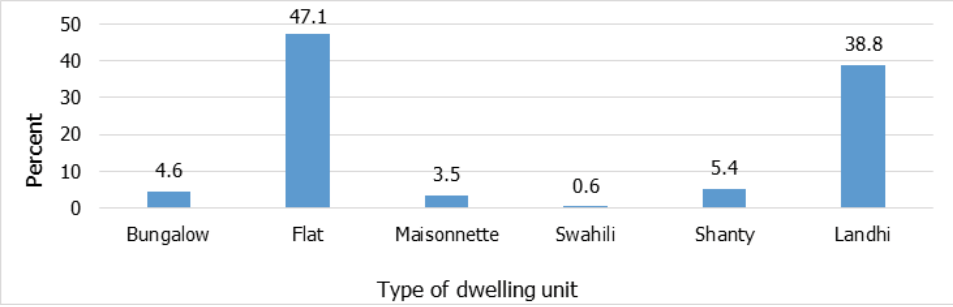
Figure 6: Predominant floor material for the main dwelling unit



Computed from Kenya Population and Housing Census (2019

Housing type, especially in urban areas, is critical in unveiling housing dynamics in urban areas, mainly associated with household socio-economic status. The results indicate that the preference for flats is high at 47.1 per cent followed by Landhi at 38.8 per cent. Shanty housing type, mainly low-quality housing made of temporary and rudimentary housing material, accounted for 5.4 per cent of the population. Shanties are found in slums and informal settlements and a key indicator of the housing problem and lack of proper planning in the housing sector. Further, 4.6 per cent occupied bungalows while maisonettes and swahili were occupied by 3.5 per cent and 0.6 per cent, respectively (Figure 7).

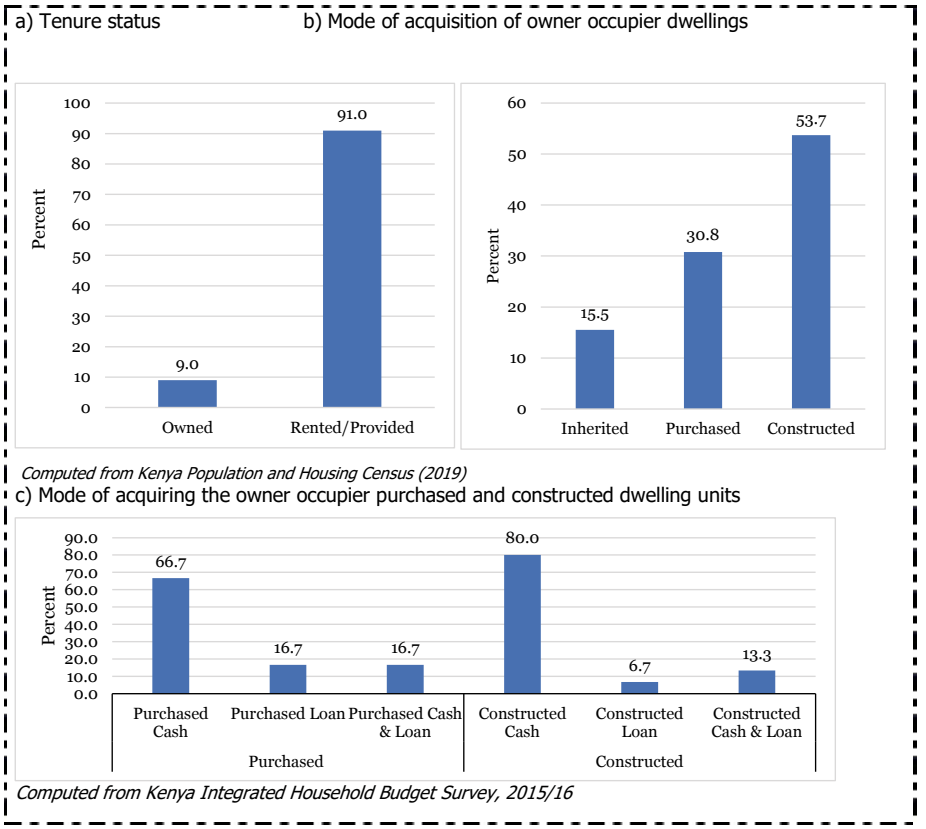
Figure 7: Percentage distribution of households by type of housing



Computed from Kenya Integrated Household Budget Survey, 2015/16

Tenure refers to the proprietary status under which households occupy a dwelling. According to Figure 8 (a), most households (91%) occupy rented and provided dwelling units. About 9.0 per cent of the households owned the dwelling units. Consequently, the owner-occupied housing units are mainly acquired through construction (53.7%), followed by purchase (30.8%), and through inheritance at 15.5 per cent (Figure 8b). The preceding tenants characterize Kenya's housing market. Therefore, affordable housing initiatives should also focus on homeownership and the affordable rental market for the population that prefers to reside in rented units. The low incidence of owner-occupation is attributable to the high cost of housing and the low purchasing power. The County Government of Nairobi's key area of focus should be increasing homeownership through affordable housing initiatives among low-income earners, who mainly fall under the social housing category. Besides, rent continues to be alarmingly high and out of line with incomes, forcing most of the population to pay more than 50 per cent of their income each month on housing (World Economic Forum, 2019).

Figure 8: Tenure status of the main dwelling unit

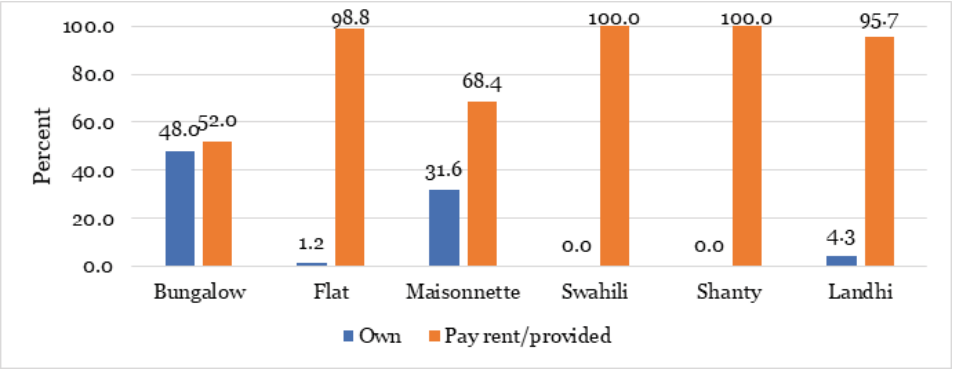


It is worth noting that the rental market is dominated by informal channels of housing delivery system of the housing stock, mainly characterized by poorly serviced infrastructure networks and public services.

Further, results indicate that most of the households purchase the housing units in cash (66.7%) and construct in cash (80%) compared to construction through loans and loan and cash (Figure 8c). This indicates that home financing preferred by the majority of households is construction and buying in cash. Constructing a house is deemed affordable compared to buying already built housing units, and also high interest makes it expensive to acquire loans for construction purposes. Most households consider constructing dwelling units of their preference, attributable to the high cost of buying homes and the flexibility of time and other factors such as designs and size in constructing their dwelling units.

With most households residing in flats, about 98.8 per cent rent the housing units compared to 1.2 per cent who own the housing units in the flats. The same scenario applies to Swahili (100%) and shanty (100%), and Landhi (95.7%) with majority of households renting the units. Compared to the other dwelling units, bungalow (48.0%) and maisonettes (31.6%) had a significant proportion of the households owning the dwelling units. The results indicate that the majority of households in Nairobi County rent their dwelling units. Therefore, homeownership is far from the reach of a significant proportion of households (Figure 9).

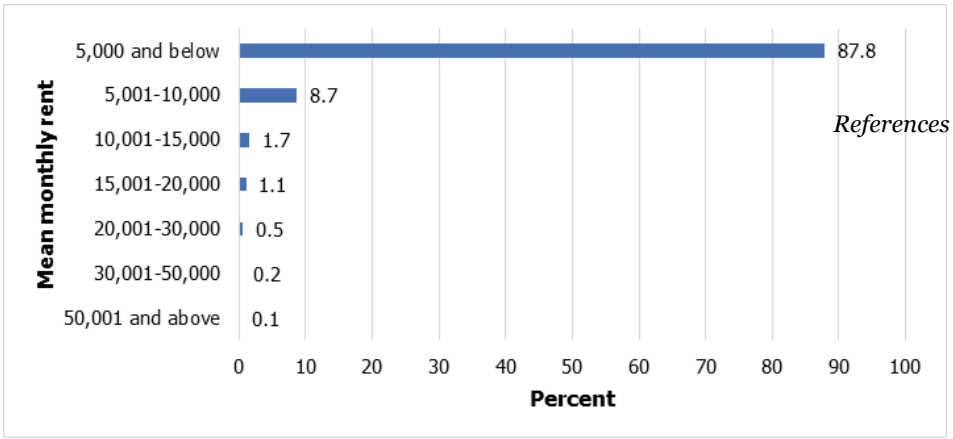
Figure 9: Percentage distribution of households by type of housing and tenure status



Computed from Kenya Integrated Household Budget Survey, 2015/16

With most households renting, the rental market is dominated (87.8%) by rent of Ksh 5,000 and below. Low rental costs are closely associated with housing structures of poor-quality housing and are over-crowded and in slums and informal settlements (Figure 10).

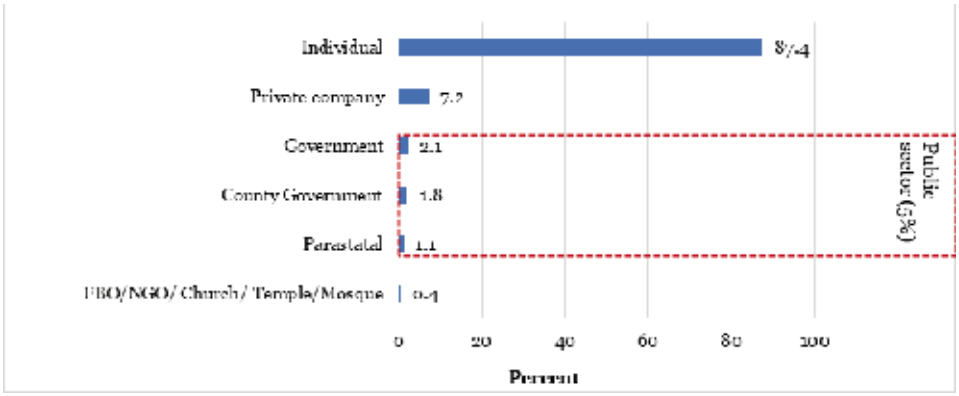
Figure 10: Distribution of average monthly rent



Computed from Kenya Integrated Household Budget Survey, 2015/16

Further, 87.4 per cent of households paid rent to the individual owners of the housing units, indicating that majority of investors in the rental housing market are individuals, followed by private companies at 7.2 per cent. However, public sector housing (National government, County government, and parastatals combined) account for 5 per cent of those who indicate that the rental stock provided is relatively low compared to the individuals and private companies, which stood at 7.2 per cent (Figure 11).

Figure 11: Provision of rental housing by various institutions

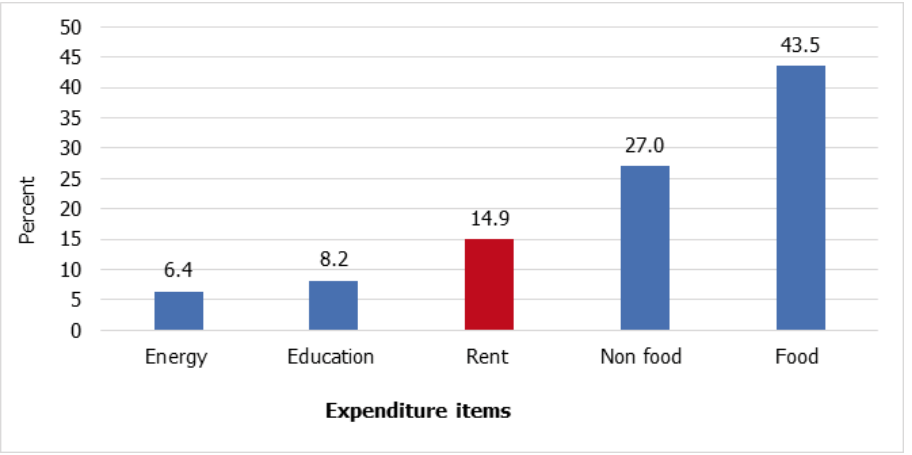


Computed from Kenya Population and Housing Census (2019)

Following the ongoing review of the public-private partnership framework to fast-track implementation of the housing project, individual investors should be incorporated as key stakeholders in delivering the affordable housing project. From the foregoing, the individual investors and private companies occupy the largest share of the rental housing market in Kenya; therefore, any progressive development in closing the housing deficit gap in Nairobi will require intervention by both the public and private sectors.

