

**UNIVERSITY OF EDUCATION, WINNEBA**  
**COLLEGE OF TECHNOLOGY EDUCATION, KUMASI**

**ASSESSMENT OF SUSTAINABLE USE OF INDIGENOUS BUILDING  
MATERIALS (IMB): THE PERSPECTIVES OF CONSULTANTS IN THE  
CENTRAL REGION.**



**ALI AKE-ANYEM WEWORA EDEN**

**2021**

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**A DESSERTATION SUBMITTED TO THE DEPARTMENT OF  
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REQUIREMENT FOR THE AWARD OF MASTER'S OF TECHNOLOGY  
(MTECH) DEGREE IN CONSTRUCTION TECHNOLOGY**

**2021**

## DECLARATION

### Student's Declaration

I, Ali Ake-Anyem Wewora Eden declare that this dissertation, with the exception of quotations and references contained in published works, which have all been identified and acknowledged, is entirely my own original work and it has not been submitted, either in part or whole for another degree in this university or elsewhere.

Signature: .....

Date: .....

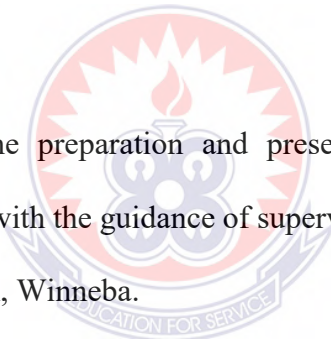
### Supervisor's Declaration

I, hereby declare that the preparation and presentation of this dissertation was supervised in accordance with the guidance of supervision of dissertation laid down by the University of Education, Winneba.

Supervisor's Name: Dr. Nongiba Alkanam Kheni

Signature: .....

Date: .....



## **ACKNOWLEDGEMENTS**

My profound gratitude goes to my supervisor Dr. Khenni for his readiness and profound interest in the subject matter, his effective and efficient supervision as well as contributions which enabled the achievement of the objectives of the study. I am grateful to my cherished respondents. I say thanks for your words of encouragement.



## **DEDICATION**

I dedicate this work to my wife Jennifer and son Davis Wewora.



## TABLE OF CONTENTS

CONTENTS	PAGES
DECLARATION .....	iii
ACKNOWLEDGEMENTS .....	iv
DEDICATION .....	v
TABLE OF CONTENTS .....	vi
LIST OF TABLES .....	ix
ABSTRACT .....	x
<b>CHAPTER ONE</b> .....	<b>1</b>
<b>INTRODUCTION</b> .....	<b>1</b>
1.1 Background to the Study.....	1
1.2 Statement of the Problem.....	4
1.3 Aim and Objectives of the Study .....	7
1.4 Research questions .....	7
1.5 Significance of the study.....	8
1.6 Scope of the study .....	9
1.7 Organization of the Study .....	9
<b>CHAPTER TWO</b> .....	<b>10</b>
<b>LITERATURE REVIEW</b> .....	<b>10</b>
2.1 Introduction.....	10
2.2 The Concept of Sustainability.....	10
2.3 Empirical Framework .....	12
<b>CHAPTER THREE</b> .....	<b>29</b>
<b>RESEARCH METHODOLOGY</b> .....	<b>29</b>
3.1 Introduction.....	29
3.2 Research Design.....	29
3.3 Population .....	30
3.4 Sample size and Sampling technique.....	30
3.4.1 Sample Size Estimation .....	31
3.5 Data Collection Instruments .....	32

3.6 Validity and Reliability of the Instrument .....	32
3.6.1 Validity of the Instrument .....	32
3.6.2 Reliability of the Instrument .....	33
3.7 Data collection Procedure .....	33
3.8 Data Analysis .....	34
3.9 Ethical considerations .....	34
<b>CHAPTER FOUR.....</b>	<b>36</b>
<b>PRESENTATION OF RESULTS AND DISCUSSION .....</b>	<b>36</b>
4.1 Introduction.....	36
4.2 Response Rate.....	36
4.3 Demographic Characteristics of Respondents .....	36
4.3.1 Gender of Respondents .....	36
4.3.2 Level of Education of Respondents .....	37
4.3.3 Position of the Respondent in the Construction Firms .....	38
4.3.4 Respondents' years of Experience in the Construction Industry .....	38
4.4 The Most used Indigenous Building Materials.....	39
4.5 Factors influencing the choice of materials for walling, roofing and floor .....	42
4.6 Environmental sustainability of indigenous building materials.....	44
4.7 Social implications of the use of indigenous building materials .....	47
4.8 Economic sustainability of the use of indigenous building materials.....	50
4.9 Average score of sustainability of indigenous housing construction.....	54
<b>CHAPTER FIVE .....</b>	<b>56</b>
<b>SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION.....</b>	<b>56</b>
5.1 Introduction.....	56
5.2 Summary of Key Findings .....	56
5.2.1 Types of indigenous building materials used in providing the housing needs ...	56
5.2.2 Environmental sustainability and friendliness of indigenous building materials	57
5.2.3 Social implications of the use of indigenous building materials .....	57
5.2.4 Economic sustainability regarding the use of indigenous building materials.....	57
5.3 Conclusion .....	58
5.4 Recommendations.....	59
5.5 Suggestion for Further Studies.....	60

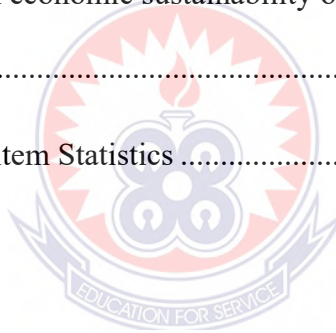
REFERENCES ..... 61  
APPENDIX A ..... 70





## LIST OF TABLES

<b>TABLES</b>	<b>PAGES</b>
Table 4. 1 Gender of Respondents .....	37
Table 4. 2 Respondent's Level of Education .....	38
Table 4.3 Most used Indigenous Building Materials .....	41
Table 4.4 Reasons for choosing such material .....	43
Table 4.5 Responses on environmental sustainability of indigenous housing construction .....	46
Table 4.6 Responses on social Sustainability of indigenous housing construction .	49
Table 4.7 Responses on economic sustainability of indigenous housing construction .....	53
Table 4.8 Summary of item Statistics .....	54



## ABSTRACT

The promotion and use of indigenous building materials are critical for the preservation of our ancestral architecture and technology. The housing needs continues to grow. To alleviate the shortfall, the circumstance necessitates more research activities. Housing issues (shortage, poor quality, high expense, etc.) are more prevalent in developing countries than in developed countries. According to Ghana's 2019 Budget Statement, Ghana's housing shortfall is 1.7 million units. The aim of the study is to assess the perspective of consultants in the sustainable use of indigenous building materials to meet the housing needs of people in the Central region of Ghana. The research design adopted for the study was a cross-sectional survey. The population for this study therefore constituted all construction professionals in the built environment in the Central region with interest in the use of indigenous building materials for the construction affordable houses. This study used purposive sampling as its sampling technique. The study found out that using indigenous building materials promotes a safe and healthy environment, preserves natural resources, and improves environmental quality. It again found that, using indigenous building materials stimulates material reuse during major restorations, lowers construction costs and improves economic sustainability, and lowers the cost of cooling and heating homes. The study concluded that using indigenous building materials is a means for the construction industry to advance toward environmental protection. The study recommends that Ghana government should promote the use of indigenous building materials in the Ghanaian construction projects since its usage comes with sustainability. Professionals within the construction industry should encourage the use of indigenous materials in construction projects by specifying them in their designs.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background to the Study

The provision of sustainable housing through the use of indigenous construction materials is a key component of the 2030 Agenda of sustainable development goals. To build peaceful and inclusive societies, a high value is put on resource sustainability (Sustainable Development Solutions Network, 2015). Furthermore, the promotion and use of indigenous building materials are critical for the preservation of our ancestral architecture and technology (Odeyale and Adekunle, 2008). However, this is contingent on the availability and long-term viability of indigenous building materials. Traditional building supplies are difficult to come by and are out of reach for the rural poor. Acheamponget al. (2014), Iwuagwu et al. (2015) and Ohene-Sarfo et al. (2016) suggested that rural communities rely heavily on indigenous building materials to meet their housing needs. This necessitates deliberate efforts through scientific studies to determine ways to sustain the source of materials. Inevitably, Sub-Saharan Africa's housing shortage continues to increase (Lorenze et al., 2017). As a result, it asks for new solutions to address the housing shortage, and the importance of locally produced building materials cannot be overstated. Furthermore, environmental sustainability is one of the most important aspects of sustainable development (SDSN, 2015). To ensure that environmental resources essential to man's survival and comfort, notably indigenous building materials, are preserved for future generations. As a result of scientific evaluation of the long-term viability of indigenous construction materials, we can assure that building materials in our local environment are always available to help fill the housing gap.

Goal nine (9) of the Sustainable Development Goals emphasizes the importance of constructing resilient infrastructure, promoting inclusiveness, and supporting innovation (SDSN, 2015). This goal can be more easily fulfilled if natural resources, such as local building materials, are preserved. Unfortunately, human actions continue to harm the ecosystem, putting natural resource survival and sustainability in jeopardy (Tomislav, 2018). It is also critical to study the current situation in the study area and to develop long-term strategies for continuing the use of indigenous construction materials in addressing people's housing needs, particularly in rural areas.

The construction industry's building materials sector is a vital contributor to the industry's success. This is because materials are the most expensive input in building, accounting for around half of the overall cost of a project (Fellows et al 1983; Mogbo, 1999). Indigenous construction materials (Cunningham & Cunningham, 2002). According to Loken et al. (1994) there are many materials that are locally produced and manufactured, naturally occurring, and abundant in a country. Indigenous materials, according to Loken et al. (1994), are those that are generated in the same bioregion or regional ecosystem where they would be used. Materials are only considered indigenous by certain practitioners if they are available on the same place where they will be used (Pearce, 2001). Indigenous materials are also subjected to the prevalent but erroneous idea that they are indigenous only if they are "primitive," requiring little or no preparation between collection and usage (Owusu, 2001).

For the production of IBM, Ghana has abundant indigenous raw resources. Since 1953, the government has made some attempts to promote the development of indigenous building materials (Atiemo, 2005). Government attempts to bolster the informal sector's role in housing delivery have failed miserably. According to the Building and Road Research Institute (BRRI) of the Council for Scientific and Industrial Research (CSIR),

the Ghana Geological Survey Department, and others, there are adequate indigenous materials appropriate for construction in all 10 regions of the country. This has resulted in the manufacturing of IBM for low-cost housing in Ghana, like as burnt clay bricks and tiles, pozzolana cement, compressed and stabilized earth blocks (Atiemo, 2005).

Surprisingly, however, prominent industry specialists have not accepted the concept for houses to be built with indigenous materials as predicted (Architects, Structural Engineers and Quantity Surveyors). There is an overreliance on traditional building materials for which local equivalents can be created and for which local production has a comparative advantage. As a result, it's become vital to look into the causes that prevent the usage of these local building materials in Ghana's construction industry.

A critical examination of current practices, techniques, and raw material sources is required for sustainable construction. Most governments around the world, particularly in poor countries, are concerned about rising construction costs. One likely factor is the rising cost of building materials, which accounts for a larger portion of the total cost of construction (Yalley & Kwan, 2008). For example, in Africa, there is a severe shortage of affordable housing, owing to the high cost of conventionally processed construction materials such as steel and Portland cement. The yearning for these materials has a detrimental consequence, reducing the value of locally accessible materials and making them appear inappropriate. In an ideal world, low-cost house materials would be made from locally available raw resources. Furthermore, it would be preferable if these basic resources were readily available or renewable (RICS, 2008). Over-reliance on foreign and imported building materials is not the only factor contributing to increased building costs; transportation from urban to rural areas and vice versa is also a concern, especially in light of Ghana's present fuel crisis and price spike.

