PERCEIVED FACTORS INFLUENCING DEVELOPMENT OF SUSTAINABLE HOUSING PROJECTS IN PERI-URBAN AREAS: THE CASE OF KAJIADO COUNTY, KENYA

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DECLARATION

This research study is my original work and has not been presented for any award in any University.

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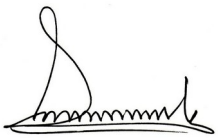
This research study has been submitted for examination with my approval as the University supervisor.

Signature:  Date: 16/8/2022

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DEDICATION

This research study is dedicated to my parents Charles Nyakinda and Janet Nyakinda, who taught me to value the gift of knowledge for its own sake. Their guidance and encouragement has been greatly appreciated.

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LIST OF ABBREVIATIONS AND ACRONYMS

ABTC - Appropriate Building Technology Centres

ABMT - Appropriate building materials and technology

AHP - Affordable housing programme

BNG - Breaking New Ground

CVI - Content Validity Index

GCMR - Greater Cairo metropolitan region

GOK - Government of Kenya

EMR - Extended metropolitan region

EPS - Expanded poly-styrene panels

HFCK - Housing Finance Company of Kenya

KMRC - Kenya Mortgage Refinance Company

ISSB - Interlocking stabilised soil blocks

KNBS - Kenya National Bureau of Statistics

NEMA - National Environmental Management Authority

NSP - National Spatial Plan

NBR - National Building Regulations

PUA - Peri-urban areas

SACCOS – Savings and credit cooperative societies

SDHUD – State department for housing and urban development

WCMA - Wildlife Conservation and Management Act

WCED - World Commission on Environment and Development

UN - United Nations

ABSTRACT

Access to adequate housing and reasonable sanitation is a basic human right enshrined in Kenya's constitution in the year 2010. The urban housing demand can be met in part by sustainable housing projects in the peri-urban zone. The study set out to ascertain the influence that certain factors had on the development sustainable housing projects in peri-urban areas in Kajiado North sub-county, Kenya. This study had four specific objectives which were: to establish the influence of economic factors on development of sustainable housing projects in peri-urban areas; to determine the influence of social factors on development of sustainable housing projects in peri-urban areas; to determine the influence of environmental factors on development of sustainable housing projects in peri-urban areas; to establish the influence of technical factors on development of sustainable housing projects in peri-urban areas.

The study was designed to assess the hypothesis that the perceived economic, social, environmental and technical factors; had a significant influence on the development sustainable housing projects in peri-urban areas in Kenya. Twenty indicators were derived from the conceptual and theoretical frameworks; these indicators were used to assess the influence that the independent variables had on sustainable housing projects. A descriptive cross-sectional survey was carried out in Kajiado North. The target population was constituted from the project beneficiaries, housing developers and professionals in the built-environment from the study area. A stratified sampling method was employed to pick a sample size of 155 study participants from the target population. During a field survey, data was collected using questionnaires containing a five point likert scale; it was then tabulated and coded.

The analysis of the study's results utilising both descriptive statistics and a multiple regression model, ascertained that the influence of economic factors on sustainable housing projects was the most significant; followed by the social, technical and environmental factors respectively. The study concluded that the perceived economic, social, environmental and technical factors induced a significant influence on the development of sustainable housing projects in peri-urban areas. The study recommended that sustainable development principles should be incorporated into the design, planning and execution of peri-urban housing projects. Finally, further research into the impact of green construction practices and the influence of Kenya's devolved governance system on the development of sustainable peri-urban housing was recommended.

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

Sustainable housing projects are a series of activities designed to provide human habitations that integrate the different functions that housing provides. The principles encompassing sustainable housing consist of more than just the physical dwelling space; they also encompass safeguarding of the surrounding environment and the socio-economic welfare of the projects beneficiaries. Sustainable housing projects therefore seek to harmonise the multiple dimensions of housing and are characterised by being economically feasible, socially admissible, technically applicable and environmentally tolerable. The definitions employed for the term 'peri-urban' are usually situation specific, other terms used interchangeably to represent the peri-urban region are: urban fringe, rural-urban interface, urban peripheries, extended metropolitan region and desakota region. Peri-urban areas are defined by Adrianna (2003), as the transitional zones commonly found between an urban centre and the encircling countryside which are neither strictly rural nor urban. The peri-urban zone in Kenya can be described as region of low density, non-continuous, unplanned urban expansion lacking municipal infrastructure and the associated social amenities. Ravetz, Fertner and Nielsen (2013), argue that while the term peri-urban cannot be simply defined, these zones can be identified by some common attributes such as: lacking spatial governance, lower density than urban areas, dispersed settlements, large commuting population and fragmented communities.

Urban populations in Africa have experienced rapid growth with access to better health care and increasing socio-economic opportunities, this has led to an unprecedented increase in the demand for land adjacent to the statutory boundaries of these cities. This demand has been met by converting semi-rural agricultural land bordering existing urban areas into both formal and informal settlements. A merging process then occurs with the existing settlements belonging to indigenous communities which distort the areas land

use patterns, property rights, socio-economic matrix and political integration (McGregor, Simon, and Thompson, 2006). Owusu-Ansah and O'Connor (2009) suggest that, housing demand largely driven by growing population, produces a noticeable effect on the process of peri-urban expansion which leads to the decentralisation of economic enteprises. Peri-urban housing is influenced both directly and indirectly by a variety of determinants which can be categorised into economic, social, environmental and technical factors. These factors often have conflicting short and long term priorities that are determined by multiple actors operating both within and without the peri-urban zone.

During the middle of the twentieth century, there was an era of economic prosperity, characterised by increased manufacturing output in the United States. Loan programs allowed many American citizens to purchase vehicles and single house dwellings. Concurrently national road-building projects and other transport infrastructural developments made it possible to have homes on relatively inexpensive sub-urban land that was previously considered to be inaccessible. The suburban homes could therefore allow more room per square metre for their residents than dwellings constructed within the traditional boundaries of the urban core (Torrens and Alberti, 2000). This dynamic served to spur more commercial and infrastructure development within the peri-urban regions eventually leading to scattered low density settlements.

The development of peri-urban zones in Australia is propelled by a variety of interrelated aspects: firstly is the general desire by the average citizen to own a family home on relatively inexpensive land; the other major contributing factor is the lobbying by land developers and speculators to have rural-zoned land rezoned for urban purposes, since the land acquisition and construction costs tend to be far greater within urban centres. The Australian building industry has also specialized in detached low density housing construction for the middle-income market. Government land development agencies in Australia have a tendency to be profit-driven; this profit is used in the provision of public services and to fund infrastructural development. Consequently these agencies actively encourage the development of green-field areas for residential, commercial and industrial purposes (Hiller, Melotte and Hiller, 2013).

In India, peri-urban development consists of urban outgrowths adjacent to urban centres known as census towns. While these towns form an integral part of the adjacent cities, they are however run by rural authorities who are not responsible for services such as solid waste management, street maintenance, water supply and sewer systems. India has two kinds of urban definition: an administrative criteria, i.e. all statutory towns and urban centres are considered as urban; the second criteria, referred to as census towns, is informed by economics and the demographical features of the area i.e. settlements with more than five thousand persons, and a density of four hundred and fifty people occupying a square kilometre and with three quarters of the adult male labour-pool not working in the agricultural sector (Shaw, 2005). India had three thousand eight hundred and ninety two census towns in the year 2011 with a population of fourteen per cent of India's total urban population (Aijaz, 2019).

The last four decades in Egypt has been characterised by a rapid urban expansion of the metropolitan region of Cairo, primarily in the urban periphery. These developments were mostly unplanned presenting a significant challenge to the urban environmental setting and leading to the loss of agriculturally productive land. The rate of urban expansion between 2001 and 2017, was approximately 461 hectares per year (Salem, 2015). The most significant driving factors for this rapid urbanisation of peri-urban areas were population growth and improved accessibility to areas further from the city. Most of the development was concentrated within a twenty kilometres radius from the city, generally being found adjacent to road and railway transportation systems (Salem, Tsurusaki, Divigalpitiya and Osman, 2018).

The process of peri-urbanisation in Asia-Pacific regions is defined by the accumulation of networks by several cities and their adjacent rural areas, commonly referred to as Extended Metropolitan Regions. This notably differs from the peri-urban area in the African context which usually describes one principal urban centre and the encompassing semirural zone. In the year 2019, the region's urban population comprised 54% of the global urban population with a density of between 10,000 to 20,000 people per square kilometre (Siddique and Pennanen-Rebeiro-Hargrave 2019). The term desakota (city-

village) referring to an Extended Metropolitan Region (EMR), was coined by McGee (1991) to describe the combination of industrial, agricultural and residential land uses that have emerged in rice growing areas surrounding Asia Pacific's globalising cities. The Asia Pacific's extended metropolitan regions consist of wide spanning urban agglomerations that reach across national borders forming integrated networks of infrastructure that serve to join the region's economies into the international trade systems (McGregor, Simon and Thompson, 2006).

In Nigeria, metropolitan Lagos is heavily built up with the most recent expansions located at the periphery of the city (Nwokoro & Dekolo, 2012). The accelerated growth of this zone is driven by complex interactions between social, economic and demographic factors; which either serve to push displaced persons into the area, or to attract immigration by offering economic opportunities and better living conditions for the new residents. The prime motivation for owner-occupied peri-urban households is the availability of cheaper land, while residents of leased premises are attracted by the lower rental prices; however both categories of residents are essentially trading of access to public infrastructure and social services by relocating further from the centre. Nigeria's peri-urban settlements can be categorised into three groups: government sponsored housing, private organisation housing projects and self-help housing schemes. Each of these categories varies in the types buildings erected, housing standards and construction methods employed. (Adedire, 2017)

The urbanization process in the interior of Kenya occurred almost entirely during the twentieth century. Previously the only urban centres to be found in Kenya were developed along the coastal region to serve as ports providing markets for Arab and Indian traders (KNBS, 2012). Prior to the colonisation of Kenya, the prevailing economic activities were agricultural and livestock herding, there was no socio-economic stimulus to spur the development of urban centres in the interior parts of Kenya (GoK, 2015). Since independence, Kenya has witnessed a rapid growth in urbanisation in which the spatial distribution of towns and built-up settlements is skewed with the concentration of these settlements in high potential agricultural areas served by road and rail transport

networks. In the year 2010, the annual urban housing demand was approximately 80,000 units, this was projected to increase to an annual demand of about 300,000 by the year 2050. Comparatively, in the year 2013 only fifteen thousand housing projects were approved in Nairobi (AHP, 2019). This shortfall has been met through proliferation of informal settlements on any unoccupied privately owned or public land. The physical expansion of towns in Kenya often consists of an indeterminate rural-urban fringe that is characterised by sprawling settlements and environmental degradation. The expansion of peri-urban developments are usually driven by economic opportunities, rather than strategic planning; these circumstances have shaped the characteristics of such settlements.

Kajiado County covers an area of approximately twenty one thousand square kilometres. Kajiado North sub-county borders Nairobi county to the south, it is divided into five administrative units known as wards. These wards are Olkeri, Ongata Rongai, Nkaimurunya, Oloolua and Ngong. The Cities and Urban Areas Act of Kenya (2011), has a number of requirements that a settlement must meet in order to be granted the legal stature of a town: it should have a minimum population of ten thousand inhabitants; demonstrable functional and financial viability; capacity to deliver essential services and adequate space for expansion (Kenya Law Reports, 2012). The two towns within Kajiado north are Ngong town and Ongata Rongai. Ngong town was developed as a district administration centre while Ongata Rongai town begun as a market centre and stone quarrying settlement but has since evolved into a low and middle income residential area due to infrastructural developments and its proximity to the Nairobi metropolitan area which has encouraged immigration into the area.

This research study is intended to provide a conceptual grounding and assist in mapping the frontiers of knowledge on challenges and approaches to sustainable peri-urban housing in developing countries. The boundaries between the factors that influence sustainable housing are somewhat fluid and the principles of each of these factors invariably incorporate issues which relate to, and have a direct influence on, the other

factors. Economic considerations inevitably outweigh all the other factors when peri-urban housing projects are being developed.

1.2 Statement of the problem

The problem this research study seeks to explore is the development of sustainable housing projects in the peri-urban area of Nairobi city comprising Kajiado North sub County of Kajiado County in Kenya. This study will concentrate on the economic, social, environmental and technical factors influencing the development of sustainable housing projects in the peri-urban zone.

Kenya's state department for housing and urban development estimates the annual housing demand as approximately 250,000 units, while the housing sector annually supplies 50,000 units (Giti, K'Akumu, Ondieki, 2019). Section 43(1) (b) of the Constitution of Kenya provides that every person has the right to "accessible and adequate housing and a reasonable standard of sanitation". In order to fulfil this requirement, housing projects are being developed in peri-urban settings to serve the rapidly expanding urban populations. These sustainable housing projects should ideally encompass the multiple dimensions of housing and offer a reasonable return on the investment while being affordable to the low income residents. These projects should be part of a planned settlement connected to supporting infrastructure with access to social amenities, educational and health facilities. In addition, the housing project would have a small environmental footprint while still conforming to the national building standards.

However, the housing projects developed in peri-urban areas in Kenya are mostly undertaken by private developers with minimal coordination by the regulating public agencies. Therefore their sustainability is dependent upon the knowledge and resources of the individual investors in these projects. Consequently, urban expansion into peri-urban areas often lacks coordinated planning, supporting infrastructure and the associated social amenities. This situation drives the production and expansion of informal settlements which are generally subjected to social and spatial segregation. While a variety of factors influence sustainable peri-urban housing projects, this study will assess the interplay

between the economic, social, environmental and technical factors. The boundaries between these factors are somewhat fluid and the principles of each of these factors invariably incorporate issues which relate to, and directly influence other factors.

1.3 Purpose of the study

This study has investigated the perceived factors influencing the development of sustainable housing projects in peri-urban areas in Kenya, the case of Kajiado North sub-county in Kajiado County.

1.4 Objectives of the study

The objectives that have been used to direct this research study are:

i To establish the influence of economic factors on development of sustainable housing projects in peri-urban areas in Kajiado North sub County.

ii To determine the influence of social factors on development of sustainable housing projects in peri-urban areas in Kajiado North sub County.

iii To determine the influence of environmental factors on development of sustainable housing projects in peri-urban areas in Kajiado North sub County

iv To establish the influence of technical factors on development of sustainable housing projects in peri-urban areas in Kajiado North sub County

1.5 Research Questions

This study sought to answer the following research questions:

i How do economic factors influence development of sustainable housing projects in peri-urban locations in Kajiado North sub County?

ii How do social factors influence the development of sustainable housing projects in peri-urban locations in Kajiado North sub County?

iii How do environmental factors influence the development of sustainable housing projects in peri-urban locations in Kajiado sub County?

iv How do technical factors influence the development of sustainable housing projects in peri-urban locations in Kajiado North sub County?

1.6 Significance of the study

Peri-urban zone in Kajiado North sub-county bordering Nairobi city is a dynamic zone in which rapid and widespread housing developments are observed. This study has attempted to map out the principles that should steer a peri-urban housing project that is expected to conform to some general guidelines so as to achieve sustainable development. This should potentially assist project planners when developing the specific goals and objectives that need to be met to ensure that their housing projects are considered sustainable.

Policy makers could use the study to inform design and planning in other urban centres within Kenya to reduce the detrimental effects on the society and the environment associated with unmanaged peri-urban housing developments. In Kenya, not much research has been done on the subjective experiences of peri-urban residents in the subject of sustainable housing. Therefore this research project has attempted to occupy this void by analysing the perceptions of various actors who have participated in peri-urban housing projects. This study has presented an empirical analysis of the economic, social, environmental and technical factors perceived to influence peri-urban housing projects in the periphery of Nairobi; this should offer useful insights to researchers conducting studies on sustainable housing solutions. There are a myriad of other factors that can be perceived to influence sustainable peri-urban housing development, thus offering a rich field for further research for academicians seeking solutions to the urban housing crisis in developing countries.

Kenya's national census of 2019 placed Nairobi's population at 4,397,073 and Kajiado's population at 1,117,840. This was a substantial increase from the 2009 census which had Nairobi's population at 3,138,369 and Kajiado's at 687,312. This rapid population expansion has caused demographic pressure directing migration towards the periphery of the built-up urban core. This study has attempted to illuminate the interaction between the various factors affecting housing development in these areas and will therefore be of assistance to investors, real estate developers, potential home owners and other residents seeking information on sustainable housing opportunities in the urban fringe.

1.7 Delimitations of the study

This research study was restricted to the statutory boundaries of Kajiado North Sub County of Kajiado County in Kenya. In Kajiado North the indigenous population has historically been nomadic in nature; therefore the effects of peri-urban housing development are more pronounced with the sudden influx of migrants into the area in the last two decades. The study investigated four independent variables namely: economic, social, environmental and technical factors; that were perceived to have an influence on sustainable housing projects. The study sampled: professionals in the built-environment, investors and the residents of medium-density, mixed use housing projects in the study area. This decision was influenced by the findings of the government of South Africa in its 2004 plan for the creation of sustainable human settlements (BNG), in which integrated residential developments comprising medium density mixed use housing facilities were acknowledged as the key contributor to sustainable housing. The study gathered data at a specific point in time using a cross-sectional descriptive research design.

