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COLLEGE OF ART AND BUILT ENVIRONMENT

DEPARTMENT OF BUILDING TECHNOLOGY

Sustainable Building Construction in the Metropolitan, Municipal and District Assemblies of the Central Region of Ghana

By

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Construction Management and that, to the best of my knowledge, it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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DEDICATION

This work is dedicated to every individual who have set his heart to promote sustainable living in our current dispensation and to the Gyesi-Mensah family- Matthew Snr., Mary, Matilda, Matthew Jnr. and Mildred. I love you all.

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ABSTRACT

Building construction plays a vital role in the economic, social and infrastructural development of a nation. Activities of building construction has however been characterized with immense contribution to air, water and land pollution and hence has great impact on the environment. There is rising global need to preserve the depleting environment which demands the activities of building construction to adopt sustainable principles to contribute to continuous human development for the current generation and the future as well. It was in line with this global need that this research was undertaken with the aim of promoting the construction of sustainable buildings by the Metropolitan, Municipal and District Assemblies (MMDAs) in the Central Region of Ghana. The objectives were to assess the construction of buildings by the MMDAs, identify challenges to the construction of sustainable buildings by the MMDAs and identify strategies for promoting the construction of sustainable buildings by the MMDAs. A survey was conducted using questionnaires to collect data from selected staffs of the MMDAs. The data collected was analyzed using descriptive statistics and Relative Importance Index (RII). An average mean score of 2.7 revealed the lack of sustainability in the buildings constructed by the MMDAs. The study also identified the lack of financial resources, ignorance or misunderstanding about sustainability, fear of higher initial cost of sustainable buildings, restrictions posed by public procurement regulations and lack of demand for sustainable buildings as the major challenges to the construction of sustainable buildings by MMDAs. The study further found that the construction of sustainable buildings can be promoted by the introduction of financial incentives to MMDAs that achieve sustainable targets. In addition, there is the need to revise contract conditions and contract specifications as well as educate public officials to understand the need and benefit of sustainable construction.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The rapid increase in the world's population together with the high rate of urbanization has resulted in increased demand for buildings and physical infrastructure to improve the quality of human life (Millenium Ecosystem Assessment, 2005). This increased demand has called for a simultaneous increase in the use of land and other natural resources to meet the needs of man which includes shelter and accommodation achieved through building construction. The exploitation and utilization of these resources affects the ecosystem and the quality of human life and has thus created a growing global concern for the state of the environment (Parkin, 2000). Building construction is known to consume one-sixth of the world's fresh water, a quarter of the wood harvest and two-fifth of its material and energy (David, 1996). This indicates the significant impact of construction activities on climatic changes. It is believed that by 2032, 70% the world's natural resources and wildlife will be destroyed by urbanization and construction activities if prudent sustainable measures of resource extraction and utilization are not enforced (UNEP, 2002). Thus the rising need for sustainability in sectorial operations including construction in all countries. There is an increasing burden on both private and public organizations to find ways of attaining sustainability through policy formulation and statutory regulations (Kühtz, 2007).

The Paperback Oxford English dictionary (2002, p.844) defines sustainability as avoiding using up natural resources. Thus to sustain our resources is to keep them over time or continuously without depleting them. Sustainability is a constant process of satisfying the needs of people within limits which will not have negative impact on the ecosystem (Shafii, 2006). Sustainable living and production meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). Sustainability in the context of this study will be considered as the extent to which natural resources of the earth can be extracted and used or disturbed by the activities of man without damaging effects on the ecosystem (Pitt et al., 2009). The concept of sustainability encompasses environmental responsiveness, social growth and economic empowerment (Pitt et al., 2009). This concept is popularly referred to as the three pillars of sustainability.

The World Commission on Environment and Development (1987) defined sustainable development as ―meeting the need of the present generation without compromising the ability of the future generations to meet their own needs‖. Resources are finite and as such the present generation must not only be concerned with utilizing it to satisfy its current need but preserve and if possible improve upon the existing resources for the future generations as well.

The contribution of construction to sustainable development is known as sustainable construction and is aimed at ensuring an enhanced quality of life for both present and future generations by providing infrastructure that enriches the social and economic standards of both generations within the carrying capacity of the environmental (Dickie and Howard, 2000). This study considered sustainable construction within the framework of sustainable development. Sustainable construction has also been described as producing a relatively permanent change to the built environment in a manner that minimizes the impact of the production processes on the ecosystem while preserving environmental resources to facilitate its continual use throughout man‘s existence (Kibert, 1994).

The construction sector is known to play a leading role in the economic and social development of all countries through the provision of housing units and physical infrastructure (Ahadzie et al., 2009). However, the construction sector is a major consumer of non-renewable resources and its activities have adverse impact on the environment (Wallbaum and Buerkin, 2003). About twenty percent (20%) to forty percent (40%) of the world‘s energy resources are consumed by construction related activities (Perez-Lombard et al., 2008). Through the construction sector, the public need for accommodation and related infrastructure is satisfied but the resultant waste and environmental impact of construction activities is a challenge to most governments especially in the developing countries (Ekanayake and Ofori, 2000). The need to adopt the concepts of sustainability in construction works must therefore be high on the policy direction of leaders of the construction industry and government agenda. The need to review the activities of the construction sector, to inculcate sustainable principles aimed at ensuring not only the good health and development of the present generation but that of the future as well is duly recognized in all parts of the world (Alkilani, 2012). Sustainable construction is the best approach to achieving sustainable development through environmental, social and economic improvement and is a key ingredient to balance the need of improving human life and preserving the environment (Shafii, 2006).

1.2 STATEMENT OF THE PROBLEM

Construction is a major consumer of natural resources and its activities has adverse effects on the environment (Wallbaum and Buerkin, 2003). About half of the materials extracted from the earth today is used for construction activities (Shafii, 2006). That notwithstanding, about twenty-five percent (25%) of these resources used for the building sector is wasted during construction (Yahya and Boussabaine, 2006). The construction sector is also recognized for its immense contribution to air, water and land pollution by the toxics wastes produced and other deleterious substances used in its operations (Pasquire, 1999). Carbon dioxide from earthmoving equipment, quarry machinery, tipper trucks and material processing and manufacturing factories have had a significant effect on the world‘s climate (Yudelson, 2008). Construction generate so much waste into the environment which turn out to affect the quality of life in every country. While the negative impact of construction pertains, the implementation of the principles of sustainable construction continues to be a major challenge to many developing countries including Ghana (Atombo et al., 2015).

In Ghana, building construction activities has been found to contribute greatly to the destruction of the ecosystem. Extensive site clearing, waste production from construction works, toxic emission from construction machinery, uncontrolled felling of timber and dereliction of land due to aggregate winning activates are among the numerous negative impact of building construction in Ghana (Ayarkwa et al., 2014). Most buildings in Ghana do not incorporate the social needs of the users neither do they provide minimal operating and maintenance cost (Bangdome-Dery & KootinSanwu 2013). This has resulted in the high energy consumption of most buildings putting great pressure on the national electricity grid (Ahadzie & Badu 2011). The situation is not different even with government funded projects. The Local Government Service of Ghana (LGS) through its Metropolitan, Municipal and District Assemblies (MMDAs) spends huge sums of public revenue annually on infrastructural development in rural and urban areas across the country (Manu et al., 2009). A good number of these government initiated building project have contributed to the negative impact construction is having on the environment. Abandoned government buildings are identified in almost all Districts in Ghana (Manu et al., 2009). The economic and social benefits of these abandoned buildings are yet to be realized although materials and resources has been expended into their construction.

Although the MMDAs undertakes numerous construction projects, no study has been carried out to assess their adherence to the principles of sustainable building construction. There has also been no effort to identify the challenges to the construction of sustainable buildings faced by the MMDAs neither has there been any attempt to identify ways of promoting sustainable construction in the local assemblies. It is in light of these needs that this present research is been undertaken to promote the construction of sustainable buildings by MMDAs in the Central Region of Ghana.

1.3 AIM OF THE STUDY

The aim of the study is to promote the construction of sustainable buildings by MMDAs in the Central Region of Ghana.

1.4 OBJECTIVES OF THE STUDY

The objectives of the research are:

- To assess the adherence to the principles of sustainability by the Metropolitan, Municipal and District Assemblies of the Central Region in the construction of their building.
- To assess the sustainability of buildings constructed by the.
- To identify the challenges to the construction of sustainable buildings by the Metropolitan, Municipal and District Assemblies of the Central Region.
- To identify ways of promoting the construction of sustainable buildings by the Metropolitan, Municipal and District Assemblies of the Central Region.

1.5 SIGNIFICANCE OF THE RESEARCH

This research seeks to assess the sustainable building construction practices in the MMDAs of Central Region. The research will expose the challenges militating against sustainable building construction and bring out ways of promoting sustainable construction in the Ghanaian public sector. The contributory knowledge from the study will facilitate informed decision making and policy formulation for the public sector.

1.6 RESEARCH METHODOLOGY

A deductive approach was used to undertake this research. Existing literature on sustainable construction was reviewed. The review of literature was aimed at finding knowledge of the sustainable construction practices in the Ghanaian public sector and to identify possible challenges to sustainable construction in the MMDAs. A survey was conducted using questionnaires designed from the findings of the literature review to collect primary data for analysis. Data was collected from the staffs of the MMDAs in the central region who are directly involved in the construction activities of the assembly. The probability and nonprobability sampling was used to select the samples. Data collected was processed before statistical descriptive tools were used for their analysis. From the analysis, findings of the study were established after which recommendations were also made.

1.7 SCOPE

The research considered sustainability in the area of building construction. It therefore examined the sustainable practices in the design, site planning, construction and maintenance of buildings constructed by the Metropolitan, Municipal and District Assemblies in the Central Region of Ghana.

1.8 STRUCTURE OF THE STUDY

The study is in five chapters:

Chapter one provides the background of study, states the problem of the study and continues to state the research aim and objectives. The chapter also gives information on the significance, scope and structure of the study. Chapter two focuses on the review of relevant literature concerning the study. Chapter three is devoted to the research design and methodology employed for this study. Chapter four presents analysis of the data collected and the final chapter discusses the result of the analysis, summary of findings of the study, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter of the study presents an extension review of existing relevant literature on the subject. The review covers the main theme of the research to understand the concept of sustainability and its application in building construction. The study also looked at the challenges militating sustainable construction strategies and the mechanism for promoting sustainable construction.

2.2 EFFECTS OF BUILDING CONSTRUCTION ACTIVITIES ON THE ENVIRONMENT

Construction plays a vital role in nation building. Its activities affect the society, the environment and the economy of all counties (OECD report, 2003). Construction contributes to socioeconomic development through the numerous employment opportunities it provides (Ahadzie et al. 2009). However, construction activities has brought significant change into the environment and contributed immensely to environmental degradation (Ofori et al, 2015). Construction is noted as a major consumer of non-renewable resources and a polluter of the environment (Wallbaum & Buerkin, 2003). Construction works are responsible for numerous environmental problems in many countries with Ghana been no exception (Chen et al., 2002). Construction activities produce significant amounts of carbon dioxide into the atmosphere contributing to a change in the world‘s climate (Yudelson, 2008). The industry also contributes to atmosphere and water pollution by toxics and harmful materials used in its activities (Pasquire, 1999). Building construction alone have been found to consume between 20-40% of the world‘s energy resources (Perez-Lombard et al., 2008). Although the final building unit may not be consuming much energy during its operational life, it would have consumed so much energy for its construction. The amount of energy and resources needed by all of the processes associated with the production of a building unit, from resource extraction, processing, manufacturing and transport as well the construction itself is also very gargantuan (Yahya & Boussabaine 2006). Cement is the most popular binder used by the industry. Although the cement content of a concrete mix is between 12-14%, its production is a major source of greenhouse gas emission (Abanda et al., 2010). Menzies, Turan, and Banfill (2007) estimates that a total of about 40-50% of the energy used by construction is embodied in the extraction processes. Wastage of materials and resources in the construction industry has also been found to be significantly high. Waste can be described as the use resources that do not bring any value (Formoso et al., 1999). About 25% of the resources used for building are wasted during construction. (Yahya & Boussabaine 2006). Waste arise due to loss of materials, under-utilization of machinery and loss of human efforts. This can be caused by changes to design, accidents on site and improper site control (Craven et al., 1994). Garas et al. (2001) added over-ordering of materials, overproduction of components, wrong handling, bad storage practices, defects during manufacturing and pilfering as potential sources of waste. It must be noted that wastage of materials does not only increase construction cost to the contractor but also drain away precious resources.

