FACTORS INFLUENCING ENVIRONMENTAL SUSTAINABILITY OF REAL ESTATE PROJECTS IN KENYA: A CASE OF GATED COMMUNITIES IN NAIROBI COUNTY

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A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT FOR THE REQUIREMENTS OF THE DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

2013

DECLARATION

This research project report is my original work and has not been submitted for an award of a degree in any university.

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This research project report has been submitted for an examination with my approval as university supervisor.

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DEDICATION

This research project report is dedicated to Mrs Doreen Ali and Jamila Ali for their financial, material and moral support throughout the course of my studies at the University of Nairobi. Without you, where could I be? May the good Lord bless you abundantly for your unwavering support and generosity.

ACKNOWLEDGEMENT

My sincere gratitude goes to my supervisor Mr Samuel J. Njuguna for his immense generosity in moderating this project from its seminal phase up to completion.

I am also thankful to my lecturers and other university staff who have contributed towards my academic and intellectual formation.

I am indebted to the University of Nairobi for providing a conducive ambiance for my studies.

I want to thank my classmates of PPM (2011 intake) for engaging me in a fruitful academic discourse through class discussions and group assignments. Your team spirit is worthy emulating and will sustain me as a prospective project manager.

I am grateful to my family (Mr Simeon Madukani my father, my sisters Rita and Margarita and my brother James) and all friends especially Fr David Larkin, Fr Oliver Leavy, Fr Anthony Mario, Kenneth Ochung and Martin Mazinga, who have helped me reach this far.

My sincere gratitude goes to St. Patrick's Missionary Society for sponsoring part of my studies at the University of Nairobi. Thanks for your kind gesture.

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ABBREVIATIONS AND ACRONYMS

CBOs:	Community Based Organisations
CCN:	City Council of Nairobi
CPP:	Consultation and Public Participation
EA:	Environmental Audit
EIA:	Environmental Impact Assessment
EMCA:	Environmental Management and Co-ordination Act
ESI:	Environmental Sustainability Index
IPPC	Integrated Pollution Prevention and Control
GNP:	Growth National Product
GoK:	Government of Kenya
JICA:	Japan International Cooperation Agency
KEBS:	Kenya Bureau of Standards
KPLC:	Kenya Power and Lighting Company
LPG:	Liquefied Petroleum Gas
MDGs:	Millennium Development Goals
NEMA:	National Environmental Management Authority
NGOs:	Non-Governmental Organisations
NHC:	National Housing Corporation
NWSC:	Nairobi Water and Sewerage Company
OECD:	Organisation for Economic Cooperation and Development
SPSS:	Statistical Package for Social Sciences
UK:	United Kingdom
UN:	United Nations
UNCED:	United Nations Conference on Environment and Development
UNDP:	United Nations Development Program
UNEP:	United Nations Environmental Program
UNESCO:	United Nations Educational, Scientific and Cultural Organisation
UNFCCC:	United Nations Framework Convention on Climate Change
USA:	United States of America
USSR:	Union of Soviet Socialist Republics
WCED:	World Commission on Environment and Development
WED:	World Environment Day

ABSTRACT

People's lives depend on the environment as the environment contains natural resources that are vital for survival. However, human activities are degrading the environment. This is portrayed through environmental problems resulting from human activities. One domain in which environmental problems are manifested due to human activities is the housing sector. The purpose of this study therefore was to investigate factors influencing environmental sustainability of real estate projects in Kenya by focussing on gated communities in Nairobi County. Nairobi County, where the study was conducted, is the largest city in Kenya with a great influx of people and high demand for housing. As such, environmental challenges resulting from real estate projects are many. Some of the environmental challenges arising from residential estates include loss of biodiversity, depletion of natural resources like flora and fauna, improper waste management and many more. This study achieved its purpose through four objectives namely environmental awareness, socio-economic factors, mitigation measures and compliance with regulatory authorities. The study reviewed literature that underpinned it through desk-top review from the global, African and local perspectives with the aim of establishing a gap which the research filled. Furthermore, this study sought to provide a conceptual framework which gave a road map and a guide to the study. The study was a descriptive research as it investigated factors influencing environmental sustainability of real estate projects in Kenya. Therefore, a cross-sectional descriptive survey design was used. Qualitative and quantitative research methods were used for the collection and analysis of data to assess factors influencing environmental sustainability of real estate projects in Kenya. Methods of collecting data included questionnaires, interview schedules and observation check list. The data collected was analysed by a mixed method of data analysis comprising both qualitative and quantitative methods. SPSS statistical tool was used in data analysis. Recommendations were made and some conclusions were drawn from the results of the study. The study found out that cost of equipment was the major obstacle towards adopting technologies that enhance environmental sustainability of real estate projects in Kenya as almost 60% of respondents cited cost as a major challenge regarding adopting technologies that enhance environmental sustainability. This study concluded that most of the respondents were aware of environmental sustainability. The study however concluded that in spite of the awareness, there was lack of will to implement what people know about environmental sustainability as 100% of the tenants were aware of the difference between biodegradable and non-biodegradable types of solid waste yet only 10% were separating the two types of substances. In addition, the study established that compliance with regulations is generally good as 100% of the gated communities carried out EIA at the planning stages of the estates. This research has the potential of providing different stakeholders and regulatory authorities with information which is vital to environmental sustainability of real estate projects in Kenya. This study also has the potential of stimulating prospective researchers with desire to explore the topic further.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Real estate is a term that is used extensively in the housing sector. According to Brueggeman and Fisher (2005), real estate refers to land and anything fixed, immovable or permanently attached to it like residential and non-residential buildings and fences. Residential buildings are either single dwelling or gated communities. They serve single-family, duplexes or other multi-family homes. Such residential buildings include apartments for sale and rent, flats, villas, condominiums, maisonettes and bungalows. This study focussed on residential estates called gated communities which come in three different types namely Lifestyle Gated Communities, Elite Gated Communities and Security Zone Gated Communities. Although they differ in their inhabitants, yet they all serve the same basic service, which is to keep unwanted individuals out (security).

From the environmental point of view of residential estate houses, Setagaya-Ku Fukasawa in Japan was found to have environmentally sustainable estate houses with solar collector for heating and solar cells among some facilities in 2007 (UN-Habitat 2012). In order to improve environmental sustainability of buildings, eco-homes are becoming a must in the construction industry in the Arab World. In Kampala, Uganda, garbage that is generated is beyond the capacity of Kampala City Council to collect and a lot of it comes from real estate houses. In Lilongwe, Malawi, out of all solid waste generated, 40% comes from residential estates and most of this is collected by Lilongwe City Assembly. In USA, EIA has become an essential tool in environmental management since its inception in 1969 (Muigua 2012). This shows that residential estates come with a number of environmental issues.

There is an increased demand for residential estates worldwide. The main determinants of the demand for residential estates are demographic. According to “The United Nations 2010 Revision of the World Population Prospects”, the world population was at 7 billion in 2011. It is predicted that by 2030, the world population will be 8.3 billion with urban areas experiencing exponential population growth. In 2009, Nairobi County had 3.1 million people. It is predicted that by 2015, the population of Nairobi will be 3.8 million people. Owing to this trend of population growth, there is high demand for residential estates and consequently a big boom in the real estate industry today (Kenya County Network).

The rapid population growth which increases demand for residential estates is one of the driving factors for environmental change in Nairobi County. Currently, the parameters of Nairobi and its outskirts are expanding to bursting point due to unprecedented demand for residential estates. Mulupi (2012) observed that the rising demand for quality housing and modern posh office space is translating into innovative and futuristic multibillion-dollar gated communities and mini cities in Kenya. In addition to the already constructed buildings, there are yet mega projects to come in the housing sector. Some of these projects are Northlands City, Tatu City which will accommodate 75,000 people, Thika Greens Limited (TGL) which will have 4,000 housing units in Thika upon completion, Four Ways Junction, Migaa Golf Estate which is a project set on 774 acres of land in Kiambu and it will feature 2,500 homes and Edenville Estate on the outskirts of Nairobi just to name a few.

The residential estates weigh heavily on the environment and consequently play a noteworthy role in the current global environmental crisis especially with their contribution to greenhouse gases. The green house gases from residential estates are contributed by among other things the burning of fossil fuels like diesel which is used in generators. There is need for substantial reduction in the emission of greenhouse gases as emphasised by Intergovernmental Panel on Climate Change if we are to tackle climate change significantly. However, the more the world population grows, the more there will be big demand for residential estates. This will result into more emission of greenhouse gases especially carbon dioxide which increases carbon footprint and contributes to global warming and climate change.

The residential estates also have considerable impact on the environment as they exploit a lot of natural resources like water and timber. In Nairobi County, water is already a scarce commodity in many households. With the boom in residential estates, more water will be needed. Therefore, if we are to tackle issues of dwindling natural resources, global warming and climate change, residential estates offer one of the largest possibilities of any sector in terms of mitigation.

Ensuring environmental sustainability is one the Millennium Development Goals (MDGs). Kenya, being a signatory to the MDGs, has an obligation to incorporate and integrate the MDGs into its programs and policies. Kenya has endeavoured to incorporate and integrate the MDGs through Kenya Vision 2030 among some of its policies and programs. The key target of the MDGs includes integrating the principles of sustainable development and one of these

principles pertains to environmental sustainability which is about reversing the loss of environmental resources and reducing biodiversity loss. In Kenya, there have been reforms from the environment point of view in the housing sector taken by various regulatory authorities like NEMA, City Council of Nairobi and Kenya Housing Cooperation as demonstrated in the literature review yet we continue to experience environmental challenges. With the boom in residential estates, it is necessary to review the existing mitigation measures and explore more ways of engaging in environmentally friendly residential estates if we are to tackle the global environmental crisis in a meaningful way; hence this study is timely.

1.2 Statement of the Problem

Statistics show that demand for housing in urban areas has been on the rise at a faster rate than the number of houses available or under construction due to influx of people into urban areas in Kenya. It is estimated that out of 150,000 housing units required annually in urban areas in Kenya, only an estimate of 35,000 are produced (National Housing Corporation, 2009). This indicates that there is huge house deficit as demand exceeds supply hence the need for more houses in urban areas to cater for the demand. The Government of Kenya estimates that supply for housing will equal demand by 2030 (Kenya Vision 2030). This means that over the next 17 years, the residential estate sector will continue to boom in an attempt to fill the gap between the actual and desired number of houses.

However, with the current inadequate number of houses in urban areas, Nairobi County is already grappling with environmental challenges like improper disposal of waste, poor drainage system in many residential areas leading to flooding when it rains, high demand for energy and the already scarce water resource. The demand for more houses is and will therefore exacerbate the environmental problems if nothing is done to mitigate environmental impact caused by residential estates. This study therefore sought to investigate factors influencing environmental sustainability of real estate projects in Kenya by focussing on residential estates called gated communities in Nairobi County. By investigating such factors, the study sought to fill in the research gap.

1.3 Purpose of the Study

The study aimed at investigating factors influencing environmental sustainability of real estate projects in Kenya by focussing on gated communities in Nairobi County.

1.4 Objectives of the Study

The study sought to:

1. Establish the level at which environmental awareness influences environmental sustainability of real estate projects in Kenya.
2. Identify how socio-economic factors influence environmental sustainability of real estate projects in Kenya.
3. Assess how mitigation measures influence environmental sustainability of real estate projects in Kenya.
4. Examine how compliance with regulations influences environmental sustainability of real estate projects in Kenya.

1.5 Research Questions

The study was guided by the following questions:

1. To what extent does environmental awareness influence environmental sustainability of real estate projects in Kenya?
2. How do socio-economic factors influence environmental sustainability of real estate projects in Kenya?
3. How do mitigation measures influence environmental sustainability of real estate projects in Kenya?
4. How does compliance with regulations influence environmental sustainability of real estate projects in Kenya?

1.6 Justification of the Study

In the Constitution of Kenya 2010, the Bill of Rights commits the Kenyan Government to provide for adequate housing as a right for all Kenyans. This is in line with Kenya Vision 2030 which puts an emphasis on infrastructure projects among some of the flagship development projects that have been lined up to achieve the Vision. Kenya Vision 2030 is a long-term development blue print for Kenya to create “a globally competitive and prosperous country with a high quality of life by 2030”. This is development which is aimed at providing a high quality of life to all Kenyan citizens and it is to take place in a clean and secure environment according to the Vision.

In addition, the 2010 Kenyan Constitution states in Article 42 that every person has the right to a clean and healthy environment which includes the right to have the environment

protected for the benefit of present and future generations through legislative and other measures. This is echoed in the "Sessional Paper No.6 of 1999" on Environment and Development and Kenya is committed to the ideas of sustainable development as stipulated in this paper. The aim of the government is therefore to conserve the environment by encouraging citizens to - among other things - adopt green building principles which emphasise on energy efficiency, resource efficiency, water conservation, indoor environmental quality and site and community impact. However, with the number of housing projects lined up to meet the annual demand, there is and there will be a continued immense pressure exerted on the already declining resource base and the country's fragile environment. The negative impact on the environment due to the residential estate projects will continue accelerating if no proper mitigation measures are put in place.

Environmental challenges arising from residential estates can hamper the realisation of Kenya Vision 2030 which has the underlying goal of economic growth and improving the welfare of Kenyans without compromising environmental integrity (Kenya State of Environment and Outlook, 2010). It was necessary therefore to undertake this study in order to explore more ways of sustaining economic growth while at the same time equipping the public and policymakers with ways and means to monitor and regulate residential estates closely so as to mitigate the negative environmental impacts that they cause.

The choice of gated communities in this study was motivated by the fact that their impact (gated communities) on the environment is huge; for instance over half of the total energy-related greenhouse gas emissions produced worldwide in 2004 came from operating residential and commercial buildings. Most of these greenhouse gas emissions from residential buildings came from gated communities (Inter-governmental Panel on Climate Change, 2007). This is a major concern as global attention on environmental issues now is mainly focussed on global warming and climate change resulting from burning of fossil fuels among other things. Gated communities also have monopoly on natural resources like water and energy due to their large infrastructure base as compared to non-gated residential buildings (Tucker, 1998). Furthermore, gated communities are middle and high income areas and according to a study called "Sustainable Development in Kenya 2012", the trend in Nairobi is that most of the recyclable waste which impacts negatively on the environment is generated from middle and high income areas.

1.7 Significance of the Study

This study sought to investigate factors influencing environmental sustainability of real estate projects in Kenya. It is hoped that findings of this study will benefit and create more awareness among real estate developers and proponents, government, architects, planners, contractors, city officials, project managers and other organizations dealing with environmental sustainability of residential estates. Those who are concerned with impacts of the built environment on the surrounding natural environment and larger community may find this study helpful. It is also hoped that this study will influence future policies pertaining to environmental protection in Kenya. As a result of this study, various stakeholders will be sensitised about the importance of environmental conservation and protection when engaging in residential estate projects. In addition, the study has added to the body of knowledge that is already in existence in the field of residential estates. Ultimately, this study has provided resource base for further exploration of the topic by prospective researchers.

1.8 Delimitation of the Study

Geographically, the study was conducted in Nairobi County. Nairobi County is located in Nairobi Province bordering counties of Kiambu to the North West, North and North East, Machakos to the East and South East, Kajiado to the South, South West and West. The County covers an area of 695.1 square kilometres and has an approximate population of 3,138,369 with a population density of 4,515 people per square kilometre and 985,016 households. Four districts constitute the county and these are Nairobi West, Nairobi East, Nairobi North and Westlands. Nairobi County has only one local authority called Nairobi City Council. Westlands, Parklands, Karen/Langata, Makadara, Kibera, Roysambu, Ruaraka, Kariobangi, Kayole, Kamukunji, Starehe, Dagoretti, Mihang'o, Nairobi West, Mathare, Kasarani and Embakasi are the seventeen constituencies that comprise Nairobi County (*Kenya County Network, 2012).*

Since real estate projects are many and are in different categories, the researcher chose to focus on residential estates called gated communities which were constructed between 2007 and 2012. This is because EIA – which is crucial for environmental sustainability – became mandatory for projects with notable environmental impacts from 2007. EIA is crucial regarding compliance with regulators by project proponents and checking compliance was one of the objectives of this study. Nairobi County was suitable to conduct this study because

of its many environmental challenges due to its large human population and many residential estate projects that are complete and ongoing.

The study restricted itself to investigating factors that influence environmental sustainability of residential estates within Nairobi County. This reduced the population parameter to Nairobi County thereby making it possible for the researcher to reach the target population. Even though other factors like population factors came up in the course of the study, attention was given to environmental awareness, socio-economic factors, mitigation measures, and compliance with regulatory authorities.

1.9 Limitations of the Study

During the process of the research, the following challenges were encountered: Security is one of the main reasons for the birth of gated communities. As such, many project proponents are suspicious of intruders. This presented a problem regarding accessing the targeted estates. In some cases, the researcher had to write a letter to the management of the estates asking for permission to access the estates. Also due to insecurity in Nairobi County, some residents live in fear. Owing to this phenomenon, some respondents were reluctant to receive the enumerators. The researcher had to enrol estate managers to introduce the researcher and enumerators to the targeted respondents. The researcher also had to assure the respondents that their identity would be kept anonymous.

Some questions touching on issues like age, income and family size were personal. This aroused suspicion among some respondents as regards the motive of the study. As such, some few respondents did not respond to questions which they considered personal.

Another challenge was that it was not possible to take accurate measurements in all instances hence in some places the researcher was forced to use observation which was not very accurate.

The researcher did not have chance to examine all relevant Acts of Parliament pertaining to environmental sustainability of residential estates. Therefore, only the most relevant Acts to this study were used like the Water Act 2002, EMCA 1999, Building Code and Zoning.

Gated communities are scattered all over Nairobi County and are not documented separately by official government agencies like City Council of Nairobi, NEMA, Kenya National Housing Cooperation or Kenya National Bureau of Statistics. As such, the researcher opted to use listings of gated communities from Knight Frank which is a major realtor dealing with residential estates in Nairobi County.

1.10 Basic Assumptions of the Study

In order to achieve the objectives of the study, the following assumptions were made: This study assumed that the respondents to be interviewed would be truthful and honest when responding to questions. It was also assumed that the respondents would be available to answer questions. It was further assumed that the respondents would understand the questions which would be posed to them.

1.11 Definitions of the Significant Terms used in the Study

Significant terms in this study are defined in this section based on how the terms were used in the study:

Environmental Sustainability of Real Estate Projects

This is the non-compromising and continued existence of real estate projects influenced by factors such as renewable energy, green cover, recycling of waste and proper garbage disposal.

Environmental Awareness

This is sensitisation concerning the environment that is created when one is exposed to both formal and informal education.

Socio-Economic Factors

This is an inter-relationship between economic activities and socio life whereby ones status in society is determined by how much they earn. It is how much one earns that determines things like spending and ability to purchase technologies that enhance environmental sustainability or engage in behaviour of excessive production of waste.

Mitigation Measures

These are efforts taken to reduce the impact of real estate projects on the environment. Such efforts include use of renewable energy, planting of trees, harvesting of rain water and many more.