## 1.2 Statement of the Problem

The housing need continues to grow. To alleviate the shortfall, this circumstance necessitates more research activities (Iwuagwu et al., 2015; Lorenze et al., 2017). According to Acheampong et al. (2014), 25% of the world's population lives in deplorable conditions, with the gap in Africa ranging from 33% to 90%. The West African Economic and Monetary Union (WAEMU) projected the Sub-housing region's shortfall at 3.5 million units in the West Africa Housing Finance Year book 2018 (WAEMU, 2018).

Housing issues (shortage, poor quality, high expense, etc.) are more prevalent in developing countries than in developed countries. According to UN estimates from 2005, around 1.3 billion urban inhabitants live in substandard housing. Nigeria, for example, is dealing with both quantitative (supply) and qualitative (quality) issues (Federal Office of Statistics, 1997; Mabogunje, 2003; Olatubara, 2008). As a result, housing is in limited supply in all of the West African Sub-countries regions (WAEMU, 2018). According to Ghana's 2019 Budget Statement, the country's housing shortfall is 1.7 million units. Joy News, on the other hand, projected the country's housing deficit at 2 million units on May 14th, 2019. Furthermore, traditional building materials are too expensive Acheampong et al. (2014) and Iwuagwu et al. (2015) making it impossible for the average African and for that matter, rural folks in Ghana to acquire them for their housing needs. The exchange rate, particularly the cedi – dollar rate, controls the pricing of traditional building materials in Ghana. With the current state of affairs, there is no certainty that prices of traditional building materials would ever fall to the benefit of the typical Ghanaian. One of the causes contributing to the housing shortage as according to Acheampong et al. (2014) is population growth, which is unlikely to slow down anytime soon. The population of Sub-Saharan Africa is expected

to grow from 1.2 billion in 2015 to 4.4 billion by the end of the twenty-first century. About 86.7% of the population in the study area resides in rural communities (Ghana Statistical Service, 2010 Population and Housing Census). This situation, therefore, requires innovative and sustainable ways of reducing the deficit via indigenous building materials.

In most rural human settlements, the utilization of indigenous construction materials in vernacular design has greatly aided in satisfying housing needs (Steenkamp & Whitfield, 2012). Buildings made of indigenous materials are more pleasant and less expensive, according to Steenkamp and Whitfield (2012), so it's important to figure out how to make them last to close the housing gap. in the Ashanti Region of Ghana. According to Acheampong et al. (2014), indigenous building materials are abundant in all communities across Ghana and might be used to promote inexpensive and sustainable housing, as well as to address the housing shortage.

In general, failure in IBM construction and the materials' general unpopularity is attributable to a lack of understanding of soil conditions before their usage in building (Madedor & Dirisu, 1991). Recent research has demonstrated that conventional building materials provide promising strength properties for low-cost construction. Soils, for example, have a wide range of qualities based on the major soil particle fraction that forms the soil and the complicated nature of its creation (Minke, 2007; Rigassi, 1985). As a result, according to Rigassi (1985), a full grasp of these qualities ensures the quality and proper performance of soil for construction purposes. Laterite, for example, has been utilized for wall building throughout the world since it is inexpensive, environmentally friendly, and abundant in tropical areas (Ukpata et al., 2012; Olugbenga et al., 2007). According to Osadebe and Nwakonobi (2007), laterite concrete has compressive and flexural strengths of 27 MPa and 4.12 MPa, respectively.

For a mixed percentage of 1:1:2:0.65, the modulus of elasticity, modulus of rigidity, and Poisson's ratios was also found to be 18888.9 MPa, 7495.6 MPa, and 0.26 MPa, respectively (OPC: laterite: granite: water). Laterite could be employed in the construction of silos, reservoirs, and other structures based on the experimental findings. The findings also demonstrated that laterite has strong strength qualities that are comparable to those of other conventional materials. The impact of weather on the performance of lateralized concrete was investigated by Lanre and Mnse (2007). The compressive strength of specimens conditioned at temperatures ranging from 75 to 125 degrees Celsius was reported to be as high as 22.52 N/mm<sup>2</sup>. The study, however, was unable to determine the crucial failure temperatures. Soil stabilization, which involves the application of stabilizing chemicals to poor soils, has been shown to improve soil geotechnical qualities (Makusa, 2012). Though stabilized earth blocks are not as sturdy as sandcrete blocks in compression, they are far superior to mud construction (Okyere et al, 2000).

The benefits of using IBM for the building have been thoroughly discussed in the literature. IBM, for example, requires simple tools and less labor, it is cost-effective, it saves energy, it promotes local culture and heritage through its construction, it has good fire-resistant properties, good thermal comfort, a good sound absorbent, which is a desirable quality in house design, and it necessitates thick walls, which is a desirable quality in house design (Adam & Agib, 2001; Cassell, 1993; Frescura, 1981; Hadjri et al., 2007; Lal, 1995; Lee, 2008; Morton, 2007; Zami & Minke, 2007).

However, low strength, frequent maintenance, requirement of increased labour work and easily wearing or erosion of the materials were found to be the major problems associated with houses built with locally available materials in Ghana (Acheampong et al., 2014; Ohene-Sarfo et al., 2016; Owusu, 2001). The study therefore sought to assess



the perspective of consultants on sustainable use of indigenous building materials to meet the housing needs of the people in the Central region. The Central region of Ghana is found to be a region that promotes cultural heritage, has abundance of indigenous building materials and with an evidence of buildings constructed with local materials. These necessitated for the region as the study area for this study.

### **1.3 Aim**

The aim of the study is to assess the perspective of consultants on sustainable use of indigenous building materials to meet the housing needs of the people in the Central region.

### **1.4 Objectives of the Study**

The specific objectives of the study are as follows:

- determine the most common forms of indigenous building materials used to meet the housing demands in the central region;
- determine the extent to which the usage of indigenous building materials in the central region is environmentally sustainable;
- determine the long-term economic viability of using indigenous building materials in the central region; and,
- evaluate the social implications of the use of indigenous building materials in the central region.

### **1.5 Research questions**

Based on the stated aim and objectives of the study, the following research questions have been formulated to guide the conduct of the study:

- What are the most common forms of indigenous building materials in the central region?
- How environmentally sustainable is an indigenous building material in the central region?
- What is the economic viability of using indigenous building materials?
- What social implications would an indigenous building material have?

### **1.6 Significance of the study**

The findings of this study will determine whether the use of indigenous building materials to meet the housing demands of Ghanaian households is sustainable. The primary types of materials utilized were recognized, as well as how accessible or difficult they were to procure. As a result, communities were better informed on improved and sustainable methods of harvesting and extracting indigenous building materials, ensuring that native construction materials were always available to meet their social, economic, and environmental housing demands. It also provides key information to policymakers, such as environmental protection agencies, non-governmental organizations (NGOs), the central government's Ministry of Works and Housing, and other stakeholders, to help them develop policies and programs that promote the long-term use of indigenous building materials to help close the housing gap. Furthermore, tight restrictions governing the usage and protection of indigenous building materials could be implemented to ensure that these materials are available from generation to generation. The findings of this study add to the body of information about the long-term viability of indigenous building materials in Ghana, Africa, and beyond.

### **1.7 Scope of the study**

The scope of this research is limited to consultants with building construction companies found in the Central region of Ghana. This is because they are impacted by building construction. Materials classification, the importance of materials for a project, purchasing of materials, purchasing departments, purchasing methods, logistics, coordination of materials and other resources, material handling, stock and waste control, element of management, control measures on-site, benefits of material management and materials management processes.

### **1.8 Organization of the Study**

The whole research work is divided into five chapters. Chapter One introduces the research work and looks at the background of the study, problem statement, the aims, and objectives of the study, research questions, and significance of the study. Other aspects of Chapter One included the scope of the study and organization of the study, while chapter two focuses on some theoretical frameworks, reviews of related literature about the subject, and the Summary of the Literature Review. Chapter Three is devoted to the methodology which describes the research design, the population, sampling size and sampling technique, data collection instrument, data analysis, and ethical considerations. In Chapter Four, results and discussions of the findings are presented. Finally, the summary of findings, conclusions, and recommendations constitute the concluding chapter of the research which is Chapter Five.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This section of the dissertation aimed to find and present significant literature in Ghana, Africa, and the rest of the world that relates to the chosen topic. This gave an indication of what had been done in regard to the topic, what lessons had been learned, and how the topic should be approached in the future.

#### 2.2 The Concept of Sustainability

The term 'sustainable' relates to the ability to maintain, sustain, uphold, support, or affirm anything to a certain extent (Asif, 2015). Because human settlement and survival are dependent on a healthy environment and natural resources, the Brundtland Commission championed the concept of sustainability in 1987, defining it as "those paths of social, economic, and political progress that meet current needs without jeopardizing future generations' ability to meet their own needs" (Brundland, Gro, &Harlem, 1987 as cited in Asif, 2015). The building and construction sector is gradually adopting this concept (Shafii & Othman, 2005). Sustainable building uses designs, technologies, and practices that are more efficient in terms of resource use, energy consumption, environmental effect, comfort, safety, and return on investment (Shafii & Othman, 2005). This guarantees that existing and future construction needs, particularly those of the indigenous built environment, are satisfied without compromising social, economic, or environmental sustainability.

Indigenous construction materials must be effectively exploited in order to meet society's housing needs for safe, sustainable, and affordable housing. If the use of indigenous building materials is relegated to the background, African architecture,

which is not respected or recognized by the western world but represents our values and identity, may be lost. This will exacerbate the already severe housing shortage. The use of indigenous construction materials has played a significant role in developing African architecture and, more importantly, housing (Odeyale & Adekule, 2008). Indigenous or local building materials refer to natural resources that are easily available in significant quantities in diverse sites or areas at any given moment (Odeyale & Adekule, 2008). To put it another way, they are resources that can be used to create a one-of-a-kind object. Depending on the geographical location, they may be plentiful in some locations but sparse in others. As a result, the concept of sustainability necessitates the wise use and management of resources in order to assure their long-term availability. Its implementation in the construction sector, particularly in the indigenous build environment, is the industry's future, and all stakeholders should support it.