Furthermore, materials from construction sites that are unusable for the purpose of construction and have to be discarded can cause environmental problems if not properly dealt with. The industry is known to generate high levels of waste into the environment each year (Ekanayake & Ofori, 2000). Waste due to construction come in the solid, liquid, gaseous or a combination of these forms. Management of construction waste has become a challenge in most developing countries and affects the quality of life of people all over the world (Ekanayake & Ofori, 2000; Atombo et al., 2015).

2.3 SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

The survival of man is directly dependent on the existence of natural resources. The continuous depletion of these resources and the environment put man‘s survival at risk and demand adoption of sustainable living. Sustainability is a continuous process of meeting the needs of man within limits which will not have negative impact on the ecosystem (Shafii, 2006). Sustainable living creates and maintains the conditions that permits the continuous existence of man and nature (Shafii 2006). Sustainability provides the capacity to meet today‘s necessities in a manner that ensures that the coming generation also have sufficient resources to meet their environmental, social and economic needs (WCED, 1987). Unlike the needs of man, the world‘s natural resources are finite. This inevitable challenge demands the review of human activities including construction to minimize consumption and preserve existing resources. Sustainable living guarantees the preservation of natural resources for the use of man throughout his existence.

The concept of sustainable development was introduced in 1972 by the Brundtland commission (Atombo et al., 2015). The commission recognized the need to meet the developmental needs of the present generation without compromising on the ability of future generations to meet theirs. The United Nations Conference on Environment and Development held in 1992 at Rio de Janeiro defined sustainable development as ―improving the quality of human life within the carrying capacity of supporting the eco systems‖ (Atombo et al., 2015). Sustainable development has also been defined as development initiatives that aims at integrating economic growth, social wellbeing and environmental change in a manner that achieves reduction in consumption, social equity, and preservation of nature as well as restoration of biodiversity (Grzebyk 2015).

Change towards sustainability has since been a major concern to all governments especially that of the developing countries as they are faced with severe environmental problems (UNCHS, 1996).

2.4 THE THREE PILLARS OF SUSTAINABILITY

The concept of sustainability established by the Brundtland commission lay equal emphasis on economic development, social wellbeing and environment sustenance (WCED, 1987). These three pillars are not independent of each other but are intertwined to collectively improve human wellbeing.

2.4.1 Social Sustainability through Building construction.

Construction is meant to bring out positive change into the society. It plays a very important role in satisfying the need of the society and enhancing the quality of life (Shen and Tam, 2002). It is through constuction that most developmental and social needs such as roads, hospitals, schools and housing accomodations are met. In Ghana and many other countries, construction works provides a source of livihood to a lot of people who are directly or indirectly engaged in its activities (Ahadzie et al., 2009). The social impact of construction in the country can therefore not be under estimated. The planning, design, construction, maintenance and demolition of construcition works should also retain measures to satisfy the social needs required. Through universal design methods of construction, the built environment provide equall access and comfortability for all of its users particulary the aged and persons with varying forms of disabilities. Through construction a healthy living and working environment is provided to imrove living standards and economic output.

2.4.2 Environmental Sustainability through Building Construction

Construction has been found to have great impact on the environment (Chen et al., 2002). Although construction poses a negative impact to the environment, it is also possible to institute judicious methods of operation to sustain the environment.

Envrionmental sustainabilty demands reducing the environmental impact of construction to the bearest minimum. The incidence of environmental degradation due to sand winning, destruction of green vegetation and pollution of water bodies in the country is a bain to creating a sustainable environment. Environmental impact assessment and management plans must be prepared for every construction work. Construction activities must adopt measures of resouce conservation and lean construction to reduce waste and material use (Liang et al. 2015).

2.4.3 Economic sustainability through Building Construction.

Construction contributes immensely to the socioeconomic development of many countries through the numerous employment opportunities it provides (Ahadzie et al. 2009). Halls (2003) posits that many countries use over fifty percent (50%) of their capital for construction procurements and ten percent (10%) of the world's gross domestic product is achieved through construction. From the extraction and manufacturing of materials to final assembling on site, a number of large, small and medium scale firms as well as individuals are engaged throughout the construction stages. Seven percent (7%) of the jobs in the world is related to construction (Halls, 2003). Employee output and productivity of organizations have all been found to be influenced by the quality of indoor environment for employees which is provided through building construction (Bangdome-Dery & Kootin-Sanwu, 2013).

2.5 SUSTAINABLE CONSTRUCTION IN DISTRICT ASSEMBLIES

Sustainable construction (SC) is a construction process which integrates economic, social and environmental improvement policies in its implementation (Parkin, 2000). SC ensures quality living standards of the present and future generations by improving socioeconomic wellbeing and preserving of the eco system. SC develops healthy environment and affords the most proficient and minimal disruptive use of land, water, energy and other resources. SC differs from the traditional construction process through the adaptation of sustainable development principles. The principles of sustainability are inherent at all stages of the construction process. For a project to be considered sustainable, there must be elements of sustainability in its planning, designing, procurement, construction, material selection, site management, and maintenance as well as final demolishing/disposal (Parkin, 2000). Sustainable construction ensures that structures that are designed, built, renovated, operated, or reused in an environmentally friendly and resource efficient manner.

In a wake to the negative impacts of construction works on the environment, the construction industry has made attempts to upgrade its activities to reduce its impact on the environment. Areas of significant improvement include the prefabrication of components utilized in building construction and has reduced site waste as well as environmental pollution (Jaillon and Poon, 2008). Passive designs for buildings have also been encouraged to reduce energy consumption and enhance the use of natural lighting and ventilation (Bangdome-Dery & Kootin-Sanwu, 2013). Energy and resource efficent plumbing and electrical fitting have also been introduced in building construction to minimize use of water and electricity.

2.6 PRINCIPLES OF SUSTAINABLE CONSTRUCTION

A study of existing literature identified six fundamental principles characterized with sustainable construction. These principles have been discussed below:

2.6.1 Minimization of resource consumption

Construction consumes huge amount of different types of resources (Yahya & Boussabaine 2006). Natural resources used in construction include: water, fine aggregates (sand), coarse aggregates, timber, laterite. Others materials such as cement, reinforcement bars (Iron rods), aluminum roofing sheets, paints and tiles are manufactured from natural resources. Existing buildings consumes over 40% of the world‘s primary energy (Mulholland and Matshe, 2009).

Energy consumption of buildings in Ghana has been found to be very high (AmpaduAsiamah et al, 2011). The growing built urban environment is has resulted in increased energy consumption of buildings in the country (Ahadzie & Badu, 2011). Minimization of resource consumption demands the elimination of material waste.

2.6.2 Reuse of Resources

Construction materials can be reused for other purposes when they are no longer needed for its current purpose instead of disposing them off. Reuse of resources ensures reduction of resource consumption (Pitt et al. 2009). Demolition and reconstruction generate a lot of waste which can be transformed into other ecologically friendly use rather than indecent disposal in landfills. Components such as louver blades, blocks, roofing sheets and wood components can be carefully removed, properly stored and reused for similar purposes.

2.6.3 Protection of the Natural Environment

The environmental impact of construction is very enormous. The construction industry must devise innovative ways of reducing the impact of construction on the natural environment. In most developed countries no construction activity can be done without first assessing the environment impact of the development and formulating strategies to mitigate them (Changbum et al. 2010). However, same cannot be said of Ghana and other developing countries as construction activities have become a major element of environmental degradation in these countries (Ekanyake & Ofori, 2000).

2.6.4 Pursue Quality in creating the built environment

Construction works should ensure quality into the built environment. This implies quality in planning, designs and construction. Achieving quality increases the life span of buildings and reduces maintenance cost (Yang 2012). Material resource waste that arises due to change in designs and reworks are duly eliminated if quality is ensured in the planning stages of construction.

2.6.5 Creating a healthy nontoxic Environment

Construction works is associated with the use of heavy machinery and chemicals which produce substantial amounts of waste and poisonous substances into the atmosphere. It has been found that existing buildings alone contributes about 24% of the carbon dioxide emission attributed to construction (Howe, 2010). Ghana as well as many other countries rely on the use of heavy duty earthmoving equipment, excavation equipment, quarry machines and other vehicles for transportation during construction.

The amount of toxic substances released by these machines into the atmosphere has significant effect on the world‘s climate and affects human health (Yudelson, 2008). The use of toxic hazardous substances in construction therefore needs to be discouraged.

2.6.6 Use of renewable/recyclable resources

To recycle means to restore to productive use. Sustainable Construction requires the ability to restore used resources into a good state for possible repetitive use or for a new purpose. Recyling reduces consumption of new materials therefore minimizes the extraction of materials with its associated environmental impact.

These principles are all relevant and inter related. Inability of fulfil the requirement of one of them affects the others also. Players of the construction industry must be guided by these principles at every stage of their work.

2.7 ELEMENTS OF SUSTAINABLE BUILDING CONSTRUCTION

A sustainable/green building is one whose construction and lifetime usage ensure the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resources (Akadiri et al., 2012). For a building to be classified as sustainable, the following fundamental elements must be evident it its design, constructing and usage.

2.7.1 Sustainable site design

As much as possible, destruction of natural habitation to compensate for urban expansion and development should be reduced to the barest minimum (Hwang & Tan, 2012). While population growth and urbanization requires putting up new buildings and infrastructure, there is also the need to minimize the rate at which green spaces and valuable land are inefficiently used for developmental needs (Abanda et al., 2000). There is the need to bring out designs and construction practices that will minimize the disturbance of natural habitation and preserve the eco-system. The renovation of existing buildings and reuse of abandoned structure and sites are effective ways of reducing the destruction of virgin sites and also increase the life span of existing buildings (Liang et al. 2015). Instead of disturbing valuable land spaces, it is prudent to complete abandoned structures and renovating existing infrastructure to serve the required purpose. It is rather sad that Ghana as well as many developing countries, lag behind in research and the utilization of strategies for developing a sustainable built environment (Bangdome-Dery & Kootin-Sanwu, 2013). This deficiency is evident in the wastage of land and the construction of buildings in unsuitable areas.When the need for new developments is inevitable, the selected site should be located in areas which will have minimal impact on the eco-system and preserve the existing habitat (Bon-Gang et al., 2015). Site clearing should be within the reasonable boundaries of the development and not extended to surrounding spaces which need not be cleared (Iwaro and Mwasha, 2013). In addition, a properly planned change from the low density development to high density development in urban areas contributes to minimize the destruction of valuable land spaces (Hwang and Tan, 2012). Minimization of urban spraw has the advantage of deducing travel distance, fuel consumption and resultant pollution (Hwang and Tan, 2012). There is the need to shift from horizontal development which requires large land spaces and immense clearing of natural vegetation to vertical development by building more high rise buildings to reduce land use and degradation of existing vegetation. Sustainable site design demands a good site evaluation to aid in building designs that make use of natural ventilation and day lighting (Bangdome-Dery & Kootin-Sanwu, 2013). Natural vegetation can be incorporated into building designs. Trees should be used as shading devices to improve natural vegetation into inner rooms. The use of artificial impervious surfaces such as concrete and asphalt should be minimal to encourage the percolation of surface water into the ground.