Further analysis indicates that rent constitutes almost a quarter of the household expenditure items higher than energy and education at 6.4 percent and 8. 2 per cent, respectively (Figure 12).

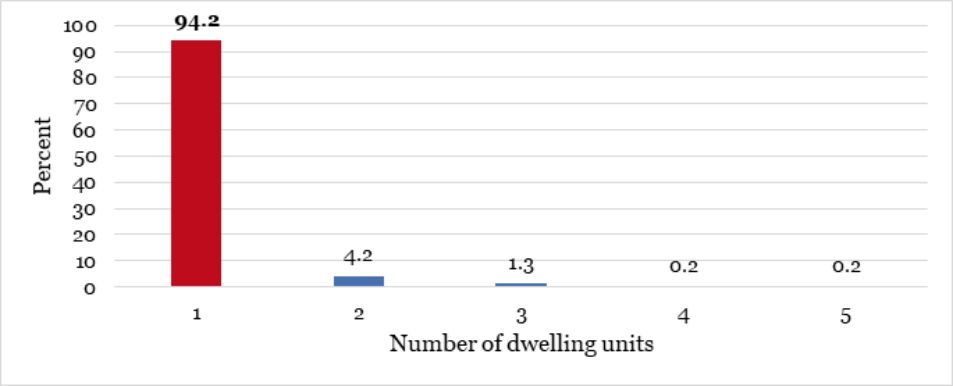
Figure 12: Percentage distribution of mean monthly per adult equivalent consumption expenditure on various expenditure items rent



Computed from Kenya Integrated Household Budget Survey, 2015/16

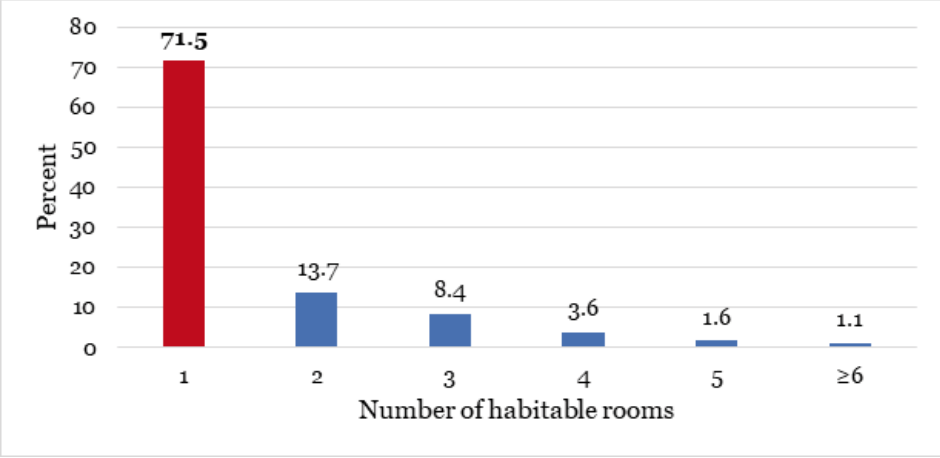
Housing occupancy focusing on the dwelling units occupied by households is critical in understanding the aspect of overcrowding. Majority (94.2%) of households have one dwelling unit, which is closely linked to the fact that majority are renting and only acquire a single unit. About 4.2 per cent have two dwelling units and 1.3 per cent, 0.2 per cent and 0. 2 per cent for households with three, four and five dwelling units (Figure 13). Further, majority (71.5%) of households dwelling unit comprised of one habitable room with only 5.9 per cent having more than one room (Figure 14). Habitable rooms refer to rooms used for living purposes or entertaining guests and excludes stores, kitchen, bathrooms, and granaries.

Figure 13: Number of dwelling units occupied by households



Computed from Kenya Integrated Household Budget Survey, 2015/16

Figure 14: Habitable rooms occupied in the main dwelling unit



Computed from Kenya Integrated Household Budget Survey, 2015/16

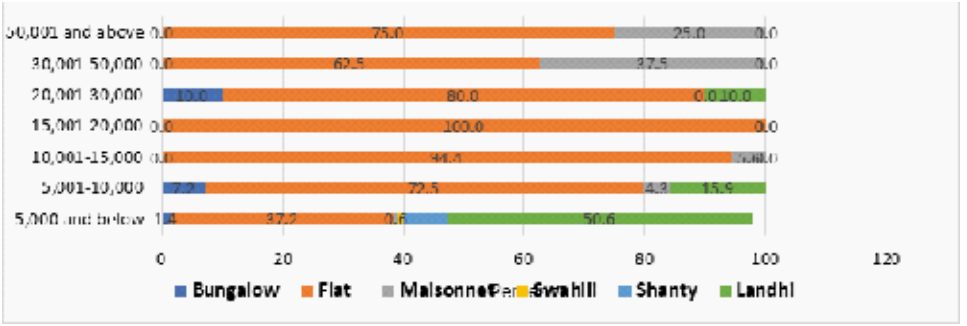
Analysis of habitable rooms by the tenure status indicates that owner-occupier dwelling units comprised of the highest number of habitable rooms. More than half (67.4%) are paying rent to occupy a one-roomed dwelling unit (Figure 15), implying that a rented housing unit with a higher number of habitable rooms is likely to be costlier. About 58.8 per cent of households who do not pay rent with consent from the owner occupy one habitable room. Further, results indicate that, on average, owner-occupier households have a comparatively higher number of habitable rooms at 3.5 than rented dwelling units at 1.6 and 2.5 for households that do not pay rent. From the preceding, the high proportion of households living in single rooms instigates aspects of overcrowding.

Figure 15: Percentage distribution of households by housing tenure and number of habitable rooms.

Computed from Kenya Integrated Household Budget Survey, 2015/16

Further, the study investigated the relationship between rent incurred by the household and the dwelling unit type. The amount of rent paid has a direct relationship with the type of dwelling unit. The results indicate that households occupying flats cut across all the rent brackets (Figure 16). This is attributable to the dominancy of flats in the housing market, whose prices vary based on the unit location, size, and quality, among other factors. Bungalows and maisonettes are mainly in the higher rent brackets, while shanties and swahili are in the lowest rent bracket of Ksh 5,000 and below.

Figure 16: Percentage distribution of households' type of dwelling unit and the monthly rent



Computed from Kenya Integrated Household Budget Survey, 2015/16

From the preceding, cumulatively, more than one quarter (30.8%) of the households were deprived of the housing wall material with low-quality building materials are predominant in sub-counties hosting major slums. Rental housing characterizes Kenya's housing market, with 87.8 per cent paying rent of Ksh 5,000

and below. Low rental costs are closely associated with poor-quality housing and overcrowded housing in slums and informal settlements. Therefore, affordable housing initiatives should also focus on homeownership and the affordable rental market for the population that prefers to occupy rented units. Most households prefer homeownership by constructing and buying in cash. Most households consider constructing dwelling units of their preference, attributable to the high cost of buying homes and the flexibility of time and other factors such as designs and size in constructing their dwelling units. The major providers of rental housing are individuals, with the government providing relatively lower housing stock. With individual investors and private companies taking the largest share of the rental housing market, any progressive development in closing the housing deficit gap in Nairobi will require public and private intervention. Further, on average, owner-occupier households have a comparatively higher number of habitable rooms at 3.5 than rented dwelling units at 1.6 and 2.5 for households that do not pay rent. From the preceding, the high proportion of households living in single rooms instigates overcrowding, depriving households of decent housing.

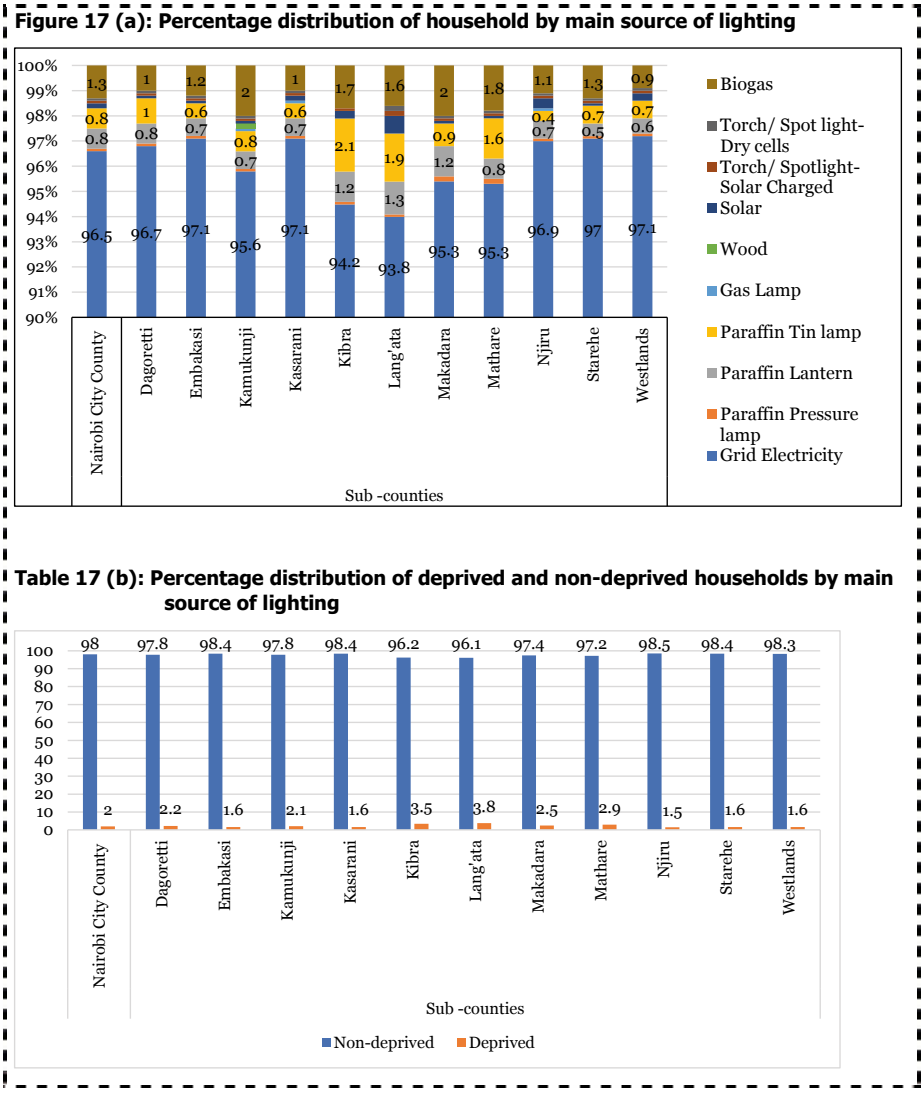
6. Intra-County Disparities and Level of Deprivation in Access to Basic Infrastructure and Housing Conditions

6.1 Disparities and Level of Deprivation in Access to Basic Infrastructure

This section builds on the first objective by providing in-depth analysis to show the disparities in access to basic infrastructure and housing conditions across sub-counties in Nairobi County, and this the need for a critical policy intervention.

Access to clean and modern energy sources for lighting energy sources is for the growth of the society and plays a key role in the socio-economic development of the society. Majority of the population across the sub-counties use electricity from the grid, which is a clean and modern source for lighting. Embakasi, Kasarani and Westlands registered the highest access of 97.1 per cent access, followed by Starehe (97%), Njiru (96.9%) and Dagoretti (96.7%). The access level for Mathare (95.3%); Makadara (95.3%), Lang'ata (93.8%) and Kibra (94.2%) recorded access levels below the average access at county level (Figure 17a). Majority of the sub-counties with relatively lower access are mainly comprised of a higher proportion of slum and informal settlements' population, hence some of the households are not suitable for electricity connection due to the low quality. Also, some of the households cannot afford to pay electricity bills, hence prefer other lighting sources. Solar and biogas energy is also an alternative clean energy source for lighting, which is used by a minimal proportion of households across the sub-counties. On average, majority (96.5%) of households in Nairobi County have access to clean energy sources for lighting and is ranked with highest access across counties (Figure 17(b). However, other households stilly relying on non-clean sources such as paraffin and wood. Other transitional lighting sources include battery and solar charged torches.

