EVALUATING AWARENESS LEVELS AND BARRIERS TO GREEN BUILDING IMPLEMENTATION: A CASE OF ENGINEERS AND ARCHITECTS IN NAIROBI CITY COUNTY

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS IN ENVIRONMENTAL PLANNING AND MANAGEMENT, FACULTY OF ARTS AND SOCIAL SCIENCES UNIVERSITY OF NAIROBI

DECLARATION

This project is my original work and has not been presented for an award of a degree, diploma or certificate in the University of Nairobi or any other award in any other university.

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Supervisor: This research project has been submitted for examination with my approval as the University of Nairobi supervisor.

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DEDICATION

I would like to dedicate this research project to my parents, Hellen and the late James Makworo, as well as to my husband, Brian Osore, for his unwavering and unconditional support. It is also dedicated to my second parents Mr. & Mrs. Nyaundi who have been very supportive, always reminding me to strive higher.

Above all, I dedicate this research project to God Almighty, my source of inspiration, knowledge and wisdom.

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ABSTRACT

The building sector contributes to some of the most significant environmental damage and therefore, embracing sustainable building is crucial in attaining sustainable development through green buildings. Green building involves the construction of structures with minimal adverse effects on the environment, encompassing processes from design to material selection and life cycle analysis. Existing literature underscores the limited adoption of Green Building Concepts (GBCs) in developing nations. This study aimed to evaluate the awareness of GBCs and the barriers to their implementation, which include sustainable sites practices, efficient use of materials, indoor air quality, energy and water efficiency within built environment projects in Nairobi City County, Kenya. Employing both qualitative and quantitative research methodologies, the researcher engaged a sample size of 154 Built Environment Professionals (BEPs), consisting of architects and engineers, drawn from the Engineers Board of Kenya and the Board of Registration of Architects & Quantity Surveyors. The sampling method employed was stratified random sampling, while data collection relied on a self-administered electronic questionnaire. Data analysis encompassed both descriptive and inferential approaches. The study revealed that BEPs in Nairobi County exhibited substantial awareness of the components associated with green buildings, including sustainable sites, sustainable materials, water efficiency, indoor air quality, and energy efficiency, each garnering an impressive mean percentage rating of 72.6%. Nonetheless, barriers to GBC implementation were identified. The research established a notable interest among BEPs in adopting GBCs, with the highest interest observed in water efficiency (84.8%), followed by energy efficiency (82.8%), sustainable materials (78.6%), sustainable site designs (75.6%), and indoor air quality (75.6%). The pronounced interest in water and energy efficiency stemmed from the significant impact of these components on utility bills. Notably, the study findings underscored that major impediments to GBC implementation included high investment costs (86.6%), inadequate public awareness (81.4%), and a shortage of financial incentives (79. 6%). Correlation results revealed a significant correlation of 56.6% between the extent of GBCs implementation and the awareness levels among BEPs ($r = 0.566$, $p = 0.000 < 0.05$). This suggests a robust positive relationship between BEPs' awareness and the practical incorporation of GBCs in their projects. In addition, regression analysis revealed that government regulations and policies; investors' demands; market trends and quest for personal branding and prestige for professionals in the field had significant influence on extent of GBCs implementation. However, tenants' interests, membership in professional bodies and civil society organizations did not show statistically significant influences on the extent of GBCs implementation. Recommendations from this study advocate for the incorporation of GBC requirements into key governmental regulations, policies, and building design standards, along with a heightened focus on creating awareness about GBCs. Expanding the research scope to other towns and counties, as well as investigating the perceptions and awareness of GBCs among other key stakeholders such as investors and end users, represents crucial areas for further exploration.

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LIST OF ABBREVIATIONS AND ACRONYMS

BEPs	Built Environment Professionals
BORAQS	Board of Registration of Architects and Quantity Surveyors
CO_2	Carbon Dioxide
EBK	Engineers Board of Kenya
ESG	Environmental and Social Governance
GB	Green Buildings
GBCs	Green Building Concepts
GBS	Green Building Standards
GDP	Gross Domestic Product
GHG	Green House Gases
HVACs	Heating, Ventilation and Air Conditioning
IPCC	Intergovernmental Panel on Climate Change
NCA	National Construction Authority
SDGs	Sustainable Development Goals
SPSS	Statistical Packages for Social Sciences
TPB	Theory of Planned Behavior
UN	United Nations
UNCHS	United Nations Centre for Human Settlements
VBN	Value Belief Norm
VOCs	Volatile organic compounds

CHAPTER ONE

INTRODUCTION

1.1Background of the study

Increased greenhouse gas (GHG) emissions, as highlighted by Honkonen and Romppanen (2022), are instrumental in the current surge of global warming, commonly referred to as climate change. This phenomenon is influenced by a combination of natural and anthropogenic factors. Noteworthy among the human-induced determinants are population growth, urbanization, heightened industrial emissions, and amplified utilization of natural resources. These elements have triggered significant alterations in the composition of the atmosphere, characterized by shifts in GHG levels, aerosols, and cloud cover, as articulated by Gunawansa (2015).

Sustainable Development Goal (SDG) 13, designed to combat climate change, requires a global response to address the impacts. While it is widely acknowledged that various sectors, including transport, agriculture, and energy, contribute to exacerbated climate change through GHG emissions, the construction sector has emerged as a major source of carbon dioxide (CO_2) emissions. Reports underscore the substantial environmental footprint of the building sector, encompassing significant land use, material extraction, and resource utilization (Ranasinghe et al., 2021). Moreover, a substantial portion of global fossil energy, approximately 40%, is consumed by the building sector. Additionally, the industry accounts for a quarter of the world's timber usage and up to 16% of global freshwater consumption (Khan & Ali, 2020). It has been indicated that by 2010, buildings accounted for up to 19% of GHG emissions globally, following fossil fuel combustion (Intergovernmental Panel on Climate Change (IPCC), 2014).

Residential buildings in the Sub-Saharan Africa (SSA) region alone contribute to over half of the energy consumption, while in the developed world, they account for roughly 20% of the total consumption (Kalua, 2020). This can be attributed to existing building codes in developed countries and energy efficiency standards as opposed to SSA countries. Therefore, it is imperative for the building sector to actively participate in efforts to reduce GHG emissions and resource depletion. The methods applied in the design, construction, operation, and decommissioning of buildings hold significant weight in this endeavor. By 2020, up to 30% of CO_2 emissions from

buildings could be mitigated through cost-effective strategies, given the introduction of various technological advancements, such as efficient heating systems (IPCC, 2007). Thus, the building sector presents a substantial avenue to address global challenges related to climate change, including reduced air pollution, decreased climate change-related mortality rates, enhanced energy security, and improved social well-being.

Empirical evidence, as posited by Hasanbeigi, Price and Lin (2012), indicates that up to 5 % of CO_2 emissions emanate from activities involving cement, mining, and manufacturing. The selection of building materials, methods employed in construction, and transportation distances to construction sites have been identified as contributing factors to heightened environmental pollution. Onkangi and Getugi (2020) further assert that although the construction sector plays a significant role in economic contributions, it concurrently depletes natural resource reserves, potentially compromising opportunities for future generations.

Consequently, it is evident that prioritizing sustainable building practices can yield considerable savings in energy, resources, and materials. As highlighted by Darko et al. (2017), sustainable practices in green building sites, efficient water usage, energy efficiency, and indoor air quality are key in achieving sustainability in green buildings. The consensus is that embracing GBCs is fundamental to achieving sustainable development. Global trends indicate a widespread embrace of GBCs in cities worldwide, with notable efforts in Europe, exemplified by countries like Sweden and Italy, which have spearheaded the renovation of existing buildings, incorporating green building principles. The European context has demonstrated a strong commitment to green building practices, which have resulted in reduced energy consumption and improved water management in numerous projects (Zhang et al., 2019). Despite this, literature suggests that there is room for improvement in the implementation of GBCs in developing countries. The initial design and implementation phases face challenges such as the high costs associated with green construction, a shortage of expertise, and a lack of government support, as observed in Nigeria by Oluwunmi, Oladayo, Role, and Afolabi (2019). Similarly, Yas and Jaafer (2020) noted that high construction costs and a lack of technical know-how are significant hindrances in the United Arab Emirates.

The significant recognition garnered by GBCs on a global scale stem from their demonstrated ability to mitigate environmental impacts, enhance energy efficiency, and contribute to overall sustainability in the built environment. Organizations like the United States Green Building Council (USGBC) have had a significant impact in shaping global awareness and establishing standards for green construction, as exemplified by the widely recognized Leadership in Energy and Environmental Design (LEED) certification. International research initiatives, such as the Dodge Data & Analytics Smart Market Report, consistently examine global trends in green construction, showcasing the increasing adoption of sustainable building practices (Data, 2017).

The implementation of green building practices varies, with notable progress across Europe, Asia, and the Middle East. For instance, Europe has witnessed a surge in sustainable construction practices driven by support from the European Commission and national governments. The European Green Building Council (EGBC) actively promotes green building practices across the continent. Meanwhile, Asian countries like Singapore have embraced GBCs, exemplified by the Building and Construction Authority's (BCA) Green Mark Scheme. In the Middle East, ambitious projects like Masdar City in the UAE and the Qatar Green Building Council have demonstrated the region's commitment to sustainable development (Awadh, 2017).

Turning the focus to Kenya, the country has remained open to the global shift toward green building practices. The Kenya Green Building Society (KGBS) serves as a local champion, actively promoting the adoption of sustainable construction practices, organizing educational programs, and spearheading awareness campaigns. Moreover, several local research initiatives, including those conducted by the University of Nairobi's Center for Urban Research and Innovations (CURI), have delved into the particulars of sustainable construction and urban development within Kenya's context. The Kenyan government has also embraced the significance of green building, as evidenced by initiatives like the Kenyan National Climate Change Action Plan, which underscores the importance of energy-efficient and sustainable construction (Symons, 2014).

In Kenya, green building has been perceived as costly. A study done by Oduho Vikiru and Mireri (2022) concludes that there is a need to change perceptions and increase awareness in Kenya, citing

the environmental importance of the whole idea of green building as environmental sustainability. There are two major groups involved in project implementation in the built environment industry: architects and engineers. For the successful adoption of GBCs, these groups need to be aware of steps to take to ensure sustainability in the construction sector. Necessary aspects of awareness in green building include technological understanding, metric contents, and contextual awareness of GBCs (Reinhardt et al., 2012). Therefore, this study was considered necessary to document findings in regard to the awareness and barriers to green building ideas in the building industry within Nairobi City County.

1.2 Statement of the research problem

In the advent of global warming and climate change, the construction sector has been identified as a core contributor to greenhouse gas emissions. Despite its advantages, the rate of adoption of green building concepts by built environment practitioners in Kenya is not in keeping with expectations. For instance, according to Were, Diang'a and Mutai (2015), only four buildings were certified to have incorporated green building concepts in their design and construction out of 293 between the years 2013 and 2015 in Nairobi. Data from the Kenya Green Building Society indicated that as at 2021 only 43 buildings in the country had received green building certification. The Kenyan construction market size has been growing. It was valued at more than 16 billion US dollars in 2021 and is anticipated to achieve an annual average growth rate of at least 6% between the years 2024 and 2026 (GlobalData, 2023). In addition to this, the government plans to build 10,000 housing units under its ambitious housing plan. The low uptake of green building concepts by built environment professionals coupled with the increase in urban population and the resultant increase in demand for housing in the country makes for a grim outlook as far as the potential of sustainable construction in Nairobi City County is concerned.

Kenya has a number of laws, strategies, national policies and development plans that touch on green building. Notable among them include the Green Economy Strategy and Implementation Plan-Kenya (2016-2030), Sessional Paper No. 10 of 2014 on National Environment Policy and National Climate Change Action Plan 2018-2022. Despite the foregoing, the approach taken up by relevant government agencies does not seem to have influenced the adoption of green building concepts by professionals in the sector.

Existing literature acknowledges awareness and knowledge gaps but needs more specificity on the depth and areas of deficiency. This study aims to fill this gap by assessing the level of awareness and identifying barriers to GBCs in Nairobi City County, contributing to a comprehensive understanding of the challenges faced by the professionals. The study can provide recommendations for improving sustainable building practices by pinpointing policy or regulatory gaps. Addressing this research problem is crucial for achieving environmental sustainability, economic development, and improved living conditions in Nairobi City County. The study's specific research questions and objectives aim to guide the research process and contribute to advancing green building in the region.

1.3 Research questions

1. What components of green building are taken into consideration by built environment professionals in construction projects within Nairobi City County?
2. What triggers awareness of green building concepts among built environment professionals in construction projects in Nairobi City County?
3. What is the extent of implementation of green building concepts by built environment professionals in building projects within Nairobi City County?
4. What are the barriers faced by built environment professionals in implementing green building concepts in construction projects in Nairobi City County?

1.4 Research objectives

The aim of the research was to investigate the level of awareness and barriers to green building concepts implementation by built environment professionals and recommended strategies to enhance green building.

The specific objectives;

1. To determine components of green building taken into consideration by built environment professionals in construction projects within Nairobi County.
2. To examine the triggers of awareness of green building concepts among built environment professionals in the construction sector in Nairobi County.

3. To evaluate the extent of implementation of green building concepts by built environment professionals in building projects within Nairobi City County.

4. To discuss the barriers to the implementation of green building concepts in construction projects within Nairobi City County.

1.5 Research Hypothesis

1. H01: There is no relationship between awareness and extent of implementation of GBCs (sustainable sites practices, efficient use of materials, indoor air quality, energy and water efficiency) by BEPs in building projects within Nairobi City County

2. H02: There is no influence of triggers of awareness of GBCs on extent of implementation of GBCs by BEPs in building projects

1.6 Justification of the study

Hampson et al. (2014) highlighted the importance of the built environment to the Gross Domestic Product (GDP); capital formation; job creation; carbon dioxide reduction; public health (air quality regulation); economic benefits; ecological and aesthetics and production of other assets which are useful in other sectors. Its contribution is mostly prime in the urban centers because many urban centres have either prospered or declined according to their economic activities, environmental impacts and surrounding natural resources (Olima, 2001). According to Mwaura (2014), between 1960 and 1980, the city of Nairobi witnessed major developments of skyscrapers as well as high-rise construction, with a lot of these towers being completed within this time frame. This was followed by a decline in construction activities for 20-years prior to picking up again (Mwaura, 2014). The last decade has thus seen an increase in construction activities in the city. Consequently, the city was listed as having some of the world's fastest-growing real estate. (Kinght, 2012). Additionally, the main contribution of the city to the GDP of the country is 27.5% besides being one of the main economic hubs in the African continent (Mburu, 2023)

Given the foregoing tremendous growth, the impact of the Nairobi’s construction sector to climate change is bound to be tangible if left unchecked. Furthermore, by virtue of Kenya being a signatory of the SDGs and the Paris Agreement, it is prudent to assess the potential for achieving the

objectives of such treaties through the construction sector. It is then important to gauge the awareness of green building standards and their applicability in Nairobi City County as this relates to the actions being taken towards GHG emission reduction.

1.7 Scope of the study and limitations

The research evaluated the knowledge of GBCs and the obstacles to their application in the built environment industry in Kenya while focusing on the experience of BEPs in Nairobi City County. Specifically, the emphasis of the study was to analyses the main components of GBCs taken into consideration, identify the triggers of awareness, determine the extent of implementation of GBCs and highlight the challenges to the adoption of GBCs in construction projects by BEPs. Additionally, the study focused on architects and engineers only as they were considered to be the most influential in building designs.

The study did not cover the benefits and importance of sustainable construction, management practices on GBCs, impacts of buildings on climate change as well as the perceptions of different actors e.g., quantity surveyors, tenants, project managers, landlords etc. on GBCs among others. Even though this work did not focus on the aforementioned, their significance on the topic of sustainable construction cannot be ignored. Secondly, due to time, budget and personnel constraints, the study did not cover construction projects outside Nairobi City County.

1.8 Operational definitions and concepts

Awareness: The state of being well-informed about green building concepts and the desire of having sustainable buildings by built environment professionals in Nairobi City County

Barriers: Impediments or interferences to achievement of sustainable buildings either partially or fully as faced by built environment professionals in Nairobi City County

Built Environment Professionals: Encompass engineers and architects, serving as crucial experts in the field of construction and urban development.

Green Buildings: Implies to construction of buildings with minimum negative environmental impacts and encompasses all the processes from the design, selection of materials in addition to life cycle analysis and energy efficiency.

Green Building Concepts: Refer to the elements of sustainable buildings including use of

sustainable materials, sustainable methods of waste water treatment, use of green energy, natural lighting, environmental quality of the building immediate environment (biodiversity, dust control, noise pollution control, thermal pollution), natural internal temperature regulation mechanism, solid waste management, building visual impacts, storm water management, site landscaping and sustainable sites.

Triggers: Motivators or catalysts that drive action among BEPs in the research area, towards recognizing, adopting and implementing GBCs in their projects.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter delves into issues pertaining to components of green buildings taken into consideration by built environment professionals, the extent of implementation of green building concepts, and the triggers and barriers faced by the professionals. It also highlights some of the theoretical underpinnings of the study, provides its conceptual understanding of the problem and identifies the gaps in the existing literature.

2.2 Green building

United Nations Environment Programme (2002) established that buildings account for up to 33% of GHG emissions worldwide as well as consuming up to 40% of the energy, generating wastes that account for up to 40% of the total in the world. On the contrary, sustainable buildings aim to have buildings with minimal negative environmental impacts, using energy and water efficiently as well as other resources. Such buildings also add to other features such as green roofs and energy efficient fittings through design, materials used and construction. Alam and Haque (2016) termed green building as a process whereby a design is first agreed on followed by assessment of other systems and elements at the site then its integration and optimization for a holistic solution. It hence requires collaboration across stakeholders at all the stages in order to have a balance in the five main elements that constitute the process that is sustainable design of the site, energy and water efficiency as well as environmental optimization and indoor air quality, resource and material efficiency.