### **2.3 History for Building Materials**

In the days ago materials used to build house for human in the pre-historical era has been recorded by researchers with opposing periods and dates. For example Al-sakkaf (2009) indicated that recorded cases of the use of soil and soil bricks/blocks date back to Mesopotamia “around 800 BC” Al-Sakkaf (2009) also indicated the record use of soil for building houses in Mesopotamia as far back as 10,000 BC. In addition, Fullerton (1984) also traced the history of the use of soil material for housing to the days of Pliny who in AD 67 recorded the existence of soil built watch-towers by Hannibal, the famous Carthaginian general almost 300 years before. Due to these opposing periods and dates given, what reason can be deduced from this historical moment and it was presented that soil is building material used by man to build shelter after moving out from the cave shelter. This deduction is supported by Reddy (2004) as cited in (Al-sakkaf,2009)

which showed that historically some of the building materials are new while others are very old and started with human shelter. In order to clear any doubt Reddy (2004), studied the historical development of other building materials and presented their chronological sequence as shown in the table 2.1

Soil in many tropical and hot regions has properties which, with a lot of sun and dry air is favorable to make durable walls. Archaeological evidence indicates that soil materials such as cob and rammed soils were highly a popular building material for both domestic and commercial houses in very dry climates. Some of the ancient structures built entirely of soil materials are still famous to date and Fullerton 1984 stated some examples namely Luxor in Egypt, the soil-built traditional savanna architectural houses in Kano in northern Nigeria, Timbuktu in Mali, churches, community centers and houses by the early European settlers and missionaries in some parts of Africa are typical examples. The use of soil material in Ghana for domestic and commercial purpose equally follows the world trend as majority of houses have been built with soil materials (Osei-Tutu & Ofori, 2009). Examples of soil –built structures are the famous Islamic Heritage Mosques, Royal Palaces and Dwelling houses in Northern Ghana, Larabanga Mosque in Damongo and Nakori Mosque in Wa, the chiefs’ palaces at Wa, Jirapa, Nandom and Fielmuo all in Upper West Region. Then also both Elmina and Cape Coast Castles were built with soil in 1482 and 1653 respectively

## **2.4 Empirical Framework**

Several well-known researchers have contributed to the scientific assessment and application of sustainability in the built environment, including the use of indigenous

building materials and their impact on vernacular architecture as well as the use of modern technology in the provision of affordable housing. These projects include, among other things, assessing impediments to the use of indigenous construction materials, integrating the materials with new techniques, improving the materials, and employing the materials in low-cost housing. Such an assessment is critical since building materials account for a larger share of the inputs in the construction of structures and account for roughly half of the entire project cost (Fellows et al, 1983; Mogbo, 1999 as cited in Acheampong, et al., 2014). This is undoubtedly one of the causes leading to the worldwide housing shortage. It suggests that a shortage of building materials, or an insufficient supply of building materials, will exacerbate the already severe housing shortage. The importance of indigenous building materials in meeting housing needs is sometimes overlooked or undervalued, despite the fact that they are the oldest and most common source of shelter in most rural areas (Kwadwo et al., 2016). In their study of "Factors Inhibiting the Use of Indigenous Building Materials in the Ghanaian Construction Industry," Acheampong et al. (2014) classified indigenous building materials as stabilized mud, laterite, straw, thatch, gravel, and raphia palm. Palm kernel shell, crushed coconut shell, clay brick, bamboo, burnt brick, and manure are among the other materials (Odeyale & Adekule, 2008). The study concluded that while using indigenous building materials has its problems, having sufficient awareness of their properties and applying new information and techniques can provide better results. In terms of technique, Acheampong et al. (2014) used a quantitative research strategy to collect primary data from structural engineers, architects, and quantity surveyors in Kumasi, Sunyani, and Accra using a structured questionnaire. The lack of standards, the insufficient strength of indigenous building materials, the lack of skilled personnel in vernacular architecture, and the inability of indigenous building materials

to meet the requirements of modern building designs are all major factors discouraging the use of indigenous building materials, according to the findings.

In order to promote the use of indigenous building materials, Acheampong et al. (2014) believe that aggressive advertising of the materials should be produced, and employees should be trained to gain the necessary skills to use indigenous building materials effectively. It was also suggested that a law be enacted to enforce the national housing strategy on the promotion and use of indigenous building materials. The study was able to identify reasons that impede the use of indigenous building materials and make recommendations to counteract the current trend. However, it did not consider how to keep the material in use, necessitating more research in this area.

Adzraku, et al. (2016) published a publication titled “Prospects for Sustainable Housing in Northern Ghana with the Use of Local Walling Materials,” which should be included in his literature review. Un-burnt earth bricks were identified as the most often used locally accessible walling material in the construction of dwellings in Northern Ghana, according to the study (Adzraku et al., 2016). The research was conducted in Bunania, a Navrongo suburb in Ghana's Upper East Region. According to the study, building characteristics in Bunania are similar to those in most places of Northern Ghana.

The data for the study was gathered using both quantitative and qualitative methodologies. To acquire the necessary replies and information, interviews, observations, and a questionnaire were used. Respondents were chosen using a snowball technique from a population that has lived in both traditional and modern homes. The major tool utilized was a structured questionnaire that included demographic information about respondents as well as their experiences with using locally accessible building materials (Adzraku et al., 2016). Respondents' responses ranged from strongly disagree (1) to strongly agree (5), therefore a five-point likert



scale was employed to collect information on the benefits and drawbacks of using locally accessible walling materials. Peer review and pilot testing were used in the study to confirm the instruments' validity and reliability, resulting in better outcomes. A total of 100 people were asked to fill out questionnaires. The data was analyzed using the Statistical Package for Social Sciences (SPSS version 20). (Adzraku et al., 2016).

According to the findings, 85.7 percent of respondents live in homes built of mud or unburned earth bricks, while 43.3 percent prefer homes made of imported conventional building materials. This demonstrates that, if properly exploited and used responsibly, indigenous building materials have the potential to reduce the housing deficit. Thermal comfort, low cost, cultural heritage development, and environmental friendliness are among the advantages of local walling materials, according to the research (Adzraku et al., 2016).

On the other hand, issues related with the usage of un-burnt earth bricks/blocks include authorities' failure to recognize their value, lack of strength and durability, inability to meet modern construction forms' needs, easy invasion by mice and termites, and low weather resistance (Adzraku et al., 2016).

Per the findings established, the following recommendations were made:

1. Sustainable housing scheme to be put in place in Northern Ghana by Government.
2. Authorities responsible for the housing sector to recognize the cost saving potential of local walling materials and allow direct participation of indigenous artisans in the self- build tradition of the people in the vernacular housing processes in accordance with approved plans/designs.
3. Simple tools should be used for the building processes of earth buildings instead of complex scientific tools.

4. More research to be done to improve the strength and durability of local walling materials, develop method statements, specifications and standards to meet the requirements of statutory authorities in the housing sector.
5. Building permits to be given to housing projects of local walling materials.
6. Local walling materials, floor and ground beneath building to be treated with chemicals to prevent termites and rodents invasion in rooms of local buildings.
7. Long roof overhangs and resilient finishes to be adopted to protect walls and foundations of local buildings.

The study concluded that un-burnt earth bricks/blocks have a lot of potential for promoting sustainable housing schemes in Northern Ghana, provided the government uses available research findings to stabilize the material and improve its strength and durability, as well as encourage key stakeholders to use local materials in the construction industry.

The study concluded that un-burnt earth bricks/blocks have a lot of potential for promoting sustainable housing schemes in Northern Ghana, provided the government uses available research findings to stabilize the material and improve its strength and durability, as well as encourage key stakeholders to use local materials in the construction industry.

In order to establish the impact of modernism on traditional houses in Vittin, in-depth interviews, focus group talks, and images were used as part of the research. Focus group talks and interviews were used to gather people's opinions on traditional earth buildings, while images were used to chronicle changes in the traditional housing system. Focus group research, according to Folch-Lyon and Trost (1981), is better appropriate for examining the dynamic relationships between people's ideas, concerns, attitudes, motivations, and issues linked to phenomena influenced by human actions. Participants

who cannot read or write are not discriminated against in focus group talks, according to the study (Apeaning, 2016).

Members of the focus group were recruited using a door-to-door approach. The focus groups were made up of only persons who lived in houses with earthen walls and were willing to participate in the conversation. Thirty (30) households were chosen as respondents. To validate and justify the results, two focus groups were organized and their talks were compared (Apeaning, 2016).

Data was analyzed systematically by coding responses that were similar from the two focus groups under the following themes:

- i. process of construction
- ii. the shape of houses
- iii. the material used
- iv. the general impression of the people towards traditional earth houses
- v. perception of influence towards modern houses in the community.

The above-mentioned themes were used to categorize and present the results. The findings revealed that the houses in Vittin's neighborhood are mostly made of earth or mud. Traditional dwellings in the area are mainly round with thatch roofs and can last up to eight decades if properly maintained, according to the study. It also indicated that cement block construction was growing popularity in the neighborhood. According to the study, mud and thatch houses represent the people's identity, culture, and tradition (Apeaning, 2016).

Danso (2013) also published a paper titled "Building with Locally Available Materials in Ghana: Benefits and Problems" that looked at the primary advantages and disadvantages of using indigenous materials to construct houses in a developing country. The study backed up the arguments of Ofori and Dampson (2011), who claim

that the snowball sampling strategy is appropriate for such a study because it allows the researcher to reach out to the requisite number of respondents through a small group that is relevant to the topic under investigation (Danso, 2013). The study also used a structured questionnaire that was self-administered to determine the advantages of building houses with indigenous materials as well as the challenges that come with it. Danso (2013) also used a five-point likert scale to gauge respondents' agreement or dissatisfaction with the usage of local materials in Dorongo house construction. It went from strongly disagreeing (1) to strongly agreeing (5). To ensure content and construct validity, the researcher assembled a two-member panel with the necessary construction expertise and abilities to validate the content, while construct validity was secured by a critically researched and established theoretical framework. Both content and construct were tested by means of Cronbach alpha reliability test.

According to the survey, 62 percent of respondents want to build their homes with local resources. This is significant evidence that local building materials play an essential role in addressing Ghanaians' housing demands and should be maintained. The promotion of cultural heritage was named first among the advantages of building houses with local resources, followed by the availability of materials. Lowering the room temperature was ranked third, followed by lower cost and affordability. Less environmental impact was ranked fifth, while fire resistance was ranked sixth (Danso, 2013).

Low strength, frequent maintenance, substantial labor, easily eroded, and rat or pest infestations are among the challenges cited by Danso (2013) with the use of indigenous resources in building buildings. This result, according to Danso (2013), supports Riza et al. (2011)'s claim that earth-based materials in their natural state lack the strength and durability required for construction. The study also agrees with Rumana (2007) that

earth or mud walls need to be repaired on a regular basis, resulting in a significant maintenance expense. The findings back with Harper's (2011) claim that mud dwellings need a lot of labor (Danso, 2013).

The paper recommended that:

1. Governments of developing countries should encourage its citizens to preserve their cultural heritage by patronizing indigenous materials to build their houses.
2. Local building materials should be used to build affordable houses and for that matter, to reduce the housing deficit.
3. People in high temperate areas especially in Northern Ghana should use local materials to build their homes in order to reduce the effects of high temperature conditions.
4. There should be continued research until a solution is found to the poor mechanical and durability properties of local buildings materials.

As a result, the study determined that local building materials, among other things, highlight people's cultural history, are widely available in communities, provide cool room temperatures, and are less expensive than conventional materials. Local building materials, on the other hand, were noted as having inadequate strength and durability, requiring frequent repair, being prone to erode, and being labor costly (Danso, 2013). However, the study did not look into how to preserve indigenous building materials such that they are always available from generation to generation. This necessitates a study of the long-term viability of local building materials.

“Major Factors Causing Housing Deficit in Ghana,” according to Afrane et al. (2016). According to the report, the country's housing deficit grows every year since administrations have failed to build housing programs to significantly reduce the deficit over the years. According to the article, the state needs to build 170,000 housing units

per year to make up for the 1.7-million-unit gap. “Major Factors Causing Housing Deficit in Ghana,” according to Afrane et al. (2016). According to the report, the country's housing deficit grows every year since administrations have failed to build housing programs to significantly reduce the deficit over the years. According to the article, the state needs to build 170,000 housing units per year to make up for the 1.7-million-unit gap. Thus:

1. Not caused
2. Less caused
3. Neutral
4. Caused
5. Highly caused

Fifty-two (52) questionnaires were administered in which 69.2% response rate was obtained. Yamane (1967) formula was used to determine the sample size. According to the formula,

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

Where n = sample size,

N = Population size,

e = Level of precision, 10% or 0.1

The sample size was therefore determined as:

$$n = \frac{52}{1 + 52(0.1)^2} = 34.21$$

The study employed average mean to evaluate the data in order to discover the primary causes generating the housing deficit in Ghana, while cross-tabulation via correlation matrix was used to analyze the significant elements driving the deficit. The level of significance of the identified causes of housing shortage was determined using

Kendall's test (0.05). The following were the primary causes that contribute to the country's housing shortage, according to the study:

1. Rural-Urban migration
2. Lack of continuity of housing schemes as a result of frequent change of government
3. Rapid increase of population of the people and urbanization
4. Weak mortgage financing Institutions
5. High cost of land for housing purposes
6. Bad land tenure system
7. Expensive conventional building materials
8. Lack of infrastructure and provision of utility services

To reduce rural-urban migration, the study advocated that social amenities and infrastructure development be extended to rural communities. According to the report, a proper land tenure system should be developed to alleviate the obstacles that come with purchasing property for housing. Mortgage loans should be made more flexible so that individuals and developers can readily get them to suit their housing needs. The document also suggests that the government move quickly to meet the citizens' housing requirements (Afrane et al., 2016).