2.7.2 Water quality and conservation

Sustainable building design and construction requires stringent measure to minimize inefficient use of potable water during construction while making provision for rainwater storage and re-use of water for other purposes (Akadiri et al. 2012).

Foundation designs must consider the site‘s natural hydrological systems in other not to disturb the natural water table. Considering the natural water movement and features of the site enable environmentally friendly designs that manages surface and storm water effectively. Furthermore wet areas and forest zones should be preserved as much as possible to ensure the natural water cycle of the environment (Akadiri et al. 2012).

Conservation of water must be considered in building design. This is achieved through the use of low-flow plumbing systems, water collection and rainwater harvesting systems (Boschmann & Gabriel, 2013). The recycling and reuse of water is highly encouraged to minimize the use of potable water. Water conservation can also be achieved through the use of landscaping methods that uses drought resistant plants (Akadiri et al. 2012).

2.7.3 Energy and Environment

Buildings require the use of energy at all stages of the building‘s life. Buildings that facilitate maximum conservation of energy and has minimal disturbance on the ecosystem play significant role in creating a sustainable environment (Schimschar et al., 2011). Reducing energy consumption reduces the depletion of non-renewable energy resources (Lee and Chen, 2008).

The life cycle of a building requires energy for its construction and operation. Huberman and Pearlmutter (2008) defines the energy needed for the construction of a building as the total embodied energy required in the process of construction and assembling as well as the extraction and manufacturing of the materials and components needed for the building. The energy required for the operation of a building is the energy used to maintain the internal environment of the building

(Dimoudi & Tompa, 2008). Studies have shown that a building's operational energy consumes at least eighty-five percent (85%) of the total energy used by the building in its life time (Thormark, 2006). Energy consumption of buildings in Ghana has been found to be very high (Ampadu-Asiamah et al, 2011). The growing built urban environment of both private and public developers is a leading contributor to the increased energy consumption of buildings in the country (Ahadzie & Badu, 2011). A significant amount of energy can therefore conserved through the use of passive building designs with good solar orientation, shape, and internal finishes that maximizes the use of natural day lighting (Bangdome-Dery & Kootin-Sanwu 2013). Using materials with low embodied energy reduces the amount of energy consumed in the production process and contributes to environmental sustainability.

2.7.4 Indoor Environmental Quality

In our present day, it is estimated that individuals spend over ninety percent (90%) of their life time indoors out of which seventy percent (70%) is spent in their homes (Sev, 2009, Adgate et al., 2002). The need to consider the individual's health, physical comfort, psychological needs as well as their productivity in building design cannot be overemphasized (Akadiri et al. 2012). Sustainable buildings provide a healthy and comfortable indoor environment for occupants. To serve its functions effectively, the building must provide quality indoor air, good ventilation, good thermal comfort and good sound insulation (Akadiri et al. 2012). Absence of these conditions will not only affect the health and comfort of occupants but reduce productivity of its occupants. To achieve quality indoor air, building materials and finishes should not contain harmful chemicals which have the tendency of contaminating the air (Sev, 2009). Good ventilation reduces moisture and room dampness (Hwang & Tan, 2012). The ventilation systems employed must be able to remove all stale air and provide clean fresh air into rooms and circulating spaces within the building and also prevent polluted air from entering the building. A good acoustic environment must be provided indoors. Controlling of noise from the exterior and mechanical equipment within must be considered in the building design and selection of wall insulation material to achieve the needed indoor noise level (Akadiri et al. 2012).

2.7.5 Materials and Resource Conservation

Resource conservation has been defined as the effective control of the use of natural resources to provide the needed satisfaction of the present generations while upholding the ability to meet the resource needs of the coming generations (Wilson et al., 1998). The construction sector is well known for the high amount of non-renewable resources it consumes (Sev 2009). There is the need for innovative methods to minimize the use of non-renewable materials and resources in construction to protect natural biodiversity (Spence & Mulligan, 1995). There is also the need to stimulate the judicious use of renewable and biodegradable materials such timber. In Ghana as well as other countries, the depletion of resources for construction and other purposes is relatively high (Manu et al., 2009). Forest are been destroyed to extract timber, sand winning in pits and along the coast leaves the land in a very deplorable manner. According to Abeysundara et al. (2009) minimizing the use of non-renewable material can be achieved at the initial stages of building design where the environmental impact of material can be considered before selected for the project. Conservation of resources include reduction in waste production. The high amount of waste produced during construction leads to numerous social, economic and envionmental problems (Akadiri et al. 2012). Waste reduction in building construction is best achieved through minimization designs (Ortiz et al., 2009). In addition recycling and reuse of products reduces resource consumption as well as waste creation and contributing to environment (Hill and Bowen, 1997).

2.8 A SUCCESSFUL BUILDING PROJECT

Traditionally professionals consider the cost, time and quality of a building project to determine how successful a project is. The traditional criteria undermines the measure of the social, economic and social benefits of buildings (Atombo et al. 2015). The reliance of professional on these three tradition criteria does not permit the recognition of the environmental, social and economic impact of building projects. Although these three traditional criterion contribute to green building, they do not provide a perfect impression of the tenant of sustainable construction. A sustainable building is one that was designed and constructed using methods and materials that are resource efficient and that will not compromise the associated health and well-being of the building's occupants, construction workers, or the future generation (Atombo et al. 2015).

It is possible to construct a building at a good cost to acceptable standards of quality and within the desired time but the contributory impact of the building to the environment and users may vitiates its purpose and benefits. There is the need for professionals to consider the long term effect of infrastructural development on the environment in their measure of project success.

2.9 CHALLENGES TO THE CONSTRUCTION OF SUSTAINABLE BUILDINGS IN THE DISTRICT ASSEMBLIES

Although sustainability in construction is gaining worldwide recognition, its implementation is yet to receive similar acknowledgement. This can be attributed to challenges that has undermined its successful implementation. Kibert (2008) identified

financial disincentives, inadequate research and lack of awareness and preference to traditional practices as the three main barriers that affects the construction of sustainable buildings. Richardson & Lynes (2007) in a case study at the University of Waterloo believes that internal leadership, unnamed goals that aim at sustainability, lack of recognition for environmentally sustainable projects and the lack of communication between designers and top management as the four main barriers that undermines the construction of green building in the university. They therefore suggest improving teamwork among employees responsible for construction works and establishing measureable goals on sustainability. A similar study conducted in Brazil suggests that challenges to the adoption of sustainable buildings in higher education institutions include the lack of incentive to minimize building maintenance cost, unavailability of indicators for evaluating sustainable buildings, high initial capital cost, lack of commitment to environmental issues by construction professionals and ineffective communication among members of the institution. Others are employee empowerment, lack of technical norm for establishing a standard construction procedure for green buildings and cultural barriers as well as resistance to change
(Jabbour et al. 2014). The barriers to sustainable building are not every different in the South East Asian countries. The lack of awareness, lack of training, education and ineffective procurement systems are key barriers in the region (Shafii 2006). Nigerian researches has also identified the lack of training and tools, lack of relevant laws and regulation, and lack of awareness as the three major barriers to sustainable construction among Nigerian corporate organizations (Ikediashi et al. 2013). In view of the situation, Ikediashi et al. (2013) recommended that the Nigerian government pass an eco-friendly bills, empower regulatory bodies to enforce regulation on sustainable practices and

create awareness on sustainability in a bid to promote sustainability in the Nigerian Construction Industry.

The situation is not very different from the findings of studies undertaken in Ghana. A recent study conducted in Ghana to ascertain the challenges Ghanaian architects face in the use of sustainable strategies in building design identified the overall cost of energy alternatives, the overall client control on design and the overall client awareness of sustainable strategies as the top three major challenges preventing architects from to use sustainable design strategies in Ghana (Bangdome-Dery & Kootin-Sanwu 2013). The findings of the study expounds the role clients play in achieving a sustainable built environment. Dzokoto et al. (2014) in another study posit that in Ghana the key barriers to sustainable construction are the lack of demand for sustainable buildings, lack of strategy to promote sustainable construction, higher initial cost, lack of public awareness and lack of Government support. The Government should therefore initiate green policies and regulations and find innovative measures of stimulating demand for sustainable construction in Ghana (Djokoto et al. 2014). Ofori et al. (2015) confirms these findings by positing that the lack of Government commitment to green building, lack of legislation, lack of professional knowledge, cultural change resistance and perceived higher initial capital are the most critical challenges in implementing sustainable strategies in Ghanaian construction industry.

The challenges identified from the review of literature can be grouped into financial, cultural, knowledge/awareness, political, leadership/management and technical challenges and has been discussed below.

2.9.1 Financial Challenges In Achieving Sustainable Construction.

Kibert (2008) identified financial issues as one of the three main barriers that affect the construction of sustainable buildings. There is a general perception that green construction increases the initial startup capital cost of a building project (Johnson, 2000). Kats and Capital (2003) suggests that the initial capital cost of a building project is expected to increase to a maximum of twenty-five (25%) with the introduction of sustainable features in its design and construction. This increased cost discourages clients who may not be interested in the life cycle cost of the project but only concerned with putting up the building at an economic cost (Häkkinen & Belloni, 2011). Thus the risk of higher initial capital costs for sustainable buildings compared with traditional buildings demotivates clients and may even make them object to its inclusion if proposed by designers (Orr, 2004). Orr (2004) statealthough the initial project cost may be a little higher to compensate for sustainability, it will bring savings on life cycle maintenance and increase work output of occupants/users (Orr, 2004). The lack of life cycle cost analysis on most construction projects do not afford client the opportunity to adequately evaluate the cost benefit of design decisions. However contrary to this general perception, Bordass (2000) and Scofield (2002) think otherwise and suggests that there is no significant increase in initial cost when sustainability is introduced at the early stages of construction. (Bartlett & Howard, 2000).

2.9.2 Cultural Challenges In Achieving Sustainable Construction.

Although sustainable methods and material may be available, lack of public interest and resistance to change towards sustainability can deter the promotion of its use. Manu et al (2009) revealed that although green building materials such as pozzolana cement and sun dried bricks are in abundance in Ghana, however it is not been utilized. On the contrary, high energy embodied material such as reinforced concrete and steel trusses are commonly used. This attitudinal preference to traditional materials and methods of construction possess a major challenge to sustainable innovations in construction. The Ghanaian construction sector is very resistive to change because of it reliance on traditional construction methods and materials usage (Ofori et al. 2015).The industry is used to non-biodegradable material such as blocks and reinforced concrete and reluctant to use alternative green building materials. It is thus not surprising that Djokoto et al. (2014) identified the lack of demand for sustainable buildings as a top ranking barrier to sustainable construction in Ghana. Attitudinal change can only be realized by increasing public awareness on sustainable construction and finding innovative ways of stimulating demand for sustainable buildings (Djokoto et al. 2014).

2.9.3 Knowledge / Awareness Challenges In Achieving Sustainable Construction.

Sustainable construction cannot be achieved if professionals of the industry lack the capacity to implement the principles in their various fields. Architects, quantity surveyors, engineers, site supervisors, contractors and manufactures must all be well knowledgeable on the principles of sustainability and consciously team up to reduce the impact of construction on the environment. CIB Report (1999) caution that ignorance and lack of understanding can be a major hindrance to sustainable building.