2.2 Components of green building taken into consideration by built environment professionals

Due to their continuous use of energy, water, and raw materials, trash production, and potentially hazardous air pollutants, buildings have both immediate and indirect effects on the surroundings. This includes construction, habitation, renovation, repurposing, and demolition stages. Discussed below are the elements/components of green buildings.

2.2.1Sustainable site design

According to Kubba (2010), the main aim of having a sustainable site is to ensure the surrounding

ecosystem is well preserved, and the overall construction process does not bring disturbance. Additionally, this process ensures that there is restoration and preservation of valuable habitat to sustain lives. When a proper site selection and design is conducted, it helps to minimize disturbance of vegetation, location of facilities at the site so that immature vegetation are not cut, use natural vegetation in order to reduce visual impact as well as re-design the building plan to reduce the building's visual impact (Kubba, 2010). The site layout and design directly affect the use of energy and water that surrounds it. This is because a green planned site can help preserve some of the natural resources in the area such as vegetation and increase efficiency in both energy and water usage because it increases the amount of storm water. The process can be achieved through use of existing vacant sites as well as efficiently using the space in the building occupying the target site (Green Building, 2009). Green Building (2009), further documented that the process starts with site selection and retaining the landscape in the area through reduced land trimming which enables to keep storm water.

2.2.2 Energy efficiency

(Yoders, 2008) outlined that there is a need to pursue design strategies for heating, cooling and ventilation through advanced approaches such as sun-shades which can ensure energy efficiency at no additional costs. Green Building (2009) indicated that more energy can be saved beyond the targets in green buildings when there is the use of passive procedures such as natural lighting. There has been an increase in CO_2 emissions through electricity use from 8.6 billion tons in the year 2004 to 15.6 billion tons by 2030 (IPCC, 2007). Green buildings are supposed to have measures aimed at managing or reducing energy consumption during processes such as processing, extraction, installation and transportation as well as other services such as heating that require power. Another technology to ensure efficiency in energy use is the use of radiant solar heating especially for residential buildings. Passive lighting can ensure that large windows pass through the natural light which ensures that energy consumption is minimized and lighting is amply provided. In turn, passive lighting reduces the use of electricity, thus saving on energy as well as providing better illumination spaces (Brownstone, 2008).

2.2.3 Water efficiency

Gelan (2022) outlines some of the technologies being deployed in ensuring water efficiency in buildings including grey water reuse and recycling, rainwater collection, installation of sensors,

low-flow fixtures. He goes on to highlight that these measures can significantly cut down on water waste, which lowers energy use and sewage volumes both of which have a positive financial impact. Through the use of water appliances, up to 30% of water consumed is conserved (Gottfried, 1996). Water efficiency approaches basically aim to make use of the natural water cycles hence there is a need to incorporate the site movements to match the natural course and hydrological systems. Therefore, importance is normally placed on infiltration and ground water recharge. There is also a need to maximize water recycling and use including storm, rain and gray water as well as minimize portable water use (Alam & Haque, 2016). There is a need for proper site assessment in order to preserve those sites which are rich in natural storm water, recharge and infiltration abilities. The primary goal of the water efficiency approach is to ensure that water is used sustainably through reduced portable water as well as the burden on public sewer lines. Green buildings result in the management of water consumption and preservation of water quality. The existing surrounding forests should also be preserved accordingly because of their important role in water recycling through evapotranspiration. The use of low-impact bio-retention, paving, walkways, and rain gardens as well as constructed wetlands and other related technologies should also be considered (Alam & Haque, 2016). Additionally, the dual plumbing system's design can be considered as it recycles water for flushing toilets. Furthermore, when designing flushing features, there is a need to use conserving technologies such as ultra-low flushing toilets as well as shower heads. The use of bidets is also important since it helps to minimize usage of toilet papers which is important to reduce and minimize traffic in the sewer lines which in turn enhances water recycling. Technologies for water treatment at point of use can also be considered since they improve the quality of water (Alam & Haque, 2016).

2.2.4 Sustainable materials and resources

A study done by Omer and Noguchi (2020) documented that its necessary to pay close attention the use of modern building materials in construction while focusing on raw materials consumed and natural resources, energy intensity of materials, safe disposal and recycling and their impacts on the environment. Therefore, it is critical to promote the use of reasonably priced, resource-efficient, low-emitting building materials, components, and systems that are climate responsive and emit few greenhouse gases and volatile organic compounds (VOCs).

Sustainable buildings are aimed at reducing the use of non-renewable materials in construction through processes that entail but are not limited to design, planning and engineering, as well as the use of recyclable aggregates. There is also a need to install new filters in air conditioning, heating and ventilation in addition to cleaning any ductwork. Residents are required to use the fresh air naturally from outdoors (Alam & Haque, 2016). The building elements are also required to be sourced from outside and only be delivered on-site in order to reduce waste, less noise, and dust and ensure recycling as much as possible.

2.2.5 Indoor air quality

Gelan (2022) outlined that a top-notch interior environment can reduce liability, increase occupant satisfaction, increase productivity and performance while reducing the need for operations and maintenance. The component offers interior spaces that promote health and well-being as well as occupant comfort and productivity. According to Gelan (2022), the use of passive designs, daylighting and natural ventilation, preventing moisture intrusion, specifying and installing the proper equipment, and using building materials with low or zero VOCs or other pollutants are just a few of the green building interventions that can help create a healthy indoor environment.

2.1 Triggers of awareness of green building concepts among built environment professionals

Energy efficiency and sustainable built environment is taking the center stage as the drivers of protecting assets and properties of a group of property investors across the world who have greatly invested in green technology which is gaining momentum (Homes, 2020). Buckley and Logan (2016) agree that in the recent past, green technology has increased and continues to double every 3 years in Brazil, Asia and South Africa. In the next decade, emerging economies such as South Africa and Brazil will be the engines of green growth worldwide. A report by Reed and Willis (2013) identifies a number of factors that are heightening attention of construction professionals to sustainability in real estate. Major drivers spurring action among BEPs include; investors (capital markets), tenants, regulatory agencies and civil society organizations. Extant literature highlights key drivers spurring action among BEPs as follows:

2.2.6 Government Regulations and Policies

Akreim and Suzer (2018) placed responsibility on governments to advance the agenda of green

buildings, motivating and providing incentives for adoption of green buildings. Additionally, Chan, Lee & Lee (2014) agreed that collaborations between governments and research institutions as well as government policies would be important in encouraging the construction of green parks and other green developments. Wong, San Chan, and Wadu (2016) added that through mandatory government policies, standards as well as NGOs requirements, green development can be pushed a notch higher. Li, Yang, He, and Zhao (2014) highlighted that to foster the awareness of green building technologies, it is critical to formulate relevant policies and regulations. A survey conducted by Buckley and Logan (2016) on the top triggers of increased levels of green building awareness amongst BEPs globally, environmental regulations was the second most important trigger according to 33% of the respondents. Similarly, Reed and Willis (2013) contended that the growing number of state and local regulations requiring property owners to reveal the energy performance of their buildings, has played a significant role towards adoption of green building. For example, Federal States of Seattle, San Francisco, Minneapolis, Austin, New York City and Boston all have energy disclosure laws for commercial or multi-family buildings in effect while states like Portland and Washington DC have either proposed or pending their effective dates for the same (Reed & Willis, 2013). Assets which do not comply and accumulate poor energy performance attract high transparency into their energy use and also decrease effective rental rates as well as asset value at disposition.

2.2.7Investors' demands

Reed and Willis (2013) documented that in the recent past, an increasing number of institutional investors have been making enquiries about green buildings from real estate investment funds with the aim of better understanding green practices. Some of them are United States (US) and European Union (EU) based firms such as APG and CalSTRS. Some of the common concerns by investors include Environmental Social Governance (ESG) factors that were taken into account when making investments, whether property developers have any ESG policies, whether the developers understand the ESG issues material to their business and how the property developers communicate ESG policies to their stakeholders (Reed & Willis, 2013).

Existing literature records that publicly traded real estate funds are not exempted from sustainability related shareholder proposals and potential exchange listing requirements either.

Reed and Willis (2013) report that "between 2011 and 2013, up to 17 of such firms received proposals from the shareholders asking them to provide annual sustainability reporting as well as their goals on reduction of GHGs. According to the report, the requests by the shareholders covered various real estate industries, including retail, hospitality, office, single-family and multi-family real estate development projects.

2.2.8 Quest for branding and prestige

An empirical focus by Kato and Rask (2009) in Australia established that building managers were driven by the desire for prestige of being named green star rated officers championing for sustainable buildings. Therefore, they were likely to advance the green building agenda. In another interrogation, Kuiken (2009) argued that in the next couple of years, green buildings will be one of the factors that would be considered in determining the value of properties. Factors such as decreasing risk and slower rate of depreciation would favor green buildings. In the near future, green building will be a distinct product in the market since people will view those championing it to be socially conscious and technologically savvy. Therefore, all the attributes would increase the brand image of the green building owners.

2.3 Extent of implementation of green building concepts by built environment professionals in construction projects

A study by Were (2015) examined the degree to which green concepts were incorporated into Nairobi construction projects between 2008 and 2012. The categories of GBC under investigation included sustainable materials, water and energy efficiency, indoor air quality, and sustainable site practices. The author claims that specific ideas from each of the categories were implemented in the finished commercial buildings within the allotted time. The most applied concepts were in the areas of water and energy efficiency, scoring 94.6% and 91.4%, respectively. The author goes on to speculate that the high scores for water and energy efficiency could be attributed to their regular use in buildings, which necessitates monitoring in addition to the expensive costs involved in providing them. The finding was consistent with the assertion made by Elizondo and Lofthouse (2010) that one option for lowering water usage is to use new, more efficient products. Among the aspects for consideration in water efficiency and conservation in construction projects are the use of water sub-meters (Zuo & Zhao, 2014), rainwater harvesting designs, water recycling (Lazarova,

Hills & Bark, 2003) and boreholes as alternative sources of water (Furumai, 2008).

Energy efficiency is another component of green building under consideration based on extant literature. Were's findings indicated that only 16% of BEPs had incorporated energy efficiency to a great extent in their projects. Furthermore, alternative sources of energy are barely used by the industry players in their projects. The author concludes that the absence of other reliable sources of electricity besides the national grid supply prompted the use of alternative energy sources. This is also supported by the fact that putting in substitutes like photovoltaic technology and solar panels has a high upfront cost unless the installed capacity is increased (Bhandari & Stadler, 2009). According to other studies, gas and charcoal are frequently used in homes and hotels, but standby generators are only applied during blackouts to prevent additional "peak demand." Previous research indicates that energy-saving measures such as light control sensors and smart meters that track energy usage are actions that can significantly contribute to energy conservation (Scott, 2009).

Thirdly, a sustainable site is another key area to be considered in green construction. According to Hill and Bowen (2007), concepts like storm water management, site landscaping, maintaining existing vegetation, and adhering to local zoning regulations should be taken into account during building construction or design and occupation. Adebayo (2002) goes on to say that in many African cities, particularly those with dense populations, buildings are constructed entirely on the allocated site, completely disregarding the surrounding natural environment. Sustainable site considerations include maintaining the existing vegetation adhering to local zoning regulations, and landscaping specifications. The adoption of sustainable materials is the fourth realm of consideration in green buildings. Some of the concepts under consideration include the use of locally produced materials and components, recycling materials, and using materials with minimal environmental impact. Lastly, the extent of the adoption of environmental indoor air quality indicators when assessing the degree of GBC adoption in construction projects, factors like space ventilation, the use of noise control, thermal control units, the provision of smoking areas, the use of low-emitting finishes and paints, and are essential. (Chiang & Lai, 2002).

2.4 Barriers to the implementation of GBCs in construction projects

2.4.1 Lack of incentives

Ding et al (2018) linked government incentives to the decision by contractors to adopt green buildings. Given financial incentives, the scholar argued that contractors are more likely to adopt green developments. Additionally, in cases where the financial incentives cover minor sustainable building costs, the contractors have no interest in advancing green buildings. Based on the argument by Samari, Godrati, Esmaeilifar, Olfat, & Shafiei (2013a), government incentives play significant role in convincing contractors to implement green building as they provide low risk as well as financial support. Whenever the initial high costs are not covered by the financial incentives, the willingness and desire by the contractors to advance implementation of green buildings reduces. Therefore, lack of incentives may not attract contractors to adopt green buildings since the initial cost can be high.

2.4.2 Lack of public awareness

Some previous studies have linked low adoption rate of green development to lack of awareness regarding sustainability of construction and green building issues (Chan et al., 2014). It has also been indicated that since most buyers have low awareness, the contractors have no interest in obtaining knowledge about green buildings. Samari et al. (2013a) added that since most of the buyers in the public sector are not aware of green buildings, they don't demand for these services from construction companies which discourage investment in green development.

2.4.3 Lack of demand

Liu (2012) linked low demand for green buildings to its low implementation rate. Samari et al. (2013b) added that this is so because the concept of green building is still being considered as fresh in the construction market. Other house buyers posit that it's worthless given its high costs. In such cases, the demand for the expensive buildings is slow and that discourages its implementation accordingly (Abidin Yusof & Awang, 2012). On the contrary and in response to the demand, contractors are more focused on meeting demand hence they don't spend on green building which have low demand. At the moment, the building industry is dominated by houses termed as middle or low-cost buildings. The fact that there is low motivation for green building discourages contractors from building green buildings.

2.4.4 Lack of expertise

Zainul (2009) acknowledged that green development faces a lag because of inadequate expertise. Hwang and Tan (2012) added that most of the existing contractors don't have technical knowhow

and expertise in issues related to sustainable buildings. The responsibility of advancing green building lies with the consultants who need to have good designs in their proposals for acceptance. However, since most contractors don't have expertise in green building, they don't dare to take chances in its construction (Zainul, 2009). Additionally, since the designs are complicated, it makes it hard for the contractors to attempt constructing them and in most cases; the expertise is from other developed countries.

2.4.5 Lack of professional knowledge

Inadequacy of professional knowledge on green buildings in the developing economies has been regarded as one of the contributing factors towards its low adoption (Abidin et al., 2012). Most contractors don't have adequate knowledge on green building from a practical point of view thus making it hard to reach level terms between the young and old contractors (Gündoğan, 2012). According to Abidin et al (2012), while the older contractors are concerned about climate change issues, the younger ones are grounded in sustainable construction. However, the older contractors decline the ideas of the younger ones which in turn puts implementation of green building at cross roads (Zainul 2009).

A study by Tanui and Tembo (2023) investigated the barriers to adopting and improving the monitoring and evaluation (M&E) of sustainable practices in landscape architecture within the growing construction industry in Kenya. The findings reveal knowledge and technical know-how challenges among practitioners, focusing more on economic than environmental and social considerations. The study emphasizes the need for increased awareness and education. Notably, the research identifies gaps in sustainable education in higher learning institutions and points out the need for more understanding of green building certification.

2.4.6 Lack of database and information

Griffin, Knowles, Theodoropoulos, & Allen (2010) and Balaban (2013) highlighted green information and data unavailability as a major factor contributing to low adoption of green buildings in emerging economies. Designing and construction of these buildings is very complex and without green data bases, for such as well as performance of the buildings in the environment, the efforts are futile. Despite its importance, lack of information about green buildings makes it difficult for contractors to advance the concept in emerging economies. Additionally, the stakeholders in this industry (buyers and sellers) have a low understanding of green buildings

coupled by low level of research on the same. This leads to a low motivation rate of such buildings given that there is low demand for them as a result of low awareness (Griffin et al, 2010).

2.4.7 Lack of technology

To successfully achieve green development, there is a need for technical and complicated technologies (Hwang & Tan, 2012). Samari et al. (2013b) argued that lack of technology has hindered implementation of green buildings in emerging economies, which is still in fresh stages given that acquiring this technology from developed economies is not easy.

2.4.8 Higher investment cost

Wilson and Tagaza (2006) argued that one of the underlying factors behind low adoption of green practices is the huge financial costs involved in the set up. It has been documented that construction of green buildings, compared to conventional ones, is very expensive (Hwang & Tan, 2012). According to Khan et al. (2014), construction of green buildings costs between 1 % and 25% more than the conventional one. Additionally, it needs more time and planning. The cost, according to Chan et al. (2014), increases depending with the greenness.

2.5 Zoning regulations in urban areas and their implications to green building

Zoning regulations in urban areas play a crucial role in shaping the built environment, and their implications are particularly significant for initiatives such as the Green Building Council Historic Building certification. The study by Boarin, Lucchi and Zuppiroli (2019) outlines an evaluation process for certified environmental sustainability in historic building preservation that emphasizes indoor air quality and energy efficiency. Zoning regulations, which dictate land use, building height, density, and other factors, directly influence the feasibility and implementation of sustainable practices in historic building projects. Boarin et al (2019) argue that zoning codes may pose challenges or provide opportunities for incorporating energy-efficient technologies, ensuring indoor environmental quality, and preserving historic values. Integrating Green Building Council Historic Building® principles into urban development requires collaboration between regulatory bodies, preservationists, and the construction industry to align zoning regulations with sustainability goals, fostering a balance between heritage preservation and modern environmental standards.

2.6 Green financing

Debrah, Chan and Darko (2022) highlighted the significant investment deficit in green buildings,

which are crucial for climate change mitigation. The green finance gap in green buildings is a key challenge, with global investment in green buildings accounting for only a fraction of the total investment opportunity. In order to bridge this gap, the study suggests leveraging innovative financing, primarily green finance, to hasten the construction of green structures. One practical solution is "green finance," which refers to financial instruments that facilitate the shift to a climate-resilient economy providing a viable option for addressing the investment shortfall in green buildings.