Compliance with Regulations

These are rules that are supposed to be adhered to in order to ensure environmental sustainability of real estate projects. The rules would include carrying out Environmental Impact Assessment and Environmental Audits.

Gated Communities

These are many housing units inside a perimeter wall fence with security as the main concern. They are communities that have a gate to limit access; they have streets and other services and accessible features to residents such as swimming pools, shops, gymnasium, play grounds which are restricted to insiders. Residents are obliged to abide by certain regulations like payment of monthly service charge for security, cleaning/gardening, street lighting, garbage collection and maintenance of facilities like gym and water pumps. Besides, there is a management put in place which enforces rules and run affairs of the community.

Sustainable Technologies

These are technologies in real estate that use less energy, few limited resources, and durable materials in order to reduce replacements.

1.13 Organisation of the Study

This research paper has five chapters. Chapter one describes the background of the study, the statement of the problem, research objectives and research questions, justification of the study, limitations and delimitations of the study, significance of the study, assumptions of the study and definition of the significant terms as used in this study.

Chapter two is about literature review. The chapter analyses and critiques literature related to the study from global, regional and local perspective. The chapter concludes with a conceptual framework which is a brief explanation of the relationship between the variables identified in the statement of the problem, the research objectives and questions.

Chapter three presents the methodology used in this study. Since this was a descriptive research study as it deals with factors influencing environmental sustainability, the researcher used a cross-sectional descriptive survey research design. Relevant issues discussed in this chapter include research design, target population, sampling procedure, a description of data collection methods, validity and reliability of research instruments, measurement of variables and methods of data analysis.

Chapter four presents the findings, analysis and implications of the survey based on the four objectives of the study. The data was present in form of tables which showed frequencies and percentages of the variables.

Chapter five is a summary of the findings. In this chapter, an in-depth discussion of the main findings is given. Recommendations based on the study are also provided in this chapter. The recommendations can create awareness and help in wide adoption of modern technologies that enhance environmental sustainability of residential estates in Kenya. In addition, the chapter provides relevant conclusions and recommends areas for further study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The previous chapter comprised an introduction to the study problem. In this chapter, relevant literature that underpins this study was reviewed. The literature was reviewed from global, African and Kenyan perspectives. The chapter focused on environmental awareness, socio-economic factors, mitigation measures and the level of compliance with regulatory authorities in residential estates. The chapter culminated into a conceptual framework that gave a road map and guide to the study.

2.2 The Level at which Environmental Awareness Influences Environmental Sustainability of Real Estate Projects in Kenya

Environmental awareness flows from environmental education. A landmark for environmental education at the international level was the International Conference on Education organised by UNESCO and UNEP at Tbilisi in former USSR in 1977. Goals of environmental awareness were defined as: creating environmental awareness, impart general knowledge for basic understanding of environment, acquiring environmental friendly attitudes and values and creating new patterns of behaviour towards the environment. Agenda 21, Chapter 36 which is devoted to environmental education states that “education is critical for promoting sustainable development and improving the capacity of people to address environment and development issues”.

With environmental education comes information which provides data sources crucial for measuring the environmental performance of real estate portfolios. Information can help developers in terms of proper choice of place for building estate projects, using building materials that are environmentally friendly and adopting ways of making real estate portfolios environmentally sustainable like usage of renewable resources, recycling of water and waste, planting of trees around the premises and many more (Hoerisch, 2002).

Environmental awareness of real estate housing requires sources of information and communication which in turn requires a medium. As such, the media has a crucial role to play in creating environmental awareness of real estate housing. We can divide media into three categories namely mass media like radio, television and newspaper; institutional media

like school, governmental officials or village leaders and traditional media like family members, relatives, friends and NGOs (Hoerisch, 2002).

Hoerisch (2002) outlines the kind of mass media that are important in explaining environmental awareness of real estate such as newspapers, radio and television. There is a lot that can be read in Kenyan newspapers about environmental awareness pertaining to real estate. The Nation Newspaper in Kenya for example, carries articles about environmental awareness of residential estates. According to Hoerisch, countries like German and India promote environmental awareness by introducing special environmental magazines. *Down to Earth* is for example a popular environmental magazine in India. The magazine fills the gap created by Indian media in terms of coverage of environmental issues.

Hoerisch (2002) informs us that the radio plays an insignificant role in creating environmental awareness of real estate because in most countries, there are few regular environmental programs on radio. In India however, motivated by the Ministry of Environment and Forests, Delhi FM broadcasts two weekly programs on environment and these are "Kinare-Kinare" and "Ao Dilli Savaren". The programs address issues like water, air, noise pollution, deforestation, solid waste disposal and others and the real estate sector is one of the major contributors to these issues. The BBC's "Earth Report" offers exclusively information on the environment and with the daily broadcast of *The New Adventures of Captain Planet* on Cartoon Network, there is at least one program on environmental issues specifically designed for children. In spite of that, the radio is well below its potential in creating environmental awareness in many countries. In order to offer environmentally sound solution to plastic waste management in Kenya, the media is involved as a strategic partner and it focuses on public awareness and education. This year (2013), there is a project on public awareness and education that is targeting 50 housing estates on trial basis in Nairobi, Kisumu and Mombasa as the initial target region (NEMA, 2013).

Institutional Media (education at school) is another valuable tool in creating environmental awareness related to residential estates. As such, environmental consciousness should inform teaching in schools and the entire education process from primary, secondary and tertiary institutions. As part of environmental awareness at tertiary level, the University of Nairobi set two sections namely Department of Real Estate and Construction Management and Department of Geography and Environmental Studies and other departments which tackle

environmental issues. Environmental education is on the syllabus in Kenya and is taught in primary schools (Langat, 1990).

There are also environmental awareness initiatives going on in Kenya. In line with the Greening the Blue Campaign which was launched on World Environment Day on June 5, 2013, Suzanna Owiyo, a UNEP National Goodwill Ambassador in Kenya started an awareness initiative known as *Soko Bila Waste – Every Little Thing Count*, aimed at sensitising farmers, households, vendors and consumers about the importance of reducing food waste across the distribution chain (UNEP, WED 2013).

Tradition media also plays a crucial role as regards environmental awareness. Tradition media includes direct interaction and communication of individuals with family, friends and neighbours. The interaction can play a significant role in enhancing environmental awareness. However, the use of traditional media is more of an indicator of prevailing level of environmental awareness than a factor contributing to it. According to a survey by Hoerisch (2002) in India, it was discovered that only 11% of interviewed persons talked about discussing ecological issues quite often whereas 60% sometimes or rarely and 29% never discussed at all. The result showed low level of environmental awareness. In spite of some inadequacies, the media still remains a powerful instrument in creating environmental awareness as it is able to reach a vast percentage of complex society.

Hoerisch, Langat and other articles discuss environmental awareness in the preceding chapters. However, none of them discusses how environmental awareness affects the behaviour and attitudes of people in terms of implementing what they know about environmental awareness. As such, the discussion does not show how environmental awareness contributes to environmental sustainability because awareness should be coupled with the will to implement what one is aware of in order to ensure environmental sustainability of real estate projects.

2.3 The Influence of Socio-Economic Factors on Environmental Sustainability of Real Estate Projects in Kenya

Socio-economic factors - also widely spoken of as socio-economic status (SES) - denote relationship between economic activity and social life. Basically, SES has three indicators namely financial resources or income, employment or occupation and level of education

(Loomis, 2000). These indicators can determine environmental sustainability of real estate projects as follows:

A simple economic theory states that there is a correlation between production and consumption. Production and consumption are related to financial resources or income. The relationship is that the more the income, the more likelihood the production and consumption. In order to preserve the environment, there is need to strive for sustainability in consumption and production patterns as these can reduce the use of natural resources and carbon dioxide emissions and in the long run achieve low carbon lifestyles and green economies. As such, the global community has to adopt more sustainable consumption and production patterns in order to alleviate some of the environmental challenges that we face (Loomis, 2000).

To improve Kenya's environmental performance, a better understanding of socio-economic and behavioural forces driving unsustainable production and consumption is required. Economic growth, as measured by per capita national income, affects environmental quality (Constatini & Martini, 2010). As economy expands, environmental damage increases. However, a number of variables vary monotonically with income and in different directions according to Shafik (1994); for example access to safe water, sanitation, clean energy like solar panels and sustainable building materials show improvement with economic growth whereas there is an indication that CO2 emissions and waste generation deteriorate. Evidently, the richest countries' carbon emissions and resource consumption are continuing to increase beyond sustainable levels whereas some developing countries appear to perform better than developed countries from the environmental point of view (Moran, et al., 2008). As such, economic growth may not necessarily be beneficial to environmental quality. Income distribution rather than average levels of income maybe critical determinant of environmental degradation.

Afroz, Keisuke and Tuddin (2010), conducted a study to obtain information on waste generation, socio-economic characteristics and willingness of the households of residential estates towards separation of waste. From 402 respondents in Dhaka City, it was discovered that dominant factors that influenced waste generation of households included household size, income, concern about the environment and willingness to separate waste. In order to improve waste management and reduce the environmental degradation in residential estates, these factors must be controlled.

Environmental sustainability of real estate projects is also related to both financial and economic sustainability. Financial sustainability is the ability of a project to generate sufficient cash flows in an on-going way to deliver vital services to stakeholders over time and to guarantee achievement of project objectives. Economic sustainability on the other hand is the ability to identify and employ available local resources in a long run and in a self-generating manner without creating dependencies. While a project should start with absorptive capacities, there must be a deliberate effort to grow the project into a transforming and sustaining enterprise. The basis for sustainable income generating is the logic of the enterprise (Levi, 2012). If a project is not financially and economically sustainable, it can have a negative impact on environmental sustainability too; for instance if a residential estate is not financially and economically sustainable, maintenance of the surrounding environment and facilities becomes a problem. This in turn affects the environment.

One of the major contemporary problems of our time concerns the challenge encountered in making sure that natural resources are consumed and waste is produced at sustainable rates. In spite of the endorsement in 2000 of environmental sustainability as one of the Millennium Development Goals to be achieved by 2015, global rates of consumption and waste production were estimated to be at least 25% higher than the capacity of the planet to provide to provide resources and absorb waste. This rate rose to 50% by 2007 (Emerson, et al., 2010). One way of achieving environmental sustainability is social change through societal transformation. Spending is usually connected with occupation. For instance, those with lucrative occupations would tend to produce more in terms of waste and buy high polluting expensive cars to match their status in society.

From the literature reviewed, there is very little said about how socio-economic factors influence environmental sustainability of real estate projects in Kenya.

2.4 The Influence of Mitigation Measures on Environmental Sustainability of Real Estate Projects in Kenya

Residential estate projects come with negative impacts like displacement of existing land uses and destruction of environmentally critical areas. They can also be a danger to residents by introducing hazardous conditions like air, water and noise pollutions, excessive depletion of resources such as fuel or timber which reduces forest cover and many more. As such,

mitigation measures are taken to ensure environmental sustainability of residential estates. There are a number of mitigation measures that can be taken to ensure environmental sustainability of residential estates. According to a study conducted by UN-Habitat (2012) concerning ecological housing in Setagaya-Ku Fukasawa in Tokyo, Japan, it was found that there were many environmentally sustainable estate houses in 2007 in Japan with high levels of thermal insulation, solar collector for heating and solar cells. There were also rain water collection equipments installed, wind turbines attached, heating and cooling methods applied and the design was made according to the local wind patterns to enable natural ventilation during hot and humid summers. It was also found that green cover was increased by preserving trees and installing green rooftops which acted as carbon sinks by offsetting carbon dioxide through the process of carbon sequestration. Some of the mitigation measures that can be taken to ensure environmental sustainability of residential estates include:

2.4.1 Green Building Technologies

Green buildings leave lighter footprint on the environment through conservation of resources, while at the same time balancing energy-efficient, cost-effective, low-maintenance products for construction needs. Green buildings are an example of green technology (environmental technology or clean technology) which is an environmentally friendly technology and is created and used in a way that conserves natural resources and the environment.

Mbogo (2012) conducted a study on green building. The findings of his study indicate that green buildings are not common in Kenya. However, he cited a few green buildings that are not residential but exist in Kenya like the one inside the UNEP headquarters in Nairobi. The building is sorely powered by renewable energy like solar power and has water collection and recycling facility. Kenya Commercial Bank is also developing such building in the financial district of Upper Hill. Daily Nation of Thursday, June 3 2013 reported that there are plans to put up eco-friendly buildings like the one at UNEP headquarters in all county headquarters. According to Mbogo, such buildings offer good examples in terms of how to harvest rainwater and water recycling systems. They also have a lighting system which is developed in such a way that natural lighting is used adequately. As one way of promoting green building, Nairobi City Council is in the process of passing a by-law to compel all buildings within the council's jurisdiction to have water harvesting facilities. This would increase water access especially in areas where water is rationed.

Mbogo (2012) also discovered that green building technology in Kenya faces a massive challenge of capital investment. In his study, he noted that banks in Kenya do not have the expertise to profile risks in loan products pertaining to technologies like green buildings. However, in order to promote green technologies in Kenya, the International Finance Corporation and the European Investments Bank are engaging Kenyan banks to improve capability of their renewable energy financing products. GoK also has a green agenda as already seen in efforts by KPLC which introduced one million energy saving bulbs into Kenyan homes thereby saving 60MW of electricity. Green building in Kenya is no longer viewed as just a fashionable trend, but an integral way to put up houses.

In some quarters in Kenya, there is an effort to adopt Leed Certification. This is a green building rating system that provides a set of standards for environmentally sustainable construction. In Kenya, Leed rating system addresses six major areas and these are: sustainable site development, water savings and efficiency, energy efficiency and atmosphere materials and resources, indoor environmental quality and innovation and design process. There is a project at Strathmore University using green building rating system. The building uses innovation in its structures, natural lighting, water management, energy efficiency and indoor air quality (The Search for Leed Certification, 2012).

Another green building technology is called eco-home which falls within the broader categories of sustainable architecture. Eco-homes make use of sustainable architecture; they create an environmentally friendly, aesthetically pleasing, cost effective and energy efficient building. Due to high cost of fuel and electricity, sustainability of buildings is the way to go. As such, eco-homes which make use of sustainable architecture are gradually becoming a must in construction industry as manifested in Europe, Arab World and Far East. Eco-homes which use sustainable housing and architecture principle can also be seen in traditional building construction which uses basic locally available materials thereby reducing transportation costs and emissions. An eco-home which is sustainable has environmental advantages as it has low-impact on the environment by reducing energy used in construction. Such house also uses sustainable building materials like timber, stabilised soil blocks, bamboo, bricks, recycled, refurbished or salvaged building components like doors and windows. Sustainable houses also use passive and active-energy regulation systems, low-energy consumption fixtures, renewable energy, rainwater harvesting, grey water systems and indigenous plants are used in landscaping. They utilise natural ventilation and lighting

extensively by constructing transparent walls and roofs. Ultimately, sustainable houses reduce carbon footprint greatly by lowering gas emissions (Obanyi, 2011).

The idea of eco-homes is in line with Chapter 33 of Agenda 21, paragraphs 76 – 78 which spells out a programme for further implementation of Agenda 21. This part of Agenda 21 is about commitment to innovative ways of applying energy efficient, environmentally sound and cost-effective technologies which are supportive of sustainable development. The challenge here as Nzioki (2002) observers is that this requires additional financial resources.

Green gardens also belong to green building technology. They boost the environmental sustainability of residential estates by intercepting storm-water runoff, reducing the load on the building's drainage system, reducing overall heat absorption of the building which in turn reduces energy consumption, cool the buildings and save energy. Apart from reducing indoor temperatures, rooftop gardens can slash the amount of electricity used on air-conditioning, purify the air and reduce noise (Shanghai Daily, 2006).

According to Getter & Rowe (2006), green roofs result to 1% energy-saving annually, 6% saving in cooling costs during summer months and 25% saving during peak cooling hours. A recent study carried out by UN-Habitat on Sustainable Housing for Sustainable Cities (2012) indicated that roof top gardens are common in China. The study noted that recent policies in Toronto and Copenhagen have posited mandatory green roofs. Roof top gardens are also mandatory in several cities in Australia, Switzerland and German.

Green buildings also include eco-renovation. This is the ultimate in recycling of the whole building and not just its components. It is argued in the article "Sustainable Housing in the East Midlands" that since eco-renovation uses low-energy and sustainably produced material, it has the potential for environmental benefit as it creates buildings with low energy requirements and running costs, enhancing health, being resource efficient and most importantly minimising waste. Such houses have the potential savings in heating energy by renovation of about 30 percent on average. In South London, Lambeth Council was persuaded by tenants to adopt eco-friendly approach in refurbishing a block on Engell Estate which was built in the 1970s. As a result, some steps were taken like replacing metal windows with timber panelling and 'breathing' construction.

The argument attributed to eco-renovation having environmental benefit is that it makes best use of the resources already in use. This is because if a building is to be demolished and another one is erected, there is a lot of waste. Although there is material re-use after demolishing a building, yet many materials can only be downgraded and if such materials are to be recycled, further energy use is involved hence from the environmental point of view, it is better to renovate and repair than to build new (Sustainable Housing in the East Midlands, 2009).

Renewable energy (clean energy) is also part of green building technology. This refers to energy supplied from renewable energy sources like wind and solar power, geothermal, hydropower, waste-to-energy and other forms of biomass which contribute to energy for sustainable development. Energy is mainly consumed in four sectors namely the manufacturing, commercial, transport and residential. There has been big concern by international conventions like The 1992 Earth Summit in Rio de Janeiro, the IPPC, the UNFCCC and the Commission for Sustainable Development in terms of massive consumption of fossil fuels which contribute to global environmental problems like global warming and climate change. The Kyoto Protocol which was a Climate Change Convention called for decrease in emissions by improving energy efficiency and the use of renewable energy sources.

Findings of a Comprehensive Study and Analysis on Energy Consumption Patterns in Kenya (2010) was that energy demand for households in Kenya showed that about 70% of the consumers in household sector use biomass while 30% use other fuels. On overall basis, the use of renewable energy from solar, biogas and wind is low in Kenya with 3%, 0.2% and 0.1% respectively. However, the energy choice decisions at household level is influenced by several key drivers like income of household head, employment level, price of energy, education level, total energy expenditure and location by region among other factors.

According to a research conducted by Kamau (2012), it was discovered that the most catastrophic effects of climate change can be averted by among other things cutting down on the use of fossil fuels in buildings and instead relying on renewable energy sources. Theoretically, if this reduction is done by about 50% today and by an additional 10% every five years, then by the year 2030 reliance on fossil fuels would be close to 0%. The ultimate aim of residential estates, which is part of the built environment, should be to make

maximum use of natural renewable energy like the use of solar power unlike artificial energies which produce greenhouse gases. In this regard, a leaf can be borrowed from Barcelona in Spain where solar thermal ordinance requires all new buildings and major renovations to use solar collectors to supply at least 60% of energy used to heat water (OECD, 2010).