1.8 Limitations of the study

The survey was carried out at a time when the republic of Kenya had imposed social restrictions due to a public health crisis resulting from a global pandemic caused by the COVID 19 virus. The researcher complied with the public health protocols developed by the ministry of health during the field survey to minimise the chances of exacerbating the health situation by endangering the study's participants. A number of the study's participants were hesitant when asked to divulge sensitive information particularly about housing issues. The researcher informed the participants of the study's objectives and research methodology; and clarified that the entire data collection process was designed to preserve their anonymity.

The design of the study was subject to resource and time constraints due to its academic nature. The study subsequently adopted a research design that enabled the researcher to conduct an objective empirical study with the resources available. Since the study was not able to analyse the changing perceptions of the respondents, a cross-sectional survey

design was employed to gather the views of the participants at a certain time. Thus findings of the study will have to be viewed in this light.

The study collected the subjective views of respondents during a field survey, the participants opinions were influenced by certain social and political upheavals. These included the electioneering period and the social restrictions necessitated by the public health measures in place due to the global pandemic. The study findings may therefore have some biases that could limit the generalisations of these results. The study attempted to mitigate this limitation by designing a logically structured questionnaire with: precise language; short statements; no leading questions; simple concepts and a section for multiple choice answers to reduce ambiguity.

Data analysis involved statistical analysis to certify if there was any correlation between the perceived influencing factors and sustainable housing projects; the statistical model however was not able to determine causation. Therefore the results of the study did not definitively provide a causal relationship between the perceived factors and sustainable peri-urban housing projects in peri-urban areas in Kenya.

1.9 Basic assumptions of the study

The study assumed that the peri-urban housing projects being developed in the study area were a direct consequence of the increasing urban population and lack of sufficient housing opportunities within Nairobi. The second assumption of the study was that there existed viable alternatives to the current policies, regulations and commonly accepted practices in housing sector that could be applied to improve sustainable peri-urban housing projects. The third assumption of the study was that the long term advantages of sustainable peri-urban housing outweighed the initial heavy capital costs of these projects. The last assumption was that the respondents being interviewed provided honest responses to the questions being asked, once they were assured of anonymity both during the data collection stage and also during the study's final publication.

1.10 Definitions of significant terms used in the study

Economic sustainability: Economically sustainable housing projects in this study was defined by the capacity of a housing project to produce enough revenue to sustain itself, repay its capital costs and produce an adequate surplus for its investors; while still being affordable by the low and middle income segments of the population.

Social sustainability: A socially sustainable housing project was defined in this study as: housing that has sufficient living area; provides the residents security of tenure; is served by mass public transportation systems while offering access to social amenities and green spaces.

Environmental sustainability: an environmentally sustainable housing project was defined in the study as: a project that maintains the local biodiversity by minimising the projects ecological impacts while provide healthy living conditions for the entire community.

Technical sustainability: a technically sustainable housing project in this study was defined as a project that conforms to industry standards, using innovative construction methods and the adaptation of emerging technologies to improve efficiency while minimising energy and water resource consumption.

Peri-urban areas: these are the intermediate zones located between the densely populated statutorily demarcated boundaries of urban centres and the surrounding sparsely populated rural areas.

Sustainable housing projects: are defined in this study as: housing projects that are economically feasible, socially admissible, technically applicable and environmentally tolerable.

1.11 Organisation of the study

This research project consists of five chapters: The first chapter provides a background to the study, outlines the statement of the problem, the research objectives and questions. The first chapter also presents the significance, delimitations, limitations, basic assumptions and provides the definitions of some significant terms that were used. The second chapter contains the literature reviewed and introduces the theme of development of sustainable housing projects in peri-urban areas in Kenya. Chapter two expounds on the economic, social, environmental and technical factors that are perceived to have an influence on development of sustainable housing projects in peri-urban areas in Kenya. The theoretical and conceptual frameworks; a summary of the literature and a brief review of the knowledge gaps that the study sought to address are presented in the second chapter. The third chapter contains the research methodology; it consists of the research design used by the study, the population framework, the size of the sampled population and the sampling procedure. In this chapter, the research instruments, the procedure used for data collection and the techniques that were applied to analyse the data are also exhibited. Chapter three has also addressed the ethical concerns that were raised during the study and the operationalisation of variables. The fourth chapter consists of data analysis and presentation of the results. The fifth chapter contains a summation of the findings, conclusions and recommendations of areas that may require further study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

In this chapter an overview of previous research on the topic under study is discussed. The thematic areas on which the literature being reviewed have been based are: the development of sustainable housing projects in peri-urban areas; economic factors and development of sustainable housing projects in peri-urban areas; social factors and development of sustainable housing projects in peri-urban areas; environmental factors and development of sustainable housing projects in peri-urban areas; technical factors and development of sustainable housing projects in peri-urban areas. The theoretical and conceptual frameworks are presented in this chapter. A summary of the literature reviewed and a brief review of the gaps in research that this study has attempted to cover are also presented.

2.2 Development of Sustainable Housing Projects in Peri-urban Areas

The primary goal of developing sustainable peri-urban housing projects is to provide adequate, affordable and safe dwellings that will enable the project beneficiaries improve their human capital and raise their standards of living by harnessing educational and income generating opportunities; such opportunities will also allow them a platform to engage in socio-political activities thus placing them in a better position to appreciate and care for their local environment. In the year 1962 about 7.8% of Kenya's population was residing in urban centres. Since then the urban population has rapidly expanded with the percentage of urban households reaching 38% of the total population (KNBS, 2018). The statutory boundaries of Nairobi have remained been the same since 1963 covering an area of 690 square kilometres, the boundaries were first adjusted in 1919 when the Nairobi township became the Nairobi Municipal Council and again in the year 1927 to cover an area of thirty square miles (Ngayu, 2015).

Peri-urban housing demand is a critical factor when determining a housing project's sustainability. The population density of a peri-urban area largely determines whether a housing project in the area can be sustainable. Density can be measured using three inter-

related components: firstly there is building density which is the number of dwellings in a specific location per unit area; secondly is occupancy density measured by the number of residents per dwelling unit; thirdly is population density which is a product of building and occupation densities, or the number of residents per unit area (Moloto, 2017). High densities put stress on the infrastructure and service provision facilities; while low density settlements increase the costs of providing service infrastructure and decrease social integration. Therefore finding the appropriate medium density that can be viably supported by a certain environment is a key issue for sustainable peri-urban housing projects.

Peri-urban housing developments in Kajiado North are situated in areas where land costs are considerably lower than what can be found within the boundaries of Nairobi city. These settlements are generally located along transportation corridors and service provision is expected to follow when the population increases. Housing here is mainly meant to serve a 'dormitory function' for the larger Nairobi metropolitan area and there is minimal provision for social amenities, public transport and other integrated community services. The periphery of any city offers the most logical solution to shelter an expanding urban population given the accessibility to vast undeveloped tracts of land in relative proximity to urban services and opportunities. This areas offer affordable options for middle-class residents relocating from densely populated areas in the urban core and also serve as entry points for rural migrants into urban areas. Makokha (2006) argues that residential settlements precede urban expansion; hence peri-urban housing settlements are the forerunners of urbanisation in the fringe zone.

Several institutions of higher learning have been established within Kajiado North and also in the neighbouring Karen area of Nairobi County. This invariably alters human settlement patterns, influencing the development of housing together with the associated services required to serve the growing communities in the neighbouring urban fringe. The Universities Act (2012) which guides university formation was not designed to cater for university towns consequently small unplanned urban centres have emerged from the neighbouring communities. This is because institutions of higher learning in Kenya tend

to fundamentally alter their physical and the socio-economic environments. Universities can be valuable economic contributors to an area, since they are generally permanent facilities they offer the surrounding community a steady market that is largely immune to business cycle fluctuations (Okong'o, 2014). Increased enrolment in primary schools in Kenya as a result of the Free Primary Education program and government subsidies for high school education has subsequently led to increasing enrolment in Institutions of Higher Learning. This situation has created opportunities for private developers to supplement the institutions housing needs by providing private facilities off campus in the adjacent settlements.

The rate of return on investment is a primary determinant of whether a peri-urban housing project is sustainable. A development can only be considered sustainable if resources can be replaced at a faster rate than they are being depleted. Thus the financial returns that investors receive when weighed against the project's inputs are a fundamental indicator of the housing project's feasibility. The return on investment in capital heavy new markets, such as peri-urban housing projects, suffers from a high degree of uncertainty and investors frequently require some form of guarantee to hedge against market fluctuations. The Government of Kenya has therefore established a national fund to mobilize housing capital and stabilise the housing market by guaranteeing developers certainty of sales thereby de-risking projects and encouraging private sector participation. This fund will also be used to provide financing for leased home purchases through a tenant purchase scheme (SDHUD, 2019).

Chapter four of Kenya's constitution affirms the right to reasonable, dignified and accessible housing. The State Department for Housing and Urban Development (2019), asserts that housing projects being developed in Kenya should ideally have land allocated for a wide range of uses such as: 50% for residential purposes; 25% for utilities, roads and associated services; 15% for open green spaces; 10% for community facilities with retail. The Government of Kenya adopted distribution policies from the 1960s that were aimed at controlling the growing population in major urban centres by encouraging rural

development and facilitating the growth of widely distributed small and medium sized urban centres (KNBS, 2012).

However, public housing initiatives in Kenya and other African countries are frequently marked by opaque decision making processes and fraudulent practices beginning with the land purchasing process, site surveying, award of construction tenders, supply of building materials and selection of the final beneficiaries of these projects. The focus tends to be on the quantity housing units provided. Moloto (2017) noted that the South African Reconstruction & Development Programme that was intended to provide housing in previously segregated areas had by the year 2010 put up over 3 million units, however nearly 610,000 needed to be rebuilt and twice that number required repairs. Furthermore, socio-political and economic concerns usually dominate the decision making process frequently marginalising sustainable development projects that require a longer maturation period; public officials tend prioritise short term projects that can be completed within the election cycle period.

Another key determinant of sustainable peri-urban housing projects is the preservation of biodiversity in the locality. This can be broadly categorised as the preservation of the natural flora and fauna; and also the indigenous communities' way of life. The preservation of wildlife habitats is a significant indicator of biodiversity conservation in an area. Peri-urban housing projects invariably encroach into areas previously covered by natural vegetation, these areas frequently contain wildlife habitats and therefore human-wildlife conflicts abound in these regions. The republic of Kenya has gazetted about 8% of its total land area for the preservation of wildlife habitats, this only accounts for a fraction of the wildlife population since more than 80% reside outside the protected areas (GoK, 2015). In order to preserve these habitats, local communities can be engaged in the joint administration of these areas and procedures for settling any grievances caused by human-wildlife encounters have been established (WCMA, 2016). To preserve the equilibrium between bio-diversity conservation and expansion of urban centres into the fringe areas; land use activities should be designed to conform to the land resources of an area.

Peri-urban indigenous communities in the developing world depend on land, animals and social networks to maintain their livelihoods. Therefore access to land for subsistence agriculture, adequate space to rear domestic animals and the ability to maintain bonds within their communities has a notable effect on the sustainable livelihoods of these communities. Lee-Smith, (2010) opines that peri-urban agriculture plays a pivotal part in providing food security and ensuring nutrition for the populations within urban centres in developing countries. The fragmentation of agricultural land for residential development reduces the viability of maintaining livelihoods via the production and sale of farm products in peri-urban settlements. Kombe (2005) asserts that even though peri-urban land is evolving from primarily agronomical to both commercial and residential uses, most of the land in the fringe area is still open enabling the continued existence of subsistence agriculture whose produce can be ferried to the city markets. Narain (2010) holds that the extension of urban settlements into previously productive agricultural areas frequently tends to disrupt the foundation of rural livelihoods. Where farmers and land owners are paid for the purchases of their properties, the landless (often tenants and land squatters) will be subsequently displaced and have to move further from urban areas onto less desirable land. An observable consequence of peri-urbanisation is the shift in employment with fewer people employed in food production and a larger workforce in transport, wholesale, retail, vending and food processing (Cohen and Garrett, 2009).

The durability of a housing project is a readily discernible indicator of sustainable housing projects. A description of sustainable housing design by UN Habitat (2012), states that it holds an extended view and takes into account the use of more sturdy components, resulting in less operating and maintenance expenditures. Durability is primarily determined by two aspects I.e the suitability of the site on which the dwelling is located and the permanency of structure. The structure's permanency depends on: the building material used for roofing, walling and the floor; and the project's compliance with building codes.

2.3 Economic Factors and Development of Sustainable Housing Projects in Peri-urban Areas

Economically sustainable housing projects generate enough revenue to maintain the operational costs and repay the capital expenditure incurred while producing adequate financial returns for the investors. The capital costs incurred when developing a housing project have a significant influence on the project's economic feasibility. Economic sustainability of any project development is principally determined by the initial expenses that are incurred before the project can be brought to an operable status. In a peri-urban housing project these costs are mainly the land acquisition and the construction costs. Traditionally in Kenya, housing was provided through the use of locally available human and material resources on communally held land that was allotted to individuals on the basis of familial relations. With the influence of colonisation on African nations, housing construction standards were adopted that dictated the materials to be used and the skill levels of the builders; the techniques required for housing construction were subsequently formalised and institutionalised (Kirimi 2007).

The process of purchasing land for housing in the peri-urban region is encumbered with lengthy and unclear procedures. Greene and Rojas (2008) argue that, the purchase price of land constitutes a significant percentage of the total housing development cost and that the viability of the project can be enhanced by gaining access to low cost land. The traditional land market theories have a pattern of continuous settlement with built up areas radiating out from the urban core efficiently using land while being serviced by public infrastructure (Ngayu, 2015). However in Kenya's peri-urban areas, speculators are frequently satisfied by purchasing land and leaving it unused for a period of time while its value appreciates (Mutua, 2013). Land speculation causes discontinuous development, which inevitably increases the costs of providing public infrastructure to these widely spaced settlements.

Material costs are subject to the laws of demand and supply, however they are also influenced by the timing, location, quantity, quality and purchaser's preferences (Alabi, 2017). A large proportion of the housing construction budget is taken up by material costs

making them an essential component when determining the affordability of projects under consideration (Windapo & Cattell, 2012). Adedeji (2012) estimates that 60% of a housing project's expenditure is consumed by building materials. The other factors that influence capital costs of peri-urban housing projects are: cost of finance; changes in legislation and policies; fluctuating fuel prices; inadequate service infrastructure; fluctuating labour costs; scarcity of skilled labour; transportation costs and supply chain inefficiencies. Cost overruns, unfortunately, are a common feature in almost all projects undertaken in the construction sector. This results in partially completed housing projects being a frequent occurrence in the outskirts of the urban core.

Government's housing policies are a critical factor in supporting economic sustainability of peri-urban housing projects. These policies manifest themselves in two ways: firstly the government can provide knowledge and material support to expand the public housing sector; or government can intervene through the reduction of bureaucratic procedures and streamlining of the building permit approvals process to stimulate private investment in the housing sector. The need to balance public and private investments while gauging the potential for growth with respect to ecological and economic interests is a significant component of the sustainable development process (Bashir, 2016). In Kenya, the National Housing Corporation is one of the public agencies authorised to carry out the government's housing programmes. The State Department for Housing and Urban Development is charged with a number of tasks to actualise sustainable housing these tasks include: acting as the key facilitator for provision of public land at a subsidised price; development or subsidisation of large infrastructural developments in specific areas; expediting the approvals process from government bodies and utility providers; ensuring the housing units are offered at an affordable price (SDHUD, 2019).

A study by Wamuyu (2017), to evaluate the procedures for building approval in Kenya, found that although various permits are a precondition for construction; high costs, delays in processing and piecemeal analysis of the plans submitted are some of the problems besieging the permit acquisition process. Kimani and Musungu (2010), opine that developers face serious challenges when trying to comply with the requirements for

construction because of the scattered nature of legislation and the multiplicity of statutes each being enforced by different institutions with overlapping jurisdictions. The primary institutions required to facilitate approval of residential development permits are: the county government, National Environmental Management Authority and National Construction Authority. Additionally, Kenya Power Company is required to grant approval for connection to the national electrical grid. In peri-urban areas where a borehole may be required for water supply of the housing project, a permit from the Water Resource Management Authority (WARMA) and an Environmental Impact Assessment approval from NEMA are required. The entire approvals process may take up to one year despite several reforms initiated by the government of Kenya.