This study reveals that the country's housing needs are really insufficient. It also demonstrates that population expansion has a significant impact on people's housing needs. This circumstance necessitates the long-term usage of indigenous building materials to lessen the shortfall, necessitating my research topic selection. The findings were improved by using Yamane's formula and Kendall's test. However, the study failed to identify the long-term usage of indigenous building materials as a viable option for addressing the country's housing shortage. My chosen research topic will have to fill this void.

## **2.5 Indigenous Building Materials in Contemporary Architecture**

The work by Agbonome et al. (2016), titled "A review of the usage of Indigenous Building Materials in Contemporary Architecture in Nigeria," is another item worth reviewing in this exercise. The article looked at how local building materials could be used to satisfy the demands of modern architecture. This work was especially critical in Nigeria, where the country's housing shortfall is expected to exceed 20 million units (Osinbajo, 2018), necessitating new and innovative approaches to close the gap. The report took a qualitative research technique, obtaining primary material through interviews and case studies. Secondary data, on the other hand, was acquired through the internet and literature. The features and characteristics of various indigenous building materials were rigorously studied and evaluated in order to discover how they are employed in Nigerian modern architecture. Local building materials often found in Nigeria, according to the study, include granite, lime stone, marble, laterite, clay, natural fiber, bamboo, and lumber, among others (Agbonome et al., 2016).

A rigorous evaluation was conducted to establish the extent to which native building materials are used in contemporary Nigerian architecture. The benefits of employing indigenous building materials, according to the report, include providing inexpensive homes for Nigerians, lowering the cost of construction, creating jobs, and developing local technologies to maximize the use of materials, among other things (Agbonome et al., 2016). Despite the numerous benefits, some people still detest buildings constructed of local materials, believing that they are only suitable for low-income earners in society, according to the survey (Agbonome et al., 2016).

The study revealed that, despite the fact that indigenous building materials have been utilized for centuries in a variety of climates, their structural performance has not been



thoroughly recognized by important players in the construction industry. The paper advocates for the standardization of indigenous construction materials as well as the retraining of builders, architects, and engineers in order to fully comprehend the benefits of these materials (Agbonome et al., 2016).

It is obvious that the findings of this article will provide useful information regarding the use of indigenous building materials in the construction industry in order to supplement the housing deficit in Nigeria and beyond; however, there was no consideration of indigenous building materials' sustainability, which is a knowledge gap that requires further research.

## **2.6 Demand for Indigenous Building Materials.**

In addition, in a paper titled "Traditional Construction Materials as a Sustainable Resource and Material for Low-Cost Housing in Nigeria: Advantages, Challenges, and the Way Forward," Ikechukwu and Iwuagwu (2016) evaluated the main indigenous building materials often used in Nigeria. The research's major goal was to conduct a critical analysis of the main benefits, drawbacks, and recommendations for using indigenous building materials to create low-cost and affordable housing in Nigeria (Ikechukwu & Iwuagwu, 2016). Energy efficiency, biodegradability, reusability, cultural heritage promotion, affordability, and material availability were some of the benefits discovered in the study (Ikechukwu & Iwuagwu, 2016).

Poor durability, low strength, deforestation, regular maintenance, and non-acceptability of the material in the construction sector were also recognized as negatives related with the usage of indigenous building materials in the study (Ikechukwu & Iwuagwu, 2019). According to the report, Africa has a severe shortage of affordable housing due to the high cost of traditional building materials such as Portland cement and steel. The report

laments that indigenous building materials have lost value and that there is a widespread belief that they are unsuitable for construction, exacerbating Nigeria's housing crisis and aggravating the situation in many developing countries (Ikechukwu & Iwuagwu, 2016). As a result, the demand for the use of indigenous building materials to promote low-cost and accessible housing is a step in the right direction, and all stakeholders should support it.

Thatch, soil, bamboo, and wild coconut trees were among the materials investigated in the study. According to the research, thatch is both renewable and conveniently available. It further stated that earth, and specifically adobe building, is frequently used in many African rural areas. Bamboo is also a fast-growing plant that may be harvested every three to four years, depending on the kind, as opposed to wood, which takes 25 to 50 years to mature. Its advantages include high strength, durability and affordability. The trunks of wild coconut trees have been discovered to be useful for structural uses such as bridges, roofs, ceilings, walls, and lintels, as well as being resistant to termite infestation and humidity (Ikechukwu & Iwuagwu, 2016).

The study suggested that local building materials be reengineered to meet modern needs. It also proposed combination of local building materials with conventional materials to improve the strength and quality of indigenous building materials. The Nigerian government was also urged to promote the use of locally produced building materials in order to reduce costs and heat effects. This will undoubtedly go a long way toward alleviating the housing crisis and lowering the cost of cooling our rooms with electricity. The study concluded that if local building materials are used as indicated, Nigeria's housing shortfall will be alleviated and dwellings will become cheaper (Ikechukwu & Iwuagwu, 2016). Clearly, the study did not critically analyze how to

conserve indigenous construction materials, and it made no recommendations on the subject. As a result, there is a knowledge gap in the study about the sustainability of indigenous building materials, which necessitates more investigation.

In Nigeria, Ikechukwu and Iwuagwu (2017) published “Bridging the Gap Between Low-Cost Housing Demand, Supply, and Affordability in Nigeria Through the Use of Indigenous Building Materials.” The research looked at Nigeria's housing intervention programs and examined the current housing demand and supply challenges. It also looked at the state's housing needs, housing provision, and the primary roadblocks to low-cost housing delivery in Nigeria. In terms of methodology, the study did a thorough literature analysis to determine low-cost housing demand, supply, affordability, and the Nigerian government's efforts and initiatives to address the problem. A broad literature review, in my opinion, is insufficient to show the housing condition in Nigeria. Other research approaches should have been used to improve the findings' quality and validity.

Low income levels of average Nigerian residents, shortage of land for housing, and high land costs are among the major constraints found in the study regarding the delivery of low-cost housing in Nigeria. The study, on the other hand, highlighted several important advantages of indigenous building materials, including their availability, cost, energy efficiency, and ozone friendliness (Ikechukwu & Iwuagwu, 2017). Indigenous building materials and technologies should be harnessed and developed to meet the housing demands of low-income earners, according to the report. The report also believes that western building methods are too expensive and ineffective for supplying low-cost housing in third-world countries. It was also suggested that the Nigerian government encourage researchers to look into low-cost housing by funding the construction of demonstration low-cost houses. It went on to

say that the advantages of local building materials should be valued because they are the Nigerian society's future; and that local standards for indigenous building materials should be established (Ikechukwu & Iwuagwu, 2017).

Despite the fact that the study thoroughly examined Nigeria's housing situation and identified indigenous building materials as critical resources for reducing the housing deficit and making housing affordable to the average Nigerian, it failed to identify ways to sustain indigenous building materials in order to maximize their potentials. To close this gap, more research is needed. As a result, my topic selection is appropriate for bridging the knowledge gap indicated in Ikechukwu and Iwuagwu's investigation (2017).

Gambino et al. (2014) conducted a study in Honduras called "A Sustainable and Resilient Housing Model for Indigenous Population of the Mosquitia Region (Honduras)" in the Mosquitia Region. One of the study's goals was to encourage efficient and long-term forest resource management. According to the article, irresponsible use of forest resources has resulted in a scarcity of excellent quality wood for houses in Moskitia settlements (Gambino et al, 2014). As a result, the study presented a housing concept that is thought to be more sustainable in addressing the Miskitia people's housing demands. The approach aims to produce an eco-sustainable home system by utilizing available local building components. A field mission in eight Honduran towns in the Mosquitia Region was used to collect data for the study. A semi-structured interview with members of the Miskitan population was also used to acquire important data for the study. Elders, teachers, leaders, doctors, biologists, and project managers were among the community's important members and experts interviewed. In addition, a home in each of the eight communities was polled to assess the living situation in terms of materials utilized, upkeep, house layout, construction process, and

occupant count. Meetings with Indigenous Miskita Associations were also used to obtain data (Gambino et al, 2014).

The study highlighted low wood durability due to improper drying, weather conditions, and pest infestation as concerns connected with existing houses in Miskitan villages. As a result, it was suggested that wood for housing be well seasoned with natural air, kept out of direct touch with the ground, and protected from pests, the sun, and rain (Gambino et al, 2014). Local building materials have the ability to meet the Honduran people's housing needs in the long run, according to the report, if the correct techniques and approaches are used (Gambino et al, 2014). Despite the fact that the study found that uncontrolled use of forest resources is causing indigenous construction materials to become rare, it failed to offer a comprehensive plan for sustaining such materials and ensuring their future advantages. This condition has produced a knowledge gap that must be filled, and my study topic is well suited to do so.

Salzer et al. (2016) wrote an essay titled "Sustainability of Social Housing in Asia: A Holistic Multi-Perspective Development Process for Bamboo-Based Construction in the Philippines" to address the difficulties facing social housing in Asia. The study looked at the necessity for socially fast-growing countries in Asia, Latin America, and Africa to have a sustainable and holistic housing development (Salzer et al., 2016). To examine the sustainability criteria of bamboo use, qualitative research methods such as field observations and interviews were used. This was done among three main stakeholder groups: "builders and users of traditional bamboo houses in the Philippines, stakeholders involved in using forest products for housing in other countries across the world, and stakeholders in the Philippines' social housing sector" (Salzer et al., 2016). To address criticisms of qualitative research's small sample size, the report systematically gathered relevant data and assessed the content by coding, sorting, and

sifting. Furthermore, the study used “many source triangulation, long-term engagement in the field, use of numerous methodologies to confirm findings, and evaluation by more than one observer or author” to reduce the danger of biased results (Salzer et al., 2016). The data was organized into a number of sustainability categories, including technology, governance, ecology, and society, in the paper (Salzer et al., 2016).

The utilization of local building materials, according to the report, is the most reliable way of meeting the housing demands of low-income populations in the Philippines and elsewhere (Salzer et al., 2016). It further claims that, while most people demand appropriate housing, traditional building technologies and materials such as concrete and steel, as well as budgetary constraints, render such housing methods unaffordable for the Philippine populace's low-income residents (Salzer et al., 2016). As a result, the article tried to establish the sustainability criteria by which bamboo-based construction may be created and promoted to meet the Philippine society's housing demands (Salzer et al., 2016). The goal of accessing the potentials of bamboo raw materials to design a building method suitable for the Philippines' social housing needs had been achieved, according to the study (Salzer et al., 2016).

As a result, it should come as no surprise that indigenous building materials such as bamboo are utilized for homes all over the world, and that if properly exploited and developed, they can assist to address the housing shortages that many countries, particularly developing ones, face. The study did not, however, determine how bamboo could be sustained in order to ensure that it is always available to meet demand in the housing sector. Because bamboo is an indigenous construction material, there is a knowledge deficit in the domain of indigenous building material sustainability.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This section of the study outlined the research methodology employed in the study. It is usually important to adopt the right methodology to ensure that the objectives of the research are met with the findings verifiable. The methodology in this work therefore includes research design, population, sample size and sampling technique, data collection instrument, and data collection procedure. It further presents the validity and reliability of the instrument, data analysis and ethical consideration.