Figure 17 (a): Percentage distribution of household by main source of lighting

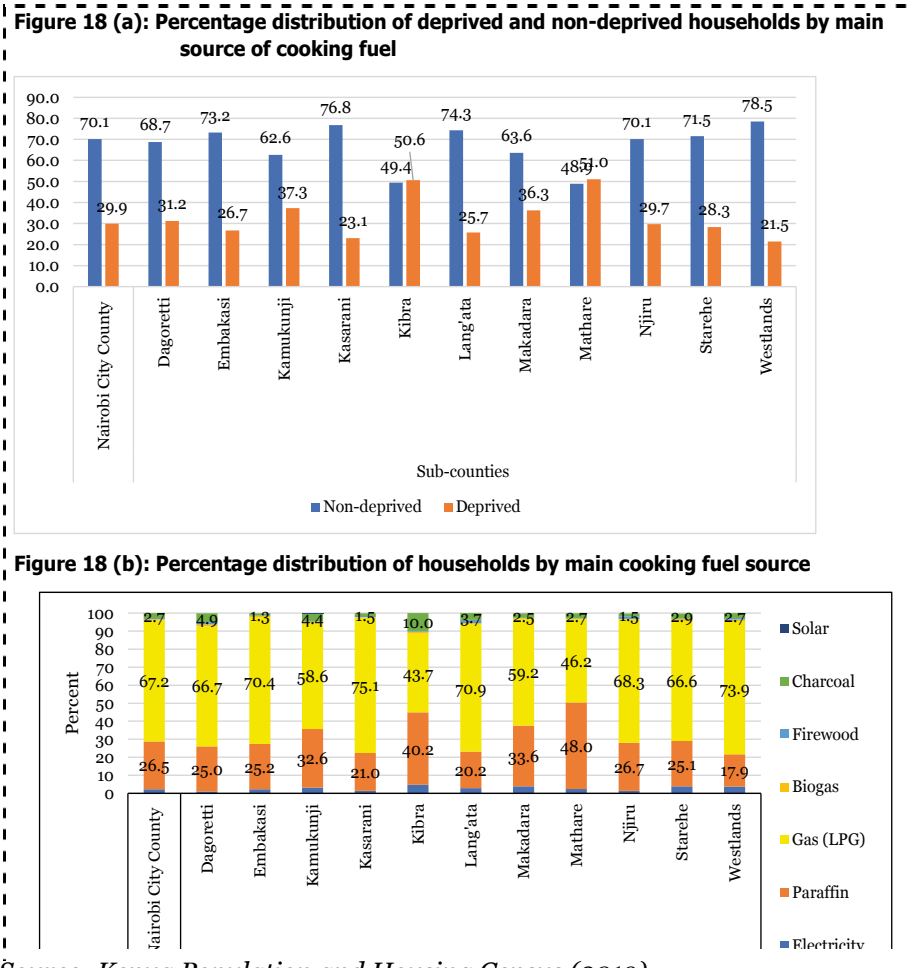


Source: Kenya Population and Housing Census (2019)

Clean cooking fuel is a key basic amenity for households and a critical component in ensuring adequate housing. Households relying on modern and clean energy sources including LPG, biogas, and electricity stood at 70.1 per cent while households deprived were reported at 29.9 per cent (Figure 18(a). Disparities show in the level of deprivation for various energy sources across the sub-counties. Overall, majority (67.2%) of households use LPG as the main cooking fuel in Nairobi County. Embakasi (70.4%), Lang'ata (70.9%), Kasarani (75.1%)

Westlands (73.9%), Njiru (68.3%) and Dagoretti (66.7%) record above average for Nairobi County, indicative that a significant population use LPG. Notably, Kibra (43.7%), Mathare (46.2%) and Makadara (59.2%) show relatively lower usage of LPG as a clean cooking fuel. The penetration of electricity biogas and solar as clean and modern sources is low across the sub-counties, with only 2.3 per cent using electricity and 0.6% relying on biogas, 0.1 per cent using solar cookers (Figure 18b). Conclusively, Nairobi County is ranked among the best performing counties in clean cooking fuel in Kenya. However, the pockets of energy poverty are evident across the sub-counties, especially in slum areas. Therefore, there is need to undertake a location-specific intervention in promoting LPG by targeting the energy-deprived at a disaggregated level.

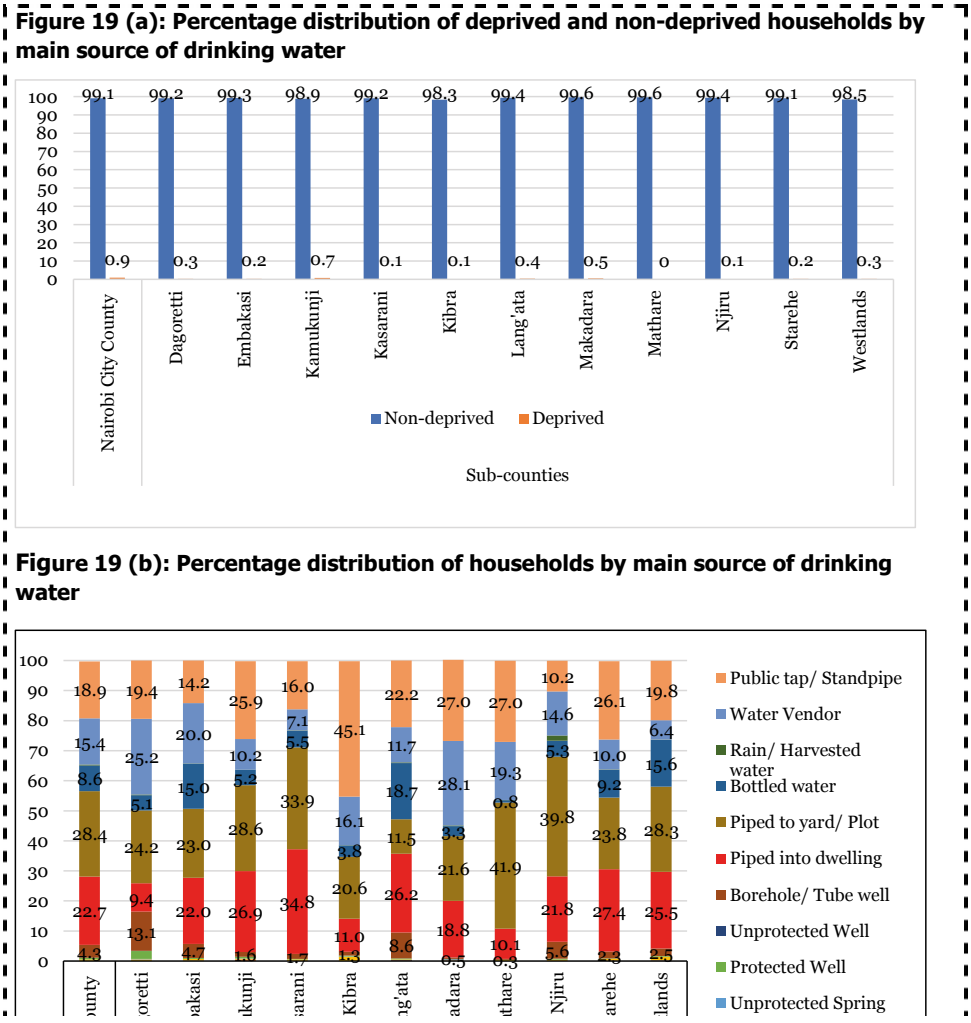
Figure 18 (a): Percentage distribution of deprived and non-deprived households by main source of cooking fuel



Source: Kenya Population and Housing Census (2019)

Equitable access to safe and improved drinking water is one of the key targets for sustainable development. Improved drinking water sources includes sources that are protected from contamination, particularly faecal matter, by nature of their construction or through active intervention. The majority (99.1%) of the population are non-deprived, hence have access to improved water sources, including water from piped supplies with tap water in their dwelling, yard, or plot; or public standposts) and non-piped supplies such as boreholes, protected wells and springs, rainwater, and packaged or delivered water (Figure 19a). Disparities show access to various water sources across the counties. The majority (28.4%) have access to water piped into the yard/compound followed by 22.7 per cent with water connected into their dwelling units and 18.9 per cent accessing water from the public water points within their communities. The highest proportion of the population with water piped in their dwelling units are mainly from Kasarani (34.8%), Starehe (27.4%), Kamukunji (26.9%), and Lang'ata (26.9%). Notably, majority of the population living in areas with slums and informal settlements depend on public water stands; Kibra (45.1%), Mathare and Makadara (27.0%) as shown in Figure 19(b). Dagoretti and Makadara sub-counties, which have a high proportion of the population living in slums and informal settlements, access water from water vendors, showing that the residents are adversely affected by water scarcity from the providers. Lack and irregular supply to piped water in such areas is castigated by poor planning of the drainage and piping systems of houses before their construction and dilapidation of the piping system. In addition, most of rental houses are poorly constructed without proper piping of water and sewage. It is worth noting that a small proportion of the population practice rain harvesting across the county, which could be partly attributable to most residents living in rented housing units that have no facilities for rain harvesting. Rooftop water harvesting could meet the deficit encountered with most households even at the city level. Therefore, the housing sector needs to adapt to green housing standards such as water harvesting as provided under the National Water Harvesting and Storage Regulations, 2019.

Figure 19 (a): Percentage distribution of deprived and non-deprived households by main source of drinking water



Source: Kenya Population and Housing Census (2019)

Access to basic improved and safely managed sanitation is also critical to the health and well-being of individuals and communities. Improved sanitation facilities are likely to ensure hygienic separation of human excreta from human contact. Overall, 72.4 per cent of the population are non-deprived, while 27.6 per cent are deprived of safely management sanitation, with more than half of the population in Kibra. About 54.3 per cent were connected to the main sewer while 18.1 per cent are connected to a septic tank and vary across the sub-counties. Disposal of human waste using covered pit latrines is prevalent in Dagorretti (44.1%), Kibra (33.8%). Biodigester and bio-septic, which are modern as sustainable

wastewater management, show low adoption (0.3%) in Nairobi County (Figure 20(a). Biodigesters can also be used to generate power for heating ad lighting. A proportion of the population also dispose human waste in open/bush (0.1%), bucket latrine (1.3%) and Ventilated Improved Pit Latrine (VIP) (6.8%) (Figure 20b, with the majority located in slums. Despite a significant proportion of the population having access to basic sanitation, majority are still lagging with disparities spread out across all the sub-counties.

Figure 20a: Percentage distribution of deprived and non-deprived households by mode of human waste disposal

Figure 20 (a): Percentage distribution of deprived and non-deprived households by mode of human waste disposal

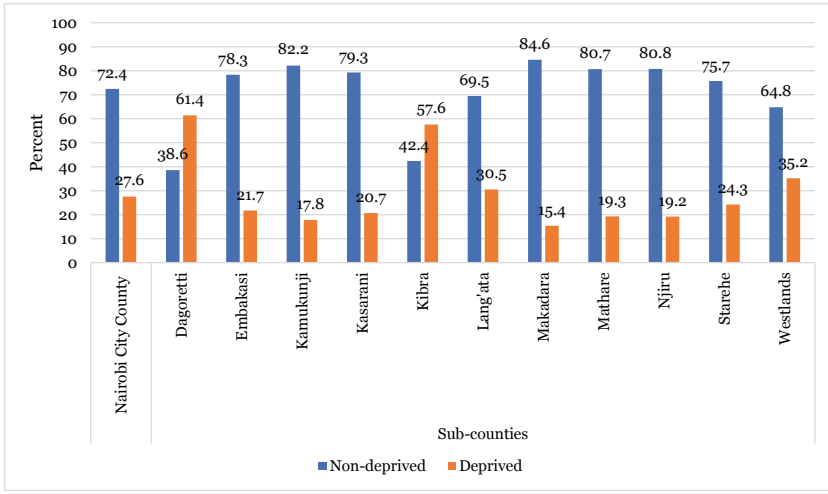
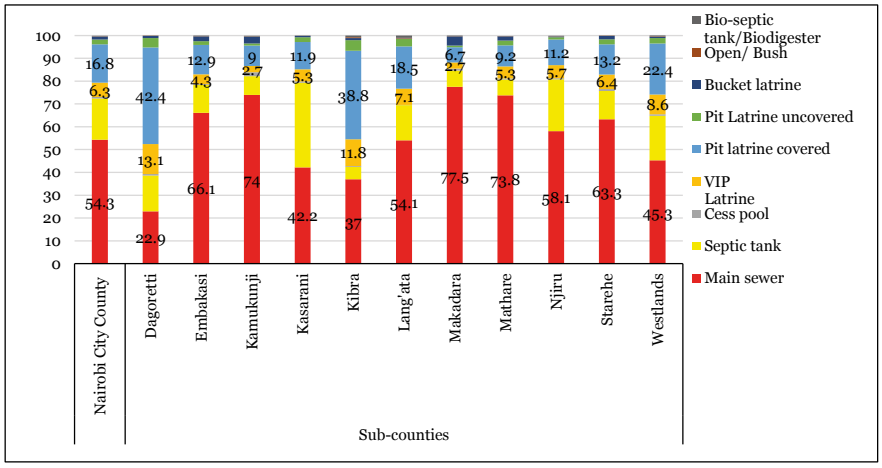


