**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,**

**KUMASI, GHANA**

# Challenges and Benefits of Integrating Environmental Sustainability in Metropolitan, Municipal and District Assemblies' (MMDA's) Construction Projects

by

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A Dissertation submitted to the Department of Construction Technology and Management,

College of Art and Built Environment

in partial fulfilment of the requirements for the degree of

**MASTER OF SCIENCE**

**NOVEMBER 2018**

## DECLARATION

I hereby declare that this submission is my own work towards the MSc Project 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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## ABSTRACT

The fast-rising degradation and deforestation of the environment has drawn government and agencies to derive and make policies to regulate and ensure sustainability of the environment. Advocating for, and application of sustainability of the construction industry could be very difficult, particularly in a developing country like Ghana. However, it is very important to consider environmental issues when constructing projects. This is a quantitative study that was conducted in selected MMDAs in the Ashanti region with an aim of exploring the challenges and benefits of integrating environmental sustainability in MMDA's construction projects in Ghana. The primary research was conducted using design survey questionnaires. These were structured questionnaires used to obtain data to ascertain the benefits and challenges with integrating environmental sustainability in MMDA's projects. Purposive sampling technique was adopted for the study. A total number of forty-five questionnaires were administered and forty were retrieved representing a response rate of 88.9%. Relative Importance Index rankings was the main tool used for analysis. The findings of the research revealed that minimal impact on environment, provide comfort to users/ occupiers, and longer building life span were the main benefits of integrating environmental sustainability in MMDA's projects. However, the main challenges associated with integrating environmental sustainability in MMDA's projects were also disclosed as lack of solid laid-down national comprehensive development policy, political inconsistency, and high demand for infrastructure. A recommendation was made that government should ensure that there are solid laid-down national comprehensive development policies to cater for environmental sustainability of projects.



**Keywords:** Benefits, Challenges, Environmental Sustainability, MMDAs, Projects.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST FIGURES

## DEDICATION

I devote this work to the Lord Almighty God for his guidance, my family for their love and support and my friends for their help and encouragement.

## ACKNOWLEDGEMENT

My heart felt gratitude is to the Almighty God who gave me the strength and knowledge to complete this research work.

My special thanks go to my supervisor, Professor Joshua Ayarkwa, for his support and immense guidance throughout my research work. I also want to thank his Graduate Assistant De-Graft Joe Opoku for his assistance throughout the work.

I also thank my family and friends for their support, encouragement and continuous prayers. To my mates, I say thank you for the diverse ways of assistance you offered me.

To all the lecturers of the Department of Construction Technology and Management, thank you for your insights.

# CHAPTER ONE

# INTRODUCTION

## 1.1 BACKGROUND OF THE STUDY

Rapid population growth rate in Ghana has tripled the demand for goods and services corresponding to industrialization and this has caused a rampant increase in demand for infrastructure such as houses, working space, roads, hospitals, etc.; falling on the construction industry (Ofori, 2012). The construction industry was rated as one very active and largely growing industry contributing to not only social and economic aspect but also the innovative building of the environment. Asamoah and Decardi-Nelson (2012) indicated that the Ghanaian construction industry employs approximately ten percent of the active labour contributing between five and ten (10) percent to the nation's Gross Domestic Product (GDP) and holds approximately 0.08% as temporary workers.

Trivess et al. (2016) explained sustainability as the peaceful ecological coexistence and adaptation to the natural environment not infringing on the existence of others organisms. The construction industry makes use of most natural resources which are not renewable (Rydin et al., 2006). The fast-rising degradation and defloration of the environment has drawn government and agencies to derive and make policies to regulate and ensure sustainability in the environment. The building industry accorded by it intensive resource usage and high energy consumption level from production of materials through the construction process and life-cycle of the built infrastructure. The Ghanaian construction industry adopted its guide and method of construction practices from the British during colonisation and though they have consented to modernized methods, the primitive raw

materials such as sand, cement, stone and timber, which were used for undertaking construction works still trends as the current materials being used most (Agyekum et al., 2016). The high request for these materials to make available basic infrastructures to meet the increasing demand of the escalating population growth rate, exerting high pressure on natural resources has contributed enormously to the destruction of the environment (Grierson, 2009). From the extraction and or production of the materials to be used and the construction process alone leads to hazardous waste generation, destruction of natural vegetation, extinct of forest reserves and wild lives, soil movement and drought and the alarming rise in emission of greenhouse gases, example is carbon dioxide (CIB report, 1999).

The enormous benefits of adapting sustainability in the construction industry has caused for the enactment of laws to regulate activities in the industry. Its application only noted among a few recently undertaken and on-going construction works by the government, exemplarily driving others towards sustainability goal (Ahn, 2012). The adverse impact of construction on the environment has enthused positive drives on government, agencies such as Metropolitan, Municipal, and District Assemblies (MMDA's), and stakeholders of the construction industry to work towards mitigation goal to make help construction industry very sustainable implementing new sustainable techniques to the construction practice (Nelms, 2005). Hence the construction industry, though contributing undoubtedly and very importantly to the nation's general development, is one major contributing factor to the destruction of the environment.

## 1.2 PROBLEM STATEMENT

Advocating for, and application of sustainability in the construction industry could be very difficult, particularly in a developing country like Ghana where most of the building materials are extracted from the environment (Zhang et al., 2011). These materials range from concrete production (made of stone, sand and cement), to the use of timber for the roofing, and finishing which shows the sole dependency of the Ghanaian construction industry on the environment (Agyekum et al., 2016).

From the perspective of a corporate entity, Sustainable Construction is implemented in a variety of ways; as legislation to be complied with, as a best practice to be adopted or a business opportunity to be exploited. The advantages of Sustainable Construction are well represented in various literatures. To this end, sustainability strategies, assessment methodologies and new technologies have been developed and applied in countries with active sustainability agenda for construction (Ding, 2008). However, the platforms under which these strategies have been leveraged on are largely absent in developing countries (du Plessis, 1999), such as strong institutional governance and robust technical capabilities for instance.

Typically, most developing countries are experiencing rapid urbanization, coupled with absence of critical infrastructure, lack of enabling rules and regulations, skills, knowledge and capacity for large scale change. They are also often faced with somewhat basic but far more pressing priorities such as addressing security, poverty, social injustice and inequity (du Plessis, 2001). As such, it is not clear if issues like sustainability in construction would be on the front burner in such countries (Larsson, 2005). Such changes in the construction sector are only likely to occur when stakeholders actually understand the purpose of such

change and see a need for it (Bal et al., 2013; Rodriguez-Melo and Mansouri, 2011; Pitt et al., 2009).

This study therefore attempts to extend the arguments for the development of the construction sector in developing countries by exploring the awareness and benefits of integrating environmental sustainability in MMDA's projects in Ghana.

## 1.3 RESEARCH QUESTIONS

The following research questions have been formulated to aid in addressing the research objectives:

1. What are the challenges associated with integrating environmental sustainability in MMDA's projects in Ghana?
2. What are the benefits of integrating environmental sustainability in MMDA's projects in Ghana?

## 1.4 RESEARCH AIM AND OBJECTIVES

### 1.4.1 Aim

The aim of the study is to explore the challenges and benefits of integrating environmental sustainability in MMDA's projects in Ghana.

### 1.4.2 Objectives

1. To identify the challenges associated with integrating environmental sustainability in MMDA's projects in Ghana; and

2. To identify benefits of integrating environmental sustainability in MMDA's projects in Ghana.

## 1.5 SCOPE OF THE STUDY

Considering the urgency to addressing the problem stated, the research is focused on selected MMDAs in the Ashanti region where massive construction projects are undertaken by the MMDAs.

The research examined challenges and benefits of integrating environmental sustainability in MMDA's projects. Contextually, the research focused on construction professionals of selected MMDAs in the Ashanti Region. These professionals include Engineers, Quantity Surveyors, Architects and Planners.

## 1.6 METHODOLOGY

The quantitative method was adopted for the study. Quantitative method entails surveying literature, preparing questionnaires to collect data and analysing the data statistically. Several literatures related to environmentally sustainable construction was critically reviewed to help identify previous work done, contributions made, limitations, criticisms, and findings arrived at and their applications. Base on the literatures reviewed, questionnaires was designed focusing on the aim and objectives of this research to gather data from the field. By employing series of questionnaires, data was collected from the construction professionals in selected MMDAs in the Ashanti Region. The sample size was determined using purposive sampling technique in order to realize a sample size of the essential number of respondents since purposive sampling technique have the advantage of ascertaining main respondents in the target population (Kumar, 1999). Finally, the data

collected was analyzed using descriptive statistics and relative importance index rankings for the identified phenomena.

## 1.7 SIGNIFICANCE OF THE STUDY

This section basically talks about the importance and purpose of the study undertaken. The study would help the Ghanaian Construction Industry yield the desired outcome of utility and also successfully inform construction stakeholders on the environmental footprints of their projects. It would cause an awareness on environmental sustainability that characterise less developed countries such as Ghana. Also, it will help in undertaking the measures concerning the activities of construction or reduce the impact on the environment and the local communities as well. At the of end of the research, the will be fully aware of the challenges and benefits of integrating environmental sustainability in their projects. The study also served as basis for other research works to be carried out in similar fields.

## 1.8 STRUCTURE OF THESIS

The research will be conceitedly generated in a list of five chapters. Chapters will be elaborated leading to interjection of sub-chapters. Chapter one gives an insight on the whole project is about, setting out the reason why the research needs to be conducted and its significance. Chapter one therefore comprises of eight sub-chapters.

The second chapter, i.e. chapter two, is the literature review section. A study on views of previous research data in connection with the research focus to be conducted. Chapter three spells out procedures to identifying answers to research questions. Chapter four deals with

the analysis of data gathered from chapter three. Chapter five concludes the research process indicating research outcome and recommending further research scope of study.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 INTRODUCTION

Several literatures were reviewed to study environmental sustainability in Ghana. In other to achieve the objective of this research, the literature is reviewed under 4 main sections, with the first looking at the current state of the Ghanaian construction industry; whereas the second aspect gives an in depth understanding of sustainability. The third part identifies the drivers of environmental sustainability. The fourth and fifth part examines the challenges and benefits of integrating environmental sustainability in MMDA's projects respectively. The Ghanaian construction industry is contributing it quota immensely towards the nation's development by significantly providing, infrastructure and adding to the country's economic growth contributing with sixty percent Gross National Capital, GNC, (Laryea, 2010).

## 2.2 THE GHANAIAN CONSTRUCTION INDUSTRY

The Ghanaian construction is growing in all success to international standard for which credit to hailed achievement is accorded to predecessors' hard work and enthusiasm for greatness, perfection. The industry has undoubtedly contributed it quota towards national development listing from provision of basic civic amenities, to making available housing unit for citizens, rendering in all healthy standard of living for the people (Ofori, 2012). Although the construction is beneficial to national economic development, it can be more of doom too, since the sustainability of end product of the construction industry relies on the design of the product (Ofori, 2012). The design quality influence the construction activities which can have an effect on competitiveness among stakeholders, economy,

either positively or negatively (Ofori, 2012). Thus, the design quality influence the construction activity.


**Figure 2.1: Relationship between sustainable design, sustainable construction and sustainable development**
***Source***: author's derivation (2018)

The construction industry forms the largest part of the economy of most nations with a proven Gross Domestic Product (GDP) contribution falling between five (5) and ten (10), and holds a larger employment capacity of approximately ten percent (10%) a nation's population (Ofori,2012). The Ghanaian construction industry, like most developing countries, is incapacitated by numerous issues which are link to a). financial constraint b). low or insufficient support from government c). inflexibility to change by stakeholders in the industry to adopt to trending innovative upgrades and rather clinging to primitive methods (Ofori, 2012; Ayarkwa et al. 2010).

The construction industry is hence deprived by the above listed to exploiting and achieving to its fullest capabilities most often (Ofori, 2006). Construction industry in the advanced world, though a criterion to the developing world measuring with it ingenuity and innovative maturation, continue to upgrade in all modification through constant habit of researching for new develop.

