

**TESTING THE UNDERSTANDING OF THE OPERATIVES ON SUSTAINABLE
CONSTRUCTION IN THE AGONA EAST DISTRICT OF GHANA: AN
EXAMINATION OF EXCAVATION WORKS**

BY

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DECLARATION

I hereby declare that this thesis is a result of my research work en route for the award of MSC. Construction Management and that, except for other materials used which have been duly acknowledgment, it does not, to the best of my knowledge, contain any previously submitted or published material by anyone else.

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ABSTRACT

Sustainability is viewed as an essential element of development. The negative impact of construction on the environment has gained much attention in recent times. As a result, several guidelines for construction works have been developed in favour of environmental sustainability. The International Council for Research and Innovation in Building and Construction (CIB) in 2002, emphasized the need for an internationally agreed Agenda on Sustainable Construction (SC). While this move has seen many construction industry players in developing countries making serious attempts to embrace SC practices in their activities, unfortunately, the situation appears to be different in developing countries such as Ghana. This study tests the understanding of operatives on SC on SC practices in the Agona East District (AED). Five newly awarded Construction Projects were purposely selected for the study. A purely qualitative approach to research was used for the study. Primary data were collected from in-depth interviews of twenty (20) key respondents. The findings of this study revealed that most construction practices of these operatives to a very large extent do not conform to SC principles or practices. The traditional construction practices are still very dominant in their construction activities. Low level of awareness of Sustainable Construction (SC) principles practices, Lack of government policy on SC, increased financial cost, absence of a mandated regulatory body and socio-cultural reason were cited as the major reasons for the low level of SC practices among the operatives of the AED. Based on the findings, the need for a clear Government policy and an authorized regulatory body among others have been recommended for this study.

KEY WORDS: Sustainability, Sustainable Construction, Operatives, Understanding, Excavation works, Ghana.

TABLE OF CONTENT

DECLARATION.....	i
ABSTRACT.....	ii
TABLE OF CONTENT.....	iii
LIST OF TABLES	viii
ACKNOWLEDGMENT	ix
DEDICATION.....	x
LIST OF ABBREVIATIONS	xi
CHAPTER ONE	1
INTRODUCTION.....	1
1.1 BACKGROUND TO THE STUDY	1
1.2 PROBLEM STATEMENT	2
1.3 AIM OF THE STUDY	3
1.4 RESEARCH OBJECTIVES	3
1.5 RESEARCH QUESTIONS.....	4
1.6 SIGNIFICANCE OF THE STUDY	4
1.7 SCOPE OF THE STUDY	5
1.8 RESEARCH METHODOLOGY	5
1.9 ORGANIZATION OF THE RESEARCH.....	6
CHAPTER TWO	7
LITERATURE REVIEW	7
2.0 INTRODUCTION.....	7
2.1 THE CONCEPT OF SUSTAINABLE CONSTRUCTION	7

2.2 SUSTAINABLE CONSTRUCTION AS AN AGENDA FOR DEVELOPING COUNTRIES	11
2.3 PRINCIPLES OF SUSTAINABLE CONSTRUCTION	12
2.3.1 Minimizing resource consumption	13
2.3.2 Using renewable resources	13
2.3.3 Protecting the natural environment.....	13
2.3.4 Non-Toxics	14
2.3.5 The use of Recycle / renewable materials	14
2.3.6 Quality	14
2.4. EXCAVATION AS AN ASPECT ON SUBSTRUCTURE WORK.....	15
2.4.1 Pre-Excavation.....	15
2.4.2 Excavation	16
2.4.3 Post Excavation	17
2.5. CHALLENGES CONFRONTING THE SUCCESSFUL IMPLEMENTATION OF SUSTAINABLE CONSTRUCTION.....	17
2.5.1 Socio-Cultural Challenges	18
2.5.2 Political Challenge.....	19
2.5.3 Absence of SC awareness.....	19
2.5.4 Financial Challenges.....	19
2.5.5 Technical Challenges.....	20
2.5.6 Leadership Challenge	20

2.5.7 Review of Recommendations to the challenges of Sustainable Construction.....	21
2.6 CONCLUSION	22
CHAPTER THREE	24
RESEARCH DESIGN AND METHODOLOGY	24
3.0 Introduction	24
3.1 Study Area Profile.....	24
3.2 Research Design.....	26
3.3 Research Strategy:.....	27
3.4 Research Population.....	27
3.5 Sampling Method.....	28
3.6 Data Collection Procedure:	29
3.7 Instruments for the Study:.....	29
3.8 Data Analysis:	30
3.9 Ethical issues that are likely to emerge during the data collection	30
CHAPTER FOUR.....	31
PRESENTATION OF DATA AND ANALYSIS	31
4.0 INTRODUCTION.....	31
4.1 THE CURRENT PRACTICES OF OPERATIVES IN EXCAVATION WORKS	32
4.1.1 Inspection of Site for Clearance	33
4.1.2 Clearing of Site Bushes/unwanted materials	35
4.1.3 Top Soil Excavation	36
4.1.4 Setting out.....	37
4.1.5 Excavation work.....	38

4.1.6 Safety Measures at the Site.....	41
4.2 CHALLENGES FACING OPERATIVES IN ADOPTING SUSTAINABLE PRACTICES IN CONSTRUCTION.....	44
4.2.1 Lack of understanding of sustainable construction principles/practices	44
4.2.2 Lack of Government policy or regulatory framework.....	45
4.2.3 Financial problems about the implementation of SC principles/practices	46
4.2.4 Socio-Cultural Challenge	46
4.2.5 Lack of proper supervision by the Planning Authority of the District Assembly	46
4.3 RECOMMENDATION TO THE CHALLENGES OF SUSTAINABLE CONSTRUCTION PRACTICES IN THE AED	47
4.3.1 The need for a clear policy document and regulatory framework.....	48
4.3.2 Introduction of a reward system	48
4.3.3 Awareness Creation.....	49
4.3.4 Sensitization among the general public	49
4.3.5 Increase the supply of sustainable construction materials.....	50
4.4 CONCLUSION	50
CHAPTER FIVE	50
SUMMARY AND CONCLUSION	50
5.0 INTRODUCTION.....	50
5.1 SUMMARY	51
5.2 CONCLUSION.....	52

5.3 RECOMMENDATION	53
REFERENCES.....	55
APPENDICES.....	59

LIST OF TABLES

Table 1. Sustainability Factors.....	10
Table 2.0 LISTS OF PROJECTS/PROGRAMMES/INITIATIVES (2019).....	27

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DEDICATION

This thesis is dedicated to my beautiful wife, Mabel Afia Mensah-Sam, for her prayers, encouragement and immeasurable support towards the completion of this research.

LIST OF ABBREVIATIONS

AED:	Agona East District
AEDA:	Agona East District Assembly
CIB:	International Council for Research and Innovation in Building and Construction
CCOHS:	Canadian Centre for Occupational Health and Safety
FC:	Forestry Commission
SD:	Sustainable Development
SC:	Sustainable Construction

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Over the years the quest for sustainable development for both developed and developing world has been on the increase (Opoku and Ahmed, 2014) with different sectors of society embracing various principles of sustainable development. One major aspect of human needs, which has received appreciable level of attention in Sustainable Development (SD), is in the area of human settlement. There is, therefore, the need to situate the role of human settlement within the context of sustainable development. It was in the light of this, that the International Council for Research and Innovation in Building and Construction (CIB) highlighted the necessity for a global established plan on Sustainable Construction (SC). This plan was published in its Agenda 21 on Sustainable Construction (CIB, 2002). The argument has been that construction activities play a vital role in the realization of SD goals due to its huge impact on the environment. The construction industry is seen as a major user of non-renewable resources and poses a threat to the natural environment. For reasons such as these and others, the built environment has come under growing apprehension regarding the harmful effects of construction practices on the environment. As a result, countries both developed and developing are embracing SC practices and principles in their built environment (Ametepey et. al., 2015) to ease the outcome. Some of these measures include managerial and technological processes, cultural, and legal frameworks.

According to (Ametepey et. al., 2015), the construction industry in different ways borders on three major sustainability scope, namely; Social, Environmental and Economic. In terms of the Social, the attention is on making stakeholders (employees, suppliers and the community) responsible for their activities. The Environment touches on waste management, judicious and efficiency in

energy and water usage among others. With the Economic aspect, the interest is on economic growth and employment.

In the light of the aforementioned, Sustainable construction is therefore perceived as an innovative way of ensuring that the construction industry responds to the various Environmental, Social and Economic challenges faced globally (CIB, 2002).

Despite its overwhelming advantages, the implementation of these environmentally friendly practices and processes in construction (Sustainable Construction) has not been without challenges. According to (Ametepey et. al., 2015) and (Baloi, 2003), these challenges vary from political to social, financial, cultural and managerial. Sustainable Construction has since been a tight spot for the construction industry.

1.2 PROBLEM STATEMENT

The construction industry encompasses all those involved in planning, developing, producing, designing, building, maintaining as well as consultants, manufacturers, clients, suppliers of construction materials, contractors, and end-users of construction amenities and services.

Several studies have attempted to explore various sustainable construction practices and processes in various aspects of construction, (Robichaud & Anantatmula, 2010; Opoku & Ahmed, 2014) while others have also tried to understand the effectiveness of SC as well as its implementation challenges from professionals in the field of construction. (Baloi, 2003; Djokoto et al., 2014; Ametepey et. al., 2015; Ogunde *et al.*, 2017). However, in all of these studies, very little attention has been given to the current practices of the operatives/workforce on SC and why they do what they do. Therefore, a study that would seek to explore the understanding of the workforce on SC practices, as well as the challenges they encounter in the discharge of their duties, would be a step

in the right direction. Due to the broad nature of construction works, this study seeks to focus only on the excavation works as an aspect of substructure works in construction.