2.7 Green legal policies and regulatory framework

According to Sangori, Kitio, Thontteh and Omonge (2020), in Kenya there are more than 20 laws addressing urbanization, the built environment, and climate change. Practitioners in the built environment can use 14 sustainability selection techniques. However, the findings reveal that 77.4% of sampled built environment practitioners believe that current policies must be revised to support the adequate adoption of emerging building technologies. There is need to review existing legislation to accommodate emerging technologies, finance pilot project and standardize selection criteria techniques including train and sensitization sessions. The study underscores the importance of aligning regulations and policies with emerging technologies to promote sustainable practices in the Kenyan building environment

2.8 Implication of the building code on green building

The study by Bucha, Onyango and Okello (2020) on building failures in Kenya highlights the increasing cases of collapsed buildings in the country, resulting in the loss of lives and economic waste of resources. The research emphasizes the role of legal frameworks in mitigating building failures, revealing that while legal frameworks have a significant effect, there are obsolete laws and multiple regulatory frameworks in Kenya that compound the challenges in the construction industry. The outdated Kenyan building code of 1968 is implied as one of the obsolete laws contributing to the shortcomings in addressing building failures. The study recommends addressing these legal and regulatory gaps to enhance the effectiveness of measures against substandard building practices and failures in Kenya's construction sector.

2.9 The National Housing Policy and its implication on promoting green building

The National Housing Policy (2018) in Kenya, outlined in Sessional Paper No. 3 of 2016, includes

several clauses supporting green housing development. In the rural housing section (3.1.1), the policy emphasizes promoting appropriate technologies and programs to improve rural shelter, indicating a commitment to sustainable and environmentally friendly building methods. Additionally, in the urban housing section (3.1.2), the policy encourages using appropriate and low-cost building materials and technologies, reinforcing the importance of environmentally conscious construction practices. While not explicitly labeled as "green housing," these clauses underscore a commitment to environmentally sustainable and energy-efficient housing development. The emphasis on appropriate technologies and low-cost materials aligns with principles commonly associated with green building practices.

2.10 Research gaps

It is evident from literature review that there is little focus on the evaluation of awareness and barriers of implementation of green building concepts among built environment professionals in Kenya. Despite the fact that the advantages of green building, green building rating systems and assessment tools have been extensively studied (Ali & Al Nsairat, 2009; Fauzi & Malek, 2013) the observation is that, there is little, about evaluation of awareness and barriers of implementation of GBCs among BEPs in Kenya. For instance, regionally, Wiafe (2017) analyzed the perspectives of Ghanaian architects on the execution of eco-friendly building practices and factors affecting the processes. Similarly, Dahiru, Bala, and Abdul'Azeez (2013) gathered professional views on the potential for adopting green building practices in Nigeria. Locally, Igunza (2012) examined the influence of green building on mitigating climate change. Therefore, available research has delved into different topics of sustainable construction with little focus on the key players of the industry. This is the first study that the author is aware of that assesses awareness of green building projects in Nairobi. Moreover, from the two major players' points of view, while looking at the barriers to implementation of GBCs.

Furthermore, there is a shortage of literature on motivating factors driving BEPs to implement GBCs in building projects. Even though existing research focuses on the industry players, findings provided did not include the motivating factors driving BEPs into action. Specifically, there are no conclusions drawn on the level of technical, metric content as well as contextual awareness of GBCs among these professionals. Furthermore, there has been a gap in knowledge regarding the application of GBCs in construction projects in the last at least five years. The findings and

conclusions of Were (2015) therefore prevented the reader from drawing objective conclusions to the research problem under study. Contrary, this research paper broadened its focus to the specific catalysts that trigger built environment industry professionals to seek knowledge on GBCs, the main categories taken into consideration as well as the extent of implementation of GBCs in construction projects in Nairobi in the past five years.

2.11 Theoretical framework

This study is anchored on the Theory of Value Belief Norm (TVBN) and Theory of Planned Behaviour (TPB).

2.11.1 Theory of planned behavior

Ajzen (1991) explains the control element of people to account for their behavior which happens as a result of norms beyond their control. The theory successes Ajzen and Fishbein's Theory of Reasoned Action (Al-Suqri & Al-Kharusi, 2015) with incorporation of volitional control. The theory of planned behaviour demonstrates that subjective norms are those which explain peoples' normative beliefs and the urge to comply with related values and norms (Iheanyichukwu, Kamarudin, Aliagha and Ufere, 2015). These norms beyond an individual's control must meet two criteria; it must be partially beyond their control and secondly, it must be able to accurately show control upon actions and motivations (Kalafatis, Pollard, East and Tsogas, 1999). Actions, also called environmental attitude, have been established to contribute towards conservation of the environment.

The study borrows from this theory in predicting that human attitude can be a contributor to people's motivations towards adopting concepts that promote environmental conservation. People's attitude towards the natural environment or certain elements of it, such as quality air, water or energy efficiency determines their actions towards achieving it. Therefore, Katrin (2012) characterized the human perspective regarding the environment as an environmental issue. The theory has thus been adopted in explaining the actions and motivations of engineers and architects on incorporating GBCs in their designs. In this study, engineers and architects' attitudes toward GBCs would play a crucial role in understanding their willingness to incorporate these concepts into their designs. By assessing their attitudes, one can gain insights into whether they value environmental sustainability and the measure by which they believe green building practices are

beneficial. Within the TPB, the concept of perceived social pressure to either participate in or abstain from a particular behaviour is denoted as a subjective norm. This study examines the subjective norms that influence engineers and architects. This includes understanding the influence of peers, clients, industry standards, and societal expectations in shaping their decisions regarding green building practices.

The theory suggests that the desire to carry out an action is a key predictor of actual behaviour. In this study, the theory assists in assessing the intention of engineers and architects in Nairobi City County to incorporate GBCs into their designs. By understanding their intentions, it is easier to make predictions about their future actions. The theory posits that the greater the intention to engage in a behaviour, the higher the likelihood of the behaviors' occurrence. Therefore, by assessing the intentions of engineers and architects in Nairobi County, one can make predictions about their actual implementation of GBCs. The theory can help identify specific areas where interventions may be needed to encourage the use of green building techniques. TPB provides a comprehensive framework for understanding and predicting the motivations and behaviors of engineers and architects in Nairobi County regarding the adoption of GBCs.

2.11.2 Theory of value belief norm

The theory, propounded by Stern, Dietz, Abel, Guagnano and Kalof (1999), clarifies environmental actions through the values and norms of the people, arguing that the predictors of environmental behaviour are social attitudes as well as personal morals and norms. Therefore, it can be argued that those people who undertake environmental related actions are guided by their moral altruistic, reasons or self-interests (Aliagha, Hashim, Sanni and Ali, 2013). The values (altruistic, biospheric, and egoistic) dictate the behaviour and beliefs of people and hence if they believe in values, it can dictate their behaviour towards environmental choices. The theory therefore elaborates the reason behind the altruistic motivation of BEPs to undertake green projects. The researcher therefore believes that this theory can explain the extent to which real estate professionals can incorporate GBCs in their construction projects.

2.12 Conceptual framework

A conceptual framework shows interlink between the study variables, guiding the study of relationships and shown the direction of the study. The framework that shows how the study variables relate to each other has been drawn in this sub section.

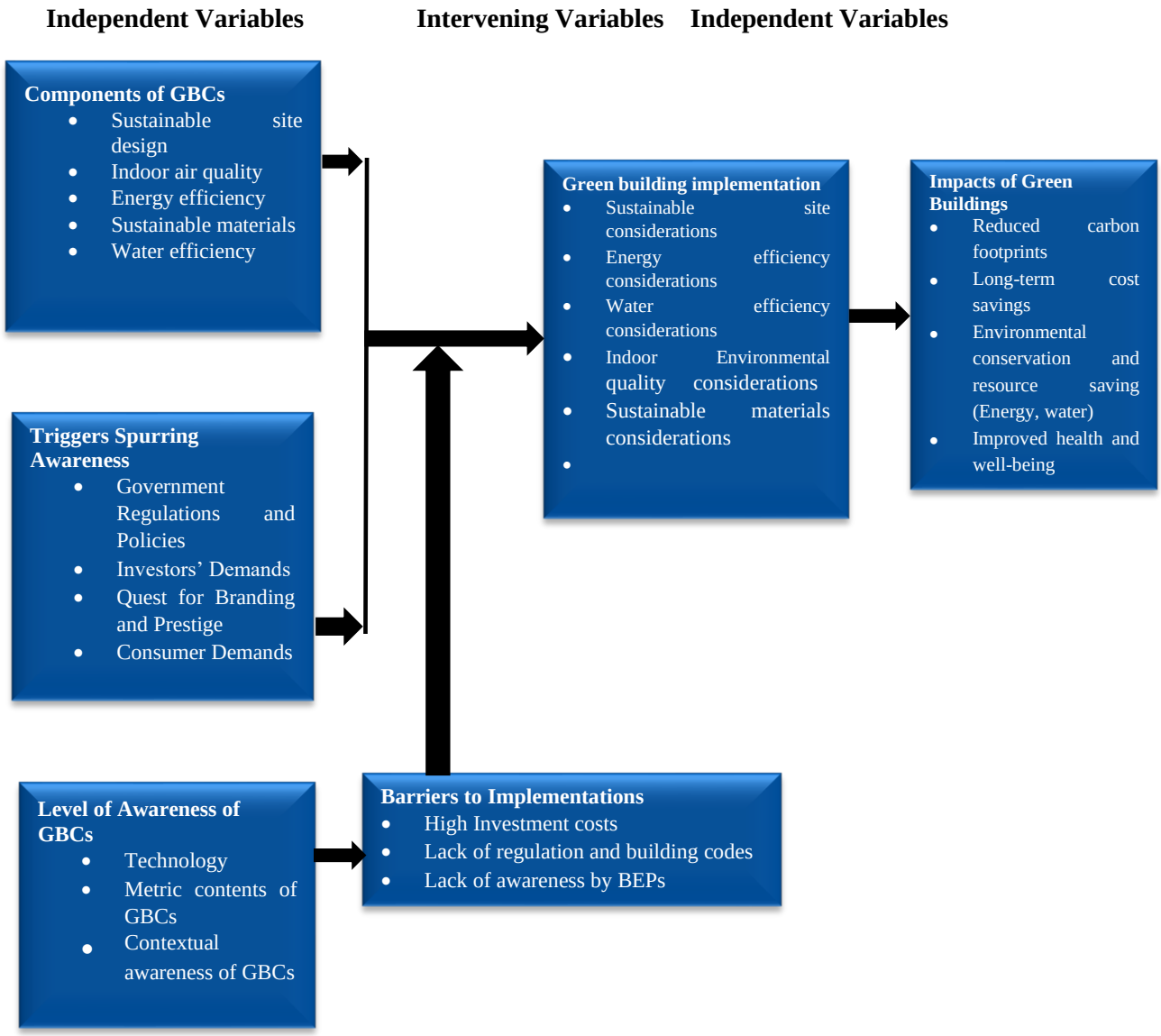

Figure 2.1: Conceptual Framework

Source: Researcher, 2023

The conceptual framework describes how various factors can influence the level of implementation of GBCs. The concepts taken into consideration in this study are sustainable materials, indoor air quality, sustainable site design, water and energy efficiency. The level of awareness of these GBCs and their importance in sustainable development including technology that support GBCs, contextual awareness affects the extent of implementation of GBCs. Equally, the level of awareness of these GBCs is influenced by various factors that include government regulations and policies, investors demand and the quest for branding amongst others. Factors such as lack of

incentive and building codes however hinder uptake. Also, regulations and policies that necessitate the incorporation of GBCs will with no barrier encourage designs that adhere to the same. Essentially the barriers to the implementations of GBCs that are looked in to in this study are lack of government incentives, lack of demand by investors as well as building codes and regulations that have not taken keen interest on GBC's. Implementation of GBCs in built industry can be shown by sustainable site considerations, energy and water considerations and environmental quality.

The extent to with GBCs are implemented in the building sector largely depends on ensuring proper systems are in place. These include government regulations and policies, government incentives to address the high investment costs barrier, creation of awareness on the need for sustainable construction and the importance of incorporating the GBCs not only by the BEPs but also investors and tenants. Once implementation of these GBCs is taken into consideration, it will result in the development of sustainable buildings which will not only lead to reduction of emissions from the built environment, but also improvement of health of residents, preservation of the environment and natural resources, and reduction of expenses in the long-run.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, an outline of the geographical context pertaining to the study is presented. It delves into the strategies employed to collect both secondary and primary data, essential for accomplishing the research objectives. This encompasses a detailed description of the study area, the chosen research design, the process of determining the sample size, selection of data collection tools and techniques, as well as the procedures for data analysis. Additionally, ethical considerations are addressed.

3.2 Study area

3.2.1 Location and size

The research was carried out within Nairobi City County, which shares its borders with Kajiado County to the south, Kiambu County to the north, and Machakos County to the east. Being an urban County, buildings and real estate have boomed. The County is 696.1 Km^2 in land cover between 36º 45’ East longitudes and latitudes 1º18’ South. The county is also above sea level at an altitude of 1,798 M (Nairobi County Integrated Development Plan (NCIDP), 2018).

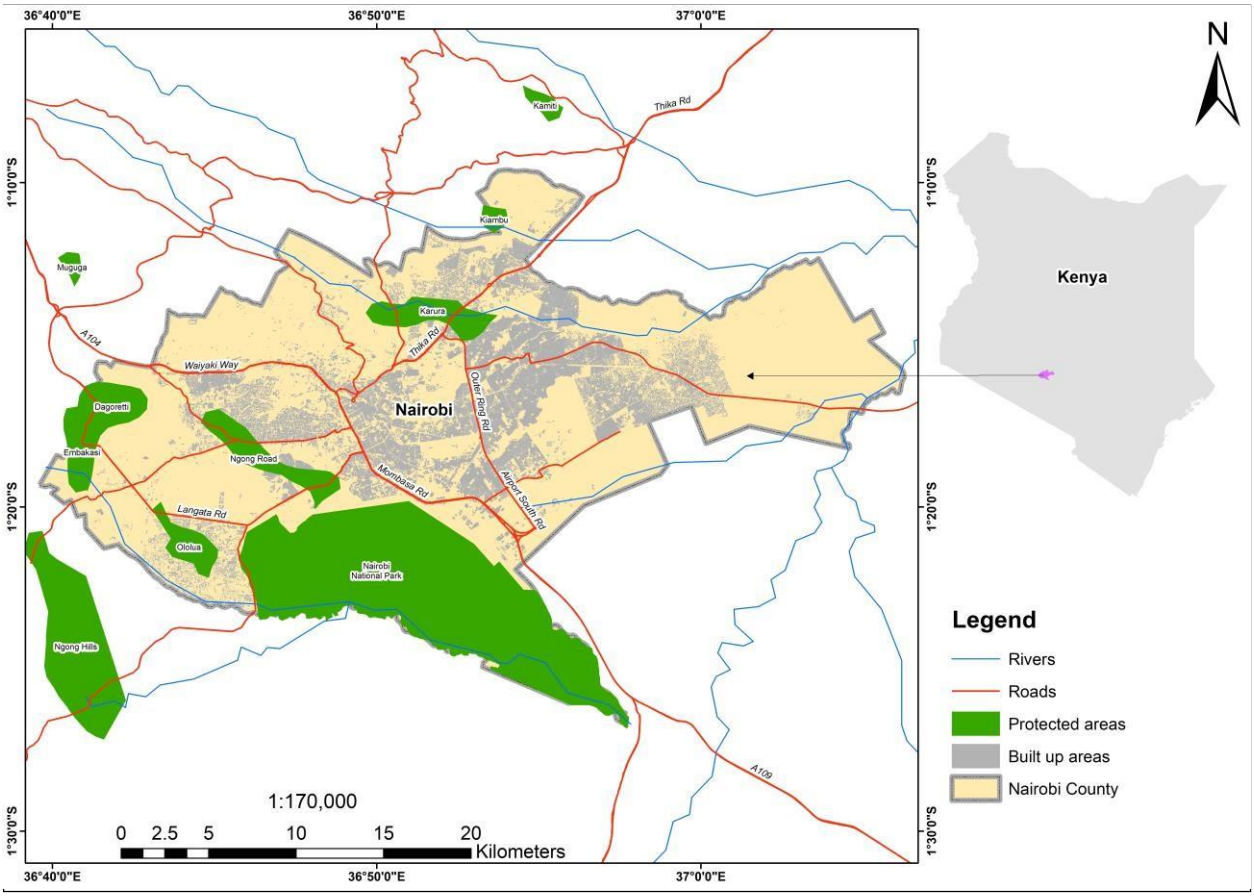

Figure 3.1: Nairobi built environment distribution map

Source: Researcher, 2023

3.2.2 Climatic conditions

The climatic conditions are characterized by cool climate mainly because of its high altitude. The temperatures in the county range from 10^0c to 29^0c. The county is also characterized by bi-modal rainfall patterns averaging 786.5 mm where the longest is 899mm between March and May. The county experiences its short rains between the month of October and December averaging 638 mm (NCIDP, 2018). The average daily sunshine hours range from 3.4 to 9.5 hours, while the average monthly relative humidity fluctuates between 36% and 55%. (NCIDP, 2018).

3.2.3 Geology

According to Nairobi City Council (NCC, 2010) report, the geological composition of Nairobi consists mainly of Cainozoic lavas and Pyroclastic overlaying folded Precambrian schists and gneisses of the Mozambique belt, with crystalline rocks occasionally exposed as agglomerates from the former Ngong volcano; the soils in the region are primarily the result of weathering of

volcanic rocks, yielding deep red soils exceeding 50 feet in thickness, categorized based on factors such as drainage, climate, slopes, lithosols, and regosols. (NCC, 2010), Nairobi's main drainage system follows the easterly regional slope of volcanic rocks, with a secondary internal drainage system that reaches the westward rift. The easterly lava plains, known as Athi and Kapiti, are made up of tuffs, lakebeds, stream deposits, and volcanic ash extending westwards from 4900 to 6000 feet in elevation, crisscrossed by gullies and gorges like those in the Mbagathi valley, which widens slightly to the east due to ongoing erosion of soft material.