The Ghanaian construction industry with it method of executing it activities, depict a more doom to societal well-being and the environment as a whole (Ofori, 2012), owing to excessive pollution and degradation to the environment and nature naming:

1) Sole dependence on nature for materials to undertake works
2) Extinction to nature in expedition for building materials gradual
3) Voluminous emissions of poisonous gases waste to production process
4) Pollution of water, air and enormous usage of energy and land resource; lacking all sustainable measures in undertakings.

Alarmed by the threatening impact of the construction industry brought about institution of sustainable policies to curb destruction meted on mother earth through formation of organisations and institution such as the United Nations Commission on Sustainable Development (UNED), Earth Submit, International Organization for Standardization (ISO), Conseil International du batiment (CIB), among others. The industry has accustomed itself to the primitive method of building making use of traditional cement and sand with sometimes stone bonded together, impeding new trending practices (Asamoah and Decardi-Nelson, 2014), leaving clients with other alternative to opt for innovations (Djokoto et al., 2013). Aside the industry's reluctance to dynamism, several other factors hinders the Ghanaian construction industry capabilities, mainly is the inability to adapt sustainable practices in discharging activities (Djokoto et al., 2013). Authors Djokoto et al. (2013) blame this on the lack of training and understanding and the know-hows on sustainable construction principles and practices. And should these challenges be solved, will enhance professionals' performance in the industry especially designers, planners, contractors, in their delivery of service to clients (Djokoto et al., 2013).

Ampadu-Asiamah and Ampadu-Asiamah (2013) identified lack of knowledge and effective communication as a major challenge in the Ghanaian construction industry resulting mostly to project delay in the country. The authors further identified project delay as the main attribute to increase interest rate, inflation, causing frustration and anxiety in clients and users who suffer higher renting expenses, thereby affecting the development plan and target of clients.

Asamoah and Decardi-Nelson (2014) stated that, with the growing population need and clients trending desire for huge buildings coupled with much sophistications and technicality, there is a core need for immediate skill training for professionals. To enable them(professionals) meet demand efficiently ensuring growth of the industry and rendering quality economic services.

## 2.3 ENVIRONMENTALLY SUSTAINABLE PRACTICES

Sustainability simply defined is protecting the natural environment. Sustainable construction on the other hand implies carrying out construction activities with precaution without creating adverse impact to the environment considering the health, safety, and comfort to the end users and the surrounding human ecology as a whole (Grierson, 2009). Again, sustainability in construction can be defined as efficiently managing and making prudent use of resources to provide healthy built environments, without compromising the ecosystem (Kibert, 1994).

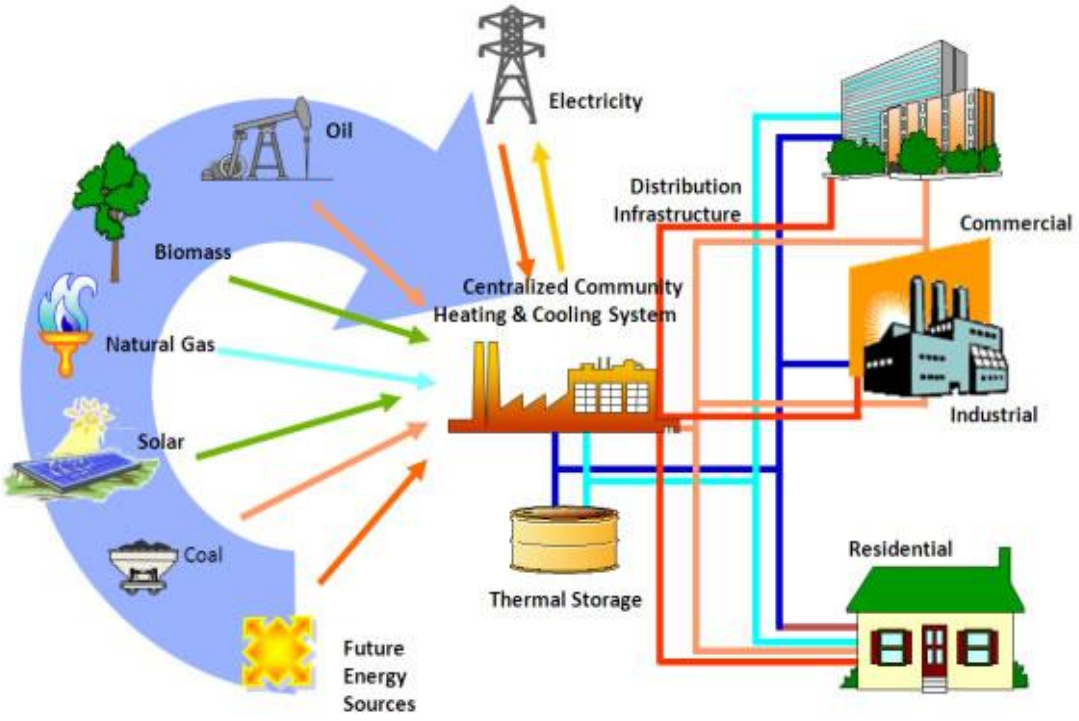


**Figure 2.2: Sustainable environment layout**
***Source***: Earth Submit (2012)

The adaptive procedure in designing and developing a nation's-built environment has profound influence on the economy, environment, and the culture quality (EPA- US, 2013). Sustainable design building practice include materials to use, plan and method of construction, and the financial resources essential to complete and achieve building performance during life cycle period (ISO 15686-2, 2001). Addressing sustainability has been a key issue in recent times, looking at the opportunities it presents with it implementation. One important aim of Sustainable building design is to, if not drastically impair, lessen the degrading effect on the environment due to construction works, in a way to ensure a safe and comfort living and improving the performance of the building (Earth Summit, 1992). Objectively, this implementation will reduce non-renewable resource usage; wastes produced and automatically create healthy enabling environments.

Several stakeholders and researchers have identified substantial impact of sustainability in the course of their studies on the subject. Sustainable building design and construction is not only focused on the design and construction aspect, but also through the project life-cycle operation (Wyatt, 1994), considering building effect on the environment and the economy. The design and construction industry is noted to be a highly active industry in almost every part of the world contributing to the social, economic, and the general environmental safe cohabitation (Asamoah and Decardi-Nelson, 2012). With the availability of building rating tools such as BREEAM, LEED, GS GH-v1 Tool, MCVSE, etc. and comprehensible methodologies easing works for stakeholders of the building industry indicate effectual existence of sustainability (Grierson, 2009). Stating also, sustainable building design aims at redefining building designs practically, to improve environmental condition for healthy and safe habitation. World Commission on Environment and Development, WCED, (1987) defined sustainability as creating a balancing ratio of human to the natural environment by preventing destruction and over-exploitation of natural resources through the activities of rapid human population growth rate. Current statistics shows the earth being rendered incapacitated due to exceeding human population, bearing sole reliance for economic, production and social needs (Rees et al., 1996).

Hence acknowledging evidently that the earth's output capacity undermatch the current excessive growing needs of the outnumbering human population (Grierson, 2009). Immediate pursuance for sustainability of the environment tends to be the only precautious remedy of consigning the damaging environment (Tickner et al., 2001). As the key to sustainable development is a sustainable environment (Grierson, 2009), sustainability of

the environment can only be achieved by prioritizing basic needs to physical wants, extravagant production and consumption crave increasing waste generation, regardless of current resource diminishing and future generation survival; increasing protection and conservation of the environment to ensure quality life for all living beings (Lovins and Lovins, 2001; Grierson, 2009). Sustainable environment hence leaves a greater responsibility on the built environment by influencing effectual policies that combats negative practice of the building industry (Grierson, 2009). The building industry is identified to make voluminous use of resources in line of it production (Zhang et al., 2011), and by-turning high greenhouse emissions, upsurge waste generation, gradual environment degradation, due to poorly assessed negative building impact (Samari, 2013).

Expedient of the building industry activities impeding sustainability of the environment require urgent in-depth understanding of the stakeholders' work impact on the environment and their conformation to sustainable building policies (Grierson, 2009), resolving to sustainable building designing (Scottish Executive, 2006). This indicates both the positive and negative impacts of the construction industry to sustainability. Sustainability adaptation and implementation in the construction industry require a quota involvement of all stakeholders in the building industry particularly the design and planning team, and the construction team, the government, environmental protection agency, statutory authorities, to enact laws and policies to guide and regulate the building industry towards sustainable design and building (Grierson, 2009). Ghana is currently striving through upsurge environmental challenges such as illegal mining, poor sanitation and waste management practice, resulting to under-development, low economic and quality life. Government recent initiative to improve quality of life for all, setting policies frowning on

unsustainable environmental activities proves a no-easy task requiring involvement of the nation as a whole on such purposeful course (Ghana Forestry Department-GFD- FDMP report, 2016). With a, cross-cut against illegal mining and setting agencies and committees in fighting against these illicit acts, damaging the resourceful environment of Ghana (Afriyie et al., 2016). Ghana Forestry Department (2016), on its master plan report has rallied support for government on this quest stating that sustainability of the environment interlines towards ideal completeness of sustainable development.

Grierson (2009), indicated that sustainable built environment requires diverse views consideration from all, regarding the materials, land, energy, cost, contest, comfort, health, management i.e. (resources and waste), indoor air quality, ornamental impact, among many other needs required for a proposed building sustainability to the environment linking directly to effective planning and designing of building. And that driving towards sustainable development requires sustainable building designing influenced by easily and extensively assessable comprehensive methods and practices of integral sustainable design tools and policies.

For a building to be factored as sustainable, the building must meet certain requirements such as; 1. Production of minimal greenhouse emission, 2. Less dependent on nature for production sources, 3. Reduction in the level of waste produced and effective management of waste (recycling), 4. Building must be safe, health aiding and be very comfortable to occupants

5. Recycling of waste created during operation, 6. Efficient use of resources (Miyakate, 1996). According to the ISO 21932 (2010), sustainability is paramount to success where the exist: (1) access to the needed/required technologies effortlessly, (2) wide expertise and

stakeholders' knowledge on sustainable design building and ease in applying principles/methods, (3) educational training, research and development to deriving new ways and technologies in adopting proactively to sustainable design building (Hakkinen and Belloni, 2011).

## 2.4 CHALLENGES ASSOCIATED WITH INTEGRATING ENVIRONMENTAL SUSTAINABILITY

Problem with increasing population growth rate, economic and political instability, and urbanization are the most common challenges in most developing countries and are hence the incapacitated cause in providing basic needs such as green housing unit to meet the high demands (De Boeck, 2013). The country is faced with social, environmental, health and economic problem of poor resident settlement increasing and litigation. Sustainability of the Ghanaian construction industry is continually hindered by social, environmental, which economic and health majors the challenges.

ISO 21929 (2010) noted that sustainability effect on a nation can be classified under the following:

- Environmental – curbing the rapid effects of degradation caused on the nation to a sustainable one.
- Economical – sustainability adoption will help combat the nation's current financial struggle and grace the nation's economic efficiency potentials.
- Social – sustainability will help alleviate the rising sanitation problem in the county which has posed health issues, affecting general wellbeing for living being survival.

These categorizations are further examined under the following sub headings.

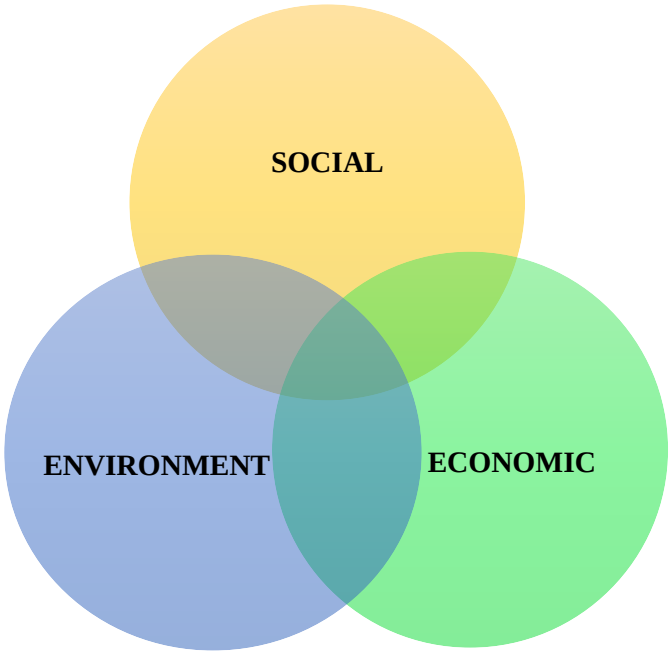


**Figure 2.3: Three major areas of identified challenges.**
***Source***: authors derivation (2018)

### 2.4.1 Social/ Cultural Challenges

The Ghanaian construction is identified to be one very difficult sector to effect change due to its traditional method of construction and the rigid consequences involved in carrying out construction activities, among other factors as a barrier to sustainability. The use of steel, aggregates, cement and water as the major materials. In the country, steel, aggregates, cement, timber and water are the main construction material which has been in use for decades, indicating resistance to change in the industry, create or adapt alternative materials and services. Over dependence on natural resources to undertake construction activities stripping the environment of greenery and ornamentation has currently led to importation building materials (Amoako, 2012); a typical example is the importation of timber which were found in abundance few years back.