#### 3.2 Research Design

The research design adopted for the study was a cross-sectional survey to assess the demographic profile of respondents including gender, age, educational qualification and occupation. It further assessed the types of indigenous building materials used, reasons for choosing such indigenous building materials, environmental sustainability of the use of indigenous building materials, social implications of the use of indigenous building materials and economic sustainability of the use of indigenous building materials. Survey research design is a type of descriptive research where the researcher administers a questionnaire to a sample or to the entire population to describe the attitudes, opinions, behaviours, or characteristics of the population (Creswell, 2012). Creswell asserts that in this procedure, survey researchers collect quantitative numbered data using questionnaires and statistically analyse the data to describe trends about responses to questions and to test research questions. Considering the nature of the study, the survey design was deemed appropriate in terms of collecting data from respondents within a relatively short period of time. Quantitative structured



questionnaire was therefore used to collect useful data and the data coded and analysed via Microsoft Excel and Statistical Package for Social Sciences (SPSS version 23).

### **3.3 Population**

Population is a collection of all possible individuals, objects or measurement that have one or more characteristics in common that are of interest to the researcher (Arthur, 2012). Thus, population is a complete set of individuals (subjects or events) having common characteristics in which the researcher is interested (Fraenkel & Warren, 2002). The population for this study therefore constituted all construction professionals in the built environment in the Central region with interest in the use of indigenous building materials for the construction affordable houses.

### **3.4 Sample size and Sampling technique**

Sampling is the process of selecting a portion of the population to represent the entire population in the study (Amedahe, 2004). Sample on the other hand, consist of a carefully selected unit of the population for a particular study (Sarantakos, 2005) or is a sub-group of the population that is an ideal representative of the entire population (Kumar, 1999). It is “the representative of the population to the extent that it exhibits the same distribution of characteristics as the population” (Arthur, 2012). Best and Kahn (1998) posit that to study a large population to arrive at generalization would be impracticable, if not impossible. Gay (1992) asserts that in general, the minimum number of subjects believed to be acceptable for a study depends upon the type of research involved. This current study used purposive sampling as its sampling technique. Out of the sample frame of 95 in the region, 77 of them representing 81.05%



were chosen as the sample size for the study. The sample size for the study was obtained using the Yamane's formula for sample size estimation (Yamane, 1967).

### 3.4.1 Sample Size Estimation

Sampling refers to the selection of units of analysis for a study (Hunter et al., 2002). The choice of a sampling technique is dependent on the research problem, purpose, design, and practical implications of the research topic. The choice of these contractors was based on the availability of contractors working on various construction projects in the part of the region covered in this study. The desire to collect data on ongoing projects has made the adoption of purposive sampling to be appropriate for the study. The primary consideration in purposive sampling is one's decision as to who can provide the best information to achieve the objectives of the study. (Guba & Lincoln, 1994; Kumar, 2011). Yamane (1967) provides a simplified formula to calculate sample sizes. This formula was used to calculate the sample sizes in the current study as shown in Equation 1.

$$n = \left[ \frac{N}{1 + N(e)^2} \right]$$

Equation 1 Yamane's formula for calculating sample size (Yamane, 1967)

Where n = sample size

N = Sampling frame = Total Population 120 (Total number construction professionals)

e = Significance level = 5% or 0.05

$$n = \left[ \frac{95}{1 + 95(0.05)^2} \right]$$

$$n = 76.61$$

$$n \approx 77$$

From the above calculations, approximately 77 construction professionals were the sample size from the study area.

### **3.5 Data Collection Instruments**

Questionnaire was used to collect data from the respondents. Oppenheim (1992) is of the view that questionnaires should be easy to administer and that there is the need to make the content of the questionnaire user-friendly. The questionnaire was self-developed for landlords/landladies which consisted of two sections. Section A consisted of personal background information of the respondents while section B was made up various questions that sought to answer the research questions. The questionnaire closed-ended statements divided into three main sections based on the themes of the research questions. It was a 5-point Likert scale (5: Strongly Agree, 4: Agree, 3: Neutral, 2: Disagree, and 1: Strongly Disagree). The Likert scale has been found to be one of the most suitable type of instrument for the measurement of attitudes and perceptions. This is because it enables respondents to indicate their degree of agreement with a series of statements on how respondents feel about an issue (Bryman, 2001).

### **3.6 Validity and Reliability of the Instrument**

#### **3.6.1 Validity of the Instrument**

Generally, instrument validity is the extent to which an instrument measures what it is supposed to measure (Kumar, 1999). In this study, it was used because it is basically concerned with determining whether the instrument on the face of it appears to measure what it is supposed to measure. The validity of research instruments was therefore ensured by assessing the questionnaire items during their construction.

Content validity was used in the study to validate the questionnaire. This was done by panel of experts examining the contents of the items of the questionnaire to check whether they represent the entire construct of the problem under consideration. The team of experts also content checked the questionnaire items and their adequateness in measuring the constructs and to know whether the chosen items are sufficient to measure the variables in the domain.

### **3.6.2 Reliability of the Instrument**

Reliability of research instrument is much concerned with consistency where stable responses are generated to build confidence in further planning and decisions in the study to provide good results. Taale and Ngman-Wara (2003) explained that, reliability refers to the consistency that measures test items from one period to another over a period of time, situations and examiners. Normally, if results obtained seems similar, from the same test across situations, time and period, high degree of reliability is produced. Sometimes, reliability is seen when consistent or stable responses are generated. Cohen et al. (2003) reiterated that, reliability has to do with measuring the consistency and reliability over time, type of instrument, and group responses. The study achieved a Cronbach Alpha of 0.7.

### **3.7 Data collection Procedure**

Quantitative structured questionnaire was used to collect useful data. A sample of 77 professionals from the built environment in the Central region were considered for the administration of the questionnaires. The questionnaires were first put in google form, and were then administered through the emails of the respondents.

Before the questionnaire was administered to the sampled population, it was pre-tested in the Ashanti Bekwai Municipality as a pilot study to ascertain the validity and reliability of the instrument to meet the research objectives. Based on the feedback restructuring was done before the final questionnaire administered was developed.

### **3.8 Data Analysis**

The data collected was extracted from google form in the form of Microsoft excel and imported to Statistical Package for Social Sciences (SPSS version 23) for analysis. The results of the analysis are presented in the form of descriptive statistics displayed in graphs and on tables. To facilitate understanding of these statistics, explanatory notes and interpretations have been added to guide readers and to enhance their comprehension of the results (Alreck & Settle, 1995). This is intended to ensure simple and very clear communication of the large volume of data collected. The researcher went further to discuss these findings in light of the literature, which provided some basis for some conclusions on the subject under study. This allowed for some useful contribution to the available literature on the subject and provides a basis for the recommendations of the study for both researchers and practitioners.

### **3.9 Ethical considerations**

Ethics are principles and guidelines that help us uphold the things we value (Johnson & Christensen, 2012). Ethical aspects, such as access and acceptance, informed consent, privacy and confidentiality, and misinterpretation and misrepresenting of data were taken into consideration. Opie (2004) emphasizes that research comes into the lives of people who are the focus in various ways, taking their time, involving them in

activities they would not otherwise have been involved in, providing researchers with privileged knowledge about them, and therefore potentially power over them.

The first ethical issue of access and acceptance was addressed, as Cohen et al. (2007) state, that “the relevance of the principle of informed consent becomes apparent at the initial stage of a research project - that of access to the institution or organization where the research is to be conducted, and acceptance by those whose permission one needs before embarking on the task”. Furthermore, “access to personal records, both as a primary or secondary source of data, must be approached both ethically and legally” (Anderson & Arsenault, 1998).

The informed consent offered information to the participants on “the nature and the purpose of the research, the risks, and benefits” (Anderson & Arsenault, 1998).



## CHAPTER FOUR

### PRESENTATION OF RESULTS AND DISCUSSION

#### 4.1 Introduction

This chapter focuses on the presentation and interpretation of the study's findings. The survey response rate, demographic characteristics of respondents, main types of indigenous building materials used in meeting household housing needs, environmentally sustainable and friendly use of indigenous building materials, social implications of indigenous building materials use, and economic sustainability of indigenous building materials use are all covered in this chapter.

#### 4.2 Response Rate

A total of 77 questionnaires were distributed to the respondents, 62 of the respondents responded to the questionnaires. As a results, an overall response rate of 80.5% was achieved by the study. This is an appropriate response rate for analysis (Punch, 2003).

#### 4.3 Demographic Characteristics of Respondents

Gender, age, educational level, and occupation of owners of houses made using indigenous building materials were among the topics covered in the background of responses. The researcher needed to know about the respondents' backgrounds in order to define their unique qualities.

##### 4.3.1 Gender of Respondents

The gender distribution of the respondents is shown in Table 4.1. According to the data received, the majority (58) of the respondents (93.5%) were males, while the remaining 4 respondents (6.5%) were females. According to the gender breakdown in Table 4.1, male respondents dominated the survey. When it comes to professionals who employ

local building materials in their projects, this validates the male-dominated construction industry in Ghana.

Table 4. 1 Gender of Respondents

<b>Gender</b>	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
Male	58	93.5	93.5	93.5
Female	4	6.5	6.5	100.0
Total	62	100.0	100.0	

#### **4.3.2 Level of Education of Respondents**

The level of education of the respondents was analyzed and the results are shown in Table 4.2. It was observed that 1 respondent representing 1.6% of the respondents was a Doctor of Philosophy holder with 7 of the respondents representing 11.3% were second-degree holders, 35 of the respondents representing 56.5% were first degree holders which represents the majority of the respondents. Diploma graduates were also 19 representing 30.6%. The results indicate that majority of the respondents are highly educated and well qualified. The distinctions in the educational background of the respondents significantly helped the researcher to obtain diverse views on the topic.

**Table 4. 2 Respondent's Level of Education**

	<b>Frequency</b>	<b>Percentage</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
PhD	1	1.6	1.6	1.6
Master's degree	7	11.3	11.3	12.9
Frist degree	35	56.5	56.5	69.4
Diploma	19	30.6	30.6	100
<b>Total</b>	<b>62</b>	<b>100</b>	<b>100</b>	

#### 4.3.3 Position of the Respondent in the Construction Firms

The study revealed that the majority of the respondents representing 41.3% were Architects, 29.1% were also Material engineers, 18.4% were Quantity surveyors whiles 11.2% were Civil engineers. Thus, the majority of the respondents are well experienced in their area of specialty which gives certainty in the data collected.

#### 4.3.4 Respondents' years of Experience in the Construction Industry

The study sought the respondents' number of years spent in the construction industry concerning their experience as far as indigenous building materials are concerned. The study reviewed revealed that 11.2% of the respondents have spent less than 5 years in the industry. 17.5% of the respondents have also spent between 5-10 years whiles 21.4% of the respondents have spent 11-15 years. However, the majority of the respondents recorded 30.8% have spent 16-20 years, and 19.1% have incredibly spent over 20 years in the construction industry. This however implies that most of the respondents have had rich experience in the industry.



#### 4.4 The Most used Indigenous Building Materials

House owners were asked to rate their level of agreement with each statement in order to determine the primary types of indigenous building materials used in meeting the housing demands of households in Central region. To ascertain the outcome, the mean and standard deviation of the respondents' responses were determined. The results are shown in Table 4.5. The respondents agreed that standardized mud/laterite is the sort of indigenous material utilized for house walls, as shown in Table 4.3. This statement had a standard deviation of 0.346 and a mean of 4.33. The respondents agreed that earth/clay blocks are the sort of indigenous materials used for house walls, with a mean score of 3.37 and a standard deviation of 1.403. Landcrete blocks (mean=2.28) and sandcrete blocks (mean=1.30) are utilized for dwellings made using indigenous building materials in the three settlements that make up Central region, according to the respondents. The intended cut-off point of 3.0 was not met by this statement.