1.3 AIM OF THE STUDY

The goal of this study was to advance plans for the execution of sustainable practices and processes within the construction industry.

1.4 RESEARCH OBJECTIVES

Sustainable Construction all over the world is perceived as an innovative way of minimizing the negative impacts of construction on the natural resource. Although, several SC practices and processes have been widely embraced, yet several factors mitigate against its effective implantation (Baloi, 2003; Djokoto et. al., 2014; Ametepey et. al., 2015; Ogunde *et al.*, 2017). The main objective of this study, therefore, is to explore the understanding of stakeholders on the overall agenda of SC and to identify the challenges confronting them in the discharge of their mandate to prioritize their needs and to envision the way forward. Base on the above, the study sought to;

1. To determine the current practices of operatives in excavation works,
2. To ascertain the extent to which these practices conform with sustainable practices,
3. To determine the challenges facing operatives in adopting sustainable practices in construction and
4. To propose measures to ensure the use of sustainable practices within the construction industry.

1.5 RESEARCH QUESTIONS

This study seeks to answer some questions regarding the understanding of the workforce on SC practices and processes. The answers to these questions will reveal the level of understanding of SC agenda among practitioners in the construction industry as well as the challenges they face in their quest to minimize the negative effect of construction on the environment. The main research questions of this study are:

1. What are the current practices of operatives in excavation works?
2. To what extent do these practices conform to sustainable practices?
3. What are the challenges facing operatives in adopting sustainable practices in construction?
4. Which proposed methods could be used to ensure sustainable practices within the construction industry?

1.6 SIGNIFICANCE OF THE STUDY

This study fills the literature gap on the understanding of the workforce on SC practices before, during, and after implementation of construction projects specifically on excavation works. It also broadens the understanding of stakeholders on the challenges confronting the operatives/workforce in the implementation of SC practices. It as well, provides probable solution to the identified challenges. Lastly, it provides plans for the successful execution of sustainable principles and practices in construction works.

It is hoped that the findings of this study will provide insight and increase the commitment of stakeholders towards the empowerment of the workforce, through the development of plans, policies, and programs that promote the understanding of sustainable practices among construction

workforce. Hence there is room for a unique contribution to literature in terms of theory and practice.

1.7 SCOPE OF THE STUDY

This study geographically focused on construction projects within the Agona East District Assembly (AEDA) of the Central Region of Ghana. The Agona East District (AED) is one of the farming communities in the country with very low educational performance at both the basic and second cycle schools. It is in the light of this, that several construction projects have been embarked on by the government of Ghana through the Assembly to cater for the needs of the people. Whilst some of these construction projects have been completed, others were still on going as at the time of this study. The focus of this study was to explore the current SC practices of the workforce in the implementation of these construction projects, particularly during excavation works. The key interest was to ascertain the understanding of the workforce on SC practices and the challenges encountered in the implementation of these practices. The selection of these construction projects within the district allowed for an in-depth examination of the level of understanding of the workforce involved in the construction of these facilities.

1.8 RESEARCH METHODOLOGY

This study used a qualitative approach of research. Qualitative data was gathered through personal interviews with respondents with the aid of a structured interview guide. The study focused on the understanding of Operatives on SC practices in the Agona East District in the Central Region of Ghana. The study uses both convenient and snowball sampling techniques for the study. Four categories of key operatives involved, in the excavation works of five major ongoing projects in the AED were interviewed for the study. These categories are: Site Supervisors, Masons,

Carpenters, and Labourers. In all, 20 respondents were sampled for the study: four (4) from each of the five (5) categories listed above, across the five selected projects.

The Data gathered from the face-to-face interviews were analyzed manually according to the themes that were generated from the interviews. Other materials from scholarly articles and books were also employed to aid the analysis of the findings that emerged from the study.

1.9 ORGANIZATION OF THE RESEARCH

This research work has been organized into five chapters. **Chapter one** introduces the core of the study by presenting the background of the research, the research problem, the aim of the study, the research objectives, and the research questions, significance of the study, scope of the study and organization of the research.

Chapter Two presents review of relevant literature on the definitions, concepts, and theories of SC from which to view later findings. Secondly, it provides a mapping and a brief overview of the challenges affecting the effective implementation of SC practices, in the construction industry.

Chapter Three covers the methodological approaches which highlight the research strategy, study population, sampling techniques, data collection instruments, and data analysis for the study.

Chapter Four covers the data presentation, discussions, and analysis of findings.

Finally, **Chapter five** contains the study summary, conclusion of the study, and recommendations as well as directions for future studies. The references and appendices follow this chapter.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter reviews relevant literature on Sustainable Construction (SC). This section seeks to achieve three (3) main objectives. Firstly, it provides a base of relevant definitions, concepts, and theories of SC from which to view later findings. Secondly, it provides a mapping and a brief overview of the challenges affecting the effective implementation of SC practices, in the construction industry to situate my study in the wider context of literature. Thirdly, it throws light on the proposed solutions to the existing challenges confronting the effective implementations of SC practice in the construction industry and the way forward. Four sets of literature are reviewed to inform my study of SC principles and processes: The concept of Sustainable Construction, Agenda 21 of Sustainable Construction in Developing Countries, challenges of Sustainable Construction and Recommendation to the Challenges of Sustainable Construction.

2.1 THE CONCEPT OF SUSTAINABLE CONSTRUCTION

The Construction industry includes the people who plan, develop, and design, clients, produce, maintain, consultants, build, manufacturers and suppliers of construction material as well as the users of the facility (Construction for Sustainable Development-Research and Innovation Needs (CRISP), 2000). Over the years, the construction industry has been considered as not only being wasteful but also being inefficient, ineffective and unsafe (Ametepey et al., 2015). SC as a concept has gained global prominence over the years. Various scholars have assigned different definitions to this concept with variation in terms of context and scope. For instance, Parkin, (2000) and Ametepey et al., (2015) describes SC as a subset of sustainable development and by extension, the application of sustainable development to the field of construction. SC encompasses issues

regarding, planning, organizing, selection of materials, tendering, minimization of waste and recycling (Opoku et al., 2014).

A very common and mostly cited definition of SC is the one given by (Kibert, 1994) where he defined SC as ‘the creation and responsible management of a healthy built environment based on prudent use of resources and ecological principles’. Another definition also sees SC as a viewpoint, involving a start to finish appraisal of project, which includes the management and servicing of project during its entire life span and ultimate deconstruction (Wyatt, 1994). This definition could be seen to focus more on the economic aspect of SC.

Meanwhile, some scholars (Parkin, 2000; Chaharbaghi & Willis, 1999) are of the view that SC should be more geared towards environmental sustainability. The argument is that environmentally sustainable construction will further generate social awareness, environmental responsibility, and economic profitability. Similarly, Osaily (2010) view SC as ‘the design, development, construction, and management of real estate such that the negative environmental effects of the construction, restructuring, and management of the built environment are reduced as far as possible.

Another broader perspective defines SC as comprising a series of procedures through which an economically viable industry provides building facilities to advance quality of life and stakeholder interest (DETR, 2000). Another acceptable definition in literature is the one given by Agenda 21, where SC is defined as a comprehensive process that aims at restoring and maintaining relationships between the natural and built environment and creating settlements that affirms human dignity and encourage equity.

Aigbavboa et al., (2017) are also of the view that every society especially the construction industry must embrace SC as part of their Cooperate Social Responsibility. This explains why clients,

consultants, and legislators are increasingly mindful of the need to adopt SC in the construction enterprise.

The United Kingdom's approach for inclusive SC suggests some indicators that the built environment could adopt to ensure a successful SC implementation. These factors include: designing for minimum waste, embracing lean construction, minimizing energy use in construction works, avoiding pollution whatsoever; enhancing and preserving biodiversity, water resources conservation, setting targets and periodic monitoring of reports to standardize performance, respect for people and local environment (DETR, 2000).

The general argument in literature has been that construction activities directly or indirectly have repercussions on the quality of life of the people; the outputs of construction activities changes the nature function and appearance of communities and environment in which people live (Ofori, 2001; Cole, 2000).

A critical look at the sustainability industry reveals three major dimensions of sustainable development. These are environmental sustainability, social sustainability, and economic sustainability. With regards to the environment, there is a need for natural resource management, efficient use of water and energy and waste management in order to reduce the damaging effect on the environment. The social dimension has to do with considering the needs of stakeholders, which include employees, suppliers and the community. The economic factors consider the industry's contribution to economic growth and employment. Research reveals that construction takes up almost half of all resources consumed by humans (Bal et al., 2013).

Sustainability in construction can be obtained when the construction activity can respond to environmental problems, cultural and social strains and provides economic improvement Bal et

al., 2013). These factors has been hammered on by McConville (2006) as shown on the table below:

Table 1. Sustainability Factors

Social Sustainability	Socio-Cultural Factor	There need for a clear understanding of societal values, customs, and traditions as a basis for construction facility.
	Community Participation	There is a need for direct participation of community members in decision making to promote ownership and empowerment among the community members.
	Political Cohesion	Development projects should meet the need and priority of the local people to increase their sense of ownership through a coordinated effort of all categories of people across all levels; local, national and international to ensure efficient delivery of building facility.
Economic Sustainability		Conscious effort to be made to ensure the availability of resources both human and material for the completion of the project.
Environmental Sustainability		This suggests that maintenance of all-natural and renewable resources are not non-renewable and other natural resources are not exhausted nor damaged in the course of the project.