3.2.4 Infrastructure

Nairobi's road infrastructure, crucial for economic growth, faces challenges due to population growth and service activities, with 80% of commercial freight transport relying on roads; however, NCC (2010) indicates deficiencies in road conditions in the late 1990s, when only 39% of surfaces were deemed excellent or adequate, and drainage issues. The city also grapples with congestion issues, particularly in the central business district, leading to significant financial losses. Despite these challenges, since 2005, Nairobi has undergone rapid growth and infrastructure investment, presenting opportunities for inclusive urban development (Global Disability Innovation Hub, 2022). According to the NCC (2010) report, Nairobi’s primary source of economic activity lies within the community, social, and personal services sectors, as well as the professional business services sector, which constitutes 52.1% of the total income generated in the city. Subsequently, other significant sectors contributing to the city's income include agriculture and forestry, wholesale and retail trade, manufacturing, and tourism.

3.2.5 Population size and composition

The county has experienced the highest growth rate compared to any other African city. Based on the 2019 population census of Kenya, Nairobi County had a total of 4,397,073 inhabitants. This population made up a total of 1.4 million households in the county. As a result, demand for housing has been growing. According to Ecological Threat Report, (2022) Nairobi presently inhabited by 5.2 million residents, is projected to exceed the 10 million population mark by the middle of the century, accommodating around 10.4 million people

3.2.6 Land and land use

According to NCIDP (2018), main land use practices of Nairobi City County are residential areas and the least are protected areas in decreasing order. It is approximated that the commercial land

has greatly declined over the past ten years despite rising demand for housing land approximated at 250 Km^2. Land for urban agriculture has greatly reduced since most of the owners are turning it into residential use, hence, the county doesn't have its own source of food but relies on other counties for the same. Most of the industrial areas in the county are concerted in Baba Dogo, industrial area and Kariobangi South.

Table 3.1: Land use type by area and percentage cover

Land use type	Area (Km2)	Cover (percentage)
Industrial/commercial/service Centers	31.8	4.57
Residential areas	175.6	25.22
Urban agriculture	96.8	13.9
Open lands	198.8	28.55
Recreation	12	1.72
Water bodies and riverine areas	11.8	1.69
Infrastructure	15.9	2.28
Others (including protected areas)	153.6	22.06
Total	**696.3**	**100**

Source: GOK/UNEP 2007

3.2.7 Housing types

House materials not only reflect the housing conditions, but also the extent to which they protect the dwellers from environmental hazards. Some of the determinants of housing materials are culture, costs and availability. The NCIDP (2018) report indicated that in Nairobi County, stone walls account for up to 65.9 % of the houses while wood and iron sheets account for the remainder. Furthermore, the report indicated that in regard to the type of floor, up to 75.8% of the households have cement floors, 7.5 % of them have tiles while 14.2 % and 2.2 % have earthen and wooden floors respectively. Majority of the residents, 56.6 %, however have roofs with corrugated iron sheets, 12.4% and 27.9 % of them have riled and concrete roofs respectively.

3.3 Research design

A research design provides a road map from data collection to analysis to be adopted in achievement of the research objectives (Field, 2009). This study used descriptive research design where quantitative and qualitative research methods were adopted. This allowed for thorough

interrogations of issues and problem. Qualitative and quantitative approaches were adopted to interrogate the issues regarding green building, as well as the awareness of the BEPs regarding the same. Additionally, this type of data was suitable in determining related relationships between the study variables.

3.4 Sampling

Orodho (2005) defined population as the entire set of units from which research is to be conducted from and results generalized. The study's target population consisted of professionals in the built environment sector. BEPs include architects and engineers. From the population, a smaller sample can be obtained to represent the entire population (Field, 2009). This sample can be obtained through a process called sampling which entails systematic selection of a smaller group from the entire target population.

The sampling frame was obtained from the individual membership bodies for each category of the BEPs in Kenya. As such, according to BORAQS there were a total of 204 registered architectural firms in Kenya in 2019. Out of these, 158 architectural firms were registered in Nairobi. Engineers involved in the built environment industry are registered by the Engineers Board of Kenya (EBK). The target population of 1295 engineers (civil, civil and structural, electrical and mechanical) was therefore obtained from the Engineers Board of Kenya Register. Table 3.2 summarizes the sampling frame within Nairobi.

Table 3.2: Sampling frame

Target population	Population Size	Regulatory/professional body
Architectural firms	158	BORAQS
Engineers	1, 295	EBK
Total	1, 453	

Source: BORAQS (2019) and EBK (2019)

The study utilized probability sampling methods in obtaining representative samples for the study. The approach employed in this method ensures that every unit within the sample has an equal probability of being selected. Given the extensive nature of the population in focus, comprising one thousand four hundred and fifty-three (1453) firms, it was impractical to encompass the

entirety. Consequently, a stratified random sampling method was utilized to select firms from each category within the target population. The determination of the sample size was accomplished using the formula developed by Finate Population Correction Formula (Obiri, 2017).

$$n = \frac{N(CV)^2}{(CV^2 + (N-1)e^2}$$

Where:

n = Sample size

N = population

CV = Coefficient of variation (0.5)

e = Tolerance of desired level of confidence take 0.05 at 95% confidence level

Therefore:

From Architectural Firms;

$$n = \frac{158(0.5 \times 0.5)}{((0.5 \times 0.5) + (158 - 1)0.05 \times 0.05))}$$

$$n = \frac{158(0.25)}{0.25 + (157)0.0025}$$

$$n = \frac{39.5}{0.64} = 61$$

Expected Sample size n from Architectural Firms = 61 firms

From Engineers;

$$n = \frac{1295(0.5 \times 0.5)}{((0.5 \times 0.5) + (1295 - 1)0.05 \times 0.05))}$$

$$n = \frac{5891(0.25)}{0.25 + (1294)0.0025}$$

$$n = \frac{323.75}{3.485} = 93$$

Total sample size from the two categories 61+93=154

Therefore; n=154

Table 3.3: The sample size

Target Population	**Population Size (N)**	**Sample Size (n)**
Architectural firms	158	61
Engineers	1295	93
Total	**1453**	**154**

Source: Field data, 2023

3.5 Data collection and analysis

The study incorporated data from both secondary and primary sources. Primary data was acquired through an online survey questionnaire. In contrast, secondary data was obtained through a comprehensive review of literature, government publications, NCA documents, maps and other documents that were obtained from relevant libraries, government offices, non-governmental offices, the media and the World Wide Web (www). Primary data was information obtained from representatives of the sampled professional firms in the built environment industry. The information was obtained through a self-administered structured questionnaire survey to the

identified firm representatives. Secondary data was collected from previous publications as well as unpublished reports on the study theme, journals as well as magazines. Secondary data was obtained through a comprehensive review of literature, providing an overarching understanding of the components of GBCs in a general context. To specifically assess the components considered in Nairobi, the selected respondents were tasked with rating their awareness level of five GBC components on a Likert scale ranging from 1 to 5, where 1 signified the least awareness and 5 represented the highest. Furthermore, respondents were asked about their usage of these concepts within the last five years. They also provided ratings concerning the triggers, level of implementation, and encountered barriers in relation to GBCs. Additionally, respondents furnished background information regarding their profession, level of qualification, and years of experience. This enabled the researcher to discern if there were disparities in awareness and implementation based on professional experience.

The data collection instruments adopted in the study were questionnaires which were electronic and self-administered. Mugenda and Mugenda (2003) supported the use of questionnaires when there is a need to cover a wider scope as well as get fresh and new ideas about a phenomenon. Kombo and Tromp (2006) supported the use of a likert scale questionnaire; hence, there is a need to rank opinions from the most to the least ratings. However, the questionnaire used in this study was semi-structured. Both closed- and open-ended questions were included to enable theresearcher not only to get quantitative data but also to probe further through open-ended questions. The questionnaires were used to collect qualitative information to enable sound data analysis for logical conclusions to be made. Since the raw data from the field is difficult to interpret, it is supposed to be analyzed for easier interpretation (Mugenda & Mugenda, 2003). Qualitative data were subjected to content analysis, whereas quantitative data were processed and analyzed using statistical tests.

3.6 Data presentation

The qualitative data obtained was presented through narratives while the quantitative data on the other hand was presented in tables, charts, and graphs. Descriptive statistics such as percentages and frequencies were used to describe the features of the data collected.

Inferential statistics was done to draw conclusions and a generalization concerning the population.

Pearson product-moment correlation coefficient was constructed to test the linear relationship between the variables. Simple and multiple linear regression analysis was used to determine the influence of the independent variables (no relationship between awareness of components GBCs) on the dependent variable (extent of implementation of components GBCs by BEPs in building projects within Nairobi City County), and at the same time, Pearson correlation was applied to determine the strength of the relationship between the independent variable on the dependent variable.

In addition, multiple linear regression model adopted was as indicated below; to test the combined effect of the triggers of awareness of components GBCs on the dependent variable.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

Where:

Y = Dependent variable: extent of implementation of components GBCs by BEPs in building projects within Nairobi City County

X1 = Government Regulations and Policies
X2 = Investors' demands
X3 = Quest for personal branding and prestige as a professional in the field
X4 =Membership in Professional Bodies
X5 =Market trends

X6=Civil Society Organizations (CSOs)

X7=Tenants interests

βo = Constant or Intercept

βi = Are regression coefficients for β_i ($i = 1, 2, 3, 4,5,6,7$)

Ɛ = error term

In the model, β_0 = the constant term while the coefficient $\beta_i = 1 \ldots 4$ was exploited to measure

the sensitivity of the dependent variable (Y) to unit change in the predictor variables X1, X2, X3 …and X7. Ɛ was the error term which captured the unexplained variations in the model.

Through SPSS, the regression models were tested whether they fit the quantitative data using the coefficient of determination, which helped to explain how closely the predictor variables explicate the deviations in the dependent variable. P-value was employed to conclude on whether to fail to accept or fail to reject the null hypotheses. The significance level was 5%. The alternative hypothesis cannot be rejected and the null hypothesis cannot be accepted if the p-value is less than 5%. The null hypothesis cannot be rejected and the alternative hypothesis cannot be accepted if the p-value is higher than 5%. (Bandalos and Finney, 2018).

3.7 Ethical considerations

Research ethics are important in ensuring that a researcher was responsible for their sponsors, participants, the public as well as their personal beliefs. Before conducting the research, an introduction letter from the university was obtained, and a research permit from the National Commission for Science, Technology & Innovation (NACOSTI) also obtained and used to make introductions to the target respondents. With their consent, they were allowed to participate in the study, however, their right to withdraw from the study was respected. The researcher clarified to the respondents that the procedure was solely an academic exercise, confidentiality and anonymity would be upheld and the information would not be shared with unauthorized persons without their permissions. Besides, they were also told of the benefits of the research in advancing sustainable built environment.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

The research results that were gathered to assess the level of awareness and the barriers to the use of GBCs in Nairobi City County's built environment industry are presented in this chapter. Tables and graphs were created using SPSS, and descriptive and inferential analysis were employed to examine the data. The researcher's assessment and the body of existing knowledge were compared with the data findings to facilitate thoughtful interpretation and discussion. The study population included engineers and architects professionals. The study targeted a total of 154 respondents who were issued with electronic self-administered questionnaires after their consent. Out of the number a total of 102 questionnaires were collected, giving a response rate of 66% of the respondents. According to Hager, Wilson, Pollak and Rooney (2003), a response rate exceeding 50% is considered satisfactory and, in this study, this response rate is therefore considered satisfactory.

4.2 Characteristics of study respondents

4.2.1 Respondent’s profession

It was requested of the respondents to state their respective professions. The BEPs that were included in the study were engineers and architects. According to the results, (Figure 4.1), 57% of the respondents were engineers whereas the rest (43%) were architects. This implies that the target respondents were the ones that participated in the study. It can thus be argued that the information was reliably obtained from the target respondents.

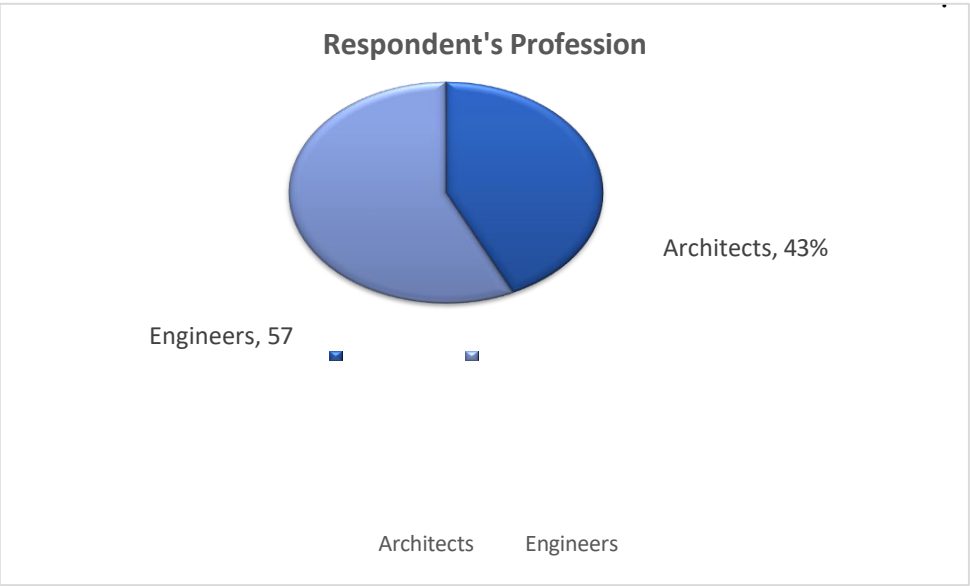

Figure 4.1: Respondent's profession

Source: Field data, 2023

The study aimed to assess the educational background of the respondents. The results are shown in Figure 4.2. The results indicated that a significant portion of the respondents (67%) had completed their highest degree at the undergraduate level. 31% of them had a postgraduate degree while only 2% had a diploma as their highest education level. This showed that majority of the respondents were well educated hence suitable to respond to the self-administered questionnaire. The high percentage of respondents with undergraduate degree can be explained by the fact that the registration bodies i.e. (EBK and BORAQS) require a person to have at least undergraduate degree as the minimal academic qualification to be registered. Those with diploma should have demonstrated years of experience.

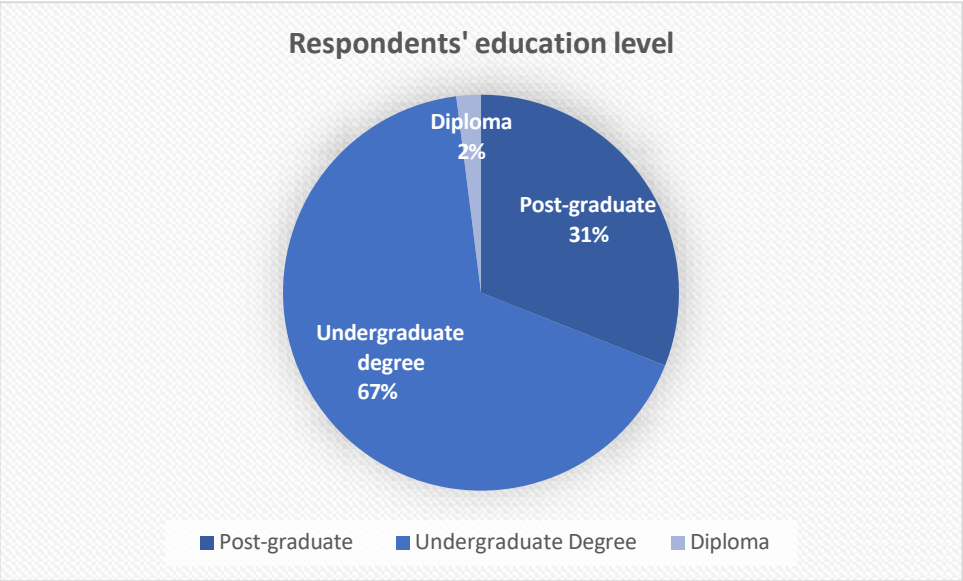

Figure 4.2: Respondent's education level

Source: Field data, 2023

4.2.2 Respondent's work experience

The study interrogated the respondent's work experience and the results are presented in Figure 4.3. A scale of; 0-5, 5-10, 10-15, 15-20 and above 20 years was adopted. The study results suggested that majority, 40.2%, of the respondents had 6-10 years' work experience in built environment, 25.5% had 10-15 years of work experience, 13.7% of them had between 15-20 years of work experience whereas those with a work experience above 20 years were only 13.7% of the respondents. In addition, 10.8% of the respondents possessed work experience of less than 5 years.

Consequently, the data suggested that 65.7% of the surveyed participants had a cumulative professional experience spanning from 6 to 15 years. Therefore, it can be alluded that they had worked in the built environment industry long enough to understand the sustainability needs in the industry.

