

**AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT**

**THE USE OF LOCAL MATERIALS TO PROVIDE AFFORDABLE HOUSING IN
RURAL AREAS IN GHANA: (A CASE STUDY IN CHARIA, WA MUNICIPAL)**

SALIFU ABDULAI

OCTOBER 2022

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**A thesis submitted to the School of Graduate Studies, Akenten Appiah-Menka
University of Skills Training and Entrepreneurial Development in partial fulfillment of
the requirements for the award of a Master of Technology in Wood Science Technology.**


OCTOBER 2022

DECLARATION

STUDENT'S DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree at this university or elsewhere.

NAME : ABDULAI SALIFU

SIGNATURE.....

DATE.....17-11-2023

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development.

NAME: PROF STEPHEN JOBSON MITCHUAL

SIGNATURE.....

DATE.....17-11-2023

DEDICATION

This is dedicated to my wife, children and much especially all love ones.

ACKNOWLEDGEMENT

I would like to acknowledge the immense contribution of my supervisor prof Stephen Jobson Mitchual at the Department of Wood Construction Technology for his guidance critical supervision. I owe it a great pleasure to my roommates and colleagues for their encouragement and contributions they made to enable me undertake this work. I wish to express my profound gratitude to the principal and his staff Wa Technical Institute. Not forgetting the role played by my friends and study mates, Mr. Ibrahim Janjena, I really acknowledge the immense and wonderful contributions I received from them.

TABLE OF CONTENTS

CONTENT	PAGE
DECLARATION	iii
DEDICATION	iv
ACKNOWLEDGEMENT	v
LIST OF TABLES	xi
LIST OF FIGURES	xii
ABSTRACT.....	xiii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background of the Study	1
1.2 Problem Statement	7
1.3 The Aim of the Study.....	10
1.4 Objectives of the Study.....	10
1.5 Research Questions	10
1.6 Significance of the Study	11
1.7 Scope of the Study	12
1.8 Delimitation	12
1.9 Limitation.....	12
1.9.1 Organization of the Study	13
CHAPTER TWO	14
REVIEW OF LITERATURE	14
2.0 Introduction.....	14
2.1 The Concept of Local Building Materials	14

2.2 Types and Usefulness of Local Building Materials	17
2.2.1 Stone	17
2.2.2 Usefulness of Stones	19
2.2.3 Clay	20
2.2.3.1 Clay Classes	20
2.2.3.2 The practical uses of clay.....	21
2.2.4 Mud (laterite) material for walling	22
2.2.4.1 The Use of Mud or Laterite	24
2.3 Local Roofing Material Types	25
2.3.1 Materials for roofing (thatch, bamboo, wood, and clay bags)	25
2.3.2 Thatch Used for Roofing	26
2.3.3. "Neem" Tree	26
2.3.4 Teak Tree	27
2.3.5. Bamboo	27
2.3.6 The Mahogany Tree.....	28
2.4 Using Cow Dung as Construction Material	28
2.5 Lime	30
2.6. Obstacles to Using Locally Sourced Building Materials	31
2.6.1. Technical factors	31
2.6.2 Socio-economic factors.....	32
2.6.3 Institutional Factors	32
2.7. The Impact of Educational Attainment on the Utilisation of Regional Construction Materials	32
2.7.1 A Look at Society	33
2.7.2 Cities that are Sustainable.....	33

2.8 How Income Level Affects the Selection of Local Building Materials.....	34
CHAPTER THREE	43
METHODOLOGY	43
3.1 Introduction.....	43
3.2 Research Philosophy.....	43
3.3 Research Approach	43
3.3.1 Study Site	44
3.4 Research Design.....	45
3.5 Research Population.....	45
3.5.1 Sample size and sampling technique	45
3.6. Instrument used for the study.....	46
3.7. Data Collection Procedure	46
3.7.1 Interviews.....	47
3.7.2. Focus Groups	47
3.8 Reliability and validity of instruments.....	47
3.8.1 Reliability.....	47
3.8.2 Validity	48
3.8.3 Ethical Consideration.....	48
3.9 Data Analysis	49
CHAPTER FOUR	50
RESULTS AND DISCUSSION	50
4.1 Introduction.....	50
4.2 Background of Respondents	50
4.2.1 Gender of respondents	50
4.2.2 Age of Respondents	51