Financing of housing developments is another indicator that is used to gauge economically sustainable peri-urban housing projects. Stake holders in the peri-urban housing sector often face serious financial constraints; this has promoted the practice of making decisions driven by initial-cost considerations while ignoring the long-term costs and life-cycle savings of sustainable housing solutions. Credit facilities from the mortgage industry in Kenya are almost exclusively available to those employed in the formal sector with a reliable monthly income. Housing accessibility and affordability are assessed by a variety of determinants which include: the purchase price; buyer's financial resources; loan and mortgages conditions primarily the relationship between the interest rate and the amount borrowed (Mwangi, 2009). Funding for the Kenyan housing market has largely been dominated by commercial banks and the Housing Finance Company of Kenya (HFCK). The Kenya Mortgage Refinance Company (KMRC) was incorporated in the year 2018 as a non-deposit taking financial institution with the single purpose of providing long-term funds to other financial institutions who would then serve as primary mortgage lenders to the general public (KMRC, 2020). This company was intended stabilise the financial industry so that the primary mortgage lenders would be able to extend their services to a wider segment of the population.

The availability of supporting infrastructure plays a decisive role in the economic sustainability of peri-urban housing projects. The lack of adequate infrastructure to

support sustainable peri-urban housing projects lays a heavy burden on investors venturing into these markets. When unplanned development occurs on the fringes of an area, it has both obvious and subtle impacts on other locations within the same area and also in adjacent localities (Njiru, 2016). This means that the infrastructure that was designed to serve small peri-urban settlements is suddenly forced to cope with a large influx of residents who expect to receive services equal to what is available in the city. A study by Adedire (2017), observed that residential segregation through exclusive gated housing developments inevitably causes unbalanced infrastructural developments leading to social segregation between the middle and low-income households. Absence of basic infrastructure such as electrical power grid connection, water and sewer systems increases the initial investment costs on developers and subsequently drives up the final purchase price of the housing projects. The cost of providing supporting infrastructure is therefore directly proportional to final purchase price of the developed housing units. A participatory approach in which local authorities deliberately involve the residents in determining the priority infrastructural services required by their communities will encourage the residents to take ownership of these initiatives and ensure the perpetual sustainability of these housing projects.

Affordability is a key factor in the determination of economically sustainable peri-urban housing projects. The underlying affordability principle of sustainable housing mandates that the housing finance proportion of a household total expenditure shouldn't compromise the fulfilment of other fundamental needs. Less than 10% of Sub-Saharan African households budgets can support a mortgage. These households are subjected to housing costs which are up to 55% higher than households in other regions relative to their per capita gross domestic product; and are therefore unable to set aside an adequate surplus for their other basic necessities (World Bank, 2017). The UN-Habitat (2016) World Cities Report estimates that almost one billion of the global population can only afford to shelter in informal settlements. A study by UN-HABITAT (2005) recognised two extraordinary results of the current urban housing situation, adequate housing that is often beyond the capacity of most residents and affordable shelter that is in short supply.

Housing prices are essentially a localized phenomenon therefore supply can be affected in the short term by the inertia of existing land planning schemes and the time taken by the planning and building phases. In Kenya, the average housing prices tripled from the year two thousand to two thousand and fifteen. During this period, the prices for one to three bedroom housing units rose from about two million to ten million Kenya shillings. Housing units with four to six bedrooms saw a price increase from about ten million to thirty one million Kenya shillings during this time period (Hassconsult, 2015).

A study by Njaramba, Gachanja and Mugendi (2018), on the sources of housing prices growth in Kenya, found that they included: the consumption expenditure per household, the cost of construction and the taxes on property. The households' incomes and levels of debt owed were found to have a temporary positive influence on prices; however supply did not exhibit a significant impact. Omtatah (2014) conducted a study on the determinants of housing demand in Nairobi using annual time series data for the period 1979 to 2009. This study found that the main factors influencing housing demand in Nairobi were: the income levels, the number of households and housing purchase prices.

2.4 Social Factors and Development of Sustainable Housing projects in Peri-urban Areas

The social sustainability of a housing project is demonstrated by its capacity to provide an acceptable "quality of life" for its occupants; which is a subjective experience but can be broadly categorised as the residents' ability to access: reliable transportation, communication networks, clean water, sanitation, affordable housing, income generating opportunities, social amenities and open spaces. Social sustainability is also influenced by the residents' ability to participate in decision making processes that affect their way of living. Socially sustainable housing is defined by UN Habitat,(2012) as "affordable, good-quality, inclusive, diverse (mixed-tenure and mixed-income), secure, healthy dwellings and communities, which are well-integrated into the wider socio-spatial systems, enabling residential environments in which all residents, irrespective of their wealth, origin or gender, can access basic public services and public spaces".

A sufficient living area is a fundamental determinant of socially sustainable peri-urban housing projects. It is primarily determined by the habitability of the housing structure. The dwelling should guarantee physical safety of the occupants; providing adequate protection against the weather, extreme temperature variations and any other threats to the residents well-being. In sub-Saharan Africa, residents of informal settlements construct their own dwellings from available resources resulting in poor quality houses in unhygienic environs lacking access to water fit for human consumption and adequate sanitation (Ganiyu, 2017). The expansion of informal peri-urban settlements to fill in the housing supply gap has created a number of potentially disastrous consequences such as: the spread of communicable diseases; social unrest and apathy among the residents of these communities. Diang'a (2011), observed that more than half of the informal settlements in Kenya were erected on state land by individuals who negotiated with the local authorities and proceeded to rent out these structures, these informal landlords were not obliged to keep up the premises or make provisions for the basic essential services. Sustainable peri-urban housing should not be constructed on or adjacent to a dangerous right of way such as: railway lines, highway reserves, airports or high voltage power lines. The dwelling should also not be sited close to a toxic waste site, or built on a flood plain or a steep incline.

Sustainable peri-urban housing developments should facilitate access to the building by persons living with disability, children and the elderly. Kenya's building regulations (NBR, 2015), specifies that this should include: ramps with hand rails which are not less than 1.5 metres wide at changes in level in the absence of an elevator. Corridors should be designed with a clear width of not less than 1.2 metres and water closet cubicles should have room for manoeuvrability a wheel chair when necessary. Kenya's building regulations define a dwelling unit as a structure with at least one habitable unit with provision for cooking and sanitation facilities. The minimum spatial area requirements for the occupants of habitable room are 3.5 m^2 per person. Each habitable room should be provided with at least one opening for natural light and ventilation (NBR, 2015).

Access to service provision amenities is a basic requirement of socially sustainable housing projects. Peri-urban domains have a strong interaction with the city and are usually characterised by similar: demographic distributions, physical attributes and occupations. However the peri-urban residents have limited access to urban service provision facilities and intermittent participation in urban planning and development (Njiru, 2016). A housing project is sustainable if it is located adjacent to income generating opportunities, medical facilities, markets, educational facilities and social amenities (Ramashamole, 2011). The distribution of education and healthcare facilities outside urban centres in Kenya has historically been uneven, however due to the devolution of governance peri-urban urban settlements have seen an appreciable increase in access to local provision of essential services. The process of urbanization in Kenya occurs either around a statutorily defined urban centre or linearly along a transport corridor such as a road (Mundia and Aniya, 2005). This results in haphazard development as individual private developers are not specifically motivated to provide social amenities such as green spaces, education and health facilities. This is because rational land owners, investors and housing developers will always seek to maximize their earnings by selecting those activities that present the highest potential for financial gain.

Integrated mixed use housing projects are a key contributor to sustainable peri-urban housing projects. This is due to the fact that human settlements do not only consist of residential houses, they are also meant to serve as income generating opportunities and allow the residents forums to participate in community decision making while simultaneously provide means for socio-cultural integration. The South African government, through its New Comprehensive Plan for the Creation of Sustainable Human Settlements (BNG), identified integrated residential development comprising of medium-density, mixed-use housing; as the core contributor of sustainable housing projects (Republic of South Africa, 2004). Mixed use housing developments in peri-urban settlements also promote infrastructural development and reduce the costs of providing supporting services. Housing projects that integrate both residential and commercial functions cater to a wider range of residents and provide adaptability for changing

patterns of utilisation by future occupants. Kupeka (2013), states that the sustainability of housing projects was greatly influenced by the stakeholders involvement in the identification, initiation, monitoring, evaluation and execution.

Access to mass public transportation systems are a key component of socially sustainable peri-urban housing. This is because the residents frequently need to access goods, services and income generating opportunities that are available in either urban or rural areas. Govender (2011) opines that mixed use housing concentrated around commercial settings with a connection to public transportation and allowances for pedestrian pathways are some of the necessary requirements for social housing settlements. Ramashamole (2011), states that some of the consequences of inefficient transport systems are reduced access to work opportunities and longer commuting times with higher costs.

The main challenges facing peri-urban mass transportation systems in Kenya are: poorly maintained infrastructure; missing linkages to settlements; absence of a transport policy for rural to urban connections and deficient terminal passenger facilities (GoK, 2015). The transport system from urban to peri-urban to rural areas in Kenya lacks the ability to accommodate the rapidly increasing volumes of traffic leading to the congestion of critical outlets. The breakdown of public service transportation in Kenya has led to the rise of market driven players in the transport sector resulting in fluctuating costs which has negative consequences on the movement of both people and goods by creating uncertainty in the sector. Non-motorised transport I.e. pedestrians, cyclists and handcarts are not adequately catered for in peri-urban infrastructural plans despite these being common means of transport for the residents. A possible solution would be to integrate land use and transportation plans so as to facilitate human settlement patterns that minimise the need for mass transit systems.

Guaranteeing security of tenure is a mandatory requirement when establishing social sustainability of a peri-urban housing project. The sustainability of livelihoods in the rural-urban interface zone is greatly dependent on the security of tenure which affects the legality of land use (McGregor *et al.,* 2006). Security of tenure guarantees legal

safeguards from involuntary evictions and persecution of the occupants from a house or a piece of land. Informal squatter settlements developed either on public or privately owned land are characterised by insecure tenure therefore the stakeholders do not engage in efforts to improve the housing facilities (Kupeka, 2013).

Property rights in rural areas in Africa can contrast substantially with the metropolitan areas, typically evolving from collectively held ancestral and community lands in rural areas to privately held tenure in regions closer to built-up settlements. Since land is a finite resource, the rights of ownership have to be limited by a governing body in order to promote sustainable usage. The National land policy of Kenya (2009) defines two primary forms of tenure on privately held properties these are: free hold tenure which confers unrestricted rights of use and disposal while still subject to the regulations of the supervisory authority; and leasehold tenure which confers limited rights for a defined period of time and is subject to the payment of land rent. The various tenure systems confer different rights of ownership on individuals, groups and other entities. The principal rights of ownership are the right to access and use land; the right to dispose of a piece of land in a legally acceptable manner; and the right to exclude others from accessing, using or disposing of the land (GoK, 2009).

The existence of parallel systems serving both the formal and informal markets is an acknowledged characteristic of the real estate industry in developing countries. The fact that the visible and administrative borders of metropolitan areas frequently do not concur with each other; with urban and peri-urban spheres falling under different regulatory authorities with varying capabilities and political alignments, only serves to exacerbate the situation (Simon, Nsiah-Gyabaah and McGregor, 2004). A socially sustainable peri-urban housing project should therefore have a variety of tenure options including leasing the property, tenant purchase facilities and the option to buy the housing unit directly from the developers.

Tenure insecurity whether customary or statutory undermines investor confidence and hinders development in the urban fringe. In the peri-urban area of Accra in Ghana, Mends (2006), carried out a study to ascertain the effects of urbanisation on customary land

tenure. The study found that the leading cause of ownership conflicts and boundary disputes among the residents was the failure of the local traditional authorities to oversee the changing traditional regulations that had been used by the local community to administer property rights. Temba (2015) emphasises that any interventions being applied to the real estate market should be focussed on bridging the gap between the formally established and unregulated markets by enabling lower-income households access the right market. The regulatory and administrative void in peri-urban areas facilitates economic liberalization, encouraging rapid changes in land use. The resulting ambiguity between various land tenure systems and property rights in these boundary zones has a tendency to marginalise the vulnerable members of these communities.

A study by Diang'a (2011) was conducted in Nairobi to investigate the concept of regularizing informal settlements for sustainable housing development for the urban poor. Using questionnaires, interviews, observations and discussions the study found that the critical determinants in the creation of sustainable housing developments are social, economic and physical systems; these systems were found to shape the nature, siting and attributes of these settlements. The opportunities available and the capabilities of the residents when faced with constraints spurred them to adjust to the prevailing systems. The economic constraints in these environments have resulted in the preponderance of leased housing units over proprietor occupied homes.

2.5 Environmental Factors and Development of Sustainable Housing projects in Peri-urban Areas

Natural ecosystems provide various services including: air filtration, regulating the micro-climate, noise absorption, waste water treatment, soil regeneration and prevention of soil erosion by managing surface water run-off. Environmentally sustainable housing development refers to well designed and managed residential projects which minimise consumption of energy, water, raw materials; while maximising the use of recycled materials and renewable resources. The relationship between housing and its surrounding

environment can be observed in three distinct categories: firstly the construction process requires the utilisation of natural resources; secondly the various domestic activities of the residents have ecological impacts on their surroundings; thirdly the activities of the inhabitants within these settlements may expose them to a variety of emerging environmental hazards (UN-Habitat, 2012).

The management of topographical changes of the peri-urban region is a key indicator of environmentally sustainable housing projects. Land use change in the environs of Nairobi is steered by various considerations such as: increasing population, economic opportunities, socio-cultural changes, institutional regulations, housing and land market failure (Thuo, 2013). The changes in topography are a discernible indicator of environmentally sustainable housing projects since the peri-urban landscape is visibly altered by: the housing facility itself, the infrastructural developments required to support the project and the activities undertaken to acquire raw materials required for construction. Natural stones are the preferred building blocks for construction projects in Kenya; the peri-urban area of Kajiado North sub-county has been a source of these stones for Nairobi city.

Ongata Rongai town, in particular, began in the 1950's as a stone quarrying settlement (Mwatu, 2013). The environmentally unsustainable quarrying processes have subsequently permanently altered the topographical landscape of parts of Ongata Rongai division of Kajiado North sub-county by creating large open pits that are hazardous to the neighbouring communities. The construction of peri-urban access roads is a significant driver in altering of the topographical state of an area because the levelling of the road bed raises depressed areas and reduces elevated segments within the defined pathway. Furthermore other supporting infrastructure such as piped water, sewer lines and electrical lines require significant alteration of the landscape so as to allow access to peri-urban housing projects.

The use of natural resources without degrading an ecosystem's carrying capacity is a defining characteristic of environmentally sustainable housing projects. The rural-urban interface forms an active semi-organic ecosystem, which acts as a source of natural resources to supply the expanding city, leading to a transformation of the region (Dutta,

2012). Housing projects are by nature a heavy consumption processes that targets the natural resources that are most readily accessible first, before venturing further afield. The three major natural resources consumed by the construction and operation of peri-urban housing projects are forest resources, sand and water. Forest ecosystems play a critical role in soil conservation, climate moderation, water supply and provisions of wide ranging habitats to support biodiversity. Peri-urban deforestation is a familiar feature of expanding metropolises worldwide. This is because timber products have traditionally been one of the primary raw materials for construction.

Domestic energy requirements account for a large proportion of forest resource consumption. In Kenya 70% of the energy demand is sourced from biomass with the vast majority of people using it for cooking and heating, the average household expenditure on bio-energy is about 30% of the total domestic budget making it an unsustainable source of energy (Kitheka, Ogutu, Oduor, Ingutia, Muga, Githiomi, 2019). This is a clear indicator that biomass remains the primary energy source for those in the lower economic scale in developing countries. In Kenya the most severe forms of environmental degradation are associated with a community's poverty levels, this is because the immediate survival needs of the people tends to conflict with the need to preserve their surrounding environment and maintain the integrity of the ecosystem. The adoption of technologies that improve the efficiency of devices that utilise biomass for domestic purposes can significantly minimise consumption levels and decrease the degree of deforestation (Kitheka *et al.,* 2019).

Sand is another natural resource that is heavily consumed by housing projects. Soil is a product of its primary source material, the climatic conditions, the passage of time and living organisms (Makokha, 2006). Since time is a deciding factor in its formation, the continuous large scale consumption of sand by housing projects is not environmentally sustainable. Bulk harvesting of sand causes widespread degradation of the environment. Peri-urban rivers have traditionally been the source of sand used in urban development projects. In Kenya, the national sand harvesting guidelines do not allow harvesting on river banks so as not to widen the rivers, harvesting is restricted to the river beds in a limited fashion that preserves an adequate quantity to ensure water retention. The

guidelines further require that sand harvesting on farms, lake and sea shores be done concurrently with the reclamation of formerly harvested sectors (NEMA, 2007).