Developing and adopting sustainability policies by the construction industry which manufacturers of the materials, the designers of building plans, the building construction team, maintenance engineers and the Environmental Protection Agencies (EPA), if applied, will ensure environmental sustainability (Adebayo, 2002). In an argument by Gilding et al. (2002), sustainability is focused much on the environment regrading less the health and safety impact of workers in the construction industry in adapting sustainable design building. Stating that an inevitable but likely minimizable accident prone industry like the construction industry, it practices and activities cannot be deemed sustainable.

Researchers, health and safety officers, have for years now been trying to determine a definite approach to accident free construction works, taking the safety of workers (Hill, 2003). Although the exist much safety measures, the persistence of fatal and minor accidents in the industry is still a worry. This being in line with the Ghana Green Building Council (GHGBC) to transform Ghana's built environment through its community planning method, design, construction, operation and maintenance, will ensure a very sustainable environment (Ghana), with the current devastating state (GBC Official Launch Handbook, 2011). The challenges faced by the construction industry in Ghana can be attributed to the political inconsistency. With several national development plans initiation by various leaders who happen to take the mantle of leadership in the country (Ofori, 2012). Clustered into a lack of solid laid-down national comprehensive development policy for the building industry to be adhered amidst political insolvency. But should the industry come to the realisation of the fact that the nation's development lies on it

capabilities and strength, the industry will shoot up in rapid developmental growth, impacting the excellent development of the nation (Ofori, 2012).

### 2.4.2 Professional Challenges

Lack of consensual cooperation and fundamental understanding on sustainability among stakeholders of the building industry to amiably work for positive growth of the industry has induced failure in most works undertaken (Asamoah and Decardi-Nelson, 2014; Ampadu-Asiamah and Amadu-Asiamah, 2013). Also, to mention is the lack of professional practices which is apportioned to the numerous ranges of stakeholders involved (Dadzie et al., 2012), although the contribution of the construction industry towards economic and social development is undeniable (Asamoah and Decardi-Nelson, 2014). The industry is also hindered by the meagre number of professionals to steer the industry towards in it services rendered (Asamoah and Decardi-Nelson, 2014). Asamoah and Decardi-Nelson (2014) blame the norm for unsustainable design building in Ghana to corruption and lack of transparency in tendering processing for securing consultants and contractors for procuring of goods, work and service, amidst the continuous degradation of the environment towing on development (Djokoto et al, 2012). Lack of consensual cooperation and fundamental understanding on sustainability among stakeholders of the building industry to amiably work for positive growth of the industry has induced failure in most works undertaken (Asamoah and Decardi-Nelson, 2014; Ampadu-Asiamah and Amadu-Asiamah, 2013). But Ofori (2012) noted that stakeholders of the building industry are the main drivers for sustainability in the construction industry.

Hydes and Creech (2000) argued that the lack of knowledge on sustainable design buildings, lack of technologies especially in a developing country like Ghana, unavailability of required materials in the country to undertake sustainable design projects, are all a contributing factor to clients' reluctance to accepting sustainable design buildings. Lack of clients' correspondents to sustainable design and construction act as barrier to sustainable built environments as identified by Ahn (2013). Hakkinen and Belloni (2011) found language a one impeding barrier to sustainable design building. Majority of principles on environmental sustainability can have misconception application contrary to it intended meaning due to language barrier (Stenberg, 2006), potentially leading to innovation and stakeholder's cooperation hindrance. The lack of sustainable building scope of information among stakeholders and inability to apply, should they be any, for fear of failure, hinders professionals' interest to implementing sustainability in their various disciplines (Rydin et al., 2006). And in the face of this proceeds to affect designing toward sustainable energy-efficient building management (Ala-Juusela et al., 2006).

### 2.4.3 Environmental Challenges

The Ghanaian construction industry can be attributed to have done less in sustaining the built environment through analysing impact of their activity over the years (Ofori, 2012). Rapid population growth resulting to increase in social vices, improper waste management causing the nation to be noted as seventh dirtiest country in the world; burdening of public utility services such as electricity and water. Unavailability of portable water in every part of the country.

#### 2.4.3.1 Pollution

According to Imaralo (2013), Ghana's population increase by 565,000 each year, and in quest for greener pastures has led to urbanisation drift, leading to unhygienic way of living, shortage of housing unit, surge in housing prices and unhygienic conditions. A steady rapid rise in the population of Ghana is gradually increasing slum growth in the country resulting to unhealthy living condition of habitants (Imaralo, 2013). Due to this, the United Nations Human Settlement Program has predicted the need for Ghana to provide 2million housing units to the current ones before the year 2020. In other to meet the demands for infrastructure, the Ghanaian construction industry is making enormous use of resources, leading to environment pollution, affecting environmental sustainability (Adebayo, 2002). The construction industry is therefore challenged on adopting sustainable measures in quest to meeting these demands (Djokoto et al.,2014).

The country's rapid population growth has resulted in poor dense settlement, pollution of the environment due to improper waste management policies, limitation of portable water to certain areas and over burdening in its distribution, in consistent electric power supply and rise in slum growth are impeding the construction industry's' present and future success growth (Ahmed et al, 2014). The current problem has led to high rise in greenhouse emissions due to over-reliance on fossil fuels, deforestation, water bodies and soil toxification, health risk/problems. Sole dependence on nature for building materials such as;

- timber for roof carcassing, formwork, scaffold and some vertical accesses (stairs, ladder)
- high sand winning for building

- quarry mining
- steel extraction for construction purposes
- cement production as binder for aggregates in masonry and concrete works;

Amoako (2014) indicated that these activities are all causes of depreciation, water and pollution, increase in waste production, and high rise of greenhouse emissions. Adding to this, the construction industry activities has caused rise in deforestation, air pollution, toxification of water and soil, health risk/issues, loss of habitats and high energy consumption (Djokoto et al., 2014). For environmental sustainability to be achieved, the involvement and intuitive contributions and collaboration of government, environmental agencies and stakeholders of the construction industry are required to solve identified problems and come out with innovative and implementable sustainable design building policies and laws (Hemmati et al., 2001). Drawing a call on government, environmental agencies and stakeholders of the construction industry to plan and come out with effective sustainable policies and rules & laws to create, protect and prevent further degradation of the environment.

#### 2.4.3.2 Energy

Lauding sustainability on it undisputed substantial impact to the building design team, less can be said of it on efficient energy management (Hakkinen and Belloni, 2011). Most buildings lack efficient energy management policy (Ala-Juusela et al., 2006); for the fact that, apart from some official/government buildings where little effort is geared energy-efficiency, other buildings specifically residential, are left to client's discretion (Hakkinen and Belloni, 2011). Bosch and Pearce (2003) identified that undoubting the excess

availability of comprehensible literatures, materials and policy propagation on sustainable design building aiding design and planning team, minute attention has been given to energy efficiency, which stand as one of the major barriers of sustainability of the built environment, to guide maintenance engineering proactively (Hakkinen and Belloni, 2011). Energy is required in various types for all kinds of buildings depending on the building purpose, magnitude and it location. Building consumption of energy is not recoverable for re-usage which include energy used for the materials manufacturing, through the construction phase to the operational phase where much energy is used for lighting, heating, cooling, and other electrical equipment (Kim and Rigdon, 1998). Kim and Rigdon (1998) stated again that dependant on coal generated electricity has resulted in enormous greenhouse emissions (i.e. CO, CO2, NO, and SO2). Nuclear electric power usage which serve an alternative has contributed largely to radioactive toxics for which no solution has been yet derived.

Hydro-electric power generation according to altruistic to be dangerous to aquatic life leading to a gradual extinct of ecosystem. Energy demand for building life-cycle can be grouped into direct and indirect energy consumption. From the design, construction, through the building's life cycle period to it demolition, energy used here is classified as direct. Whereas the indirect energy is used in the production process and transportation of the building materials. Operational energy forms the larger part of energy consumption in a building production and life-span compared with the production and demolition aspects. Operational energy needed is between 90 -95 percent in a building life-cycle energy demand (Sartori and Hestnes, 2006). Huge amounts of energy are consumed in production of these materials. During the design and construction phase, a substantial amount of

energy is consumed also through to the operation and demolition of the building (Ofori, 2012). Involvement of all stakeholders of the built environment industry and policymakers to genuinely derive comprehensive sustainability development policy will help the of built environment design and planning stakeholders to innovate building designs that truly reflect sustainability (Hakkinen and Belloni, 2011).

#### 2.4.3.3. Illegal Mining Activities

Ghana is one country in western Africa which blessed abundantly with all kind of natural resources and has had environmentalist and altruists commending the ecological setup. Mitchell (2006) stated that these resources include minerals such as gold, diamond, bauxite, iron, manganese, etc.; forest reserves, water bodies, very fertile soil to support growth of all kinds of crop and plant, with a well demarcated landmark. Ghana currently stand as the seventh dirtiest country in the world according to World Health Organisation (WHO) and United Nations Children's Fund (UNICEF) (2015) progress report on the Millennium Development Goal (MDG) amidst battling dilapidating destruction of the soil through exploitation for minerals, mainly gold, and the process commonly referred to as small scale mining. Small scale mining has in recent times escalated involving mostly the youth and foreigners in the country, mostly Chinese, in this dangerous act impeded by it lucrativeness (Crawford and Botchwey, 2017).

Small scale mining has long been a legalized business in Ghana because of the economic benefits it blessed the government with coupled with alleviation of job provision for the youth especially (Amegbey et al., 2007). Failed responsibility of leaders, specifically politicians, chiefs and the nation as a whole brought in massive immigrants, mainly

Chinese, indulging in the mining activity amongst the citizens pervasively destroying farmland, forest reserves and waterbodies through their illicit activities (Crawford and Botchwey, 2017). Contemporary advocate for sustainability led to implementation of laws by government debunking illegal mining activities predominantly controlled by the foreign artisans in the year 2016 (Afriyie et al., 2016). Small scale mining popularly referred to as 'galamsey' amongst the local people has precipitated citizens living around these mining areas onto a scanty degraded landmark (Hilson, 2010). Mensah (2015) highlighted that the unregulated small-scale mining has rendered soil infertile, causing Ghana much fortune to import food for the nation's survival.

Sefor- Armah (2006) research showed an approximate damage of 58 percent waterbodies and 45 percent farmlands caused by small scale mining in the western region alone. The research conducted in the western only, indicated high number of purifiers used in making pipe-borne water wholesome for consumption in the region due to reckless waste and poisonous minerals, such as mercury used for the extract, disposal into rivers by the illegal miners. The efforts of the Ghana Water Company (GWC) in the region to purify water to consumption standard for consumers in the region prove less worthful as the water remains brown coloured mostly for habitants around the mining zone. Mensah (2015) attributed scarcity treated pipe borne water drought faced in the mining areas to frequent break-down of water treatment plant due to enormous amount of filth and residue disposed into waterbodies because of galamsey activities. The quest of government to improve the environmental condition towards sustainable measure, has enacted laws laying a ban on small scale mining in the country specifically against illegal miners whose activities has evidently degraded not only land, but waterbodies, forestry, health complications, among

several negativities (Afriyie et al., 2016); though galamsey predominantly serve as the alternate source of livelihood in most part of the country amidst high unemployment rate (Hilson and Banchirigah, 2009). Atongo (2014) opined that illegal mining has in effect destroyed the environment factored as one of the major causes for designers' inability to adapt to current sustainable building design trends around the globe forcing designers and contractors in the construction industry to maintain primitive design and buildability suite. According to Crawford and Botchwey (2017) and Hilson (2010), efforts government to reclaim lands mortally mined by illegal artisans, has been identified will cause the nation billions of American dollars, for which these funds could be channeled to solving economic crises in the country. Sustainable design building begins with pre-sustained environment (Altomonte et al., 2015), nonetheless, illegal mining activity and it dominant impact has rendered the environment incapable for the construction industry's advancement towards environmental sustainability.