4.2.3. Income Group Distribution of Respondents	52
4.2.4 Educational Background of Respondents	53
4.2.5 Professional Background of the Participants	54
4.3 Extent of Local Material Use	55
4.3.1 Interview Results on Objective 1: The extent to which the Charia locality in the Wa	
4.3.2. Results of Group Discussion (FGD) on Objective 1	56
4.3.3. Discussion of the local use of the material	57
4.4 Perception of Local Materials	58
4.4.1 Objective Two Interview Results on objective two: the perception of respondents on the	
use of locally produced building materials	58
4.4.2 Results of focus group discussion (FGD) on objective two	59
4.4.3 Discussion on the perception of local materials	59
4.5 Impact on Economic Conditions.....	60
4.5.1 Results of the interview on research objective 3: The effect of the use of local building	
materials on the rural economic of Charia	60
4.5.2 Results of Focus Group Discussion (FGD) on Objective Three.....	61
4.5.3 Discussion of economic impacts on objective three	62
4.6 The Relationship Between Education and the Use of Local Building Materials	63
4.6.1 Results of the interview on research objective 4: the relationship between educational	
level and the use of locally produced building materials in Charia community in Wa	
Municipality of Ghana.....	63
4.6.2. Results of focus group 4	63
4.6.3. Discussion of results for objective 4.....	64
4.7 The relationship between income and the choice of local building materials	65

4.7.1 Results of the interview on research objective 5: The relationship between income level and the choice of local building materials	65
4.7.2 Results of the focus group on goal 5.....	65
4.7.3 Discussion of results for objective 5	66
CHAPTER FIVE	67
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS	67
5.1 Introduction.....	67
5.2 Summary of Findings.....	67
5.2.1 Use of local building materials in Charia	67
5.2.2 Local perception of indigenous materials in Charia	67
5.2.3 Economic conditions.....	68
5.2.4 Relationship to education.....	68
5.2.5 The effect of income	68
5.3. Conclusions.....	68
5.4. Suggestions and recommendations	70
5.5. Suggestions for Further Research	71
REFERENCES	72
APPENDICES	79

LIST OF TABLES

TABLE	PAGE
Table 4.1: Gender of Respondents.....	50
Table 4.2: Age Distribution of Respondents.....	51
Table 4.3: Income Brackets of Distribution of Respondents.....	52
Table 4.4: Educational Background of Respondents.....	53
Table 4.5: Participants Occupational Background.....	54
Figure 4.1: Results of available local building materials were used in building.	55

LIST OF FIGURES

FIGURE	PAGE
Figure 2.1: Bamboo Roof	28
Figure 2.2: Plastering a bamboo-framed house with a cow dug out.....	29
Figure 2.3: A Building Made of Mould Earth Blocks	41
Figure 2.4: A Building Made of Compressed Earth Blocks	41
Figure 2.5: An Earth mould blocks.....	41
Figure 2.6: A Compressed Mould.....	42
Figure 2.7: Mud houses built with local building materials in Charia community.	42
Figure 3.1: A map of Wa municipal with study site been marked Red	44