Figure 20 (b): Percentage distribution of deprived and non-deprived households by mode of human waste disposal



Source: Kenya Population and Housing Census (2019)

Sustainable access to sanitation, including controlled waste disposal facilities, is a crucial basic need for households. Waste poses a threat to public health and the environment if it is not stored, collected, and disposed of properly. In Nairobi County, 72.4 per cent of the population have access to organized waste collection methods, and 27.6 per cent are deprived (Figure 21a). Disparities show across the counties such as Kasarani (88.1%), Embakasi (86.0%), Makadara (84.5%), and Westlands (82.9%), with a high proportion of the population having access to organized solid waste collection modalities (Figure 21b). Kibra records the highest deprivation across counties, with more than half (57.5%) of the population without access to organized solid waste collection modalities. In Kibra, the highest proportion (47.7%) dumps solid waste in the streets and waterways. Notably, a higher proportion (37.9%) of the population rely on collection by community organizations, with more than half of the population in Njiru (59.7%), and Mathare (55.1%) relying on community organizations. The collection of waste by private companies is dominant in Westlands (56.3%), Dagorretti (43.2%), and Starehe (31.6%). Solid waste management cuts across various sectors and stakeholders. Therefore, to effectively address solid waste management, policy integration and a multisectoral approach are vital. The enactment of the National Sustainable Waste Management Bill 2018 will guide the formulation of procedures for waste collection, separation, recycling, and secure final disposal, including segregation and storage of collected waste, methods of transportation, treatment, recycling, reuse, and final disposal of non-recoverable waste.

Figure 21(a): Percentage distribution of deprived and non-deprived households by mode of garbage disposal

Figure 21(a): Percentage distribution of deprived and non-deprived households by mode of garbage disposal

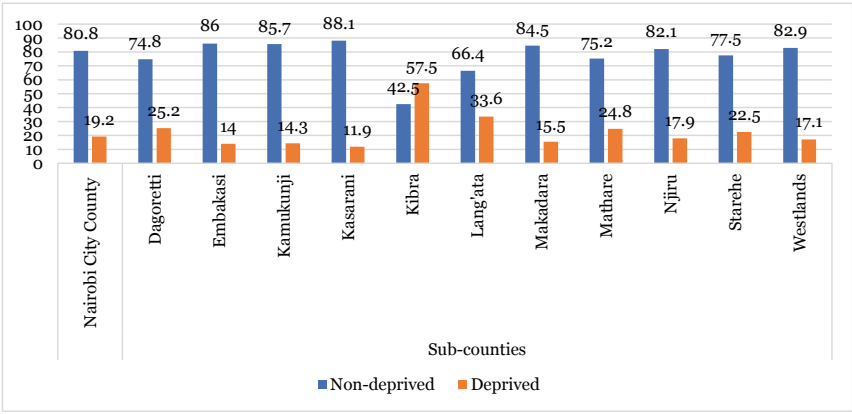
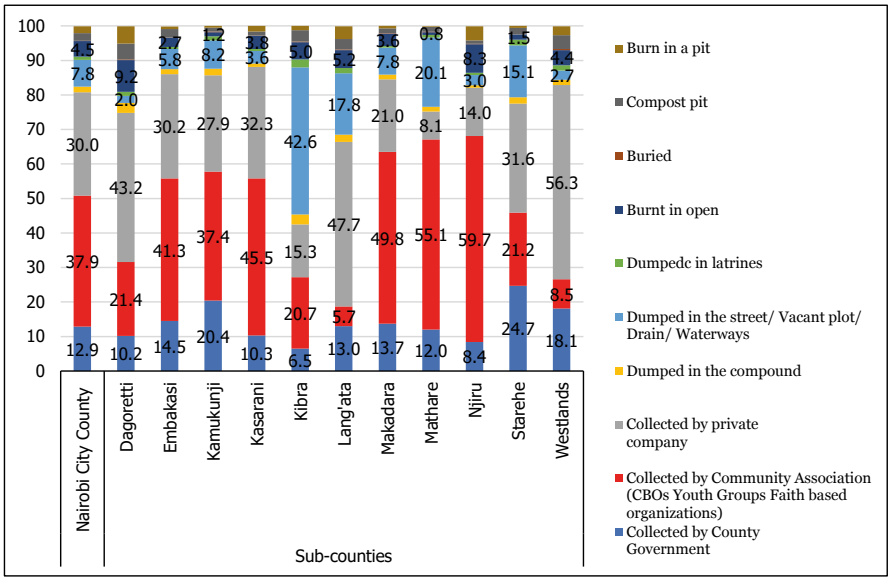


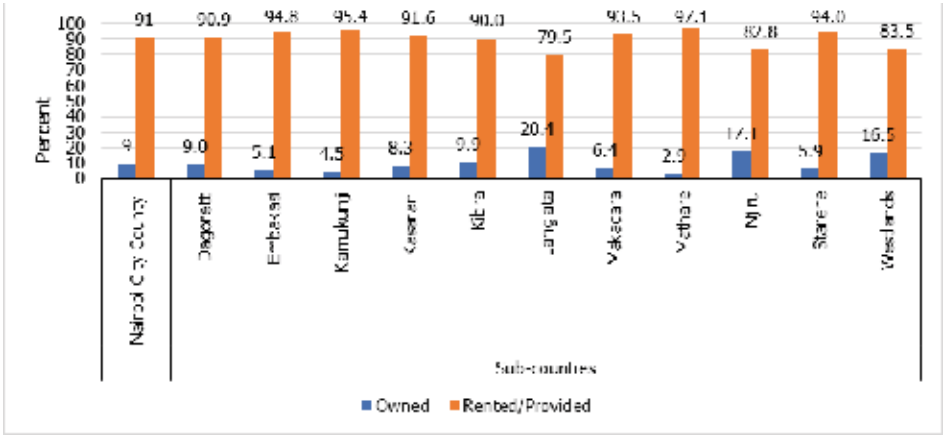
Figure 21(b): Percentage distribution of households by mode of garbage disposal



6.2 Disparities and level of deprivation in housing condition across sub-counties

According to Figure 22, most of the households renting housing units are in Mathare (97.1%) followed by Kamukunji (95.4% and Embakasi (94.8%), among others. Sub-counties with a higher proportion owning dwelling units include Langata (20.4%), Njiru (17.1%), and Westlands (16.5%). The results indicate that house renting is the primary form of house tenure in Nairobi County as homeownership is far from the reach of most households.

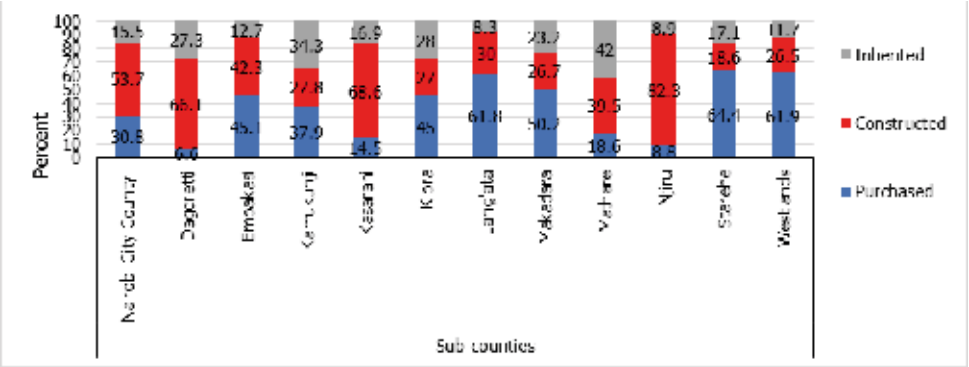
Figure 22: Percentage distribution of households by tenure status



Source: Kenya Population and Housing Census (2019)

Disparities show in the distribution of households by mode of acquisition of owner-occupied dwelling units. More than half of the households situated in their dwelling units are in Njiru (82.3%) followed by Kasarani (68.6%) and Dagoretti (66.1%) have constructed (Figure 23). The majority in Westlands (61.9%), Starehe (64.4%), Lang'ata (61.8%), and Embakasi have purchased the housing units. Inheritance is more prevalent in Mathare (42%), Kamukunji(34.3%), Kibra (28.0%), and Dagoretti, which comprises some of the oldest estates and Nairobi County, hence higher level of inheritance. Constructing a house is deemed affordable compared to buying already built housing units, and, high interest makes it expensive to acquire loans for construction purposes. Also, most households consider constructing dwelling units of their preference is attributable to the high cost of buying homes and the flexibility that comes with time and other factors such as designs and size in constructing their own dwelling units.

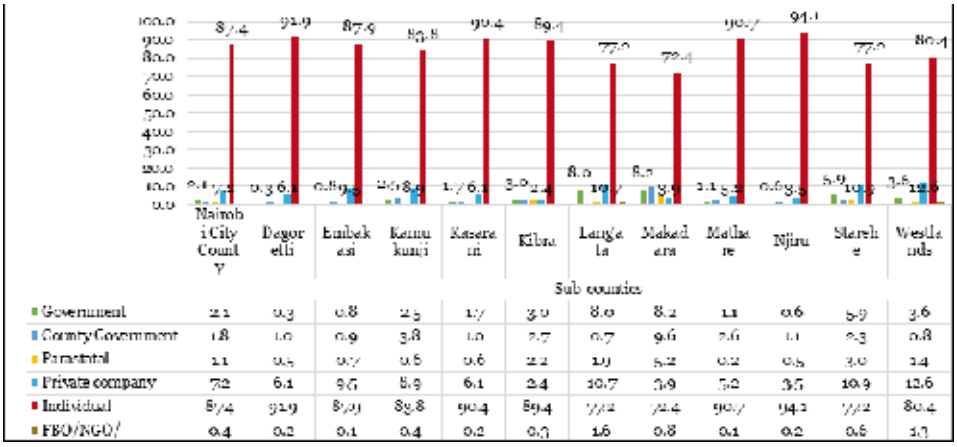
Figure 23: Percentage distribution of households' mode of acquisition of owner occupier dwelling units



Source: Kenya Population and Housing Census (2019)

With majority of Nairobi residents renting their dwelling units, the providers of rental housing vary across the sub-counties. The provision of rental housing by the National Government is mainly in Lang'ata, Makadara and Starehe (Figure 24). However, most of the government estates comprise of old housing stock with dilapidated basic services. Private companies have invested more in areas such as Westlands, Starehe, Embakasi and Langata. Notably, more than half of all the rented housing units across the sub-counties are provided by the individual investors. This shows that the individual investors play a critical role in provision of housing; however, there is need to ensure that the planning and zoning regulations are adhered to.