Another component of green building technology is sustainable building materials. One of sustainable building materials that are significant is timber. Timber has been used from time immemorial in the building industry. However, a system using structural insulated panels has been developed recently. This is two composite timber sheets enclosing a rigid insulation to form a load bearing wall. Building using timber has advantages in the sense that timber is the only renewable structural building material with replacement in that if each tree felled is replaced, it can never run out. Timber also has a low embodied energy in comparison with other building materials. Timber accounts for very little pollution in its manufacturing since it is a low energy user. There is very little waste generated in the production and use of timber as each part of the tree has viable end use. As trees grow, they absorb carbon dioxide; as such, harvested timber acts as 'carbon sink' that locks up the carbon dioxide absorbed by the tree until it is burnt or rots away. In the article "Sustainable Building Materials and Technologies", it is spelt out that one kilogram of dry timber contains about 50 percent carbon, which binds in 1.8kg of carbon dioxide. An average tree absorbs 9.1 kg of carbon dioxide in one year, equivalent to the amount emitted by a car travelling 18,300km. A good example of timber frame buildings that were built in 15th century onwards are still standing in UK (Environmental Impact of Materials, 1995).

According to Kamau (2012), biodegradable materials in construction instead of the more commonly used synthetic materials in buildings have to be the way to go. Synthetic materials are not sustainable building materials as they cannot be readily broken down by elements of nature once the building ceases to be functional. Usually, owners are unwilling to reuse the rabble resulting from such buildings. The use of timber as mentioned above and other elements like earth and stones is highly encouraged since they are biodegradable and easily accessible. The use of sustainable building materials and technologies resonates with the Habitat Agenda adopted in the Instanbul Habitat Conference of 1996 which aims at reducing the negative environmental implications of building materials and construction technologies. The Habitat Agenda emanates from The Brundtland Commission's Report Our Common

Future 1987 which addresses environmental sustainability, concerning the use of renewable materials and the reduction of green house gas emissions.

2.4.2 Other Mitigation Measures

Reducing, Recycling and Re-Using of Waste is another mitigation measure that can enhance environmental sustainability of real estate. Waste is an item or substance which has no utility value to the holder of the item. It may include any matter whether liquid, solid, gaseous or radioactive discharged, emitted or deposed in the environment in such a volume likely to cause alteration of the environment (Environmental Management and Coordination Act, 1999). Agenda 21, Chapters 7 and 21 is on solid waste management and sewerage related issues. Measures to reduce waste and promote its re-use, recycling and recovery are central to sustainable environment. In the 21st century alone, we have witnessed unprecedented increase in volumes of waste that equals and sometimes outpaces economic growth. Usually, out of all waste that is generated, less than half is recycled according to Agenda 21.

In European Region for example, as of 2007, out of the total waste generated, 31% was land filled, 42% was recycled, 6% was incinerated with energy recovery and 21% was unaccounted for. Land filling and incineration result into water, air, noise and land pollution. Waste is therefore a serious and growing problem worldwide. The EU however has adopted what is called the 'waste hierarchy' which calls for waste management in the order of reducing waste generation first. If reducing is not possible, then recycling and incinerating waste with energy recovery should be pursued. The worst option is identified as use of landfill and incineration without energy recovery (Life and Waste Recycling, 2007). According to an article in "Our Planet" by UNEP, an estimate 1,000 tonnes of solid waste is generated in Nairobi each day. About 500 tonnes pile everyday without hope of being removed. For liquid waste, the sewerage system is overloaded and poorly maintained thereby leading to frequent bursting (Nzioki, 2002).

As regards garbage collection and treatment system, uncollected garbage mostly from residential estates has contributed to a vicious cycle of water pollution, water-borne diseases, poverty and environmental degradation in Nairobi County. Waste management is a growing problem in Nairobi as increase in solid waste generation is not marched by capacity to address the problem, argues Tibaijuk (2007). Plans to tackle solid waste are underway in Kisumu. According to a correspondent of Daily Nation, Wednesday May 15, 2013, Kisumu

has set aside Sh100 million to deal with solid waste. This will be done by buying land in an environmentally safe region and set up three biogas digesters, incinerators and landfills. At the biogas plant, biodegradable wastes will be sorted at transfer stations set up at various points in Kisumu Town. The biogas generated will be piped to homes near the plant. The idea of biogas digesters is environmentally friendly. However, incinerators and landfills are not that environmentally friendly as land filling and incineration result into water, air and land pollution.

According to the City Council of Nairobi, in 2002 some 1530 tonnes of solid waste was generated in Nairobi everyday of which 40% was uncollected, disposed of by burning or illegally dumped. Food waste, plastic and paper are the most dominant forms of solid waste in Nairobi (City Council of Nairobi, 2007). Plastic waste is major sources of many environmental problems. Plastic waste blocks gutters and drains thereby creating serious storm water problems. Improper disposal of plastic bags provide breeding habitats for mosquitoes which cause malaria and when burned, plastic releases toxic gases like furan and dioxin. According to a report by Chemical Information Exchange Network (CIEN) waste dumpsites in Kenya are often located near the most vulnerable communities especially in densely populated environments like Dandora Municipal Dumping Site which accommodates most of Nairobi's solid waste. Such dumpsites cause health problems especially to the poor. Sometimes waste is dumped into rivers causing water pollution, poisoning, death and even extinction of some aquatic plants and animals.

In Nairobi, the trend is that most of the recyclable waste is found in middle and high income areas. However, there are also companies for waste recycling which play a key role in resource recovery of solid waste by buying recovered material from the scavengers for re-processing. The materials that are recycled from solid waste include waste paper, cardboard, glass, metal and rubber. Players in plastic industry in Nairobi endeavour to collect plastic waste before its gets to dumpsites by organising youths to collect plastic waste from homes and selling them to big industries for recycling because it is difficult to recycle for example polythene bags contaminated with dirt (Sustainable Development in Kenya, 2012).

Rain water harvesting and re-use of water is also central to environmental sustainability of real estate. Urban development, persistent drought and climate change are among other notable phenomena that have brought pressures and significant strain on fresh water supplies.

According to estimates by Holcim Foundation for Sustainable Construction (2009), 2/3 of global population will face water shortage by 2025. As such, utilisation and judicious use of water is a must now. One of the ways of utilising water is by re-using bath and shower water or harvesting rain water from the roof in order to use such water for purposes like flashing of toilets and watering gardens instead of using fresh drinking water. In United Kingdom however, it is cost effective to save water than to reuse rain water or grey water. Capture and use of water on site has environmental advantages as the method does away with the need for piping and pumping water thereby reducing green house gas emissions and carbon footprint (Urban Water Harvesting and Reuse of Water, 2010).

Due to climatic challenges, harvesting and re-use of water is prominent in Adelaide Region in Australia. The water is stored and provides a back during prolonged dry periods. Such water captured in rain water tanks requires little or no treatment (Urban Water Harvesting and Re-Use of Water, 2010). This system has many advantages in terms of being cost effective and water quality improvement. But it also has some disadvantages like providing mosquito breeding areas in terms of open storages and space requirements in terms of above ground tanks. Nevertheless, harvesting and re-use of water has more environmental advantages than disadvantages. In Melbourne, Australia, 40,000 homes are required to use class A recycled water, metered and delivered separately rather than portable waster for toilet flushing, washing cars and watering outdoor landscaping (OECD, 2010).

2.5 The Influence of Compliance with Regulations on Environmental Sustainability of Real Estate Projects in Kenya

There is big temptation for developers of residential estates to turn a blind eye on regulations as they feel that complying with them is expensive. Of course some regulations to real estate industry are complex hence costly but dodging them can prove to be expensive in the long run to the environment and the wider living community. Regulations pertaining to the environmental sustainability of residential estates are both local and international. One of such international regulations is the Montreal Protocol which is aimed at phasing out chlorofluorocarbons (CFS). The following are some notable regulations to be complied with when planning, building and operating residential estates:

2.5.1 Environmental Management Coordination Act 1999

EMCA is an Act of Parliament meant to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for the matters connected therewith and incidental thereto. One of the general principles of EMCA is that every person in Kenya is entitled to a clean and healthy environment and every person in turn has a duty to safeguard and enhance the environment. The Act established an Authority called NEMA under Section 7 which is responsible for environmental protection and conservation issues. Some of the key elements of EMCA are EIA, Environmental Audit and Monitoring and Consultation and Public Participation.

2.5.1.1 Environmental Impact Assessment (EIA)

EIA is "a systematic examination conducted to determine whether or not a program, activity or project will have any adverse impacts on the environment" (EMCA, 1999). This is an assessment carried out in order to determine potential environmental impacts of a proposed development so as to obtain information that can help in decision making by relevant authorities. Some countries have adopted strategic EIA at planning level in order to consider potential impact on the environment of alternative strategies in achieving a given policy objective.

Muigua (2012) observes that EIA has gradually become an essential tool in environmental management since the time it was adopted in the USA in 1969, in the 1972 Stockholm Conference and in the 1972 National Environmental Protection Act of USA. Principle 17 of the 1992 Rio Declaration on Environment and Development also expresses the need for EIA. Agenda 21 endorses the need for individuals, groups and organisations to participate in EIA procedures and assess the environmental suitability of infrastructure in human settlements.

EIA is one of the tools for environmental management under EMCA in sections 58 and 59 in Kenya. It is required for residential estates at the planning stage. Compliance with EIA regulation in residential estates is proving to be a challenging and daunting task in Kenya. According to a study carried out on Environmental Impact Assessment in Kenya, Muigua (2012) states that there is need for all proposals of real estate projects to consider EIA in order to ensure sustainable development. This is an obligation in relation to the environment as stipulated in Article 69 of the Kenyan Constitution. However, in his study, Muigua discovered that recent real estate projects in Kenya have not adequately complied with EIA

and other sound environmental management practices. Muigua also observes that implementing EIA is a challenge in Kenya due to the numerous lead agencies dealing with specific components of the environment like forestry, water, energy and other ministries. As such, sound environmental management has been hindered by the lack of a harmonised regulatory framework. At the Centre of EIA is public participation as explained below:

2.5.1.2 Environmental Audit and Monitoring

As indicated, EIA is required for residential estates at the planning stage. For residential estate projects that are completed, what is required are yearly Environmental Audits (EA) as specified in Section 68 of EMCA to be carried out with clear mitigation measures spelled out (Kimani & Musungu, 2010). In Section 68, it is stated that the Authority (NEMA) shall be responsible for carrying out the environmental audit of all activities that are likely to have significant effect on the environment. In the same section, it is also indicated that the owner of the premises shall make annual reports to the Authority describing how far the project conforms in operation with the statements made in the EIA study report.

2.5.1.3 Consultation and Public Participation

The UN Conference on Environment and Development launched the idea of sustainable development to governments and communities. It emphasised the need for public participation. One of the significant stakeholders that can contribute to environmental sustainability of residential estates is the local community. The local community is important in any real estate and indeed development project as its members are affected everyday by aspects of new development. The community members can be affected in terms of quality of air as vegetation is cleared to pave way for buildings. It is vegetation like trees that act as carbon sequestration and improve air quality. The surrounding community can also be affected by pollution as the new buildings bring in people with cars and other things that increase carbon footprint. The surrounding community can further be affected by obstructed views, traffic congestion, increasing demand on available facilities like schools and others. Involving the local community in decision making process gives the community control over shaping its own living environment and sharing ownership of new initiatives. The involvement should be coupled with capacity building which helps people to understand their rights, responsibilities and possibilities. Without public intervention, competitive private developers may generate a city with insufficient public land use and amenities to the

detriment of the environment. As such, the influence of the public is important to environmental sustainability of residential estates (UNCED, 1992).

Green developers in USA are of the view that involving the surrounding community in the process from the beginning helps promote mutual understanding while ensuring that the development addresses the community needs. Wilson et al. (1998, p.197) observe that listening to communities early dispels prolonged difficulties created later by people who are determined to have their say. Developers can involve stakeholders in discussions and site walks early in development process to allow for neighbourhood mitigation measures, design and density changes. Developers should talk to neighbourhoods on an ongoing basis and truly listen to what they hear. In Kenya, public participation is supposed to take place during the process of conducting the EIA study. The project proponent in consultation with NEMA must seek the views of persons who will be affected by the project.

2.5.2 Zoning

Zoning is one of the names given for the regulation of land use and density of development. Zoning means that one reserves land for a particular purpose and imposes minimum (maximum) restrictions on the size of the plot of land or housing unit that can be built. The main aim is to attract a particular mix of inhabitants or activities (Proost, 2010). Zoning was introduced first in 1869 in New York City to prevent unhealthy and odorous industrial land uses from locating near residential areas. In the study "The Geography of Nowhere" conducted by Kunstler, it is stated that zoning is a kind of control seeking stability in a time of explosive and destructive growth. Zoning prevents compact and mixed-use development in towns (Wilson et al, 1998). In Nairobi County, there is some regulation of land use like the division of housing into low, medium and high density areas.

2.5.3 Building Code

Building code is established to regulate construction at local level, mainly for safety, health and to protect property. One of the famous building codes are energy building codes which regulate various energy-related elements like building thermal design, indoor climatic conditions and air quality, systems for heating, hot water, ventilation, cooling, lighting, and the design. Mandatory building codes are rare in developing countries. However, the building codes provide guidelines regarding building standards and regulations in Kenya. The current building code in Kenya is also known as the Local Government Act. Under Cap 256 in

Articles 17 and 18, it is stated that the space in front of any building should be at least twenty feet (six metres frontage) whereas the space at the side where opening is located should be eight feet (2.4 metres).

Otieno (2012) observes that the building code is disregarded by some developers of residential houses in Nairobi County as evidenced by many buildings in Nairobi which sit cheek to cheek without an allowance even for opening windows. Otieno goes on to argue that the current building code is archaic. It is modelled on and is a replica of the British Building Regulations of 1948 which uses imperial system of measurement which is in feet contrary to the metrical system (metres) which Kenya uses currently. As such, there is need to adopt speedily the new code which is in the pipeline. The prospective code has some positive things like the regulation that every plot needs to have at least one access road. This may improve situations of places like Ongata Rongai where in some places buildings are constructed in such a way that two vehicles cannot pass each other along the narrow access roads.

2.5.4 Water Act 2002

Problems facing water resources in the world are mainly climate variability and environmental degradation. This has resulted into catchments degradation, drying up of rivers, degradation of water qualities and increased water use conflicts due to competition of the little available water resources. Due to rapid population growth in urban areas and mushrooming of residential estates, there is further strain put on the provision of water services in Nairobi County as the number of unserved people is increasing coupled with ineffective autonomous institutions to manage water supply and sewerage services. As such, the Water Act of 2002 came into existence in order to address the foregoing problems. Water Act is an Act of Parliament meant to provide for management, conservation, use and control of water resources and the acquisition and regulation of rights to use water (Cap.372).

The Water Act, as stipulated in No. 44, is mandated to establish an authority whose duty is to take special measures for the protection and conservation of ground water for public interest stake. The Act is also mandated to establish a Water Services Regulatory Board which shall have powers and functions to monitor compliance and establish standards for the design, construction, operation and maintenance of facilities for water services. In Number 55(1)(a), the Board also may arrange for the exercise and performance of all or any of its powers and functions under the licence and entrust these to agents known as water service providers. The

Act is also supposed to establish Water Resources Management Authority with one of its duties being regulating and protecting water sources quality from adverse impacts [No. 8(1)(c)].

Karanja (2011) observes that water supply and sanitation in Nairobi County is characterised by achievements and challenges. Among some of the achievements are the expansion of infrastructure to keep pace with population growth in particular through the construction of the Thika Dam and the reduction of water looses called *revenue water* from 50% to 40%. Some of the challenges include poor quality and eratic water supply (only 40% of those with house connections receive water continuously), loss of storage capacity in reservoirs behind dams through siltation accelerated by erosion in the Aberdare Range and blockages of sewers resulting in overflows. Waitathu (2013) on the other hand observes that there is water scarcity in Nairobi County as daily demand of water is about 700,000 cubic metres but available sources are only able to provide about 550,000 cubic metres every day. Water demand in Nairobi County is expected to continue especially with the urbanisation trend. However, most of water sources in Nairobi County continue to be threatened by human activities that even during the rainy season, consumers are faced with water rationing.

2.6 Conceptual Framework

The above reviewed literature has shown that demand for residential estates continues to rise everyday due to population growth among other factors yet the supply side is not able to meet the rising demand. It has also been revealed that the current number of residential estates is already causing environmental damage by production of waste and green house gases which cause global warming and climate change among other things. As more houses will be built to cater for the rising demand, more damage will be done to the environment if proper mitigation measures are not taken.

It is worth noting that a lot has been done in Kenya and other countries to curb the damage on the environment resulting from the effects of residential estates. Efforts have been put in place to ensure the environmental sustainability of the residential estate sector through sensitisation programs, establishment of EMCA and other regulatory authorities like the City Council of Nairobi and the Ministry of Housing. There is need for good will among all players in order to ensure that such efforts must yield good results. Apart from good will, there is also need to emulate success stories from other countries that have practised

sustainable housing by emphasising on clean and renewable energy, sustainable building technology and prevention and recycle of waste among other things. However, not much is said from literature reviewed on environmental awareness and compliance with regulations when it comes to real estate projects in Kenya. Nairobi County is struggling with issues like poor waste management, lack of sufficient clean water, lack of adequate of energy and issues of climate change.

In order to enhance environmentally sustainable housing in Nairobi County, it is conceptualised that factors such as environmental awareness, socio-economic, mitigation measures and compliance with regulations need to be re-looked with the aim of striking a balance. The result of this synthesis will be an increase in awareness of environmental conservation issues and mitigation measures when engaging in real estate projects, reduction of environmental degradation and an increase in sustainable real estate housing just to mention a few.