ABSTRACT

The global scarcity of building materials, particularly in emerging nations, necessitates significant substitutes in the construction sector. Like any other developing nation, Ghana needs creative solutions for projects involving cheap housing to balance out the country's current built environment. The purpose of this study was to explore the use of local building materials to produce affordable housing in Charia within the Wa Municipality. The study specifically sought to; determine the extent to which the Charia locality uses locally produced building materials, assess the perception of respondents on the use of locally produced building materials, assess/determine the effect of the use of local building materials on the rural economic of Charia, determine the relationship between educational level and the use of locally produced building materials in Charia community and to assess the relationship between income level and the choice of local building materials. The study employed a qualitative case study research design. The target population consists of locals who build houses using local materials, experts who are familiar with local building supplies, and non-governmental organisations that work on rural housing. Sixty (60) people were chosen as the sample size using a convenience sampling technique, and 60 of them responded. Focus groups, on-site inspections, and interviews, with local building materials for cheap housing were used as the methods in this research. The primary instrument for gathering data were questionnaire, and both descriptive and inferential statistics were used to analyse the data. The study revealed that a vast majority of participants stated they purchase their building supplies locally for construction-related projects. The study further revealed that, the absence of infrastructure is strongly perceived as an extra cost that must be paid for each month by the household. Also, majority of respondents express dissatisfaction with the quality of materials obtained from various quarries or production sites. It has been shown that the kind and composition of materials used greatly influence the quality of structures. It was discovered that using native materials preserves cultural history, keeps money in the community's economy, maintains a cool environment, and is generally inexpensive. Notwithstanding these difficulties, the use of native materials promotes local communities' cultures and keeps money flowing into the local economy. The study's conclusions demonstrated that the high cost of imported building materials makes dwellings expensive. A complete strategy is needed to encourage communities to build with locally sourced materials, and it makes sense for local material producers to incorporate new technology into their production processes. It is advised that research organisations like the Forest Research Institute of Ghana and BRRI Ghana raise awareness by building structures in Ghanaian locations where local building materials are readily available, as this is the best way to replace traditional building material.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

"The building is an enclosed and permanent structure for living and serves the prisoners as privacy," stated Harris (1975). Humans require comfort in order to live strong, healthy lives all the time. Using locally available materials was one of the board's initial considerations when launching Habitat for Humanity International, which is a major provider of houses for the world's impoverished, according to Wayne (1979).

The Building and Road Research Institute (2016) states that numerous governments have worked together to encourage the use of domestic building materials throughout the nation in order to foster an atmosphere that is conducive to the advancement of the nation's infrastructure requirements. The Ghana Tourism Board, Rural Development and Cottage Industries, and other non-governmental organisations have all made different kinds of contributions to encourage the use of local building materials, particularly in their regions of operation. One of the strongest and fastest-growing economic sectors is construction. In this lower-middle-income, emerging nation, the industry serves as a crucial catalyst for economic expansion. According to the Ghana Statistical Service (2013), the subsector of construction did in fact contribute 9.7% of GDP in 2012. According to Opoku et al. (2015), Ghana's growing population and human activity have led to a sharp rise in the need for buildings to house people and their activities (i.e., to provide residential, commercial, industrial, or combinations of any of the building categories).

Nonetheless, the need for building has drawn industry activity in the construction sector (BCI) to keep the growth wheels turning, particularly in emerging nations (Ofori, 2012; Lopes, 2012). To increase a person's quality of life, they must have access to sufficient housing in a respectable human settlement that meets their social, biological, and physical

needs (Kronenburg, 2001). But even though housing production has been trending upward over time, improvements have typically fallen short of what is needed to meet growing demand for housing in Ghana's metropolitan areas and to make up for past deficits (Andersen et al., 2006).

Government officials have been negatively impacted by the housing shortage, which has caused political unrest, which is not surprising given that the country has not taken decisive and sustained actions in housing materials to enable housing production (Badu & Owusu-Manu, 2011). A critical analysis of current methods, practises, and raw material sources is necessary for sustainable construction (Danso, 2013). At the moment, there is an excessive reliance on imported and foreign resources, particularly in the building sector, where the country imports around 80% of building supplies at the expense of domestic production (Tamakloe, 2012). Danso(2013) refutes this assertion, claiming that the severe lack of cheap housing is mostly caused by the exorbitant price of conventionally processed building materials like Portland cement and steel. The adverse effect of the demand for these resources is to lower the perceived unsuitability and value of locally accessible materials.