Source: McConville 2006

2.2 SUSTAINABLE CONSTRUCTION AS AN AGENDA FOR DEVELOPING COUNTRIES

In 1992, Agenda 21 was formulated during the Earth Summit in Rio. The Agenda 21 outlined the internationally acceptable blueprint for SD. This Agenda stirred up the desire for development planners all over the world to look for and pursue SD in their various contexts and field. Following this agenda of SD, another action plan was developed; the Habitat Agenda to address the issues related to human settlement in SD in 1999 after a far-reaching collective inquiry (CIB Report Publication: 237) The core objectives of the Agenda was to provide a definite objective, aim, and concept for SC. The concept of SC could be said to extend far beyond the environmental to economic terrain. It extends deeply to even cover social issues involving justice and equity (Bal et al., 2013).

The utmost concern for SC is not only to reduce undesirable environmental impact and improve economic sustainability but to as well provide affordable, value, efficient and quality facilities to clients and users. This focus of agenda 21 for SC requires the development of institutional bodies and infrastructure as well as appropriate mechanisms for risk and disaster management and the information about all these in other for the intergenerational preservation of natural environment for use of human.

According to UNEP SC should possess certain characteristics that are considered essentials to SC.

These characteristics are as follows:

- Project should be habitually planned and preserved in a way that optimizes the entire life cycle of the project.
- Building legislation and standards are key ingredients/requirement of Sustainability

- Environmental consideration both for long and short term as a necessary ingredient of a sustainable project.
- Government to ensure the availability of Policies and incentives aimed at supporting SC buildings and practices.
- All construction stakeholders should be proactive in demanding and encouraging the development of sustainable projects and practices.

To achieve this aim, various stakeholders must come on board to ensure the maximum effective and efficient implementation of SC. These stakeholders according to Bal (2013) include: Managing director, Engineer, Development Manager, Technical Director, Design Coordinator, Environmentalist, Project Manager, Sub-contractor, Area Manager, Architect, Quantity surveyor, Client, Specialist Contractors, Regulatory Agency Conservationist, Archaeologist among others. From the on-going discussion, one could conclude that the overall aim of SC is to ensure judicious use of materials to benefit society. It is often argued that for SC to be effective, certain factors must be in place. These factors are termed the drivers of SC, which include legislation demands, financial incentives and client demand (Aigbavboa et al., 2017). The hunt for SC globally is primarily to ensure that there is stability in terms of infrastructural development and the environment for both current and future generations.

2.3 PRINCIPLES OF SUSTAINABLE CONSTRUCTION

The resources often utilized by the built environment include Power, water, creativity, materials and land, human energy, waste materials and information (Kilbert, 1994). He further went ahead to propose Six Principles of Sustainable Construction. These principles are:

Reducing resource utilization (Conserve); increasing or encouraging resource reuse (Reuse) embracing the use of renewable or recyclable resources (Renew/Recycle,) preserving the natural

environment (Protect Nature), building a healthy, environment devoid of toxics (Non-Toxics), and hunting for quality in making the built environment. These factors are discussed below:

2.3.1 Minimizing resource consumption

This factor considers high-efficiency systems such as high levels of insulation, the use of durable materials that last long and requires low maintenance, low flow textures, and high-performance windows. It also entails the adoption of energy minimizing measures such as providing heating cooling ventilation and lighting for construction facilities.

2.3.2 Using renewable resources

This factor considers the need to use already extracted materials. A significant business in architectural items such as windows, doors, and bricks that can be reused in new construction and renovation has proven to be profitable as owners and architects strive to recapture a sense of the past in new spaces. Other resources such as water can be reused through the use of gray water systems and use of third main systems. Creating new spaces in “gray zones,” areas formerly used for buildings, can use Land.

2.3.3 Protecting the natural environment

The need to protect the environment for future generations is one of the cores of SC. This acknowledges the human power to destroy the world's complex ecological systems and reminds us that we must tread carefully lest we destroy ourselves in the process. Gray zones can be remediated, detoxified and returned nearly to their original state. The abuses of river straightening, marsh draining, and deforestation can be remedied by intelligent intervention in creating the future built environment.

2.3.4 Non-Toxics

The many industries and machines available to man today have been both a blessing and a bane to the future of man. The proliferation of toxic substances produced by these industries that have invaded the environment and had inevitable negative effects on humans. Lead, mercury, asbestos, and dioxins come quickly to mind. The products constituting the built environment and the actual construction of the built environment are accompanied by a wide variety of hazardous and toxic substances that ultimately threaten human health and well-being.

2.3.5 The use of Recycle / renewable materials

SC demands that renewable resources or materials should be given priority over others. Recyclable resources have recycled content, or that are from renewable resources must be embraced by construction industry players. This Principle applies to energy where renewable sources such as solar and wind power are available for use. It applies to materials such as wood. This common construction material can be supplied from certified sustainable forests that provide the buyer with a reasonable level of assurance that the suppliers are managing their resources in a manner that protects the environment.

2.3.6 Quality

This factor has to do with excellence in the design of buildings as an essential component of sustainable construction because spaces that are not valued by their occupants will, by their very nature, fall into disuse, disrepair, and disorder, contributing to the exact antithesis of what sustainability strives to achieve. Selection of materials, energy systems, design of passive energy and lighting systems, and a host of other decisions rest on the idea that significant analysis and designs are required.

The outcome of stating and exploring these principles is to acknowledge just how interconnected all these factors are and how badly integration of this knowledge is needed. The benefits of the adoption of these SC principles have been lauded in literature over and over again. Some of the benefits identified in the literature include: Cost reduction, increased productivity, improved health, waste minimization, better use of materials, environmental protection, noise avoidance, better quality of life, emergence of new materials and more room for experimentation (Osaily, 2010; Ametepey et al., 2015).

2.4. EXCAVATION AS AN ASPECT ON SUBSTRUCTURE WORK

Excavation is the process of moving earth, rock or other materials with tools, equipment or explosives. It includes earthwork, trenching, wall shafts, tunneling, and underground. Excavation has several important applications including exploration, environmental restoration, mining, and construction. Among these, construction is one of the most common applications for excavation. Excavation is used in construction to create building foundations, reservoirs, and roads. According to the American Pipeline Contractors Association (APCA), the entire excavation process must conform to certain sustainable principles, which have been spelled out in the guidelines as follows:

2.4.1 Pre - Excavation

Before the actual excavation works begins the following are the steps appropriate to follow to ensure the sustainability of the entire excavation process.

- Get arrangement sheets and other materials such as the drawings of the project so that is will be easy to pinpoint excavation position.
- Certify that all mounted overhead or underground structures are properly marked and crossed out.

- Ensure there is an adequate examination of all tools to check for any item that needs replacement or repair before works begin.
- All persons on site should be required to wear protective clothing at all times according to the various tasks being performed.
- Guarantee the use of a spotter at all times for overhead power lines and all underground utilities.
- Ensure at all times that only experienced person is on-site.
- Public safety should be an utmost priority at all times especially from all opened excavations.

2.4.2 Excavation

Once the pre-excavation measures are taken care of, there is a need to ensure certain practices even as the excavation works are on going. These measures are:

- All legislations on excavation and government policies should be observed at all times for the excavation works.
- A spotter should be used for all overhead and underground utility.
- 2-foot horizontal open area should be maintained for every material, tools, and equipment.
- For all excavations of 5 feet and beyond, there should be an appropriate slopping, technique, and benching for all excavations of Assure that proper sloping, benching, or shoring techniques.
- All accumulated water should be checked and removed from all excavation works.
- All utility lines and crossings must be covered at all times.
- For 20 feet or above excavation depth, there should be a designed protective system.

- Only experienced persons should be allowed to examine and document the excavation checklist periodically and after every change of persons or weather.
- The excavation can only be entered after it has been checked and examined by a competent person as safe for entry.
- Employees of the site should be at all times made aware of the dangers and the appropriate processes and methods associated with the work.

2.4.3 Post Excavation

After the excavation works certain measures must as well be taken into consideration for the entire sustainability process to be complete.

- All work done should be inspected to ensure compliance with company backfilling and specifications.
- Check for assurance that all utility lines and structures are protected and supported.
- Ensure that at all times all equipment and tools are removed from the site as well as other debris before backfilling.

2.5. CHALLENGES CONFRONTING THE SUCCESSFUL IMPLEMENTATION OF SUSTAINABLE CONSTRUCTION

Despite the numerous advocacies and sensitization on the benefit for and need for SC, very little achievement has been attained. So many reasons have been listed as challenges affecting the efficient implementation of SC practices all over the world (Aigbavboa et al., 2017). Some of the major challenges highlighted in literature have been the inability to reduce the harmful effects of SC activities on the environment and local communities (Aigbavboa et al., 2017). The Construction Industry Development Board (CIDB) in the Agenda 21 for Sustainable Construction in Developing countries highlighted the fact that SC has not been given the needed attention in decision-making.

Another challenge identified by Miranda & Marulanda (2001) is that there is a perception among construction firms that SC is a cost inflated activity in construction projects devoid of the numerous advantages of SC to the environment. Besides, the construction industry is confronted with inadequate resources to employ advanced technology in its practices. The fear is that the investments in advance technology will further reduce their profit margin. It is argued that the inadequate or lack of technical-know-how impede the progress of SC (Reffat, 2004).