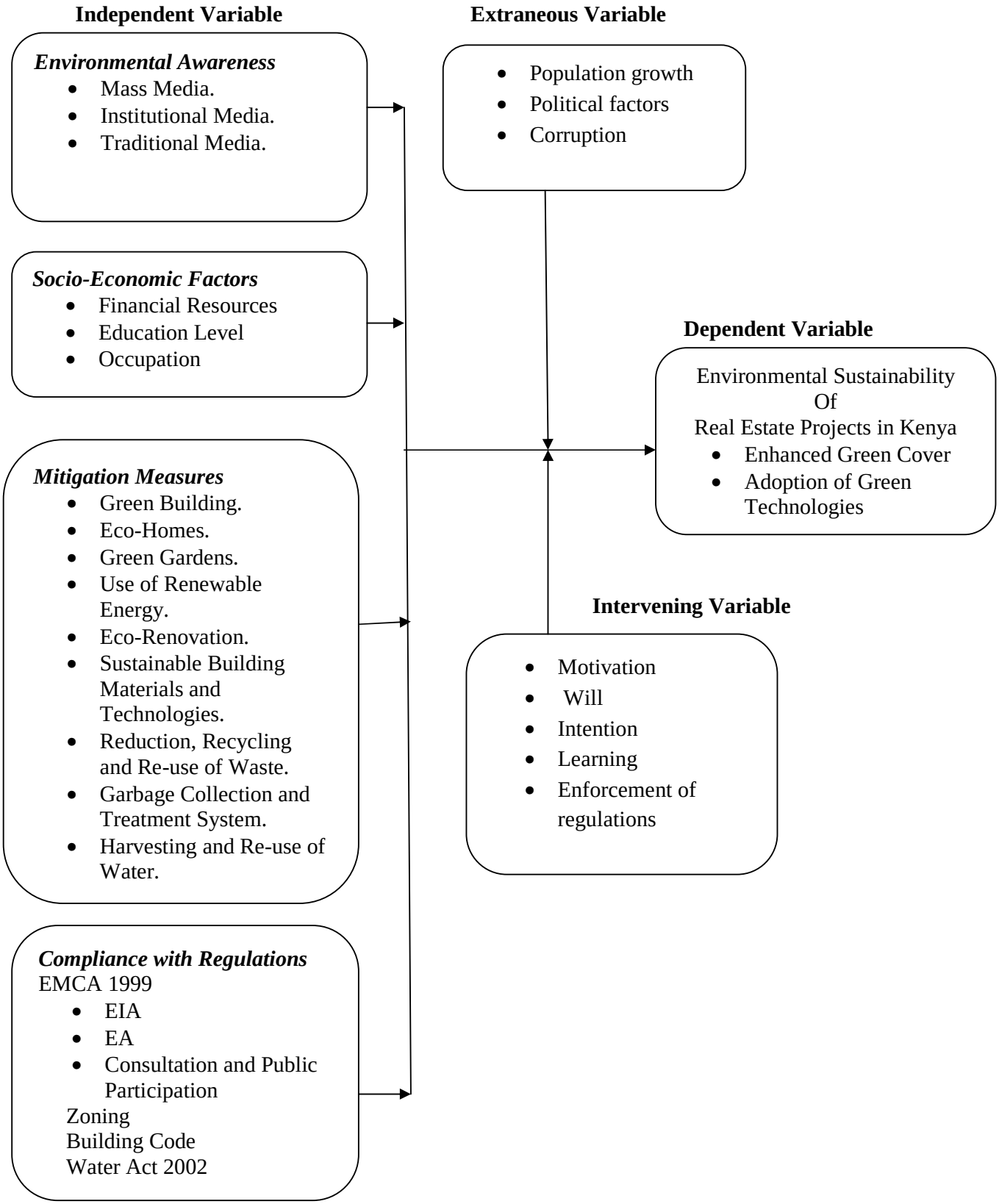

Figure 1. Conceptual Framework

Environmental awareness contributes to environmental sustainability of residential real estate. It is usually attained through environmental education that comes through media like radio, television and formal education in schools. Environmental education opportunities increase people's knowledge about the environment in terms of how to respond to negative impacts on the environment and adoption of the existing technologies and practises that contribute to the environmental sustainability of residential real estate.

Socio-economic factors contribute to environmental sustainability through ability to purchase things that enhance environmental sustainability like solar panels and other types of clean energy. Socio-economic factors can also help in improving handling of waste through proper collection and treatments.

Mitigation measures like green cover, prevention, recycling and re-use of waste, harvest and re-use water, proper garbage collection and exploitation of sources of renewable energy like solar electricity also contribute to the environmental sustainability of residential real estate. Harvest and re-use of water for instance utilises the already scarce water commodity and increase in green cover acts as carbon sequestration by absorbing carbon dioxide and in turn reduces carbon footprint which contributes to global warming and climate change.

Compliance with regulations is also of paramount importance in ensuring environmental sustainability of residential estates. Law pertaining to environmental sustainability can be legislated but it has to be enforced in order to contribute to the environmental sustainability of residential real estate. Some of the regulatory policy and framework include zoning which spells the type of building to be erected in particular areas, building code which guides the building process itself, EMCA 1999 which is legal framework pertaining to environmental sustainability and the Water Act of 2002.

2.6 Summary of Chapter Two

There are a myriad of benefits that come with real estate projects in Kenya in terms of improving the quality of life of people. However, the real-estate projects come at an environmental cost as noted above. Efforts are being taken in Kenya to engage in housing projects that are environmentally friendly. For instance, NEMA is encouraging private developers to increase green cover around houses by planting trees among other things which act as carbon sinks. Also, tenants are encouraged to reduce carbon footprint by emitting as

little carbon dioxide as possible in their daily undertakings. Reduction of carbon footprint is one of the ways of reducing green-house gases responsible for global warming and climate change. Various private developers and stakeholders in Kenya are being encouraged to go green by adopting eco-homes technology like in the United Kingdom and green building technology. Tenants are also encouraged to recycle certain substances like water and to dispose waste in a proper manner that is not detrimental to the environment. There is growing development effort to increase housing projects especially in urban areas in Kenya in order to meet the rising number of population and improve the quality of life of people. From the literature review, a lot has been said about mitigation measures and compliance with regulators to ensure environmental sustainability of real estate projects in Kenya. However, very little has been said about how environmental awareness by various stakeholders in Kenya influences environmental sustainability of real estate projects. This study therefore aims at fulfilling this gap established in the literature review together will other gaps in mitigation measures and compliance objectives.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides the methodology that was used in conducting the study. It gives the specific procedures that were followed in undertaking the study. Issues discussed in this chapter include target population, sample and sampling techniques that were used, the research design, description of tools that were used in collecting data, measurement of variables and techniques that were used in analysing the collected data.

3.2 Research Design

A research design is a conceptual structure, map or blueprint for conducting research in terms of instruments for collection, measurement and analysis of data (Selltiz, 1962). This study was a descriptive research as it investigated factors influencing environmental sustainability of real estate. As such, the study used a descriptive survey research design. There are different types of survey research designs; this study used a cross-sectional type of survey whereby different groups of people who differ in the variable of interest, but share other characteristics like educational background were asked questions about their experience on environmental issues.

3.3 Target Population

This study targeted all gated communities in Nairobi County that were constructed from 2007 to 2012. Gated communities from 2007 were targeted because this is the year when Environmental Impact Assessment became mandatory for all projects with significant environmental impact. According to this study, EIA is crucial to one of the objectives of this study which is compliance with regulatory authorities. As such, it is practical to get EIA reports for gated communities built from 2007. According to Private Building Plans approved by Nairobi City Council, there were 35,926 residential buildings constructed from 2007 – 2012. Gated community plans were included in the 35,926 residential buildings but were not documented separately. As such, the population of gated communities was drawn from a Kenyan realtor in real estate called Knight Frank. According to listings by Knight Frank, there were 103 gated communities built between 2007 and 2012. The study also targeted all residents of the sampled gated communities, estate managers and regulatory officials.

3.4 Sampling Procedure

Regarding sampling techniques, this study applied both probability and non-probability sampling techniques to ensure a good representation in all categories. The researcher used simple random sampling technique and purposive sampling technique methods. The reason for using these methods was because the study aimed at capturing information from diverse group of people with different occupations, gender, income, age and levels of education. The study wanted to cross-relate these different aspects to see if they have an influence on the environmental sustainability of real estate projects. In order to achieve this, the population was divided into two main sections namely the residential estates (gated communities) and the respondents. A simple random sampling technique was adopted for the gated communities. The respondents were divided into three sub-groups namely the tenants, estate managers and regulatory officials. For the sub-group of tenants also know as category one respondents, simple random sampling technique was used. For the sub-group of estate managers also known as category two respondents, all the estate managers of the sampled gated communities were picked since they were few as guided by Kothari (1985). For the sub-group of regulatory officials, purposive sampling technique was used to deliberately choose the sample (regulatory officials) that had the required information. This was done in order to get in-depth information from expert entities dealing with residential estates in relation to the objectives of this study.

Appendix iii on page 81 is a schedule for the tenants. *Appendix iv* on page 84 is a schedule for estate managers. *Appendix vi* on page 90 is an observation checklist that was marked when collecting data in order to determine mitigation measures, compliance or non-compliance, awareness or lack of awareness.

The size of the sample was selected as representatively as possible to minimise sampling error. A minimum sample size of 234 respondents was taken. The minimum figure was arrived at after considering the finances available for data collection and the length of time available to collect data. For the population of gated communities, 10% of the total number of 103 gated communities was sampled as guided by Kothari (1985). As such, the sample size was 10 gated communities. For the sub-category of tenants, 10% was picked from each of the sampled gated communities and the sample size was 220 tenants. For the sub-category of estate managers, the sample size was 10 estate mangers. For the sub-category of regulatory officials, 4 officials from City Council of Nairobi, NEMA, Kenya National Housing

Cooperation and Ministry of Water and Irrigation were sampled. *Table 3.1* shows sample sizes for each category of the population of respondents.

Table 3.1 Sample Procedure Matrix

Population under Study		
	Category of Participant	**Sample Size**
Category 1	Tenants	220
Category 2	Estate Managers	10
Category 3	Regulatory Officials	4
	Total	**234**

3.5 Data Collection Instruments

This section explains the way data was collected, processed, analysed and reported. Questionnaires and structured interview schedules were the main data instruments of collecting primary data. Secondary data was collected by using desk-top review.

3.5.1 Primary Data Collection

The required data was collected by using the following instruments:

3.5.1.1 Interview Schedule

Two sets of questionnaires were developed. One was for tenants of the gated communities (one questionnaire per household) and another one for estate managers of the gated communities. Structured interview schedules were administered to selected regulators so as to get in-depth information related to environmental sustainability of residential estates. *Appendix iii* on page 81 and *Appendix iv* on page 84 show the questionnaires that were used to collect data for tenants and estate managers respectively. The questionnaires comprised both close-ended and open-ended questions. One to one interview method was also used. The interviews were both structured and semi-structured. The interview method was chosen because of its high potential of accuracy in terms of outcome (Kothari, 1985).

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3.5.1.2 Observation

Observation was used in this study as a method of collecting data. This involved watching and documenting the status of waste-disposal areas, facilities for rain waster harvesting, types of electric bulbs used, usage of renewable sources of energy like solar panels, use of natural light, coverage area by green matter around the buildings, recycling of water and others. Through observation, the researcher was able to analyse the situation in order to determine issues like living standards that help to reduce carbon footprint and traffic congestion. This method was important in uncovering shortcomings in the existing methods with the aim of improvement. A checklist to aid observation is attached as an *Appendix vi* on page 90.

3.5.2 Secondary Data Collection

Prior to field work, secondary data collection involved desktop-review procedure. Documents that contain relevant information to the case under study were identified and systematically analysed. It is essential to review secondary data for the purpose of building a case for the study. The secondary data reviewed helped in shedding more light on the challenges and successes of residential estates in Kenya and the world at large. Some of the secondary data sources that were reviewed included legal Acts, past theses, research reports on residential estates, journals, online articles, books, Kenya Vision 2030 documents, Kenya County Network Report, Publications by UN Habitat and UNEP among others.

3.6 Validity of Data Collection Instruments

Validity is about how accurate the data obtained in a study represents the variables of the study. This means that a test must measure what it purports to measure and results obtained from an analysis of data must be representative of the issue that is being studied. In order to ensure validity in this study, there was a pre-test of the interview guides conducted by using ten respondents within the target population before the study was conducted as recommended by Mugenda and Mugenda (1999). The aim of the pre-test of the schedule was to make sure that the questions were set properly. In the process, suggestions and comments concerning instructions, clarity and relevance of the questions were sought from the ten respondents with the aim of making adjustments and improvements to the schedule.

As a way of avoiding the problem of instrumentation (unreliable measuring instrument), the study used only four research assistants. The number of research assistants was few in order to avoid the scenario of inconsistency that arises when the research assistants are many. If the

research assistants are many, there is a likelihood of inconsistency among the researchers in observing, measuring, scoring or assessing the characteristics under study (Mugenda & Mugenda, 1999). The study endeavoured to develop accurate measures or instruments and standardised data collection procedures by holding a training session for all who were involved in collecting data.

3.7 Reliability of Data Collection Instruments

Reliability tests the consistency of the instruments used after repeated trials. As a way of enhancing reliability, the study strove to reduce random error (deviation from true measurement) because an increase in random error decreases reliability. This was done by ensuring accurate coding of data and offering clear instructions to the subjects. As guided by Mugenda and Mugenda (1999), the study also employed a method of ensuring reliability called test-retest technique whereby a test-retest reliability coefficient was calculated by administering the same instruments twice to the same group of subjects at different times but under same conditions. The time lapse between the first test and the second test was four weeks as guided by Mugenda & Mugenda (1999). A reliability coefficiency of 0.8 was accepted since it implied that the instruments were reliable and consistent enough to measure the objectives of the study.

3.8 Data Processing and Analysis Techniques

When the data was collected, it was edited, coded and analysed. The data was processed using the following procedure: Firstly, in order to make sure that the answers which respondents provided were in line with the questions asked, all the questionnaires returned were edited. This was a very important procedure owing to the fact that different questions were administered to different categories of respondents. Furthermore, this exercise ensured that questionnaires from respondents who did not provide relevant answers to the questions asked were eliminated.

Secondly, a verification of the interviews conducted was carried out through a process known as back checking which involved cross-checking with the interviewees by repeating the process of asking questions. In some instances, certain questions were repeated in different format in the questionnaires. This was another form of validation as the researcher was expecting the same answer to the different ways of formulating the same question. The next

step involved converting the answers provided to the questionnaires into codes. This required preparing a data coding sheet with the accompanying explanation of each code.

The data was analysed by using a mixed method of data analysis which involved both qualitative and quantitative data analyses. The first step in analysing the data collected was to summarise the data using descriptive statistics which is quantitative analysis. This enabled the researcher to meaningfully describe distribution of scores or measurements using a few indices or statistics. Since the study involved research questions and objectives pertaining to getting people's experiences, opinions and attitudes, qualitative method of data analysis was also used to achieve this. Qualitative analysis was used for all data that was not quantifiable. This was done in a systematic way in order to come to some useful conclusions and recommendations. Recurring words were identified and used as basis for making judgements and conclusions. The statistics program SPSS version 17 was used to generate frequency distributions using descriptive statistics in order to examine the pattern of responses. Findings were presented on tables in form of frequencies and percentages.

3.9 Operational Definition of Variables

An operational definition, also known as functional definition in relation to data collection, is a clear and concise detailed definition of how variables will be measured in a particular study (Mugenda & Mugenda). *Table 3.2* shows how the variables were measured in this study.

Table 3.2: Types of Variables and their Measurements

Objectives	Variables	Indicators	Measurements	Scale	Data Collection Instrument	Data Analysis
1. To establish how environmental awareness influences environmental sustainability of real estate projects in Kenya.	**Independent Variables** Environmental Awareness	*Knowledge of existing technologies *Media roles *Adoption of existing technologies *Gender	i. Education level. ii. Level of awareness. iii.Male/female	Ordinal Ordinal Nominal	Questionnaires	Correlation and Descriptive Statistics
2. To identify how socio-economic factors influence environmental sustainability of real estate projects in Kenya.	Socio-Economic Factors	*Income *Occupation *Education *Age	i. Amount of income. ii. Type of job iii. Monthly service charges. vi.Number of years	Ordinal Ordinal Ordinal Ordinal	Questionnaires	Correlation and Descriptive Statistics
3. To assess how mitigation measures influence environmental sustainability of real estate projects in Kenya.	Mitigation Measures	*Green building *Eco-Homes *Eco-Renovation *Roof top gardens *Use of renewable energy *Waste disposal	i.Methods of waste disposal ii. presence of eco-homes, use of sustainable building materials iii.amount of space left for green cover	Ordinal Ordinal Ordinal Ordinal Ordinal	Interview guides, Observation, camera and questionnaires.	Descriptive statistics
4. To examine how compliance with regulations influences environmental sustainability of real estate projects in Kenya.	Compliance with Regulations	*Presence of EIA and EA reports. *Certificates of approval.	Adherence to policy and regulatory framework of: i.Building code ii. Zoning iii.EMCA 1999 vi. Water Act of 2002	Ordinal Ordinal Ordinal Ordinal Ordinal	Interview guides, observation and questionnaires.	Descriptive statistics
Environmental Sustainability of Real Estate Projects in Kenya.	**Dependent Variable** Environmental Sustainability	Residential Estates that are environmentally sustainable	*Estates that have large base of green cover. *Use of environmentally sustainable technologies.	Ordinal	Observation	Descriptive statistics

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter focused on presentation, interpretation and analysis of findings based on primary data collected from the respondents using questionnaires, interviews and observation guide. A critical analysis of each objective was done. From the data obtained, inferences and deductions were made in relation to the research objectives. The findings presented in this chapter have been discussed under thematic areas and sub-sections in line with the study objectives. The thematic areas include: study demographics, environmental awareness, socio-economic factors, mitigation measures, and compliance with regulations. The results are presented in form of tables.

4.2 Response Rate

A total of 220 questionnaires were administered to tenants and out of this, a total of 180 questionnaires were returned. This accounted for 82% of all questionnaires distributed. A total of 10 questionnaires were distributed to the estate managers and all were returned representing a response rate of 100%. This was a very good return rate as Babbie (2010) recommends that for survey research, 60% response rate is good and 70% response rate is very good and can ensure valid findings. Four officials from four regulatory authorities namely NEMA, Ministry of Housing, Ministry of Water and Irrigation and City Council of Nairobi were interviewed.

4.3 Demographic Characteristics of the Respondents

Since data was collected from tenants, estate managers and officials, it was necessary to present data first in terms of demographics of respondents.

4.3.1 Distribution of Respondents by Gender

During data collection, the gender of respondents was noted. Resulting distribution showed that out of the 180 tenants who participated in the study, 108 (60%) were male while 72 (40%) were female as shown in *Table 4.1*. The table shows that the distribution of gender is not evenly skewed. The gender of the respondents was noted because it has some relationship with a variable on environmental awareness.

Table 4.1: Gender Distribution of Tenants

Gender		Frequency	Percentage
Valid	Male	108	60
	Female	72	40
	Total	**194**	**100**

4.3.2 Distribution of Respondents by Age

The findings presented in *Table 4.2* shows that out of 180 tenants, there was no respondent in the age group of 18-25; the age group of 26-35 had 38 respondents (21%), the age group of 36-45 had 88 respondents (49%) and the age group of 46-95 had 54 respondents (30%). The age of the tenants was noted as it had some relationship with the possession of cars.

Table 4.2 Age Distribution of the Tenants

	Age Group	Frequency	Percentage
Valid	18-25	0	0
	26-35	38	21
	36-45	88	49
	46-95	54	30
	Total	**180**	**100**

4.3.3 Distribution of Respondents by Level of Education

The findings presented in *Table 4.3* show that out of 180 tenants, there was no respondent with only primary education; 7 (4%) had reached form four, 54 (30%) had completed college and 119 (66%) had completed university. The education levels were noted in relation to environmental awareness.

Table 4.3 Education Levels of Tenants

Education Level		Frequency	Percentage
Valid	Some Primary School (Class 1-8)	0	0
	Secondary Education (Form 1-4)	7	4
	Completed College	54	30
	Completed University	119	66
	Total	**180**	**100**

Table 4.4 shows that out of 10 estate managers, there was no respondent with secondary education only, 5 (50%) had completed college education and 3(30%) had completed university education.