The environmental sustainability of peri-urban housing projects is strongly influenced by the preservation of wetlands in these areas. Wetlands are defined by NEMA (2009) as permanently or seasonally flooded area. These areas include: riparian zones; coastal areas beneath marine water of no more than six metres at low tide, river banks; swamps; marsh and other areas of impeded drainage. Wetlands are essential to sustainable housing because they filter and store water that is required for domestic purposes. Wetlands are essential to their local environs because they offer services such as: control of floods, ground water recharge, nutrient retention, preventing coastal erosion and provision of marine wildlife habitats (GoK, 2015). Wetlands are a key water source for peri-urban housing projects which are rarely served by centralised piped water systems.

Unfortunately peri-urban wetlands are also threatened by the encroachment of urban developments and pollution. Urban development's result in compaction and surface sealing of peri-urban landscapes; compaction hinders water infiltration causing high saturation levels in surface soil rather instead of slow percolation into deeper levels (Makokha, 2006). This impacts underground water source recharge capacities while encouraging large scale surface run-offs causing soil erosion leading to sedimentation of water-ways. In Kenya the regulatory body, NEMA, attempts to mitigate the damage done to wetlands by the requiring that environmental impact assessments and environmental audits be undertaken for any activity expected to have adverse effects on any wetland. Furthermore the wetland regulations require owners, occupiers or land users adjacent to a wetland its degradation and maintain its ecological functions. In addition, the 'polluter pays' principle passes the cost of damage control, victim compensation and the cost of beneficial uses lost to the party convicted of polluting the environment (NEMA, 2009).

Peri-urban developments tend to clear the vegetative cover which further reduces water infiltration into the soil and leads to higher rates of surface evaporation. The accumulation of surface run-off in the peri-urban region is caused by rainfall that can no longer be absorbed by the land due to uncontrolled expansion (Roesner, Bledsoe and

Brashear, 2001). Flooding in peri-urban areas is also caused by various structures obstructing natural water-ways and drainage systems, which may result in overflows of latrines and other waste water disposal systems leading to contamination of water sources. Mitigating the effects of surface run-off requires the engagement of all involved parties in the construction of storm drains to direct the rain water into natural water-ways.

The management of solid waste is a key pillar of environmentally sustainable peri-urban housing projects. Most peri-urban settlements are devoid of solid waste-management facilities. These areas frequently lack waste dumping grounds, and where available they are not properly sited with insufficient capacity. Maleyo (2014) notes that the lack of solid waste disposal points in urban centres in Kajiado North results in the waste being dumped in storm water drainage channels along the roadsides; this leads to overflowing storm water which carries decomposing waste matter into residential areas causing disease outbreaks. The management of the waste produced by a community is a critical component when planning for sustainable settlements. NEMA (2006) defines environmentally sound management of waste as; "taking all pragmatic measures to ensure that waste is managed in a form that will safeguard human health and the environment from any resulting detrimental effects". In peri-urban areas, recycling of certain types of waste can reduce the overall transportation load while providing a source of income to local entrepreneurs. UN Habitat (2012) advices that waste should be pre-sorted so that kitchen, garden and any other biodegradable waste can be used for composting. As the newly devolved county government units in Kenya get better acquainted with their duties, it is expected that they will establish landfills and regulate waste collection in peri-urban settlements.

The management of liquid waste is a primary indicator of the environmental sustainability of a peri-urban housing project. The most optimal disposal system for a housing project would be through connection to a centralised sewerage disposal system. However most of the peri-urban housing in Kenya lacks access to municipal waste disposal systems. Sewer systems are usually located in urban areas which are characterized by insufficient coverage of these areas, the urban sewer systems in Kenya serve about 7.2% of the population. Due to inefficient operation and maintenance of these

systems, about 60% of the wastewater that drains into these network arrives at the treatment plants (GoK, 2015). The majority of Kenya's population relies on pit latrines, septic tanks and other self-maintained methods of waste disposal. A study by Abong'o, Onyatta and Hinga (2017) in Ongata Rongai, one of the major urban settlements in Kajiado north, found that boreholes in the area were affected by domestic septic tanks leaking inorganic constituent contaminants into the water sources.

A study by Okong'o (2014) on "accelerated urban development in Baraton in Nandi County due to the establishment of the University of Eastern Africa Baraton", found that there were significant land use changes in the area. Farming activities were gradually encroaching on riverine ecosystems and wetlands. The hilltops had been cleared of natural vegetation leading to soil erosion. The study also found that most of the residential houses within the centre lacked access to a centralised sewer connection. Water wells and pit latrines were located less than thirty metres apart within residential compounds increasing the risk of contamination of water sources. The solid waste management strategies in Baraton were found to be: county garbage collection; burning of garbage over open fires; disposing of waste in demarcated pits often adjacent to residential areas; dumping of waste on any unoccupied piece of land or by the roadside.

A research study by Makabeni, (2018) on "the environmental impacts of informal economic activities in a low cost housing development, a case study of Dunoon, Cape-town", found that the long term ecological impacts in low cost housing developments were as a result of informal economic activities that the occupants engaged in order to sustain their livelihoods. These activities resulted in clogged drainage systems, the infrastructural capacity of the sewage system was exceeded and there was disposal of solid waste in the local environment. The residents were uninterested in caring for their environment as it was assumed to be the local municipality's duty. The study recommended that the residents be involved in designing and planning these low-cost housing developments.

2.6 Technical Factors and Development of Sustainable Housing projects in Peri-urban Areas

The use of technology in this research study is defined as innovation in construction processes and the introduction of new materials, tools, techniques and energy sources to increase overall efficiency by the reduction of costs, time and labour required to complete housing development projects. The principal determining factor of the technical sustainability of a peri-urban housing project is the adherence to the building regulations as laid out by professionals in the built-environment and the relevant state regulatory agencies. In Kenya the National Building Regulations (NBR, 2015) is used by stakeholders in the building industry to guide the design, construction and maintenance of buildings. The Ministry of Transport, Infrastructure, Housing and Urban Development; sponsored the formation of these regulations to replace the previous set which were out-dated, scattered and uncoordinated. These regulations are enforced at a national level by the National Construction Authority (NCA) and at the local level by the various county physical planning departments.

A key concern of technically sustainable peri-urban housing projects is the selection of appropriate building materials that will be used during the construction process. To satisfy the sustainable housing demand, the developed housing units should be affordable; this will necessitate the use of sustainable building materials (Alabi, 2017). The choosing of materials is an intricate process shaped and guided by several preconditions, decisions and considerations (Wastiels & Wouters, 2009). Mehta, Mehta and Sharma (2014) argue that the criteria for selection of housing material should also incorporate sustainability concerns such as: renewable materials, recyclable materials, naturally plentiful, locally available, salvaged material, refurbished or re-manufactured material.

Kenya's building code gives the specification of materials for residential construction projects; this limits the selection of locally available materials for developers of peri-urban housing projects. Appropriate Building Materials and Technology [ABMT] in the building industry refers to the materials, construction methodology and equipment used;

and ensuring their compatibility with the physical, economic, environmental and social aspects of their locations. ABMT should ideally be: locally sourced, easy to use, within the financial reach of the average citizen and have a minimal impact on the environment. The appropriateness of the materials and technology is dependent on a number of variables such as: the project's location and specifications; the projects financial capacity; environmental guidelines and legal statutes. The use of ABMT is not widespread in Kenya's building sector due to the following factors: scattered and conflicting building regulations; differing standards of workmanship; high production costs; inadequate local manufacturing and equipment servicing capacity; lack of knowledge by the built-environment professionals (SDHUD, 2019). Current materials available in Kenya include; Interlocking Stabilised Soil Blocks [ISSB], Interlocking Concrete Blocks [ICB], Expanded Poly-Styrene Panels [EPS], Precast Concrete Panels and Compressed Agricultural Fibre (SDHUD, 2019).

Sikuku (2014) conducted a study on "the impact of constituency Appropriate Building Technology Centres on access to housing in Kenya"; the study found that while access to a skilled properly equipped workforce produced a positive effect on access to housing availing of the plants to construct the ABMT's did not any significantly affect access to housing. The study also found that the existing plants were operating below capacity therefore the policy to set up more centres in every constituency needed to be reconsidered.

The application of suitable project management techniques produced a quantifiable impact on the technical sustainability of the housing projects. The technical sustainability of a building project is in part determined by the decisions taken by the developer, construction management professionals and other stakeholders; both before and during the construction process. Sustainable housing projects are reliant on the efficient management of personnel, resources and time in order to be viable mechanisms for housing delivery. Koskela & Howell (2001), hold that construction management requires extensive knowledge of current management techniques and construction processes. Changes in the design of a housing project when work is on-going have a significant impact on technical sustainability due to the resource and time required to accommodate

the additional work. Abdul-Rahman, Wang and Yap (2015) hold that the additional activities necessitated by design change can vary initial costs by up to 50%, this could substantially alter a project's viability. Design changes can originate from: any one of the stakeholders involved in a housing project; changes in building policies; housing market condition; the building site condition of the proposed project or changes in the economic situation of the projects investors.

The traditional building design formats espouse a 'silo mentality' in which the designer usually considers only their own discipline and then passes the drawings on to the next phase for further adjustment (Koskela, Ferantelli, Niiranen, Pikas 2017). The traditional method for housing construction management starts with breaking down the project into a number of discrete activities; each activity is then placed on a schedule with personnel and resources assigned to it. Project managers then attempt to analyse each task separately so minimise the time and resources that it would require. These processes focus on unique tasks requiring specialised technical solutions applied in isolation. The logistics of procurement and supply are also singularly applied to individual activities resulting in redundancies and wastage of the projects time and resources.

Lean construction has been defined as "a way to design production systems to minimize waste of materials, time and effort in order to generate the maximum possible amount of value" (Koskela *et al.,* 2002). This system emerged as a panacea to a specific set of construction challenges but has since evolved through the absorption of other lean production principles (Koskela *et al.,* 2017) Lean construction is primarily customer focused and requires understanding of the clients expectations in order to best utilise the time, personnel and resources available to the project. Lean construction techniques are concerned with identifying processes that get the work at a construction site to flow reliably by aligning the supply chain to minimise waste and maximise the value that can be derived. A defining aspect of the Lean construction phenomenon is the "pull" system, this system ensures that raw materials are ordered for as dictated by the work schedule and rate of consumption; this practice frees up the capital that would otherwise have been used in the acquisition of stock that was not immediately required. Lean construction

practices are dynamic requiring continuous adjustment and constant improvement of processes in response to various environmental stimuli.

A study conducted by Ayuya (2012), on "the influence of lean construction processes on the housing building projects in Nairobi County", found that the principal goal of lean construction is to curtail the waste resulting from erratic workflow at the construction site. Construction industry waste can be organised into the following groups: manufacture of defective products; delays caused by waiting for activities that cannot run concurrently; over processing; producing more than is required; the construction process design; the supply chain and operations at the project site.

The management of energy supply and consumption is one of the indicators of a technically sustainable housing project. Some peri-urban settlements in Kenya do not have adequate access to the national electrical grid, or when connected to the grid the residents have been unable to cope with the financial burden. Residents have therefore resorted to unsustainable sources of energy for domestic use such as firewood and charcoal. These activities have had adverse environmental impacts and as the easily accessible natural vegetation is cleared, the cost of these energy sources has increased proportionally.

A study conducted by Kitheka, Ogutu, Oduor, Ingutia, Muga and Githiomi, (2019) called "Piloting Biomass Energy Audit For Energy And Environmental Conservation In Homa-Bay County, Kenya" found that on average residents searching for fuel-wood spent 1.5 hours walking about 5 kilometres thrice a week. The time spent collecting firewood was estimated to be about two eight hour working days per month. The study recommended that the adoption of efficient improved cooking stoves would decrease the amount of wood required to prepare a meal thus minimising the time and effort required to collect firewood while simultaneously preserving the local forest cover.

Renewable energy is derived from sources that are continuously being replenished from natural sources they include: wind, rivers, ocean tides, geothermal heat and solar energy from the sun. A passive solar house design can minimise the energy required for lighting and temperature control of a building eliminating the need for additional supporting

systems such as air-conditioning systems. Kenya's building regulations, (NBR 2015) require each room in a dwelling to have an opening on an external wall or roof for natural lighting. Solar energy from the sun can be economically incorporated into the design for sustainable peri-urban housing since Kenya's position on the equator means it receives 4 to 6 kWh/m² of daily insolation. Solar photovoltaic panels can be used to directly convert solar radiation into electricity which is then stored in solar batteries, this is particularly useful for peri-urban locations that are not serviced by the national electrical grid. According to UN-Habitat (2012), more than 50 % of the inhabitants of the developing countries do not have access to electricity and depend on solid fuels for cooking and lighting which cause approximately two million fatalities yearly worldwide from respiratory associated problems.

A study by Busiswe, (2007) on "an approach to sustainable, energy efficient design for low cost housing in Botswana" found that sustainable housing designs that deliberately incorporated energy efficient practices resulted in significant improvements to: the building's temperature control, the inhabitants' contentment and well-being. Energy efficient housing designs were found to reduce the running and maintenance costs of the building while minimising the associated negative environmental effects of low cost housing projects.

Management of water supply and consumption is another fundamental indicator of a technically sustainable housing project. When preparing a sustainable water management strategy, it is necessary to identify what a community considers as acceptable standards and uses of reclaimed water and incorporate these findings into a cohesive plan. This plan can then be utilised to minimise water loss and reduced reliance on traditional water sources to meet demand. The Oloolaiser Water and Sewerage Company, a county government water supply agency, has not had the capacity to provide the residents of Kajiado North sub-county with a reliable supply of treated piped water. The peri-urban settlements in Kajiado north Sub County are therefore heavily reliant on water sourced from boreholes (Abong'o, Onyatta and Hinga 2017).

Bore hole water is sourced from groundwater which is formed when precipitation such as rain seeps into the soil to occupy openings in the beds of rock forming aquifers. When impurities permeate into a ground water source it is referred to as contamination, however if the contamination is on a large scale it is referred to as pollution (Momodu and Anyakora, 2010). Groundwater sources in built-up settlements are susceptible to contamination from solid waste extracts, unprocessed sludge and various discharges that leach into these water sources (Lapworth, Nkhuwa, Okotto-Okotto, Pedley, Stuart, Tijani, Wright, 2017). Therefore alternative sources of clean water for domestic use are required for peri-urban housing projects. An integrated water management system can enable water harvesting from several stages of the water cycle. Sustainable housing developments in peri-urban areas should ideally be designed enable rain water harvesting from the rooftops through strategically placed gutters into storage tanks. In a household context grey water is the leftover water from baths, hand wash basins and laundry. This grey water can be reused for domestic functions that do not require clean water such as flushing of toilets. Black water is any waste water that is contaminated with water discharged from a toilet. Waste handling systems such as such septic tanks, bio-digester or a bio-gas system can be incorporated into the sustainable housing design to safely dispose of black water.

Ashiembi (2013) conducted a study on peri-urban wastewater management in Kenya. It was ascertained during the study that portable water was primarily sourced from boreholes and that the distance of water sources from the points of use was up to 2 kilometres. The study's respondents demonstrated a limited understanding of the various agencies charged with regulating the supply and disposal of water in their locality. The study further determined that water accessibility, scarcity and the distance from the water source were the primary motivators for the residents in these areas to adopt wastewater management techniques that enhanced recycling and reuse.

2.7 Theoretical Framework

The two theories on which this study is based are sustainability and accelerator theories.

i Sustainability theory

Sustainability theory derives its origins from the WCED Brundtland (1987) report which established the concept of sustainable development. All project developments tend to have a negative effect on their local environments and the social coherence of the communities in which they are undertaken. The idea that sustainable development can cause no damage to the environment while having financial gain and concurrently contribute to the community's development is described as the triple bottom line concept (Pearce, 2005). Elkington (1997) first articulated the term "triple bottom line" when discussing the concept of sustainable development by corporate entities. Sustainability theory defines the relationship between economic gain, social equity and the environmental concerns arising from a project's development.

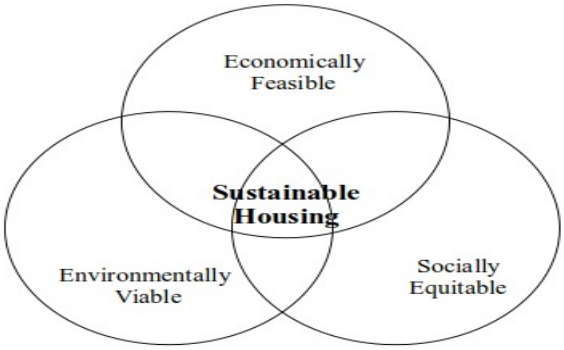

Figure 1: The three principles of sustainability

Therefore, according to this theory a sustainable peri-urban housing project has to achieve a balance between the three principles of sustainability i.e. economic requirements, socio-cultural needs and environmental concerns.

ii Accelerator theory

The accelerator principle was first proposed by J.M. Clark (1923) in "Studies in the Economics of Overhead Costs", where he posited that "investment demand can fluctuate severely if consumer demand fluctuations exhaust existing productive capacity."