Rydin et al. (2006) claim that most designers are not confident on sustainability indicating their low level of understanding on the subject matter. Studies on professionals in Ghana has however indicated that construction professionals are knowledgeable on the subject of sustainability but are not able to fully implement it due to other barriers to its implementation (Dzokoto et al., 2014 and Bangdome-Dery and Kootin Sanwu, 2013). Knowledge barrier exist when there is a misunderstanding and lack of education on sustainable designs. A barrier is created when designers have little or no knowledge of sustainable measures and alternatives that can be used. It is evident from research that not all professionals are very resourced with sustainable techniques (William & Dair, 2006). Ignorance of clients and the lack of awareness of the benefits of sustainable construction are barriers that is worth noting. There is the need to educate the public and make them know that the depletion of resources and climatic changes demand the adherence to sustainable practices. In a situation where general public awareness on sustainable construction is very low, it becomes difficult to promote sustainability. Extensive education and sensitization is therefore needed to drive sustainability. The concept of sustainability must be made inclusive in syllabus of all educational fields.

2.9.4 Political Challenges in Achieving Sustainable Construction.

Political barriers arise due to the lack of commitment by government, absence of building codes and regulations to enforce sustainability and lack of public policies to promote sustainable construction (Ofori et al. 2015). Since government is a key stakeholder to the construction industry, sustainable construction can be easily promoted when the government is very committed to it, formulate policies, enact regulation and enforce the regulations. The emergence of sustainable thinking requires government to review existing building codes and regulations to incorporate sustainable elements. Most developed countries have been able to formulate new policies and reviewed it building regulations to include ecofriendly measures (Khalfan et al., 2015). The Energy Performance of Building Directive (EPBD), has been formulated to ensure that all European Union (EU) countries build to conform to laid down energy performance standards (Hwang & Tan 2012). In the United States, buildings are required to fulfill the basic requirements of the Leadership in Energy and Environmental Design (LEED) (Hwang & Tan 2012). With these regulations, developers are forced to meet environmental sustainability in their projects. However, the same cannot be said of developing countries including Ghana. The public procurement Act 2003, Act 663 which modulate procurement of goods, works and services in all public entities has no significant provisions for sustainability procurement. Conditions of contract and contract specifications do not have specified targets that meet requirements for environmental sustainability (Glavinich, 2008). Absence of these regulations makes it difficult to know what is expected of contract parties in terms of sustainability and to enforce sustainable building.

2.9.5 Technical Challenges in Achieving Sustainable Construction.

Technical barriers arise through the lack of sustainable technologies and green material for construction as well as the lack of sustainability measurement tools. Measuring tools such as the Leadership in Energy and Environmental Design (LEED) of the United States, The Energy Performance of Building Directive (EPBD) of EU and the

Building Research Establishment Environmental Assessment Method (BREEA) of the United Kingdom has established standards for sustainable design and construction in these regions (Hwang & Tan 2012). The tools serve as targets to meet minimum energy performance and standards in building construction. The absence of a rating tool do not motivate achieving sustainable standards. These tools on the other hand do not afford comprehensive assessment of the full range of sustainability (Sourani & Sohail 2011). Lack of exemplary projects is also a demotivating factor. Demonstrative projects stimulate demand and serves as a benchmark for future developments.

2.9.6 Management / leadership Challenges

Leadership problems such as delay in decision making, lack of motivation and managers aspirations deters the success of sustainable buildings (Rohracher, 2001). A success factor to sustainable construction is the commitment of managers and decision makers to advance and execute policies that promote sustainable construction (Ofori et al. 2015). Without the much support from management it will be very difficult for sustainability to be enshrined in both public and corporate organizations. However, managers and clients fail to motivate professional to encourage the inclusion of sustainability in their work. A recent study conducted on Ghanaian architects found the lack of motivational schemes as the fifth most severe challenge architects face to implement sustainability in their designs (Bangdome-Dery & Kootin-Sanwu 2013).

2.10 PROMOTING THE CONSTRUCTION OF SUSTAINABLE BUILDINGS

The benefit of constructing sustainable buildings has been found to be enormous. These benefits include reduced life cycle cost, low maintenance cost, minimum use of energy resources, and preservation of the ecosystem. The need therefore to promote the construction of sustainable buildings cannot be over emphasized. Promoting the construction of sustainable buildings means to encourage the adoption of the elements of sustainability in building construction works and increase demand for sustainably constructed buildings. As found in a recent study by Dzokoto et al. (2014), there is a lack of demand and lack of strategy to promote sustainable construction in Ghana. The study therefore searched for strategies for promoting sustainable construction that has been implemented elsewhere and has been recommended by previous studies.

Hwang & Tan, (2012) suggests that to stimulate demand for sustainable buildings, public education on the essence of preserving depleting resources and saving the deteriorating global climate through sustainable interventions must be intensified. Bangdome- Dery & Kootin-Sanwu (2013) supported that to increase market demand for sustainable products, public education through the media must be undertaken to educate the general public on the need for sustainability and the benefit of sustainable development.

Professional instituitions for architects, engineers, quantitity surveyors etc. can also contribute to creating awareness for sustianable contruction through its educational programs for the public and its continous professional development (CPD) for its members (Bangdome- Dery & Kootin-Sanwu, 2013). Pitts et al (2009) posit that in a bid to promote sustainable construction, government must introduce attractives incentives to developers, building owners and building consultants who adopt sustainable products and technologies. Incentives can be in the form of grant programs which provides a support facility for contractors to replace old equipments with new eco friendly equipments (Changbum et al., 2010). Incentives can also be in the form of tax immunities, tax discounts and credit of tax to contractors and developers who adopt sustainable technologies (Changbum et al., 2010). Khalfan et al. (2015) also contributed that financial incentives and the availability of sustainable materials are prime drivers for sustiainable construction. Atombo et al. (2015) believes that there is the need to review conditions of contracts and requirements for tendering to make provision for sustianable initiatives. This action will promote the inclusion of sustainable initiatives at the precontract stages of the project. Tender evaluation will then consider proposals for environmmental protection and resource conservation during construction to assess tenderers. The contract will therefore not be awarded to the lowest evaluated tenderer as has been the convention way but to the lowest evaluated sustainable tenderer. Awarding contract to tenderers who have records of achieving sustainable targets will challenge construction firms to review their goals and introduce policies that will drive sustainability into their organisations (Pitt et al., 2009).

Sustainable construction can also be promoted through the formulation of policies and regulations for building construction (Djokoto et al., 2014). Femenias (2005) and Samari (2013) suggests that the multi-disciplinary nature of construction makes the use of building regulations the most effective way of ensuring quality and promoting sustainable building construction.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter describes how the research was carried out. The chapter explains how the samples size was determined, how samples were selected and how data was collected and analyzed to achieve the aim and objectives of this research.

3.2 RESEARCH DESIGN

This study made use of descriptive survey to assess the construction of sustainable buildings in the MMDAs of the central region. A descriptive survey was appropriate to describe the existing state of sustainable building construction in the MMDAs as the lack of extensive knowledge on sustainable construction in the MMDAs prevented correlation to be drawn from the study. Quantitative methods were used to conduct the study with the aim of to maximizing objectivity in the study. Hence data was collected in quantitative forms and subjected to quantitative analysis with the use of descriptive statistics. The data was collected by the use of questionnaires which were administered to staffs of the MMDAs

3.3 SOURCES OF DATA

Both primary and secondary sources of data were obtained for the study. The primary data was obtained directly staffs of the MMDAs with the use of questionnaires. The secondary data was obtained from the review for the study. The essence of the secondary data was to recognize existing knowledge on the subject to guide the current the study.

3.4 SAMPLING TECHNIQUE

Sampling is the process of choosing research units from a target population. There are twenty (20) MMDAs in the central region. A mixture of probability and nonprobability sampling was used to select the samples for the research. The simple random sampling technique was used to select the MMDAs to be considered for the study while purposive sampling was used to select the research units. The following MMDAs were selected for the study:

- Komenda- Edina- Eguafo-Abrem Municipal Assembly
- Assin North Municipal Assembly
- Mfantsiman Municipal Assembly
- Cape Coast Metropolitan Assembly
- Upper Denkyira West District Assembly
- Twifo Hemang Lower Denkyira District Assembly
- Abura-Asebu-Kwamankese District Assembly
- Ekumfi District Assembly
- Awutu Senya District Assembly
- Ajumako Enyan-Essiem District Assembly
- Assin South District Assembly

3.5 SAMPLE SIZE DETERMINATION

The Kish formular was used to determine the appropriate sample size needed for the study.

The Kish formular states:

$n = \quad n^1$

(1 + n^1/N)

Where; n = sample

size N= population

size $n_1 = S_2/V_2$

V= the standard error of sampling distribution = 0.05

S^2 = the maximum standard deviation of the population

Total error = 0.1 at confidence interval of 95%

S^2= P (1 – P) where P = 0.5

= 0.5 (1 – 0.5)

= 0.25

P = the proportion of the population elements that belong to the defined region.

Since $n^1 = S^2/V^2$ n1 = 0.25 = 100

0.05^2

N = 89 n = 100 =

47.09 = 47

(1 + 100/89)

Therefore the minimum sample size for the study was 47 respondents.

3.6 DATA COLLECTION

A survey was conducted with the use of questionnaires. The questionnaires were designed and administered in selected MMDAs in the Central Region. The questions were in four main sections. Section one collected the demographic information of respondents. Section two collected data to assess the construction of sustainable buildings by the MMDAs. The respondents were asked to express their views on the adoption of the elements that make up sustainable building construction by their

MMDAs on a five-point Likert scale (from 1 = _strongly disagree‘, 2 = _disagree‘, 3 = _neutral_, 4 = _agree‘ to 5 = _strongly agree‘). Section three collected data to identify the challenges to the construction of sustainable buildings faced by the MMDAs. The respondents were asked to measure the severity of identified challenges to the construction of sustainable buildings in their MMDAs on a five-point Likert scale (from 1 = _Very severe‘ 2 = _Severe‘, 3 = _neutral_, 4 = _Not severe‘ to 5 = _Not severe at all‘). Section four collected data on the strategies to promote the construction of sustainable buildings by the MMDAs. Respondents were asked to identify the best strategy for promoting the construction of sustainable buildings in their MMDAs. A sample of the questionnaire can be found in the appendix.

3.7 DATA ANALYSIS

The data collected for the study was analyzed using the Statistical Package for Social Sciences (SPSS) in order to understand its parts, relationships and to discover its trend. The data collected was analyzed using descriptive statistics which describes the features of the data collected quantitatively. The analysis provided simple summaries about samples and measured central tendencies and dispersions. The descriptive analysis measured central tendencies by describing how the data was crowded around a central point. It used the mean, median, and mode to describe how the data was clustered around the dominant point. The descriptive data analysis also measured dispersion which indicated the extent to which the scores crowded around the average or spread out from the average. The Statistical Package for the Social Sciences (SPSS) software was used to aid the analysis. The mean score of respondents was used to analyze data received on assessing the adoption of the elements of sustainable building construction by the MMDAs. The Relative Importance Index (RII) was used to identify the challenges to the construction of sustainable buildings by the MMDAs (Adnan et al., 2007).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter of the research gives detail information of the data collected and how it was analyzed. The chapter made use of tables and charts to enable good understand of the presentation and discussion.

4.2 RESPONDENTS PROFILE

A survey was conducted with questionnaires administered to the staffs of the works department of MMDAs in the central Region. The respondents were made up of engineers, technician engineers and Quantity surveyors. The responses from these professionals were considered significant since they play a leading role in the planning, construction and maintenance of buildings for the MMDAs. They serve as consultants for the Assembly‘s construction projects and are in a better position to assess sustainability in the Assembly‘s building works. Out of the 70 questionnaires given out, 52 were received and used for the study, giving a response rate of 74%. Out of the 52 respondents, 2 were engineers, 44 were technician engineers and 6 quantity surveyors. Figure 4.1 gives information on the profession of the respondents.