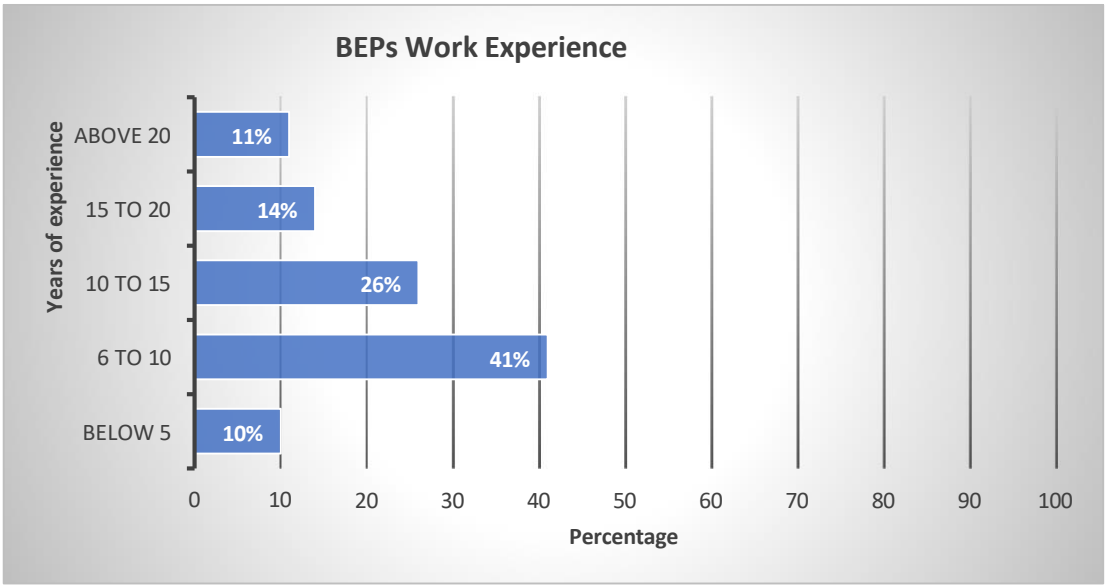

Figure 4.3: Respondents' years of experience

Source: Field data, 2023

4.2.3 Respondents' experience in green building projects within Nairobi in the past 5 years

The study aimed to ascertain whether the professionals in the built environment had experience in green building projects within Nairobi. Data indicated that majority of the respondents (68%) had contributed towards green building projects in Nairobi in the past 5 years whereas 32% had not. This further indicated that a large percentage of the respondents had knowledge as well as recent experience regarding GBPs hence suitable in giving reliable information.

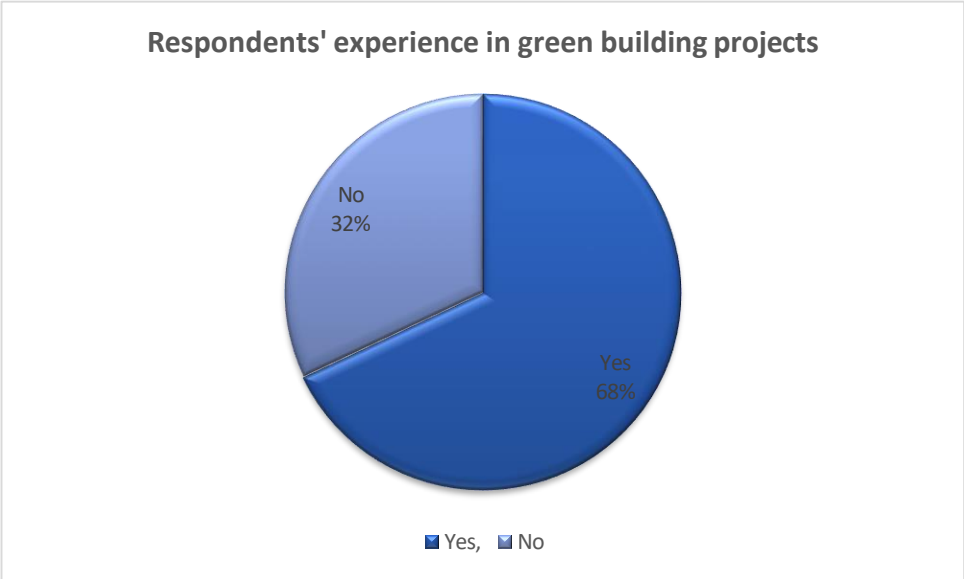

Figure 4.4: Respondents' experience in green building projects in Nairobi County

Source: Field data, 2023

Additionally, the respondents' experience in green building projects outside Nairobi was analyzed and the results presented in Figure 4.5. It was indicated that 58% of the professionals had no experience in green building projects outside Nairobi whereas 42% of them had incorporated green building components in projects outside Nairobi. This can be explained by the fact that Nairobi is the capital city of Kenya and a large percentage of environment is built. There has been an increase in construction projects especially commercial and residential developments to cater for increased demand for commercial space and also decent living houses. This has been highly contributed by rural to urban migration. Professionals outside Nairobi may not have interest in GBCs because of less demand for construction and essentially the natural environment is least disturbed. However, the devolvement of government to the counties has attracted investors to capital cities of each county which may necessitate the application of GBCs for them to develop sustainably.

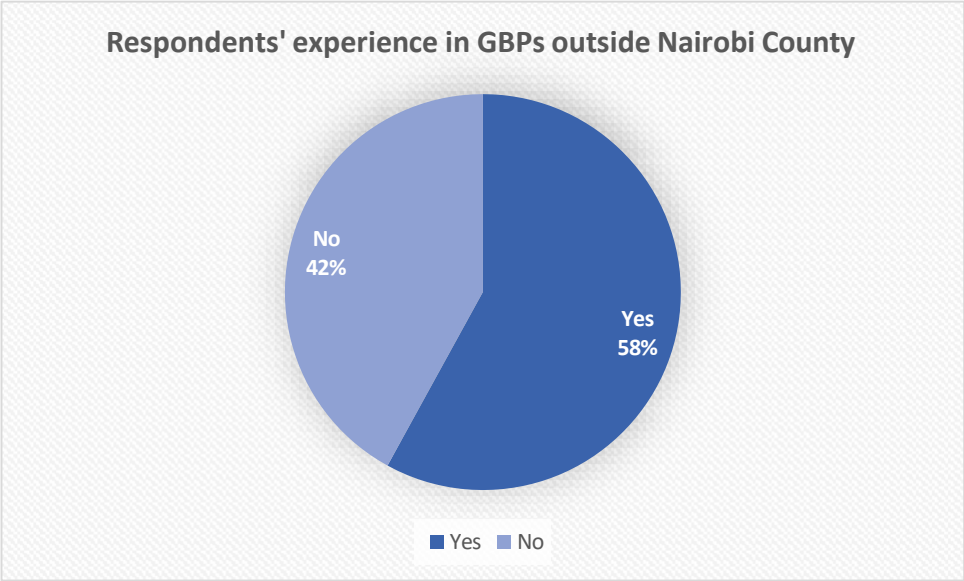

Figure 4.5: Respondents' experience in GBPs outside Nairobi County

Source: Field data, 2023

4.3 Green building concepts taken into consideration by BEPs in construction projects in Nairobi City County

The first objective analyzed the GBCs taken into consideration by BEPs in construction projects in Nairobi County. Based on secondary data, the environmental components of GBCs taken into consideration by BEPs were: indoor air quality, water efficiency, energy efficiency, sustainable sites, and sustainable materials. To interrogate the level of awareness on these components among the respondents, a 5-point likert scale questionnaire was adopted from 1 to 5 where 1 stood for 'not at all' while 5 stood for 'to a very great extent' and the findings are as outlined below:

4.3.1 Level of awareness of green building concepts

According to the findings of the study (Figure 4.6), the level of awareness of the five components was reasonably high, as each scored a mean percentage of 72.6%. This can be attributed to the recent increase in research on the building sector and, specifically, the impacts of buildings on the environment. The last decades have seen rapidly growing numbers of studies on green buildings with a major focus on the benefits of green buildings compared to conventional buildings and, more so, the environmental aspects of green buildings (Zuo & Zhao, 2014). Nevertheless, the survey results showed that out of the five components, water efficiency was captured as the one

with the highest level of awareness among the respondents. The highest percentage of 84.8% evidences this, followed relatively closely by energy efficiency with 82.8%. This would be normally related to the utility bills associated with the increased consumption of the two components, as pointed out by Gottfried (1996) and Yoders (2008).

The lowest level of awareness was the indoor air quality, which recorded a percentage of 72.6%, while the variable on attention to the use of sustainable materials was 75.6%. Sustainable sites attained 78.6%. All in all, the survey results indicate that BEPs are aware of each of the GBCs to a great extent. Sharma (2020) identified that materials for buildings are chosen through practical, specialized and budgetary necessities. Towards this, the use of sustainable materials, for instance, equally relates to the availability of funds and technical know-how of the professionals before applying the knowledge in the construction of buildings. From the findings, it can be identified that the professionals had ideas of the GBCs and how they are applicable in the building and construction industry, which also proved the need to determine whether and how they had incorporated these components in their projects in Nairobi City County.

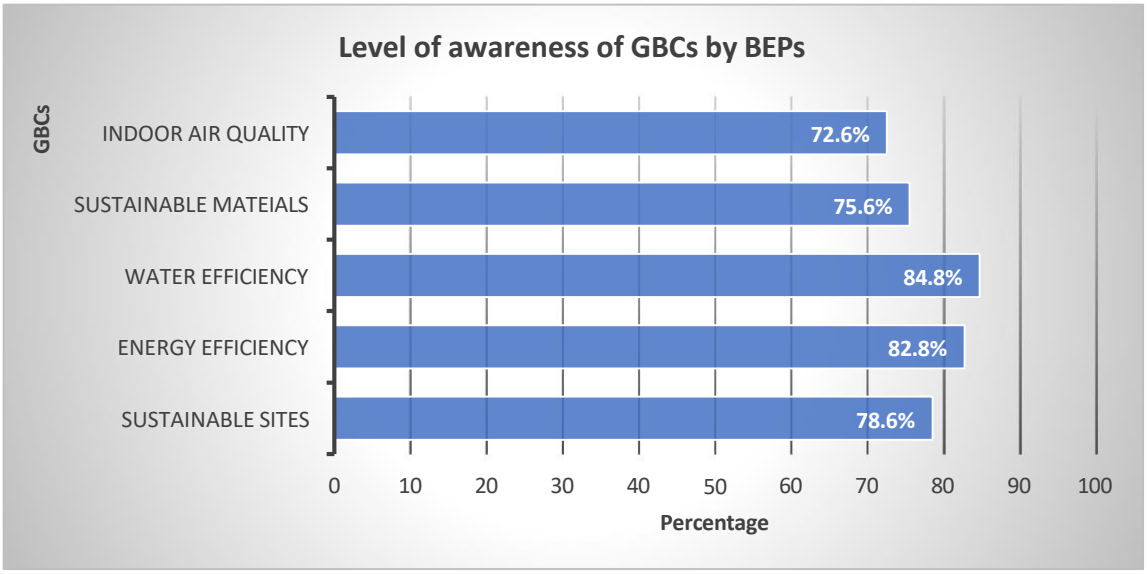

Figure 4.6 Level of awareness of the components of GBCs among BEPs

Source: Field data, 2023

4.3.2 Interest of BEPs in ensuring GBCs are incorporated in projects

Additionally, respondents were asked to rank the extent of their interest in ensuring that the five GBCs are incorporated in their projects. The findings indicated that the professionals had interest in ensuring GBCs are incorporated in development projects to a great extent. Out of the five components, the professionals showed more interest in ensuring that water and energy efficiency components are incorporated into buildings with a score of 89.8% for both components. The findings also outlined that sustainable materials, sustainable sites and indoor air quality were also of interest to the professionals with percentages of 84.2%, 82.2% and 81.7%, respectively. Figure 4.7 outlines the results.

The high level of interest in incorporating the GBCs could be related to the increased knowledge and availability of materials on green buildings and the need to reduce GHG emissions from all sectors, the building sector being one of them. Further scrutiny of the findings based on the mean rankings of the responses on each variable from the study participants revealed implementation of water efficiency and energy efficiency principles jointly draw the greatest interest for incorporation into construction projects in Nairobi County. This could be related to the fact that implementing these GBCs could be considered easier in terms of skills and the specific aspects of the two GBCs having to be metered therefore results are able to be quantified. The category that elicits the lowest interest among BEPs was indoor air quality. Nevertheless, according to the survey findings, the interest of implementing all the five GBCs by BEPs in Nairobi County was indicated to be to a great extent.

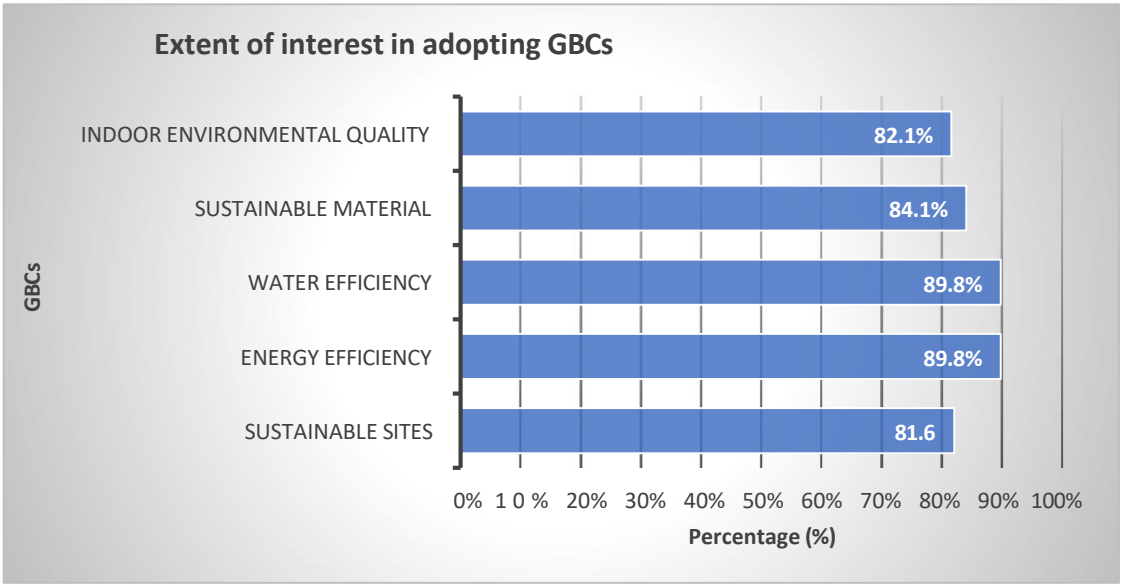

Figure 4.7: Level of interest in adopting GBCs by BEPs in Nairobi County

Source; Field data, 2023

Discussion

A high percentage of BEPs had interest on energy efficiency and water efficiency component since they are key sectors that most developers have keen interest in as they determine future cost and profitability of the development. Buildings with energy efficiency will have lower energy costs and demand for energy. A study by Bisher & Maak (2013) emphasized the importance of site selection in green building practices to minimize environmental impact. Proper site selection helps minimize vegetation disturbance, reduces visual impact, and optimizes solar gain for energy efficiency. Igunza (2012) investigation into green buildings in Nairobi County also emphasized the significance of site development strategies in mitigating environmental impact. The awareness level, while slightly lower, is still significant, possibly reflecting an understanding of the importance of site selection and design in reducing environmental footprints. BEPs' interest in sustainable site development is justifiable, as it aligns with the awareness of minimizing environmental impact. Proper site selection and design can lead to long-term benefits in terms of reduced maintenance and operational costs (Igunza, 2012).

Mulei (2021) stresses that energy efficiency is crucial for reducing total energy consumption in green buildings. The research highlights the role of equipment maintenance to support sustainable

energy sources like solar panels, geothermal machinery, and wind turbines. The study also mentions the importance of passive design strategies, emphasizing natural ventilation and thermal mass cooling as methods for energy efficiency. BEPs' awareness of energy efficiency is well-founded, as it directly correlates with reduced energy consumption and operational costs. The study by Kanda et al. (2023) highlights the importance of energy efficiency, further validating these findings.

Bisher & Maak (2013) underlined the goal of managing water sustainability in green buildings, including reducing portable water consumption and efficient reuse of non-portable water resources. The study also discussed the use of rainwater harvesting systems, which can significantly contribute to water efficiency in buildings. The high awareness of water efficiency can be justified by its direct impact on cost savings. Efficient water usage not only reduces water bills but also minimizes the burden on municipal water systems, a significant concern in urban areas like Nairobi (Kanda et al, 2023). BEPs' high interest in water and energy efficiency aligns with the awareness levels. The strong interest can be justified by the potential for significant cost savings and reduced environmental impact associated with efficient water and energy usage, as highlighted by Bisher & Maak (2013). The component of sustainable materials is supported by Khodadadzadeh (2016), who suggests the use of recycled, reused, renewable, or locally sourced materials in green building practices. The research emphasizes that green products are often comparable or superior in quality and performance to traditional materials. Bisher & Maak (2013) highlights the significance of indoor environmental quality for occupant well-being and productivity and practices such as using low-VOC materials and proper ventilation. The study acknowledges that indoor air quality is a critical feature of green building and emphasizes the importance of maintaining a healthy indoor environment.

The percentages and ranks provided align with the importance of these GBCs as supported by Mulei (2021). Awareness and interest in these concepts among BEPs in Nairobi County reflect a strong commitment to sustainable building practices, driven by the desire to reduce environmental impact and enhance occupant well-being and energy efficiency. While indoor air quality is a crucial component of GBCs, it may have a slightly lower awareness level, possibly because it is a less tangible aspect compared to energy and water efficiency.

4.4 Triggers to awareness of GBCs among built environment professionals

The study examined the triggers to awareness of GBC among BEPs in the construction industry in Nairobi County. According to Buckley and Logan (2016), the global green building sector is expanding at a steady pace, doubling every three years. This section of the study addressed the research question; "What triggers awareness of GBC among BEPs in construction projects in Nairobi?". Reviewed secondary data highlighted a number of factors that this study interrogated, among them government regulations, investors' demands, the quest for personal branding and prestige, membership in professional bodies, market trends, CSOs and tenants' interests.