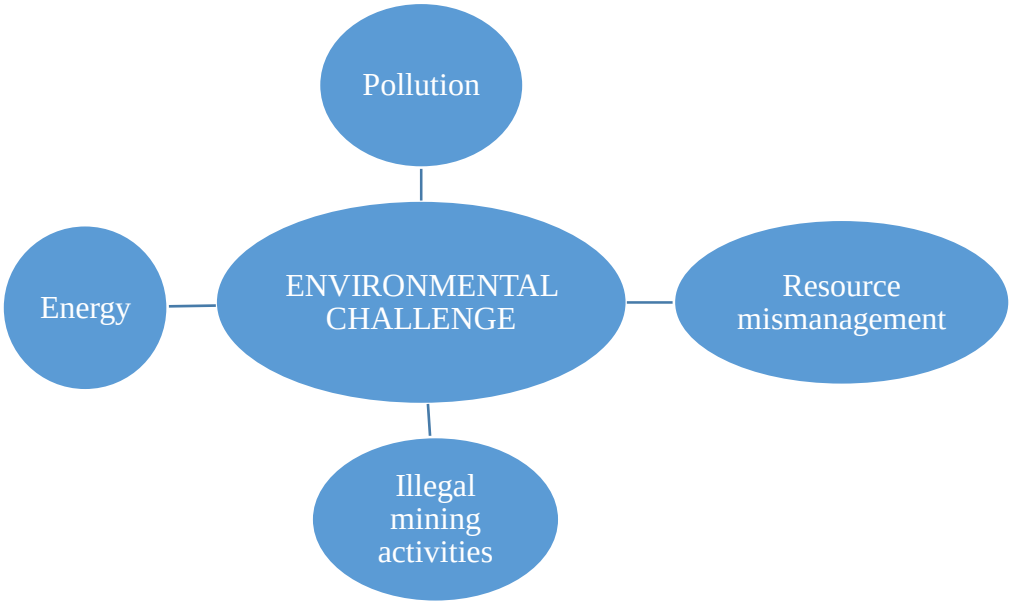


**Figure 2.4: Environmental Challenges**

**Source: author's derivation (2018).**

#### 2.4.3.4 Economic Challenges

Sustainable design building is victimized very expensive choice in undertaking building works, mostly by clients and are hence unwilling to comply for it application (Larsson and Clark, 2000). Hakkinen and Belloni (2011), acknowledged that although upgrading sophisticated technologies and methods for green building keep soaring the construction market, acceptance by clients for application by the design and construction stakeholders is much objected on basis of higher cost implication. Clients' unwillingness for sustainable designing and building is limited on higher cost expense i.e., during design and construction phase, and low market competition, less regarding the minimal cost benefits during building life cycle and the substantial effect on environmental sustainability (Zhou and Lowe, 2003). Higher cost mostly due to lack of support on the part of manufacturers and suppliers leading to over or under estimation by the consultant. Most clients argue about the higher cost implications of sustainable design building practice and in pursuance to adopting it can lead to unhealthy financial implication (Larsson and Clark, 2000; Nelms et al., 2005).

Also, lack of clients understanding on the cost effects of sustainable design building, not only at the design and construction stage but through the life-cycle of building which prove very less expensive, compared to the traditional method of building which may appear cost effective at the design and construction face but higher cost effects during the building life-cycle with several health issues to human and the environment due to its lacking sustainable measures (Hakkinen and Belloni, 2011). Bon and Hutchinson (2000) also identified that wrong perceptions of higher cost implications on sustainable design

buildings which is recurring through-out building life span with less market value, stands as a high barrier to sustainability in the design and construction industry.

The above point can be accorded to consultants over and under estimation of energy capital cost and potential cost savings respectively (Bartlett and Howard, 2000).

Furthermore, consultants(designers) and construction team resultant to charging higher fees to curb risk, mostly due to unfamiliarity with sustainable design and construction methods (Hydes and Creech, 2000). Identifying sustainable design building as an expensive alternative is still major trending obstacle (Lam, 2009). The defected environment of Ghana lacking sustainability in the building industry and with pressing need for housing units for the up-surging population growth, according to Hakkinen and Belloni (2011) can be remedied through the provision of incentives for clients. Also, availability of soft loans with very low interest rate for mortgage, will motivate clients to implementing sustainable designing and building.

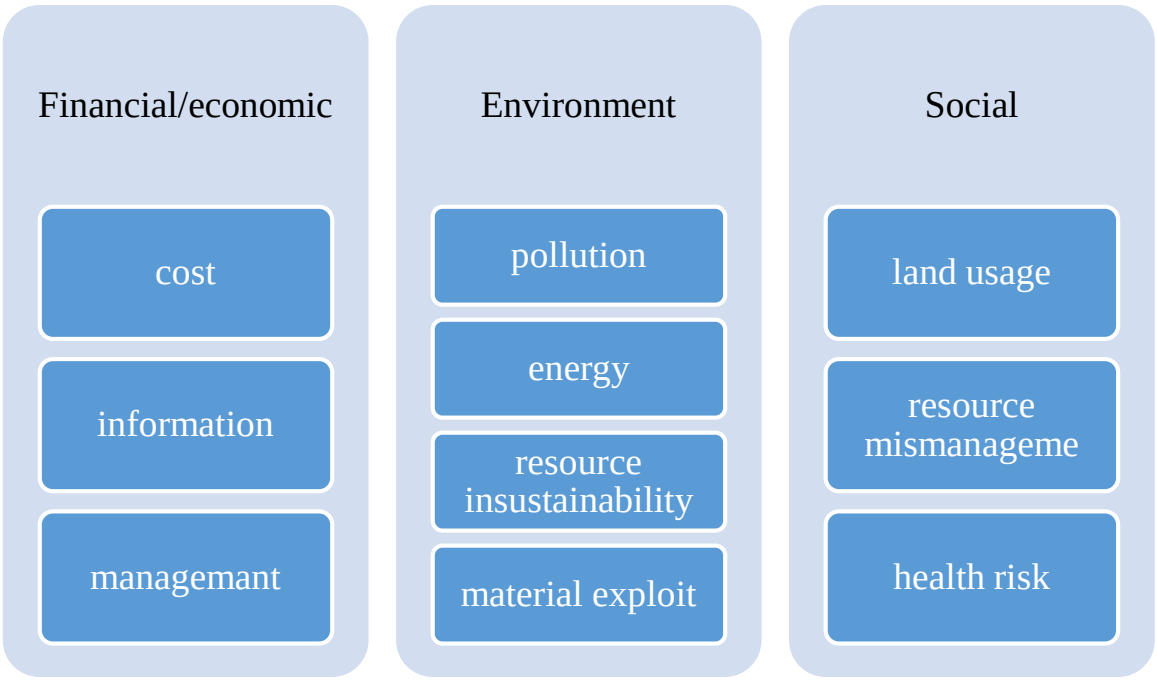


**Figure 2.5: Challenges of Sustainable Building Design**
**Source**: author's derivation (2018)

## 2.5 DRIVERS OF ENVIRONMENTAL SUSTAINABILITY

Grierson (2009) said taking building designs for granted in our current generation potentially extends a very negative legacy for future generations. Making use of sustainable design principles allows for design to be discussed at every phase of the process which will champion a sustainable design outcome, resulting to healthy and safe environment and occupants comfort, not compromising the end product. But Ofori (2012) noted that stakeholders of the building industry are the main drivers for sustainability in the construction industry.

### 2.5.1 Innovative Drive

In the Article 13 report of the Commission for Environmental Cooperation, CEC, (2008), it stated that in driving for sustainable design building, should there be continuous innovation in designing buildings and their orientation in the environment, thus the designing, positioning and construction procedure implemented, positivity in way of life can be achieved. The diving force of Information Communication Technology, ICT, in every aspect of life has not only led to invention of machineries to aid easy, fast and safe undertaking of construction works. ICT has also innovatively help create software that help assess a building performance and impact on environment right at the design stage. ICT tools qualitatively designed to help stakeholders of the construction industry to evaluate building performance, rating from the environment, social, economic, to health, defined various buildings and adapting to upgrading system of extension and evaluation; aim at booting sustainable building (Roth et al., 2015). A common one is the Multi Criteria Voluntary Sustainability Evaluation (MCVSE) system designed in 1990. Availability of several ICT tools aiding various disciplines in the construction industry are AutoCAD for architects, StruCAD for structural engineers in analysing building designs, Hevacomp for heating, ventilation and air-conditioning building design analysis, etc. (Graham, 2005).

Ghana has not been left out on the Earth Summit's (1990) drive for sustainable environment, setting the Ghana Green Building Council (GHGBC) to ensure sustainability of the environment.

The intended goal for GHGBC is to drive the Ghanaian construction industry towards sustainability through precautious planning and designing, construction, operation and maintenance (GBC Official Launch Handbook, 2011). Stating further that the aim for

GHGBC is to improve the general health requirement of the environment through minimisation of greenhouse effects on the nation. Sustainable building measurement tool was first developed by Building Research Establishment Environmental Assessment Method, BREEAM, prior to the 1990's which assess and evaluates building performance (Graham, 2005) considering the building design, purpose, construction method, without compromising comfort and safety of occupants and the environment (Larsson and Cole, 2000). GHGBC developed a Building Rating System called the GS GH-v1 Tool. The building rating tool assist designers, specifically architects, and contractors in the design and construction disciplines towards sustainable design building (GBC Official Launch Handbook, 2011). The BREEAM (1990) has serve a benchmark in assessing the sustainability of any building, on the fact that building designs were too robust and redundancy focused acting as a barrier against safety and alteration, inspired interest of incorporating sustainable measures in building designs. The measurement tool was first tested with a group of developers limiting it to office buildings only, and recorded a 25 percent client interest which led to gradual extension of the performance tool to all other buildings including homes and recreation centres and further upgrade of the tool (BREEAM 1990). Graham (2005), noted the existence several comprehensively innovated upgrades of sustainable design building measurement tools. Example is the Envest which designers can use to determine the impact of all elements of a building design on the environment to guide designers to come up with sustainable building designs. Also, is the Integrated Data Model (IDM), IES Virtual Environmental software guiding the design team to design buildings analysing the performance life cycle of buildings used in Atkins corporation (Graham, 2005). The objective drive for the innovative ICT Tools thus the

Building Rating/ Assessment Tools is to help the various disciplines of the building industry (designers, planners, developers, contractors, facility managers, etc.) to analyse building performance and it impact on the environment during the design and planning stage to derive substantial sustainable viewpoint for the proposed activity (Daniotti and Lupica Spagnolo, 2007). Effectual application of sustainable building principles will guide towards economically sustainable life cycle of the building.

### 2.5.2 Social Integration Drive

Asamoah and Decardi-Nelson (2014) stated that the dwindling effect of greenhouse emission and rampant destruction to the environment such as pollution, deforestation, etc.; has caused leaders around the world to implement proactive measures to help rebuild, protect and maintain the natural environment from further deterioration Quest of government towards protection and management of the environment by creating a balance between economic and environmental exploit, surfaced with alarms raised altruist and environmentalist on the current dilapidated environment citing the tendency of the country suffering scarcity in near time which will the nation having to depend foreign aids for survival. Ghana as a developing country is very much affected by the very less practice of sustainability, which has most projects undertaken with less consideration on sustainability, is grazing away all her unpriceable resources, leaving a great worry about future generations' survival. The diminishing rate of the environment has urged for the immediate and effective sustainable building design measures and their implementation method, with a starting progress noted in recent infrastructural projects by government and associated agencies (Ofori, 2012).