Table 4.4 Education Levels of Estate Managers

Education		Frequency	Percent
Valid	Some Secondary Education (Form 1-4)	0	0
	Completed College	5	50
	Completed University	3	30
	Total	8	80
Missing		2	20
	Total	**10**	**100**

4.3.4 Occupation of Respondents

The findings presented in *Table 4.5* show the occupation of the tenants. The study established that out of 180 respondents, 141 (78%) were employed, 39 (22%) were business people. There was neither unemployed nor students respondents as regards occupation. Occupation was analysed in relation to the number of times tenants drive out each day as this has an effect on the carbon footprint that they leave.

Table 4.5 Occupation of Tenants

Occupation	**Frequency**	**Percentage**
Employed	141	78
Business	39	22
Students	0	0
Unemployed	0	0
Total	**180**	**100**

4.3.5 Gross Income per Month

The findings presented in *Table 4.6* show the gross income per month earned by the tenants. The study found out that those who earned between Ksh 50,000-100,000 were 7 (4%), those who earned between Ksh 100,001-200,000 were 48 (27%), those who earned between Ksh 200,001-300,000 were 86 (48%), those who earned between Ksh 300,001-400,000 were 26 (14%) and those who9 earned over Ksh 400,000 were 13 (7%). Income was noted in order to

establish the relationship between the income itself and the type of solid waste produced and the ability to procure things that enhance environmental sustainability like solar energy.

Table 4.6 Gross Income per Month

Income (Ksh)		Frequency	Percentage
Valid	50,000-100,000	7	4
	100,001-200,000	48	27
	200,001-300,000	86	48
	300,001-400,000	26	14
	Over 400,000	13	7
Total		**180**	**100**

4.4 The Extent at which Environmental Awareness Influences Environmental Sustainability of Gated Communities in Nairobi County

The first objective of this study was to establish to what extent environmental awareness influences the environmental sustainability of real estate projects in Kenya. This section has subheadings as follows: relationship between education level and environmental awareness, sources of information, Awareness on bio-degradable and non-biodegradable solid waste, Reasons for not separating solid waste, awareness on domestic solid waste in relation to gender and awareness of technologies in relation to Levels of education.

4.4.1 Relationship between Education Level and Awareness of Technologies

This part of analysis shows respondents' awareness of technologies that enhance environmental sustainability in relation to their levels of education. The respondents were asked about whether they had heard about the outlined technologies. *Table 4.7* presents the distribution of their responses. The finding shows that 10% of respondents with college education were aware of green buildings as compared to 30% of respondents with university education. On renewable energy like solar, 50% respondents with college were aware compared to 30% of respondents with university education who were aware. None of the respondents with college education was aware of eco-renovation where as 10% of those with university education were aware. Among the respondents with university education, 30% were aware of sustainable building materials and recycling of waste compared to 10% of respondents with college education. As regards rain water harvesting, 20% of those with college education were aware as compared to 20% of respondents with university education.

The results show that awareness of different technologies that enhance environmental sustainability of residential estates increases with education level.

Table 4.7 Awareness of Technologies vis-a-vis Levels of Education of Estate Managers

Environmental Awareness							
Level of Education	**Base**	**Green Building**	**Renewable Energy**	**Eco-Renovation**	**Sustainable Building Materials**	**Recycling of Waste**	**Rain Water Harvesting**
College	5	1(10%)	5 (50%)	0 (0%)	1 (10%)	1 (10%)	2 (20%)
University	3	2 (20%)	3 (30%)	1 (10%)	3 (30%)	3 (30%)	2 (20%)
Missing	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
% Index	**10**	**3 (30%)**	**8 (80%)**	**1 (10%)**	**4 (40%)**	**4 (40%)**	**40 (40%)**

4.4.2 Sources of Information

Regarding the definition of environmental sustainability, most respondents gave the correct definition according to this study. The study further set to establish the sources of information on environmental sustainability. *Table 4.8* shows the data of where estate managers got information about environmental sustainability from. Those who got the information from radio were 5 (50%), those who got it from internet were (30%), those who got it from television were 5 (50%), those who got it from newspapers or magazines were 3 (30%), those who got it from school were 2 (20%) and those who got it from friends constituted 1 (10%). This implies that the radio and television are the most effective avenues of disseminating information pertaining to environmental sustainability. This can be attributed to the reality that most respondents have easier access to radio and television unlike the internet and newspapers. From the analysis, it also means that the respondents rarely talk about environmental sustainability as those who heard it from friends constituted only 10%.

Table 4.8 Where Estate Managers got Information about Environmental Sustainability

Source	Heard it From Radio	Heard it from internet	Heard it from Tv	Heard it From Newspaper	Heard it from school	Heard it from friends
Frequency	5	3	5	3	2	1
% Index	50%	30%	50%	30%	20%	10%

Table 4.9 shows the sources from which tenants got information about environmental sustainability. Out of the outlined methods used for disseminating information pertaining to environmental sustainability, 65 (36%) of the respondents heard it from television, 49 (27%) of the respondents heard it from newspapers/magazines, 25 (14%) of the respondents heard it from school, 18 (10%) of the respondents heard it from radio, 13 (7%) of the respondents heard it from internet and 11 (6%) of the respondents heard it from friends. This means that television remains the most effective instrument of disseminating information about environmental sustainability. The results also show that the internet and tradition method of disseminating information (neighbour to neighbour) still remain ineffective means of disseminating information concerning environmental sustainability in gated communities.

Table 4.9 Where Tenants got Information

Source	Heard it From Friends	Heard it from Internet	Heard it from Radio	Heard it from school	Heard it from Newspapers	Heard it from Tv
Frequency	11	13	18	25	49	65
% Index	6%	7%	10%	14%	27%	36%

4.4.3 Awareness of Types of Solid Waste

The study sought to establish if respondents were aware of the difference between biodegradable and non-biodegradable solid waste (garbage). Interestingly, all respondents said that they were aware of the two types of substances. The study then probed on whether the respondents separate these two when disposing them. *Table 4.10* shows responses from different respondents. The results showed that 162 (90%) of the respondents do not separate solid waste into biodegradable and non-biodegradable waste, 4 (2%) separate their garbage and 14 (8%) were missing. The results show that most of the respondents do no separate domestic solid waste into biodegradable and non-biodegradable in spite of the awareness.

Table 4.10 Separation of Biodegradable and Non-biodegradable Solid Waste by Tenants

Respondents		Frequency	Percentage
Valid	Those who separate	4	2
	Those who do not separate	162	90
	Total	166	92
Missing		14	8
Total		**180**	**100**

The study further probed the reasons why the majority of the respondents do not separate their solid waste into biodegradable and non-biodegradable substances. The reasons that were given are presented in *Table 4.11*. The results show that 70 (39%) of the respondents cited lack of separate bins to discriminate biodegradable and non-biodegradable substances when disposing, 52 (29%) said that they leave it to the waste collectors to separate the two, 22 (12%) said they have never thought about it, 14 (8%) said they do not bother to do so, 13 (7%) said that it is time consuming and 11 (6%) said that they do not see the need for doing that. The results therefore indicate that there is need to encourage and sensitise people to change their attitudes on the importance of separating the two types of solid waste.

Table 4.11 Reasons why Tenants do not separate Solid Waste

Reason	Don't see The need	It is time consuming	I don't bother	Never thought About it	I leave it to to the waste collector	Separate bins not provided
Frequency	11	13	14	22	52	70
% Index	6%	7%	8%	12%	29%	39%

One of the big concerns regarding the environment in the 21st century is the rate at which solid waste is being produced, treated and disposed. This study set to establish the kind of waste that is created in households of the tenants. *Table 4.12* shows the relationship between gender and solid waste awareness. The results of the findings show that 95 (53%) of men were aware of food as source of domestic solid waste, 28 (16%) of them were aware of polythene papers, 8 (4%) of them were aware of tins and 3 (2%) were aware of glass bottles. Women on the other hand showed more awareness than men as those aware of food as a source of domestic solid waste were 70 (39%), polythene bags/papers were 71 (39%),

tins/cans were 72 (40%) and glass bottles were 70 (39%). This implies that women are key partners in environmental protection for they are generally responsible for buying food, cooking, gathering water and fuel and other household chores especially in Africa. Women also have more awareness hence incentives to be stewards of nature in finding creative solutions to environmental crisis.

Table 4.12 Awareness on Domestic Solid Waste in Relation to Gender of Tenants

Gender	**Sources of Solid Waste**							
	Food		Polythene bags		Tins/cans		Glass bottles	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Men	95	53%	28	16%	8	4%	3	2%
Women	70	39%	71	39%	72	40%	70	39%
Total	**165**	**93%**	**99**	**55%**	**80**	**44%**	**73**	**41%**

The aforementioned analysis on environmental awareness shows categorically that a lot is known about environmental awareness. However, the analysis has shown that in spite of the awareness, very little is being done to enhance environmental sustainability in gated communities as depicted in the way residents dispose their waste. Moreover, other avenues for disseminating information pertaining to environmental sustainability like internet, school and radio are yet to be exploited.

4.5 The Influence of Mitigation Measures on Environmental Sustainability of Gated Communities in Nairobi County

The study looked into mitigation measures that may enhance environmental sustainability of residential estates. Measures such as pollution, handling of solid waste, water use and use of renewable energy were considered. Some of the issues like solid waste have been dealt with already in the preceding section.

4.5.1 Pollution

All respondents in this study acknowledged owning a vehicle. Some respondents had more than one vehicle. As such, the usual mode of going out for almost all the respondents was private vehicle and not public transport. Fossil fuel combustion particularly as it occurs in

motor vehicles has been identified as the largest contributor to air pollution in the world. But not all pollution produced by cars is the same. Pollution by cars is determined by engine size, age of vehicle, fuel type and usage. *Table 4.13* presents findings on types and age of vehicles in relation to the age group of respondents. The results show that most of the respondents who owned cars with heavy engines belonged to the age group of 36-45 years accounting for 32%. This can be attributed to the fact that most respondents in this age group have settled and have money to buy expensive vehicles. Most of the respondents who owned cars with light engine belonged to the age group of 26-35 years accounting for 18%. This can be attributed to the fact that respondents who belong to such age group are still settling in life and many of them are just few years employed hence they cannot get enough money to buy expensive vehicles. From the findings, it also shows that most cars have heavy engines thereby contributing more pollution to the environment.

On the age of vehicles, 24% were less than a year old, 40% were between 1-3 years old, 26% were between 4-6 years old and 10% were more than 7 years old. This means that most of the cars were fairly new hence less pollution from engine fumes as new cars pollute less than old cars.

Table 4.13 Type/Brand and Age of Vehicles in Relation to Age Group of Tenants

Age Group	**Cars with heave Engines like Range Rover and Benz**	**Cars with light engine, like Toyota Corolla and Nissan Salon**	**Age of Vehicle**			
			1 year less	**1-3years**	**4-6years**	**Over 7 years**
18-25	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
26-35	21 (11%)	32 (18%)	15 (8%)	29 (16%)	7 (4%)	2 (1%)
36-45	57 (32%)	13 (7%)	20 (11%)	39 (22%)	39 (22%)	6 (3%)
46-95	32 (20%)	21 (12%)	9 (5%)	3 (2%)	1 (0.4%)	10 (6%)
% Index	**114 (63%)**	**66 (37%)**	**44 (24%)**	**71 (40%)**	**47 (26%)**	**18 (10%)**

Pollution from vehicles is also determined by use of vehicle as already hinted. This study set to establish the number of times respondents go out every day on average. *Table 4.14* shows

the frequency of going out by the tenants. The study found out that 63% of the respondents go out once a day, 24% of the respondents go out twice every day, 7% go out thrice a day, 2% go out four times a day and 4% go out many times a day. This shows that there is no much pollution from vehicles based on usage of vehicles per day as the majority of the respondents (63%) go out only once a day and those who go out many times per day comprise only 4%. It can be deduced that most of the respondents go once a week because majority of the tenants who took part in this study are employed implying that they go to work in the morning and come back in the evening.

Table 4.14 Frequency of Going Out by Tenants

Going out		Frequency	Percentage
Valid	Once	114	63
	Twice	43	24
	Thrice	12	7
	Four Times	3	2
	Many Times	8	4
Total		**180**	**100**

4.5.2 Waste Disposal

Once domestic solid waste is produced, it has to be collected and disposed of in proper places to ensure environmental sustainability. This study set to establish how domestic solid waste is collected and disposed by the tenants. *Table 4.15* shows how domestic solid waste is handled in gated communities by tenants. The study revealed that waste is properly collected in the gated communities by licensed waste collectors as all respondents (100%) mentioned that their domestic solid waste is collected by private establishment.

Table 4.15 Handling of Domestic Solid Waste by Tenants

Mode of Collection	Frequency	Percentage
Collected by municipality	0	0
Collected by licensed garbage collectors	180	100
Dumped at a nearby ditch	0	0
Burned	0	0
Total	**180**	**100**

4.5.3 Sources of Water

Fresh water is becoming a scarce commodity not just in Nairobi County but worldwide. The study set to establish the sources of water for domestic use. *Table 4.16* shows the findings from tenants data on the sources of water for domestic use. The results show that most respondents get their water from Nairobi Water and Sewerage Company (93%). A good number get it from boreholes (40%). From the interview with Ministry of Water official, it was discovered that dependency on boreholes is attributed to water rationing in Nairobi County which forces estates to sink boreholes as a back-up. Very few (8%) harvest rain water (8%). This implies a huge strain put on boreholes when water is being rationed by NWSC and this is not sustainable as the water table in Nairobi is going down hence many boreholes are destined to dry up one day.

Table 4.16 Sources of Water for Domestic Use by Tenants

Mode of Collection	Frequency	Percentage
Nairobi Water and Sewerage Company	168	93
Borehole	72	40
Harvested Rain Water	14	8
Buy from Vendors	0	0
Total	**180**	**100**

4.5.4 Alternative Means of Energy

With the rationing of electricity in Kenya, the study set to establish the alternative means of energy respondents use when there is no power from KPLC. *Table 4.17* presents the findings of alternative means of energy that respondents use. Those who use generator constituted 5%, those who use candles constituted 26%, those who use batteries constituted 27%, those who use paraffin constituted 4%, those who use biogas constituted 2%, those who use solar power constituted 36%. This shows that most of the respondents use clean energy as alternative means in absence of power from KPLC as those who use generators constitute only 5%.

Table 4.17 Alternative Means of Energy

Means of Energy	Biogas	Paraffin	Generators	Candles	Batteries	Solar Energy
Frequency	4	7	9	47	49	65
% Index	2%	4%	5%	26%	27%	36%

As part of saving energy, the study sought to establish if respondents use energy saving bulbs. Most of the respondents from the tenants' data were aware of energy saving bulbs. *Table 4.18* shows the proportion between those who use energy saving bulbs and those who do not use them. Those who use energy saving bulbs constituted 78%, those who do not use them constituted 20% and 2% of the respondents did not give any answer. The results show that most respondents use energy saving bulbs. This is a positive response to a campaign by KPLC of distributing energy saving bulbs and encouraging people to use them in order to save power. The study probed further why the 20% do not use energy saving bulbs and most of them said that they do not use them because they are expensive compared to the ordinary bulbs.

Table 4.18 Usage of Energy Saving Bulbs by Tenants

Respondents		**Frequency**	**Percentage**
Valid	Those who use energy saving	140	78
	Those who do not energy saving	36	20
	Total	176	98
Missing		4	2
	Total	**180**	**100**

4.5.5 Adoption of Technologies

Respondents were asked about the kind of technologies that their estates have adopted to enhance environmental sustainability. *Table 4.19* shows the various types of technologies adopted that enhance environmental sustainability of residential estates. Among the respondents, 5 (50%) had adopted solar energy; 3 (30%) had adopted rain water harvesting technology and 1(10%) had adopted waste water recycling technology. None of the estates had adopted modern technologies like green building, eco-homes, wind energy, green gardens, eco-renovation and sustainable building materials. This means that solar technology remains the most popular clean technology in gated communities because residents see its

direct utility especially with rampant power cuts. Water harvesting technology is not given much thought in cases where respondents feel they have plenty of water. The least adopted technology is waste recycling as some respondents are not aware of it and others expressed that it is very expensive to install. Many respondents were not aware of other technologies like green buildings, green gardens and eco-renovation. As such, it is necessary to create awareness and promote such clean technologies.

Table 4.19 Technologies Adopted in Residential Estates

Technology	**Adoption of the Technology**		
	Tally		
	Yes	**No**	**% of Adoption**
Solar Energy	5	5	50%
Rain Harvesting	3	7	30%
Water Recycling	1	9	10%
Green Building	0	10	0%
Eco-Homes	0	10	0%
Wind Energy	0	10	0%
Green Gardens	0	10	0%
Eco-Renovation	0	10	0%
Sustainable Materials	0	10	0%

There are a number of challenges encountered by estates in adopting modern technologies that enhance environmental sustainability. This study sought to establish such challenges. Respondents cited different challenges/reasons. *Table 4.20* shows data from estate managers on challenges encountered in adopting the modern technologies. Among the respondents, 1 (10%) said that their estate is not designed to accommodate such modern technologies, 4 (40%) of respondents cited cost of installation being high as reason for not adopting the modern technologies, 4 (40%) said that their estates had enough water hence did not think of rain water harvesting, 1 (10%) cited cost of equipment being high, 1 (10%) cited cost of maintenance being high and 1 (10%) cited lack of awareness as the reason for not installing modern technologies that enhance environmental sustainability in their estates. The results show that cost is the main hindrances towards adopting the modern technologies that enhance environmental sustainability of the gated communities.

Table 4.20 Challenges in Adopting Modern Technologies in Residential Estates

Technology	Cost of Installation	Water is Plenty	Cost of Equipment	Cost of Maintenance	Lack of Proper Design	Lack of Awareness
Frequency	4	1	4	1	1	1
% Index	40%	10%	40%	10%	10%	10%

4.5.6 Training of Estate Managers on Environmental Sustainability

Training on environmental sustainability is vital for those who manage estates. The study set to establish if the management of the estates under study train the estate managers and other workers on environmental sustainability. When the respondents were asked whether they get training on ways to enhance environmental sustainability, only 1 (10%) admitted getting training and the rest said they did not as depicted in *Table 4.21*. This means that most proponents of the gated communities do not take initiative to train their managers on ways to enhance environmental sustainability although it was established from an interview with NEMA official that NEMA offers training to stakeholders who ask for it.

Figure 4.21 Training Rates of Estate Managers

Response		**Frequency**	**Percentage**
Valid	Those who get training	1	10
	Those who do not get training	9	90
	Total	**10**	**100**

4.5.7 Green Cover Enhancement

Enhancing green cover is very vital for environmental sustainability of residential estates. The study sought to establish efforts taken by estate proponents in enhancing green cover. *Table 4.22* shows the results. When asked about how they are enhancing green cover in their estates, 7 (70%) of the respondents said that they were planting trees, 4 (40%) said that they were planting grass/maintaining lawn, 3 (30%) said that they were planting shrubs and 1 (10%) constituted those who were using green fences. This means that each estate was making efforts to maintain green cover by engaging in one, two or three of the mentioned activities. Most of the estates are engaging in planting trees (70%) whereas very few are

engaging in green fence technology (10%). The small percentage of those using green fences can be attributed to the fact that in Kenya, according to law, a wall is supposed to be 300x300 mm thick made of stone. This was revealed during an interview the researcher had with an official from the Ministry of Housing.