This theory assumes that the amount of investment in a certain commodity is directly proportional to either the markets demand for that commodity or the income of potential buyers. This theory is of the view that very high demand can be managed by raising prices or by increasing investment to match the demand. Based on this theory, rapid population growth in peri-urban areas creates demand for housing which prompts housing developers to increase investment in housing developments, which spurs local authorities to extend infrastructure and social amenities to service these areas. With adequate planning and infrastructural investment, this may result in development of sustainable housing projects.

2.8 Conceptual Framework

This is a tool used to display the relationship between the variables in a research study. An indicator is the empirical, observable element of a concept. The concept of sustainable peri-urban housing can be used to provide a framework that unifies the disparate elements that make up the factors that collectively provide economic, social, environmental and technically viable shelters for peri-urban residents in Kenya.

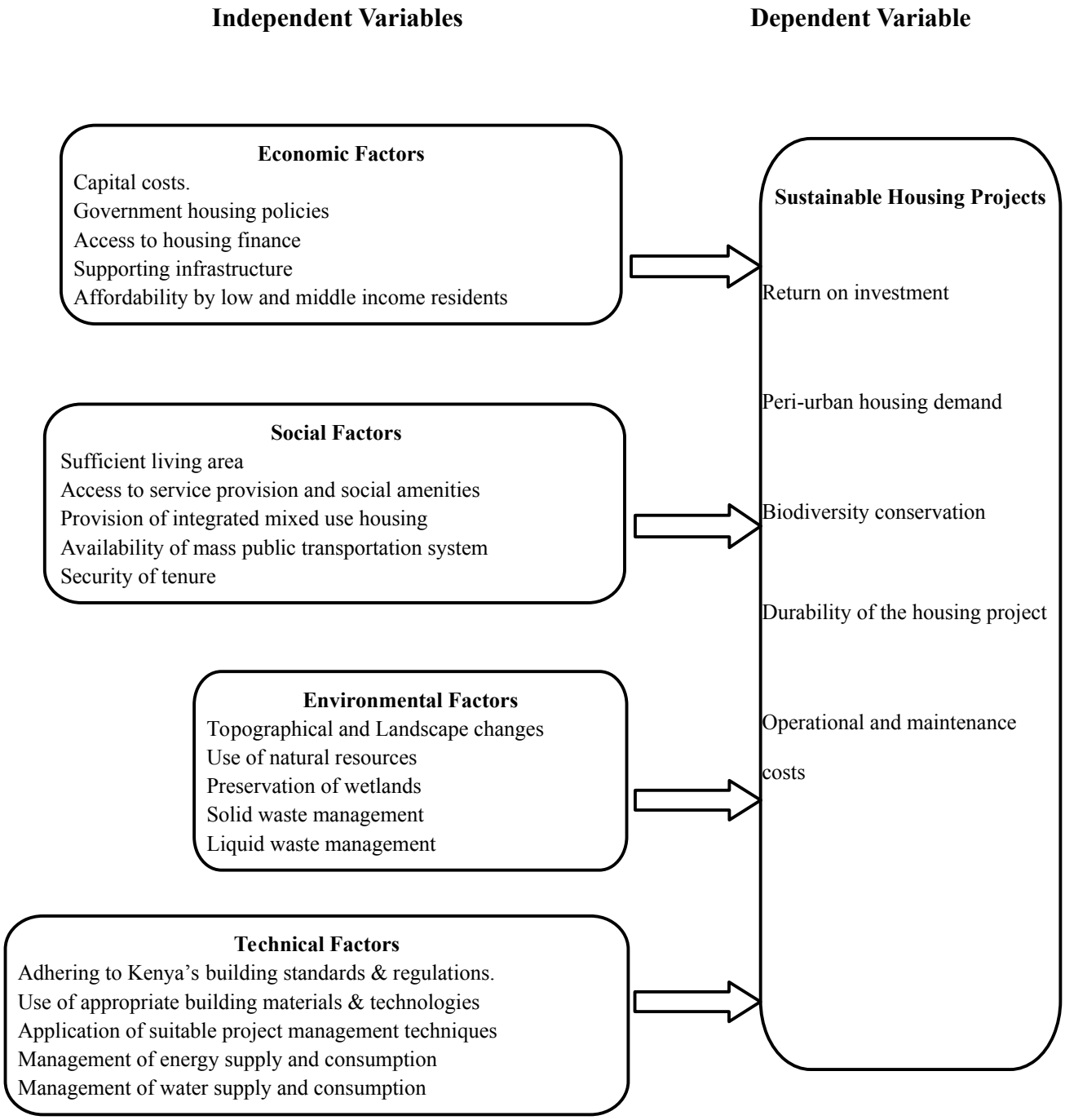

Figure 2: Conceptual Framework of Perceived Factors Influencing the Development of Sustainable Housing Projects in Peri-urban areas

2.9 Summary of literature

Unregulated peri-urban development is a predominant feature of large urban centres in most African countries. Due to the severe financial resource constraints of both the residents and the local authorities, these urban outgrowths are likely to remain the defining characteristic of the peri-urban zone. Housing developments on the urban periphery generally occurs with minimal oversight from the relevant government planning agencies and developers do not readily engage with the approving authorities so as to minimise the costs and time spent on their housing projects. The indigenous community; immigrant population in informal settlements; commercial and industrial investors; and middle-class residents in the peri-urban region often have conflicting interests and points of view. However due to the dynamic nature of the population in these areas, the composition and aims of these factions tends to adjust as the political, social and economic characteristics of the general population gradually shift.

The main impediments to sustainable peri-urban housing developments in Kenya are: rapid population growth, haphazard settlement structures, uncoordinated service provision, quasi legal land subdivision, financial constraints and institutional system inefficiencies. Unrealistic high standards which accompany urban master plans increase construction costs to the point where a high proportion of housing developments, particularly low income, are forced into informal, unregulated peri-urban settlements. In Kenya, housing issues differ within counties and also within communities; therefore any solutions applicable to one region may not be applicable to other counties. Urban sprawl has created large administrative units therefore there is need to prepare local communities to share the responsibility for the administration of services not adequately provided.

2.10 Knowledge Gaps

This chapter will highlight some of the key findings from empirical studies that were reviewed and the knowledge gaps that this study will attempt to address.

Table 2.1 Knowledge Gaps

Variable	Author	Title of study	Key Findings	Knowledge gaps
Economic factors	Kilonzo Mati Hilary (2012)	"Determinants Of Investment For Affordable Urban Housing In Kenya, (In The Period: 1982 -2009)"	This study found a positive correlation between credit allocated to the urban housing sector and housing investments.	The study did not review the social and environmental factors influencing sustainable housing
Social factors	Temba Salome (2015)	"Factors Influencing The Provision Of Housing In Kenya: A Case Of Nairobi"	Security of tenure, Cost and technology have a strong influence on housing provision in Nairobi.	This study did not take environmental factors into account.
Environmental factors	Okongo Herbert Odhiambo (2014)	"Institutions Of Higher Learning As Drivers Of Urban Development: A Case Study Of University Of Eastern Africa, Baraton Nandi County-Kenya"	Limited urban planning; weak institutional and legal frameworks; lack of political goodwill hinder policy implementation Urban development led to increased opportunities creating a positive impact for the community	This study did not discuss the technical factors that are perceived to influence sustainable housing developments in peri-urban areas in Kenya.
Technical factors	Ayuya Andrew (2012)	"Influence Of Lean Construction On The Performance Of Housing Scheme Building Projects In Nairobi County, Kenya."	Poor waste management is prevalent. Energy, raw materials and water use are not sustainable. Few projects are completed within the stipulated contract period.	This study did not address the social and economic factors that influence sustainable housing projects
Technical factors	Sikuku Charles Wafula (2014)	"The Impact Of Constituency Appropriate Building Technology Centres On Access To Housing In Kenya: A Case Study Of Kakamega County."	Availability of properly equipped skilled workers had a significant impact on access to housing. Availability of physical facilities did not have any observable influence on access to housing.	This study did not address the economic, social and environmental factors that influence sustainable housing.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research design that has been adapted for this study. This includes: the target population; the sample size and the sampling procedure employed; the research instruments and the procedure for collection and analysis of data. The chapter has also addressed the ethical considerations to be taken into account and presents a table indicating the operationalisation of the variables that were used to conduct the study.

3.2 Research Design

This research project adopted a descriptive cross sectional survey design. This design was influenced by the topic and the nature of the research questions posed. The study utilised questionnaires with statements on a likert scale and open ended questions, to obtain the viewpoints of the respondents on factors influencing sustainable housing in peri-urban areas at a specific moment in time from a sample size of 155 respondents. The data from the likert scale in the questionnaires was grouped under the respective variables and ranked on a five-point scale. Descriptive and inferential analysis was used to interpret and give meaning to the data collected.

3.3 Target population

This research project's population framework was composed of: housing developers; project beneficiaries such as home owners and tenants; professionals in the built-environment such as architects, engineers, quantity surveyors, construction managers and physical planners from Kajiado North. The units of analysis used in this study were mixed-use, medium density housing projects; each housing project had a minimum of twenty separate housing units each containing at least one water closet and a kitchenette. This selection was influenced by a study conducted in 2004 by the South African government titled 'New Comprehensive Plan for the Creation of Sustainable Human Settlements' (BNG), which identified integrated residential development essentially comprising of medium-density, mixed-use housing opportunities; as the core contributor

to the establishment of settlements that are sustainable (Republic of South Africa, 2004). Due to resource constraints, this research study purposively selected ten housing projects in the study area that met the criteria of sustainable housing projects as defined by the study.

Table 3.1 Target population

Population description (strata)	Target Population
Project beneficiaries	200
Housing developers / investors	10
Professionals in the built-environment	13
Total	223

3.4 Sample size and sampling procedure

The study sampled a subset of the target population that was representative of the population in Kajiado North sub-county that had access to sustainable housing projects.

3.4.1 Sample size

The sample size selected from the target population was 155 respondents. The study partitioned the population into three strata based on their common characteristics. The sample table derived from the formulae developed by Krejcie and Morgan (1970) was used to determine the sample size for the project beneficiaries. In the second and third strata drawn from the housing developers and professionals in the built-environment, the entire target populations were used.

3.4.2 Sampling procedure

This research project utilised a stratified sampling procedure. The beneficiaries of the housing projects formed the first stratum; housing developers formed the second stratum; professionals in the built-environment such as architects, civil engineers, quantity surveyors, construction management professionals and physical planners formed the third stratum. A simple random sampling procedure was applied to the first stratum consisting of project beneficiaries. The second and third strata composed of housing developers and professionals in the built-environment had a population size of ten and thirteen

respectively; the entire populations of these two strata were sampled since Krejcie and Morgan (1970), were of the opinion that for such small populations a census approach should be adopted.

Table 3.2: Representation of the sampling matrix

Population description (strata)	**Target population**	**Sampling method / Formulae**	**Sample size**
Project beneficiaries	200	Krejcie and Morgan (1970) sample table	132
Housing developers / Investors	10	Purposive sampling	10
Professionals in the built-environment	13	Purposive sampling	13
Total	223		155

3.5 Research Instruments

This research project gathered primary data during a field survey using a questionnaire with both statements on a five point likert scale and open-ended questions. The questionnaire design was directed by the research questions and the study's objectives. The questionnaire was arranged into the following six parts: Section A was composed of the study participants' demographical information; Section B consisted of statements pertaining to the economic factors variable; Section C contained statements pertaining to the social factors variable; Section D was composed of statements pertaining to the environmental factors variable; Section E contained statements pertaining to the technical factors variable; Section F covered the dependent variable which is sustainable housing projects in peri-urban areas. Section G consisted of the open-ended questions that were issued to the housing developers and the professionals in the built environment. The data for each individual variable was collected using specific statements that were ranked on the five point likert scale. The measure used on the scale ranked from five to one where:

5 was (very significant); 4 was (significant); 3 was (neutral); 2 was (slightly significant) and 1 was (not significant).

3.5.1 Pilot testing of instruments

The study conducted a pilot test on 10% of the sample population. The pilot study was a mini-study using 15 of the respondents from the sample size of 152. The questionnaire was presented to the respondents. The unclear and ambiguous questions were reworded so that the responses given could be interpreted in a meaningful way and the analysis yielded relevant results. The results from the pilot study were not included in the main study's results.

3.5.2 Validity of instruments

Validity is a way of verifying the meticulousness with which the instruments will measure what the research study has been designed to investigate. Expert opinion, from the researcher's project supervisor and two professionals in the built-environment were used to independently judge the open-ended questions and statements that were presented on the likert scale; against the objectives and research questions that are exhibitted in chapters 1.4 and 1.5.

The two professionals in the built-environment were presented with the questionnaire so as to assess the relevancy of the statements posed by the questionnaire in relation to the study's objectives and research questions. Their responses were rated on a four point scale ranging from 4 (very relevant), 3 (relevant), 2 (not relevant) and 1 (not very relevant). The validity was established by applying a content validity index, which was derived by calculating the sum the responses ranked 4 and 3; and dividing the result by the number of statements posed in the questionnaire. A content validity index of 0.75 was attained using this method. Amin (2005), is of the opinion that 0.70 is an acceptable validity co-efficient for a research instrument.

3.5.3 Reliability of instruments

"A research instrument is reliable to the extent that it gives consistent results when used under equivalent circumstances with the identical parameters" (Cooper and Schindler,

2008). The questionnaires reliability was ascertained by testing for the internal consistency or interrelatedness of the items measuring a single variable under investigation in this study. The questionnaire was distributed to a pilot group consisting of thirteen respondents. Cronbach's alpha was then calculated for each of the variables to determine the reliability of the questionnaire being used in this study. The values in this scale range from 0 to 1, with values closer to 1 indicating better internal consistency.

Table 3.3 Reliability of research instrument

Variable	Number of Items	Scale	Cronbach's Alpha
Economic factors	5	1 - 5	0.765
Social factors	5	1 - 5	0.813
Environmental factors	5	1 - 5	0.88
Technical factors	5	1 - 5	0.7
Sustainable housing projects	5	1 - 5	0.78

3.6 Data collection procedure

The researcher received an introductory letter from the University of Nairobi and a research licence from the "National Commission for Science, Technology and Innovation". The researcher then acquired research permits from the Kajiado County Commissioner, the Kajiado County Director of Education and the County Government of Kajiado County Secretary. Primary data was compiled using a questionnaire and observation of the study area during a field survey. The respondents filled in the questionnaires provided while being assisted by the researcher; the researcher also provided the participants with questionnaires for a self-administered survey which were collected the next day. Secondary data was obtained from reference books, empirical studies from institutions of higher learning, published papers, documented information from government bodies, relevant articles from journals, maps, policy papers and data from relevant websites on the internet.

3.7 Data analysis techniques

Twenty indicators were derived from the conceptual and theoretical frameworks of the study. These indicators were used formulate statements on a five point Likert scale questionnaire to determine the influence that each independent variable had on sustainable housing projects in peri-urban areas. The study's participants were requested to rank the various statements by choosing between "very significant", "significant", "neutral", "slightly significant" and "not significant". The data was analysed using descriptive statistics comprising of: mean, standard deviation and variance. SPSS version 25 was used during the data analysis. A multivariate regression model was used to determine the relationship between the perceived factors and sustainable housing projects in peri-urban areas in Kenya.

3.8 Ethical considerations

The participants were informed of the objectives and the research design of the study. The participants' anonymity was preserved during the final presentation of the research findings. The study minimised the risk of harm to the participants by following the public health safety protocols issued by the Government of Kenya's ministry of health since the research survey was conducted at a time when the country was affected by the Covid 19 global pandemic. The participants of the study were not paid, compensated or influenced in any other manner that would have altered their opinions on the research subject being undertaken in this study.

3.9 Operationalisation of variables

Operationalisation of variables can be characterised as the organisation of the variables under study into numerically quantifiable units. The key indicators for each variable are displayed alongside the scale, data collection method to be employed, the techniques and tools of analysis.