Another critical challenge identified in literature is the lack or low awareness on the part of clients. Most clients see the SC as the sole responsibility of the government and the contractors but not the client or user (Miranda & Marulanda, 2001).

In their study on sustainable construction implementation in Ghana, Ametepey et al., (2015) identified certain barriers to the successful implementation of SC practices. The study further identified five most severe obstructions to the successful implementation of SC as lack of government commitment, absence of legislation, cultural change resistance, fear of inflated cost of investment, and lack of professional knowledge. The study also highlighted some weak challenges to the success of SC as including lack of system knowledge, lack of market segmentation, lack of employee training and development and delay in decision making among others. Details of these challenges are presented below:

2.5.1 Socio-Cultural Challenges

This has to do with the low demand for SC product and the inability to change certain cultural practices to embrace new trends in favor of SC. Meanwhile, it would be difficult to adopt SC practices without the support or developers' consent. The explanation given is that the Ghanaian community is often used to old way of construction in terms of method, practices and materials used that any attempt to convince or educate stakeholders on the need to change these ways proves

futile. Hence low demand for SC materials by clients, which further leads to its low supply (Dair & Williams, 2006).

2.5.2 Political Challenge

Several studies have identified political challenges as a major bottleneck to the adoption of SC practices in the construction industry (Dzokoto & Dadzie 2014; Osaily, 2010). They cited the absence of building codes, very minimal government support and commitment as well as the lack of substantive legislation as a major problem in the campaign for SC. Government as a key stakeholder in the Construction industry is expected to champion the cause of SC by providing the enabling atmosphere for the effective implementation of SC.

2.5.3 Absence of SC awareness

Lack of awareness has been stated as a very significant reason behind the ineffective implementation of SC. Low level of clients' awareness on the part of professionals with regards to the knowledge and benefits of SC practices. Most clients and developers are not fully conversant with the importance of SC. Lack of education and in-depth knowledge of sustainable design and practices account for this (Häkkinen & Belloni, 2011). The various actors within the construction industry need to appreciate and endorse SC to the core. All these stakeholders must come together as a team to achieve the SC agenda.

2.5.4 Financial Challenges

There is this notion that SC practices in general increase the cost of investment, has a long Pay-back period, and absence of financial resource to fund the cost of project and ignorance on the part of client on the profit life cycle of SC projects. This notion has negatively impacted the progress of SC practices over the years. The Fear of the high cost of SC projects has compared to traditional building practices as well as the risk of unforeseen cost often makes it difficult for people to adopt

the SC practices in construction (Häkkinen & Belloni, 2011). Although Hydes and Creech (2000) opine that SC increases the cost of capital up to 25% at the initial stage, this cost is however covered for by the operational cost later in the life cycle of the people as well as user comfort. Nevertheless, perceived benefits, which are often expressed in the long run as environmental and social benefits, are not enough to compel stakeholders to embrace the SC practices and processes (Häkkinen & Belloni, 2011).

2.5.5 Technical Challenges

According to Ametepey et al., (2015) some of the technical obstructions to effective SC are the absence of accessible guidance, absence of sustainability measurement tools, chronic labour shortage, lack of environmentally sustainable materials. The technicality of these challenges stems from the fact that their presence or absence directly impact on the sustainability of construction projects or otherwise. There is also the assertion that some designers in the construction industry lack the necessary skills to successfully embark on SC projects. Similarly, certain SC materials such as advance glazing systems are not locally available. Some of these products have to be imported from elsewhere in many cases. Besides, some of the designers are as well not fully equipped with appropriate SC guidance or principles (Osaily, 2010).

2.5.6 Leadership Challenge

Studies have revealed that certain managerial issues negatively affect the progress of SC (Osaily, 2010; Ametepey et al., 2015). Management here refers to the leadership of the construction and individual organizations. These managerial issues include lack of motivation from leadership, lack of commitment on the part of management and lack of market segmentation and above all, delay in decision-making. These challenges to a large extent affect the successful implementation of SC

in Ghana. Leadership, therefore, has a major role to play in the successful implementation of SC or otherwise.

2.5.7 Review of Recommendations to the challenges of Sustainable Construction

Following the numerous challenges leveled against the successful implementation of SC, various studies have come out with possible solutions or recommendations to address the challenges. Some of the recommendations are discussed below:

Dobson et al., (2013) in their study on the cost and benefit of SC, outlined various challenges to the success of SC some of which have been discussed above. For instance, it was revealed that SC increases investment cost and confounds the ability to construct projects but at the same time saves running cost through the reduction of building carbon output. The findings of the study produced some recommendations to address the problems. The recommendations are:

The introduction of stricter government legislation in favor of SC practices and processes

- The need for all stakeholders to enhanced education and communication necessary to ensure compliance by all parties involved in the construction processes.
- More attention should be paid to the designing stage to deliver sustainable output solution at a moderate cost (Larson & Clark, 2000).
- There is the need for increased competition among manufacturers and suppliers for competitive prices and quality product to beat down the cost associated with SC;
- There is a need for increased commitment of all stakeholders in the construction sector especially the developers and clients to make sustainable principles become common practice. Since the success of SC is very much dependent on the ability of stakeholders to commit themselves to change and hard work towards the achievement of the SC goals (Ametepey et al., 2015).

- There is a need to increase awareness on government intervention and invention to motivate clients and developers for successful SC adoption.

The ultimate argument has been that, SC concept would be successful provided all stakeholders especially the government generate a policy document or legislation and put in place enforcement mechanisms in all aspects of sustainable development. Another recommendation made by Dzokoto & Dadzie (2013) is that the government should make it a point to ensure that all government construction projects adopt SC practices. All government ministries, department and agencies should lead the campaign for SC by ensuring that all new projects within these sectors follow the SC principles. This will give the government the moral right to insist that all private organizations and individual emulate and abide by the SC principles. It is also very crucial that all technical information concerning SC be made available to design professionals, contractors and consultants and all those responsible for implementation and evaluation of designs and construction projects as access to information is cited as a major barrier to the success of SC (Osaily, 2010).

Besides, managers of all organizations and agencies should be committed to the SC principles by providing the requisite resources and support and be ready to address any change that arises as a result of the adoption of SC in project execution (Osaily, 2010). For Osaily, (2010) it will be difficult to achieve the aims of SC without commitment, innovation and support on the part of management.

2.6 CONCLUSION

The consensus from the discussion so far has been that there is the need to embrace SC practices in all of Construction activities. There is a need for drastic measures to be taken by the government, developers, and clients as well. An all-inclusive approach is needed to enforce the SC principles

and practices considering the numerous challenges discussed above as impeding the successful implementation of SC.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

This section presents the strategy by which the study employs to collect and analyze the necessary information for the study. The main objective of this research is to determine the current practices of the operative/workforce on sustainable construction practices and processes in the Agona East District (AED) in the Central region of Ghana. This chapter presents the study area profile and discusses the methods employed in gathering and analyzing the data for the study.

3.1 Study Area Profile

The Agona East District (AED) was carved out of the defunct Agona District in 2008 by Legislative Instrument 1921 in 2007 as a means of ensuring effective administration and bringing development to the doorstep of its citizens. It is one of the twenty-three (23) Political and Administrative Districts in the Central Region of Ghana. Agona East District is situated in the eastern corner of the Central Region within latitudes 5⁰30' and 5⁰50'N and between longitudes 0⁰35' and 0⁰55' W., It is bounded on the South-west by the Agona West Municipal Assembly. The West Akim and Birim South District Assemblies lie to the north of the District whilst it is bounded on the East by Awutu Senya and South-East by Gomoa East District and to the West by Asikuma-Odoben-Brakwa and Ajumako-Enyan Essiam District. It has a total land area of 539.7 square kilometers, which is about six percent (6%) of the total land area of Central Region. The District whose capital is Agona Nsaba falls within the forest belt of Ghana and is a cocoa producing area. The total population of Agona East District is 85,920, according to the 2010 Population and Housing Census, representing 3.9 percent of Central Region's population (2,201,863). The females

(44,885) make up 52.2% of the population as against 41,035 (47.8%) males denoting more females than males.

The vision of the district is to enhance the human resource capacity of the people in the District for them to develop and improve their standard of living. The mission of the District is “to ensure sustainable and qualitative improvement in the living conditions of the people, through the efficient mobilization and usage of resources, to support the development of the agricultural, health, education, trading and other sectors of the economy in collaboration with the communities, NGOs, Private and other Development Partners”.

According to the 2018 Composite budget of the AED, the district exists to perform the following functions among others:

- Ensure that the outline of District development plans and budget are prepared and submitted to the government for approval and recommendations.
- All programs of the district are formulated and all strategies put in place for the effective organization of people and materials for the development of the district. Initiate program for the development of basic infrastructure and provide municipal works and services in the District.
- Be responsible for the development, improvement, and management of human settlements and the environment in the District.
- In co-operation with the appropriate national and local security agencies, be responsible for the maintenance of security and public safety in the District.

- Ensure ready access to the courts and public tribunals in the District for the promotion of justice.
- Initiate, sponsor or carry out such studies as may be necessary for the discharge of any of the functions conferred by this law or any other enactment; and
- Perform such other functions as may be referred to it by the government.

The major occupation of the people is farming followed by trade and commerce.