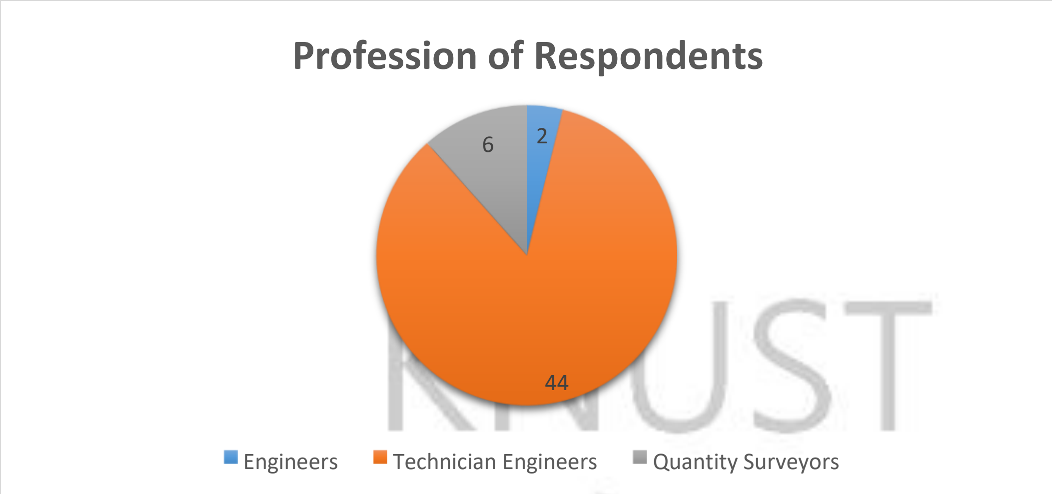

Figure. 4.1 Profession of Respondents.

Out of the 52 respondents, 23 has work with MMDAs for less than five years, 16 has with the MMDAs between five and ten years, 7 has worked between eleven and fifteen years while 6 has worked for than 15 years with the MMDAs. Figure 4.2 shows the working experience of respondents with the MMDAs.

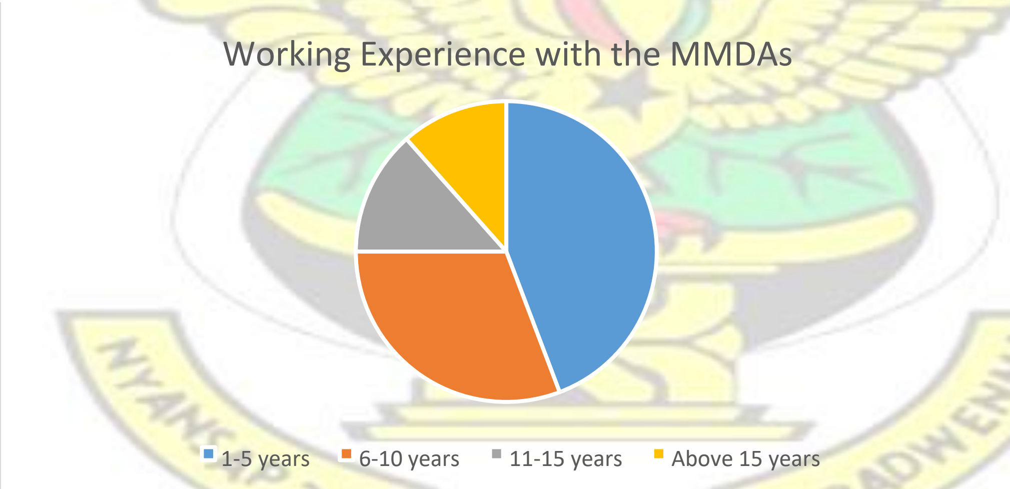

Figure. 4.2 Working years with the MMDAs

Thirty-Two (32) of the respondents were HND holders, nineteen (19) were degree holders and only one (1) had a post graduate degree. Fig. 4.3 presents the education background of respondents.

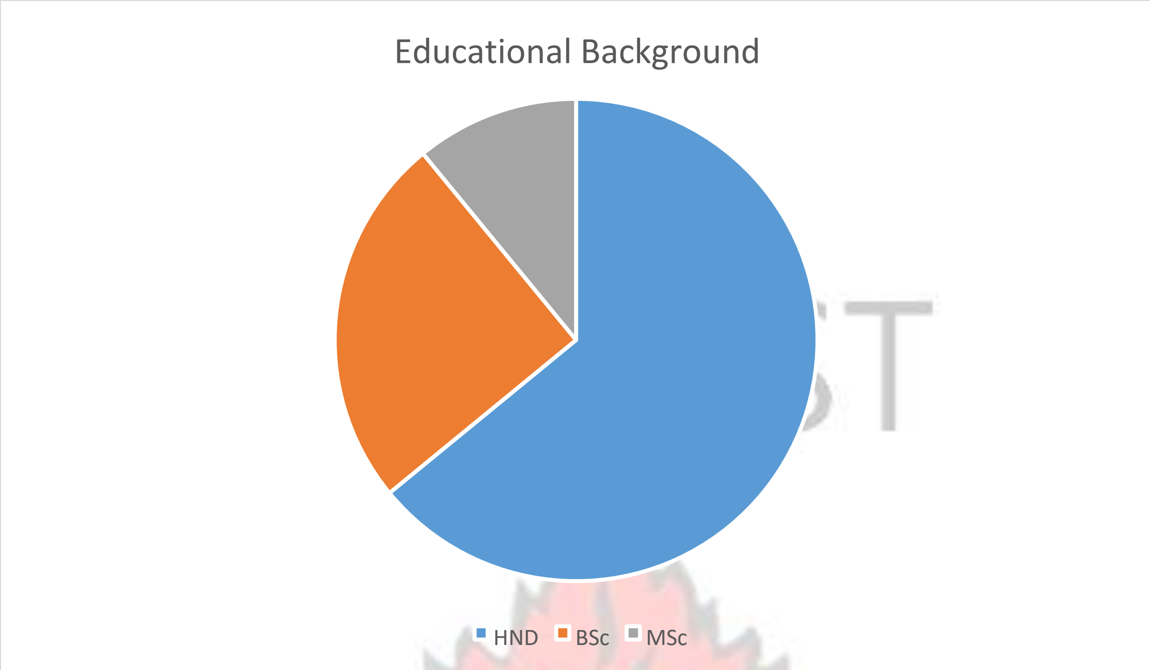

Figure 4.3 Educational background of respondents

4.3 THE CONSTRUCTION OF SUSTAINABLE BUILDINGS BY THE MMDAs

This section of the questionnaire was to assess the construction of sustainable buildings by the MMDAs. The questions were categorized into five groups to assess the five elements of sustainable building identified from the literature review. The five elements of sustainable building are discussed as follows:

1. Sustainable site design
2. Water quality and conservation of water during construction
3. Energy efficiency and Environmental sustainability
4. Indoor Environmental Quality
5. Efficient use of material and resources

On a five point likert scale (1='strongly disagree', 2= _disagree', 3= _Neutral', 4= _Agree', 5= _Strongly agree') respondents were asked to choose the extent to which they agree with their compliance to these elements in their MMDAs. The responses of the respondents have been discussed below.

4.3.1 Sustainable Site Design

Questions under this category was to assess the extent to which the MMDAs design and construct buildings that reduces site disturbance, preserves natural habitat, and the ecosystem to sustain human life. Figure 4.4 to figure 4.8 shows the results of the responses. A total of 65.4% of the respondents did not agree that their MMDAs make good use of abandoned structures when considering on acquiring a building facility. Their MMDAs prefer the use of virgin lands for new building projects to the upgrading of existing structures to serve the purpose. When respondents were asked if they agree that their MMDAs examine the impact of existing structure with respect to sunlight and natural breeze on the new buildings they intend to put up, 48 of them representing 92.3 % of the respondents disagreed. This means the effect of existing structures are not considered when siting new buildings. Although 21.2% of the respondents agree that their MMDAs use landscape design to protect the immediate surroundings of its buildings, a greater majority of 63.5% think otherwise. 38.5 % of respondents declared that their MMDA never protect building surroundings. It was found that MMDAs ensures that only the portion of land needed is cleared for construction of the buildings as affirmed by 84.6% of the respondents (Fig. 4.7). With respect to the usage of trees as shading devices for its buildings, 13 respondent representing 25% agreed that trees are used as shading devices for buildings while 55.7% disagreed. The remaining 19% were uncertain and could not attest whether indeed tress are used for shading. The mean of these responses have been analyzed in table 1 below.

Table 4.1 Sustainable Site Design

	N	Min.	Max.	Mean	Std. Deviation
MMDAs consider the reusage of abandoned structures and renovating old buildings before building a new one	52	1	5	2.52	1.093
MMDAs examine the orientation of existing structures and factor it in the design of new buildings to optimize daylight and natural breeze to new buildings	52	1	5	1.52	.828
MMDAs use landscape design to preserve the surroundings of its buildings	52	1	5	2.23	1.231
MMDAs ensures that only the required area of land is affected and cleared during building construction	52	1	5	3.87	.886
MMDAs plant trees to serve as shading devices for its buildings	52	1	5	2.37	1.237
Average mean				**2.50**	

From responses in table 1 above, it is evident that most MMDAs do not consider the reuse of abandoned structures for new projects. The MMDAs therefore do not consider the economic value of rehabilitating old buildings to preserve resources to serve their present needs. Liang et al (2015) suggests the use of abandoned structures and the development of brown fields to fulfill present needs. By so doing the destruction of virgin lands is reduced and the life spans of existing buildings are increased as well. As much as possible, destruction of natural habitation to compensate for urban expansion and development should be reduced to the barest minimum (Hwang & Tan, 2012). As suggested by Abanda et al. (2000), there is also the need to minimize the rate at which green spaces and valuable land are inefficiently used for developmental needs. Therefore as much as possible, the use of virgin lands for new buildings should be the last resort.

It was also evident from the table that MMDAs do not consider the effect of existing nearby buildings with respect to enhancing maximum usage of day lighting and ventilation in the new building when selecting the orientation of new buildings. There is therefore the possibility of the existing structure blocking the passage of natural ventilation to the new building or casting its shade onto it. Akadiri et al (2012) cautions that for a building to serve its intended purpose, adequate ventilation and thermal comfort should be endured. It is therefore necessary to consider the effect of adjourning structures when determining the orientation of the building.

It was also found that MMDAs do not use indigenous plants, lawns and trees to preserve the immediate surroundings of their buildings and do not plant trees as shading devices as required. Trees and plants are meant to restore the natural environment that has been disturbed by the building activities (Dimoudi & Tompa, 2008). The absence of trees therefore disrupts the vegetation. The average mean of 2.5 is an indication that buildings constructed by the MMDAs did not adhere to sustainable designs.

4.3.2 Water Quality and conservation

Questions under this category were to assess the extent to which the MMDAs ensure that the construction of their buildings do not disturb the natural water cycle of building sites and also to assess the use of potable water in its buildings. The responses received have been presented in figure 4.9-4.13 below. 78.9 % confirmed that the MMDAs prepares designs that reduces excavation works on site during construction of its buildings. Exactly half of the respondents uncertain as to whether their MMDAs are able to ensure minimum usage of potable water in its buildings or not. Majority of the respondents (88.4%) rejected the assertion that their MMDAs make provision for rainwater harvesting in its buildings. Out of the 52 respondents 38 admitted that their MMDAs makes good efforts to preserve wet areas and mature vegetation at proposed building sites.