### 2.5.3 Professional Knowledge and Training

Atongo (2014) stated that the aim of the Ghana Institute of Architects is to motivate its members to create/develop innovative designs and provide supervision to ensure exact buildability by contractors, considering time to make available projects. Noting the fact that designers' (architects) play a major role in designing infrastructure and the drive for sustainable design building can easy be substantiated through them. Not undermining the substantial impact of the construction industry to the environment, quest for implementing effective positive practices in the industry curbing all odds drastically (Ebolon and Rwelamila, 2001). Hemmati (2002), noted that the beneficial growth of forums for professionals of the industry which begun in the early 1990's and has since taken turns, educating the professionals on environmental sustainability and it benefits to sustainable development of a nation. Example cited is the UNED Forum, which its vital aim is imploring professionals to adopt sustainable practices among during their discharge of duty in the environment; through collaborative teaching and understanding and upgrading decision making.

Ghana in recent times has enhance Her understanding on sustainable construction impact and it benefit to the environment and human. Hence taken educative means to groom professionals into the industry with in-depth knowledge and understanding to ensure proliferation in all aspect of the construction industry (Ofori, 2012). Citing an example of these educative measures taken is the establishment of the Construction Industry Development Institute (CIDI) at the Kwame Nkrumah university of Science and Technology in Kumasi-Ghana (Ofori, 2012). The prime aim for this set-up as stated above is to ensure artifice in the built environment leadership style which seek to contribute

towards the earnest development of the industry. In terms of knowledge and understanding and improving it method of delivery in the country and beyond. The Ghana Construction Industry Development Agenda (CIDA), sets to achieve its objectives of supporting the construction industry growth through scaling and development programs, which focus on:

1. Insuring completion proactively/or as scheduled.
2. Developing positive upgrading mind-set towards the industry growth.
3. Performing duty adherent to (contract) agreement (Ofori, 2012)

### 2.5.4 Adaption to Dynamism and Categorical Imperative

According to Foxon et al. (2004), the existence of sustainable building principles and policies cannot prove sustainability in the building industry as innovation must prioritize understanding of implementers to use tools extensively to aid their applications. The building industry can be laud to have, in recent times, taken intuitive turn in it practice to achieve sustainable end built, yet the dominance of the traditional method of construction still applies (Zhou and Lowe, 2003), drawing in voice of government encouraging implementation of set policies to the built environment. A research conducted by Halme et al. (2005) recorded not any barrier posed by energy-efficiency rather uprising issues from actions and inactions of planners, designers, policymakers of sustainability showing less interest on efficient energy management. Energy stands a major challenge of subject to environmental sustainability. Energy efficiency relays vivacious apprehensible impact on sustainable environment hence requiring energy facilitators and service engineers guide on-board towards sustainability of the built environment.

## 2.6 BENEFITS OF INTEGRATING ENVIRONMENTAL SUSTAINABILITY

Adoption of sustainable development policy by various governments enforcing the course, is currently affecting positive improvement on most developing countries. There is evident of dominant demand for environmentally sustainable projects once understanding of the efficacious significance to sustainable development is received (Robichaud and Anantatmula, 2011). To meet the current needs to challenges faced by the construction industry automatically drives towards environmental sustainability of the built environment. Zainul (2010) highlighted that environmentally sustainable practices when implemented, potentially improves the project performance, listing out numerous benefits which include; minimal life cycle cost of the end product, increase building efficiency and provide comfort to users/ occupiers, longer building life span, and higher productive investment returns gained by client and developer. The major hindrance to the practice of environmental sustainability according to most client is that it is expensive to practice but Kats (2003) argues the statement out, saying much expense is involve from the onset but eventually pays off by reducing the operational cost of a building life-cycle drastically.

In a research conducted by Trivess et al. (2016) comparing cost effect of green building to the conventional type indicated very minimal Life Cycle Cost of sustainable building, tailored from sustainable design, compared to the conventional. Indicating that the assumption of sustainable design building being expensive was because earlier analyzers only used ‘cost-benefit’ to assess their value. In the quest to achieving a sustainable environment, the design and construction of green buildings is of much importance. Sustainable buildings are designed and developed with much greater consideration for the full lifecycle of the building than conventional ones.

Doyle et al. (2009) indicated that sustainable buildings impact the environment less during construction, provide healthier place for their occupants and are more cost-efficient over the life cycle than conventional structures. Edward (1998) stated that sustainable building practices can considerably reduce the built environment's role in energy consumption. Edward (1998) further indicated that, people claim an enhanced sense of wellbeing in environmentally sustainable buildings. The improved marketability subject of sustainable buildings is the main current competitive advantage which are easier to sell and lease, which reduces vacancy times and thus results in income losses (McKee, 1998). Furthermore, environmentally sustainable projects also enhance the image of the organisation (McKee, 1998).

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

This chapter details the procedures and strategies employed to achieve the research aim and objectives of this study. It outlines the research design, research strategy and methodology. It presents the study design, population, sample selection and size. Finally, the chapter would present what data collection and data analysis strategies would be adopted for the study.

## 3.2 RESEARCH DESIGN

Research design is a plan or a framework for guiding a study (Adams and Schvaneveldt, 1991). This deals with the organization, collecting and analyzing data; the structure that influences the technique for collection and analysis of data and provides the connection between empirical data as well as its conclusion in a logical sequence to the initial research question of the study (Baiden 2006; Bryman, 2004; Yin, 2003). The research design adopted is an exploratory design and utilizes questionnaire survey. It is used in the quest to explore the awareness and benefits of integrating environmental sustainability in MMDA's projects in Ghana. It would enable the researcher to use smaller groups of people to make inferences about larger groups which would be prohibitively expensive to study (Holton and Burnett, 1997). Questionnaire survey enhances consistency of observations and improves replication due to its inherent standardized measurement and sampling techniques (Oppenheim, 2003).

## 3.3 RESEARCH STRATEGY AND APPROACH

Research strategy can be defined as the enquiry of research objectives (Naoum, 1998). The research strategy that was adopted for the study is the survey. Baiden (2006) indicated that, the three main types of research methods are adequate for a survey; quantitative, qualitative, and triangulation. Nonetheless, the choice to adapt any particular method practically depends on the drive of the study, the type, as well as availability of information for the research (Naoum, 1998 *c.f* Baiden, 2006). Hence, this research adopted a quantitative method of enquiry. The quantitative method utilizes statistics in its analysis. The study used the survey design with structured self-administered questionnaires. To gather data for the study, self-administered questionnaires would be distributed to construction professionals of selected MMDAs in the Ashanti Region. These professionals include Engineers, Quantity Surveyors, Architects and Planners.

## 3.4 SOURCES OF DATA

According to Bernard et al. (1986) data gathering is very crucial in research. This is because data contributes enormously to a better understanding of a theoretical background (Bernard, 2002). It then turns out to be imperative that selecting the method of obtaining data and from whom the data will be acquired be done with sound judgment, especially since no amount of analysis can make up for improperly collected data (Tongco, 2007). This aspect of the research methodology addresses data collection instruments, methods, and procedures. It provides exhaustive explanations to each of the methods that was used in addressing the aim, objectives, and research questions. Data gathering is crucial in research, as the data contributes to a better understanding of a theoretical background (Bernard, 2002). In this study, both primary data and secondary information were

employed. The approach for gathering data involves both literature review (secondary information) and field survey (primary data).

### 3.4.1 Primary Data

Bernard et al. (1986) concurs that primary data is a kind of data that is collected at first hand. In this study the main instrument that was used in collecting the primary data was the use of questionnaires. Primary data for the introductory stage of the research was collected from the construction professionals which include Engineers, Quantity Surveyors, Architects and Planners of selected MMDAs in the Ashanti Region.

### 3.4.2 Secondary Information

This type of data collection is the one based on already existing data. Secondary information for this study were collected from literature (books, journals, articles, magazines, etc.) internet, and databases. As part of this study, secondary information was collected from different books on topic from libraries and on-line source and also secondary information from journals formed a substantial part of the literature review.

## 3.5 TARGET POPULATION

According to Mason et al. (1997) the population of a study is the collection of all possible individuals, objects or measurements of interest. It consists of all the individuals whom the measurement is being taken (Cooper et al., 2001). The study population include construction professionals in selected MMDAs in the Ashanti Region such as Engineers, Quantity Surveyors, Architects and Planners. The population size for the study was forty-five (45). The professionals are responsible for all construction activities of the MMDAs

and is expected that respondents will demonstrate good knowledge about the awareness and benefits of integrating environmental sustainability in MMDA's projects.

### 3.6 SAMPLING TECHNIQUE AND SAMPLE SIZE

According to Strydom et al. (2005), sampling means taking any portion of a population or universe as representative of that population. It is generally stated that the larger the population, the smaller the percentage of that population the sample needs to be and vice versa (Naoum, 1998). If the population itself is relatively small, the sample should comprise a reasonably larger percentage of the population (Polit and Hungler, 1999). Large samples enable researchers to draw more representativeness and accurate conclusion and to make more accurate predictions than in smaller samples (Polit and Hungler, 1999).

Purposive sampling technique was used in this research based on the research design, purpose, and practical implication of the study. Simply put, the researcher decides what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience (Lewis and Sheppard, 2006; Bernard, 2002; Tongco, 2007). Bernard (2002) described purposive sampling as a form of non-probability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria which may include specialist knowledge of the research issue, or capacity and willingness to participate in the research. The sample size for the study was forty-five (45). The purposive sampling technique was chosen based on the fact that, the identified respondents were involved in construction activities in the assemblies and had knowledge on environmental sustainability.

## 3.7 DATA ANALYSIS AND STATISTICAL TOOLS

Strydom et al. (2005) described data analysis as a means of finding answers by way of interpreting the data and results. To interpret is to explain and find meaning. It is difficult or impossible to explain raw data, one must first describe and analyze the data and then interpret the results of the analysis (Strydom et al., 2005). Analysis means the categorization, ordering, manipulating and summarizing data to obtain answers to research questions. The purpose of analysis is to reduce data to a clear, understandable and interpretable form so that the relations of research problems can be studied, tested and also allow conclusions to be drawn. Interpretation takes the results for analysis, makes inferences pertinent to the research relations studied and draws conclusions about these relations. The completed questionnaires were edited to ensure completeness, consistency and readability. Once the data had been checked, they were arranged in a format that would enable easy analysis.

A comprehensive assessment of available analytical and statistical tool greatly affects the choice of the analytical tool to be adopted. In choosing statistical tool, parametric and non-parametric statistical test would be considered. In choosing one of the two, much efficacy was be placed basically on the level of measurements realized in the study and also the type of variables. Non-parametric statistical testing using descriptive statistics would be used. Quantifiable data from the questionnaires were coded into the software for analysis. For this study, SPSS Windows Version 17 and Microsoft excel were used for the analysis. Furthermore, relative importance index rankings were also used to ranking the identified variables using the formula:

- ✓ Relative Agreement Index (RAI) = $\frac{\sum W}{A \times N}$, where;

W = the cumulative sum of weight, ranging from 1 to 5,

A = the highest weight (i.e. 5 in the study)

N = the total number of respondents.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 INTRODUCTION

This chapter of the research details the analysis and the discussion of the results obtained after the administration of the research instruments; the survey questionnaire which agitated data to provide the basis for this chapter. This chapter is divided into two sections. The first section deals with the background profile of the respondents. The second section captured detailed analysis of the specific objectives of the study. Utilizing the structured questionnaire, information on the challenges associated with integrating environmental sustainability in MMDA's projects, and benefits of integrating environmental sustainability in MMDA's projects were sought. These information were very critical for the analysis. Analysis and discussion of the results were then conducted. This includes Relative Importance Index rankings of data obtained in the field survey. This analysis forms the basis of the conclusion made in this study and helps to identify areas relating to this study which may be the focus of future research. A total of forty-five (45) questionnaires were designed and administered to construction professionals working with the Kumasi Metropolitan Assembly, Oforikrom Municipal Assembly, and Asokore Mampong Municipal Assembly in Kumasi metropolis the Ashanti Region of Ghana. Forty (40) questionnaires were retrieved and were adequate for analysis representing an 88.9% response rate. Richardson (2005) stated that a response rate of 60% or more is deemed adequate for a scientific research. Against this background, the response rate of 88.9% obtained for this study was deemed adequate for analysis.