The respondents agreed that thatch, laterite, and zinc are utilized as roofing materials for dwellings constructed with indigenous building materials. The mean of this statement was 4.04, and the standard deviation was 1.129. Again, the respondents agreed that thatch and laterite are employed for roofing indigenously constructed buildings. This statement had a 3.68 average and a 1.311 standard deviation. However, the respondents agreed that laterite is sometimes used only for roofing houses built with indigenous building materials in Central region, with a mean of 3.76 and a standard deviation of 1.284. The respondents, on the other hand, disagreed that only thatch (mean=1.59) and zinc (mean=1.275) are utilized for roofs constructed with indigenous construction materials. The specified cut-off point of 3.0 was not met by these remarks. When it came to the type of finishing materials used on house walls in Central region, the respondents agreed that rammed laterite is utilized as a finishing material for house

walls constructed with local building materials. With a mean of 4.22 and a standard deviation of 1.57, this assertion was made. In addition, the respondents agreed that sand/cement mortar is utilized as a finishing element for house walls constructed with local materials. The average score for this statement was 3.51, with a standard deviation of 1.78. The respondents, on the other hand, disagreed that rammed laterite/cement (mean=2.33) and pit sand without cement (mean=1.00) are the materials used to finish dwellings constructed with indigenous construction materials. The specified cut-off point of 3.0 was not met by these remarks.

The respondents agreed that sand/cement mortar is utilized for floor finish in houses built with indigenous building materials. The mean of this statement was 4.48, with a standard deviation of 1.09. Respondents stated that rammed laterite/cement is used for finishing the floor of houses made using indigenous construction materials, with a mean of 3.11 and a standard deviation of 1.55. The respondents, on the other hand, disagreed that rammed laterite (mean=1.13) and pit sand without cement (mean=1.10) are used to complete the floors of houses constructed with indigenous construction materials. The specified cut-off point of 3.0 was not met by these remarks.

Table 4.3 Most used Indigenous Building Materials

Types of materials used for houses	Responses		Remarks
	Mean	SD	
<b>Materials for house walls</b>			
Stabilized mud/laterite	4.33	.346	Agreed
Earth/Clay blocks	3.37	1.403	Agreed
Landcrete blocks	2.28	1.089	Disagreed
Sandcrete blocks	1.30	1.217	Disagreed
<b>Types of roofs used for house</b>			
Thatch, laterite and zinc	4.04	1.129	Agreed
Thatch and laterite	3.68	1.311	Agreed
Laterite only	3.76	1.284	Agreed
Thatch only	1.59	1.177	Disagreed
Zinc sheets only	1.69	1.275	Disagreed
<b>Types of finishing applied to house walls</b>			
Rammed laterite	4.22	1.57	Agreed
Sand/cement mortar	3.51	1.78	Agreed
Rammed laterite/cement	2.33	1.83	Disagreed
Pit sand without cement	1.00	0.94	Disagreed
<b>Types of floor finish house is made of</b>			
Sand/cement mortar	4.48	1.09	Agreed
Rammed laterite/cement	3.11	1.55	Agreed
Rammed laterite	1.13	1.04	Disagreed
Pit sand without cement	1.10	1.08	Disagreed

The discovery suggests that for house walls constructed using indigenous building materials, standardized mud/laterite and earth/clay blocks are employed. Thatch,

laterite, and zinc looked to be utilized for roofing dwellings constructed with local building materials. The discovery also indicated that rammed laterite and sand/cement mortar are employed as finishing materials for indigenously constructed home walls. Furthermore, sand/cement mortar and rammed laterite/cement are utilized to complete the floors of houses constructed with indigenous building materials, according to the study. The discovery backs up Odeyale and Adekule's (2008) study, which found that there are a variety of indigenous building materials in Nigeria, including granite, limestone, marble, laterite, clay, natural fiber, bamboo, and lumber, among others. Indigenous materials like as thatch, dirt, bamboo, and wild coconut trees, among others, are also employed for construction, according to Agbonome et al. (2016). According to the research, thatch is both renewable and conveniently available. It further stated that earth, and specifically adobe building, is frequently used in many African rural areas. Bamboo is also a fast-growing plant that may be harvested every three to four years, depending on the kind, as opposed to wood, which takes 25 to 50 years to mature. Thatch, laterite, zinc, and wild coconut tree trunks were found to be acceptable for structural applications such as bridges, roof, ceiling, wall, and lintel constructions, and to be resistant to termite attack and humidity, according to Ikechukwu and Iwuagwu (2016).

#### **4.5 Factors influencing the choice of materials for walling, roofing and floor**

Mean and standard deviation were used to investigate the factors that influence the owner's choice of walling, roofing, and finishing floor materials. The summary for each variable is shown in Table 4.4.

Table 4.4 Reasons for choosing such material

S/N	Reasons for choosing material	Responses		Remarks
		Mean	SD	
1.	Cheaper	3.51	1.92	Agreed
2.	Readily available	3.40	1.88	Agreed
3.	Comfortability	3.23	1.80	Agreed
4.	Durability	2.28	1.84	Disagreed
5.	Environmentally friendly	1.92	1.96	Disagreed
6.	Renewable	1.02	1.30	Disagreed

According to the findings of the study, cheaper materials have an impact on the purchasing of indigenous resources for house construction in the Central region. This statement had a 3.51 mean and a 1.92 standard deviation. The availability of indigenous materials influenced the buying choice of owners of houses built using indigenous materials, with a mean of 3.40 and a standard deviation of 1.88. The respondents, however, agreed that comfortability influences their buying selection of indigenous materials for building houses in the Central region, with a mean of 3.23 and a standard deviation of 1.80.

On the contrary, respondents disagree that indigenous materials' durability (mean=2.28), environmental friendliness (mean=1.92), and renewability (mean=1.02) influence their buying decision. The cut-off point of 3.0 was not met by these comments. Owners of houses built using indigenous materials stated that lower costs, ease of availability, and comfort influenced their decision to build with indigenous materials, according to the data. The finding was in line with the findings of Nwoke and Ugwuishiwu (2011) which found that indigenous building materials have been

employed as construction materials because of their ease of availability, workability, and strength. People used local walling materials, according to Adzraku, et al. (2016), because of their thermal comfort, low cost, promotion of cultural heritage, and environmental friendliness, among other things. Indigenous materials have been the preferred choice for low-cost or cost-effective housing, according to Acheampong et al. (2014).

#### **4.6 Environmental sustainability of indigenous building materials**

This section aimed to prove that indigenous building materials are environmentally sustainable and friendly. The researchers employed a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree" in descending order for the study. The standard deviation (SD) and mean (X) were calculated. The results are shown in Table 4.5.

The top ranked environmental sustainability of indigenous dwelling building is creating a safe and healthy environment, according to the results of the relevance index ranking (Table 4.5). The standard deviation for this statement was 0.382, and the mean was 4.82. The next environmental sustainability of indigenous dwelling construction was to preserve natural resources. The standard deviation for this statement was 0.388 and the mean was 4.82. The respondents, on the other hand, agreed that using indigenous building materials in a sustainable manner improves the environment's quality. The standard deviation for this statement was 0.424, and the mean was 4.77. The respondents agreed that unsustainable collection of indigenous construction materials depletes natural resources in the ecosystem, with a mean score of 4.73 and a standard deviation of 0.411.

The respondents, on the other hand, agreed that a lack of indigenous building materials has an impact on the quality and safety of local housing. The standard deviation for this

statement was 0.475, while the mean was 4.66. The respondents agreed that unfavorable procedures of getting indigenous construction materials and building techniques pollute the environment, with a mean of 4.56 and a standard deviation of 0.475. Furthermore, the respondents felt that planting tree species utilized in indigenous construction materials ensures their long-term viability as dwelling materials. A mean of 3.60 and a standard deviation of 0.492 were used to make this statement. Furthermore, the respondents believed that reducing indiscriminate bushfires increases the availability of tree species suitable for construction in the indigenous housing industry. The standard deviation was 0.487 and the mean was 3.38.

The respondents, on the other hand, argued that unsustainable use of indigenous construction materials is caused by indiscriminate firewood collecting, charcoal burning, farming, and bush burning. The standard deviation for this statement was 1.112, with a mean of 2.32. The respondents also disagreed that indiscriminate firewood gathering, charcoal burning, farming, and bush burning are causing a shortage of indigenous building materials. The mean and standard deviation for this statement were 2.20 and 1.235, respectively. The average cut-off point for these assertions was 3.0.

Table 4.5 Responses on environmental sustainability of indigenous housing construction

Environmental sustainability	Responses		Remarks
	Mean	SD	
The use indigenous building materials promotes safe and healthy environment	4.82	.382	Agreed
Sustainable use of indigenous building materials preserves the natural resources	4.82	.388	Agreed
Sustainable use of indigenous building materials enhances the quality of environment	4.77	.424	Agreed
Unsustainable harvesting of indigenous building materials depletes the natural resources in the environment	4.73	.411	Agreed
Scarcity of indigenous building materials affect the quality and safety of local houses	4.66	.475	Agreed
Negative processes of obtaining indigenous building materials and techniques of building pollute the environment	4.56	.475	Agreed
Planting of tree species used for indigenous building materials ensure the sustainability of such materials for housing purposes.	3.60	.492	Agreed
Prevention of indiscriminate bush burning promote the availability of tree species suitable for building purposes in the indigenous housing sector	3.38	.487	Agreed
Indiscriminate firewood harvesting, charcoal burning, farming and bush burning are the main causes of unsustainable use of indigenous building materials	2.31	1.112	Disagreed
Indigenous building materials are becoming scarce due to indiscriminate firewood harvesting, charcoal burning, farming and bush burning	2.20	1.235	Disagreed

According to the findings, using indigenous building materials fosters a safe and healthy environment, conserves natural resources, and improves environmental quality.



Furthermore, it was discovered that unsustainable harvesting of indigenous building materials depletes natural resources, and that the scarcity of indigenous building materials has an impact on the quality and safety of local homes. Because they come from a quickly renewing resource, indigenous building materials are thought to be environmentally benign (Gichohi, 2014). Increased use of indigenous materials can help to decrease deforestation, encourage new and existing cultivators to plant more trees, and make better use of wasteland, underused land, and riverbanks, resulting in improved soil conservation and flood disaster mitigation (Jianghua, 2001; Nwoke&Ugwuishiwu, 2011). This will not only benefit the environment since trees reduce air and soil carbon content, which has a good influence on the greenhouse effect. Aside from that, it has the potential to create large job possibilities, thereby improving the socioeconomic standing of the local population (Ham, 1990; Ham & Shroyer, 1993; Singh, Kumar & Singh, 2003).

Indigenous construction materials, according to Agbonome et al. (2016), are often natural materials with minimal energy consumption and maintenance costs, as well as being easily deconstructed and repurposed during demolition. Initial and recurrent energy consumption are both included in the embodied energy consumption of indigenous building materials.

#### **4.7 Social implications of the use of indigenous building materials**

In order to promote sustainable development in Central region, this section looks at the social effects of using indigenous building materials on people, households, and the Central region community at large. The researchers employed a 5-point Likert scale ranging from "Strongly disagree" to "Strongly agree" in descending order in the study.

The standard deviation (SD) and mean ( $\bar{X}$ ) of the data were calculated. The results can be found in Table 4.8.