3.2 Research Design

Creswell (2013), defines research designs as plans and processes for a research project that spans across the decisions, assumptions, methods of data collection and analysis adopted by the investigator. Generally speaking, there are three types of research methods: quantitative, qualitative and the mixed methods approach (Creswell, 2013). The decision to use any of these methods depends extensively on the type or nature of the study to be undertaken. This study employs the qualitative method of research to test the understanding of operative on the principles and practices of SC. This is because the study has to do with both participant observation and indebt interview. The survey used the non-experimental, descriptive research method. The aim is to gather information from a sample of population such that the results are representative of the population within a certain degree of error. One major advantage of the qualitative research design is that it provides an avenue for a researcher to have control over prominent physical and socio-economic characteristics of the target population that are likely to influence operative views on sustainability practices in the excavation works.

3.3 Research Strategy:

A strategy is the art and science of formulating, implementing and evaluating a plan to achieve a desired goal or objective. In undertaking a research strategy, the researcher aims at getting results to a research problem he or she is undertaking. In doing so, the researcher designs a research objective and questions or hypothesis to arrive at a logical deduction and conclusion at the end of the research. In this piece, the strategy the researcher used was descriptive method of research through the collection of qualitative data. This helped the researcher to arrive at a logical deduction.

3.4 Research Population

The research population comprises of key operatives involved in the excavation works in the AED. This comprises of all Four (4) categories of operatives who are currently undertaking five major construction projects within the district under the supervision of the AEDA. These projects are listed below:

Table 2.0 LISTS OF PROJECTS/PROGRAMMES/INITIATIVES (2019)

NO.	TITLE OF PROJECT	LOCATION	FUNDING
1	Construction of Kindergarten Block	OTEPRO PRIMARY SCHOOL	GETFUND
2	Construction of 1No. 6-Unit Classroom Block with ancillary facilities	MENSAKROM	GETFUND
3	Construction of 1No. Kindergarten block	AGONA KOKOADO	GETFUND
4	Construction of 1No. 6-Unit Classroom Block with ancillary facilities	FANTE BAWJIASE	GETFUND

5	Construction of 1no. CHPS Compound	AGONA MANKRONG JUNCTION	DACF
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Source: AEDA list of Project for July 2019.

Out of these five projects, the four categories of operatives interviewed were: Site managers, Masons, carpenters, and Labourers.

3.5 Sampling Method

Sampling procedures afford a range of approaches that helps a researcher minimize the amount of data needed to collect, by focusing only on data from a subcategory instead of relying on other possible causes. (Saunders, et al., 2011). The sampling techniques used for this study is both convenient and snowball. A convenient sample was used in choosing the study area and snowball was used to identify the needed operatives from the various construction projects.

The sampling population was five each of the above-listed categories of operatives who are currently working on five of the major construction works currently ongoing in the AEDA. Thus: Five (5) Site Supervisors, Five (5) Masons, Five (5) Carpenters, and Five (5) labourers. One operative from each category was identified from each of the above-listed projects. Therefore, the sample size is Twenty (20). This is because, construction operatives are deemed to exert some influence in embracing sustainability principles and practices in the built environment amongst other stakeholders (Shi et al., 2014). Consequently, the finding of this study is based on the responses of twenty operatives from five construction projects in the AED.

3.6 Data Collection Procedure:

Both primary (the use of interview guide) source and secondary data (literature review) was obtained for the study to present informative facts to test the understanding and challenges of SC practices among operatives in AED. The researcher drew the primary data through a designed structured interview guide for twenty (20) respondents who were identified through the snowball method selected across the four categories of operatives in the various five ongoing construction projects in the AED. The secondary data was drawn from scholarly articles, journal and relevant books that are related to the study.

3.7 Instruments for the Study:

The official instrument for the study was an interview guide. Appropriate interview guide was designed by the researcher concerning the research questions to carry out the research. For this study, only open-ended questions were asked to allow for each respondent subject views on each question asked (Creswell, 2013). The interview guide for the study consisted of 18 semi-structured questions categorized into five (5) major themes: biography of respondents, excavation practices at the construction site, whether or not these practices conform to sustainability principles, challenges of sustainable construction implementation, and recommendations. The first section of the interview guide aimed at establishing the background of respondents in the study including years of experience, educational qualification, category of organization working with, and their positions in the organization. This information aided in the understanding of the knowledge base of the respondents regarding the subject under study. The Face-to-face interview approach was used to collect data from the respondents in the AED. The use of the semi-structured interview guide allowed the researcher to probe and collect large amounts of data in a relatively short time.

3.8 Data Analysis:

All recorded interviews, documents, observation, discussions, journal entries and field notes were transcribed. The transcription process helped to be familiar with the data. After grouping the data into themes, a file was created for the primary data collected. For confidentiality; the file created was saved on a personal computer and backed up on a Gmail account and protected with a password for safekeeping. The qualitative data gathered through audio interviews was carefully transcribed. After transcribing the audio interviews, the data gathered were grouped under various themes that emerged from the interviews. Sub-themes were generated from main themes until the point where no new themes were discovered by the researcher. This process is what Rusell & Morse, (1995) termed saturation.

The contextual meaning of the data collected was used as a unit of analysis for coding and description. The data was hereafter analyzed case-by-case following the sub-themes that emerged from the data about the research questions (Huberman & Miles 2002). The guidelines developed by Braun and Clarke (2013) was used to analyze the qualitative data. The guidelines are as follows;

(1) Getting familiar with the data, (2) Generating initial codes, (3) Recording throughout each transcript, (4) Reviewing themes, (5) Naming and defining themes, (6) Producing the report.

3.9 Ethical issues that are likely to emerge during the data collection

In conducting the research, the researcher is aware of the ethical implication of the research particularly by the respondents and the academia. In this study the researcher takes note of three major ethical issues: firstly, respondents anonymity was ensured by only asking questions that were directly related to the research questions but not personal details; also, the researcher ensured

flexibility and freedom of respondent to decide to respond to certain questions or not. These made the respondents feel comfortable with the kind of questions the researcher administered.

CHAPTER FOUR

PRESENTATION OF DATA AND ANALYSIS

4.0 INTRODUCTION

In recent times, there has been increasing demand for the need to ensure sustainable practices in every facet of life especially in the development of our environment. One aspect of the environment, which has received major attention over the years, is the area of human settlement. Arguably, human settlement activity such as building and construction has been cited as one major activity that largely polluted the environment (Ametepey et al., 2015). It is in the light of the aforementioned that International the CIB emphasized the need for a globally recognized principles on SC, published in the Agenda 21 on Sustainable Construction (CIB, 2002). It was expected that construction stakeholders both in developed and developing countries would adhere to the stipulated construction practices for development. However, many studies on sustainable

construction both in Ghana and beyond, alluded to the fact that these SC practices are not been embraced (Dzokoto & Dadzie, 2013; Osaily, 2010; Miranda & Marulanda, 2001) due to several factors, most of which have already been spelt out in the Chapter Two of this study. The goal of this study is to advance approaches for the implementation of SC practices and processes within the construction sector. To attain this aim, the study sort to answer four major questions: What are the current practices of operatives in excavation works? To what extent do these practices conform to sustainable practices? What are the challenges facing operatives in adopting sustainable practices in construction? How can the proposed measure promote the implementation of sustainable practices within the construction industry?

The study however concentrated only, on the excavation works of construction projects. Excavation is the preliminary activity of the construction project. It is a process that involves the removal of earth, rock or other materials with tools, equipment or explosives. It also includes trenching, wall shafts, tunneling, and underground. It is the preliminary activity of the construction projects according to the Canadian Centre for Occupational Health and Safety (CCOHS). To answer these research questions, qualitative data were gathered through interview schedules from operatives of five (5) major ongoing construction projects in the AEDA. The findings of the study are presented and analyzed below in categories according to the various research questions.

4.1 THE CURRENT PRACTICES OF OPERATIVES IN EXCAVATION WORKS

The qualitative data gathered identified five major practices of operatives in the AED. These practices are as follows: Inspection of site for clearance, clearing of the site bushes, topsoil excavation, setting out on ground, ground excavation work, management of excess materials and safety measures.

4.1.1 Inspection of Site for Clearance

Respondents were asked to identify the first thing they do upon getting to the site before excavation works begin. More than half of the respondents attested to the fact that the very first thing they do when they get to the site is to inspect the site. By inspection, they check for the topography of the site or the nature of the ground. Thus, whether the ground is steep, level, or waterlog. They do this to be informed on the next plan of action to take. One of the respondents has this to say:

“The first thing I do is to check if the ground is in good shape. By good shape, I mean if the ground is not waterlogged or steep. Because if the ground is waterlogged, I would have to fill the ground and leave it for some time before work can continue” (a 32 years old Mason, with five years of working experience; 20th August 2019).

It was also gathered that in the case of hilly grounds, arrangement has to be made for leveling the ground before excavation work can begin. Another reason given for the inspection of the site is to ascertain the location of the building on the site. Almost all the Site managers cited this as a very important reason to decide what to do or expect before actual groundwork begins. It is, however, important to note that, most of the labourers and carpenters cited inspection of the site as a necessary practice before excavation work. This could probably be because most of the labourers and carpenters’ services are needed after the site is cleared for excavation to begin.