Consequently, respondents were requested to specify the extent to which the mentioned factors had played a role in heightening their attention, as BEPs, towards recognizing, adopting and implementing GBCs in their projects. The results are presented in Figure 4.8. Out of the seven identified triggers, the quest for personal branding, market trends and investors' demands had the highest scores, respectively (80.8%, 76.5% & 76.7%). The quest for personal branding was high and could be related to the interest by owners to be considered champions of green building and climate change advocates. This is also the case for market trends as no-one wants to be left behind when it comes to trends in the building sector. Tenants' interests, views by Civil Society Organizations (CSOs) and Government's regulations had the least scores (49%, 42.5%, 56.5%). Taking into consideration that most tenants in Nairobi get to occupy already built and completed buildings, the study results clearly related to this phenomenon as the professionals in most cases do not get to interact with the tenants. From the findings, there was a clear indication that there are no adequate government regulations on green buildings in place to motivate the BEPs to incorporate GBCs in the construction processes. Government regulations play a great role in ensuring the GBCs are incorporated in the built environment industry. With no proper existence of these policies and regulations, the BEPs tend not to take these aspects into much consideration.

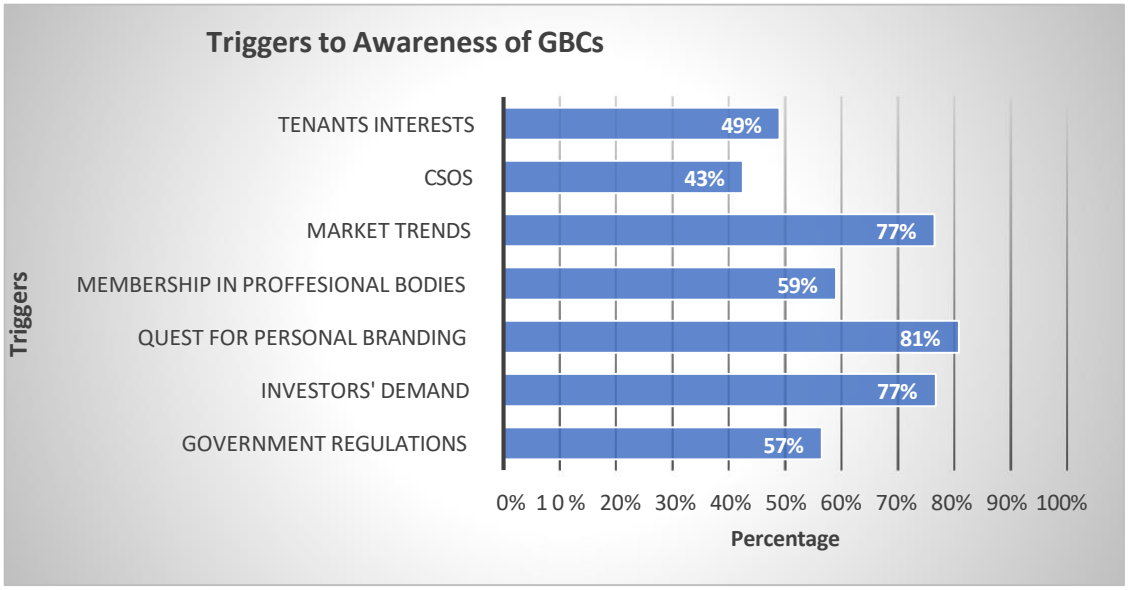

Figure 4.8 Triggers to awareness of GBCs

Source: Field data, 2023

In order to further get more understanding of the triggers to the awareness of GBCs by the professionals, three areas of focus were narrowed into as discussed below:

The research inquired about the respondents' views regarding whether the government had a primary role in incentivizing stakeholders within the construction sector to embrace and implement green building principles. As shown in Table 4.1, the results indicated that a significant proportion of the respondents, 71.6%, strongly agreed or just agreed with the statement, as compared with 5.9% who strongly disagreed, while 11.8% were neutral. These findings were in tandem with the assertions of Akreim and Suzer (2018), who stated that it was the role of the government to drive the green building agenda. The government should, therefore, ensure that there are proper systems in place to ensure the GBCs are incorporated into the building plans by having in place proper policies and regulations outlining the roles played by each contributor.

Table 4.1: Whether the government has a greater role motivating adoption of GBCs

Rating	Frequency	Percentage
Strongly Disagree	6	5.9
Disagree	11	10.8
Neutral	12	11.8
Agree	33	32.4
Strongly Agree	40	39.2
Total	**102**	**100.0**

Ranking scale: 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree

Source: Field data, 2023

The survey also found out what respondents thought about whether or not green buildings make a unique product that is perceived as cutting edge, ecologically and socially conscious, and has a good effect on the organization's brand and the reputation of building owners, including those who rent out green buildings. The data, as indicated in Table 4.2, indicates that the majority of respondents (87.3%) agreed or strongly agreed with the statement. The finding explains an earlier finding whereby the majority of the respondents indicated that quest for personal branding was the greatest trigger of GBCs awareness among BEPs in Nairobi. The findings outline that when buildings are green and sustainable, it brands the organization in a positive way in terms of how its green and how it considers to improve the state of environment by reducing GHG emissions. This attract more customers especially for the profit-making organizations and also attracting the number of people that want to be associated with the organization.

Table 4.2: Whether green buildings have positive impacts on organization's brand

Rating	Frequency	Percentage
Disagree	4	3.9
Neutral	9	8.8
Agree	27	26.5
Strongly agree	62	60.8
Total	**102**	**100.0**

Ranking scale: 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree

Source: Field data, 2023

The study also established the respondent's opinion on whether real estate investors' concerns on ESG performance controls real estate firms' choice of professionals to engage. The results (Table 4.3) showed that a majority of the respondents, 32.4%, agreed with this statement while 26.5% were neutral. Those who strongly agreed with this statement represented 16.7% of the respondents closely followed by 14.7% who strongly disagreed. These findings showed that most BEPs were not much keen on the ESG considerations, an area that needs to be keenly looked into to ensure sustainable buildings are in place.

Table 4.3: Whether real estate firms' choice of professionals depend on ESG concerns

Rating	Frequency	Percentage
Strongly disagree	15	14.7
Disagree	10	9.8
Neutral	27	26.5
Agree	33	32.4
Strongly agree	17	16.7
Total	**102**	**100.0**

Ranking scale: 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree

Source: Field data, 2023

Discussions

Contrary to the findings of Buckley and Logan (2016) on top triggers of increased levels of green building awareness amongst BEPs globally, the survey results did not place environmental regulations among the top three triggers for BEPs in Nairobi County. The findings however agree with those of a study by Wong, San-Chan and Wadu (2016). who indicated that government regulations, policies and standards were critical factors in driving adoption of green projects?

Finally, the study findings place the quest for personal branding and prestige as the greatest motivator of stakeholders in adopting and implementing the GBCs in Nairobi Kenya. Similarly, Kato & Rask (2009) demonstrated that building managers in Australia placed importance on their prestige in adoption of green buildings and were happy when regarded as champions of sustainability in the industry. While some studies suggest that green building costs are only slightly higher than conventional construction, long-term benefits, such as energy savings and improved occupant performance, can offset these initial costs. The perceived cost-effectiveness of green building can impact its adoption Fuerst & McAllister (2014). Market trends and cost-effectiveness of green building initiatives is an essential consideration. These factors interact with expected payback periods and can influence decision-making. In some cases, green technologies may have a longer payback period, which can affect their adoption. The assessment of cash flow and cost-effectiveness plays a role in this determination (Darko, Chan, Ameyaw, He, & Olanipekun, 2017)

Government regulations and incentives play a significant role in influencing awareness and adoption of GBCs. Policies that promote green building practices through penalties, incentives, and certification requirements encourage professionals to consider and implement these concepts. Government actions can drive change in the construction industry (Adshead, 2011). For the Government's role in motivating adoption of GBCs, the findings align with the concept that government policies and regulations can be a significant trigger for awareness. The high percentage of respondents who agreed suggests that government policies have a substantial influence on professionals in the construction sector (Akreim & Suzer, 2018).

Green building technology is a multi-sensory experience, and the built environment can influence human senses and prestige. Factors such as lighting, temperature, air quality, and acoustic comfort all affect how individuals perceive and interact with the built environment. (Abidin et al., 2012) explain that green building designs that prioritize these sensory experiences can impact occupant satisfaction. The satisfaction of building occupants is a critical measure of green building success.

Green buildings, on average, tend to be more comfortable and satisfactory for occupants in terms of air quality and thermal comfort. However, there can be variations among green buildings, with some performing better than others in different aspects. Regarding the positive impacts of green buildings on organization brand, the high percentage of agreement among respondents is supported

by the idea that green buildings can enhance corporate sustainability and brand equity.

This aligns with the broader understanding that green initiatives contribute positively to an organization's reputation (US Green Building Council, 2014). Concerning the dependence of real estate firms on ESG concerns, the percentage of agreement among respondents indicates that real estate firms are influenced by ESG considerations when choosing professionals. This aligns with the growing importance of ESG factors in the real estate industry (Eichholtz, Holtermans and Kok, 2019).

4.5 Implementation of GBCs by BEPs in construction projects

This objective evaluated the degree to which GBCs were put into practice by professionals in the built environment within construction projects in Nairobi County. The researcher sought to evaluate the extent of implementation of the GBCs by BEPs in construction projects in Nairobi in their projects in the last five years (between the years 2015 to 2020). According to the findings, the most widely implemented component was water efficiency (81%) closely followed at second place by energy efficiency at 78.6% the two components were likely highly implemented due to the utility bills that accompany for these essential commodities and their ability to be metered. The third and fourth components were ‘Use of sustainable materials’ (68%) and ‘Use of sustainable sites’ respectively (67.6%). These also had a high score as their application results in savings in other sectors for instance, proper construction waste management under sustainable will lead to improved health of occupants. Even though the results show that the application of indoor environmental quality was the least (66.6) of the GBCs, its extent of application is fairly high this was because the BEPs take into consideration that a lot of time is spent in buildings be it at work, home, school, hospitals etc. whereby indoor air quality is essential in ensuring proper health of occupants.

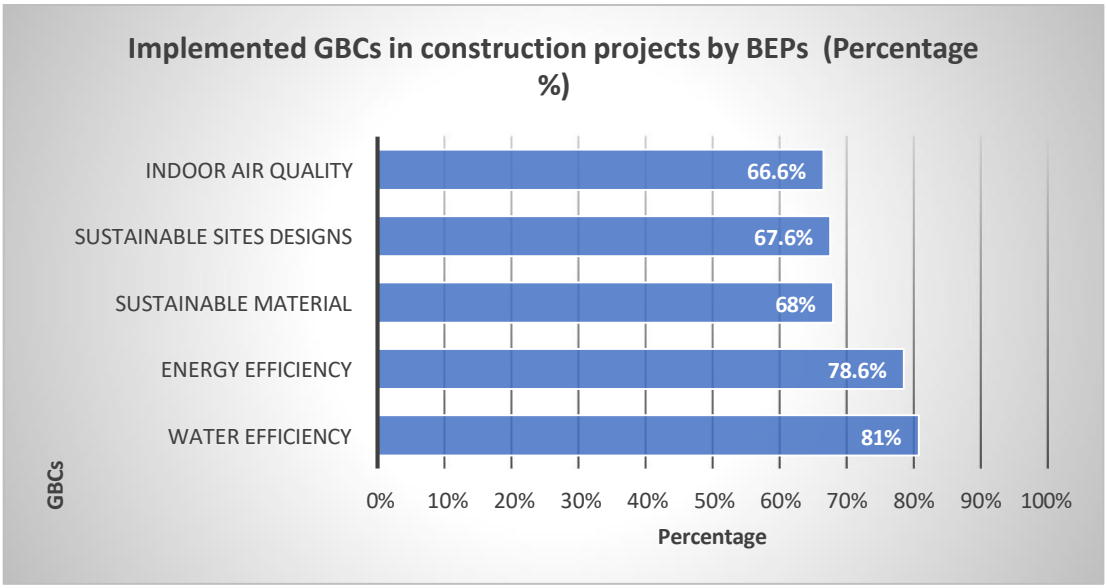

Figure 4.9: Implemented GBCs in construction projects by BEPs in Nairobi in the past five years

Source: Field data, 2023.

The study also conducted a comparative analysis of the extent of application of principles under each of the five GBCs applied in construction buildings as below:

Sustainable sites: building and development density control; application of construction waste management; application of resource efficient construction; application of protection, restoration and rehabilitation of habitat and application of building resilience and safety

Energy efficiency: use of equipment that are energy efficient, appliances and fittings; energy monitoring and management systems; renewable energy sources use; use of natural lighting and energy conservation measures e.g., occupancy sensors

Water efficiency: waste water management, optimum water use, water conservation measures (recycle, reduce and reuse), maximizing rain and storm water, and water efficient fittings and fixtures

Sustainable materials: use of climate responsive materials; low-carbon building materials and suitable building technology; use of materials that are available locally and the utilization of recyclable or reusable materials after the building's life

Indoor air quality: use of Indoor air quality testing and monitoring; use of low emitting carpeting and flooring; use of natural Heating ventilation and Air Conditioning (HVAC) systems, use of user-friendly HVAC systems.

The results were used to rank the most extensively applied principles in projects located in Nairobi in the past five years by BEPs. As outlined in Table 4.4, under energy efficiency, the use of natural lighting (87%) was highest. This can be readily associated with the decrease in energy expenses linked to the use of alternative energy sources and the need for natural lighting that enables a more comfortable environment. Under indoor air quality, natural HVAC system was the most widely applied green building principle (81.6%) by BEPs. Also featuring highly under water efficiency was the principle on maximizing rainwater and storm water usage for optimal water usage. This is because even though some costs are incurred to have the water collection fixtures in place, a lot of cost is saved in the long term. Under sustainable materials, the use of local materials was considered to be most adopted. This finding relates to the fact that local materials are considered to incur less costs that include transportation costs and are readily available. Under sustainable sites, application of protection, restoration and rehabilitation of habitat was considered to be highly adopted. This finding can be related to the hazardous impact of construction processes that include health and safety matters that need to be considered with much precaution. The foregoing contributes to the theme that energy and water efficiency are high in the list of priority by BEPs in Nairobi.

Table 4.4: Extent of adoption of various GBC principles

Rank	Green Building Aspects	Percentage (%)
	Energy Efficiency	
1	Natural Lighting	87%
2	Energy conservation measures	80%
3	Application of Energy Efficient Equipment	78.8%
4	Application of Renewable Energy Sources	75.6%
5	Application of Energy Monitoring and Management Systems	64.8%
	Water Efficiency	
6	Water Efficient Fixtures and Fittings	74.6%
7	Water Conservation Measures	74.2%
8	Optimal Utilization of Water	75.4%
9	Sustainable Management of Waste Water	73%
10	Maximizing Rain Water and Storm Water	78.4%
	Use of Sustainable Materials	
11.	Use of Local Materials	80.8%
12.	Use of Climate Responsive Materials	68.2%
13.	Materials with low carbon footprint	60.6%
14.	Use of reusable or recyclable materials	61.6%
15.	Appropriate building technology	73.2%
	Sustainable sites selection	
16.	Building and development density control	65%
17.	Application of construction waste management	65.8%
18.	Application of resource efficient construction	69.8%
19	Application of protection, restoration and rehabilitation of habitat	71.2%
20	Application of building resilience and safety	76.4%
	Indoor Air Quality	
21.	Use of Indoor Air Quality Testing and Monitoring	54.8%
22.	Use of Low emitting carpeting and flooring	53.8%
23.	Use of Natural HVAC systems	81.6%
24.	Use of user-friendly HVAC systems	75%

Source: Field data, 2023

The ranking of water efficiency as the most extensively implemented GBC aligns with previous studies emphasizing the important role that water conservation plays in sustainable construction. Water scarcity and the need for sustainable water management practices have made this component a top priority globally. The findings concur with the works of Wakhungu (2021), who underscored the importance of sustainable water practices in residential developments. Energy Efficiency, reflects the global shift towards reducing energy consumption and adopting energy-efficient technologies (Mulei, 2021). The study's ranking supports the idea that BEPs in Nairobi recognize the importance of energy conservation measures in achieving sustainability goals. Sustainable

materials and site design indicate a positive shift towards eco-friendly material choices and site planning practices among BEPs in Nairobi, suggesting increased awareness and implementation of sustainable material usage and site design principles. The study assessed the extent of adoption of various GBC principles within the five GBC categories, providing insights into specific practices prioritized by BEPs.

High rankings for natural lighting and HVAC systems within the energy efficiency category reflect the global trend towards energy-efficient building design (Ding et al., 2018). BEPs recognize the significance of these principles in reducing energy consumption and enhancing indoor comfort. The high ranking of maximizing rainwater and storm water usage in the water efficiency category aligns with the emphasis on water conservation and sustainable water management (Shikuku et al., 2022). This practice supports water-efficient fixtures and fittings, as emphasized in previous studies. The preference for using local materials and climate-responsive materials in the sustainable materials category reflects a global shift towards sustainable material choices. This ranking aligns with the growing recognition of the environmental impact of materials, supporting the study's findings. The extent of GBC implementation by BEPs in construction projects in Nairobi reflects a commitment to sustainable practices, particularly in water and energy efficiency. These rankings are supported by previous studies emphasizing the importance of water conservation, energy efficiency, and sustainable material choices in sustainable construction. The findings suggest a positive shift in BEPs' priorities towards eco-friendlier practices and materials in Nairobi's construction industry, contributing to the region's sustainability goals.

4.6 Barriers faced by BEPs in implementing green building components

The fourth objective of the study was to discuss the barriers to the implementation of GBCs in construction projects in Nairobi County. To achieve this objective, the researcher ranked responses on the extent to which the following factors: lack of incentives, public awareness, demand, proficiency, industry knowledge, database, and information, technology and higher investment costs acted as hindrances to the implementation of GBCs by BEPs in Nairobi County. Figure 4.9 presents the results.