Table 3.4: Operationalisation of variables

Objective	Variable	Indicator	Scale	Data Collection Method	Technique of data analysis	Tools of analysis
To establish the influence of economic factors on development of sustainable housing projects	Economic factors	• Capital costs • Government housing policies • Access to housing finance • Provision of supporting infrastructure • Affordability by low and middle-income residents	Nominal Ordinal Interval	Questionnaire	Descriptive analysis and inferential analysis	Mean, Standard deviation, variance, Regression
To determine the influence of social factors on development of sustainable housing projects	Social factors	• Sufficient living area • Access to service provision and social amenities • Provision of integrated mixed use housing • Access to mass public transportation systems • Security of tenure	Nominal Ordinal Interval	Questionnaire	Descriptive analysis and inferential analysis	Mean, Standard deviation, variance, Regression
To determine the influence of environmental factors on development of sustainable housing projects	Environmental factors	• Topographical changes • Use of natural resources. • Preservation of wetlands • Solid waste management. • Liquid waste management	Nominal Ordinal Interval	Questionnaire	Descriptive analysis and inferential analysis	Mean, Standard deviation, variance, Regression
To establish the influence of technical factors on development of sustainable housing projects	Technical factors	• Adherence to the building code • Use of appropriate building materials and technologies • Application of suitable project management techniques • Energy management • Water management	Nominal Ordinal Interval	Questionnaire	Descriptive analysis and inferential analysis	Mean, Standard deviation, variance, Regression
	Sustainable housing projects in peri-urban areas	• Return on investments • Peri-urban housing demand • Biodiversity conservation • Durability of the facility • Operation and maintenance costs	Nominal Ordinal Interval	Questionnaire	Descriptive analysis and inferential analysis	Mean, Standard deviation, variance, Regression

CHAPTER FOUR
DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents the results, analysis and interpretation of the data collected during the field survey. The specific objectives of this research project were to establish the influence of economic factors on development of sustainable housing projects in peri-urban areas; to determine the influence of social factors on development of sustainable housing projects in peri-urban areas; to determine the influence of environmental factors on development of sustainable housing projects in peri-urban areas; and to establish the influence of technical factors on development of sustainable housing projects in peri-urban areas. The questionnaire collected data on an ordinal five point Likert scale. The study's participants were required to rank the various statements by choosing between "very significant", "significant", "neutral", "slightly significant" and "not significant". Descriptive statistics were employed to analyse the data and the results have been presented in the form of tables and figures. A regression analysis was used to ascertain the statistical association between the perceived factors and development of sustainable housing projects in peri-urban areas in Kenya. The results were then interpreted with a brief discussion to expound on the phenomena of sustainable peri-urban housing in Kenya.

4.2 Questionnaire return rate

155 questionnaires were given to respondents in Kajiado North sub-county. Thirty-five questionnaires were either not returned or did not capture data that could be used in the study. One hundred and twenty questionnaires had positive responses that were used for data analysis. The target population was partitioned into three strata consisting of investors / developers, professionals in the built-environment and project beneficiaries. Table 4.1 displays how many questionnaires' were returned by each strata. The study's overall response rate was 77.4%.

Table 4.1 Questionnaire return rate

	Developers / Investors	**Professionals in the built-environment**	**Project beneficiaries**
Questionnaires issued	10	13	132
Questionnaires returned	9	13	98
Percentage Response rate	90%	100%	76.6%

4.3 Demographic Characteristics of the Respondents

This research project intended to ascertain the demographical characteristics of the participants so as to determine whether they had sufficient capability to comprehend and informatively address the statements in the questionnaire issued. The information requested included: age, gender, strata, occupation, profession in the built-environment and the work experience of the professionals in the built environment.

4.3.1 Distribution of Respondents by Age

A total of 120 study participants gave responses that were used in the study. The respondents were asked to state their age bracket; their responses are displayed in table 4.2. This made it possible for the study to determine to whom the research findings could be generalized and also allowed for comparisons to be made across other similar research studies.

Table 4.2 Distribution of Respondents by Age

	Frequency	Percent	Cumulative Percent
18 - 30 years	52	43.3	43.3
31 -45 years	48	40.0	83.3
46 - 60 years	15	12.5	95.8
Above 60 years	5	4.2	100.0
Total	120	100.0	

The findings revealed that a majority (83.3%) were within the ages of 18 to 45 years. These age groups were the most socially active and economically productive segments of the population, with both the desire to and the capacity to engage in sustainable peri-urban housing projects. The findings additionally indicated that 16.7% of the study's participants were above the age of 46 and could therefore be considered to have a wide breadth of knowledge on the factors perceived to have an influence on sustainable peri-urban housing projects.

4.3.2 Distribution of Respondents by Gender

This research project aspired to determine the participants gender distribution in order to highlight the different patterns of behaviour and involvement that men and women play in development of sustainable peri-urban housing projects. The participants were asked to state their gender; their responses are in table 4.3.

Table 4.3 Distribution of Respondents by Gender

	Frequency	Percentage	Cumulative Percentage
Male	71	59.2	59.2
Female	49	40.8	100.0
Total	120	100.0	

From the responses displayed above, both male (59.2%) and female (40.8%) respondents participated in the study. However, the statistical findings show that the male respondents had a higher degree of participation in sustainable peri-urban housing development than the female respondents. The distribution of the study's participants was found to be adequate to meet the requirements for gender parity.

4.3.3 Distribution of Respondents by Strata

A stratified sampling procedure was adopted in which the project beneficiaries consisting of home owners and tenants formed the first stratum; housing developers and investors formed the second stratum; professionals in the built-environment formed the third stratum. Table 4.4 displays the responses from the study's participants.

Table 4.4 Distribution of Respondents by strata

	Frequency	Percent	Cumulative Percent
Home owner	13	11.3	11.3
Tenant	80	69.6	80.9
Developer	9	7.8	88.7
Professional in the built environment	13	11.3	100.0
Total	115	100.0	

The study attempted to determine the distribution of the respondents by population strata so as to determine their familiarity with the factors perceived to influence sustainable housing projects in peri-urban areas. From the results displayed in table 4.4, most of the project beneficiaries consisted of tenants (69.6%), this implied that sustainable housing projects in peri-urban areas had a larger market for rental properties. The results also depict that developers (7.8%) and professionals in the built-environment (11.3%) participated in the survey, the study was therefore able to to draw from their specialized knowledge and experience to interpret the key sustainable housing development issues so as to present the findings in a holistic manner. Five respondents did not indicate their strata.

4.3.4 Distribution of Respondents by Occupation

This research project endeavoured to determine the economic status of the respondents so as to gauge whether they were able to invest in sustainable peri-urban housing projects. The participants were asked to specify their occupation; table 4.5 displays their anwers.

Table 4.5 Distribution of Respondents by Occupation

	Frequency	Percentage	Cumulative Percentage
Employed	26	22.0	22.0
Self-employed	54	45.8	67.8
Unemployed	8	6.8	74.6
Retired	3	2.5	77.1
Student	27	22.9	100.0
Total	118	100.0	

It was determined that a majority of the respondents were employed with 22% being formally employed and 45.8% were self-employed. These results implied that 67.8% of the sampled population was actively engaged in income generating activities and could therefore meaningfully invest their resources in sustainable housing. Furthermore, the study also found that 2.5% of the respondents were retired from formal employment but had previously invested in sustainable housing opportunities. The results also show that 6.8% of the respondents were unemployed and students accounted for 22.5% of the study's participants. Two respondents did not indicate their occupations.

4.3.5 Distribution of respondents by profession in the built-environment

This research project endeavoured to ascertain the qualifications of the participants with expert knowledge of the housing industry so as to assess the validity of their assessments on issues pertaining to sustainable housing projects. The participants were petitioned to state their professional qualification, table 4.6 displays their answers.

Table 4.6 Distribution of respondents by profession in the built-environment

	Frequency	Percent
Architect	2	15.4
Engineer	4	30.8
Quantity Surveyor	2	15.4
Physical Planner	1	7.7
Construction Manager	4	30.8
Total	13	100

A majority of the participants (61.6%) were found to be construction managers and engineers. These respondents have had continuous on site experience with the development of housing projects from the initial design stage to the final commissioning stage and could therefore offer detailed and comprehensive information on the subject matter at hand. This research project also surveyed two architects, two quantity surveyors and one physical planner; who added to the breadth of technical knowledge and provided further observations on the unique conditions influencing development of sustainable housing projects in Kajiado North Sub County.

4.3.6 Distribution of respondents by work experience

The general work experience of the professionals was required to determine their ability to offer an expert opinion based on their actions and observations in the peri-urban housing industry. The participants were asked to specify their years of experience; table 4.7 displays their answers.

Table 4.7 Distribution of respondents by work experience

	Frequency	Percent
5 - 10 years	7	53.8%
More than 10 years	6	46.2%
Total	13	100%

The responses indicate that 53.8% of professionals in the built environment who were surveyed had professional experience of between 5 to 10 years; while 46.2% had more than 10 years. These findings implied that the participants interviewed had a sufficient

amount of practical knowledge in their chosen fields and could thus be relied upon to offer valid expert opinions on the subject of sustainable peri-urban housing projects.

4.4 Basic Statistical Assumptions

This research projected sought to determine the distribution of the data collected during the field survey and also to ascertain the extent of correlation between the independent variables. The distribution of data determines the descriptive statistics that will be used to analyse and interpret the data. A high degree of correlation between the independent variables tends to distort the values of regression coefficients when conducting inferential statistics

4.4.1 Tests of Normality

The distribution of the data from the field survey was determined by application of normality tests conducted in SPSS. The null hypothesis of the distribution test was "the data was normally distributed." The findings are displayed in table 4.8.

Table 4.8 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Economic factors	.151	120	.000	.907	120	.000
Social factors	.127	120	.000	.967	120	.005
Environmental factors	.118	120	.000	.968	120	.005
Technical factors	.117	120	.000	.963	120	.002

a. Lilliefors Significance Correction

The "Kolmogorov – Smirnov test" and "Shapiro – Wilk test" for normality distribution were applied to the data collected for the four independent variables. The P values were found to be less than the study's alpha level of significance which was 0.05. The study therefore rejected the null hypothesis and concluded that the data distribution of all four independent variables is not normally distributed.

4.4.2 Multicollinearity Analysis

Multicollinearity is defined as "a high degree of correlation between the independent variables" (Kothari, 2004). This study used a Variance Inflation Factor (VIF) analysis to determine the degree of correlation between the independent variables. James, Witten, Hastie and Tibshirani (2017), hold the opinion that a VIF of less than 5 is an acceptable value for a research study.

Table 4.9 Multicollinearity Analysis

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1 (Constant)	-4.079	1.422		-2.868	.005		
Economic factors	.568	.063	.496	9.057	.000	.711	1.407
Social factors	.348	.065	.301	5.366	.000	.679	1.472
Environmental factors	.136	.046	.151	2.969	.004	.821	1.218
Technical factors	.188	.056	.182	3.343	.001	.723	1.383

a. Dependent Variable: Sustainable housing projects in peri-urban areas

From the analysis displayed in table 4.9, the variance inflation factors of the independent variables range from 1.218 to 1.472. These values indicate that the independent variables have a very low degree of correlation and can therefore be used for regression analysis.

4.5 Economic Factors and Development of Sustainable Housing Projects

This research project firstly attempted to establish the influence of economic factors on development of sustainable housing projects in peri-urban areas in Kenya. The respondents were issued a questionnaire with statements designed to elicit their opinions. These statements queried the following indicators: the cost of land; construction costs; access to housing finance; the availability of supporting infrastructure; affordability by low and middle income earners. The participants were petitioned to classify the statements on a five-point ordinal scale where: "very significant = 5", "significant = 4", "neutral = 3", "slightly significant = 2" and "not significant = 1". Their responses are in table 4.10.

Table 4.10 Economic Factors and Development of Sustainable Housing Projects

Statement	Level of significance	Frequency	Percentage	Mean	Standard Deviation	Variance
Access to land influences the development of sustainable housing projects	Very significant	85	70.8%	4.71	0.456	0.208
	Significant	35	29.2%			
Construction costs influence the development of sustainable housing projects	Very significant	92	76.7%	4.74	0.494	0.244
	Significant	25	20.8%			
	Neutral	3	2.5%			
Access to housing finance, loan and mortgage facilities influences the development of sustainable housing projects	Very significant	60	50.0%	4.38	0.723	0.522
	Significant	47	39.2%			
	Neutral	11	9.2%			
	Slightly significant	2	1.7%			
Access to roads, electrical power, water supply and sewer systems influences the development of sustainable housing projects	Very significant	67	56.3%	4.38	0.834	0.695
	Significant	35	29.4%			
	Neutral	12	10.1%			
	Slightly significant	5	4.2%			
Affordability by low & middle income earners influences the development of sustainable housing projects	Very significant	49	41.5%	4.2	0.822	0.676
	Significant	49	41.5%			
	Neutral	15	12.7%			
	Slightly significant	5	4.2%			

The cost of construction was the most influential economic indicator influencing the development of sustainable housing, with a mean of 4.74 out of a maximum score of 5. 76.7% of the respondents' ranked construction costs as 'very significant' and 20.8% ranked it as 'significant'. The economic indicator that had the second highest influence was the 'access to land' with a mean of 4.71. 70.8% of the participants ranked this indicator as 'very significant', while 29.2% rated it as 'significant'. The study observed that the rapid pace of urbanisation of Kajiado North has led to the subdivision of land while increasing its purchase value, particularly the parcels adjacent to the main road transport corridors. Furthermore, the acreage of land allotted for the housing project has a noticeably visible effect on its sustainability particularly in areas not served by public utilities that facilitate clean water supply and waste disposal. The county government of Kajiado has subsequently set out to regulate these subdivisions by limiting the sizes to: low density settlements are limited to a minimum size of 0.2 Ha; medium density settlements to a minimum size of 0.1 Ha; high density settlements such as those within a radius of 2 to 4 kilometres from Ngong, Ongata Rongai and Kiserian townships; have a minimum permitted acreage of 0.5 Ha.

Access to housing finance was ranked as 'very significant' by 50% of the respondents and 'significant' by 39.2%. This signified that most of the studies participants deemed the ability to secure sufficient funding from financial institutions to be a key component of economically sustainable housing projects. However, the study discovered that the ability to access credit or mortgages from financial institutions and attract investors to these projects is attached to the unambiguous proprietorship of the land on which the housing project is to be sited. The investors in these projects are required to have legally valid title deeds or certificates of lease.

The availability of supporting infrastructure such as access roads, electrical power, piped water and sewer systems; had a positive influence on sustainable housing projects. 56.3% of the respondents ranked supporting infrastructure as 'very significant' while 29.4% rated it as 'significant'. The study found that prior to devolution of administration in Kenya, the ambiguities in the administrative boundaries and the lack of oversight created

opportunities for the development of uncoordinated and unsustainable housing projects. Subsequently, the property owners have had exaggerated expectations for their land and later attempts to allocate space for public utilities has exacerbated the land owners resulting in numerous legal conflicts over property rights.

The study's participants were of the opinion that affordability of the housing units by low and middle income earners was a key determinant of the projects ability to attract sufficient clientele in order to become economically sustainable. 41.5% of the respondents rated affordability as 'very significant', another 41.5% ranked it as 'significant', while 12.7% selected 'neutral'. The study observed that most of the sustainable housing developments within Nairobi city and its environs are aimed at the high end market. The scarcity of low cost sustainable peri-urban housing has resulted in the mushrooming of informal settlements preventing these budding urban centres from acting as the prime movers for the socio-economic advancement of the wider Kajiado County.

4.6 Social Factors and Development of Sustainable Housing Projects

This research project also set out to determine the influence of social factors on development of sustainable housing projects in peri-urban areas in Kenya. The study's participants were supplied with specific statements concerning the social factors influencing development of sustainable housing projects in peri-urban areas. These statements queried the following indicators: the adequacy of the living space; access to social amenities; provision of facilities for home based commercial enterprises; access to public transportation systems and the security of tenure. The statements were ranked on a five-point ordinal scale where "very significant = 5", "significant = 4", "neutral = 3", "slightly significant = 2" and "not significant = 1". The responses are in table 4.11.

Table 4.11 Social Factors and Development of Sustainable Housing Projects

Statement	Level of significance	Frequency	Percentage	Mean	Std Deviation	Variance
Having a living area with adequate spacing, natural lighting and ventilation influences development of sustainable housing projects	Very significant	53	44.2%	4.33	0.7	0.49
	Significant	55	45.8%			
	Neutral	10	8.3%			
	Slightly significant	2	1.7%			
Access to schools, health facilities, markets & open green spaces influences the development of sustainable housing projects	Very significant	48	40.7%	4.09	0.896	0.803
	Significant	38	32.2%			
	Neutral	27	22.9%			
	Slightly significant	5	4.2%			
Having space for home based commercial enterprises influences the development of sustainable housing projects	Very significant	14	11.7%	3.44	0.887	0.786
	Significant	43	35.8%			
	Neutral	45	37.5%			
	Slightly significant	18	15.0%			
Access to public mass transportation systems influences development of sustainable housing projects	Very significant	94	78.30%	4.75	0.506	0.256
	Significant	22	18.30%			
	Neutral	4	3.30%			
Having title deeds & lease agreements influences the development of sustainable housing projects	Very significant	64	53.30%	4.45	0.659	0.434
	Significant	47	39.20%			
	Neutral	8	6.70%			
	Slightly significant	1	0.80%			

An evaluation of the findings showed that the adequacy of the living space had a statistically significant influence on sustainable housing projects in peri-urban areas with a mean ranking of 4.33 out of a maximum score of 5, and a standard deviation of 0.7. The study determined that a large proportion of the participants were positively biased by the adequacy of the living space in the housing units. 44.2% of the respondents ranked this indicator as 'very significant', while 45.8% ranked it as 'significant'. The study deduced that a housing unit providing a living area with adequate spacing, natural lighting and ventilation; significantly increased its social sustainability ranking by the projects beneficiaries. The study observed that the design of living space was influenced by: firstly, the requirements laid out in the national building regulations; secondly, the size and shape of the land available along with the investors desire to maximise the total sum of habitable units; and finally the needs and expectations of the intended project beneficiaries primarily the need to meet the minimum floor area per person. Kenya's National housing policy Sessional Paper No. 3 of 2016, states that in general the minimum floor area per square person is 70 – 89 square feet, while a room inhabited by two people should be at least 110 square feet.