Table 4.2 Water Quality and Conservation

	N	Min.	Max.	Mean	Std. Deviation
MMDAs prevent extensive excavation works during construction of its buildings	52	1	5	3.73	.795
MMDAs ensure minimum use of potable water in its buildings and during its construction	52	1	5	3.23	.899
MMDAs make provision for rainwater harvesting and treatment of waste water to be reused in its buildings	52	1	5	1.65	.861
MMDAs consider the ground water table when designing the foundation of its buildings	52	1	5	1.71	.997
MMDAs preserve wet areas, forest and mature vegetation at places where new buildings are constructed	52	1	5	3.73	.795
Average mean				**2.81**	

The results brings to light that the MMDAs are not able to adequately selecting designs that do not require extensive excavation works, minimizes soil disturbance, minimizes the construction area and makes good efforts to preserve wet areas and mature vegetation. Analysis of the mean of the responses from table 4 indicates that MMDAs make little provision for rainwater harvesting and disregard the impact of the water table of proposed site in the design of foundations. Akadiri et al. (2012) posits that sustainable minimizes the use of potable water and make good use of rainwater. Boschmann & Gabriel (2013) add that, every building must have a mechanism to harvest rainwater and preserve it for other uses. However, buildings constructed by the

MMDAs has been found to rely solely on potable water and have no mechanism for harvesting and using rainwater. This makes them unable to reduce their consumption of potable water as expected. An average mean of 2.81, do not give much credit to the efforts of the MMDAs to conserve and preserve the quality of water on proposed building sites.

4.3.3 Energy and Environment

Sustainable building demands minimum energy usage and minimum impact of the construction activities on the environment. This section assessed the extent to which the MMDAs are able to introduce measures that ensure efficient energy usage and minimize the adverse impact of construction on the environment. Sustainable buildings must be energy efficient and constructed in an environmentally friendly manner. The respondent‘s assessment of the ability of their MMDAs to ensure energy efficiency and environmental sustainability has been presented in figure 4.14 - figure4.18 below. Seventy one percent (71%) of the respondents agreed that buildings constructed by their MMDAs make adequate use of sunlight in all areas of the building and therefore do not need artificial lighting during the day. More than half of the respondents also agreed that buildings constructed by their MMDAs have good ventilation but do not use energy efficient electrical appliances. When asked whether their MMDAs prepare environmental management plans for its building construction, half of the respondents strongly disagreed. Again, only 3 out of the 52 respondents came out strongly to agree that waste produced during building construction are disposed off in an environmentally friendly manner compared to a total of 30 respondents who disagreed that their MMDAs prepare environmental management plans for its buildings.

Table 4.3 Energy and Environment

	N	Min.	Max.	Mean	Std. Deviation
MMDAs ensure the adequate use of sunlight in its buildings	52	1	5	3.69	.897
MMDAs ensure the provision of good natural ventilation in its buildings	52	1	5	3.46	1.075
MMDAs specify energy efficient electrical fittings and appliances in its buildings	52	1	5	2.44	1.018
MMDAs ensures that waste produced during construction of its buildings are disposed off in an environmentally friendly manner	52	1	5	2.37	1.284
MMDAs ensures that Environmental Management Plans are prepared for its all building projects	52	1	5	1.71	.893
Average mean				**2.70**	

Findings of this section reveal that buildings constructed by the MMDAs make adequate use of sunlight in all areas during the day and have good ventilation. This achievement has the advantage of reducing the energy consumption of the building. Reducing energy consumption reduces the depletion rate of non-renewable resources and therefore creates a sustainable environment. However waste produced during construction is not disposed off in an environmentally friendly manner as required for sustainable building. This finding confirms the position of Chen et al (2002) that construction works are responsible for numerous environmental pollution in many developing countries by the unfriendly disposal of waste produced. As found by Ekanayeke & Ofori (2000) and Atombo et al. (2015), management of construction waste is a challenge to most developing countries. An average mean of 2.7 (table 4.3) shows that the buildings constructed by the MMDAs has not have contributed to the pollution of the environment.

4.3.4 Indoor Environmental Quality

Sustainable buildings provide a healthy and a comfortable indoor environment for occupants. It is a functional requirement for buildings to provide quality indoor air, good ventilation, good thermal comfort and good sound insulation in all internal spaces (Akadiri et al. 2012). In this category, respondents were required to assess the indoor features of buildings constructed by their MMDAs to determine their adherence to sustainable requirements. The results are presented in table 5 and figures 4.19- 4.23 below.

Seventy percent (70%) of the respondents acknowledged the provision of good sound insulation in buildings put up by their MMDAs while less than 8% thought otherwise. Over 70% believe that their buildings have the required thermal insulation. However when asked if the MMDAs use material that do not contain or generate harmful substances for its buildings 42.3% were uncertain and could not acknowledge or deny the efforts of their MMDA. Also 67.3 % agreed that easily operable windows are used in their buildings while less than 50% thought the internal spaces in their buildings was not adequate for its purpose.

Table 4.4 Indoor Environment Quality

	N	Min.	Max.	Mean	Std. Deviation
MMDAs ensure the provision of adequate sound insulation in its buildings	52	1	5	3.71	.776

MMDAs ensure the provision of adequate thermal insulation in its buildings	52	1	5	3.63	.908
MMDAs ensures that materials used for constructing its buildings do not contain or generate harmful substances	52	1	5	3.13	.929
MMDAs specify the use of easily operable windows in its buildings	52	1	5	3.62	.973
MMDAs ensures the provision of adequate internal spaces in its buildings	52	1	5	3.13	1.103
Average Mean				**3.44**	

The responses reveal that the buildings constructed by the MMDAs have good sound insulation and good thermal comfort to serve its purpose. Akadiri et al. (2012) suggest that sustainable buildings must provide quality indoor air, good ventilation, good thermal comfort and good sound insulation. However the use of material and finishes that contain harmful substances contaminate the air. Sev (2009) explains that to achieve quality indoor air, building materials and finishes should not contain substances that can contaminate the air. An average mean of 3.44 indicates that

MMDAs are not providing the required air quality in its buildings.

4.3.5 Materials and Resources

Another element of a sustainable building is the minimum use of non-renewable materials and maximum use of re-usable, renewable and ecologically friendly materials for its construction. This category assessed the usage of materials and the specification of the MMDAs that promote the usage of environmentally friendly local materials. The responses have been presented in table 2.5 and figure4.24- figure 4.28 below.

The responses presented below (fig. 4.24) shows that almost 85% of the respondents accepted that the use of non-degradable material by their buildings is dominant. Waste produced during construction is also not properly collected and separated for recycling or reuse (Fig. 4.25). In the same light, 69% of respondents reveal that, their MMDAs do not make specific requirement for wood from certified wood forest and operators to be used for construction. When asked if the MMDAs promote the use of local materials, 52% agreed that their MMDAs do while 33% of them did not agree. In addition, 54% out of the respondents disagreed that MMDAs specify the use of materials with minimum environmental impact for their buildings.

Table 4.5 Materials and Resources

	N	Min.	Max.	Mean	Std. Deviation
MMDAs ensure minimum usage of nondegradable materials for its building construction	52	1	5	1.83	1.133
MMDAs make provision for wastes produced in its buildings to be collected and separated for recycling and reuse	52	1	5	1.69	1.001
MMDAs specify the use of lumber from certified forests for its building construction	52	1	5	2.23	1.148
MMDAs specify building designs that promote the use of local materials	52	1	5	2.81	1.189
MMDAs specify the use of materials					

with minimum environmental impact for its building construction	52	1	5	2.73	1.190
Average mean				**2.26**	

The results of this section revealed that most of the materials used by the MMDAs for it buildings are non-degradable. As admitted by Sev (2009), building construction uses high amounts of non-renewable resources. Spence & Mulligan (1995) suggest that there is the need for innovation to minimize use of non-renewable materials. It is also evident from table 4.5 that their buildings do not have mechanisms to collect, separate and reuse or recycle wastes produced. Waste recycling and reuse reduces the consumption of new materials and resources (Hill & Bowen, 1997). The inability to reuse or recycle resources increase it consumption and contribute on resource depletion. Furthermore, MMDAs do not specify wood from certified wood forest neither do they specify the use of materials with minimum environmental impact for its buildings as required of sustainable building. They also fail to advocate for the use of materials that has minimal impact on the environment with respect to its extraction and usage. In addition, MMDAs do not consider the use of material that are locally available for its building construction. Using locally available material creates employment for people in the locality and reduces the cost of transportation as well as the associated air pollution from transporting vechicles.

An average mean of 2.26 is indicate that the MMDAs use high amount of materials whose extraction, usage or disposal endangers the natural environment.

4.4 CHALLENGES TO THE CONSTRUCTION OF SUSTAINABLE BUILDINGS

This section was aimed at identifying the challenges to the construction of sustainable buildings in the MMDAs. The questions presented categorized challenges to the construction of sustainable buildings identified from the existing literature to the respondents. Respondents were asked to determined the severity of these challenges in their MMDAs on a five point likert scale(5 = _Not severe at all;, 4 = _severe', 3 = _fairly severe', 2 =.'Severe', 1= _very severe'. The data collected was then analyzed using their Relative Importance Index (RII). The index is calculated in Adnan et al., (2007) as:

$$RII = \frac{5n5+4n4+3n3+2n2+n1}{5(n5+n4+n3+n2+n1)}$$

Where: n1 = number of respondents who answered ―Not severe at all‖ n2 = number of respondents who answered ―Not severe‖

n3 = number of respondents who answered ―neutral‖ n4 = number of respondents who answered ―severe‖

n5 = number of respondents who answered ―Very severe‖

Table 4.6 shows the RII of the challenges from the responses.

Table 4.6 Relative Importance Index of the challenges identified to the MMDAs

ITEM	CHALLENGES	RELATIVE IMPORTANCE INDEX
1	Fear of higher initial cost of sustainable building construction	0.92
2	Unawareness of life cycle cost benefit of sustainable construction	0.86
3	Lack of financial resources	0.95
4	Difficulty to justify decision for sustainability to financial auditors	0.75
5	Lack of government policies/support	0.61

6	Lack of building codes that enforce sustainable building construction	0.77
7	Lack of government commitment	0.62
8	Lack of legislation/laws that promote sustainability	0.87
9	Lack of management support	0.85
10	Lack of motivation and aspiration of managers	0.88
11	Delay in decision making	0.82
12	Limited incentives for innovation	0.81
13	Lack of employee training and development	0.58
14	Lack of environmentally sustainable materials	0.60
15	Lack of sustainability measurement tools	0.56
16	Lack of exemplar demonstration project	0.82
17	Lack of technical ability	0.58
18	Lack of environmental management systems for construction works	0.62
19	Lack of sustainable provisions in the contract specifications	0.82
20	Restrictions posed by public procurement regulations	0.89
21	Lack of demand for sustainable buildings	0.89
22	Resistance to change from old ways	0.88
23	Preference to traditional methods of construction.	0.88
24	Lack of awareness of professionals	0.79
25	Lack of professional knowledge	0.77
26	Lack of awareness of the benefits of sustainable buildings	0.87
27	Ignorance or misunderstanding about sustainability	0.94
28	Lack of education and knowledge in sustainable design.	0.88

A high RII means the challenge has a very severe impact on the MMDAs while a low RII means the impact of that challenge is low. From table 4.6, the lack of financial resources had the highest RII of 0.95. This revealed that the lack of financial resources is a major challenge to the MMDAs to incorporate sustainability in their building constructions. Ignorance or misunderstanding about sustainability ranked 2nd with a RII of 0.94, fear of higher initial cost and restriction posed by procurement regulations placed 3rd and 4th with a RII of 0.92 and 0.89 respectively. Lack of demand for sustainable buildings with RII of 0.89 ranked 5th, lack of motivation and aspiration of manger, resistance to change from old ways of construction, preference to traditional methods and lack of education and knowledge in sustainable design tied at the 6th position with a RII of 0.88. On the other hand, lack of environmentally sustainable materials with RII of 0.60 ranked 25th. Lack of employee training and development and lack of technical ability were ranked 26th with a RII of 0.58 while lack of sustainability measurement with a RII of 0.56 was the last. Table 4.7 shows the rankings of the challenges.