Figure 24: Percentage distribution of households by provider of rental housing

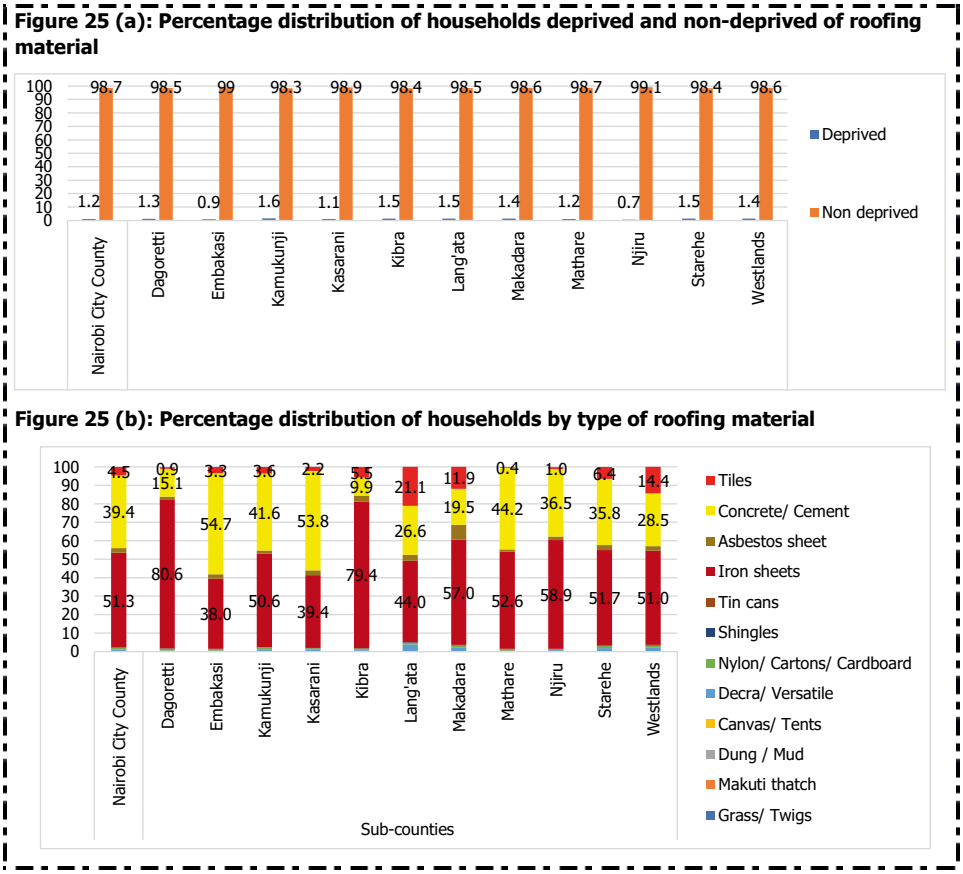


	Nairobi City County	Dagoretti	Embakasi	Kamukunji	Kasarani	Kibra	Lang'ata	Makadara	Mathare	Njiru	Starehe	Westlands
Government	2.1	0.3	0.8	2.5	1.7	3.0	8.0	8.2	1.1	0.6	5.9	3.6
County Government	1.8	1.0	0.9	3.8	1.0	2.7	0.7	9.6	2.6	1.1	2.3	0.8
Parastatal	1.1	0.5	0.7	0.5	0.6	2.2	1.9	5.2	0.2	0.5	3.0	1.4
Private company	7.2	6.1	3.6	5.9	6.1	2.4	10.7	3.9	5.2	3.5	10.9	12.6
Individual	87.4	91.9	87.9	85.8	90.4	89.4	77.2	72.4	90.7	94.1	77.2	80.4
FBO/NGO/	0.4	0.2	0.1	0.4	0.2	0.3	1.6	0.8	0.1	0.2	0.6	1.1

Source: Kenya Population and Housing Census (2019)

Majority (98.7%) of the households have durable roofing material and are spread out across the sub-counties (Figure 25a and b). However, a small proportion is still relying on rudimentary roofing materials including tin cans and cartons.

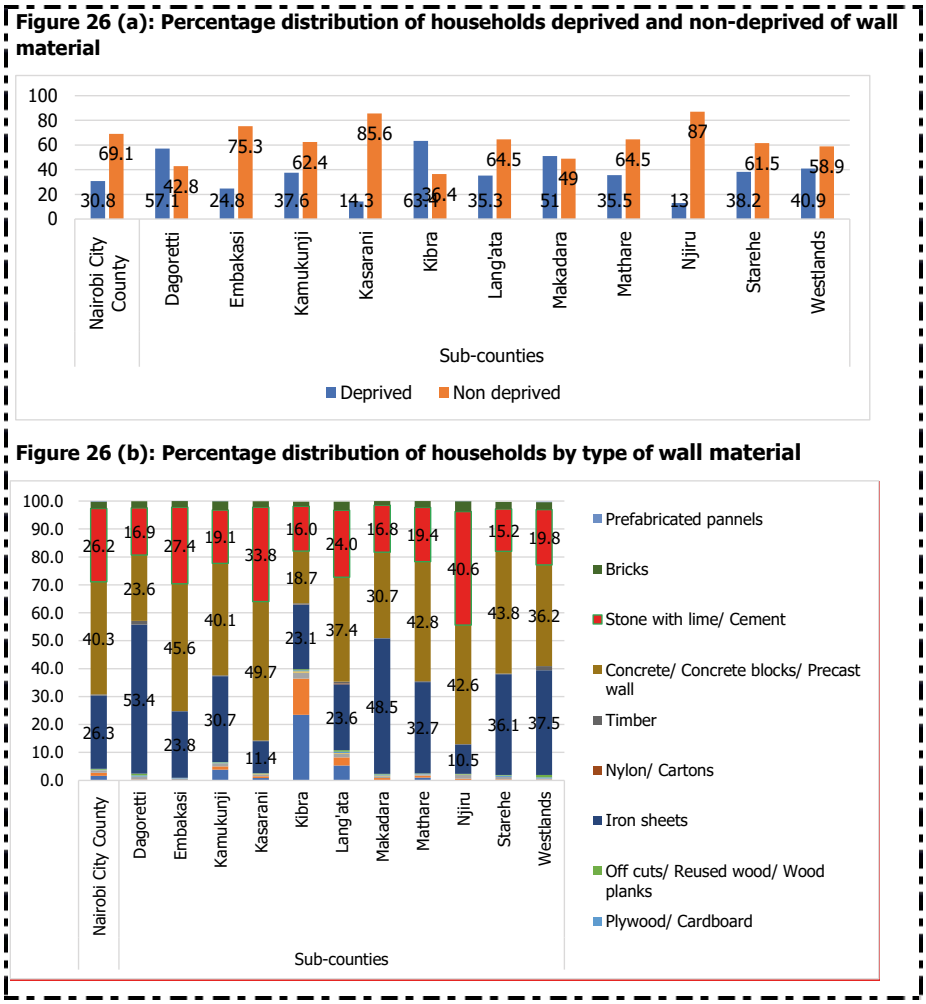
Figure 25 (a): Percentage distribution of households deprived and non-deprived of roofing material



Source: Kenya Population and Housing Census (2019)

On the contrary, the wall material presents lower quality standards across the sub-counties. Majority of deprived households are in Kibra (63.4%), Makadara (51.0%) and Dagoretti (57.1). Njiru (87.0%) Kasarani (85.6%) and Embakasi show low levels of deprivation (Figure 26a). Notably, Mathare has a significant slum population, but more than half of the population have housing units with durable wall materials.

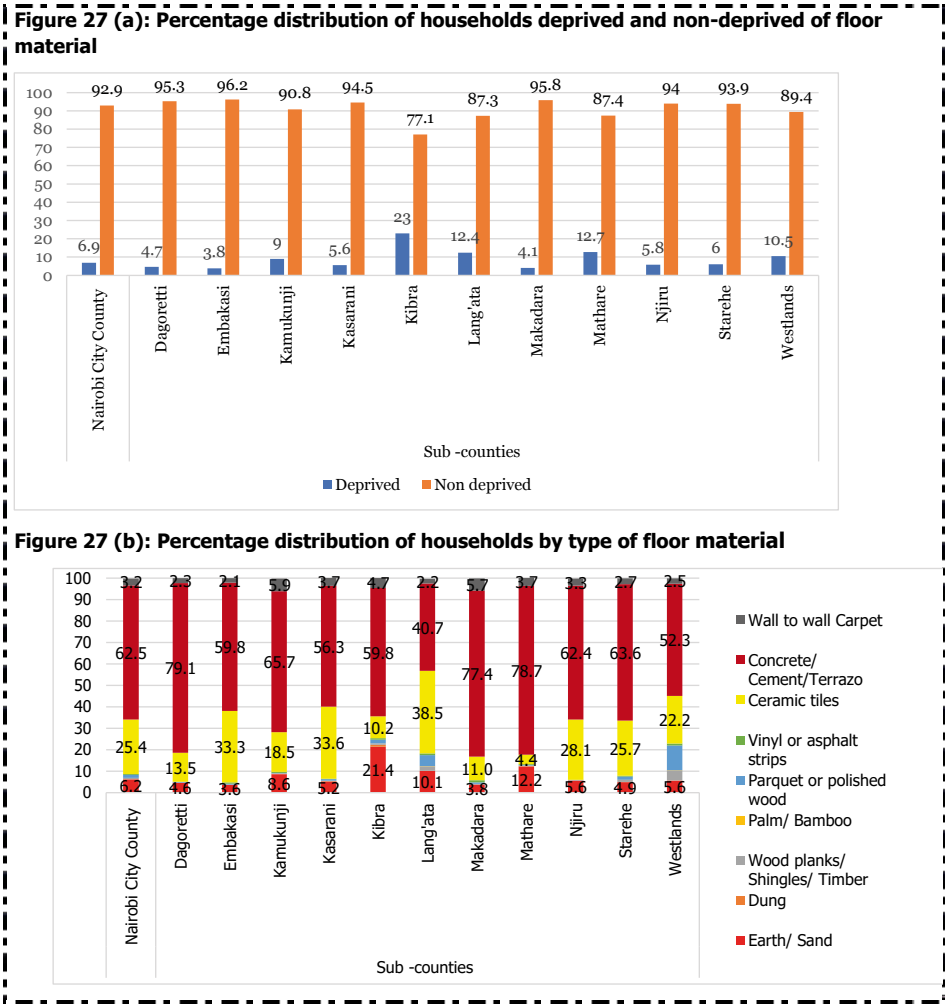
Figure 26(a): Percentage distribution of households deprived and non-deprived of wall material



Source: Kenya Population and Housing Census (2019)

Disparities show in the distribution of house floor material across the sub-counties. The deprivation in quality floor material in Kibra and Mathare is significantly high compared to other sub-counties. Earth and sand floor are seemingly higher in Mathare and Kibra (Figure 27a). Figure 27 (b) indicates that a high proportion of dwelling unit floor material was made of cement/concrete floors and ceramic tiles.

Figure 27 (a): Percentage distribution of households deprived and non-deprived of floor material



Source: Kenya Population and Housing Census (2019)

Access to Internet is also considered a key basic amenity for the households' welfare. The proportion of the population above 3 years using Internet stood at 52.4 per cent, with disparities showing across the sub-counties. Regions dominated by low-income earners including Mathare, Kibra, Kamukunji, Dagoretti and Njiru, which have less than half of the specified population with no access to Internet (Figure 28a).

Figure 28a: Percentage distribution of population above 3 years using the Internet

Figure 28 (a): Percentage distribution of population above 3 years using the internet

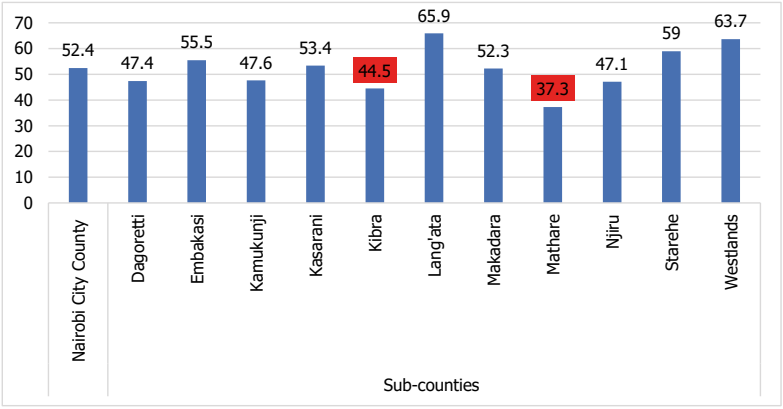
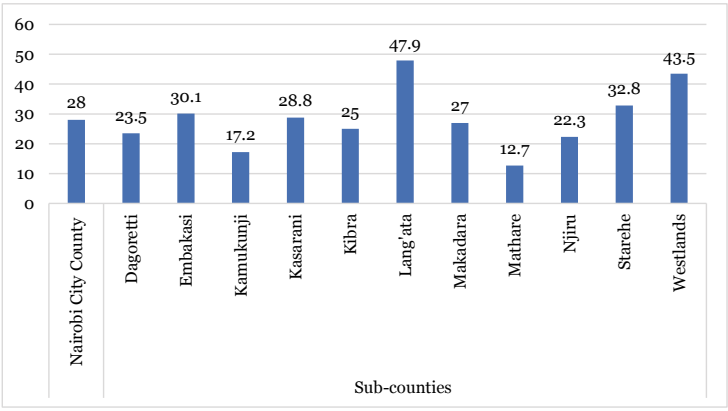


Figure 28 (b): Percentage distribution of population above 3 years using desktop /computer/tablet



Further, about 28 per cent of the population above three years use desktops/ computers /tablets. The highest proportion of the specified population in Mathare, Kamukunji, Kibra, Dagoretti and Njiru show lower use level. This indicates that the penetration of ICT devises is still low even in the urban centres (Figure 28b).