## 4.2 RESPONDENTS PROFILE

Respondents' demographic information was analyzed by descriptive statistics which employed the IBM SPSS (International Business Machines Statistical Package for Social Sciences) statistics version 17. Table 4.1 shows the demographic profile of respondents. BSc holders (45.0%) greatly outnumbered the other academic qualifications. HND (35.0%) and MSc holders (15.0%) had the second and third place respectively. Technician/ CTC I, II, III (5.0%) least dominated the study. The probable low figures for the technicians could be that, most professionals would now want to upgrade themselves academically even though they are in industry so as to acquire more professional knowledge. As this would aid in the identification of theoretical knowledge in solving practical problems in the industry. In terms of the position in the assembly, Engineers comprised 40.0% of the respondents, Planning Officers comprising 25.0% of the respondents, and Quantity Surveyors 7.0% of the respondents. However, the remaining 7.0% of the respondents were Architects.

Most (27.5%) of the respondents have between 6-10 years of professional practice. Altogether, about a quarter (20.0%) of the respondents have between 1-5 years' experience. Looking at the construction professionals who were involved in the study, more than half (52.5%) of the respondents indicated that they belong to the works department and 32.5% of the respondents indicated they belong to the town planning department. Notwithstanding, only a few of the respondents (15.0%) indicated that they belong to the planning department. The demographic profile of respondents shown in Table 4.1 illustrates that survey respondents are comparatively BSc holders, who were Engineers with between 6 to 10 years of professional experience in practicing and usually

work in the works department of the Assemblies. This could be as a result of the fact that most of the construction activities in the Assemblies are initiated in the works department.

**Table 4.1: Demographic profile of respondents (N=40)**

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Years in the Assembly** | | |
| Less than 1 year | 9 | 22.5 |
| 1 – 5 years | 8 | 20.0 |
| 6 – 10 years | 11 | 27.5 |
| 11 – 15 years | 5 | 12.5 |
| More than 15 years | 7 | 17.5 |
| **Academic Qualification** | | |
| MSc | 6 | 15.0 |
| BSc | 18 | 45.0 |
| HND | 14 | 35.0 |
| Technician/ CTC I, II, III | 2 | 5.0 |
| **Position in Assembly** | | |
| Engineer | 16 | 40.0 |
| Architect | 7 | 17.5 |
| Quantity Surveyor | 7 | 17.5 |
| Planning Officer | 10 | 25.0 |
| **Department of Respondents** | | |
| Works | 21 | 52.5 |
| Planning | 6 | 15.0 |
| Town Planning | 13 | 32.5 |

Source: Researcher's survey (2018)

## 4.3 CHALLENGES ASSOCIATED WITH INTEGRATING ENVIRONMENTAL SUSTAINABILITY IN MMDA'S CONSTRUCTION PROJECTS

Preliminary descriptive analysis such as relative importance index of each of the challenges variables aided in providing a vibrant representation of the outcome of the survey; and the results are tabulated in Table 4.2. With the five-point Likert rating scale, a variable was randomly reflected critical if it had a mean value of 3.50 or more (Field, 2013). From Table 4.2, ten of the variables have mean values above the accepted population mean of 3.5, it is therefore rational to deduce that they constitute the most significant challenges associated with integrating environmental sustainability in MMDA's projects. The highest responsive or challenge variable from the table is: *lack of solid laid-down national comprehensive development policy,* followed by the second highest: *political inconsistency* and the third highest variable is: *high demand for infrastructure.* Furthermore, the fourth highest variable is: *lack of technologies*, the fifth highest variable is: *meagre number of professionals* and the sixth highest variable is: *unavailability of sustainable materials.* In addition, the seventh highest variable is: *lack of sustainable building scope of information among stakeholders,* the eighth highest variable is: *lack of transparency in tendering processes,* the ninth is: *lack of knowledge,* and the tenth highest variable is: *language barrier*. The least responsive or challenge variable is: *lack of professional practices.* This confirms Ofori (2012) assertion that the industry come to the realisation of the fact that the nation's development lies on it capabilities and strength, the industry will shoot up in rapid developmental growth, impacting the excellent development of the nation. Thus, base on the descriptive statistics, it could be confidently concluded that

the variables identified as the challenge variables through literature review and the survey indicates the views of the respondents.

**Table 4.2: Challenges associated with integrating environmental sustainability in** MMDA's construction projects

| | RATING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **CHALLENGES** | **1** | **2** | **3** | **4** | **5** | **Total** | **∑W** | **Mean** | **RAI** | **Rank** |
| Lack of solid laid-down national comprehensive development policy | 1 | 0 | 5 | 21 | 13 | 40 | 165 | 4.13 | 0.83 | 1st |
| Political inconsistency | 1 | 0 | 7 | 20 | 12 | 40 | 162 | 4.05 | 0.81 | 2nd |
| High demand for infrastructure | 0 | 1 | 9 | 17 | 13 | 40 | 162 | 4.05 | 0.80 | 3rd |
| Lack of technologies | 1 | 3 | 5 | 21 | 10 | 40 | 156 | 3.90 | 0.78 | 4th |
| Meagre number of professionals | 1 | 1 | 11 | 15 | 12 | 40 | 156 | 3.90 | 0.77 | 5th |
| Unavailability of sustainable materials | 2 | 0 | 10 | 18 | 10 | 40 | 154 | 3.85 | 0.76 | 6th |
| Lack of sustainable building scope of information among stakeholders | 1 | 0 | 13 | 20 | 6 | 40 | 150 | 3.75 | 0.75 | 7th |
| Lack of transparency in tendering processes | 1 | 0 | 12 | 26 | 1 | 40 | 146 | 3.65 | 0.73 | 8th |
| Lack of knowledge | 1 | 5 | 9 | 19 | 6 | 40 | 144 | 3.60 | 0.72 | 9th |
| Language barrier | 1 | 5 | 12 | 15 | 7 | 40 | 142 | 3.55 | 0.71 | 10th |
| Lack of consensual cooperation | 1 | 4 | 17 | 14 | 4 | 40 | 136 | 3.40 | 0.68 | 11th |
| Lack of professional practices | 0 | 5 | 6 | 25 | 4 | 40 | 136 | 3.40 | 0.67 | 12th |

## 4.4 BENEFITS OF INTEGRATING ENVIRONMENTAL SUSTAINABILITY MMDA'S CONSTRUCTION PROJECTS

The study in the quest to explore the challenges and benefits of integrating environmental sustainability in MMDA's construction projects in Ghana also sought to identify benefits of integrating environmental sustainability in MMDA's construction projects. The literature review conducted provided a list of benefits of integrating environmental sustainability in MMDA's construction projects. These benefits were developed into the questionnaire where respondents were required to rate, on a scale of 1-5 their level of agreement to these benefits. The results were analysed using the Relative Agreement Index (RAI) rankings. The five-point Likert scale, ranging from 1(Strongly Disagree) to 5 (Strongly Agree) was adopted for each variable.

The benefits were analyzed and ranked as shown in Table 4.3. The variables were ranked based on the RAI value obtained. Where two variables obtained the same RAI values, the variable with the higher mean value was ranked higher. From the analysis, minimal impact on environment was ranked first with a RAI of 0.85 and a mean value of 4.25. Provide comfort to users/ occupiers was ranked second, and longer building life span was also ranked third. The first three ranked benefits of integrating environmental sustainability in MMDA's construction projects are discussed in the following sub sections.

### 4.4.1 Minimal Impact on Environment

Ensuring environmental sustainability in construction reduces the impact of the construction project on the environment. Doyle et al. (2009) stated sustainable buildings impact the environment less during construction, provide healthier place for their

occupants and are more cost-efficient over the life cycle than conventional structures. The study revealed that for MMDA's to ensure that little damage is done to the environment as a result of their developmental projects, MMDA's must ensure that they integrate environmental sustainability into their developmental projects.

### 4.4.2 Provide Comfort to Users/ Occupiers

As indicated by Abidin (2010), environmentally sustainable practices when implemented, potentially improves the project performance, listing out numerous benefits which include; minimal life cycle cost of the end product, increase building efficiency and provide comfort to users/ occupiers, and higher productive investment returns gained by client and developer. The study revealed that MMDA's must integrate environmental sustainability into their developmental projects so as to provide comfort to users and occupiers of the projects.

### 4.4.3 Longer Building Life Span

The integration of environmental sustainability in MMDA's developmental projects prolong the life span of the project. Trivess et al. (2016) and Abidin (2010) opined that comparing the cost effect of environmentally sustainable building to the conventional type indicated very minimal Life Cycle Cost of environmentally sustainable building and also longer building life span. Furthermore, environmentally sustainable projects can considerably reduce the built environment's role in energy consumption (Edward, 1998).

**Table 4.3: Benefits of integrating environmental sustainability in MMDA's construction projects**

| | RATING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **BENEFITS** | **1** | **2** | **3** | **4** | **5** | **Total** | **∑W** | **Mean** | **RAI** | **Rank** |
| Minimal impact on environment | 0 | 0 | 4 | 22 | 14 | 40 | 170 | 4.25 | 0.85 | 1st |
| Provide comfort to users/ occupiers | 0 | 0 | 5 | 22 | 13 | 40 | 168 | 4.20 | 0.84 | 2nd |
| Longer building life span | 0 | 1 | 6 | 18 | 15 | 40 | 167 | 4.18 | 0.84 | 3rd |
| Efficient use of resources | 0 | 1 | 6 | 18 | 15 | 40 | 167 | 4.18 | 0.83 | 3rd |
| Reduces the operational cost of buildings | 0 | 1 | 6 | 22 | 11 | 40 | 163 | 4.08 | 0.82 | 5th |
| Improves energy consumption | 0 | 2 | 4 | 24 | 10 | 40 | 162 | 4.05 | 0.81 | 6th |
| Higher productive investment returns | 0 | 2 | 7 | 19 | 12 | 40 | 161 | 4.03 | 0.81 | 7th |
| Improves project performance | 0 | 0 | 13 | 15 | 12 | 40 | 159 | 3.98 | 0.80 | 8th |
| Minimal life cycle cost of the end product | 0 | 1 | 15 | 14 | 10 | 40 | 159 | 3.96 | 0.80 | 9th |
| Increase building efficiency | 0 | 2 | 10 | 16 | 12 | 40 | 158 | 3.95 | 0.79 | 10th |
| Corporate image | 0 | 1 | 8 | 23 | 8 | 40 | 158 | 3.95 | 0.78 | 11th |
| Enhanced sense of wellbeing | 0 | 1 | 14 | 19 | 6 | 40 | 150 | 3.75 | 0.75 | 12th |

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATIONS

## 5.1 INTRODUCTION

This study is aimed at explore the challenges and benefits of integrating environmental sustainability in MMDA's construction projects in Ghana. To achieve this aim, two objectives were set. To achieve the objectives, a critical literature review was conducted where the theoretical underpinnings of environmental sustainability in MMDA's projects was exployed leading to the development of a questionaire to collect emperical data from respondents in the selected Assemblies. The analysis conducted with each of the objectives are presented in the following sub sections.

## 5.2 ACHIEVING THE RESEARCH OBJECTIVES

### 5.2.1 The First Objective; To identify environmentally sustainable practices in MMDAs in Ghana

This objective was achieved in literature. Literature helped to identify some environmentally sustainable practices in MMDAs. Furthermore, the ways of integrating environmental sustainability in MMDA's projects were also ascertained. Literature also gave an overview of the Ghanaian construction industry.