Table 4.22 Enhancing Green Cover in Residential Estates

Enhancing Green Cover	Planting Trees	Planting Grass	Planting Shrubs	Using Green Grass
Frequency	7	4	3	1
% Index	70%	40%	30%	10%

4.5.8 Use of Renewable Sources of Energy

There are a number of renewable (clean) sources of energy used in residential estates like solar energy, biomass (gas), wind energy and hydro-electric power. *Table 4.23* shows data from estate managers. From the responses, the estates which use hydro-electric power were 10 (100%), those which use solar energy constituted 4 (40%) and those which use biomass (gas) were 100%. None of the estates uses wind energy and other renewable sources of energy. For those who do not use solar energy, the reason is that cost of installation is high although the use of solar energy is cheaper than hydro-electricity in the long run. Other respondents cited lack of information as the reason for not exploiting the other sources of renewable energy. The results show that hydro-electric power and gas are the most used in the gated communities followed by solar energy. This means a great strain put on KPLC which provides electricity. The other sources of renewable sources of energy have not been explored into great detail.

Table 4.23 Use of Renewable Source of Energy in the Estates

Source	Hydro-electric Power	Gas	Solar Energy
Frequency	10	10	4
% Index	100%	100%	40%

The foregoing analysis on mitigation measures shows categorically that there are quite a number of practices/behaviour in gated communities that enhance environmental

sustainability. From the analysis, it was discovered that although most respondents have vehicles yet the frequency of going out is small (once a day on average); waste is collected by licensed waste collectors, the type of energy used is generally clean, for instance hydro-electric energy, solar energy and cases of using power from generators are very few. There were also many respondents who use energy saving bulbs. However, some practices in the gated communities are detrimental to the environment and people's health. This study found out that many cars used by residents have heavy engines and there are many types of solid waste produced from food, tins/canes, polythene papers and glass bottles. There is also too much dependence on water from boreholes and there is little use of sustainable water source like water from rain harvesting.

4.6 The Influence of Socio-Economic Factors on Environmental Sustainability of Gated Communities in Nairobi County

The study considered socio-economic factors that may enhance environmental sustainability of the estates. Measures such as gross income per month, occupation, types of domestic solid waste produced were considered. Some of the issues like domestic solid waste have been dealt with already in the preceding section.

4.6.1 Energy Use

One of the practises threatening the environment is the cutting down of trees for firewood and charcoal which is used for cooking. The use of charcoal and firewood also pollutes the environment. The study set to establish the kind of energy/fuel that respondents used in cooking or boiling water in relation to their gross income per month. *Table 4.24* shows the relationship between gross income per month and the kind of energy/fuel used for cooking. The results show that the majority of respondents 179 (99%) used gas for cooking. A good number of the respondents 68 (38%) used electricity for cooking. None of the respondents used charcoal or firewood and only 1 (0.5%) of the respondents used paraffin/kerosene. This is good for the environment as most of the respondents use clean energy for cooking. The results further reveal that fuel/energy use in this study is determined by gross income per month as those with gross income rate of between Ksh 300,001-400,000 and above Ksh 400,001 use both electricity and gas whereas the majority of respondents who earn between Ksh 100,001-200,000 and Ksh 200,001-300,000 mostly use gas unlike electricity. This is the case most probably because electricity is more expensive than gas. Furthermore, the results imply than adoption of clean energy is determined by income.

Table 4.24 Relationship between Gross Income per Month and Energy Use by Tenants

Gross Income	ENERGY USE				
Per Month (Ksh)	**BASE**	**Electricity**	**Gas**	**Charcoal/Firewood**	**Paraffin**
50,000 - 100,000	**7**	0 (0%)	6 (3%)	0 (0%)	1 (0.5%)
100,001 – 200,000	**48**	8 (4%)	48 (27%)	0 (0%)	0 (0%)
200,001 – 300,000	**86**	21 (12%)	86 (48%)	0 (0%)	0 (0%)
300,001 – 400,000	**26**	26 (14%)	26 (14%)	0 (0%)	0 (0%)
Above 400,001	**13**	13 (7%)	13 (7%)	0 (0%)	0 (0%)
Total	**180**	**68 (38%)**	**179 (99%)**	**0 (0%)**	**1 (0.5%)**

4.6.2 Monthly Service Charge

In order to keep the surroundings of estates clean, there is need to raise funds. Many estates levy monthly service charges. Data from tenants shows that all respondents pay monthly service charges ranging from Ksh 2,000 to K 5,000. The study probed on how satisfied the tenants were with the monthly service charge. *Table 4.25* presents the findings on a likert scale. From the findings, it shows that most respondents are either neutral or dissatisfied with the monthly service charge. This implies likelihood of defaulters thereby affecting the maintenance of the estates and consequently affecting the environmental sustainability of the estates. This calls for sustainable ways of generating income.

Table 4.25 Attitude towards Monthly Service Charge by Tenants

Attitude	Extremely Dissatisfied	Dissatisfied	Neutral	Satisfied	Extremely Satisfied
Frequency	25	72	43	34	5
% Index	14%	40%	24%	19%	3%

The study probed further regarding challenges that estates encounter in raising funds through monthly service charges. *Table 4.26* shows the challenges as obtained from the estate managers' data. The respondents who mentioned defaulters as a challenge were 6 (60%) and 2 (20%) of the respondents said that some tenants pay in instalments; those who said that some tenants have to be reminded every month were 4 (40%) and some respondents 3 (30%) said that other tenants do not understand why they should pay monthly service charge. These

challenges imply that it is difficult to raise the required monthly service charges to maintain the estates and this can consequently affect the environmental sustainability of the estates.

Table 4.26 Challenges Encountered in Collecting Monthly Service Charge

Challenge	Those who pay in Instalments	Those who don't understand	Those reminded every month	Defaulters
Frequency	2	3	4	6
% Index	20%	30%	40%	60%

The aforementioned analysis shows that the manner of raising funds for maintenance in the gated communities under study is not economically and financially sustainable. The estates lack ability to use local resources to generate sufficient cash flows in an ongoing way to deliver vital services in the long run and in a self generating manner without creating dependencies. This can impact on environmental sustainability as among other things the gated communities are likely to find it hard to pay workers who take care of the surrounding environment.

4.7 The Influence of Compliance with Regulations on Environmental Sustainability of Gated Communities in Nairobi County

The study considered compliance with regulations as a means to enhancing environmental sustainability of the gated communities. Compliance with regulatory authorities like the surrounding community, NEMA, CCN, Ministry of Water and Irrigation and National Housing Cooperation were considered. The study established that all the gated communities under study conducted an EIA during the planning stages. Also reading from the EIA reports, it was indicated that alternative projects with less negative environmental impacts were considered. As such, EIA was a regulation that was enforced 100%. The study also established that all the gated communities under study consulted the surrounding community, NEMA, CCN, Ministry of Water and National Housing Cooperation at the planning stages of the estates. The underlined stakeholders were consulted in the following ways: the surrounding community was consulted through public participation, NEMA was consulted through carrying out of EIA, CNN was consulted in terms of approving housing plans, zoning and recommendations on waste management, Ministry of Water and Irrigation was consulted

on issues like advice on sinking boreholes and Ministry of Housing was consulted on the issues pertaining to the building code.

It is also a requirement by NEMA for all residential estates to conduct EA every year. *Table 4.27* shows the results of the findings on EA obtained from the estate managers' data. The study established that only 1 (10%) of the gated communities carries out annual EA as per requirement by NEMA, 2 (20%) did not indicate and 7 (70%) do not conduct the exercise. This implies that the regulation on EA is not enforced strictly.

Table 4.27 Conducting of EA by Estates

Respondents		Frequency	Percentage
Valid	Those who conduct EA	1	10
	Those who don't conduct EA	7	70
	Total	8	80
Missing		2	20
Total		**10**	**100**

From the preceding analysis, the study showed that compliance with regulations is generally good as the study established that consultations with relevant authorities was done by the gated communities under study before construction. However, compliance with regulations after construction leaves a lot to be desired as the study established that only 10% of the gated communities under study carry out EA which is a pivotal exercise in fulfilling action plans that are spelt out in EIA in ensuring environmental sustainability.

4.8 Qualitative Data Analysis

Qualitative data was obtained from the checklist. The researcher observed that in few estates, drums were installed to harvest rain water as shown in *Appendix vi* on page 90. However, it was noted that residents in many estates were using clean water from borehole or Nairobi Water and Sewerage Company to clean cars and water the loan. This is not environmentally sustainable as water from borehole is bound to dry up one day.

It was observed that most of the residents do not separate their waste into biodegradable and non-biodegradable domestic solid waste. A visit to most of the estates showed that waste is not separated and it is all put in one polythene plastic which is later collected by the garbage collecting companies and dumped at places like Dandora Municipal Dumping Site. A visit to Dandora Municipal Dumping Site showed that most of the waste that is dumped there is not sorted out. According to Mr. Meener who manages the site, most of the waste comes from middle and high income areas and the estates under this study fall into that category.

The study also established that in many estates, timber which is a renewable building material is used. However, having said that, there are also a lot of synthetic materials being used in the residential estates. These building materials are not sustainable as they cannot be readily broken down by elements of nature once the building ceases to be functional. Regarding the building code, the study established that some estates have houses built in such a way that natural light does not penetrate in some spaces within the houses thereby forcing residents to use electricity during day time. As established from an interview with Ministry of Housing official, the building code is obsolete, hence hardly adhered to and this results into 75 sick houses in Nairobi County. It was therefore observed that in many estates, the largest portion of free space was cabro and the space left for green cover was very little. In most of the estates, cabro and roads occupied approximately 75% of the empty space and the remaining 25% was used for green cover.

It was observed that in many estates, renewable energy is used. However, the commonly source of renewable energy used is solar energy and in most estates, it is up to individual residents to buy their own solar panels and install. There were few generators seen in some of the estates but the study established that most of the estates do not use generators. It was also observed that only one estate uses waste water recycling system

The study established that each housing unit in most of the estates was allocated two parking spaces. This means that if an estate has for instance 300 housing units, which would mean 600 parking spaces. From observation, most of the parking spaces were occupied especially during weekends and evening when tenants were at home. This implies more green house gases emitted by the tenants around the estates as they drive in and out every day. This affects the quality of surrounding air and consequently the health of the people due to fumes from the vehicles.

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSION, RECOMMENDATONS AND CONCLUSIONS

5.1 Introduction

This chapter illuminates strategies that can be used to improve factors that enhance environmental sustainability of gated communities. The chapter is divided into five sections. The first section is a summary of findings in relation to the objectives of the study. A discussion of the findings and a comparison of the findings with the literature review comprise the second section. The third section is a highlight of the study recommendations. The fourth section is a conclusion of the study. The fifth section suggests potential areas for further research.

5.2 Summary of Main Findings

Table 5.1 summarises the findings of the study. The findings are arranged according to the objectives of the study.

Table 5.1 Summary of Findings

Variable/Objective	Respondents
Environmental Awareness	TENANTS • 50% learnt about environmental sustainability from radio, 30% learnt from internet, 50% heard from television, 30% learnt from magazines and newspapers, 20% learnt from school, 10% learnt from friends. • 4% completed Form Four, 30% completed college and 66% completed university. • 100% are aware of the difference between biodegradable and non-biodegradable waste; however only 2% separate domestic solid waste into biodegradable and non-biodegradable, 98% do not. • 53% of women are aware of sources of domestic solid waste namely food, plastic bags/papers, tins/cans and glass bottles. ESTATE MANAGERS • 80% have heard about environmental sustainability and 20% have not. • 50% heard about environmental sustainability from radio, 30% from internet, 50% from television, 30% from newspapers/magazines, 20% from school and 10% from friends. • 20% with university college aware of rain water harvesting compared to 20% with college education, 30% with university education aware of recycle of waste and green building

	compared to 10% with college education, 30% with university education aware of solar energy compared to 50% with college education, 10% with university education aware of eco-renovation compared to 0% with college education, 30% with university education aware of sustainable building materials compared to 10% with college education.
Mitigation Measures	TENANTS • 63% drive out once a day, 24% drive out twice every day, 7% drive out thrice a day, 2% drive out four times a day and 4% drive out many times a day. • 100% of estates have solid waste collected by licensed companies. • 93% get water from NWSC, 40% from boreholes and 8% harvest water. • 5% use generator, 26% use candles, 27% use batteries, 4% use paraffin, 2% use biogas and 36% use solar power. • 78% use energy saving bulbs, 20% do not. ESTATE MANAGERS • 50% adopted solar energy, 30% adopted water harvesting technology and 10% adopted waste water recycling technology. None adopted modern technologies like green building, eco-homes, wind energy, green gardens, eco-renovation and sustainable building materials and technologies. • On challenges in adopting modern technologies, 10% cited houses not designed to accommodate such modern technologies, 40% talked about cost of installation, 40% said their estates had enough water, 10% cited cost of equipment being high, 10% cited cost of maintenance being high and 10% cited lack of awareness. • On enhancing green cover, 70% are planting trees, 40% are planting grass/maintaining lawn, 30% are planting shrubs and 10% are using green fences. • On training, 10% receive training and 90% do not. • On separating solid waste, 10% do and 70% do not, 20% were missing. • On usage of renewable energy, 100% use hydro-electricity, 100% use gas and 40% use solar energy. • On generators, 10% use them,60% do not and 30 were missing.
Socio-Economic Factors	TENANTS • 99% use gas for cooking, 38% use electricity for cooking, none uses charcoal or firewood and only 0.5% use paraffin/kerosene. • Ksh 300,001-400,000 and above Ksh 400,001 use both electricity and gas, those between Ksh 100,001-200,000 and Ksh 200,001-300,000 mostly use gas unlike electricity.

	• Monthly service charge ranges from Ksh 2000 – Ksh 5000. ESTATE MANAGERS 60% defaulters regarding paying monthly service charge, 20% pay incomplete amount, 40% are to be reminded every month, 20% do not understand. • Monthly service charge ranges from Ksh 2000 – Ksh 5000. • On challenges, 20% were defaulters, 40% were to be reminded every month, 30% do not understand
Compliance with Regulations	ESTATE MANAGERS • 100% carried EIA at planning phase. • 10% carry out annual EA, 20% were missing and 70% do not.

5.3 Discussion

The findings of the study based on the four objectives of the study namely environmental awareness, socio-economic factors, mitigation measures and compliance with regulations are discussed in this section.

5.3.1 The Extent at which Environmental Awareness Influences Environmental Sustainability of Real Estate Projects in Kenya

The study revealed that most respondents (80%) heard about environmental sustainability. The study further revealed that most of the respondents who had an idea about environmental sustainability learnt about it either from radio or television. This implies that the radio and the television are the most popular ways of disseminating information about environmental sustainability unlike tradition media (friends and neighbours), internet or newspapers. The results confirm what Hoerisch (2002) found out about the radio and the television as the most popular media in explaining environmental awareness.

In terms of domestic solid waste, all the respondents could distinguish between biodegradable and non-biodegradable solid waste yet only 2% of them separate the solid waste. This shows that there is lack of will to take measures in spite of the awareness.

World Environmental Days and House Expos should expose people to environmental awareness. Nevertheless, these events have seemingly failed in this regard as none of the respondents mentioned either environmental days or house exhibitions as places where they learnt about environmental sustainability. On a positive note, the study showed that

environmental awareness is enhanced by levels of education as 57% of those who completed university were aware whereas only 21% of those who had completed college were aware of environmental sustainability. This means that if a lot can be invested in education and training on environmental sustainability, then positive results can be yielded vis-a-vis enhancing environmental sustainability. This finding is in line with Agenda 21, Chapter 36 which is devoted to environmental education and it states that "education is critical for promoting sustainable development and improving the capacity of people to address environment and development issues".

It was noted that all respondents were aware of biodegradable and non-biodegradable solid waste. The respondents cited lack of proper labelled equipment disposal as the reason why they do not separate the two. This means that if estate owners or garbage collectors can provide separate chutes and encourage people to separate the waste, then there is bound to be an improvement in separation of domestic solid waste. This can consequently help a great deal those who recycle waste like polythene paper and tins. Interestingly enough, the study established than women were more aware of different sources of domestic solid waste like food, polythene papers, tins and bottles than men. The study therefore showed that awareness is generally good. However the will to implement what people know about environmental sustainability like separating domestic solid waste is the hindrance towards environmental sustainability.

5.3.2 The Influence of Mitigation Measures on Environmental Sustainability of Real Estate Projects in Kenya

The study investigated mitigation measures that are likely to determine the environmental sustainability of the gated communities. The study touched on the use of motor vehicles, collection and treatment of solid waste, use of renewable sources of energy, harvesting of rain water, use of energy-saver bulbs and enhancement of green cover. The study established that the mitigation measures determine the environmental sustainability of the gated communities in the following manner:

It was noted that 63% of the respondents drive out once a day, 24% drive out twice a day, 7% drive out thrice a day, 2% drive out four times a day and 4% drive out many times a day. Most of the respondents (63%) drive out once a day because they are employed hence they go to work in the morning and come back in the evening. This is a positive development as the

small frequency of driving out implies reduction in emission of greenhouse gases from vehicles which pollute the surrounding air and contribute to global warming and climate change.

The study noted that 100% of the gated communities have their solid waste collected by licensed companies. This is a very positive development. The proper collection of waste by licensed companies can also be described as positive in relation to compliance with City Council by-laws which require residential estates to procure the services of licensed garbage collectors. However, the problem is that most of the waste collected is not separated into bio-degradable and non-biodegradable substances by the residents. The study established that those who separate the waste constituted only 10%. As a result, both biodegradable and non-biodegradable waste is dumped in the same place thereby introducing substances into the soil that do no decompose. This is very detrimental to the environment as non-biodegradable materials are composed of toxic chemicals that pollute the environment.

It was noted that 50% of the gated communities adopted solar energy, 30% adopted water harvesting technology and 10% adopted waste water recycling technology. None adopted modern technologies like green building, eco-homes, wind energy, green gardens, eco-renovation and sustainable building material technology. The study further established that the main hindrances towards adopting the modern technologies are cost of installation and cost of maintenance. The finding confirms what Mbogo (2012) established in terms of challenges encountered in adopting the modern technologies that enhance environmental sustainability. Mbogo found out that modern technologies that enhance environmental sustainability in Kenya face a massive challenge of capital investment. In his study, he noted that banks in Kenya do not have the expertise to profile risks in loan products pertaining to technologies like green buildings and solar energy. However, the good news is that the International Finance Corporation and the European Investments Bank are engaging Kenyan banks to improve capability of their renewable energy financing products in order to promote technologies that enhance environmental sustainability

With regard to enhancing green cover, the study established that 70% of the estates are planting trees, 40% are planting grass/maintaining lawn, 30% are planting shrubs and 10% are using green fences. This is a positive development as green cover contributes to fresh air due to the process of photosynthesis. The fresh air is good for the health and well- being of

people dwelling within the gated communities. However, the drawback is that the amount of space occupied by green cover is roughly 25% as compared to an estimate of 75% space that is concrete (cabro) in most the gated communities.