The respondents opined that access to social amenities such as schools, health facilities, markets and open green spaces resulted in a statistically noteworthy influence on the social sustainability of the housing projects with a mean of 4.09. 44.7% of the respondents ranked this indicator as 'very significant', while 32.2% ranked it as 'significant' and 22.9% of the respondents rated it as 'neutral'. The study observed that public social amenities are engines for social progress and economic growth. Economically they provide access to locally produced goods and services. Socially they provide places where the community can gather to contribute ideas on political, social and developmental issues.

The study inferred that readily available access to mass public transportation was the strongest indicator of socially sustainable peri-urban housing projects since this indicator had the highest mean of 4.75 out of a maximum score of 5. 78.3% of the respondents ranked it as 'very significant', 18.3% ranked it as 'significant' and 3.3% rated it as

'neutral'. The study observed that housing development in Kajiado North is dominated by a transport facilities-oriented settlement where the growth of towns are linear along both trunk and feeder roads. The public service vehicles operating in the sub-county mainly ply the routes between Nairobi city and the various major towns in Kajiado North.

The provision of facilities for home based commercial enterprises was found to be the least influential social indicator with a mean of 3.44. 11.7% of the respondents ranked it as 'very significant', 35.8% ranked it as 'significant', 37.5% of the respondents rated it as 'neutral' and 15% of the respondents found it to produce a slightly significant influence on sustainable housing. The security of tenure was found to be a key determinant of socially sustainable housing projects in peri-urban areas. 53.3% of the respondents ranked this indicator as 'very significant' and 39.2% ranked it as 'significant'.

4.7 Environmental Factors and Development of Sustainable Housing Projects

This research projected sought to determine the influence of environmental factors on development of sustainable housing projects in peri-urban areas in Kenya. The indicators investigated included: the changes in the landscape; use of natural resources; preservation of wetlands; solid and liquid waste management. The participants were petitioned to rank the statements presented by the degree of significance. The statements were ranked on a five-point ordinal scale where "very significant = 5", "significant = 4", "neutral = 3", "slightly significant = 2" and "not significant = 1". The responses are in table 4.12.

Table 4.12 Environmental Factors and Development of Sustainable Housing Projects

Statement	Level of significance	Frequency	Percentage	Mean	Std Deviation	Variance
Changes in the landscape influences the development of sustainable housing projects	Very significant	13	10.9%	3.32	1.016	1.033
	Significant	42	35.3%			
	Neutral	39	32.8%			
	Slightly significant	20	16.8%			
	Not significant	5	4.2%			
Harvesting and use natural resources such as sand, stones & timber for construction influences the development of sustainable housing projects	Very significant	11	9.2%	3.46	0.952	0.906
	Significant	57	47.5%			
	Neutral	32	26.7%			
	Slightly significant	16	13.3%			
	Not significant	4	3.3%			
Preservation of wetlands influences the development of sustainable housing projects	Very significant	27	22.5%	3.87	0.849	0.722
	Significant	58	48.3%			
	Neutral	28	23.3%			
	Slightly significant	6	5.0%			
	Not significant	1	0.8%			
Solid waste management influences the development of sustainable housing projects	Very significant	54	45.0%	4.38	0.624	0.39
	Significant	59	49.2%			
	Neutral	6	5.0%			
	Slightly significant	1	0.8%			
Management of liquid waste influences the development of sustainable housing	Very significant	61	50.8%	4.45	0.606	0.367
	Significant	52	43.3%			
	Neutral	7	5.8%			

Direct observation of the study area revealed that Kajiado North sub-county has undergone significant topographical changes due to residential and commercial developments along with the attendant supporting urban infrastructure. However, the study's respondents did not hold that these landscape changes had substantial influence on the environmental sustainability of the housing projects. 10.9% held that these changes were 'very significant', 35.3% held that they were 'significant', 32.8% selected 'neutral' while 16.8% opined that the topographical changes were 'slightly significant'.

The study found that the harvesting and use of natural resources had some influence on the development of sustainable housing projects. 9.2% of the respondents found this indicator to be 'very significant', 47.5% held that it was 'significant', 26.7% selected 'neutral' while 13.3% were of the opinion that it was 'slightly significant' and 3.3% felt it was not significant. The study observed that sand harvesting in many seasonal rivers in the sub county had become a lucrative business due to the swift urbanisation of the locality and banning of harvesting exercises in neighbouring counties. These activities have had serious environmental impacts including destruction of riparian land; depletion and pollution of water in river channels. Furthermore, building stones were being quarried in several areas in Ngong and Gataka, most of this quarrying was open cast leaving huge pits which posed a danger to the health and safety of the residents. The forested areas have also been significantly reduced by illegal logging and charcoal burners.

Preservation of wetlands was found to have an influence in the development of sustainable housing projects. 22.5% of the respondents found this indicator to be 'very significant', 48.3% held that it was 'significant', 23.3% selected 'neutral' while 5% were of the opinion that it was 'slightly significant'. The study noted that the wetlands in Kajiado North are located in the high-water potential areas of Ngong hills and along the permanent and seasonal rivers. Seasonal wetlands are widely scattered; their distribution is mostly determined by the soils characteristics, local topography, drainage pattern and geological formations. These wetlands are threatened by siltation, unregulated water abstraction, vegetation destruction and pollution from urban developments.

The respondents surveyed for the study considered solid waste management to be a critical component of sustainable housing. 45% found waste management to be 'very significant', 49.2% held that it was 'significant', 5% selected 'neutral' as their response. The study noted that Kajiado North Sub County has had only one gazetted dumpsite in Ngong town which has since been closed leading to a waste management crisis in the sub-county. This has contributed to the flourishing of ungazetted dumping sites in Ongata Rongai, Kiserian and Ngong towns. The study observed that solid waste in area was mainly disposed of by private waste collection companies; burning; dumping into open pits, along public roads or in adjacent undeveloped land.

The management of liquid waste was a key concern of the project beneficiaries during the development of sustainable housing. During the field survey 50.8% deemed liquid waste management to be 'very significant' while 43.3% were of the opinion that it was significant. Among the indicators under investigation for the environmental factors variable, liquid waste management exhibited the highest significance ranking averaging 4.45 out of a maximum score of 5 and a standard deviation of 0.606. Kajiado North, however, was found to lack sewer lines and wastewater treatment plants. Consequently, residents drained their household wastewater into pit latrines, cess pits, septic tanks and streams, rivers and swamps. During the field survey, the study noted that a sewer line system and treatment plant were under construction to serve Kiserian town and its environs.

4.8 Technical Factors and Development of Sustainable Housing Projects

Finally this research project attempted to establish the influence of technical factors on the development of sustainable housing projects in peri-urban areas in Kenya. The indicators investigated included: conforming to Kenya's building code; use of appropriate building materials and technologies; application of suitable project management techniques; the management of supply and consumption of energy and water. The indicators were used to formulate statements ranked on a five-point scale where "very significant = 5", "significant = 4", "neutral = 3", "slightly significant = 2" and "not significant = 1". The responses are in table 4.13.

Table 4.13 Technical Factors and Development of Sustainable Housing Projects

Statement	Level of significance	Frequency	Percentage	Mean	Standard Deviation	Variance
Applying Kenya's building standards and regulations influences the development of sustainable housing	Very significant	89	74.2%	4.74	0.440	0.193
	Significant	31	25.8%			
Use of locally sourced appropriate building materials influences the development of sustainable housing projects	Very significant	57	47.9%	4.38	0.701	0.491
	Significant	52	43.7%			
	Neutral	9	7.6%			
	Not significant	1	0.8%			
The use of project management methods influences the development of sustainable housing projects	Very significant	10	8.8%	3.37	0.858	0.736
	Significant	38	33.6%			
	Neutral	51	45.1%			
	Slightly significant	12	10.6%			
	Not significant	2	1.8%			
Management of energy supply and consumption influences the development of sustainable housing projects	Very significant	52	43.3%	4.26	0.739	0.546
	Significant	47	39.2%			
	Neutral	21	17.5%			
Management of water supply and consumption influences the development of sustainable housing projects	Very significant	59	49.6%	4.39	0.714	0.51
	Significant	50	42.0%			
	Neutral	7	5.9%			
	Slightly significant	3	2.5%			

The analysis conducted on the collected data found that the projects technical sustainability was greatly influenced by conforming to Kenya's building standards and regulations. This indicator produced a mean response of 4.74 out of a maximum of 5 with a standard deviation of 0.44, this was the highest ranking of the indicators measuring the technical factors variable. 74.2% of the respondents rated this indicator as 'very significant' and 25.8% held that it was 'significant'. The study observed that there is marked variation in the standards of housing developments in Kajiado North. The proximity of several socio-economic classes in the area has culminated in a wide range of housing typologies whereby detached single residences are interspersed with medium income sustainable multi-dwelling housing units and low income unsustainable informal settlements. The study also observed that the time and expense involved in the attainment of building permits from the approving state agencies discourages developers who want to adhere to the stipulated regulations. In addition, a number of individuals opt to relocate from Nairobi to its environs where the enforcement of building regulations has traditionally been hampered by a lack of adequate enforcement resources by the local authorities.

The study established that the employing locally sourced appropriate building materials and technologies was a vital component of the housing project's technical sustainability. 47.9% of the respondents opined that it was 'very significant', 43.7% held that it was 'significant' while 7.6% rated the significance of this indicator as 'neutral'. The Government of Kenya has been promoting the use of locally available low cost appropriate building materials and technologies by establishment of centres to disseminate pertinent information and train personnel. However, the study noted that these materials is not widespread in the construction of sustainable housing projects in Kajiado North. Most of the observed housing projects have been constructed by conventional building materials such as quarry stones, bricks and mortar.

The study noted that the respondents were mostly undecided as to whether the application of suitable project management methods influenced the technical sustainability of the

housing projects. 8.8% held that it was ‘very significant’, 33.6% held that it was ‘significant’, 45.1% rated the significance of this indicator as ‘neutral’ and 10.6% opined that it was ‘slightly significant’. The study observed that although the respondents did not prioritise the use project management techniques, these methodologies provide a basis for adaptive management and the continuous measurement of key indicators throughout the housing project’s lifecycle. They can be used to assess a housing project’s viability in order to ensure sufficient economic returns for the investors, socially adequate conditions for the residents and mitigate the environmental impacts of the project on its environs.

The study inferred that management of the housing projects energy supply and consumption made a substantial contribution to the project’s technical sustainability. 43.3% of the respondents opined that it was ‘very significant’, 39.2% held that it was ‘significant’ while 17.5% rated the significance of this indicator as ‘neutral’. According to a report by Kajiado CSP (2019), the residents of Kajiado North sub-county had the highest access to electricity in the county, with 78.2% of the population having a connection to the national electrical grid. The Kenya integrated household budget survey of 2015/2016 found that in Kajiado county 35.3% of households used liquid petroleum gas for cooking, while 20.2 % used kerosene. Furthermore, a large proportion of the households in the area have access to some form of sustainable sources of energy.

An evaluation of the data demonstrated that the participants felt that the management of water supply and consumption positively influences the development of sustainable housing projects. 49.6% of the respondents held that it was ‘very significant’, 42% held that it was ‘significant’ while 5.9% rated the significance of water supply and consumption as ‘neutral’. The study noted that Kajiado County is classified as part of Kenya’s arid and semi-arid lands. A report by Kajiado CSP (2019) observed that approximately 70% of the freshwater available for domestic use is Kajiado North is from boreholes situated in natural drainage basins obtaining water from permeable rock bands. The groundwater, however, contains high salt levels making it unsafe for drinking while sources in urban centres such as Ongata Rongai are contaminated by unregulated disposal of liquid waste from the residential and commercial developments in the area. In order to

promote sustainable water supply, the County government of Kajiado has subsequently set out to establish regulations that will require all upcoming building to have a provision for rain water harvesting and storage as part of the projects design.

4.9 Development of Sustainable Housing Projects in Peri-urban Areas in Kenya

This research project attempted to elicit the study's participants views on the dependent variable 'sustainable housing projects'. The research project attempted to ascertain the degree of significance the participants placed on the indicators used to determine the sustainability of a peri-urban housing project by issuing a questionnaire composed of statements formed from these indicators which consisted of: the rate of return on the investment; demand for housing; biodiversity conservation; the durability of the house; management of operation maintenance and costs. The statements were ranked on a five-point ordinal scale where "very significant = 5", "significant = 4", "neutral = 3", "slightly significant = 2" and "not significant = 1".The responses are in table 4.14.

Table 4.14 Sustainable Housing Projects in peri-urban areas

Statement	Level of significance	Frequency	Percentage	Mean	Standard Deviation	Variance
The time taken to get a return on the investment influences the development of sustainable housing projects	Very significant	85	70.8%	4.7	0.478	0.229
	Significant	34	28.3%			
	Neutral	1	0.8%			
Housing demand in peri-urban areas influences the development of sustainable housing projects	Very significant	94	78.3%	4.75	0.506	0.256
	Significant	22	18.3%			
	Neutral	4	3.3%			
Minimising damage to the environment influences the development of sustainable housing projects	Very significant	48	40.7%	4.09	0.896	0.803
	Significant	38	32.2%			
	Neutral	27	22.9%			
	Slightly significant	5	4.2%			
How long a building will last influences the development of sustainable housing projects	Very significant	76	63.3%	4.59	0.587	0.344
	Significant	40	33.3%			
	Neutral	3	2.5%			
	Slightly significant	1	0.8%			
Management of the project's operation and maintenance costs influences the development of sustainable housing projects	Very significant	68	56.7%	4.41	0.815	0.664
	Significant	38	31.7%			
	Neutral	10	8.3%			
	Slightly significant	3	2.5%			
	Not significant	1	0.8%			

Analysis of the results displayed demonstrated that the rate of return on the investment was a vital component of sustainable housing projects. Data collected revealed that 70.8% of the respondents held that the return rate was 'very significant' and 28.3% deemed it to be significant. The demand for housing in the study area was also found to be a key factor in the development of sustainable housing projects. 78.3% of the respondents opined that the demand for housing was 'very significant' while 18.3% rated demand as significant. Of the indicators under investigation for this variable, housing demand had the most significant ranking with a mean score of 4.75 out of a maximum score of 5 and a 0.506 standard deviation.

The study further determined that the conservation of the areas biodiversity by minimising damage the project does to the environment has a positive influence on the development of sustainable housing. 40.7% of the respondents held that biodiversity conservation was 'very significant', 33.3% rated it as significant, 22.9% selected 'neutral' while 4.2% opined that it was 'slightly significant'. The study found that the durability of the structure greatly influenced the development of sustainable housing projects. 63.3% of the respondents opined that durability was 'very significant', 32.2% rated it as significant and of the study's participants 2.5% held a 'neutral' opinion.

Management of the housing project's operation and maintenance costs was found to be an integral part of sustainable housing development. 56.7% of the respondents held that cost management was very significant, 31.7% rated it as significant, 8.3% of the respondents were 'neutral' while 2.5% felt that it had a 'slightly significant' influence on development of sustainable housing projects.

4.10 Inferential Analysis of the Study Variables

The inferential analysis was used to determine the accuracy of the hypothesis that the perceived economic; social; environmental and technical factors have an influence on development of sustainable housing projects in peri-urban in Kenya.

The null hypothesis of this study H_0: The perceived factors do not have an influence on development of sustainable housing projects in peri-urban areas in Kenya.

The alternate hypothesis H_1: The perceived factors have an influence on development of sustainable housing projects in peri-urban areas in Kenya.

4.10.1 Regression Model

"Regression is the determination of the statistical relationship between two or more variables" (Kothari, 2004). A regression model was utilised to assist in determining the statistical relation between sustainable housing projects in peri-urban areas and the perceived economic; social; environmental & technical factors. The model took the form of the following multiple regression equation; (in which 'Y' is the dependent variable).

$$\mathbf{Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon}$$

Y = sustainable housing projects in peri-urban areas

α = intercept of the regression line / value of Y when X is 0

$\beta_1, \beta_2, \beta_3$ and β_4 = Regression coefficients

X_1, X_2, X_3 and X_4 = Independent variables

ε = error term

4.10.2 Regression analysis

In order to establish the statistical relationship between the perceived factors and development of sustainable housing projects in peri-urban areas in Kenya, a regression analysis was administered. The evaluation is displayedd in table 4.15.

Table 4.15 Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.869[a]	.755	.746	1.244

Predictors: (Constant), Technical factors, Environmental factors, Economic factors, Social factors

The analysis derived from the model summary in table 4.15 indicate that the R^2 value is 0.755, indicating that 75.5% of the variance in the development of sustainable housing projects can be explained by the perceived factors under investigation in this study.