The respondents agreed that using indigenous building materials allows the poor and vulnerable in society to afford housing, as shown in Table 4.8, with a mean of 4.32 and a standard deviation of .467. Furthermore, the respondents felt that adopting indigenous building materials meets the housing needs of families and households while also promoting community trust and belonging. The mean of this statement was 4.10, with a standard deviation of .299. Indigenous construction materials, according to Ripper, Silva, and Moreira (2001), can be used to create basic buildings that are easy to erect and lightweight, resulting in material and labor cost savings. The majority of the respondents believed that using indigenous building materials enhances communal spirit and social cohesion in communities. The mean of this statement was 4.09, with a standard deviation of .651. The respondents agreed with the statement that using indigenous building materials promotes social sustainability by encouraging community members to exercise patience and love. A mean score of 4.05 was found, with a standard deviation of .401.

Furthermore, with a mean of 3.99 and a standard deviation of .577, the respondents agreed that using indigenous building materials preserves indigenous architecture, building method, and skill. The usage of indigenous building materials, on the other hand, promotes social compassion among community members, according to the respondents. This statement had a 3.91 mean and a .571 standard deviation. Furthermore, the respondents agreed with the assertion that using indigenous building materials fosters beneficial community bonds. The mean of this statement was 3.84, with a standard deviation of 1.621.

The respondents, on the other hand, disagreed that using indigenous building materials enhances social relationships among individuals, families, households, and communities. The mean of this statement was 2.73, with a standard deviation of 1.615. Furthermore, the respondents disputed that using indigenous building materials improves social tolerance among households and communities, with a mean of 2.43 and a standard deviation of 1.513. The respondents, on the other hand, disagreed that a lack of indigenous building materials is a source of conflict between households and clans. The mean score for this statement was 2.13, with a standard deviation of 1.225. All of these assertions fell short of the 3.0 cut-off threshold.

Table 4.6 Responses on social Sustainability of indigenous housing construction

Social sustainability	Responses		Remarks
	Mean	SD	
Enables the poor and vulnerable in society to afford shelter	4.32	.467	Agreed
Provides the housing needs of families and households, promotes trust and belongingness among community members	4.10	.299	Agreed
Promotes communal spirit and social cohesion in communities	4.09	.651	Agreed
Enhances social sustainability through the exercise of patience and love among community members	4.05	.401	Agreed
Indigenous architecture, building technique and expertise are preserved	3.99	.577	Agreed
Social compassion is sustained among community members through the process of erecting indigenous structures for shelter	3.91	.571	Agreed
Promotes positive relationship among community members	3.84	1.621	Agreed
Strengthens social connectedness between individuals, families, households and communities	2.73	1.615	Disagreed
Encourage social tolerance among households and communities	2.43	1.513	Disagreed
Scarcity of indigenous building materials is a source of disagreements between households and clans.	2.13	1.225	Disagreed

The findings suggest that employing indigenous building materials allows the poor and vulnerable in society to afford shelter, meets family housing needs, and fosters community spirit and social cohesion. The study also found that using indigenous materials improves social sustainability by encouraging community members to exercise patience and love, as well as preserving indigenous architecture, building techniques, and expertise. The findings support a Ministry of Forestry and Mines study that found indigenous building materials meet families' housing needs while also promoting communal spirit and social cohesiveness in communities. Many people rely on this item for their livelihood. Promoting indigenous building materials helps to minimize deforestation, which is a major contributor to poverty and urban migration (Ministry of Forestry and Mines, 2011).

According to Ham (1990), developing housing based on locally available building materials allows the poor and vulnerable in society to afford shelter, meets the housing needs of families, and improves the skills of local people, which helps them earn money and keeps them from migrating elsewhere, thus improving the social fabric. Because only basic carpentry and masonry tools and skills are required for the construction of local houses (Ky-lakula and Gombya (2008), Larasati, Ihsan, and Mawardi (2013), and Nwoke and Ugwuishiwu (2011)), the skills and expertise can be easily transferred to community members with little or no experience.

#### **4.8 Economic sustainability of the use of indigenous building materials**

The economic viability of using indigenous building materials in Central region is discussed in this section. The researchers employed a 5-point Likert scale ranging from

"Strongly disagree" to "Strongly agree" in descending order for the study. The standard deviation (SD) and mean (X) were calculated. The results are shown in Table 4.9.

Table 4.9 shows that using locally sourced building materials improves material reuse during large renovations. The mean score for this statement was 4.22, with a standard deviation of 0.415. Furthermore, the respondents believed that using indigenous building materials lowers construction costs and improves economic sustainability. The mean score for this discovery was 4.06, with a standard deviation of 0.231. The respondents agreed that using indigenous building materials reduces the cost of cooling and heating homes, with a mean score of 3.92 and a standard deviation of 1.252. According to Kesari (2006), indigenous building materials are less expensive, more durable, and more cost-effective than alternative options like as brick and concrete.

Furthermore, the respondents agreed with the statement that indigenous housing is easy to maintain, faster to build, has lower labor costs, and is less expensive to rent. The average score for this statement was 3.62, with a standard deviation of 1.337. In addition, the respondents agreed with the assertion that sustainable use of indigenous building materials improves the economic well-being of families and households. The mean score for this statement is 3.52, with a standard deviation of 1.417. Table 4.9 clearly shows that one of the advantages of using indigenous materials is the availability of free communal labor. This discovery had a 3.47 mean score and a 1.88 standard deviation. Furthermore, the respondents claimed that the practice of communal spirit through communal labor by community members to help families and households erecting indigenous houses has a significant economic impact. This statement had a standard deviation of 1.70 and a mean of 3.04. The respondents, on the other hand, disagreed that planting tree species ideal for indigenous house materials lowers the cost of getting indigenous housing materials. The mean of this statement was 2.89, and the

standard deviation was 1.66. Furthermore, the respondents disagreed, with a mean of 2.88 and a standard deviation of 1.66, that indiscriminate harvesting of indigenous building materials, which destroys farm lands and medicinal plants, raises the economic cost of food and health for families and households. The specified cut-off point of 3.0 was not met by these remarks.

According to the findings, using indigenous building materials stimulates material reuse during major restorations, lowers construction costs and improves economic sustainability, and lowers the cost of cooling and heating homes. Furthermore, it appears that indigenous housing is simple to maintain, quick to construct, involves low-cost labor, and is less expensive to rent; it also promotes the economic well-being of families and households. The findings are consistent with a study by Honduras et al. (2014), which found that indigenous building materials are frequently used as a less expensive alternative to imported building materials. According to Jianghua (2001), the utilization of indigenous building materials has become a backbone industry in rural economic development and poverty reduction, as well as a new source of economic growth in remote communities.

Table 4.7 Responses on economic sustainability of indigenous housing construction

Economic sustainability	Responses		Remarks
	Mean	SD	
Encourages reuse of materials during major renovations	4.22	.415	Agreed
Reduces the cost of building and enhances economic sustainability	4.06	.231	Agreed
The use of indigenous building materials in building reduces the cost of cooling and heating homes	3.92	1.252	Agreed
Indigenous housing is easy to maintain, faster to complete, cheap labour and cheaper to rent	3.62	1.337	Agreed
The economic wellbeing of families and households is improved through sustainable use of indigenous building materials	3.52	1.417	Agreed
Free communal labour is one of the benefits of building with indigenous materials	3.47	1.88	Agreed
The exercise of communal spirit through communal labour by community members to support families and households putting up indigenous houses is a huge economic benefit	3.04	1.70	Agreed
Planting of tree species suitable for indigenous housing reduces the cost of obtaining indigenous housing materials	2.89	1.66	Disagreed
Indiscriminate harvesting of indigenous building materials which destroys farm lands and medicinal plants increases the economic cost of families and households for food and health	2.88	1.66	Disagreed

According to Dagilis (1999), the economic benefits of indigenous building materials stem not only from their low cost, but also from the fact that they provide a source of income for those who work with them, whether it is in the construction of houses or the manufacture of engineered bamboo construction materials. Traditional agricultural jobs, which are popular in underdeveloped countries, are among these jobs. Using

indigenous materials in building or housing projects where indigenous materials are abundant has become a source of income for those who were previously familiar with it, according to Acheampong et al. (2014), and encourages reuse of materials during significant restorations. People who are still reliant on agriculture can diversify their income by participating in sustainable indigenous material cultivation.

#### 4.9 Average score of sustainability of indigenous housing construction

Simple averages of each of the three components of the sustainability of indigenous dwelling construction were calculated. The summary is shown in Table 4.10.

Table 4.8 Summary of item Statistics

<b>Sustainability of indigenous material</b>	<b>No. of items</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Decision</b>
Environmental sustainability	10	3.16	0.558	Agreed
Social sustainability	10	3.55	0.894	Agreed
Economic sustainability	9	3.51	1.158	Agreed
<b>Average</b>	<b>29</b>	<b>3.41</b>	<b>0.871</b>	<b>Agreed</b>

As shown in Table 4.10, using indigenous materials as a construction material has a positive impact on society. With a mean score of 3.16 and a standard deviation of 0.558, the use of indigenous building materials can help to conserve the environment. Individuals, households, and the Central region community as a whole benefit from the use of indigenous building materials in supporting sustainable development in Central region, with a mean score of 3.55 and a standard deviation of 0.894. The economic viability of using indigenous building materials, on the other hand, had a mean score of 3.51 and a standard deviation of 1.158. This means that the cost of the material and the income opportunities it generates are both considered in the economic element of indigenous building materials. This means that promoting indigenous building



materials techniques aims to strike a balance between economic, social, and environmental performance when carrying out construction projects, particularly those in the indigenous housing sector. Indigenous building materials provide significant environmental benefits, according to a study by Adewuyi, Otukoya, and Olaniyi (2015), making them a favored green building resource. According to Adewuyi et al. (2015), the use of indigenous resources as a building material has not only environmental but also social and economic implications, as well as a long-term sustainability impact.



## CHAPTER FIVE

### SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

#### 5.1 Introduction

This part contains a summary of the primary findings, as well as general conclusions based on the findings and recommendations that are regarded useful.

#### 5.2 Summary of Key Findings

Following a discussion of the responses, a number of conclusions were reached. The following is a summary of what they are:

##### 5.2.1 Types of indigenous building materials used in providing the housing needs

- The study found that for house walls made of indigenous building materials, standardized mud/laterite and earth/clary blocks are employed.
- It was discovered that thatch, laterite, and zinc were utilized to roof dwellings constructed with local building materials. The discovery also indicated that rammed laterite and sand/cement mortar are employed as finishing materials for indigenously constructed home walls.
- The study discovered that the floors of houses constructed with indigenous construction materials are finished with sand/cement mortar and rammed laterite/cement.
- The study discovered that in the Central region, low-cost indigenous materials, ease of availability, and comfortability impact the decision to build dwellings with indigenous materials.

### **5.2.2 Environmental sustainability and friendliness of indigenous building materials**

- According to the study, using indigenous building materials promotes a safe and healthy environment, preserves natural resources, and improves environmental quality.
- Unsustainable collection of indigenous construction materials depletes natural resources, according to the study, and scarcity of indigenous building materials affects the quality and safety of local houses.

### **5.2.3 Social implications of the use of indigenous building materials**

- The findings revealed that employing indigenous building materials allows the poor and vulnerable in society to afford shelter, meets the housing needs of families, and fosters community spirit and social cohesion.
- The study found that using indigenous materials improves social sustainability by encouraging community members to exercise patience and love, as well as preserving indigenous architecture, building techniques, and expertise.

### **5.2.4 Economic sustainability regarding the use of indigenous building materials**

- According to the findings, using indigenous building materials stimulates material reuse during major restorations, lowers construction costs and improves economic sustainability, and lowers the cost of cooling and heating homes.
- The findings demonstrated that indigenous housing is simple to maintain, quick to construct, uses low-cost labor, and is less expensive to rent, as well as improving the economic well-being of families and households in Central region.