5.3.3 The Influence of Socio-economic Factors on Environmental Sustainability of Real Estate Projects in Kenya

The study also investigated socio-economic factors that can determine the adoption of technologies that enhance environmental sustainability of gated communities. The determinants included financial resources, education level and occupation. Apart from waste generation of households that is determined by household size, income, concern about the environment and willingness to separate waste which Afroz, Keisuke and Tuddin (2010) have mentioned before, past researchers seem to have ignored this aspect in spite of its major influence on environmental sustainability of gated communities as follows:

Production of waste is usually determined by income. The simple and common economic theory states that the better the income, the more likely the production of waste. The study could not measure the exact amount of waste produced in households in relation to level of income and household population. However, it was established that most of domestic solid waste dumped at Dandora Municipal Dumping Site and other dumping sites is created from middle and high income residential areas. Gated communities belong to such areas. As such, it is important for gated communities to adopt more sustainable consumption and production patterns in order to alleviate some of the environmental challenges that we face as Loomis (2000) recommends.

It was noted that those who earned Ksh 300,001 to Ksh 400,000 and above Ksh 400,001 used both electricity and gas to cook and boil water; those who fall in the income group of between Ksh 100,001-200,000 and Ksh 200,001-300,000 mostly used gas unlike electricity and only 0.5% used paraffin and earned less than Ksh 100,000. None of the respondents used charcoal or firewood. Using electricity for cooking is more expensive than using gas. Also using gas for cooking is considered by some people as more expensive than using paraffin or charcoal. Therefore, the study shows that the use of renewable energy is determined by level of income. None of the respondents use charcoal or firewood as this source of fuel is considered primitive and time consuming.

In terms of social status, the use of charcoal and firewood is considered as for those who earn very little. The fact that most of the gated communities are high income areas is a positive development in so far as this influences residents to use clean energy for cooking and boiling water. Another positive development is that most gated communities do not use generators which emit greenhouse gases. When the study probed on why most gated communities do not use generators, it was established that the reason is cost. This implies that if the cost of using generators was low, then it would follow that most gated communities would use them as none mentioned the negative effect that generators have on the environment as the reason for not using them. The findings of this study confirms the past findings of a Comprehensive Study and Analysis on Energy Consumption Patterns in Kenya (2010) which states that energy choice decisions at household level is influenced by several key drivers like income of household head, employment level and price of energy among some factors.

The study further set to establish how funds are raised in order to maintain the environments of the gated communities. It was discovered that all gated communities raise their funds by levying monthly service charge ranging from Ksh 2000 – 5000. This way of raising funds is not sustainable as evidenced by most of the gated communities which struggle to deal with defaulters. Asking residents to contribute money every month is not sustainable as some get tired, others do not agree with such way of raising funds hence many defaulters.

5.3.4 The Influence of Compliance with Regulations on Environmental Sustainability of Real Estate Projects in Kenya

The study revealed that 100% of the gated communities conducted EIA at planning phase of the estates. This shows that the regulation on EIA by NEMA is being enforced strictly. This is positive as many issues pertaining to environmental sustainability are supposed to be addressed in EIA before a building is constructed. In spite of the positive development on EIA, it was discovered that only 10% of the gated communities carry out annual self environmental audit and the remaining 90% do not. The findings on the ground do not agree with Section 68 of EMCA 1999 which states that the Authority (NEMA) shall be responsible for carrying out the environmental audit of all activities that are likely to have significant effect on the environment. In the same section, it is also indicated that the owner of the premises shall make annual reports to the Authority describing how far the project conforms in operation with the statements made in the EIA study report. This is not being done on the ground. This reality can affect the environmental sustainability of the gated communities

adversely because it is the EA that helps estate owners to detect environmental issues. This means that many residential owners do not bother to conduct the exercise and NEMA does not enforce the regulation strictly in gated communities.

5.4 Recommendations

It was stated in the background of the study that the main determinants of the demand for residential estates are demographic. Consequently, the first and foremost recommendation therefore is population reduction by cutting birth rate through family planning. However, in light of the findings of this study, the study recommends the following measures that can be used to enhance environmental sustainability of residential estates in the study area:

5.4.1 Training of Estate Managers

It was noted from the interview with NEMA Regional Coordinator for Nairobi County Mr Koiyiet that NEMA provides training on environmental awareness and sustainability to interested stakeholders. The government through NEMA should encourage management of gated communities to have their staff (estate managers) attend such training as it was noted from the survey that estate managers and other staff do not get training on ways to enhance environmental sustainability. After the training, the estate managers and other staff will have a role to create awareness about environmental sustainability among the tenants, recommend to management different technologies that can be installed to enhance environmental sustainability. The trained staff can also help in maintaining the estate in such a way that environmental sustainability is enhanced. If this is done, environmental sustainability will be enhanced from local level.

5.4.2 Awareness Campaigns Through Forums like House Expos and World Environment Days

The study discovered that NEMA is already conducting campaigns on environmental awareness by publishing pamphlets and conducting trainings. However, it was admitted by NEMA official that many people are yet to get the message about environmental sustainability. There is need therefore for government and other stakeholders to explore more avenues of disseminating information pertaining to environmental sustainability in forums like House Expos and World Environment Days. The house expo of this year which took place from 23rd May to 27th May had very little about environmental sustainability of the gated communities estate. Instead, the emphasis was just on the economic aspect.

5.4.3 Adoption of Modern Technologies

On modern technologies like water harvesting and solar energy, the study recommends that CNN should make by-laws requiring all gated communities plans to have provision for the modern technologies. This will encourage estate owners to adopt the modern technologies and in the end save resources like water and energy. It is also important to explore how other technologies like green buildings can be adopted in Kenya.

5.4.4 Self-Generating Income Activities

It was observed from the questionnaire and estate tours that funds for maintenance of the gated communities come from only one means which is the levying of monthly service charge. This is not a sustainable way of generating income as there are many defaulters. It is also a cumbersome exercise to ask tenants to pay such a charge every month. Ultimately, this is not sustainable to the environment. This study therefore recommends that the gated communities must find alternative means of generating income for the maintenance of their estates. Such means may include letting the tenants own and have a stake in joint income generating activities like shopping centres inside the gated communities. Proceeds from such activities can be used to finance the maintenance of the estates without bothering the tenants each and every month.

5.4.5 Funding Options

One of the hindrances towards adopting modern technologies that enhance environmental sustainability of gated communities is cost. The Kenyan Government removed tax on renewable energy like solar panels, wind energy, geo-thermal, hydro-electric power and biomass. Also there is an effort to promote green technologies in Kenya by the International Finance Corporation and the European Investments Bank which are engaging Kenyan banks to improve capability of their renewable energy financing products. In spite of these efforts, the cost of installing renewable energy still remains exorbitant. For instance, it costs about Ksh 200,000 to install a solar panel for heating water. In order to promote renewable energy, Kenya should take advantage of the Clean Development Fund called UN Framework Convention on Climate Change set up by United Nations and Carbon Finance Unit (CFU) set by World Bank. These are established to allow rich countries that emit more carbon dioxide in the atmosphere than permitted under the Kyoto Protocol to buy emissions that poor countries prevent through conserving forests or promoting renewable energy.

5.4.6 Enforcement of Regulations

Although this study established that compliance with regulations is good, yet there is a lot that can be improved; for instance the study established that environmental audit is not done in most of the gated communities and this is a very vital exercise regarding environmental sustainability. The study recommends strict enforcements of regulations like annual environmental audits by NEMA in all the gated communities.

5.4.7 Car-pulling

Smoke produced from vehicles can increase the quantity of certain toxic chemicals discharged by vehicles into the air. These chemicals can be very detrimental to one's health as they cause mild to severe irritation of the eyes, nose, throat and lungs; deterioration in general health if absorbed by the body. Buses are generally recognised as an environmentally friendly form of transport in relation to number of car journeys needed to carry the equivalent number of passengers. The researcher observed that in many gated communities, both husband and wife own cars and go to work using their respective cars. This increases carbon footprint as the more cars leave the gated communities each morning, the more greenhouse gases are emitted. The study therefore recommends car-pulling as alternative to travelling by buses for those who own vehicles. Car-pulling means that several people can use one car to their places of work instead of using separate cars and causing more pollution in the process.

5.4.8 Provision and Use of Separate Chutes for Bio-Degradable and Non-Biodegradable Domestic Waste

The study noted that in most estates, separate chutes are not provided to separate waste into biodegradable and non-biodegradable solid waste. As such, it is difficult for those who recycle stuff like polythene papers. This study therefore recommends that all estates make a provision of well labelled chutes for disposing of the two types of solid waste before it is collected by the licensed garbage collectors.

5.4.9 Curtailing of the Use of Polythene Papers

The study established that Kenya has invested a lot in the polythene industry. Because of this, we see polythene papers everywhere being used to wrap commodities at selling points. This study recommends the curtailing of polythene bags by polythene industries in order to discourage the rampart use of polythene papers. The study also recommends that a legislation be effected which obliges supermarkets like Nakumatt, Tuskys, Uchumi, Naivasi, Ukwala

and many more to encourage shoppers to bring with them bags for carrying commodities when they go shopping. Nakumatt has already done something in this regard but not enough. For those who do not bring bags, the supermarkets should sell the plastic bags to them as they do in South Africa instead of giving them free of charge. This would discourage the habit of using polythene papers just once before throwing them away.

5.5 Conclusions

The study was meant to investigate factors influencing environmental sustainability of real estate projects in Kenya. The area of study was Nairobi County. The study had four objectives which were environmental awareness, socio-economic factors, mitigation measures and compliance with regulations. The study aimed at establishing how the four objectives may determine environmental sustainability of residential estates.

In view of the analysis presented in the preceding chapters, the study ultimately concludes that economic factors are the major barriers as regards the adoption of technologies that influence environmental sustainability of residential estates. There was further revelation by the study that those gated communities that have not adopted technologies that influence environmental sustainability of residential estate are inhibited by cost of procuring and installation. Although the cost of procuring and installation of the technologies is exorbitant yet it is cheaper to use the technologies in the long run once they are installed; for example, a lot of gated communities stated that the procurement and installation of solar energy is expensive and as such they opt to use hydro-electric power and generators which are very expensive in the long run from the view of cost. Also, the impact of generators on the environment is huge due to greenhouse gases that generators produce.

The study also concludes that although the level of environmental awareness in most of the gated communities is good, yet there is lack of good will to implement what the residents know about environmental awareness. This is clearly exemplified by the fact that most residents are aware of the difference between biodegradable and non-biodegradable solid waste, yet almost none of them separate these two substances.

In particular, the following were some major factors that were established as limiting the adoption of modern technologies that enhance environmental sustainability of gated communities in Nairobi County: awareness and economic factors such as levels of education,

income, financing and cost. Many respondents had never heard about modern technologies like roof top gardens, green building, eco-renovation and others. Some of the responses given also exposed lack of awareness; for instance, some respondents said that their gated communities had not considered water harvesting because they have plenty of water around. Obviously such an answer shows lack of awareness as the water table in Nairobi is going down and some years from now, it will be difficult if not impossible to sink boreholes in Nairobi as it was established from an interview with an official from Ministry of Water and Irrigation who said that water table in many places in Nairobi is going down. It was also interesting to note that many gated communities do not use generators because of high cost not because of the negative impact of the generators on the environment. In such cases, if the cost of operating generators becomes cheap, it is given that many would opt using them.

5.6 Recommended Areas for Further Research

The study was about factors influencing environmental sustainability of real estate projects in Kenya and it focussed on gated communities in Nairobi County. The study was narrowed down to investigating factors such as environmental awareness, socio-economic factors, mitigation measures and compliance with regulations. In light of the findings, the study recommends the following areas for further study:

- Factors influencing the adoption of modern technologies that influence environmental sustainability of residential estates.
- The financial and economic sustainability of residential estates in Nairobi County.
- The role of ICT in promoting environmental awareness and adoption of modern technologies that enhance environmental sustainability of residential estates.

REFERENCES

A Comprehensive Study and Analysis on Energy Consumption Patterns in Kenya. Nairobi: Kenya Institute for Public Policy Research and Analysis (KIPPRA), 2010.

African Ministerial Conference on the Environment, Twelfth Session. Johannesburg: UNEP, 7 – 12 June, 2008.

Afroz, R., Hanaki, K., & Tuddin, R. (2010). The Role of Socio-Economic Factors on Household Waste Generation: A Study in a Waste Management Program in Dhaka City, Bangladesh. Research Journal of Applied Sciences, 2010, volume 5, 183-190.

A Guide to Project Management Body of Knowledge, 4th ed. Atlanta: Project Management Institute, Inc, 2008.

Anderson, P. (2012), *The Complete History of US Real Estate Bubbles Since 1800.*

Babbie, E.R. (2010), *The Practice of Social Research,* 12th ed. New York.

Brueggeman, W., & Fisher, J. (2005). *Real Estate Finance and Investments* (5th ed.). New York: McGraw Hill.

Chein, I. (1982). An Introduction to Sampling. In C. Selltiz, et al., *Research Methods in Social Relations,* (4th ed.). New York: Holt, Renehart and Winston.

City of Nairobi Environmental Outlook, Nairobi: CCN, UNEP and UN-Habitat, 2007.

Composite Indicators of Environmental Sustainability, OECD (2004). Prague: Charles University Environmental Press.

Constatini, V., & Martini, C. (2010). A Modified Environmental Kuznets Curve for Sustainable Development Assessment using Panel Data. Int. J. Global Environmental Issues, 10(1/2), 84-122.

Coordinating & Accelerating MDGs in Kenya's Development Process: Transition Period for the Completion of the Project. Mainstreaming MDGs in Kenya's Development Process, 2005-2008.

Cities and Climate Change, OECD (2010). Paris.

Deforestation Costing Kenyan Economy Millions of Dollars Each Year and Increasing Water Shortage Risk, Press Release, (November 5, 2012). Nairobi: UNEP.

Doyle, A. (2008). *Environment Correspondent,* OSLO, blogs.reuters.com/environment/ Accessed on 1st December, 2012.

Draft National Building Maintenance Policy (2011). Nairobi: Ministry of Housing, Republic of Kenya.

Education for Sustainable Development: Implementation Strategy, Nairobi: NEMA, 2008.

Emerson, J., Levy, M., Esty, D.C., Kim, C., Mara, V., & Srebotnjak, T. (2010). 2010 Environmental Perfomance Index. New Haven: Yale Centre for Environmental Law and Policy.

Environmental Impact of Materials, CIRIA Special Publication 116, Vol. A, 1995.

Getter, K. & Rowe, B. (2006), The Role of Extensive Green Roofs in Sustainable Development. *Journal of HortiScience,* Vol. 41, No.5 pp. 1276-1285.

Hedegaard, C. (2011). *A Clear and Fair Incentive to Pollute Less,* Global Environmental Changes on Environment Forum: Reuters. Retrieved from http://blogs.reuters.com/environment/

Hoerisch, H. (2002). A Comparative Study on Environmental Awareness & Environmentally Beneficial Behaviour in India. CMS Envis Centre.

Holcim Foundation for Sustainable Construction (2009), Second Holcim Award, Sustainable Construction 2008/2009, Staubli AG: Zurich.

Human Development Report (1996). United Nations Development Programme, New York: Oxford University Press.

Intergovernmental Panel on Climate Change. Climate Change 2007: Mitigation (Metz, B., Davidson, O.R., Bosch, P.R., Dave, R. & Meyer, L.A. (Eds)), Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge.

Kamau, L. (2012). Sustainability in Building & Climate Change. *The Quantity Surveyor Official Journal of the Quantity Surveyors of Kenya.* Vol. 14 Issue 002.

Karanja, J. (2011). Improving Water Provision in Nairobi Through Control of Non-Revenue Water. Global Water Summit 2011. Global Water Intelligence, pp. 212 – 213.

Kenya State of the Environment and Outlook : Supporting the Delivery of Vision 2030, Nairobi: NEMA, 2010.

Kenya Vision 2030: A Globally Competitive and Prosperous Kenya, 2007.

Kenya County Network. Retrieved from http://www.countyke.com,

Kimani, M. & Musungu, T. (2010). Reforming and Restructuring Planning and Building Laws and Regulations in Kenya for Sustainable Urban Development, 46th ISOCARP Congress.

Klein, E. (2009, May 28). Bill Clinton and the Housing Bubble. *Washington Post.* Retrieved 2013-03-20.

Kothari, C.R. (1985). *Research Methodology: Methods and Techniques.* New Delhi: New Age International (P) Limited Publishers.

Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998.

Langat, L. (1990). A Study of Materials Availability for Teaching and Learning Environmental Education in Primary School in Emkwen Location, *Bomet Division. Kericho District:* Kenya.

Latta, A, (1968). *Introduction to Sustainable Development,* The Tragedy of the Commons, by Garrett Hardin.

Life and Waste Recycling (2007). *Innovative Waste Management Options in Europe*, Luxembourg, (2007). European Commission Environment Directorate-General.

Loomis, J.B. 2000). Can Environmental Economic Valuation Techniques Aid Ecological Economics and Wildlife Conservation? Wildlife Society Bulletin 28(1):52-60.

Martin-Ortega O., & Wallace R.M. (2009). *International Law* (6th ed.). London: Thomson Reuters (Professional) UK Limited.

Mbogo, S (2012). *Nairobi Gets Taste of Green Architecture.*

Moran, D.D., Wackernagel, M., Kitzes, J.A., Goldfinger, S.H., & Boutaud, A. (2008). Measuring Sustainable Development – Nation by Nation. Ecological Economics, 64, 470-474.

Mugenda, O.M., & Mugenda A.G. (1999). *Research Methods: Qualitative and Quantitative Approaches.* Nairobi: Acts Press.

Muigua, K. (2012). *Environmental Impact Assessment (EIA) in Kenya.* Nairobi.

Mulupi, D (2012). *Kenya's Real Estate Sector: Boom or Doom?* Venture Africa, www.mwakilishi.com, accessed on 19th March, 2013.

Mwasi, B.N, & Roba, A.W, (2006). *Integrating Environmental Dimensions of Poverty Reduction into Local Development Planning and Governance in Kenya*, Nairobi: Community Development Trust Fund (CDTF).

Namadzunda, C. (2010). Waste Management Challenges at Lilongwe, Malawi. *Digital Journal Report.* Retrieved from http://www.digitaljournal.com.

Nation Correspondent. (2013, Wednesday, May 15, 2013). Sh100m Plan Launched to Tackle Waste. *Daily Nation.*

National Housing Policy for Kenya, (2004). *Session Paper No.3*, Nairobi: Ministry of Housing, 2004.