Even though the inspection of the site is an integral aspect of excavation works, inspection of the site is not only limited to finding out the nature of the ground and the portion of the ground to site the building. Several probes were done to find out other possible reasons for inspection but it seems respondents were not very conversant about important reasons for site inspection. For instance, one of the labourers said

“it is very important to inspect the site before work begins so that we can locate the site the next time, in that case, we won't get lost especially if it's in a remote area” (A Labourers with four year's work experience; 21st August 29, 2019). Even though inspection of site is very necessary in sustainable construction, the reason cited by this respondent for inspection of site to a very large extent is trivial and does not conform to Sustainable Construction practices. For instance, according to the Canadian Centre for Occupational Health and Safety (CCOHS) the site must always be inspected to check for the following:

- Check for all laws that pertain to that area and the kind of protective approach to be implemented to ensure safety at all times.
- Decide where and how to position the building on the ground.
- Identify the nature of the ground i.e. hilly, waterlog, etc.
- All buried utility lines must be identified and necessary steps taken to redirect the lines if possible or the appropriate action taken.
- All active power or energy lines must be de-energized as required by law before any action taken on the land.
- All contacts of the utility bodies must be available to the developer for immediate correspondence in case of emergency
- There should be proper planning of the construction site before the work begins. Plan appropriate organization of the work site, and
- Workers should be trained on good housekeeping measures including moving debris and excavated soil far enough away from the excavation site.

All the above-mentioned factors are necessary to consider for planning and for making necessary arrangements towards unforeseen circumstances. However, identifying the nature of the ground and

locating the portion for placement of the building are the major activities practiced by the operatives of the AED. Other factors as outlined by CCOHS were not mentioned or regarded as necessary. Sustainable construction practices can therefore, not be said to be fully practiced by the respondents with regards to the inspection of ground.

4.1.2 Clearing of Site Bushes/unwanted materials

Another common practice among the operatives is clearing of the Site bushes. This practice renders the land naked and makes it possible to access all features of the land. According to the respondents, the bushes on the land are often cleared manually with the aid of cutlasses. The researcher wanted to find out if the entire bushes on the land are cleared or otherwise. The study revealed that not the entire piece of land is often cleared for the construction works. One of the respondents revealed that:

"We cannot clear the entire piece of land. Why should we clear the entire four plots of land when in fact the building will only occupy let's say two plots of land? That is a total waste of time and costly" (Site manager2).

This shows that the entire land is often not cleared because of the cost involved and feeling that it is not necessary. *When asked how the waste is disposed he asserted "we burn them on the site" (Site manager 2).* It appears that the practice of not clearing the entire bushes on the site before construction is dominant among the operative at AED. In terms of cutting down of trees, it was revealed that trees were cleared together with the bushes provided it falls within the building space. When asked, whether permission was sort from Forestry Commission (FC) before the cutting down of trees, almost all of the respondents said no. While some felt it was not necessary, others claimed they were not even aware of such a thing. No sustainable measure is taken about cutting down of trees.

Another respondent disclosed something of cultural significance. According to him; *‘I always find out if there is any shrine on the site or any tree with cultural significance before I embark on bush clearing. I have had issues with that before, so I am careful these days’* (Site manager 4). This practice is in line with SC in terms of preserving cultural values and heritage. This practice conforms to McConville (2006) assertion that socially acceptable project is built on an understanding of local traditions and core values.

These practices to some extent can be said to be in tandem with sustainable practices especially the practice of finding out if there is a shrine or any tree of cultural significant. This is necessary for respect and mutual understanding between cultural and traditional leaders for the sustainability of the construction projects. Some of the sustainable practices sited in literature as appropriate for bush clearing include but not limited to; clearing the bushes, trees, walls, slabs from the entire site; seeking the approval of the Forestry Commission or District Assembly before a tree is cut; sending all cleared materials to the Landfill site rather than leaving it on the site while work is still on going. Also burning of cleared bushes is not a sustainable practice. There should be plans for afforestation to replace the cut-down trees. The burning of bushes or rubbish on the site is not allowed.

4.1.3 Top Soil Excavation

Another identified practice is the excavation of the topsoil. This is necessary to get rid of the vegetable soil to get access to the hard ground for further excavation. Another reason is to get rid of any chemical present in the topsoil that could be harmful to the future of the construction project. The study revealed that the topsoil is normally removed with the aid of a tractor or bulldozer. The removed soil heaped at a particular point very far away from the working space. This is how a respondent put it: *"normally, the excavated topsoil is heaped somewhere on the site about fifty*

meters away from the working space. The reason is that we don't want the removed soil to distract our work". (A Labourer with three years working experience). This respondent could not tell whether heaping the removed topsoil 50 meters away from the working space is the right thing to do. It was also discovered that the heaped topsoil, which was removed, is mostly used for hardcore filling. This practice is deemed appropriate to them because it is less expensive.

According to the Canadian Centre for Occupational Health and Safety (CCOHS), the topsoil or vegetable soil of a construction site must be removed for excavation to be done on the hard ground for sustainability of the structure. It is also appropriate to heap the removed soil at a distance quite far away from the working space. In that case, the fifty meters distance cited by one of the respondents would be the right thing to do. However, one thing that does not conform to sustainable practice is using the topsoil for hardcore filling. This should not be an acceptable construction practice because the topsoil is loose and hence not compact enough to hold the hardcore. For sustainable reasons, laterite (a mixture of sand and gravel) is mostly preferred due to its solid nature and the ability to create a firm ground. Even though respondents appear to be aware of the use of the laterite instead of the vegetable soil, they prefer the use of the vegetable soil because it is readily available and less costly.

4.1.4 Setting out

Setting out is the process of developing the physical location of angles and walls of a building, and moving measurements from the layout plan to the actual ground. The setting out clearly defines the outline of the excavations and the Centre lines of the walls, so that construction can be carried out according to the plan. According to the respondents, *"it is also mandatory to detect the situation of the building on the ground"*; it determines the position of the walls, which in turn determines where the ground is to be excavated, and the concrete poured to create the foundation trenches.

From the data gathered, the equipment needed for setting out include: Timber, round poles or pegs, nylon thread, nails, white chalk, clear hosepipe for determining horizontal levels, sledgehammer, measuring tape, builders square, drawing, 30m tape, 3m tape, steel setting out pins, lump hammer. According to one of the respondent, "*we site the building where the client prefers. Sometimes we can advise the client but mostly it is what he wants that we do*" (Site Manager 3). This shows that so many factors are not considered when setting out. The preference of clients always supersedes that of the developer even if the latter is being guided by sustainable principles. Meanwhile, many of the clients are not abreast with sustainable practices. It, therefore, implies that setting out is mostly carried out without recourse to sustainable principles.

The data gathered from the respondents' shows that respondents do not adhere to several sustainable practices during setting out. Meanwhile, the acceptable sustainable practices that should be practiced are as follows: Checking for the orientation of the building, checking for the levels of the ground, and checking for building corners and building line for accuracy of measurement on the ground which could affect the sustainability of the building. Besides, it is an acceptable principle that all Buildings to have North-South orientation Rectangular shapes to reduce exposure to solar radiation Compact courtyards for thermal storage. It was revealed that respondent do not follow any of the above-mentioned practices hence sustainable construction practices during setting out is not mostly adhered to.

4.1.5 Excavation work

After setting out, the next agenda is excavation. Excavation is the process of moving earth, rock or other materials with tools, equipment or explosives. It includes earthwork, trenching, wall shafts, tunneling, and underground. Excavation has several important applications including exploration, environmental restoration, mining, and construction. Among these, construction is

one of the most common applications for excavation. Respondents asserted to the fact that the soil excavation is done manually with the aid of shovels and pick-ax instead of excavator. During excavation, we normally use buckets or pumps to drain the trenches when there is water in it depending on the volume of water present. The researcher sort to find out what respondents do when they come into contact with underground service line. While some of the respondents specifically the site managers said, "*we normally call the service regulatory authority for relocation or we suspend the exaction work till the relocation is complete*" (Site manager 1) this practice can be said to be sustainable inclined. Others, (mostly labourers) expressed that "*During excavation when we come across any utility line, we continue the excavation work and later cast concrete around the utility line and then continue with construction work.*" (A Labourer with 1-year work experience). These responses cannot be said to be sustainable inclined because in case of any future occurrence the building could be demolished before the service line could be attended to or it will be expensive to relocate the service because the building could have blocked the entire way of the service lines. With regards to the management of the excavated material, it was revealed that excavated materials are usually used for backfilling. However, if the excavated materials are contaminated, it was sent to the landfill site. This practice could be said to be sustainable because excavated material if found useful is reused without going waste.

According to the American Pipeline Contractors Association's excavation best practices for operators, the following practices should be adhered to at all times during excavation works for construction. Before the actual excavation works begins the following are the appropriate steps to follow to ensure the sustainability of the entire excavation process.

- Get arrangement sheets and other materials such as the drawings of the project so that is will be easy to pinpoint excavation position.

- Certify that all mounted overhead or underground structures are properly marked and crossed out.
- Ensure there is an adequate examination of all tools to check for any item that needs replacement or repair before works begin.
- All persons on site should be required to wear protective clothing at all times according to the various tasks being performed.
- Guarantee the use of a spotter at all times for overhead power lines and all underground utilities.
- Ensure at all times that only experienced person is on-site.
- Public safety should be an utmost priority at all times especially from all opened excavations.