In conclusion, disparities show across the sub-counties. Most of the population uses grid-electricity for lighting; however, households still rely on non-clean sources such as paraffin and wood. Overall, households use LPG as the primary cooking fuel, with Kibra (43.7%) and Mathare (46.2%) recording lower usage of LPG. The penetration of electricity, biogas and solar as clean and modern sources is low across the sub-counties. Much of the population living in slums and informal settlements depends on public water stands and vendors. Further, a small proportion of the population practices rain harvesting across the sub-

counties, partly attributable to most residents living in rented housing units with no rain harvesting facilities. Overall, about 27.6 per cent are deprived of safely management sanitation; however, more than half of the population is deprived in Kibra and Dagorretti.

Further, house renting is the primary form of house tenure in Nairobi sub-counties as homeownership is far from the reach of most households. Inheritance is more prevalent in Mathare (42.0%), Kamukunji (34.3%), Kibra (28.0%), and Dagoretti, which comprises some of the oldest estates and Nairobi County, hence higher level of inheritance. The majority (98.7%) of the households have durable roofing material and are spread out across the sub-counties. On the contrary, the wall material presents lower quality standards across the sub-counties, with Kibra (63.4%), Makadara (51.0%), and Dagoretti (57.1%) leading. The deprivation in quality floor material in Kibra and Mathare is significantly high compared to other sub-counties. Further, the population above three years using desktops/ computers/tablets records low in Mathare, Kamukunji, Kibra, Dagoretti, and Njiru indicate that ICT devices' penetration is still low even in the urban centres.

7. Estimation of Multidimensional Housing Deprivation Index for Nairobi County

7.1 Correlation of Indicators for multidimensional housing deprivation index

The correlations across indicators chosen for estimating multidimensional housing deprivation are used to determine the strength and direction of association between the variables and suitability in developing the index (Table 3). The result of the spearman's correlation show that most coefficients have low correlation, with the highest being 0.473 (wall material and toilet facility). We therefore conclude that the indicators can be applied in the MHDI analysis.

Figure 29 shows the uncensored headcount ratio for the ten indicators across households in Nairobi County.[4] The uncensored headcount ratio represents the proportion or share of households deprived of a specific indicator despite their deprivation status. Across the indicators, the highest uncensored headcount is in deprivation of handwashing facility at 55.5 per cent, followed by clean cooking at 54.2 per cent, wall material at 34.0 per cent, internet access at 32.7 per cent, garbage collection at 30.0 per cent, toilet facility at 29.8 per cent. The indicators with a lower proportion of households deprived include roof material (0.2%), drinking water (1.9%), floor material (5.7%) and lighting (7.4%).

7.2 Incidence, Intensity, and Multidimensional Housing Deprivation Index

Table 4 shows the MHDI, incidence (censored headcount ratio), and intensity of housing deprivation for the deprivation cut-off of 0.33 (33.3%) of the weighted indicators. The incidence (H) of MHDI stood at 40.7 per cent, indicating households multidimensionally deprived (at a cut off 33.3%) in Nairobi City County.

This suggests that 4 out of 10 households are multidimensionally deprived of housing in Nairobi City County. The intensity of multidimensional housing deprivation which reflects the share of deprivations that deprived households experience stood at 48.0 per cent. This shows that multidimensionally deprived households, on average, were deprived in at least 4 of the weighted indicators. The results also indicate the Multidimensional Housing Deprivation index which is the product of the headcount ratio (H) and the intensity (I). The MHDI ranges from 0 and 1 with results close to 1 showing higher multidimensional housing deprivation. As shown in table 4.2, the MHDI was reported at 0.195, means that multidimensionally deprived households in Nairobi City County experience 19.5 per cent of the total deprivations.

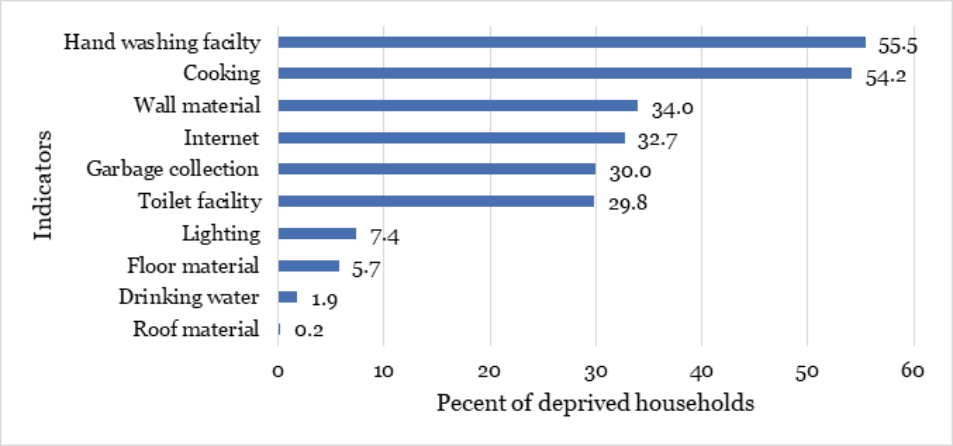
4 Each indicator is out of 100 per cent.

Table 3: Spearman's rank correlation for the indicators

	Cooking fuel	Lighting	Drinking water	Toilet facility	Hand washing facility	Garbage collection	Wall material	Floor material	Roof material	Internet
Cooking fuel	1									
Lighting	0.2458	1								
Drinking water	0.0161	0.0137	1							
Toilet facility	0.3311	0.2641	-0.0593	1						
Hand washing facility	0.3547	0.2248	0.123	0.4614	1					
Garbage collection	0.2289	0.1391	0.0301	0.3424	0.2043	1				
Wall material	0.4099	0.2743	-0.0406	0.4738	0.2666	0.4592	1			
Floor material	0.147	0.1431	-0.0338	0.1178	0.013	0.2556	0.3266	1		
Roof material	-0.0468	-0.0122	-0.0059	-0.028	0.0386	-0.0281	-0.0309	-0.0106	1	
Internet	0.3095	0.2245	-0.0079	0.2096	0.2525	0.1806	0.2645	0.1501	-0.03	1

Source: Authors' computation

Figure 29: Aggregate households deprived by indicator; uncensored headcount ratio



Source: Authors' computation

Table 4: Incidence, intensity, and Multidimensional Housing Deprivation index

Housing Deprivation cut-off	Indices	Coef.	Std. Err.	95% Conf. level	Interval
K value =33.3 per cent	Headcount ratio (H)proportion of housing deprived	0.407	0.021	0.365	0.448
	Intensity ratio (A)	0.480	0.008	0.465	0.495
	Multidimensional Housing Deprivation index	0.195	0.011	0.174	0.216

Source: Authors' computation

7.3 Decomposition of Multidimensional Housing deprivation Index by indicators and dimensions

The breakdown of MHDI by indicators is critical in understanding the depth of the deprivation by providing insights on key indicators driving MHDI, hence inform specific areas that require policy intervention. The percentage contributions reflect the weights and the censored headcounts.

According to Table 5, the highest contributor to MHDI deprivation in clean cooking at 26.7 per cent, followed by Internet access (18.8%); garbage collection

Households deprived in at least 33. 3 per cent of the weighted indicators.
Adjusted Multidimensional Headcount (multidimensional housing deprivation index) M0 = H*A

(18.7%), and handwashing facility (12.2%). In turn, the indicators that contributed the least (less than 10%) to MHDI include lighting source (5.4%), drinking water (1.1%), toilet facility (8.9%), wall material (7.0%) and and floor material (1.3%), respectively. Regarding dimensions, the percentage contributions show a similar trend as those of the respective indicators, with cooking fuel being the most significant contributor at 26.7 per cent and the least is drinking water at 1.1 per cent.

Table 5: Contribution of indicators to Multidimensional Housing Deprivation Index

Per cent contribution of indices to overall index	
Headcount (H)	0.407
Intensity ratio (A)	0.480
Household share	0.195
Decomposition by indicator (MHDI)	
Clean cooking fuel	0.267
Lighting source	0.054
Drinking water	0.011
Toilet facility	0.089
Hand washing facility	0.122
Garbage collection	0.187
Roof material	0.000
Floor material	0.013
Wall material	0.070
Internet	0.188
Total	1.000
Decomposition by dimension (MHDI)	
Cooking	0.267
Lighting	0.054
Water	0.011
Sanitation	0.210
Waste management	0.187
House composition	0.083
Information communication Technology	0.188
Total	1.000

Source: Authors' computation

7.4 Decomposition of multidimensional housing deprivation index by sub-groups

Further, this study decomposes the MHDI by sub-group characteristics, including poverty status, monthly rent paid, and house ownership status.

a) Poor and non-poor

The results show substantial differences in the incidence and intensity of MHDI by the household's poverty status (Table 6).

The MHDI was higher for the poor (43.4%) than the non-poor (16.7%). For the incidence of deprivation, 84.2 per cent of the households that were multidimensionally deprived were poor, while 35.5 per cent were non-poor. The highest proportion of multidimensionally deprived households are poor (89.5%), and non-poor stood at 10.5 per cent. The proportional contributions of the poor and non-poor to the MHDI were computed by dividing each sub-group's weighted indices by the MHDI, with weights given by the related population share. The results indicate that 76.6 per cent of MHDI is attributable to non-poor households and 23.4 per cent by poor households. Similarly, non-poor contribute higher (78.2%) to incidence of housing deprivation while 21.8 per cent emanates from poor households.

The proportional contributions of indicators within the poor sub-group is higher for clean cooking fuel (26.6%), handwashing facility (11.3%), garbage collection (18.5%), and Internet access (18.5%). For the non-poor category, clean cooking fuel (26.7%), Internet (18.9%), handwashing facility (12.5%), garbage collection (18.7%) contributes more than 10 per cent to overall multidimensional housing deprivation. Poor households contribute more to deprivation in most of the indicators, including lighting source, drinking water, toilet facility, garbage collection, and floor material. Non-poor households contribute more across various indicators, including cooking fuel, Internet, handwashing facility, and garbage collection.

Table 6: Decomposition of Multidimensional Housing Deprivation Index among the poor and non-poor

	Poor	Non-poor	Overall
Absolute value in each subgroup			
Headcount (H)	0.842	0.355	0.407
MHDI	0.434	0.167	0.195
Household share	0.105	0.895	1.000
Proportional contributions of each sub-group of the households to MHDI			
Headcount (H)	0.218	0.782	1.000
MHDI	0.234	0.766	1.000
Decomposition of MHDI by indicator			

Cooking fuel	0.266	0.267	0.267
Lighting source	0.058	0.053	0.054
Drinking water	0.017	0.009	0.011
Toilet facility	0.087	0.089	0.089
Hand washing facility	0.113	0.125	0.122
Garbage collection	0.185	0.187	0.187
Roof material	0.000	0.000	0.000
Floor material	0.019	0.011	0.013
Wall material	0.071	0.07	0.07
Internet	0.185	0.189	0.188
Total	1.000	1.000	1.000
Decomposition by dimension (MHDI)			
Cooking	0.266	0.267	0.267
Lighting	0.058	0.053	0.054
Water	0.017	0.009	0.011
Sanitation	0.199	0.214	0.21
Waste management	0.185	0.187	0.187
House composition	0.09	0.081	0.083
Information communication Technology	0.185	0.189	0.188
Total	1.000	1.000	1.000

Source: Authors' computation

Further, the MHDI methodology allows statistical tests on the estimates with standard post estimation commands. To test for statistical differences of M0 and H between the sub-groups, the analysis applied postbymain option. The intensity of multidimensional housing deprivation shows a significant difference (0.000) between poor and non-poor households and the overall multidimensional index (Prob > chi^2 = 0.0000) (Table 7).