### 5.2.2 The Second Objective; To identify the challenges associated with integrating environmental sustainability in MMDA's projects in Ghana

With the background knowledge on the various challenges gained from literature, a questionnaire was designed to address the second objective, of which 12 variables were recognized which was then tested on a number of construction professionals working with

the Kumasi Metropolitan Assembly, Oforikrom Municipal Assembly and Asokore Mampong Municipal Assembly in the Ashanti Region of Ghana. The literature sources from which these procedures were identified included; Asamoah and Decardi-Nelson (2014), Amoako-Attah (2014), Van den Bergh (2013), Ofori (2012), and Hydes and Creech (2000) among others. The questions highlighted on challenges such as lack of consensual cooperation, lack of professional practices, meagre number of professionals, lack of transparency in tendering processes, lack of knowledge, lack of technologies, unavailability of sustainable materials, language barrier, lack of sustainable building scope of information among stakeholders, high demand for infrastructure, political inconsistency and lack of solid laid-down national comprehensive development policy. It was realized that the variables (i.e. 12 challenges) could be assessed using the same central effect. Relative Importance Index (RII) was used to rank the challenges and then discussed.

### 5.2.3 The Third Objective; To identify benefits of integrating environmental sustainability in MMDA's projects in Ghana

To achieve this objective, literature study was conducted to identify the benefits of integrating environmental sustainability in MMDA's construction projects as revealed by other researchers. The literature sources from which these benefits were identified included; Trivess et al. (2016), Robichaud and Anantatmula (2011), Abidin (2010), Doyle et al. (2009), Edward (1998), and McKee (1998) among others. In all, a total of 12 benefits were identified from the literature. The identified benefits were then included in the research questionnaire which was used to gather empirical data. The collected data was then analyzed using the Relative importance index. The main benefits which were highly agreed to according to respondents were identified to include minimal impact on

environment, provide comfort to users/ occupiers, and reduce the environmental impact. Enhanced sense of wellbeing was however ranked as the least benefit of integrating environmental sustainability in MMDA's projects in Ghana.

## 5.3 CONCLUSION

Environmental sustainability has become an important area in the development of every economy. Therefore, integrating environmental sustainability in MMDA's projects help to achieve a country's sustainable development. Furthermore, there are numerous benefits that are associated with integrating environmental sustainability in MMDA's construction projects which include minimal impact on environment and provision of comfort to users/ occupiers of the projects. However, there are also challenges that are associated with integrating environmental sustainability in MMDA's construction projects. These challenges also include lack of solid laid-down national comprehensive development policy and political inconsistency. There is therefore the need for governments to ensure that there are solid laid-down national comprehensive development policies to cater for environmental sustainability of projects.

## 5.4 RECOMMENDATIONS

The following recommendations are therefore proposed as a result of the study:

- Government should ensure that there are solid laid-down national comprehensive development policies to cater for environmental sustainability of projects.
- Management of Assemblies should ensure that employees are adequately trained on environmental sustainability issues.

- There should be the provision of adequate technology to aid in the practice of environmental sustainability at the various Assemblies.

## 5.5 LIMITATIONS OF THE RESEARCH

The underlisted limitations were associated with the work:

- The limitation of the survey to only three MMDAs in the Ashanti region may affect the generalizations of the findings.
- The analytical tool used for the analysis may also affect the generalization of the results of the study.

## 5.6 DIRECTIONS FOR FUTURE RESEARCH

The study focused on MMDAs in the Ashanti region of Ghana. A similar study could be conducted in other jurisdictions where data could be gathered to aid the extent of generalization of the findings.

## REFERENCES


Abidin, N. Z. (2010). Investigating the awareness and application of sustainable construction concept by Malaysian developers. *Habitat International*, *34*(4), 421-426.

Adams, G. R. and Schvaneveldt, J. D., (1991), *Understanding Research Methods*, 2nd ed., New York: Longman, Print.

Adebayo, A. A. (2002). Sustainable construction in Africa. *Agenda*, *21*, 1-11.

Adotey, D. K., Stibilj, V., Serfor-Armah, Y., Nyarko, B. J., and Jaćimović, R. (2011). Dietary supply of selenium for adolescents in three residential care orphanages in Southern Ghana.

Afriyie, K., Ganle, K. J., and Adomako, A.A.J., (2016). The good in evil: a discourse analysis of the galamsey industry in Ghana.

Afriyie, K., Ganle, K. J., and Adomako, A.A.J., (2016). The good in evil: a discourse analysis of the galamsey industry in Ghana.

Agyekum, K., Adjarko, H., Ayarkwa, J., and Amoah, P., (2016), Implementation of environmental sustainable construction principles (ESCPs) in the Ghanaian construction industry.

Ahn, Y. H., Pearce, A. R., Wang, Y., and Wang, G., (2012), Drivers and barriers of sustainable design and construction: The perception of green building experience, pages 35-45.

Ala-Juusela, M., Huovila, P., Jahn, J., Nystedt, A., & Vesanen, T. (2006). Energy Use and Greenhouse Gas Emissions from Construction and Buildings. Final report provided by VTT for UNEP. Parts of the text published in: UNEP (2007) Buildings and Climate Change Status, Challenges and Opportunities, Paris, UNEP.

Amegbey, N., A., Dankwa, J.B.K., and Al-Hassan, S., (2007). Small scale mining in Ghana – techniques and environmental considerations.

Amoako-Attah, J. (2014). Impact of standard construction specification on thermal comfort in UK dwellings. *Advances in environmental research*, *3*(3), 253-281.

Ampadu-Asiamah, A. D., and Ampadu-Asiamah, O. K. (2013). Management of Government Funded Construction Projects in Ghana: Stakeholders' Perspective of Causes of Delays in Construction of Public Buildings. Developing Country Studies, 3(12), 149-156.

Asamoah, R. O., and Decardi-Nelson, I. (2014). Promoting Trust and Confidence in the Construction industry in Ghana through the Development and Enforcement of Ethics. *Information and knowledge*, *3*(4), 63-68.

Asamoah, R. O., and Decardi-Nelson, I., (2014), Promoting Trust and Confidence in the Construction Industry in Ghana through the Development and Enforcement of Ethics. *Information and Knowledge,* Vol. 3, No.4, pp. 63-68.

Asamoah, R. O., and Decardi-Nelson, I., (2014). Promoting Trust and Confidence in the Construction Industry in Ghana through the Development and Enforcement of Ethics. Information and Knowledge, 3(4) pp. 63-68.

Ayarkwa, J., Ayirebi-Dansoh, & Amoah, P. (2010). Barriers to implementation of EMS in the construction block using the SBTOOL sustainability rating system, 2012, pg. 285-293.

Baiden, B. K., (2006), *Framework for the Integration of the Project Delivery Team,* Thesis (PhD), Loughborough University, United Kingdom.

Bartlett, E., and Howard, N. (2000). Informing the decision makers on the cost and value of green building. *Building Research & Information*, *28*(5-6), 315-324.

Bernard, H. R., Pelto, P. J., Werner, O., Boster, J., Romney, A. K., Johnson, A., Ember, C.R., and Kasakoff, A., (1986), The construction of primary data in cultural anthropology, *Current Anthropology*, Vol. 27, No.1, pp. 382-396.

Bernard, H.R., (2002), Research Methods in Anthropology: Qualitative and quantitative methods, 3rd ed., Altamira Press, Walnut Creek, California.

Bon, R., and Hutchinson, K. (2000). Sustainable construction: some economic challenges. *Building Research & Information*, *28*(5-6), 310-314.

Bosch, S. J., and Pearce, A. R. (2003). Sustainability in public facilities: Analysis of guidance documents. *Journal of Performance of Constructed Facilities*, *17*(1), 9-18.

Bryman, A., (2004), Qualitative Research on Leadership: A critical but Appreciative Review, Leadership Quarterly, Vol. 15, No. 1, pp. 729 -769.

Crawford, G., Botchwey, G., (2017). Conflict, collision and corruption in small-scale gold mining: Chinese miners and the state in Ghana. Commonwealth & comparative politics, vol. 55.

Cullingworth, J. B., and Nadin, V. (2006). *Town and Country Planning in the UK*. Routledge.

Dadzie, J., Abdul-Aziz, and. Kwame, A., (2012). Performance of consultants on government projects in Ghana: client and contractor perspective. International Journal of Business and Social Research; Vol. 2, pp. 256-267.

Ding, G. K. C. (2008). Sustainable construction--The role of environmental assessment tools. *Journal of Environmental Management*, Vol. 86, pp. 451-464.

Djokoto, S. D., Dadzie, J., and Ohemeng-Ababio, E. (2014). Barriers to sustainable construction In the Ghanaian construction industry: Consultants perspectives. *Journal of Sustainable Development, 7*(1), 134.

Doyle, J. T., Brown, R. B., De Leon, D. P., and Ludwig, L. (2009). Building green-potential impacts to the project schedule. *International Transactions*, PS.08.01-PS.08.11.

du Plessis, C., (2001), Sustainability and sustainable construction: The African context, *Building Research & Information,* Vol. 29, pp.374-380.

du Plessis, C., (1999), Sustainable development demands dialogue between developed and developing worlds. *Building Research and Information,* Vol. 27, pp. 378-389.

Edward, B. (1998). *Green buildings Pay*. Oxford: Alden Press.

Foxon, T., Makuch, Z., Mata, M. and Pearson P. (2004). Innovation systems and policy-making processes for the transformation to sustainability. In: Kalus Jacob, Manfred Binder and Anna Wieczorek (eds.) Governance for industrial transformation. Pgs.17.

Ghana Forestry department, (2016). Forestry development master plan FDMP (2016 – 2036).

Gilding, P., Humphries, R., and Hogarth, M. (2002), *Safe companies: A practical path for operationalizing sustainability*, ECOS Corporation, Sydney, Australia.

Graham, S (2005) Sustainable building design - a systematic approach. Atkins Consultants Ltd, Woodcote Grove, Ashley Road, Epsom, KT18 5BW, UK Sustainable Building Design – A Systematic Approach.

Grierson, D., (2009), Towards sustainable building design, *Design Principles and Practices,* Vol. 3, No.3, pp. 143-152.

Häkkinen, T., & Belloni, K. (2011). ‘’Barriers and drivers for sustainable building,’’ *Building Research & Information, (39*)3, pg. 239-255.

Halme, M., Nieminen, J., Nykänen, E., Sarvaranta, L. and Savonen, A. (2005). Business from Sustainability. Drivers for Energy Efficient Housing. Espoo VTT Tiedotteita . Research Notes 2310. 61 p. + app. 1 p.

Hemmati, P. G., Gillissen, B., von Haefen, C., Wendt, J., Stärck, L., Güner, D., ... and Daniel, P. T. (2002). Adenovirus-mediated overexpression of p14 ARF induces p53 and Bax-independent apoptosis. *Oncogene*, *21*(20), 3149.

Hill, D. C. _2003_. *Construction safety management and engineering*, American Society of Safety Engineers, Des Plaines, Ill.

Hilson, G., Banchirigah, M.S., (2009). Are alternative livelihood projects alleviating poverty in mining communities? Experience from Ghana. Vol. 45, pgs. 172- 196.

Holton, E. F. III, and Burnett, M. F., (1997), Quantitative research methods In: Swanson, R. A. and Holton, E. F. III (Eds.) Human resource development research handbook: Linking research and practice (pp. 65-87). San Francisco: Berrett-Koehler.

Hydes, K. R., and Creech, L. (2000). Reducing mechanical equipment cost: the economics of green design. *Building Research & Information*, *28*(5-6), 403-407.

Hydes, K. R., and Creech, L. (2000). Reducing mechanical equipment cost: the economics of green design. *Building Research & Information*, *28*(5-6), 403-407.

ISO 15686-2:2001, Buildings and constructed assets – Service life planning: Service life prediction procedures.

Karbo, N. (2017). Research for Development (R4D) platform facilitation and climate change sensitization in Africa RISING Ghana sites.

Kats, G. (2003). *Green building costs and financial benefits* (p. 1). Boston: Massachusetts Technology Collaborative.

Kibert, C. J. (2016). *Sustainable construction: green building design and delivery*. John Wiley & Sons.

Kim, J. and Rigdon, B. (1998), *Principles of Sustainable Design*, National Pollution Prevention Center for Higher Education, Ann Arbor, MI, pp. 9- 15.

Kriebel, D., Tickner, J., Epstein, P., Lemons, J., Levins, R., Loechler, E. L., ... and Stoto, M. (2001). The precautionary principle in environmental science. *Environmental health perspectives*, *109*(9), 871.