Table 4.16 Analysis of variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	547.833	4	136.958	88.439	.000[b]
	Residual	178.092	115	1.549		
	Total	725.925	119			

a. Dependent Variable: Sustainable housing projects in peri-urban areas
b. Predictors: (Constant), Technical factors, Environmental factors, Economic factors, Social factors

Table 4.16 presents the analysis of variance for the perceived factors. The P value of 0.00 is less than the study's alpha level of 0.05, indicating that the predictors have a statistically significant influence on the dependent variable. Therefore, the study can reject the null hypothesis and accept the alternate hypothesis that the perceived factors have an influence on development of sustainable housing projects in peri-urban.

Table 4.17 Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4.079	1.422		-2.868	.005
	Economic factors	.568	.063	.496	9.057	.000
	Social factors	.348	.065	.301	5.366	.000
	Environmental factors	.136	.046	.151	2.969	.004
	Technical factors	.188	.056	.182	3.343	.001

Dependent Variable: Sustainable housing projects

From the evaluation displayed in table 4.17, the regression coefficients indicate that the perceived economic, social, environmental and technical factors; all have a positive

influence on development of sustainable housing projects in peri-urban areas in Kenya. The regression equation: $\mathbf{Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4}$

Can now be expressed as:

Y = -4.079 + 0.568*Economic + 0.348*Social + 0.136*Environmental + 0.188*Technical

This implies that for every unit increase in the perceived economic factors a 0.568 increase in sustainable housing projects is expected holding all other factors constant, this is statistically significant since the P value for the economic variable 0.000 is less than the alpha of 0.05. A unit increase in the social factors variable results in a 0.348 increase in sustainable housing projects if all other factors are held constant. Similarly, a unit increase in environmental factors yields a 0.136 increase in sustainable housing projects while a unit increase in technical factors yields a 0.188 increase in sustainable housing projects; when holding all the other variables constant respectively. Both the environmental and technical factors variables were found to be statistically significant with P values of 0.004 and 0.001 respectively.

The inferential analysis applied to the study's findings concluded that the economic factors variable had the highest statistically significant influence, on the development of sustainable housing projects, among the factors under consideration in this study. This implies that the intended beneficiaries of peri-urban housing developments tend to place their first concern on the projects economic aspects. While a large proportion of the participants held that the environmental factors had an influence on the development of sustainable housing projects; this influence was found to be the least statistically significant among the factors under investigation in this study. This observation signified that the project beneficiaries did not prioritise the environmental factors when making decisions concerning the sustainability of peri-urban housing development projects. The study found that while the perceived technical factors had a statistically significant influence on sustainable peri-urban housing projects in Kenya, it was less influential than the perceived economic and social factors.

CHAPTER FIVE
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter will present a summary of the study's findings on perceived factors influencing development of sustainable housing projects in peri-urban areas in Kenya. Furthermore, the chapter offers conclusions that can be drawn from observations made from the specific objectives and the recommendations of this research project.

5.2 Summary of the Findings

A response rate of 79% was obtained from a sample size of 152 respondents from Kajiado North Sub County. Mugenda and Mugenda (2003) are of the opinion that a response rate of more than 70% is suitable for analysis of the findings and drawing the appropriate conclusions. This study explicitly focused on the influence of perceived: economic, social, environmental and technical factors; on sustainable housing projects in peri-urban areas in Kenya.

5.2.1 Economic factors and development of sustainable housing projects.

This research project set out to determine the influence of perceived economic factors on development of sustainable housing projects in peri-urban areas in Kenya. The findings noted that the perceived economic factors had a favourable impact on the development of sustainable housing in peri-urban areas. Additionally the mean values that ranged from 4.2 to 4.74 'very significant' was the most frequent response selected by the surveyed participants. The study also observed that the standard deviation of the indicators measuring access to land and construction costs was less than 0.5; this indicated that there were few divergent opinions from most commonly held opinion of the participants. The other three indicators measuring access to financing, availability of supporting infrastructure and affordability had standard deviations ranging from 0.72 to 0.84; implying that there was a wider divergence from the majority opinion on their level of influence on the development of sustainable housing projects.

The study inferred that the initial capital costs were the primary determining factor for the economic sustainability of a peri-urban housing project. The regression analysis found that among the variables under consideration in this study, when holding all other factors constant, economic factors variable had the highest statistically significant influence on the development of sustainable housing projects in peri-urban areas.

5.2.2 Social factors and development of sustainable housing projects.

The study also sought to determine the influence of perceived social factors on development of sustainable housing projects in peri-urban areas in Kenya. An analysis of the mean values of the statements querying: access to social amenities, public transportation systems and security of tenure; ranged from 4.09 to 4.75. This indicated that most of the respondents held the opinion that these indicators had a substantial influence on development of sustainable peri-urban housing. The other two statements measuring the sufficiency of the living area and provision of integrated mixed use housing had the most commonly selected responses being 'significant' and 'neutral.' The study also observed that the standard deviation for the availability of public transportation was 0.256, indicating a convergence of opinion among the respondents. However, the standard deviation for access to social amenities and provision of integrated mixed use housing was 0.8 and 0.78 respectively, implying a wider divergence from the average opinions of the study's participants. The regression analysis found that the influence of the perceived social factors on the development of sustainable housing projects was the second highest among the factors under investigation in this study.

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5.2.3 Environmental factors and development of sustainable housing projects.

The study sought to establish the influence of perceived environmental factors on development of sustainable housing projects in peri-urban areas in Kenya. The findings indicated that the most frequent response for the significance of statement relating to management of the projects liquid waste was 'very significant.' All the other four statements had 'significant' as the most common response. This signified that most of the

study's participants perceived environmental factors as having a significant influence on development of sustainable peri-urban housing.

An analysis of the results found that the standard deviations of the indicators measuring the topographical and landscape changes; use of natural resources and preservation of wetlands; ranged from 1.01 to 0.85. This indicated a notable divergence from the most commonly expressed opinion that these indicators had a significant influence on the development of sustainable housing projects. The other two indicators had standard deviations of approximately 0.6 implying more divergent responses around the means. The study further deduced that the respondents were only moderately concerned about: the changes in the landscape; the preservation of wetlands and the harvesting and use of natural resources. The respondents however exhibited a higher degree of concern for the housing projects management of solid and liquid waste. The study therefore inferred that the environmental factors that had a direct impact on the residents' daily activities and comfort levels were deemed to have a more meaningful influence on the environmental sustainability of the housing projects. The analysis of the inferential statistics tests applied to the collected data concluded that when all other factors under investigation in this study were held constant, the environmental factors had the least statistically significant influence on the development of sustainable peri-urban housing.

5.2.4 Technical factors and development of sustainable housing projects.

The study set out to determine the influence of perceived technical factors on the development of sustainable housing projects in peri-urban areas in Kenya. The collected data was subjected to descriptive analytical tests and the most frequent response to the statement concerning the 'application of suitable project management methods' was 'neutral,' with a mean score of 3.37. All the other statements under the technical factors variable had 'very significant' as the most frequent response, with means ranging from 4.26 to 4.74. The standard deviation of the responses for the indicator measuring the adherence to Kenya's building regulations was 0.4, which implied that there was a convergence of opinion among the study's participants that this indicator had a very significant influence on the development of sustainable housing projects. All the other

indicators had a wider convergence of opinions with standard deviations ranging from 0.7 to 0.85. The regression analysis of the data found that the perceived technical factors had the third largest statistically significant influence on the development of sustainable housing projects, when all other factors were held constant.

5.3 Conclusions

This research study came to the conclusion that the peri-urban housing sector provides a critical strategic alternative to accommodate the expanding populations of densely populated urban centres in Kenya. The peri-urban housing industry has a profound positive economic impression on the livelihoods of both rural and urban populations. The influence of the initial capital costs on sustainable peri-urban housing projects was found to be very significant. The availability of credit facilities from financial institutions in the formal sector was found to be a key facilitator of sustainable peri-urban housing developments. The study further concluded that government intervention in the form of provision of supporting infrastructure was a necessary component for the evolution of peri-urban housing into sustainable housing projects.

Additionally, this study came to the conclusion that socially sustainable peri-urban housing is dependent on the comfort, safety and security of the residents. These conditions are ensured by provision of adequate living space and access to social amenities. This indicates that the ideal locations for socially sustainable peri-urban housing projects are areas in close proximity to market centres, educational and health facilities; which are also served by mass public transportation networks. The study also found that security of tenure was an essential indicator of socially sustainable peri-urban housing. This implied that state intervention by facilitating the processing of legal documentation such as title deeds and lease agreements is a key component of socially sustainable housing.

The study determined that disruption of the peri-urban region's ecosystem due to the housing development significantly affected the project's environmental sustainability. The harvesting and use of natural resources altered the areas topography endangering wildlife habitats and posing a challenge to the preservation of wetlands and water-ways.

The study concluded that the management of solid and liquid waste from a housing project was the most useful indicator of the environmental sustainability of a peri-urban housing project.

The final conclusion of the study was that the most discernible indicator of the technical sustainability of a peri-urban housing project was how well the construction complied with Kenya's building code. The study also deduced that the use of locally sourced appropriate materials and technologies contributed to the projects sustainability. The study further determined that the prudent management of the projects water and energy, supply & usage, induced a significantly noticeable effect on the operational and maintenance costs thus contributing to the technical sustainability on the peri-urban housing project.

5.4 Recommendations

This research study advances various policy recommendations to assist in the development of sustainable housing projects in peri-urban areas. The government of Kenya has enacted an ambitious affordable housing programme targeting the lower-middle income sectors of the real estate market in densely populated urban centres. The study recommends that private investors in the peri-urban housing market be offered similar incentives which would include: tax incentives for sustainable housing developers; provision of state subsidised tenant purchase schemes; streamlining building approvals processes for standardised housing designs; reducing the bureaucratic hurdles to obtaining title deeds and certificates of allotment in peri-urban areas.

The study proffers a number of practice recommendations: firstly, the adoption of evolving project management practices to manage both the time and resources so as to ensure that the housing projects being developed attain the standards required for sustainability. Secondly, the study recommends adherence to the building code and implementation of the best practices used in the construction industry so as to ensure the safety of the occupants and the durability of the housing projects. Thirdly, the study recommends the wide scale adoption of locally available appropriate building materials

so as to reduce material costs while simultaneously spurring the local construction industry within the peri-urban areas.

5.5 Areas for Further Research

This study endorses additional research into perceived influences that governance may have on the development of sustainable peri-urban housing. This influence will be discernible in the administrative / jurisdictional challenges of the boundary zones and the effects of devolution of government services on peri-urban housing developments. The study also recommends research into the effect of mass migration on sustainable peri-urban housing projects. These immigrants are typically not heterogeneous in nature with varying income levels and socio-cultural practices which will significantly influence the development of sustainable peri-urban settlements. Finally, this study recommends further investigation into the influence that sustainable green construction practices may have when developing housing projects in peri-urban areas.

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APPENDICES

APPENDIX 1
WORK PLAN AND BUDGET

Activity	**Date**													
	2021 Feb	2021 Mar	2021 April	2021 May	2021 June	2021 July	2021 Aug	2021 Sept	2021 Oct	2021 Nov	2021 Dec	2022 Jan	2022 Feb	2022 Mar
Background study of proposed research topic														
Literature review														
Selection of research methodology														
Preparation of proposal														
Oral defence of proposal														
Correction of proposal														
Field survey approval from University of Nairobi														
Application to NACOSTI for research permit														
Acquiring the data														
Analysis and formulation of a preliminary report														
Oral defence of the report														
Submittal of the report														

BUDGET

Allocation	**Cost (in Kenya shillings)**
University Research Project fees	50,000
Preparation and printing of questionnaires	9,000
NACOSTI research permit service charge	1,000
Research assistants allowance	10,000
Travelling costs	10,000
Preparation, printing and binding of final document	10,000
Total cost	90000

APPENDIX 2
QUESTIONNAIRE

The questionnaire below has been set in order to compile information for this study. All the questions are pertinent to perceived factors influencing development of sustainable housing projects in peri-urban areas in Kenya. Please answer all the questions.

Building name / number	
Date	
Interview Number	

Section A: Background Information

This section is about your personal background information, please tick accordingly.

1. Age:

   18 - 30 years [ ] 31 - 45 years [ ] 46 - 60 years [ ] Above 60 years [ ]

2. Gender:

   Male [ ] Female [ ]

3. Type of respondent:

   House owner [ ] Developer [ ] Tenant [ ] Professional in the built-environment [ ]

4. Occupation:

   Employed [ ] Self-employed [ ] Unemployed [ ] Retired [ ] Student [ ]

This section is for professionals in the built-environment

7. If you are a professional in the built-environment, what is your profession?

   Architect [ ] Engineer [ ] Quantity surveyor [ ]

   Planner [ ] Construction management [ ]

8. How many years have you been practising professionally?

   1 - 5 years [ ] 5 - 10 years [ ] More than 10 years [ ]

Section B: Economic factors

In your opinion how much significance do the following statements have on economic sustainability of peri-urban housing projects? Rate your level of agreement on the scale below by ticking against each statement.

Statements	**Very significant**	**Significantly**	**Neutral**	**Slightly significant**	**Not significant**
Access to land influences development of sustainable housing projects					
Construction costs influence development of sustainable housing projects					
Access to housing finance, loan and mortgage facilities influences development of sustainable housing projects					
Access to roads, electrical power, water supply and sewer systems influences development of sustainable housing projects					
Affordability by low & middle income earners influences development of sustainable housing projects					

Section C: Social Factors

In your opinion how much significance do the following statements have on social sustainability of peri-urban housing projects? Rate your level of agreement on the scale below by ticking against each statement.

Statements	**Very significant**	**Significantly**	**Neutral**	**Slightly significant**	**Not significant**
Having a living area with adequate spacing, natural lighting and ventilation influences development of sustainable housing projects					
Access to schools, health facilities, markets & open green spaces influences development of sustainable housing projects					
Having room for home based commercial enterprises influences development of sustainable housing projects					
Access to public transportation systems influences development of sustainable housing projects					
Having title deeds and lease agreements influences development of sustainable housing projects					

Section D: Environmental Factors

In your opinion how much significance do the following statements have on environmental sustainability of peri-urban housing projects? Rate your level of agreement on the scale below by ticking against each statement.

Statements	**Very significant**	**Significantly**	**Neutral**	**Slightly significant**	**Not significant**
Changes in the landscape influences development of sustainable housing projects					
Harvesting and use natural resources such as sand, stones & timber for construction influences development of sustainable housing projects					
Preservation of wetlands and sources of water influences development of sustainable housing projects					
Waste and garbage management influences development of sustainable housing projects					
Management of liquid waste from kitchen & toilet influences development of sustainable housing projects					

Section E: Technical Factors

In your opinion how much significance do the following statements have on the technical sustainability of peri-urban housing projects? Rate your level of agreement on the scale below by ticking against each statement.

Statements	**Very significant**	**Significantly**	**Neutral**	**Slightly significant**	**Not significant**
Applying Kenya's building standards & regulations influences development of sustainable housing projects					
Use of locally sourced appropriate building materials influences development of sustainable housing projects					
The use of project management methods influences development of sustainable housing projects					
Management of energy supply and consumption influences development of sustainable housing projects					
Management of water supply, and consumption influences development of sustainable housing projects					

Section F: Sustainable housing projects in peri-urban areas in Kenya

How much significance do the following statements have on sustainable housing projects in peri-urban areas in Kenya? Rate your level of agreement on the scale below by ticking against each statement.

Statements	**Very significant**	**Significantly**	**Neutral**	**Slightly significant**	**Not significant**
The time taken to get a return on the investment influences development of sustainable housing projects					
Housing demand in peri-urban areas influences development of sustainable housing projects					
Minimising damage to the environment influences development of sustainable housing projects					
How long a building will last influences development of sustainable housing projects					
Management of the project's operation and maintenance costs influences development of sustainable housing projects					

Section G

This section is for developers, investors and professionals in the built-environment.

Economic Factors

- How does land availability influence the development of sustainable housing projects?

- Is there sufficient market demand for affordable sustainable housing projects?

- How does access to supporting infrastructure influence the development of the project?

- What were the requirements to access housing finance from financial institutions?

- Have state policies and peri-urban planning and management programmes influenced the development of the housing projects?

Social Factors

- What are the considerations when determining the adequacy of the living spaces in the housing projects?

- What effect does the availability of social amenities have on the development of the housing project?

- What kind of public transportation is available for residents of the housing project?

Environmental Factors

- How has housing development affected the biodiversity of the area?

- What environmental effect has the consumption of natural resources by the housing project caused?

- How is liquid waste from the housing project disposed of?

- How is solid waste from the housing project managed?

Technical Factors

- Does the housing project comply with the building codes and the construction industry's best practices?

- Does the housing project make use of locally available low cost appropriate building materials and technologies?

- Do the housing project you are currently undertaking have access to sustainable energy sources?

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