Once the pre-excavation measures are taken care of, there is a need to ensure certain practices even as the excavation works are ongoing. These measures are:

- All legislations on excavation and government policies should be observed at all times for the excavation works.
- A spotter should be used for all overhead and underground utilities.
- 2-foot horizontal open area should be maintained for every material, tools, and equipment.
- For all excavations of 5 feet and beyond, there should be an appropriate slopping, technique, and benching for all excavations of Assure that proper sloping, benching, or shoring techniques.
- All accumulated water should be checked and removed from all excavation works.
- All utility lines and crossings must be covered at all times.
- For 20 feet or above excavation depth, there should be a designed protective system.

- Only experienced persons should be allowed to examine and document the excavation checklist periodically and after every change of persons or weather.
- The excavation can only be entered after it has been checked and examined by a competent person as safe for entry.
- Employees of the site should be at all times made aware of the dangers and the appropriate processes and methods associated with the work.

After the excavation works certain measures must also be taken into consideration for the entire sustainability process to be complete.

- All work done should be inspected to ensure compliance with specifications.
- Check for assurance that all utility lines and structures are protected and supported.
- Ensure that at all times all equipment and tools are removed from the site as well as other debris before backfilling.

These are acceptable practices that every construction worker must take note and practice accordingly. Unfortunately, most of the respondents are not aware of these practices at the AED.

4.1.6 Safety Measures at the Site

This is the last but not the least of practices identified by the respondent as being part of the excavation works at the construction site. Respondents were asked to identify any safety measures taken at the excavation site to prevent unforeseen or harmful effects to both the operatives and other materials on the site. Some of the identified safety measures taken by the respondents include the wearing of helmet and safety boot at the site and sometimes the wearing of reflector on the site. Even though the wearing of helmet and boot is very common at sites, the practice of wearing reflectors are not so common since most contractors do not add importance to it. It appears that issues of environmental and human safety do not attract much attention from the operatives at

AED. For instance, on most of the construction sites hoardings were not provided to shield the site from children or other intruders who might get hurt if not restricted from moving close to the site. When asked whether respondents have ever been involved in any injury on-site, some labourers; and a mason attested to the fact that they once had injury on site. These injuries, however, were not had during excavation work but either during concrete work and block laying works. Almost all respondents saw certain site injuries as normal or expected. They did not blame anyone for such injuries. But upon further probe, one labourer, for example, had this to say: *there was a time I fell into a trench and broke my left leg but it wasn't a severe injury. I recovered almost immediately. I know certain measures should be taken to avoid any future reoccurrence but these things are normal with construction works.*" This shows that some operatives take safety measures for granted and so fail to demand safety mechanisms from their employer. They don't seem to appreciate the implication of taking safety measures for granted.

To a very large extent, construction site safety practices in the AED construction sites can be said to be very poor. Most operatives do not even know that proper safety measures expected to be carried out at the construction site. For instance, the CCOHS has published the recommended safety measures. All hazards and potential risks must be identified by the developer even before the work starts since he has the responsibility of ensuring the safety of workers at all times. These steps are

- ❖ Soil type must be first identified to inform the developer on what to expect about the impending excavation works.
- ❖ The properties of the soil are also key in excavation works and must not be left unidentified this is because the soil type could change from top to bottom and along the length of a trench.

- ❖ All areas surrounding the site must be inspected for potential hazards and for other factors that can temper with the stability of soil. Other factors that could cause the vibration of the soil should also be taken into account.
- ❖ All nearby structures of around project site should also be taken into consideration because their foundation could serve as a source of pressure to the trench of the excavation.
- ❖ All hazardous gas, dust, and vapours should be put to test before entering the site.
- ❖ Oxygen levels in the space around the site should be tested before entering, during and after work.
- ❖ Measures should be made to protect all workers from falling into the excavation trench.
- ❖ Appropriate measures should be made to protect persons and equipment with the use of high conspicuous attire for vehicular traffic.
- ❖ All workers must be made to wear protective apparel.
- ❖ Effort should be made to put a worker above ground whenever someone is working in the trench so that those under the trench should be warned in the face of danger to provide emergency help.
- ❖ Ensure that all activities have working permit already sorted for works at confined spaces.
- ❖ At all times, workers should be made aware of using exit readily provided from the inside of the trench.in case of emergency.
- ❖ Plans should be made for hostile weather conditions such as hot or cold environments, storms, etc.
- ❖ Prepare an emergency plan and rescue procedures.
- ❖ First aid boxes should properly stock and made available at all times at the site.

- ❖ All workers should be properly trained and educated on potential hazards and existing hazards and risks as well as their corresponding safety measures.

From the responses gathered it was obvious that most of these above-listed safety measures were neither provided nor adhered to. It is therefore obvious that safety sustainable practices at the construction sites are not being practiced. The reasons gathered are due to negligence and cost. Besides most of the respondents do not even attach so much importance to safety at the construction site.

4.2 CHALLENGES FACING OPERATIVES IN ADOPTING SUSTAINABLE PRACTICES IN CONSTRUCTION

The study sort not just to identify the current practices of operatives in excavation works, but also, to ascertain the challenges faced by operatives in adopting sustainable practices. The study identified five major challenges facing operatives in their excavation works. These Challenges are:

- Lack of understanding of sustainable construction principles/practices
- Lack of Government Policy and regulatory framework on SC,
- Financial problems about the implementation of SC principles/practices,
- Socio-Cultural Challenge, the inability to embrace change in the old ways of doing things.
- Lack of proper supervision by the Planning Authority of the Assembly

4.2.1 Lack of understanding of sustainable construction principles/practices

One of the major challenges identifies was lack of understanding and technical know-how on sustainable construction principles and practices. Except the site managers, all other respondent seems not to understand the concept of sustainable construction. Even with respondents who express some knowledge of SC, their understanding of the SC principle seems to be shallow. For instance, one respondent replied that "*Yes I have heard it before. Sustainable Construction means*

using resources that can last long instead of fake or inferior goods.” (Site Manager). While SC entails the use of quality material, SC goes beyond the use of quality material. It compasses all those practices that aim at sustaining our environment for the future generation. It appears that the entire concept of SC is not common among the operative of AED. Even with some of the practices that conform to SC, respondents could not identify them as SC practices. One of the respondents was asked the significance of leaving some trees on the site after clearance. The rationale for this question was to find out whether respondents know the implication of this practice. The respondent gave the desire of the clients as the reason for this practice. Clearly, these respondents do not understand SC or the need for it which is a major problem.

4.2.2 Lack of Government policy or regulatory framework

Another challenge is the lack of Government policy or regulatory framework. As a result of absence of regulation or policy on the acceptable SC practices on excavation works, most operatives engage in practices that are not sustainable in any way because these are the practices best known to them. Even where there appears to be some sort of regulation, lack of willingness to enforce the existing laws makes it extremely difficult for operatives to embrace SC practices. For instance, indiscriminate cutting of trees without replanting, not informing utility regulators on the need to relocate utility lines before construction among others are some of the practices operatives engage in due to the absence of government policies or lack of enforcement of these policies on such activity. There is also the absence of a regulatory body solely in charge of managing excavation works on various sites. Although the district assembly has some form of oversight responsibility on construction works in the district, enforcing SC practices on excavation works does not seem to be one of their responsibilities.

4.2.3 Financial problems about the implementation of SC principles/practices

One major challenge that runs through the entire interview is financial constraints. It was revealed that, even when certain practices are deemed appropriate and Sustainable, most clients complain about the financial cost of such practice which most of the time makes it impossible to embark on such practice. "*Sometimes, we want to send the cleared bushes and materials to the refuse dump but the cost of sending these cleared materials to the refuse dump makes us leave it on the site and burn them*" (A Mason with seven years' work experience). Most often clients often see the cost of embracing SC practice as expensive so they prefer going the traditional way. Operatives also are of the view that it is better to use the topsoil for backfilling rather than just leaving it there or using it for plantation or vegetable cultivation. This is in line with the findings of Häkkinen & Belloni (2011). Where they identified that current and the fear of unforeseen cost of SC practices makes construction stakeholders shy away from embracing these practices.

4.2.4 Socio-Cultural Challenge

It appears there is little or no urge to embrace SC practices. Most of the operatives are so conversant with the traditional way of construction and hence little effort is made to embrace new sustainable methods. The taste for old construction methods and practices are so strong that any attempt to immediately shift into SC practices will be a bit difficult. There is the view that most developers want the easy way out hence any practice that will cost them in terms of financial and time will not be easily embraced. This has also resulted in the low patronage of SC materials by clients and subsequently low supply for SC materials (Williams & Dair, 2006).

4.2.5 Lack of proper supervision by the Planning Authority of the District Assembly

Furthermore, the Lack of proper supervision by the Planning Authority of the District Assembly is another challenge. The district assembly has oversight responsibility overall construction works

within the assembly, especially government-funded projects. However, supervision by the assembly is low. According to one of the respondents, "*the assembly is mostly concern about the acquisition of permit from the assembly. And the permit acquisition is mostly concerned about the design of the project*" (Site Manager). The Assembly's concern with regards to construction work is mostly limited to checking whether or not the building has permit. "*Even though the district Assembly officials periodically come to construction sites for inspection. They do not ask questions about SC. Maybe if they start showing concern for SC practices most construction operatives will be conscious of SC practices.*" (A Mason). This assertion proves that the absence of SC inclined supervision is another reason for low awareness of SC among operatives of the AED. The SC practices are more visible at the implementation stage of the project. Therefore, supervision of on-going projects is necessary to identify whether or not operatives are using SC methods or not. This is obviously, the duty of the DA officials in the district. The absence of such supervision leaves operatives to embrace the traditional construction methods they have been using to which in most cases are not sustainable.