### 5.3 Conclusion

Indigenous construction materials must be effectively exploited in order to meet society's housing needs for safe, sustainable, and affordable housing. To address their housing demands, rural populations rely heavily on indigenous building materials. The provision of sustainable housing through the use of locally available building materials is one of the three components of sustainable development goals. However, this is contingent on the availability and long-term viability of indigenous building materials. In Central region, standardized mud/laterite and earth/clay blocks are utilized for house walls built with indigenous building materials, according to the current study. Additionally, thatch, laterite, and zinc are utilized for roofing indigenously constructed buildings, and rammed laterite and sand/cement mortar are used as finishing materials for indigenously constructed house walls. The investigation also revealed that in Central region, sand/cement mortar and rammed laterite/cement are used to finish the floors of houses constructed with local building materials.

Indigenous building materials have long been the preferred choice for most low-cost or cost-effective homes in the Central region. In addition, the ease with which indigenous building materials can be obtained and the comfort with which they can be used are important elements in the decision to use them. According to the study, using indigenous building materials creates a safe and healthy environment, maintains natural resources, and improves environmental quality. According to the findings, unsustainable harvesting of indigenous building materials depletes natural resources, and scarcity of indigenous building materials has an impact on the quality and safety of local homes.

It is reasonable to assume that employing indigenous building materials allows the poor and vulnerable in society to afford shelter, meets the housing needs of families, and fosters community spirit and social cohesion. Again, using indigenous construction materials promotes social sustainability by encouraging community members to show patience and affection for one another, as well as preserving indigenous architecture, building techniques, and expertise. According to the study, using indigenous building materials increases material reuse during major restorations, lowers construction costs, improves economic sustainability, and lowers the cost of cooling and heating dwellings. In addition, the study found that indigenous housing is easy to maintain, quicker to construct, requires less labor, and is less expensive to rent, all of which increases the economic well-being of families and households. The study concluded that using indigenous building materials is a means for the construction industry to advance toward environmental protection. The goal of promoting indigenous building materials is to strike a balance between economic, social, and environmental performance while developing projects.

#### **5.4 Recommendations**

The following recommendations were made based on the study's findings and conclusion:

1. To be successful, buildings produced using indigenous building materials must be perceived as good or even superior to alternative ways by consumers, according to the study. As the globe becomes green, the environmental, economic, and social benefits of indigenous building materials over conventional building materials are already a big advantage.

2. The Ghanaian government should promote the use of indigenous building materials in Ghanaian construction projects. This is how public knowledge of indigenous building materials for housing construction and acquisition, as well as job development for economic well-being, could be raised.
3. Architects should encourage the use of indigenous materials in construction projects by specifying them in their designs.
4. Professionals in the construction business should use indigenous materials in their projects to boost public acceptance.
5. People should be educated about the advantages of employing indigenous materials in the construction of their homes in terms of durability, thermal comfort, and cost.
6. The state should fund more research at science, technology, and technical universities to find ways to improve the quality of indigenous building materials.

### **5.5 Suggestion for Further Studies**

Similar research can be conducted to examine the social, economic and environmental sustainability of indigenous building materials in different geographical location other than Central Region of Ghana. There is a need for future designing of a framework for implementing sustainability in the use of indigenous building materials for construction projects.

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## **APPENDIX A**

### **QUESTIONNAIRE**

UNIVERSITY OF EDUCATION, WINNEBA-KUMASI CAMPUS.

DEPARTMENT OF DESIGN AND TECHNOLOGY EDUCATION.

### **QUESTIONNAIRE ON SUSTAINABILITY OF INDIGENOUS BUILDING**

#### **MATERIALS.**

This questionnaire aims at gathering factual information on the sustainability of indigenous building materials, factors militating against sustainable use of indigenous building materials, challenges associated with maintenance of houses made of local materials, types of materials predominantly used, factors responsible for the choice of materials, the impact of materials harvesting on the environment, impact of firewood extraction on the quality and availability of indigenous building materials, types of vernacular roofs mostly used and factors responsible for the choice of such roofs and benefits of the use of indigenous building materials.

The researcher is a student from the above-mentioned Institution and would be very grateful if you could give your views by responding to the following questions as it may be applicable to you in order to help rate the current use of indigenous building materials and their sustainability in Central region.

You are assured that your responses will be treated with utmost confidentiality.

Thanks for agreeing to respond to the questions.

#### **Instructions for completing the questionnaire.**

a. Please do not write either your name or phone number(s) on the forms.

b. Note the meaning of the following responses in section C:

1 = Strongly Disagree – means you strongly disagree with the statement as it applies.



2 = Disagree – means you disagree more than you agree with the statement.

3 = Neither agree nor Disagree - means you neither strongly agree nor disagree with the statement.

4 = Agree - means you entirely agree with the statement as true.

5 = Strongly Agree - means you strongly agree with the statement as it applies to sustainability of indigenous building materials.

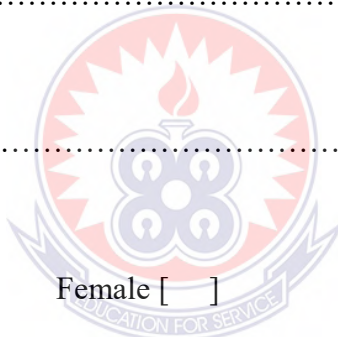
### SECTION A: Bio-Data

Please tick (✓) in the box where appropriate.

1. Company name:.....

2. Year of establishment:.....

3. Gender --- Male [  ] Female [  ]



4. Profession --- Architect [  ] Project manager [  ] Quantity Surveyor [  ]  
Civil Engineer [  ] Other, please specify.....

5. Level of education

HND [  ] Bachelor's Degree [  ] Master's Degree [  ] Doctorate degree [  ]  
] other, please specify.....

6. Level of experience in years

Below 5years [  ] 5-10 years [  ] 10-15 years [  ] 15-20 [  ]  
above 20 years [  ]

**SECTION B:**

10. What type of materials do you use in the construction of houses in the Central region?

- i. Stabilized mud/laterite  ii. Earth/Clay blocks  iii. Landcrete blocks   
 iv. Sandcrete blocks  v. Other; please specify.....

11. What is the reason for the use of such a material in 10 above? i. Cheaper  ii.

Readily available

- iii. Environmentally friendly  iv. Comfortable  v. Other; please specify.....

12. What means of transport do you use to collect walling materials? i. Foot

- ii. Truck  iii. Tractor  iv. Donkey cart  v. Other; please specify.....

13. How far do you go to obtain your walling materials? i. Less than 1km

- ii. 1-2km  iii. 3-4km  iv. 5km or more

14. What type of walling material is predominantly used in your community?

- i. Stabilized mud/laterite  ii. Earth/Clay blocks  iii. Landcrete blocks   
 iv. Sandcrete blocks  v. Other; please specify.....

15. What type of roof is your house made of? i. Thatch only  ii. Thatch and

- laterite   
 iii. Laterite only  iv. Thatch, laterite and zinc  v. Zinc only

16. Why do you choose such roofing materials? i. It is cheap  ii. It is readily

available

- iii. It provides comfort  iv. It is durable  v. It is renewable

17. How far do you go to obtain your local roofing materials? i. Less than 1km

- ii. 1-2km  iii. 3-4km  iv. 5km or more

18. What is the cost of building a room made up of only indigenous building materials?

- i. Less than GhC 1000.00  ii. GhC 1100.00 – 2000.00  iii. GhC 2100.00 – 3000.00   
iv. GhC 3100.00 – 3900.00  v. GhC 4000.00 and above

19. How long does it take to build a room made of indigenous building materials?

- i. Less than 3 months  ii. 4 – 6 months  iii. 7 – 9 months  iv. 10 – 12 months   
v. Above 1 year

20. What type of finishing is applied to your house walls? i. Rammed laterite

- ii. Pit sand without cement  iii. Sand/cement mortar  iv. Rammed laterite/cement

v. Other; please specify .....

21. What type of floor finish is your house floors made of? i. Rammed laterite

- ii. Pit sand without cement  iii. Sand/cement mortar  iv. Rammed laterite/cement

v. Other; please specify .....

**SECTION C:**

Please indicate your level of agreement or disagreement in the following statements with a thick (√). Please note the meaning of the responses of the five (5) point likert scale.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree)

№	Statement  (Social Sustainability)	Responses				
		1	2	3	4	5
22	The process of indigenous housing construction promotes communal spirit and social cohesion in communities.					
23	The use of indigenous building materials strengthens social connectedness between individuals, families, households and communities.					
24	The use of indigenous building materials in providing the housing needs of households and communities encourage social tolerance among households and communities.					
25	Social compassion is sustained among community members through the process of erecting indigenous structures for shelter for families and households.					

Please indicate your level of agreement or disagreement in the following statements with a thick (√). Please note the meaning of the responses of the five (5) point likert scale.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree)

№	Statement (Social Sustainability)	Responses				
		1	2	3	4	5
26	The use of indigenous building materials for housing enhances social sustainability through the exercise of patience and love among community members.					
27	Sustainable use of indigenous building materials for housing promotes positive relationship among community members.					
28	Scarcity of indigenous building material is a source of disagreements between households and clans.					
29	Indigenous architecture, building technique and expertise are preserved and transferred from one generation to another through the continued use of the materials.					
30	The use of indigenous building materials enables the poor and vulnerable in society to afford shelter through communal support.					
31	The use of indigenous building materials in providing the housing needs of families and households promote trust and sense of belongingness among community members.					

Please indicate your level of agreement or disagreement in the following statements with a thick (√). Please note the meaning of the responses of the five (5) point likert scale

. (1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree)

№	Statement  (Environmental Sustainability)	Responses				
		1	2	3	4	5
32	Sustainable use of indigenous building materials enhances the quality of environment.					
33	Sustainable use of indigenous building materials preserves the natural resources.					
34	The use of indigenous building materials promotes safe and healthy environment.					
35	Unsustainable harvesting of indigenous building materials depletes the natural resources in the environment.					
36	Negative processes of obtaining indigenous building materials and techniques of building pollute the environment.					
37	Indigenous building materials are becoming scarce due to indiscriminate firewood harvesting, charcoal burning, farming and bush burning.					
38	Indiscriminate firewood harvesting, charcoal burning, farming and bush burning are the main causes of unsustainable use of indigenous building materials.					
49	Scarcity of indigenous building materials is affecting the quality and safety of local houses.					
40	Prevention of indiscriminate bush burning will promote the availability of tree species suitable for building purposes in the indigenous housing sector.					
41	Planting of tree species used for indigenous building materials will ensure the sustainability of such materials for housing purposes.					

Please indicate your level of agreement or disagreement in the following statements with a thick (√). Please note the meaning of the responses of the five (5) point likert scale.

(1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree)

№	Statement  (Economic Sustainability)	Responses				
		1	2	3	4	5
42	The exercise of communal spirit through communal labour by community members to support families and households putting up indigenous houses is a huge economic benefit.					
43	Community volunteerism in indigenous housing construction reduces the economic cost of individuals and families for obtaining shelter.					
44	The economic wellbeing of families and households is improved through sustainable use of indigenous building materials in Central region.					
45	Indiscriminate harvesting of indigenous building materials which destroys farm lands and medicinal plants increases the economic cost of families and households for food and health.					
46	Benefits of the use of indigenous building materials for building houses include low cost of materials, easy to maintain, faster to complete, cheaper labour, cheaper to rent, etc.					
47	Free communal labour is one of the benefits of building with indigenous materials.					
48	Another major economic benefit of the use of indigenous building materials is that, most of the materials are reused during major renovations.					

49	The use of indigenous building materials shortens transport distances thereby reducing the cost of building and enhances economic sustainability.					
50	The use of indigenous building materials in building reduces the cost of cooling and heating homes.					
51	Planting of tree species suitable for indigenous housing reduces the cost of obtaining indigenous housing materials.					