Kumar, R., (1999), *Research Methodology: A step-by-step guide for beginners*, 1st ed., SAGE Publications limited, London, ISBN 978-1-84920-300-5.

Kumar, R., (1999), *Research Methodology: A step-by-step guide for beginners*, 1st ed., SAGE Publications limited, London, ISBN 978-1-84920-300-5.

Lam, J. S. L. (2015). Designing a sustainable maritime supply chain: A hybrid QFD–ANP approach. *Transportation Research Part E: Logistics and Transportation Review*, *78*, 70-81.

Larsson, N. K., and Cole, R J., (2000). Green Building Challenge: the development of an idea, Natural Resources Canada, Ottawa, Canada.

Larsson, N. K., and Cole, R J., (2000). Green Building Challenge: the development of an idea, Natural Resources Canada, Ottawa, Canada.

Larsson, N. K., and Cole, R. J., (2005), Green Building Challenge: the development of an idea. *Building Research & Information*, 29, 336-345.

Laryea, S. A. (2010). Challenges and opportunities facing contractors in Ghana. Pp. 215-226.

Lewis, J. L., and Sheppard, S. R. J., (2006), Culture and communication: can landscape visualization improve forest management consultation with indigenous communities?, Landscape and Urban Planning, Vol. 77, No. 1 pp.291–313.

Lovins, A., and Lovins, L.H. (2001). *Natural Capitalism: Path to Sustainability?* (Corporate Environmental Strategy, 8(2), pg. 99 – 108 (10).

Mason, J. M., Champion, L. E., and Hook, G., (1997), Germ-line effects of a mutator, mu2, in Drosophila melanogaster. *Genetics*, Vol.146, No.4, pp.1381—1397.

McKee, W. (1998). Green buildings and the UK property industry. In B. Edward (Ed.), *Green Buildings Pay*. Oxford: Elden Press.

Mensah, A. K., Mahiri, I. O., Owusu, O., Mireku, O. D., Wireko, I., and Kissi, E. A. (2015). Environmental impacts of mining: a study of mining communities in Ghana. *Appl. Ecol. Environ. Sci.*, 3(3), 81-94.

Mitchell, P. (2006). Mining and economic growth: the case for Ghana and Tanzania. South African journal of international affairs, vol. 13.

Naoum, S.G., (1998), Dissertation Research and Writing for Construction Students, Bultermouth-Heinemom, Oxford.

Nasir, H., Ahmed, H., Haas, C., and Goodrum, P. M. (2014). An analysis of construction productivity differences between Canada and the United States. *Construction Management and Economics*, *32*(6), 595-607.

Nelms, C., Russel, A. D., and Lence, B. J., (2005), Assessing the performance of sustainable technologies for building projects, *Canadian Journal for Civil Engineering*, Vol. 32, pp.114-128.

Ofori, G. (2006). Attaining sustainability through construction procurement in Singapore. CIB W092–Procurement Systems Conference 2006, Salford, UK.

Ofori, G. (2012) The construction industries in developing countries: strategic review of th book. In Ofori, G. (Editor) *New Perspectives on Construction in Developing Countries*. Spon, Abingdon, pgs. 1-15.

Oppenheim, A. N., (2003), Questionnaire Design, Interviewing and Attitude Measurement, New ed., Continuum International Publishing Group, London.

Pakkala, P., (2002), *Innovative Project Delivery Methods for Infrastructure: An International Perspective*, Helsinki, Finnish Road Enterprise, Headquarters. ISBN 952-5408-05-1.

Pitt, M., Tucker, M., Riley, M., and Longden, J., (2009), Towards sustainable construction: promotion and best practices, *Construction Innovation: Information, Process, Management*, Vol. 9, No.1, pp. 201-224.

Polit, D. F., and Hungler, B. P., (1999), Nursing Research: Principles and Methods, 6th ed. (Revised). London: Lippincott Williams and Wilkins.

Rees, W. E. (1996). Revisiting carrying capacity: area-based indicators of sustainability. *Population and environment*, *17*(3), 195-215.

Robichaud, L. B., & Anantatmula, V. S. (2010). Greening project management practices for sustainable construction. *Journal of Management in Engineering*, *27*(1), 48-57.

Rodriguez-Melo, A., and Mansouri, S. A., (2011), Stakeholder Engagement: Defining Strategic Advantage for Sustainable Construction, *Business Strategy and the Environment*, Vol. 20, pp.539-552.

Roth, M., Georgescu, M., Chow, W. T. L., Wang, Z. H., Brazel, A., Trapido-Lurie, B., and Benson-Lira, V. (2015). Prioritizing urban sustainability solutions: coordinated approaches must incorporate scale-dependent built environment induced effects. *Environmental Research Letters*, *10*(6), 061001.

Rydin, Y., Amjad, U., Moore, S., Nye, M., & Withaker, M. (2006). Sustainable Construction and Planning. The Academic Report. Centre for Environmental Policy and Governance, The LSE SusCon Project, CEPG, London School of Economics, London.

Rydin, Y., Amjad, U., Moore, S., Nye, M., and Withaker, M., (2006), Sustainable Construction and Planning, The Academic Report. Centre for Environmental Policy and Governance, The LSE SusCon Project, CEPG, London School of Economics, London.

Samari, M., Godrati, N., Esmaeilifar, R., Olfat, P., & Shafiei, M. W. M. (2013). The Investigation of the Barriers in Developing Green Building in Malaysia. *Modern AppliedScience*,7(2).

Sartori, I., Wachenfeldt, B. J., and Hestnes, A. G. (2009). Energy demand in the Norwegian building stock: Scenarios on potential reduction. *Energy Policy*, *37*(5), 1614-1627.

Stenberg, A.C. (2006) The social construction of green building. Chalmers University of Technology, Doctoral thesis, pp. 178–183.

Strydom, A., Livingston, G., King, M., and Hassiotis, A., (2007), Prevalence of dementia in intellectual disability using different diagnostic criteria", *British Journal of Psychiatry*, Vol. 191 No. 150-157

Tongco, D.C., (2007), Purposive sampling as a tool for informant selection, *Enthobotany Research and Applications,* Vol. 5, No.1 pp.147-158.

Trivess, M., Ridley, L., Strengers, Y., Maller, C., and Horne, R., (2016), Dwelling performance and adaptive summer comfort in low-income Australian households, pp. 443-456.

Trivess, M., Ridley, L., Strengers, Y., Maller, C., and Horne, R., (2016). Dwelling performance and adaptive summer comfort in low-income Australian households, pgs. 443-456.

Van den Bergh, J., Beliën, J., De Bruecker, P., Demeulemeester, E., and De Boeck, L. (2013). Personnel scheduling: A literature review. *European Journal of Operational Research*, *226*(3), 367-385.

World Commission on Environment and Development (WCED), (1987). *Our common future.* Oxford University Press, Oxford.

World Health Organization. (2015). *Global tuberculosis report 2015*. World Health Organization.

Wyatt, D.P., 1994. Recycle and Serviceability: The Twin Approach to Securing Sustainable Construction. Proceeding of 1st International Conference of CIB TG 16 on Sustainable Construction, Tampa, Florida, p.69–78.

Yin, K.Y., (2003), Applications of Case Study Research, 2nd ed., Sage Publications, Inc., California.

Zhang, X., Shen, L., and Wu, Y. (2011). Green strategy for gaining competitive advantage in housing development: a China study. *Journal of Cleaner Production*, *19*(2-3), 157-167.

Zhou, L., and Lowe, D. J. (2003, September). Economic challenges of sustainable construction. In *Proceedings of RICS COBRA Foundation Construction and Building Research Conference* (pp. 1-2).

## APPENDIX

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI**

**COLLEGE OF ART AND BUILT ENVIRONMENT**

**Department of Construction Technology and Management**

(MSc. Project Management)

**Survey Questionnaire**

**CHALLENGES AND BENEFITS OF INTEGRATING ENVIRONMENTAL SUSTAINABILITY IN METROPOLITAN, MUNICIPAL AND DISTRICT ASSEMBLIES' (MMDA'S) PROJECTS**

Dear Sir/Madam

This questionnaire forms part of an MSc. Research project which aims to **explore the challenges and benefits of integrating environmental sustainability in MMDA's projects in Ghana.** Environmental sustainability has become a very important area in the construction of projects. The results of this study will identify the challenges associated with integrating environmental sustainability in MMDA's projects in Ghana. The results will also identify benefits of integrating environmental sustainability in MMDA's projects in Ghana.

I would like to invite you to participate in the above project. Completion of the questionnaire is completely voluntary and returning the completed questionnaire will be

considered as your consent to participate in the survey. The questionnaire will take you about 10 minutes to complete.

The data collected will be used purposely for this research and any solutions obtained will be shared for the entire construction indusry.

I appreciate that you are already busy and that participating in this survey will be another task to add to your busy schedule, but by contributing you will be providing important information. **All data held are purely for academic purposes and would be treated as strictly confidential.**

In the event of questions or queries, please do not hesitate to contact me. Thank you for your time and valid contribution in advance.

Yours faithfully,

STEPHEN TAWIAH OFOSUHENE
MSc. Researcher
Email: stofs2007@yahoo.com
Tel: 0242707037

**SECTION A: RESPONDENT'S PROFILE**

**Please, kindly respond to the questions by ticking (√ ) in the appropriate box(s) for each item.**

1. Please state the number of years you have been in the Assembly
   - □ Less than 1 year
   - □ 1 – 5 years
   - □ 6 – 10 years
   - □ 11 – 15 years
   - □ More than 15 years

2. Please indicate highest qualifications (please do not tick **(√ ) more than two boxes**)
   - □ MSc
   - □ BSc
   - □ HND
   - □ Technician/ CTC I, II, III
   - □ Other……(please indicate)

3. Please indicate your position in the Assembly.
   - □ Engineer
   - □ Architect
   - □ Quantity Surveyor
   - □ Planning Officer
   - □ Other …….(please explain further)

4. Please indicate your Department in the Assembly.
   - □ Works
   - □ Planning
   - □ Town Planning
   - □ Other ……..(please explain further)

**SECTION B: CHALLENGES ASSOCIATED WITH INTEGRATING ENVIRONMENTAL SUSTAINABILITY IN MMDA'S PROJECTS**

1.Please read the following and tick the box that best represents your level of agreement to the identified challenges associated with integrating environmental sustainability in MMDA's projects.

**Use the scale: 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree**

| ITEM | CHALLENGES | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | Lack of consensual cooperation | | | | | |
| 2 | Lack of professional practices | | | | | |
| 3 | Meagre number of professionals | | | | | |
| 4 | Lack of transparency in tendering processes | | | | | |
| 5 | Lack of knowledge | | | | | |
| 6 | Lack of technologies | | | | | |
| 7 | Unavailability of sustainable materials | | | | | |
| 8 | Language barrier | | | | | |
| 9 | lack of sustainable building scope of information among stakeholders | | | | | |
| 10 | High demand for infrastructure | | | | | |
| 11 | Political inconsistency | | | | | |
| 12 | lack of solid laid-down national comprehensive development policy | | | | | |
| | | | | | | |
| | | | | | | |

Please state below any relevant information which you deem necessary

……

……

……

**SECTION C: BENEFITS OF INTEGRATING ENVIRONMENTAL SUSTAINABILITY IN MMDA'S PROJECTS**

1. Below are the benefits of integrating environmental sustainability in MMDA's projects. From your experience, express your opinion on the level of agreement to the following benefits. **Use the scale: 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree**

| ITEM | BENEFITS | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | Improves project performance | | | | | |
| 2 | Minimal life cycle cost of the end product | | | | | |
| 3 | Increase building efficiency | | | | | |
| 4 | Provide comfort to users/ occupiers | | | | | |
| 5 | Higher productive investment returns | | | | | |
| 6 | Improves energy consumption | | | | | |
| 7 | Enhanced sense of wellbeing | | | | | |
| 8 | Corporate image | | | | | |
| 9 | Reduces the operational cost of buildings | | | | | |
| 10 | Longer building life span | | | | | |
| 11 | Efficient use of resources | | | | | |
| 12 | Minimal impact on environment | | | | | |
| | | | | | | |
| | | | | | | |

Please state below any relevant information which you deem necessary

……

……

……

……

Thank you.