4.3 RECOMMENDATION TO THE CHALLENGES OF SUSTAINABLE CONSTRUCTION PRACTICES IN THE AED

The fourth objective of this study was to identify possible recommendations to the challenges gathered for SC practices among the operatives of AED. Based on the views gathered from respondents. The recommendation gathered are as follows: the need for government policy document and regulatory framework, massive sensitization of construction stakeholders on the need for SC practices among construction workforce, the need to award contractors who embrace sustainable practices in their construction work, the need to increase the knowledge of SC among

the general public and the need to increase the supply of SC materials on the market. The recommendations have been explained below:

4.3.1 The need for a clear policy document and regulatory framework

One of the major recommendations that gained popularity among respondents is the need for a clear policy document and regulatory framework for all construction stakeholders to abide by. In the absence of such building document, the probability of doing what one feels appropriate in his own eyes would be high. *“The government need to bring out a policy on embracing SC practices for every construction work that we would have no option but to conform to it”* (Site manager)

This implies that the non-conformance to these principles is due to the absence a concrete regulatory framework that spells out what is required to be done at each stage of construction work. Even though, the DA has a supervisory role over all construction works within the district, checking whether or not construction works follow SC practice is not really within the domain of the DA.

4.3.2 Introduction of a reward system

Another recommendation was for the Government to institute a reward system where contractors who engage in SC practices are award for their effort in sustaining the environment. Whiles those who do not embrace SC practices would also be punished. This would serve as motivation as well as a deterrent to other offenders. Similarly, government contracts should be given to only contractors who have shown considerable effort in using SC methods in their construction work and have a standing track record in the use of SC practices. These actions will encourage other non-conformist from embracing SC practices in their construction works.

4.3.3 Awareness Creation

It was evident that most of the operatives have very little or no knowledge in SC. While some have not heard about the term SC before, others who have heard about it do not know what it entails. It was also realized that even though some of these practices conform to SC principles, most of the operatives have no understanding of the rationale behind such practices. It is, therefore, necessary for the government through the district assemblies and other professional bodies to create awareness of the need for SC practices among operatives. Frequent seminars and workshops should be organized periodically for construction stakeholders especially, among operatives. These seminars should be aimed at enlightening stakeholders on the rationale, principles, practices, and benefits of SC. When stakeholders are aware of the need for SC practices, they would appreciate SC and embrace it.

4.3.4 Sensitization among the general public

There is also the need for general sensitization among the general public on the consequences of the continuous use of the traditional excavation method. The general public must be aware and willing to embrace it. *“There are times that we try to convince the clients on the best practice example the need to hoard the excavation area as a signal for danger, but the clients will not support us because they don’t see the need for it.”* (A Labourer). This shows that since the clients are the ones paying for the entire cost of the project, they tend to influence the process so much with their wishes and desires. However, a well-informed client is likely to insist on the best SC practice for his work even when the developer prefers otherwise. Massive sensitization is, therefore, necessary to change the mentality of Ghanaians on the traditional ways of construction.

4.3.5 Increase the supply of sustainable construction materials

There was also the view that most of the materials in the market are not sustainability friendly. The scarcity of SC materials implies that one has to get what is there to do the work. But when there are no options but to get a SC material, then all construction materials would be sustainable. Using SC materials is a step to ensuring SC practice. *“It is difficult to practice sustainable construction, all available materials are not sustainable materials.”* (A mason). *“Most of the materials used in construction especially in Ghana are not sustainable for instance, most of our cement blocks and wood are not good”* There is the need to increase the supply of SC materials so that construction work can at least conform to SC standard.

4.4 CONCLUSION

This chapter presents the data gathered through face-to-face interviews of twenty respondents on the current practices of operators on excavation works in the AED, the challenges they face in the course of their work and the recommended solutions for the challenges identified above.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.0 INTRODUCTION

The main focus of this study was to discover the current practices of operatives/workforce during excavation works and to identify the challenges they face in the course of their work. This study aimed at developing strategies for the implementation of Sustainable practices and processes within the construction industry. Having already presented and analyzed the findings and recommendations to the challenges identified in the preceding chapters, this chapter presents the summary and conclusions of the study.

5.1 SUMMARY

The findings of the study identified five major practices of operatives during the excavation work in AED. The practices are as follows: Inspection of site for clearance, clearing of the site bushes, top soil excavation, setting out on ground, ground excavation work, management of excess materials and safety measures.

Even though some of the practices of the operative at the various stages of the excavation work could be said to be somewhat sustainable, many of the practices as discussed earlier were not in line with sustainable principles. It was also identified that even with the few that were somehow sustainable, most of the operatives do not know these practices conform to sustainable principles. The operatives, with the exception of some three-site managers were not even aware of sustainable measures in construction. Some had not even heard the term SC before. Most of the practices of the operatives were abreast with the traditional method of construction. It was concluded that, to a very large extent the practices of the AED operatives do not conform to sustainable principles.

With regard to the challenges, five factors have been identified as challenges to the successful implementation of sustainable practices. These challenges are: Lack of understanding of sustainable construction principles/practices: Lack of Government Policy and regulatory framework on SC, Financial problems in relation to the implementation of SC principles/practices, Socio-Cultural Challenge that is Inability of embracing change in the old ways of doing things, Lack of proper supervision by the Planning Authority of the Assembly. These challenges to a greater extent mitigate the effectiveness of sustainable construction practice among the operatives of AED. While some of the operatives are aware of these challenges, many were also not aware of these challenges since they knew very little or nothing about SC as desirable practice in the field of construction.

To address these challenges, certain recommendations were gathered. Among the recommendation were the following: the need for government policy document and regulatory framework, massive sensitization of construction stakeholders on the need for SC practices among construction workforce, the need to award contractors who embrace sustainable practices in their construction work, the need to increase the knowledge of SC among the general public and the need to increase the supply of SC materials on the market. It is believed that when these measures are put in place, it will improve the successful implementation of sustainable construction practices in AED. There is therefore the need for government to collaborate with construction stakeholders to put in place appropriate measures to ensure a boost in the implementation of SC practices in the country.

5.2 CONCLUSION

This study has been successful in identifying the current practices of operatives in excavation works in AED. These current practices mostly conform to the traditional construction method, which are generally not SC inclined. The study identified six major practices of operative in AED which are: Inspection of site for clearance, clearing of the site bushes, top soil excavation, setting out on ground, ground excavation work, management of excess materials and safety measures. To a very large extent, these practices do not conform to SC practices for several reasons, which have been explained earlier.

The study also revealed five major challenges to the successful implementation of SC. These challenges are: Lack of understanding of sustainable construction principles/practices: Lack of Government Policy and regulatory framework on SC, Financial problems in relation to the implementation of SC principles/practices, Socio-Cultural Challenge that is the inability of embracing change in the old ways of doing things, Lack of proper supervision by the Planning Authority of the Assembly. The study further discussed that, while a few of these practices could

be said to be in line with SC, most all of the practices identified were not in tandem with SC practices. The above-mentioned challenges were identified as factors affecting the successful implantation of SC in the AED. Unless these challenges are addressed, the implementation of SC practices will continue to be a problem in AED. It is in the light of these challenges that, this study proposes five main recommendations for government and construction stakeholders to consider and implement to ensure that there is a drastic improvement on the implementation of SC in AED and in Ghana as a whole.

5.3 RECOMMENDATION

To address the identified challenges, certain measures have been recommended for consideration by the Government and all construction stakeholders. The recommendation are as follows: the need for Government policy document and regulatory framework, massive sensitization of construction stakeholders on the need for SC practices among construction workforce, the need to award contractors who embrace sustainable practices in their construction work, the need to increase the knowledge base of SC among the general public and the need to increase the supply of SC materials on the market. For operatives in the AED to embrace SC more frequently these measures should be given the needed attention and adhered to.

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APPENDICES

INTERVIEW GUIDE

SECTION A. BIO-DATA

1. Age of respondent
2. Qualification of respondent
3. Profession of Respondent
4. Years of experience of respondents in the construction field.

B. TO DETERMINE THE CURRENT PRACTICES OF OPERATIVES IN EXCAVATION WORKS

1. What do you look out for when you want to clear site bushes?
2. What do you do with the cleared bushes?
3. In clearing of site, do you clear the entire site?
4. Do you cut down all trees found on-site?
5. What do you do with the trees you cut down?
6. What do you do before you excavate topsoil?
7. Which method or technique do you employ when excavating topsoil?
8. Do you excavate the topsoil of the entire site?
9. Do you do setting out?
10. Which technique or method do you use when setting out?
11. What do you consider before setting out?
12. What are the factors you consider before excavation?

13. Which method do you employ for excavation?
14. What do you do when found any underground utility lines?
15. Where do you hip your excavated material during excavation?
16. After excavation, what do you do with the excavated materials?

C. TO ASCERTAIN THE EXTENT TO WHICH THESE PRACTICES CONFORM WITH SUSTAINABLE PRACTICES

1. Why do you engage in each of the practices discussed?
2. Do you know the implication of engaging in each of the practices discussed?

D. TO DETERMINE THE CHALLENGES FACING OPERATIVES IN ADOPTING SUSTAINABLE PRACTICES IN CONSTRUCTION

1. Do you encounter any challenge in any of the practices discussed?
2. Follow up

E. TO PROPOSE MEASURES TO ENSURE THE USE OF SUSTAINABLE PRACTICES WITHIN THE CONSTRUCTION INDUSTRY.

1. In your opinion how can these challenges be addressed?