Nzioki, N. (2002). *Sustainable Human Settlements: A Report on Civil Society Review of the Implementation of Agenda 21 in Kenya.*

Obanyi, D. (2011, Thursday, July 28). Power Disruptions Call for Eco-Homes. *Daily Nation.* Retrieved from http://www.nation.co.ke.

Organisation for Economic Cooperation & Development, Paris: OECD Publishing.

Otieno, J. (2012, Thursday, April 12). Current Building Code Fit for Archives. *Standard Paper.* Retrieved from http://www.standardmedia.co.ke.

Peters, K. (1998). Community-Based Waste Management for Environmental Management and Income Generation in Low-Income Areas: *A Case Study of Nairobi, Kenya, Nairobi*: Mazingira Institute.

Pivo, G. (2009). Social and Environmental Metrics for US Real Estate Portfolios. *Journal of Property Investment & Finance,* Vol. 27 No. 5, pp. 481-510.

Proost S. (2010). The Role of Stakeholders, *Sustain City Working Paper 2.2b,* CES-Kuleuven, Belgium.

Report of the World Commission on Environment and Development: Our Common Future 1983.

Road to Success in Real Estate, (2012, Thursday, April 12). *The Daily Nation.* Retrieved http://www.nation.co.ke

Rodja, R.A. (2001). *Forest 'Sinks' as a Tool for Climate-Change Policymaking: A look at the Advantages and Challenges,* Accra.

Shafik, N. (1994). Economic Development and Environmental Quality: An Econometric Analysis. Oxford Economic Papers, 46 (1994), 757-773.

The Water Act, (17th October, 2002). No.8 of 2002

Tucker, C. (1998). Gated Communities: Barriers go up. Public Management, 80, 1-3.

Selltiz, C. (1962). *Research Methods in Social Sciences.*

Shanghai Daily (July 20, 2006). *Shanghai Builds Rooftop Gardens to Cool down Buildings.*

Simplified Version of Existing Housing Sector Incentives, 2nd ed. Nairobi: Ministry of Housing Ardhi House, 2011.

Smith, M. (2012). *Survey of Green Growth/Environmental Sustainability Accounting and Indicators,* Rotterdam.

Statistical Abstract: Kenya National Bureau of Statistics. Nairobi: Government Printer, 2011.

Stockman, D. (2009). http://finance.yahoo.com/blogs/daily-ticker/housing-bubble-2-0-david-stockman-133026817.html

Sustainable Development in Kenya: Stocktaking in the Run up to Rio+20 (2012). Nairobi.

Sustainability of Rural Development Projects. International Fund for Agricultural Development (IFAD), 2009.

Sustainable Housing for Sustainable Cities: A Policy Framework for Developing Countries Nairobi: UN-Habitat, 2012.

The Habitable Planet. Retrieved from http:// www.learner.org.

The Constitution of Kenya (2010). Nairobi: The Government Printer.

The Environment Management and Coordination Act (1999). Kenya Law Report.

The Search for Leed Certification: A Look at Strathmore University. *The Quantity Surveyor Official Journal of the Institute of Quantity Surveyors of Kenya,* April-June 2012, Vol. 14, Issue 002.

The United Nations Revision of the World Population Prospects, (2010).

The 16th edition of the World Bank's Development Indicators, (7th December, 2012). *Daily Nation.* Retrieved from http://www.nation.co.ke

The 2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship, Geneva: Yale Center for Environmental Law and Policy.

Tibaijuka, A. (2007). *Nairobi City Development Strategy Top Priority for 21st Century,* Future of the Kenyan Capital, UNEP.

Uganda: Urban Housing Sector Profile (2010). Nairobi: UN-Habitat.

United Nations Conference on Environment and Development Rio de Janerio, Brazil, (3 to 14 June 1992). Agenda 21.

United Nations Environmental Programme, (2011). Buildings: Investing in Energy and Resource Efficiency, p.336, UNEP.

UN-Habitat (1996), The Habitat Agenda Goals and Principles, Commitments and the Global Plan of Action; Brundtland Commission (1987), Our Common Future.

Urban Water Harvesting and Reuse (2010). Water Sensitive Urban Design Technical Manual, Greater Adelaide Region: Australia.

Urban Development website of the World Bank. Retrieved from http://go.worldbank.org PQE9TNVD 10 (accessed November 2012).

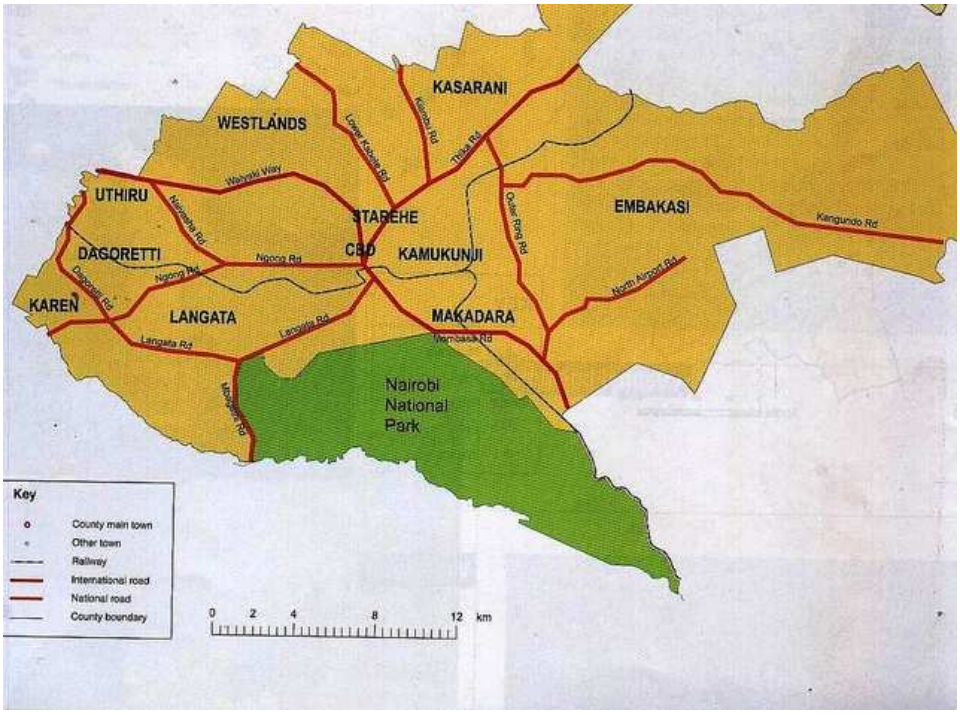
Verzuh, E. (2005). *The Fast Forward MBA in Project Management*, New Jersey: John Wiley & Sons, Inc.

Waitathu, N., (2013, Monday, May 20). Poor Funding of Water Storage Returns to Bite Nairobi County. *The Standard.*

Wilson, A., Uncapher, J.L., McManigal, L., Hunter, L., Cureton, L.M., Browning, W.D. (1998). *Green Development: Integrating Ecology & Real Estate.* New York: John Wiley & Sons. Inc.

APPENDICES

Appendix i: Administrative Boundaries of Nairobi County



Source: Kenya County Network

Appendix ii: Letter of Transmittal

Harry Simeon Madukani
University of Nairobi
School of Distance and Continuing Education
Department of Extra-Mural Studies
P.O Box 30197-00100, G.P.O, Nairobi
Tel: 0732492382; E-mail: harrymadukani@yahoo.com

Re: A Research on Factors Influencing Environmental Sustainability of Real Estate Projects in Kenya

I am a graduate student of the above university and am presently pursuing a Master of Arts in Project Planning and Management. My research is geared towards exploring factors that influence the environmental sustainability of residential real estate in Kenya. I will be very grateful and appreciative if you help me achieve my goals by responding to the attached questionnaire. Any information that you provide will solely be used for the purposes of this research and will be treated with utmost respect and confidentiality.

The significance of this study is that it will help relevant stakeholders with information regarding enhancing environmental sustainability of residential real estate. It will also assist regulatory agencies with information regarding policy making. A copy of the final document will be made available to you upon request. Thanks for accepting to be part of this study.

Sincerely yours,

Harry Simeon Madukani

Appendix iii

Questionnaire for Tenants

Please answer the following questions as honestly as possible. There is no need to indicate your name anywhere. Write or tick in the box as appropriate.

Schedule A

1. Age: 18-25 26-35 36-45 46-95
2. Gender: Male Female
3. What is the highest level of education you have attained?
   a) Some primary school (class 1-8)
   b) Secondary education (Form 1-4)
   c) Completed college
   d) Completed University
   e) Others e.g. tertiary of apprenticeship, mechanic etc_____
4. Occupation: Employed Business
   Student Unemployed
5. What is your gross income per month?
   a) Between Ksh 50,000 - Ksh 100,000
   b) Between Ksh 100,001 - Ksh 200,000
   c) Between Ksh 200,001 - Ksh 300,000
   d) Between Ksh 300,001 - Ksh 400,000
   e) Over Ksh 400,001

Schedule B

1. Have you ever heard about environmental sustainability?
   Yes (Please answer question 2)
   No (please skip question 2 and go directly to question 3).
2. If yes, what is your understanding of environmental sustainability?

   _____

   _____
3. Where do/did you learn about environmental sustainability? (tick where appropriate)
   a) Radio b) Newspaper/magazine c) Television d) Internet
   e) School f) Friends/neighbours

4. List all elements in your estate/house that enhance environmental sustainability_____

4. Are you aware of decomposable (biodegradable) and non-decomposable (non-biodegradable) type of garbage or substance?

   Yes No

5. If yes, do you separate these two substances when disposing them?

   Yes No

6. If no, why not?_____

Schedule C

1. Do you own a vehicle/s?

   Yes No (If no, go straight to question 4)

2. What type/brand of vehicle/s do you own?_____
3. How old is your vehicle/s?_____
4. What is your usual mode of transport when going out?

   a. Private vehicle b. Public vehicle c. Walking d. Cycling

5. If you go out every day, how many times per day on average?

   a. Once b. Twice c. Three times d. Four times e. Many times

6. What are the sources of solid waste (garbage) created in your house? (tick where appropriate)

   a) Food b) Plastic bags/papers c) Tin/cans d) Glass bottles

7. How do you mainly dispose of your domestic solid waste (garbage)?

   a) Collected by municipality/government agency
   b) Collected by private establishment
   c) Dumped at a nearby ditch
   d) Burned

8. What is/are your source/s of water for domestic use?

   a. Supplied by Nairobi Water and Sewerage Company b. Borehole c. Rain water harvesting d. Buy from vendors

9. What alternative energy do you use for lighting and other things when there is no power from KPLC?

a. Generator b. Solar Power c. Biogas d. Paraffin/Kerosene
e. Battery f. Candles

10. Have you heard about energy saving bulbs?
    a. Yes b. No
11. If yes, do you use them?
    a. Yes b. No
12. If you do not use them, why not?
    a. Not easily available b. They are expensive c. Other (specify)_____
13. In your view, which activity consumes electricity most in your household?
    a. Cooking b. Lighting c. Ironing d. Other (specify)_____
    _____
14. How do you cook/boil water?
    a. Using electricity b. Using gas c. Using charcoal/firewood
    e. Using paraffin/kerosene f. Other (specify)_____

Schedule D

1. What is your approximate monthly electricity bill?

a. Less than Ksh 1,500
b. Between Ksh 1,501 - Ksh 2,000
c. Between Ksh 2.001 - Ksh 2,500
d. Between K2,501 - Ksh 3,000
e. Over Ksh 3,000

2. How much do you pay for monthly service charge? _____
3. How satisfied are you with the monthly service charge?
    a. Extremely satisfied b. Satisfied c. Neutral d. Dissatisfied
    e. Extremely dissatisfied

Appendix iv

Questionnaire for Estate Managers

Please answer the following questions as honestly as you can. You do not need to indicate your name anywhere. Write or tick as appropriate.

Schedule A

1. What is the highest level of education you have attained?
a. Some primary school (class 1-8)
b. Secondary education (Form 1-4)
c. Completed college
d. Completed University
2. How many housing units are in your estate? ☐
3. How long has your estate been in operation?
   Less than 1year ☐
   1 – 2 years ☐
   3 – 4 years ☐
   More than 4 years ☐

Schedule B

1. Have you ever heard about environmental sustainability?
   Yes No (If no, go straight to question 4)
2. If yes, where do/did you hear about it from?
   a. Radio b. Internet c. Television d. Magazines/Newspapers d. School f. Friends
3. What is your understanding of environmental sustainability?_____-
   _____
4. Have you heard about **Solar Panels/Energy?**
   Yes No (if no, go straight to question 6)
5. If yes, have you applied such technology in your estate?
   Yes No
6. If no, why have you not applied it?_____
7. If yes, what in your view are the benefits of applying the technology mentioned above in your estate?_____

8. What are the challenges of applying the said technology?_____
9. Have you heard about **Water Harvesting?**

   Yes No (if no, go straight to question 11)
10. If yes, have you applied such technology in your estate?

    Yes No
11. If no, why have you not applied it?_____
12. If yes, what in your view are the benefits of applying the technology mentioned above in your estate?_____
13. What are the challenges of applying the said technology?_____
14. List any other technologies used in your estate that enhance environmental sustainability_____
15. Do you get training on how to enhance the environmental sustainability of real estate?

    Yes b. No
16. If yes, how satisfied are you with the training?

    1=Extremely dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Extremely satisfied

Schedule C

1. What existed on the site before this project?_____
2. What are you doing in your estate to enhance green cover?
   a. Planting trees b. Maintaining lawn c. Planting shrubs d. Other (specify)_____
3. Have you heard about Environmental Impact Assessment? Yes No

   (If no, go straight to question 9 below).
4. When the idea of this estate was conceived, was an Environmental Impact Assessment done?

   Yes No
5. If no, why Not?_____
6. If yes, did you consider an alternative project with less negative environmental impact as opposed to the current one?
   a. Yes b. No
7. If no, why not?_____

8. If yes, what was your alternative project and why?_____

9. Do you separate domestic solid waste into biodegradable (decomposable) and non-biodegradable (non-decomposable) in your estate?

   Yes No

10. If yes, how do you deal with each category?

    a. Biodegradable (decomposable)_____
    _____

    b. Non-biodegradable (non-decomposable)_____
    _____

11. Are you aware of private companies dealing with garbage collection and treatment in Nairobi?

    Yes No

12. If yes, do you use their services?

    Yes No

13. If you do not use their services, how do you dispose solid waste (garbage)?

    a. It collected by municipality/government agency
    b. Landfill (filled in pits around the estate then buried)
    c. It is dumped at a nearby ditch
    d. It is burned

14. If you use private companies to dispose solid waste, do you know how they handle the waste after collection?

    Yes No

15. If yes, how do they handle waste after collection?_____
    _____

16. If you use private companies, how can you rate their services?

a. Good b. Very good c. Excellent d. Average e. Poor

17. How do you deal with runoff (water)?

a. It flows into the drainage b. We let it find its way c. It is absorbed through green cover c. Other (specify)_____

18. How do you deal with used water in the estate?_____
19. Do you use any renewable source of energy in your estate?

    Yes No

20. If yes, mention source(s) of renewable energy used in your estate.
    a. Solar panels b. Biogas c. Wind energy d. Hydro-electricity (KPLC)
    e. Other (specify)_____
21. If no, explain why you do not use any of the known renewable sources of energy?_____
22. How many parking spaces do you have for the residents? ☐
23. Do you use a generator in your estate?
    a. Yes b. No
24. If yes, how often?_____
25. If no, why do you not use it?_____
26. What other challenges do you face with tenants on handling solid waste?_____

Schedule E

1. Did you involve the following stakeholders during the planning stage of this project?
    a. The surrounding community: Yes No
    b. NEMA: Yes No
    c. City Council of Nairobi: Yes No
    d. Ministry of Housing: Yes No
    e. Ministry of Water: Yes No
2. If you involved them, how did they help enhance environmental sustainability of your estate?
    a. Surrounding community:_____
    _____
    b. NEMA_____
    _____
    c. City Council of Nairobi:

_____

_____

d. Ministry of Housing:

_____

_____

e. Ministry of Water:_____

3. Do you carry out an environmental audit for your estate?
   a. Yes b. No
4. If no, why not?

   _____
5. If yes, how often?_____

Schedule F

1. How much do you charge tenants for monthly service charge?_____
2. What are the challenges you face in raising such funds?_____
3. Have you thought of any means of generating income for the maintenance of the estate?_____

Appendix v

Interview Schedule

Guiding Questions for Regulatory Officials

1. What is your position in your organization? _____
2. Do you have regulations that guide the construction of residential estates from the environmental point of view? Yes No
3. If yes, may you explain how you apply them?

   _____

   _____
4. What are the challenges you face when implementing the regulations if any?

   _____

   _____
5. Where do you get information pertaining to factors that enhance environmental sustainability of residential estates? Do you undergo any training in this regard?_____

   _____
6. Does your organisation get involved in the planning and operation of residential estates regarding environmental sustainability issues? If yes, how?_____

   _____
7. How can you describe the level of compliance by residential real estate to the regulations you formulated in order to ensure environmental sustainability of residential
   estates?_____

   _____
8. Any challenges from the environmental point of view that you encounter when dealing with residential
   estates?_____

   _____

Appendix vi

Table 6.1: Observation Checklist

Environmental Monitoring Item	Focal Area	Implemented?			Remarks (*i.e. specify location, good practices, problem observed, possible cause of nonconformity and/or proposed corrective/preventative actions*)	Responsibility
		Yes	**No**	**N/A**		
1. Building Materials						
a. Are the building materials local?	Material sources					
b. Are the building materials sustainable?						
2. **Energy Conservation**						
a. Is natural light used during day time?	Near and within settlements					
b. What is the system for switching on and off the security lights?	Within the compound					
3. Renewable Sources of Energy						
Any sources of renewable energy used?	Near and within settlements					
i. Solar panels						
iii. Wind energy						
4. Water and Air Pollution Control						
a. Wastewater not	All discharge points and					

discharged to the storm rains? Is the wastewater being treated?	streams					
b. Are there non-renewable sources of energy that emit smoke like generators used?	Within the compound					
5. Waste Management						
a. Are separate chutes used for inert and non-inert (biodegradable) wastes?	Around and inside the compound					
b. Is solid waste collected and disposed of properly by licensed collectors?	Around the compound					
6. Building Code						
a. How much space is left for other things?	Around the houses.					
b. What percentage of space has been used for cabro, roads and green matter?	Around the houses.					
7. Protection of Flora, Fauna and Landscape						
a. Are disturbances to terrestrial flora	Road corridor and surrounding habitat					

minimized (e.g. plants to be preserved)?						
b. Are disturbances to terrestrial fauna minimized (if rare species identify)?	Road corridor and surrounding habitat					
c. Is the gated community not altering natural flow of a river?	Surrounding community					
8. Resource Conservation						
a. Is water pipe leakage and wastage prevented? Water taps turned off when not in use?	Inside and outside the houses					
b. Any drums installed to harvest rain water?	Around the compound					
Health and Safety						
a. Is water runoff and surface water properly collected (proper gutters around)	All the grounds of the compound					