Table 7: Postestimation significance differences by poverty status

	Indices			
	Headcount	MHDI	Headcount	MHDI
	Poor_nonpoor_0	Poor_ nonpoor_1	Poor_ nonpoor_0	Poor_ nonpoor_1
yi	0.842	0.355	0.434	0.167

(1) [H] Poor_nonpoor_0 - [H] Poor_nonpoor _1 = 0

chi^2(1) = 219.17

Prob > chi^2 = 0.0000

test [Mo]_b[Poor_nonpoor _0] = [Mo]_b[Poor_nonpoor _1]

(1) [Mo] Poor_nonpoor _0 - [Mo] Poor_nonpoor _1 = 0

chi^2(1) = 248.26

Prob > chi^2 = 0.0000

Summary

The results indicate that that the composition of MHDI across the poor and non-poor is quite distinct across sub-groups. The same set of indicators contribute to housing deprivation among the poor and non-poor. However, the contribution of various indicators shows distinctive differences within and across the sub-groups. From the preceding, the highest contributor to MHDI across the sub-groups stems from clean cooking fuel and differs minimally among the poor (27.3%) and non-poor (27.1%) households. The contribution of lighting source, drinking water, toilet facility, garbage collection, and floor material is relatively higher among the poor compared to non-poor households. Therefore, a significant proportion (incidence) of poor households is multidimensional housing deprived compared to non-poor households.

b) Average monthly rental income

Decomposition of MHDI by monthly rent paid by households for households that pay rent is key in understanding whether housing quality and access to basic amenities are linked to the rent paid. The results indicate distinctive differences in the composition of MHDI among the higher and lower rent brackets.

The MHDI is larger (0.221) for ≤ Ksh 10,000 rent category compared to 0.7 for the >Ksh 10,000 rent category. Further, on the housing deprivation headcount, which refers to the incidence of deprivation, 46.3 per cent of households that were multidimensionally deprived were in the ≤ Ksh 10,000 rent category while 1.5 per cent were in the >Ksh 10,000 category. This implies that the incidence of multidimensional housing deprivation is higher among households in the lower rental bracket. Also, the proportion of multidimensionally deprived households is

quite distinct with 86.6 per cent among the ≤ Ksh 10,000 rent category and 89.5 per cent for the >Ksh 10,000 category (Table 8).

The proportional contributions of each sub-group of the households to the overall index were computed by dividing each sub-group's weighted indices by the overall index, with weights given by the related population share. The results indicate that 99.5 per cent of MHDI is attributable to ≤ Ksh 10,000 rent category households and 0.5 per cent for >Ksh 10,000 rent category. Similarly, 99.5 per cent of ≤ Ksh 10,000 rent category households contribute to the incidence of deprivation, and 0.5 per cent emanates from >Ksh 10,000 rent category households.

The proportional contributions of indicators within the sub-groups indicate that cooking fuel (26.7%), handwashing facility (12.2%), garbage collection (18.2%), Internet access (19.2%) contribute more to housing deprivation for ≤ Ksh 10,000 rent category households. For the >Ksh 10,000 rent category, clean cooking fuel (30.0%), handwashing facility (15.0%), garbage collection (30.0%), toilet facility (15.0%) contributes more than 10 per cent to overall multidimensional housing deprivation.

The results across the sub-groups indicate that >Ksh 10,000 rent category households contribute more to deprivation across most of the indicators, including cooking fuel, toilet facility, handwashing facility, garbage collection, and wall material. Households in the ≤ Ksh 10,000 rent category contributed higher in lighting, drinking water, floor material, and Internet.

Table 8: Decomposition of Multidimensional Housing Deprivation Index by monthly rent paid by households

	≤ Ksh 10,000	>Ksh 10,000	All
Absolute value of the indices in each subgroup			
Head count (H)	0.463	0.015	0.403
MHDI	0.221	0.007	0.192
Household share	0.866	0.134	1.000
Proportional contributions of each subgroup of the population to the overall index.			
Headcount (H)	0.995	0.005	1.000
M0	0.995	0.005	1.000
Decomposition by indicator (MO)			
Clean cooking fuel	0.267	0.300	0.267
Lighting source	0.054	0.000	0.054
Drinking water	0.012	0.000	0.012
Toilet facility	0.087	0.150	0.087
Hand washing facility	0.122	0.150	0.122

Garbage collection	0.182	0.300	0.183
Roof material	0.000	0.000	0.000
Floor material	0.012	0.000	0.012
Wall material	0.072	0.100	0.072
Internet	0.192	0.000	0.191
Total	1.0000	1.000	1.000
Decomposition by dimension (MO)			
Cooking	0.267	0.300	0.267
Lighting	0.054	0.000	0.054
Water	0.012	0.000	0.012
Sanitation	0.209	0.300	0.209
Waste management	0.182	0.300	0.183
House composition	0.084	0.100	0.084
Information communication Technology	0.192	0.000	0.191
Total	1.0000	1.000	1.000

Note: Adjusted Multidimensional Headcount M0 = H*A

Source: Authors' computation

Further, post-estimation for statistical differences of the main indices shows a significant difference (Prob > chi^2 = 0.0000) in the intensity of multidimensional housing deprivation, between ≤ Ksh 10,000 rent category and >Ksh 10,000 rent category households. However, the overall multidimensional index does not significantly differ (the Prob > chi^2 =0.3173) between the two categories (Table 9).

Table 9: Postestimation significance differences by ownership status

e(b)[1,4]				
	Headcount	MHDI	Headcount	MHDI
	Rentpaid_0	Rentpaid _1	Rentpaid _0	Rentpaid _1
yi	0.463	0.154	0.221	0.007

test [H]_b[Newrent$_{21}$] = [H]$_b$[Newrent$_{22}$]

(1) [H] Rentpaid $_{21}$ - [H]N Rentpaid $_{22}$ = 0

chi^2(1) = 332.05

Prob > chi² = 0.0000

test [Mo]_b[Rentpaid _2_1]= [Mo]_b[Rentpaid _2_2]

(1) [Mo] Rentpaid _2_1 - [Mo] Rentpaid _2_2 = 0

chi²(1) = 1.00

Prob > chi² = 0.3173

Summary

The contribution of subgroups to MHDI differs across the indicators, and dimensions vary among groups. More than half of the indicators contributing more to MHDI emanates from households in the higher rental brackets. Higher contribution of clean cooking fuel, garbage collection, hand washing facility, wall material, and toilet facility to MHDI stems from households in the higher rent brackets. Therefore, the amount of rent paid does not translate to access to basic infrastructure or adequacy of housing. Therefore, households paying higher and lower rent are equally affected by multidimensional housing deprivation. Notably, the incidence of deprivation is higher among the higher renters and statistically significant. Therefore, there is a need to focus on improving access to basic infrastructure in both areas with both high and low renters in reducing the multidimensional housing deprivation in Nairobi City County. Also, rental housing should follow the planning requirements provided in the Physical and Land Use Planning Act, 2019.

(c) Ownership status

From the housing ownership perspective, the multidimensional housing deprivation index was higher for the households not paying rent at 0.243 than owner-occupier 0.202 and renters at 0.192. Further, 89.5 per cent of households that pay rent were multidimensionally deprived, 5.5 per cent own the housing units, and 5.0 per cent do not pay rent with the owner's consent. Notably, the incidence of deprivation is high among the households not paying rent at 51.9 per cent, compared to renters (40.3%) and owner-occupier at 36.7 per cent (Table 10).

The proportional contributions of each household sub-group to the overall index indicate that housing renting contributes highest to housing deprivation incidence (H) at 88.6 per cent and to Multidimensional Housing Deprivation Index (Mo) at 88.8 per cent. Households not paying rent stood at 6.4 per cent and 6.2 per cent for H and (Mo), respectively. The owner-occupier sub-group is a less significant contributor with an incidence of 0.50 per cent and Mo of 0.57 per cent.

The proportional contributions of indicators within the sub-groups vary within and among the sub-groups. Households paying rent indicate a higher contribution in drinking water (1.2%), wall material (7.2%), and Internet (19.1%). Households not paying the rent with consent from the owner contribute higher in cooking fuel (28.3%), toilet facility (10.9%), and floor material (2.9%). The owner-occupier contributes more in lighting at 7.1 per cent and waste management at 23.5 per

cent. Overall, clean cooking, handwashing facility, garbage collection, and Internet contribute to more than 10 per cent of Mo within and among the housing ownership categories.

Table 10: Decomposition of Multidimensional Housing Deprivation Index by housing ownership status

	Owner-occupier	Pay rent	No rent paid	All
Proportion of multidimensional housing deprivation*				
Absolute value of the indices in each subgroup				
Headcount (H)	0.367	0.403	0.519	0.407
MHDI	0.202	0.192	0.243	0.195
Household share	0.055	0.895	0.050	1.000
Proportional contributions of each subgroup of the population to the overall index.				
Head count (H)	0.050	0.886	0.064	1.000
Mo	0.057	0.880	0.062	1.000
Decomposition by indicator (MO)				
Clean cooking fuel	0.235	0.267	0.283	0.267
Lighting source	0.071	0.054	0.043	0.054
Drinking water	0.000	0.012	0.000	0.011
Toilet facility	0.094	0.087	0.109	0.089
Hand washing facility	0.106	0.122	0.130	0.122
Garbage collection	0.235	0.183	0.196	0.187
Roof material	0.000	0.000	0.000	0.000
Floor material	0.016	0.012	0.029	0.013
Wall material	0.055	0.072	0.058	0.070
Internet	0.188	0.191	0.152	0.188
Total	1.000	1.000	1.000	1.000
Decomposition by dimension (MO)				
Cooking	0.235	0.267	0.283	0.267
Lighting	0.071	0.054	0.043	0.054
Water	0.000	0.012	0.000	0.011

Sanitation	0.200	0.209	0.239	0.210
Waste management	0.235	0.183	0.196	0.187
House composition	0.071	0.084	0.087	0.083
Information communication Technology	0.188	0.191	0.152	0.188
Total	1.000	1.000	1.000	1.000

Source: Author's computation

Further, results show a significant difference (p=0.0007) in the intensity of multidimensional housing deprivation (p=0.0001) between the three housing ownership categories (Table 11).

Table 11: Post-estimation significance differences by ownership status

e(b)[1,4]						
	Headcount	MHDI	Headcount	MHDI	Headcount	MHDI
	Ownership_1	Ownership_1	Ownership_2	Ownership_2	Ownership_3	Ownership_3
yi	0.367	0.403	0.519	0.202	0.192	0.243

2. test $[H]_b[io2_1] = [H]_b[io2_2] = [H]_b[io2_3]$

(1) $[H]io2_1 - [H]io2_2 = 0$

(2) $[H]io2_1 - [H]io2_3 = 0$

$chi^2(2) = 14.53$

$Prob > chi^2 = 0.0007$

3. test [Mo]_b[io2_1] = [Mo]_b[io2_2]=[Mo]_b[io2_3]

(1) [Mo]io2_1 - [Mo]io2_2 = 0

(2) [Mo]io2_1 - [Mo]io2_3 = 0

$chi^2(2) = 18.39$

$Prob > chi^2 = 0.0001$

Summary

The contribution of various indicators to MHDI differs across different housing ownership categories. The contribution of households renting to the multidimensional housing deprivation is higher than owner-occupier and paying the rent with the consent of owner households. The proportional contributions of households renting contribute highest to housing deprivation incidence (H), and Multidimensional Housing Deprivation Index (Mo) compared to owner-occupier and those not paying rent. The highest contribution of drinking water (wall material and Internet to deprivation emanate from households renting). Households not paying the rent with consent from the owner contribute higher in cooking fuel toilet facility and floor material. In contrast, the owner-occupier contributes more to lighting and waste management. The differences in the contribution of indicators and dimensions to MDHI reflect the inequality and disparities in access to basic amenities and housing conditions in relation to the ownership of the dwelling units. Further, the results indicate a statistically significant difference for the Intensity (I) and MHDI between the three housing ownership categories. Therefore, the focus should be on improving access across all the housing tenure categories, which is critical in reducing multidimensional housing deprivation in Nairobi County.

From the preceding, 4 out of 10 households were multidimensionally deprived of housing in Nairobi City County, and on average, multidimensionally deprived households were deprived in at least 4 of the weighted indicators. Further, 19.5 per cent of multidimensionally deprived households face deprivation in 3 (cut off

33.3%) or more of weighted indicators. The indicators contributing the most to MHDI include cooking fuel at 26.7 per cent, followed Internet access (20.4%); garbage collection (18.8%), and handwashing facility (12.2%). In turn, the indicators that contributed the least (less than 10%) to MHDI include lighting source (5.4%), drinking water (1.1%), toilet facility (8.9%) and wall material and floor material contributing 7.0 per cent and 1.3 per cent, respectively. The highest contributor to MHDI across poverty status sub-groups stems from clean cooking fuel with a minimal difference the poor (27.3%) and non-poor (27.1%) households. Further, more than half of the indicators contributing more to MHDI emanates from households in higher rental brackets. Therefore, households paying higher and lower rent experience multidimensional housing deprivation. In addition, the incidence of deprivation is higher among the higher renters and statistically significant. Therefore, there is need to improve access to basic infrastructure in high-end and low-end residential areas. Further, the results indicate a statistically significant difference for the Intensity (I) and MHDI between the three housing ownership categories. Therefore, the focus should be on improving access across all the housing tenure categories, which is critical in reducing multidimensional housing deprivation in Nairobi County.