According to the results, high investment costs was the biggest obstacle to the implementation of GBCs in Nairobi with a percentage of 86.7%. Investment in green buildings can be costly at the

beginning but saves on cost in the long-term and this becomes aa major hindrance in the development of sustainable buildings. Inadequate public awareness and inadequate financial incentives posted scores of 81.4 % and 79.6% respectively. Financial incentives are necessary when it comes to green buildings as green buildings can be costly. Having incentives in place enables the costs to be lower and therefore encourages investments in green buildings. The public needs to be aware of what green building entails as they occupy the buildings and can have a great influence on how the professionals in the construction industry can incorporate these aspects. Interestingly according to the survey, the lack of demand for green buildings was the least ranked barrier to the implementation of GBCs in Nairobi with 69% as the public awareness is inadequate. Based on the results BEPs view inadequate technology as more of a hindrance than lack of demand from potential consumers to taking up green construction projects in Nairobi.

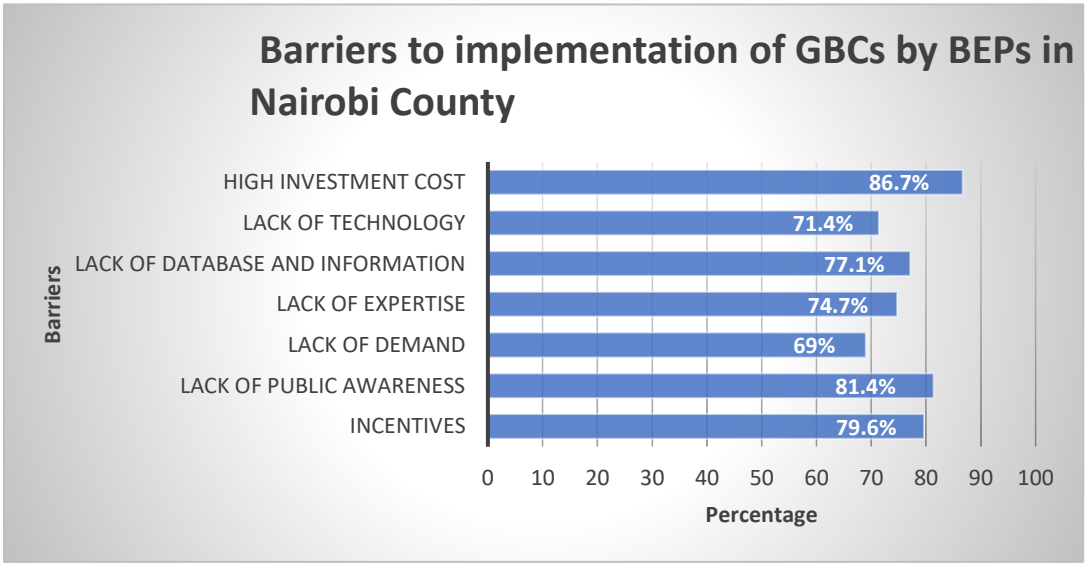

Figure 4.10: Barriers to implementation of GBCs by BEPs in Nairobi County

Source: Field data, 2023

Discussions

High investment costs as a significant barrier to green building implementation in Nairobi County aligns with the findings in the study by Gelan (2022) and is consistent with broader research trends. Green building practices often involve the use of eco-friendly materials, advanced technologies, and sustainable designs, which can be initially more expensive than traditional construction methods. This expense includes the procurement of energy-efficient systems, environmentally

friendly materials, and specialized expertise in green building. Furthermore, the need for urban planning and site adjustments to accommodate green features can also inflate costs.

The high percentage assigned to inadequate public awareness is justified by the fact that without sufficient familiarity with and comprehension of GBCs, there is often resistance to their adoption. Limited public awareness can result in misconceptions about the benefits of green buildings, making it difficult to gain support from stakeholders, including property buyers and developers. This challenge is echoed by Macherla and Agarwal (2023), indicating that public education and awareness campaigns are vital to overcoming this barrier. The high percentage reflects the critical role of public awareness in green building adoption. Inadequate financial incentives play a significant role as a barrier to green building implementation, consistent with findings from various studies. The lack of sufficient financial incentives, such as subsidies and tax breaks can discourage BEPs from investing in green building projects (Were, Diang & Mutai, 2015). This challenge is exacerbated when BEPs perceive that conventional construction methods are more financially attractive. Adebayo (2002) also underscores the importance of incentives and policies in promoting sustainable construction.

As outlined in the study by Gelan (2022), the lack of comprehensive and up-to-date information on green building materials, technologies, and practices can hinder the planning and execution of sustainable projects. Häkkinen & Belloni (2011) further emphasize the importance of robust databases and information systems in sustainable construction. The high percentage reflects the essential role of data and information in overcoming this barrier. BEPs may face challenges in finding construction sector professionals with the necessary expertise in green building design, construction, and project management. This concern is supported by broader research trends that emphasize the need for training and education in sustainable construction practices. The percentage reflects the substantial impact of the shortage of qualified experts on green building projects. Prior research indicates that limited access to green technologies, including energy-efficient systems and sustainable construction materials, can impede the adoption of GBCs. The percentage assigned to this barrier reflects the challenges associated with technology access and adoption in Nairobi County. The relatively lower percentage assigned to inadequate demand is justified by the perception that, in Nairobi County, the lack of consumer demand for green

buildings is less of a barrier compared to other factors. This lower percentage acknowledges that while demand is a factor, it may be less pronounced compared to high investment costs and other challenges in of Nairobi County.

4.7 Hypothesis testing

4.7.1 Relationship between awareness level and extent of implementation of sustainable sites concept

The study used Pearson correlation to test the hypothesis (H01:) that there is no relationship between awareness and extent of implementation of green building concepts (sustainable sites, energy efficiency, water efficiency, sustainable materials and indoor air quality) by BEPs in building projects within Nairobi City County. This section delves into exploring the correlation between awareness levels and the extent of implementation concerning sustainable sites among BEPs. The Pearson correlation method was applied to ascertain the strength and direction of this relationship. The analysis aimed to uncover insights into how the awareness of sustainable site practices align with their actual implementation within building projects in as shown in Table 4.5.

Table 4.5 Relationship between awareness level and extent of implementation of sustainable sites concept

		Extent of implementation of sustainable sites concept	Level of awareness of Sustainable Sites concept
Extent of Implementation of Sustainable Sites	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	102	
Level of awareness of Sustainable Sites	Pearson Correlation	.333**	1
	Sig. (2-tailed)	0.001	
	N	102	102

** Correlation is significant at the 0.01 level (2-tailed).

The Pearson correlation coefficient (r) between the extent of implementation of sustainable sites and awareness of sustainable sites concept was 0.333. This correlation is statistically significant at the 0.01 level (2-tailed), given the p-value of 0.001. This suggests a moderately positive relationship between the awareness and the extent of implementation of sustainable sites component. As awareness levels increase, there is a tendency for a parallel increase in the actual

implementation of sustainable site practices within building projects. This finding aligns with the expectation that a higher degree of awareness among BEPs regarding sustainable site considerations contributes to a more robust incorporation of these practices into their projects.

4.7.2 Relationship between awareness level and extent of implementation of energy efficiency concept

The study analyses the correlation between the level of awareness and extent of implementation of energy efficiency among BEPs involved in building projects within Nairobi City County as outlined in Table 4.6

Table 4.6: Relationship between awareness level and extent of implementation of energy efficiency concept

		Extent of implementation of energy efficiency concept	Level of awareness of energy efficiency concept	
Extent of Implementation of Energy Efficiency	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	102		
Awareness of Energy Efficiency	Pearson Correlation	.434**	1	
	Sig. (2-tailed)	0.000		
	N	102	102	

** Correlation is significant at the 0.01 level (2-tailed).

The Pearson correlation coefficient (r) between the extent of implementation of energy efficiency and awareness of energy efficiency is 0.434. The correlation is statistically significant at the 0.01 level (2-tailed), with a p-value of 0.000. This indicates a moderately strong positive relationship between awareness and the extent of implementation of energy efficiency measures. As the awareness levels of BEPs regarding energy efficiency increase, there is a corresponding increase in the practical incorporation of energy-efficient practices within building projects. The strength of the correlation suggests that interventions aimed at increasing awareness are likely to have a meaningful impact on the actual implementation of energy efficiency measures. BEPs who are more informed about the benefits and techniques of energy-efficient construction are more inclined to integrate these practices into their projects.

4.7.3 Relationship between awareness and extent of implementation of water efficiency concept

The study investigated the relationship between the awareness and practical implementation of water efficiency measures by BEPs participating in building projects within Nairobi City County as shown in Table 4.7.

Table 4.7 Relationship between awareness and extent of implementation of water efficiency concept

		Extent of implementation of water efficiency concept	Level of awareness of water efficiency concept
Extent of implementation of water efficiency	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	102	
Awareness of water efficiency	Pearson Correlation	.460**	1
	Sig. (2-tailed)	0.000	
	N	102	102

** Correlation is significant at the 0.01 level (2-tailed).

Results showed that there was a strong and favorable relationship between the extent of implementing water efficiency measures and the awareness levels of these measures among BEPs ($r=0.460$, $p=0.000<0.01$). This indicates a robust and positive connection between BEPs' awareness and the actual integration of water efficiency measures into their building projects. In simpler terms, as the awareness of water efficiency among BEPs increases, so does the tangible application of water-efficient practices. The strength of this correlation implies that interventions focusing on raising awareness can be influential in prompting tangible changes in the

implementation of water efficiency measures. BEPs with heightened awareness regarding the benefits and methodologies of water-efficient construction are evidently more predisposed to incorporate these practices into their projects

4.7.4 Relationship between awareness and extent of implementation of sustainable material concept

Relationship between the awareness level and the practical incorporation of sustainable materials among built environment professionals engaged in building projects within Nairobi City County was presented in Table 4.8.

Table 4.8 Relationship between awareness and extent of implementation of sustainable materials concept

		Extent of implementation of sustainable materials concept	Level of awareness of sustainable materials concept
Extent of implementation of sustainable material	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	102	
Awareness of Sustainable Materials	Pearson Correlation	.565**	1
	Sig. (2-tailed)	0.000	
	N	102	102

** Correlation is significant at the 0.01 level (2-tailed).

The statistical analysis, employing the Pearson correlation coefficient (r), divulges a significant correlation of 0.565 between the extent of implementing sustainable materials and the awareness levels among BEPs. This correlation is not merely a coincidence; it holds statistical significance at the 0.01 level (2-tailed), as indicated by a p-value of 0.000. This illuminates a compelling connection between BEPs' awareness and the tangible integration of sustainable materials into their building projects. In simpler terms, as the awareness of sustainable materials among BEPs intensifies, so does the actual utilization of these materials in construction practices. The robustness of this correlation suggests that interventions focusing on increasing awareness can have considerable influence in instigating tangible changes in the implementation of sustainable

materials. BEPs with heightened awareness regarding the advantages and usage of sustainable construction materials are evidently more inclined to incorporate these materials into their projects.

4.7.5 Relationship between awareness level and extent of implementation of indoor air quality concept

Table 4.9 Relationship between awareness level and extent of implementation of indoor air quality concept

		Extent of Implementation of Indoor air quality concept	Level of awareness of indoor air quality concept
Extent of Implementation of Indoor air quality	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	102	
Awareness of Indoor Environmental Quality	Pearson Correlation	.534**	1
	Sig. (2-tailed)	0.000	
	N	102	102

** Correlation is significant at the 0.01 level (2-tailed).

The findings revealed a significant correlation of 53.4% between the extent of implementing indoor air quality measures and the awareness levels among BEPs ($r = 0.534$, $p=0.00<0.01$). This explicates a substantial connection between BEPs' awareness and the tangible incorporation of indoor air quality measures into their building projects. The statistical significance of this correlation underscores the pivotal role of awareness in steering the implementation of indoor air quality measures. This emphasizes the need for targeted educational initiatives and awareness campaigns tailored to BEPs, aimed at deepening their understanding of the significance and application of measures to enhance indoor air quality. BEPs with heightened awareness regarding the importance of indoor air quality are evidently more inclined to incorporate measures to enhance indoor air quality into their projects. This correlation suggests that interventions focusing on increasing awareness can exert a considerable influence in instigating tangible changes in the implementation of measures to enhance indoor air quality.

4.7.6 Overall relationship between awareness level and extent of implementation of green building concepts by built environment professionals in building projects

Overall, the study explored the relationship between the extent of implementing GBCs by the

professionals in building projects within Nairobi City County and their level of awareness regarding this sustainable building practice as shown in Table 4.10.

Table 4.10 Relationship between level awareness and extent of implementation of green building concepts

		Extent of implementation of GBCs by BEPs in building projects	Level of awareness of Green Building Concepts
Extent of implementation of GBCs by BEPs in building projects	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	102	
Awareness of Green Building Concepts	Pearson Correlation	.566**	1
	Sig. (2-tailed)	0.000	
	N	102	102

** Correlation is significant at the 0.01 level (2-tailed).

Findings reveal a significant correlation of 56.6% between the extent of GBCs implementation and the awareness levels among the BEPs ($r = 0.566$, $p = 0.000 < 0.05$). This suggests a robust positive relationship between BEPs' awareness and the practical incorporation of GBCs in their projects. Therefore, the hypothesis positing a relationship between awareness and the extent of GBC implementation by BEPs is rejected, given the statistical significance of the correlation coefficient (p-value = $0.000 < 0.05$) and the positive nature of the observed relationship. This rejection implies that there is a substantial association between the awareness levels of BEPs and their actual implementation of GBCs in building projects within Nairobi City County. This finding implies that as BEPs enhance their awareness of sustainable building practices, there is a corresponding increase in the practical implementation of GBCs in their projects. The positive correlation suggests that higher levels of awareness are associated with a greater commitment to integrating green building principles into actual construction processes. This aligns with the broader literature emphasizing the pivotal role of awareness in promoting environmentally friendly methods in the building sector. The rejection of the null hypothesis underscores the statistical significance of this relationship, reinforcing the idea that fostering awareness among BEPs positively influences the extent to which they implement GBCs in their building projects.

4.8 Influence of triggers of awareness of GBCs on extent of implementation of GBCs by built environment professionals in building projects

Multiple regression was used to determine influence of triggers awareness of GBCs on extent of implementation of green building concepts by BEPs in building projects. The findings from the regression analysis provide casual influence of triggers of awareness on the overall implementation of sustainable building concepts within the context of Nairobi City County as outlined in Table 4.11.

Table 4.11 Regression model summary for triggers of awareness of green building concepts on extent of implementation of the concepts by BEPs in building projects

R	R Square	Adjusted R Square	Std. Error of the Estimate
.726a	0.527	0.492	0.56899

a Predictors: (Constant), Tenants interests, Quest for personal branding and prestige as a professional in the field sig., Membership in Professional Bodies, Investors' demands sig., Government Regulations and Policies sig., Market trends sig., Civil Society Organizations (CSOs)

The regression model summary outlined that the coefficient of determination (R Square) stands at 0.527, indicating that approximately 52.7% of the variability in the extent of GBCs implementation can be explained by the identified predictors.

Table 4.12 Regression coefficient of estimates for triggers awareness of GBCs on extent of implementation of green building concepts by BEPs in building projects

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.039	0.292		3.565	0.001
Government Regulations and Policies.	0.142	0.065	0.181	2.195	0.031
Investors' demands	0.228	0.058	0.324	3.952	0.000
Quest for personal branding and prestige as a professional in the field	0.142	0.052	0.209	2.703	0.008
Membership in Professional Bodies	0.033	0.062	0.050	0.532	0.596
Market trends.	0.171	0.057	0.252	3.020	0.003
Civil Society Organizations (CSOs)	0.083	0.078	0.116	1.068	0.288
Tenants' interests	-0.077	0.053	-0.125	-1.456	0.149

a Dependent Variable: extent of implementation of GBCs by BEPs in building projects

From the results, the unstandardized coefficients provide information about the magnitude and direction of the relationship, while the standardized coefficients (Beta) offer insights into the relative importance of each trigger. Among the triggers, government regulations and policies exhibit a significant positive influence on the extent of GBCs implementation, as evidenced by a Beta value of 0.181 ($p=0.000<0.05$). This implies that, holding other variables constant, a one-unit increase in government regulations and policies is associated with a 0.181-unit increase in the extent of GBCs implementation. The significance level ($p=0.031$) indicates that this relationship is unlikely to have occurred by chance.

Similarly, investors' demands and market trends also show significant positive influences on GBCs implementation, with Beta values of 0.324 ($p=0.000<0.05$) and 0.252 ($p=0.003<0.05$) respectively. These results suggest that both external pressures from investors and alignment with current market trends play pivotal roles in driving the adoption of sustainable building practices among BEPs. Quest for personal branding and prestige as a professional in the field also displays a significant positive influence (Beta=0.209, $p=0.008<0.05$), indicating that BEPs who are motivated by personal branding and professional prestige are more likely to implement GBCs. Conversely, tenants' interests, membership in professional bodies, and CSOs do not show statistically significant influences on the extent of GBCs implementation, as indicated by non- significant Beta values and p-values above the 0.05 threshold.

CHAPTER FIVE

SUMMARY OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter provides an overview of the results obtained from the survey data. These findings informed the development of the study's conclusions, which, in turn, influenced the recommendations. The chapter identifies potential areas for future research.

5.2 Research findings

The study explored the awareness levels and obstacles hindering the adoption of GBCs by BEPs in the Kenyan construction industry. This section gives a summary of the study findings per objective.