Table 4.7 Ranking of the challenges to sustainable building

ITEM	CHALLENGES	RELATIVE IMPORTANCE INDEX	RANKING
1	Lack of financial resources	0.95	1ST
2	Ignorance or misunderstanding about sustainability	0.94	2ND
3	Fear of higher initial cost of sustainable building construction	0.92	3RD
4	Restrictions posed by public procurement regulations	0.89	4TH
5	Lack of demand for sustainable buildings	0.89	5TH
6	Lack of motivation and aspiration of managers	0.88	6TH
7	Resistance to change from old ways	0.88	6TH
8	Preference to traditional methods of construction.	0.88	6TH
9	Lack of education and knowledge in sustainable design.	0.88	6TH
10	Lack of legislation/laws that promote sustainability	0.87	10TH
11	Lack of awareness of the benefits of sustainable buildings	0.87	11TH
12	Unawareness of life cycle cost benefit of sustainable construction	0.86	12TH
13	Lack of management support	0.85	13TH
14	Delay in decision making	0.82	14TH
15	Lack of exemplar demonstration project	0.82	14TH
16	Lack of sustainable provisions in the contract specifications	0.82	14TH
17	Limited incentives for innovation	0.81	17TH
18	Lack of awareness of professionals	0.79	18TH
19	Lack of building codes that enforce sustainable building construction	0.77	29TH
20	Lack of professional knowledge	0.77	20TH
21	Difficulty to justify decision for sustainability to financial auditors	0.75	21ST
22	Lack of government commitment	0.62	22ND
23	Lack of environmental management systems for construction works	0.62	23RD
24	Lack of government policies/support	0.61	24TH
25	Lack of environmentally sustainable materials	0.6	25TH
26	Lack of employee training and development	0.58	26TH
27	Lack of technical ability	0.58	27TH

28	Lack of sustainability measurement tools	0.56	28TH

Table 4.8 Ranking of the five category of challenges

Item	Challenges	Relative importance index	Mean relative importance index	ranking
A	**SOCIO-CULTURAL CHALLENGES**		**0.88**	**1ST**
21	Lack of demand for sustainable buildings	0.89		
22	Resistance to change from old ways	0.88		
23	Preference to traditional methods of construction.	0.88		
B	**FINANCIAL CHALLENGES**		**0.87**	**2ND**
1	Fear of higher initial cost of sustainable building construction	0.92		
2	Unawareness of life cycle cost benefit of sustainable construction	0.86		
3	Lack of financial resources	0.95		
4	Difficulty to justify decision for sustainability to financial auditors	0.75		
C	**KNOWLEDGE/AWARENESS CHALLENGES**		**0.86**	**3RD**
24	Lack of awareness of professionals	0.79		
25	Lack of professional knowledge	0.77		
26	Lack of awareness of the benefits of sustainable buildings	0.87		
27	Ignorance or misunderstanding about sustainability	0.94		
28	Lack of education and knowledge in sustainable design.	0.88		
D	**MANAGEMENT /LEADERSHIP CHALLENGES**		**0.79**	**4TH**
9	Lack of management support	0.85		
10	Lack of motivation and aspiration of managers	0.88		
11	Delay in decision making	0.82		
12	Limited incentives for innovation	0.81		
13	Lack of employee training and development	0.58		
E	**POLITICAL CHALLENGES**		**0.72**	**5TH**
5	Lack of government policies/support	0.61		
6	Lack of building codes that enforce sustainable building construction	0.77		
7	Lack of government commitment	0.62		
8	Lack of legislation/laws that promote sustainability	0.87		

F	TECHNICAL CHALLENGES		0.70	6TH
14	Lack of environmentally sustainable materials	0.6		
15	Lack of sustainability measurement tools	0.56		
16	Lack of exemplar demonstration project	0.82		
17	Lack of technical ability	0.58		
18	Lack of environmental management systems for construction works	0.62		
19	Lack of sustainable provisions in the contract specifications	0.82		
20	Restrictions posed by public procurement regulations	0.89		

Further analysis was conducted to rank the six (6) main category of challenges identified from the study using the mean of the RII of the challenges of the various categories. The result is presented in table 4.8.

The study found socio-cultural challenges as the most severe in the MMDAs with a mean of 0.88. Financial challenges was ranked 2nd with a mean of 0.87, and knowledge/awareness challenges was ranked 3rd with a mean of 0.86. Management/ leadership challenges with a mean of 0.79, political related challenges with a mean of 0.72 and challenges relating to technical abilities with a mean of 0.70 were ranked 4th, 5th and 6th respectively.

4.4.1 Lack of financial resources

The study found the lack of financial resources as the most severe challenge to sustainable building in the MMDAs. There is the need for MMDAs to secure adequate funding for all its building project before it can be executed. Kats and Capital (2003) suggests that the cost of a building project is expected to increase to a maximum of twenty-five (25%) with the adoption of sustainable features and can discourage clients from favoring design and construction method that are sustainable. This challenged was confirmed by Sourani and Sohail (2011), when they suggested that the limited funds available for public sector organizations is the main challenge for public clients in their attempts to obtain a more sustainable outcome. Lack of financial resources therefore forces the MMDAs to consider least cost rather than adopting sustainable options.

4.4.2 Ignorance or misunderstanding about sustainability

The findings of the study ranked ignorance or misunderstanding about sustainability as the second most severe challenge to the adoption of sustainable building construction by the MMDAs. This revelation confirms a study conducted by Häkkinen & Belloni (2011) that ignorance is a major challenge to sustainable building to both the private and the public sector clients. Management staffs of the MMDAs cannot appreciate the need to introduce certain features into the building design due to their ignorance or misunderstanding of the concepts of sustainability. Designers will not be confident to specify sustainable features in building designs if they lack knowledge or have misconceptions about sustainability (Rydin et al., 2006). The effect of ignorance or misunderstanding of the concepts of sustainability on sustainable building construction is very highly and can therefore not be overlooked (Zhang et al., 2011).

4.4.3 Fear of higher initial cost

Fear of higher initial cost of construction was identified as the third most severe challenge to the MMDAs. This confirms the claim by Johnson (2000) that there is a general perception that sustainable building increases the initial cost of the building project and deters client from adopting it. Definitely it is prudent for clients and project managers to reduce the cost of building in ways that are possible. However, the anticipated higher initial cost of sustainable building is compensated by the economic benefit of the innovation if life cycle cost analysis is applied (Kats, 2003). Sustainable building has been found not only to economic in the life cycle but also improves life satisfaction and productivity of its occupants (Akadiri et al. 2012).

4.4.4 Restrictions posed by public procurement regulations

This study further identified that restrictions posed by public procurement regulations is a severe challenge to sustainable building in the MMDAs. The restrictions on public sector spending are a prime challenge facing public clients who make efforts to procure sustainable products (Sourani and Sohail, 2011). The fear of the inability to justify sustainable decision to financial auditors restricts MMDAs from adopting sustainable methods in their procurements (Sourani and Sohail, 2011).

4.4.5 Lack of Demand for sustainable buildings

The lack of demand for sustainable buildings was found by the study to be the fifth most severe challenge to sustainable building by the MMDAs. All other things been equal, the supply or construction of sustainable buildings will be directly proportion to the available demand for sustainable products. The study confirms the position of Djokoto et al. (2014) that there exist a lack of demand for sustainable buildings in Ghana and this situation is a major barrier to sustainable construction in the country. MMDAs become reluctant to adopt sustainable building because there is no demand for sustainable buildings by its stakeholders. Lack of demand can be attributed to the low public unawareness and fear of increased cost of construction associated with sustainable buildings.

4.5 PROMOTING THE CONSTRUCTION OF SUSTAINABLE BUILDINGS IN THE MMDAs

This section identified strategies for promoting the construction of sustainable buildings in the MMDAs.

The review of literature identified strategies for driving sustainable construction.

Respondent were asked to select the strategy they believe will be the best for promoting sustainable building construction in their MMDAs. Out of the 52 respondents, 30 believes that the introduction of financial incentives in the form of grants is the best strategy to promoting the construction of sustainable buildings in their MMDAs. Nine (9) of the respondents thought the best strategy is to review the conditions of contract and contract specifications to make room for sustainable elements while eight (8) respondents felt the best way is to educate the staff of the MMDAs to understand the need and benefit of using sustainable technologies. Only five (5) respondents suggested the enforcement of sustainable building in their MMDAs through the revision of building codes. Figure 4.29 below shows the responses.

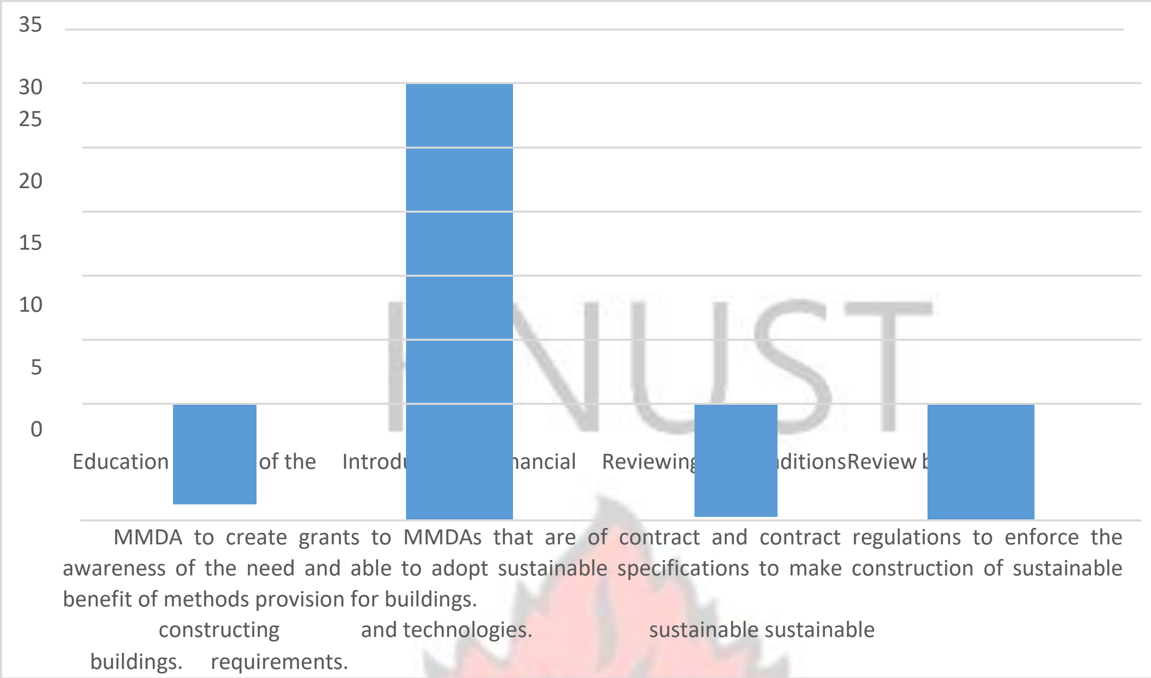

Figure 4.29 Strategies for promoting the construction of sustainable buildings in the MMDAs.