8. Conclusion and Policy Recommendations

8.1 Conclusion

This study highlights disparities deprivations in access to basic amenities and housing conditions and probes into the multidimensional deprivation index, disaggregated across various sub-groups.

8.1.1 Status of housing and access to basic infrastructure

Rental housing characterizes the housing market in Nairobi City County as homeownership lags. The low incidence of owner-occupied housing units is attributable to the low purchasing power as more than half (61%) of the household's income is below Ksh 20,000 while homeownership targets high-end market segment. Besides, majority (87.8%) of tenants pay rent of Ksh 5,000 and below with the mainly provided by individual investors who mostly follow the informal channels of housing delivery system of the housing stock, mainly characterized by poor-quality housing, poorly serviced infrastructure networks, and public services.

8.1.2 Inter-county disparities in access to basic infrastructure

Distinctive disparities show in access to basic infrastructure and housing conditions across sub-counties in Nairobi County. The primary energy source for lighting is electricity, with more than 94 per cent of households across counties using grid electricity.

Nairobi County ranks among the best performing counties to access clean cooking fuel in Kenya. However, pockets of energy poverty are evident across sub-counties. The use of LPG clean cooking sources is dominant in Embakasi, Langata, Kasarani Westlands, Njiru and Dagoretti sub-counties that record access level above the county level, with Kibra, Mathare and Makadara sub-counties falling below the average access. Notably, penetration of electricity, biogas, and solar as clean and modern sources of energy is relatively low across all the sub-counties.

Safe and improved water sources are accessed by most households in Nairobi County. For instance, a piped water connection network is accessible to a higher population in Kasarani, Starehe, Kamukunji, and Langata. Notably, sub-counties with a dominant population in slums and informal settlements, including Kibra, Mathare, Makadara, and Dagoretti, mainly rely on public water stands and water vendors, showing that the residents are adversely affected by water scarcity from the providers. Lack and irregular supply of piped water is instigated by the poor planning and dilapidated piping system infrastructure.

Access to basic improved and safely managed sanitation is also critical to the health and well-being of individuals and communities. Overall, 72.4 per cent of the population are non-deprived. In comparison, 27.6 per cent are deprived of safely managed sanitation, with more than half of the deprived households situated

in Kibra sub-county. Despite a significant proportion having access to basic sanitation, the majority still use unsafe and unimproved sanitation. Disparities show across the counties such as Kasarani (88.1%), Embakasi (86.0%), Makadara (84.5%), and Westlands (82.9%), with a high proportion of the population having access to organized solid waste collection modalities. Kibra records the highest deprivation across all the sub-counties, with more than half (57.5%) of the population having no access to organized solid waste collection modalities. Most of the households in Kibra dump solid waste in the streets and waterways.

Most of the households have durable roofing/floor material. This is spread across the sub-counties with a minimal proportion relying on rudimentary roofing materials such as tin cans and cartons. On the contrary, the deprivation of wall material is comparatively higher in Kibra (63.4%), Makadara (51%), and Dagoretti (57. 1%).

Internet access is also considered a basic critical amenity for households' welfare. The population above 3 years using the Internet stood at 52.4 per cent, with disparities showing across the sub-counties. Regions with a higher proportion of low-income earners such as Mathare, Kibra, Kamukunji, Dagoretti, and Njiru have less than half of the specified population with no access to Internet.

Further, about 28 per cent of the population above three years use desktops/ computers/tablets. The highest proportion of the specified population in Mathare, Kamukunji, Kibra, Dagoretti, and Njiru show a lower use level. This implies that the penetration of ICT devices is still low, even in an urban setups.

Most of housing developments across the sub-counties do not comply with current planning and building regulations, with most of informal settlements characterized by unimproved drinking water, unimproved sanitation facilities, and indecent housing.

8.1.3 Multidimensional housing deprivation index

Multidimensional Housing Deprivation Index is a product of the incidence of deprivation (percentage of deprived) and intensity of deprivation (average deprivation share of the households that are deprived in housing). The MHDI for Nairobi County stood at 0.195, which means multidimensionally deprived households in Nairobi City County experience 19.5 per cent of the total deprivations. Further, the incidence of MHDI, indicates that 40.7 per cent of the households were multidimensionally deprived, suggesting that 4 out of 10 households are deprived of housing in Nairobi City County. Further, the intensity of multidimensional housing stood at 48.0 per cent, indicating that almost half of the population is deprived of more than four of the weighted indicators.

The highest contributors of the Multidimensional Housing Deprivation Index were cooking fuel (26.7%), Internet (18.8%), garbage collection (18.7%), and handwashing facility (12.2%). This highlights the improvements these indicators would bring on overall improvement to the MHDI. In turn, the indicators that contribute the least to MHDI include lighting source (5.4%), drinking water

(1.1%), toilet facility (8.9%) and wall material and floor material contributing 7.0 per cent and 1.3 per cent, respectively.

8.1.4 Decomposition of the multidimensional housing deprivation index

Decomposition of the Multidimensional Housing Deprivation Index by poverty indicates that deprivation (0.434) among the poor is higher than the overall MPI reported at 0.195 while the non-poor MPI stands at 0.167. Regarding the contribution of each indicator for the poor and non-poor differences in composition of housing deprivation was revealed. The largest contributor for the poor sub-group stems from clean cooking fuel (26.6%), hand washing facility (11.3%), garbage collection (18.5%), and access to Internet (18.5%). Further, the results show a significant difference in Intensity (A) and MHDI and between poor and non-poor households. Notably, even non-poor households are deprived of various components of housing.

Distinctive differences show in the composition of MHDI among the higher and lower rent brackets. The MHDI is larger (0.221) for ≤ Ksh 10,000 rent category compared to 0.7 for the >Ksh 10,000 rent category. This indicates multidimensional housing deprivation is higher among households in the lower rental bracket. The contribution of each indicator across the rent categories indicates that the largest contributor for Ksh ≤10,000 rent category was cooking fuel (26.7%), hand washing facility (12.2%), garbage collection (18.2%), Internet access (19.2%). Further MHDI for >Ksh 10,000 rent category is primarily influenced by cooking fuel (30.0%), handwashing facility (15.0%), garbage collection (30.0%), toilet facility (15.0%). Notably, MHDI is not significantly different across the rent categories. Therefore, indicative households paying higher and lower rent are equally affected by multidimensional housing deprivation.

The MHDI is higher for households not paying the rent with consent from the owner at (0.243) than the owner-occupier (0.202) and renters at 0.192. Further, the Incidence (I) of deprivation is high among households not paying rent at 51.9 per cent compared to renters (40.3%) and owner-occupier (36.7%). The MHDI for the category of households not renting category is influenced mainly by cooking fuel (28.3%), toilet facility (10.9%), handwashing facility (13.0%), garbage collection (19.6%), and Internet access (15.2%). The sub-groups contribution across indicators shows that households that were renting contribute more to drinking water, wall material, and Internet while owner-occupier contribute the highest in garbage collection. Further, results indicate a statistically significant difference in the intensity of multidimensional housing deprivation across the three housing ownership categories. The differences in the contribution of indicators and dimensions to MDHI reflect the inequalities and disparities in access to basic amenities and housing conditions in relation to the ownership of the dwelling units.

8.2 Policy Implications

With most households renting their dwelling units, there is need to ensure housing provides for specific emphasis on preferences for alternative dwelling types and tenure options and be based on factors influencing housing decisions and variation across socio-demographics of the population. This will act as a guide for the sector in initiating a demand-driven affordable housing plan for homeownership, affordable rental housing and other tenure modalities.

Majority of households earn less than Ksh 20,000; therefore, the affordable housing project implementation plan for Nairobi County should be keen on providing a higher proportion of affordable housing under the social housing plan as stipulated under the National Housing Development Fund Regulations, 2020.

Individual investors play a critical role in housing provision; however, the enforcement of the existing legal provision on physical planning, land use, and zoning regulations is vital in ensuring that all the investors comply with the set-out standards. Similarly, infrastructure expansion needs to follow the pace of urban growth, the formal process of plan-service-build occupy instead of occupy-build-service-plan.

Besides, there is need for a multisectoral approach to provide seamless, integrated planning in providing basic infrastructure, whereby County Integrated Development Plans incorporate the specific areas of intervention based on the level of deprivation.

Multidimensional Housing Deprivation Index reveals the sectors and the segments of households that require policy intervention and resource allocation to meet the needs of the deprived population. Cooking fuel, access to Internet, garbage collection, handwashing facility, toilet facility and wall material are key priority areas that require intervention. The large contribution of deprivation on access to modern and clean cooking fuels reflects the dominance of non-clean fuels as primary cooking fuels and the slow pace of LPG adoption and universal transition to clean cooking fuels. There is need to intensify the LPG promotion campaign and introduce a direct subsidy on LPG appliances such as cylinders and cookstoves targeting the energy poor households to facilitate their switch from traditional biomass fuels.

Measuring and monitoring the level of accessibility is central for an adequate provision of basic services and for exploring how the delivery of basic services in the most problematic regions may be improved. It is central that the housing sector has effective methods to assess the changes in accessibility attributable to a reform programme of basic services and the corresponding impact on equity of access to basic services.

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Appendices

Appendix 1: Definition of operational terms

Household: Refers to a person or a group of people living in the same compound (fenced or unfenced); answerable to the same head and sharing a common source of food and income as a single unit in the sense that they have common housekeeping arrangements (that is, share or are supported by a common budget).

Affordable housing: A house is considered reasonable if the household's expenditure on housing alone does not exceed 30% of the household's total net monthly income, adequate in terms of quality of construction and access to basic infrastructure.

Basic infrastructure: Refers to physical infrastructure utilized by households, including water, sanitation, sewerage, solid waste management, Internet, and clean cooking and lighting energy sources.

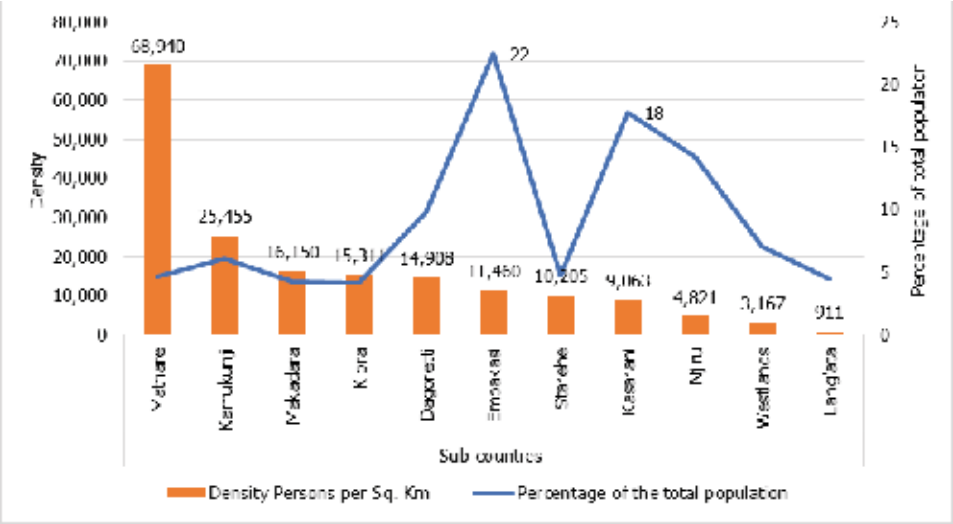
Adequate housing: Housing with adequate privacy and space, physical accessibility, adequate security, secured tenure, structural stability and durability, adequate services and infrastructure, suitable environmental quality, and health-related factors. Encompass adequacy of the physical structure (building), spaces within the building (spatial attributes), and services (e.g., water and power supply and sanitation).

Urbanization: Defined as the increase in the proportion of a population living in urban areas.

Dwelling Unit: This is a place from abode or residence occupied by a household. It is made of a structure that a household uses for sleeping, eating, entertaining guests, etc. A dwelling unit may be a whole structure or part of a structure, especially in an urban setting.

Basic Infrastructure: Refer to public/private service provision systems that meet human basic needs including drinking water, sanitation and hygiene, energy, mobility, waste collection, health care, education, and information.

Appendix 2: Percentage of total population and density



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