5.2.1 Main components of GBCs taken into consideration by built environment professionals for construction projects in Nairobi

The main components taken into consideration by building professionals in Nairobi were sustainable materials, sustainable sites, energy efficiency, and water efficiency. The study established that the BEPs had interest in adopting the GBCs with the highest interest being water efficiency at 84.8% followed by energy efficiency (82.8%), sustainable material (78.6%) sustainable sites designs (75.6%) and lastly indoor air quality (75.6%). This shows that the BEPs in Nairobi have more interest in adopting water and energy efficiency than sustainable sites design and indoor air quality.

5.2.2 Triggers of awareness of GBCs among built environment professionals in construction projects in Nairobi

The study findings showed that the greatest triggers of adopting GBCs by the BEPs in order of importance were quest for personal branding and prestige followed by investors' demands then market trends, membership in professional bodies, government regulations, policies and standards, tenants and lastly CSOs. This indicated that government regulations, policies and standards, tenants' interests and CSOs had the least effect in triggering adoption of green buildings in Nairobi City County by BEPs.

The majority of the BEPs in Nairobi City County, according to the findings, believed that the government should play a bigger role in encouraging those involved in the construction industry to embrace and apply GBCs. Additionally, they held the opinion that green buildings distinguish themselves in the marketplace and are seen as technologically sophisticated, environmentally conscious, and socially conscious. This benefits the organization's brand as well as the reputation of building owners, including those who rent out green buildings. The study also established that majority of BEPs in Nairobi City County don't believe that real estate investors' concerns on ESG performance controls real estate firms' choice of professionals to engage.

5.2.3 Extent of implementation of the GBCs by built environment professionals in construction projects in Nairobi

The third objective of the study evaluated the extent of implementation of GBCs by BEPs in construction projects in Nairobi County. The study findings indicated that only water and energy efficiency have been implemented by the BEPs in Nairobi City County to a great extent. The incorporation of sustainable site practices, sustainable material usage, and indoor environmental quality principles has been moderately implemented by BEPs in Nairobi County. The study also ranked the extent of adoption of GBCs and established that the most extensively adopted concept by BEPs in Nairobi was natural lighting followed by use of natural HVAC systems. On the other hand, the concepts of appropriate building technology, sustainable management of wastewater and application of protection, restoration and rehabilitation of habitat are the least extensively adopted by BEPs in Nairobi. However, the green building aspects which had been adopted to a moderate extent were application of resource efficient construction, use of climate responsive materials, application of construction waste management, building and development density control, application of energy monitoring and management systems, use of reusable or recyclable materials, materials with low carbon footprint, use of indoor air quality testing and monitoring as well as use of low emitting carpeting and flooring.

5.2.4 Barriers faced by built environment professionals in implementing GBCs in construction projects in Nairobi

It was established that indeed the BEPs faced barriers in pursuit of implementation of green buildings. The most experienced challenge was high investment cost followed by inadequate

public awareness and inadequate financial incentives. The study established that lack of demand for green buildings as well as inadequate technology and demand are not considered as significant barriers in the implementation of green building concepts by BEPs in Nairobi.

5.2.5 Relationship between awareness and extent of implementation of GBCs by built environment professionals in building projects

The correlation analysis indicates noteworthy relationships between awareness levels and the extent of implementation of various GBCs by built environment professionals in building projects within Nairobi City County. The correlation between awareness and sustainable materials implementation shows a compelling connection, emphasizing the tangible integration of sustainable materials into projects with heightened awareness.

The relationship between awareness and the extent of implementing indoor air quality measures underscores the pivotal role of awareness in steering their implementation. The strongest correlation is found in water and energy efficiency implementation, indicating a substantial association between BEPs' awareness levels and their practical implementation of GBCs. The rejection of the null hypothesis underscores this association, suggesting that heightened awareness among BEPs positively influences the extent to which they implement GBCs in building projects. This finding aligns with broader literature emphasizing the crucial role of awareness in driving sustainable practices within the construction industry.

5.2.6 Influence of triggers of awareness of GBCs on extent of implementation of GBCs by BEPs in building projects

The study also employed multiple regression analysis to identify triggers influencing GBCs implementation, with government regulations and policies, investors' demands, and market trends emerging as significant positive influencers. However, certain triggers, such as tenants' interests, membership in professional bodies, and civil society organizations, did not exhibit statistically significant influences on GBC

5.3 Research conclusions

This research concludes that built environment professionals in Nairobi are aware of GBCs. However, the level of awareness varied. The highest level of awareness was on water efficiency

followed by energy efficiency, sustainable sites, sustainable material and the least awareness was shown in regard to indoor air quality in that order. It was also similarly concluded that the BEPs had a great interest in adoption of these practices; however, they had more interest in adopting water and energy efficiency than sustainable sites design and indoor air quality.

Some of the important triggers to adoption of GBCs by BEPs were quest for personal branding and prestige followed by investors' demands, membership in professional bodies and market trends. Additionally, the study concludes that government regulations, policies and standards, tenants and Civil Society Organizations had the least effect in triggering adoption of green buildings in Nairobi City County by BEPs. It was also concluded that the government plays a pivotal role in motivating stakeholders within the construction sector to embrace and implement GBCs. Furthermore, green building improves the reputation of the building owner, the organization's brand, and its tenants by differentiating itself from the competition and projecting an image of being environmentally and socially conscious as well as technologically advanced. The study also concludes that there is variation in the extent to which GBCs have been implemented by BEPs in Nairobi County. Specifically, the study concludes that the most adopted GBCs are water and energy efficiency while the moderate implemented ones are sustainable sites, sustainable material usage and indoor environmental quality principles. Another notable conclusion from the study is that some of the least implemented green building aspects are application of resource efficient construction, use of climate responsive materials, application of construction waste management, building and development density control, application of energy monitoring and management systems, use of reusable or recyclable materials, materials with low carbon footprint, use of indoor air quality testing and monitoring as well as use of low emitting carpeting and flooring. Lastly, the study concluded that BEPs faced barriers in pursuit of implementation of green buildings in Nairobi City, County. Some of the most experienced challenges were high investment cost followed by inadequate public awareness and inadequate financial incentives. The least experienced challenges were lack of demand for green buildings as well as inadequate technology.

The findings of the study reveal a substantial correlation between the awareness levels of built environment professionals and the practical implementation of GBCs in building projects within

Nairobi City County. The observed patterns suggest positive impacts of awareness on practical implementation. For sustainable sites, energy efficiency, and water efficiency, there is a discernible increase in actual implementation as awareness levels rise. The positive relationships observed across various GBC components underscore the importance of awareness in influencing sustainable practices within the construction industry. Additionally, the identified triggers, particularly government regulations and policies, investors' demands, and market trends, emphasize the external factors influencing GBC implementation. However, certain triggers deemed influential in literature, such as tenants' interests CSOs, did not manifest significant impacts in the Nairobi context.

5.4 Research recommendations

5.4.1 Recommendations for policy

This study recommends for inclusion of GBCs as a requirement in key government regulations, policies and standards of building designs and also focus on creating awareness on GBCs. Results from this study shows that Government regulations, policies and standards, tenants and Civil Society Organizations had the least effect in triggering adoption of green buildings in Nairobi City County by BEPs. This implies that these important factions of the society have not significantly appreciated the importance of green buildings in the Kenyan society.

Therefore, there is a need for these three main factions to champion for green buildings. This can be accomplished by creating rules and regulations for the application of sustainable building principles, along with financial support from both local and federal authorities. There is a need for the relevant professional bodies as well as the government and research institutions to ensure proper implementation of existing policies related to green buildings in the industry.

It is imperative to raise awareness and advocate for the implementation of strategies like natural ventilation, passive design, and the use of daylighting. These measures can significantly improve indoor environments that support occupant comfort and productivity while also improving well-being and health. This can be done through running public awareness, using print and social media as well as availing more information about green building in the public domain.

Since the BEPs face challenges such as high investment cost and inadequate financial incentives

in pursuit of implementation of green buildings in Nairobi County, the study recommends a need for the stakeholders involved to work on the cost modalities, including cost sharing in order to ensure that there is a balance in cost implications. Additionally, the government can step in by bearing some of the cost through provision of financial incentives in order to bear some of the costs and motivate adoption of green building.

Furthermore, regulatory frameworks should be strengthened and enforced to incentivize GBC adoption, including tax incentives and certification programs. Collaboration and networking platforms should be facilitated to encourage knowledge-sharing among BEPs, and green building concepts should be integrated into academic curricula. Green building design short courses can be in introduced in continuous professional development programs to update the built environment professionals. Research initiatives focusing on sustainable construction practices should be supported, and industry certification programs acknowledging commitment to sustainability be promoted. Extending public awareness campaigns beyond industry professionals can create a broader demand for sustainable buildings, influencing industry-wide GBC adoption. Lastly, the Government should consider exploring mechanisms for availing of subsidized green funds and repealing the outdated building codes of 1968 and replace it with one responsive to environmental and climate change sustainability.

5.4.2 Recommendations for further research

The study investigated the level of awareness and barriers to the implementation of green building strategies by BEPs in the Kenyan built environment. It however narrowed down to Nairobi County. Other studies can widen the contextual scope of a related study in other counties in order to compare the findings.

Studies can also be undertaken on the perception and awareness of GBCs by other key stakeholders in the field including investors, end users/owners, public authorities, manufacturers and civil society. Additionally, ffuture studies can also widen the contextual scope by studying GBC awareness and barriers in other Kenyan counties.

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APPENDICES

Appendix I: Survey Questionnaire

Introduction

I am a student at the University of Nairobi pursuing Master of Arts in Environmental Planning and Management and carrying out a research project titled **'Evaluation of the Awareness and Barriers to Implementation of Green Building Concepts in the Built Environment Industry in Kenya: The Case of Nairobi County'.** I kindly ask that you take a moment to respond to a few inquiries. The data you submit will only be utilized for educational purposes.

Section A: Respondent's Data

Profession		**Qualification**	
Architect	( )	Diploma	( )
Engineers	( )	Undergraduate Degree	( )
		Post Graduate Degree	( )
Experience (years)			
Below 5	( )		
6 – 10	( )		
10- 15	( )		
15- 20	( )		
Above 20	( )		

Section B: The main components of Green Building Concepts (GBCs) taken into consideration by built environment professionals in construction projects in Nairobi County

1. Do you have any professional experience with Green building projects in the last five years;

a) In Nairobi?

Yes ( ) No ( )

b) Outside Nairobi?

Yes ( ) No ( )

2. The five environmental categories that make up Green Building Concepts are Sustainable sites, Sustainable Materials, Energy efficiency, Indoor air Quality, Water Efficiency Sustainable Site, Water and Energy Efficiency, and Sustainable Site.. To what extent would you say you are aware of each of these concepts?

(Scale: 1-5; 1- 'not at all'; 5; 'to a very great extent')

	Green Building Concept	**Example**	**1**	**2**	**3**	**4**	**5**
1.	Sustainable Sites	Sustainable Sites: Maximizing usage of built spaces, Building resilience and safety (against disaster risks), landscaping, construction waste management, protection and rehabilitation of habitat					
2.	Energy Efficiency	Energy Efficiency: Energy efficient equipment, appliances and fittings, Energy monitoring, Use of energy sources that are renewable, natural lighting use					
3.	Water Efficiency	Water Efficiency : e.g. maximum water use and sustainable waste water management water conservation measures (recycle, reduce and reuse), maximizing rainwater and storm water, water efficient fixtures and fittings					
4.	Sustainable Materials	Sustainable Materials : Use of materials that are climate responsive, materials with low carbon footprint, appropriate building technology					
5.	Indoor air Quality	Indoor air Quality: User-friendly heating, cooling, and ventilation systems, natural ventilation ensures indoor air quality testing and monitoring					

33. Have you used any green building concepts in the projects you have finished in the past five years? Yes ( ) No ( )

3. When undertaking a new project, to what extent are you interested in ensuring the following concepts are incorporated in the project?

(Scale: 1-5; 1- 'not at all'; 5; 'to a very great extent')

	Green Building Concept	**1**	**2**	**3**	**4**	**5**
1.	Sustainable Sites					
2.	Energy Efficiency					
3.	Water Efficiency					
4.	Use of Sustainable Materials					
5.	Indoor Environmental Quality					

Section B: Triggers of awareness of GBCs among built environment professionals

4. To what extent would you say that the below factors have contributed to heightening your attention, as a BEPs, towards recognizing, adopting and implementing green building concepts in your projects?

(Scale: 1-5; 1- 'not at all'; 5; 'to a very great extent')

	Triggers of Awareness to GBCs	**1**	**2**	**3**	**4**	**5**
1.	Government Regulations and Policies					
2.	Investors' demands					
3.	Quest for personal branding and prestige as a professional in the field					
4.	Membership in Professional Bodies					
5.	Market trends					
6.	Civil Society Organizations (CSOs)					
7.	Tenants' interests					

5. How much do you think you agree or disagree with each of the following statements?

(Scale: 1-5; 1- 'strongly disagree'; 5; 'strongly agree)

		1	2	3	4	5
a)	The preeminent role in motivating stakeholders in the construction sector to implement and adopt GBCs is attributed to the government.					
b)	Green building produces a distinctive product in the market, recognized for its technological advancement, environmental responsibility, and social consciousness. Consequently, these qualities collectively enhance the organization's brand and contribute positively to the					

		1	2	3	4	5
	building owner's image, and perception of tenants in green buildings.					
(c)	Real estate investors' concerns on Environmental and Social Governance (ESG) performance controls real estate firms' choice of professionals to engage.					

Section C: The extent of implementation of the GBCs by built environment professionals in construction projects in Nairobi?

6. In the last five years, to what extent have you incorporated the five environmental categories in construction projects you have been involved in?

(Scale: 1-5; 1- 'not at all'; 5; 'to a very great extent')

	Category	**1**	**2**	**3**	**4**	**5**
1	Sustainable Sites					
2	Energy Efficiency					
3	Water Efficiency					
4	Use of Sustainable Material					
5	Indoor air Quality					

7. The following table lists several green building ideas according to the environmental classifications that are typically used in Kenya. Please rate the degree to which you have used these ideas.

(Scale: 1-5; 1- 'not at all'; 5; 'to a very great extent')

	Sustainable Sites					
		1	2	3	4	5
a.	Building and development density control					
b.	Building resilience and safety					
c.	Construction waste management					
d.	Resource efficient Construction					
e.	Protection/ restoration/rehabilitation of habitat					
f.	Others specify					

	Energy Efficiency					
		1	2	3	4	5
a.	Use of Energy efficient equipment, appliances and fittings					
b.	Energy monitoring and management systems					
c.	Renewable energy sources use					
d.	Use of natural lighting					
e.	Energy conservation measures					
f.	Other Specify					
	Water Efficiency					
		1	2	3	4	5
a.	Optimal utilization of water					
b.	Sustainable management of waste water					
c.	Water conservation measures (recycle, reduce and reuse)					
d.	Maximizing rainwater and storm water					
e.	Water efficient fixtures and fittings					
f.	Other specify					
	Sustainable Material					
		1	**2**	**3**	**4**	**5**
a.	Use of climate responsive materials					
b.	Materials with low carbon footprint					
c.	Appropriate building technology					
d.	Use of local material					
e.	Using materials that are capable of recycled or reused at the end of building lifecycle.					
f.	Other specify					
	Indoor air quality					
		1	**2**	**3**	**4**	**5**
a.	Natural ventilation, heating and					

	cooling					
b.	user-friendly ventilating, heating and cooling systems					
c.	ensure indoor air quality testing and monitoring					
d.	Use of low emitting carpet and flooring					
e.	Other specify					

Section D: The barriers faced by built environment professionals in implementing Green Building Concepts in construction projects in Nairobi

8. Please rank in a scale of 1 – 5 the factors that hinder the adoption of GBCs in Kenya.

(Scale: 1-5; 1- 'not at all'; 5; 'to a very great extent')

	Barriers to implementation of GBCs	**1**	**2**	**3**	**4**	**5**
1.	Lack of incentives					
2.	Lack of building codes and regulations					
3.	Lack of Public awareness					
4.	Lack of demand					
5.	Lack of expertise					
6.	Lack of professional Knowledge					
7.	Lack of database and information					
8.	Lack of technology					
9.	High investment cost					
10.	Other Specify					

Please feel free to share any additional information or comments you have on this subject.

……

Thank you.

Appendix 2: Research permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **295730**

Date of Issue: **21/August/2019**

RESEARCH LICENSE

This is to Certify that Ms.. Phanice Mokeira of University of Nairobi, has been licensed to conduct research in Nairobi on the topic: Evaluation of the and barriers to implementation of green buildings concepts in the built environment industry Kenya: The case of Nairobi county for the period ending : 21/August/2020.

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Appendix 3: BORAQS letter of introduction.

Board of Registration of Architects and Quantity Surveyors (BORAQS) Kenya

Ngong Road
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Transcom House Annexe
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P. O. Box 40866 – 00100
Nairobi, Kenya
Tel. 2728444, 0726 243005
info@boraqs.or.ke

BORAQS/GEN/48/2019 **24th September, 2019**

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

PHANICE MOKERIA- RESEARCH ON: EVALUATION OF THE AWARENESS AND BARRIERS TO IMPLEMENTATION OF GREEN BUILDING CONCEPTS IN THE BUILT ENVIRONMENT INDUSTRY IN KENYA

The above named is a student at University of Nairobi pursuing a Masters of Arts degree in Environment planning and Management.

She is doing a research on Evaluation of the awareness and barriers to implementation of green building concepts in the Built Environment Industry in Kenya. She wishes to interview Architectural and Quantity Surveying firms to collect data for academic use only. Any assistance accorded to her during her research is highly appreciated.

Yours Sincerely,

BOARD OF REGISTRATION
ARCHITECTS AND
QUANTITY SURVEYORS OF KENYA
P.O. Box 40866 - 00100
NAIROBI - KENYA

QS. George C. Omondi
REGISTRAR