Analysis of the responses reveal that the introduction of financial grants, revision of condition of contract and contract specifications and the education of staffs can be good strategies to promote the construction of sustainable building in the MMDAs of the Central region. The best of these strategies is the issue of financial grants to MMDAs that are able to adopt sustainable strategies. As found in this study, the lack of financial resources is a major challenge to sustainable building in the MMDAs of the central region. Hence the introduction of incentives such as grants will stimulate MMDAs to adopt sustainable measures in a bid of securing financial support for its projects.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This study was carried out with the aim of promoting the construction of sustainable buildings by MMDAs of the central Region. The objectives were to assess the construction of sustainable buildings, identify challenges faced in constructing sustainable buildings and suggest ways of promoting the construction of sustainable buildings by MMDAs of the Central Region. This chapter presents the conclusion and recommendations of the study.

5.2 SUMMARY OF FINDINGS

To achieve the objectives of the study, a survey was carried with selected MMDAs in the Central Region of Ghana. The following conclusions were established by the study:

- The Metropolitan, Municipal and District Assemblies of the central region fail to adopt elements of sustainability in their building construction. Summary of the responses received revealed that the MMDAs do not ensure a sustainable site design for its buildings. MMDAs and fail to conserve water and preserve its quality for its buildings. Furthermore building constructed by the MMDAs are not energy efficient and do not provide adequate indoor environmental quality neither do they use environmentally friendly materials and resources efficiently for its building construction.
- The study observed that the top ten (10) challenges to the construction of sustainable buildings by the MMDAs are lack of financial resources, ignorance or misunderstanding about sustainability, fear of higher initial cost of sustainable buildings, restrictions posed by public procurement regulations and lack of

demand for sustainable buildings. The others are lack of motivation and aspiration of managers, resistance to change, preference to traditional methods of construction, lack of education and knowledge in sustainable design and lack of legislation that promote sustainability.

- The study also concludes that the best way of promoting the construction of sustainable buildings is to introduce financial grants for performing MMDAs, review conditions of contract and contract specifications to make provision for sustainable requirements and educate staffs of the MMDAs to create awareness of the need and benefit of sustainable buildings.

Sustainability in our world today is a necessity that cannot be overemphasized. There is the need for all stakeholders of the environment to be made aware of the threatening exhaustion of the world‘s finite resources. The government, state owned organizations, non-governmental organizations, private corporate bodies, religious bodies and every individual must assess the impact of their activities on the environment and formulate policies and agenda as well as a change of attitude to ensure a sustainable environment in Ghana and the world at large.

5.3 RECOMMENDATION

Based on the findings of the study, the following recommendations are given;

1. Government should introduce a financial incentive program that will provide grants to MMDAs. Annual assessment of the construction works of the MMDAs is required to determine the extent to which sustainability is adopted in the operations of the MMDAs. MMDAs with good sustainable practices can

be reward with developmental grants. It is believed that MMDAs will be motivated to adopted sustainable principles in a bid to benefit from the grants.

2. The standard conditions of contract and contract specification for public works should be reviewed to incorporated sustainable elements. The introduction of sustainable conditions of contract binds contract parties to enforce sustainability.
3. The Local Government Service (LGS) of Ghana should organize sustainability training workshops for staffs of the MMDAs. Education is needed to overcome the level of ignorance and misunderstanding about sustainability.

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APPENDIX I

SAMPLE OF THE QUESTIONNAIRES

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ARTS AND BUILT ENVIRONMENT

DEPARTMENT OF BUILDING TECHNOLOGY

INTRODUCTION

This is an academic research been carried out at the Department of Building Technology of the Kwame Nkrumah University of Science and Technology in partial fulfillment of studies for an award of a Post Graduate Degree in Construction Management.

The research aims at promoting the construction of sustainable buildings by the MMDA‘s of the Central Region. The objective of the research is to assess the construction of buildings by the MMDAs, identify challenges to the construction of sustainable buildings by the MMDA‘s and identify strategies for promoting the construction of sustainable buildings in Ghana.

We will be grateful if you can spend few minutes of your time to respond to the questions.

We assure you that any information provided will be treated with strict confidentiality.

Thank you.

OVERVIEW OF THE QUESTION

The questionnaire is in four (4) sections. The first section records the demographic information of respondent. Section two assess the building construction activities of the MMDAs, section three seeks to identify the challenges to the construction of sustainable buildings by the MMDA‘s, and the last section identifies strategies for promoting sustainable construction in Ghana.

SECTION ONE: DEMOGRAPHIC INFORMATION

1. Please indicate your profession. (please tick to select)

☐ Engineer ☐ Quantity Surveyor ☐ Technician Engineer

2. Number of years working with the Metropolitan, Municipal or District Assembly.

☐ 1-5years ☐ 6-10years ☐ 11-15 years ☐ above 15 years

3. Highest Educational Qualification

☐ HND ☐ BSc ☐ MSc

SECTION TWO: CONSTRUCTION OF SUSTAINABLE BUILDING BY THE MMDA's

This sections seeks to assess the construction of sustainable buildings by your Assembly.

Please tick the appropriate column to indicate the extent to which you agree with the following statements as it applies to your assembly.

No.	**Statement**	**Strongly disagree**	**Disagree**	**Fairly Agree**	**Agree**	**Strongly agree**
A	**SUSTAINABLE SITE DESIGN**					
1	When your assembly needs to put up a new building, it considers using existing old buildings and abandoned structures that can be renovated and used for that purpose instead of using a virgin land for the new development.					
2	When it becomes necessary to construct a building on a virgin land, your assembly examines the location and orientation of existing buildings in order to maximize the use of natural day lighting, natural breezes and ventilation for the new building.					
3	For each building that is constructed, landscape design (e.g. Trees, plants and grasses) are used to preserve and restore the surroundings after the building has been completed.					
4	For construction on virgin lands, your Assembly ensures that a small area of land is used and only the area where the building will be sited is cleared.					
5	Whenever a new building is constructed, your Assembly ensures that trees are planted at some places to serve as natural shading for the buildings.					
No.	**Statement**	**Strongly disagree**	**Disagree**	**Fairly Agree**	**Agree**	**Strongly agree**
B	**WATER QUALITY AND CONSERVATION**					

1	In the design of the buildings, the engineers of your Assembly consider the existing natural slope/gradient and features of the land so there is no need for extensive excavation and earthmoving during construction.					
2	Buildings constructed by your Assembly to minimize the use of potable water by using low-flow plumbing fixtures such as water closets that uses small amount of water for flushing and waterless urinals.					
3	Buildings constructed by your assembly have designs features that harvests rain water or design features that allows used water to be recycled and used again.					
4	During the design stage of the building, the engineers of your assembly conduct studies to ascertain the water table (Water level) of the site and uses the information to design a suitable foundation.					
5	Your assembly makes special effort to preserve wet areas of the site that serve as natural storm water retention and ground water infiltration and recharge systems and preserve existing forest and mature vegetation.					
C	**ENERGY AND ENVIRONMENT**					
1	Buildings constructed by your Assembly are designed to makes adequate use of natural sun light in all areas and therefore do not need artificial lighting energy during the day.					
2	Buildings constructed by your Assembly are well ventilated and therefore do not require frequent use of ceiling fans and air conditioners all the time.					
No	**Statement**	**Strongly disagree**	**Disagree**	**Fairly Agree**	**Agree**	**Strongly agree**
3	Your Assembly always purchase energy efficient appliance such as air conditioners with energy rated star certifications.					

4	Waste produced from your assembly's construction sites are disposed off in a manner that do not pollute the environment					
5	Contractors working in your assembly are made to prepare environmental management plan for all projects undertaken by the Assembly					
D	**INDOOR ENVIRONMENT QUALITY**					
1	Your Assembly's buildings are designed and constructed with materials that provide the required sound insulation.					
2	Your Assembly's buildings are designed and constructed with materials that provide the required thermal insulation (temperature) throughout the year.					
3	Building materials, adhesives and finishes used on your assembly's buildings do not contain, harbor or generate harmful substances (e.g Asbestos).					
4	Your Assembly's buildings use operable windows that effectively control indoor ventilation					
5	Internal spaces of your buildings are large enough to serve the purpose of occupants of the buildings					
E	**MATERIALS AND RESOURCES**					
1	Your Assembly ensures that the use of non-degradable materials such as steel, aluminum etc. is minimized in its building projects.					
2	Your Assembly ensures that waste produced on construction sites are separated for recycling and reused for other purposes.					
No	**Statement**	**Strongly disagree**	**Disagree**	**Fairly Agree**	**Agree**	**Strongly agree**
3	Your Contract specifications include provision requiring contractors to use lumber and wood products from certified forests where the forest is managed and lumber is harvested using sustainable practices.					

4	Your Contract specification make provision for contractors to use locally harvested and manufactured materials to improve livelihood of local business and to reduce transportation and fuel use.					
5	Your Building designs specify the use of materials whose extraction, manufacturing and usage has minimal adverse impact on the eco-system					

SECTION THREE: CHALLENGES TO SUSTAINABLE BUILDING CONSTRUCTION

The section seeks to identify challenges to the construction of sustainable buildings in your Assembly. Please tick the appropriate column to indicate the severity level of the following challenges your MMDA is facing in the constructing sustainable buildings.

NO.	**Challenges**	**Very severe**	**Severe**	**Fairly severe**	**Not Severe**	**Not severe at all**
A	**FINANCIAL CHALLENGES**					
1	Fear of higher initial cost of sustainable building construction					
2	Unawareness of life cycle cost benefit of sustainable construction					
3	Lack of financial resources					
4	Difficulty to justify decision for sustainability to financial auditors					
B	**POLITICAL CHALLENGES**					
1	Lack of government policies/support					
2	Lack of building codes that enforce sustainable building construction					
3	Lack of government commitment					
4	Lack of legislation/laws that promote sustainability					
C	**MANAGEMENT/ LEADERSHIP CHALLENGES**					
1	Lack of management support					
2	Lack of motivation and aspiration of managers					
3	Delay in decision making					
4	Limited incentives for innovation					

5	Lack of employee training and development					
D	**TECHNICAL CHALLENGES**					
1	Lack of environmentally sustainable materials					
2	Lack of sustainability measurement tools					
3	Lack of exemplar demonstration project					
4	Lack of technical ability					
5	Lack of environmental management systems for construction works					
6	Lack of sustainable provisions in the contract specifications					
7	Restrictions posed by public procurement regulations					
NO.	**Barrier**	**Very severe**	**Severe**	**Fairly severe**	**Not Severe**	**Not severe at all**
E	**SOCIO-CULTURAL CHALLENGES**					
1	Lack of demand for sustainable buildings					
2	Resistance to change from old ways					
3	Preference to traditional methods of construction.					
F	**KNOWLEDGE/ AWARENESS CHALLENGES**					
1	Lack of awareness of professionals					
2	Lack of professional knowledge					
3	Lack of awareness of the benefits of sustainable buildings					
4	Ignorance or misunderstanding about sustainability					
5	Lack of education and knowledge in sustainable design.					

SECTION FOUR : PROMOTING THE CONSTRUCTION OF SUSTAINABLE BUILDINGS

This sections seeks to identify the best strategy for promoting the construction of sustainable buildings by your MMDA.

Which of the following options is the best way of promoting the construction of sustainable buildings in you MMDA? **Please tick only one (1)**

- Education of staffs of the MMDA to create awareness of the need and benefit of constructing sustainable buildings.

- Introduction of financial grants to MMDAs that are able to adopt sustainable methods and technologies.

- Reviewing the conditions of contract and contract specifications to make provision for sustainable requirements.

- Review building regulations to enforce the construction of sustainable buildings.

Thank you.