The economy loses out on much-needed foreign exchange due to this issue, which is necessary for continued growth. Ghana is endowed with a wealth of regional raw materials that are used to produce native building materials. The development of locally produced building materials has been the focus of certain national initiatives since 1953 (Atiemo, 2005). Government attempts to increase the amount of housing provided by the unorganised sector have not proved promising. According to research conducted by the Geological Survey of Ghana, the Building and Road Research Institute (BRRI) of the Council for Scientific and Industrial Research (CSIR), and other organisations, local materials are abundant throughout all sixteen regions of the nation which are appropriate for building.

As a result, materials for low-cost building in Ghana were produced, including pozzolanic cement, fired clay bricks and tiles, and pressed and stabilised earth blocks (Atiemo, 2005). Interestingly, though, the major players in the field—civil engineers, surveyors, and architects—did not embrace the idea that the dwellings would be constructed using locally sourced materials as they had anticipated. There is an over-reliance on traditional building materials, for which there is a comparative advantage to local manufacturing and local alternatives that can be developed. Investigating the barriers to the use of these locally produced building materials in Ghana's construction sector is therefore essential (Acheampong et al., 2014). One strategy to support sustainable development on the planet is to employ locally available building materials. Sustainable development is defined as development that satisfies present needs without jeopardising the ability of future generations to satisfy their own. The global heritage in the building sector is extremely rich across all nations.

However, in industrialised nations, using local resources for construction has declined in importance. Since the composition of the materials varies locally, it is impossible to standardise them, so these procedures have been abandoned. This material can once again be a local source of traditional housing in order to address the economic and environmental issues associated with the construction of concrete or cinder blocks in Africa (Lawane et al., 2012).

Furthermore, because the expense of importing conventional building materials into this nation is rising, there is now a greater need for patronage for the use of local building materials.

It's interesting to notice, for instance, that people were employing local building materials—which are plentiful and less expensive than conventional building materials—before foreign building materials were brought into this nation. The growing cost of building with

conventional building materials is directly responsible for the high cost of house development; most state developers' suppliers and consumers might not even be aware of the availability of local building materials (Manu et al., 2017).

The government launched a programme of self-help housing, public housing, and the provision of serviced sites to housing developers, according to the Songso (2003) annual report. Approximately 3,000 Ghanaians were given loans for building materials and a service site for those who wished to build for themselves.

Even though Ghanaians built high-quality homes before independence using local resources like mud, stone, laterite, wood, bamboo, leaves, thatch, cow manure, and the like, Hagar (1984) claims that all these initiatives were introduced along with the use of modern techniques, which also increased the cost of construction. No less. In today's culture, the usage of contemporary building materials and the acceptance of new technologies have raised issues and provided answers. This new way of thinking and approaching the housing crisis in Ghana's rural communities is intended to reserve and develop the movement of young people to the cities in search of work.

In contrast, even a real estate developer would not permit himself to finance new projects due to the exorbitant expenses of the majority of these homes and the interest rate, which is almost unconscionable.

The cost of building materials has skyrocketed, and our parents—especially those of us living in rural areas—no longer have the means to pay for anything beyond their own homes due to these and other issues with high import prices. The issue of affordability is a common one in Wa Municipal's rural areas, particularly in the old Charia area.

In order to assist us in providing excellent building materials, the Almighty Father has made a wealth of local building materials which are appropriate for building. As a result, materials for low-cost building in Ghana were produced, including pozzolanic cement, fired clay bricks

and tiles, and pressed and stabilised earth blocks (Atiemo, 2005). Interestingly, though, the major players in the field—civil engineers, surveyors, and architects—did not embrace the idea that the dwellings would be constructed using locally sourced materials, as they had anticipated. There is an over-reliance on traditional building materials, for which there is a comparative advantage to local manufacturing and local alternatives that can be developed. Investigating the barriers to the use of these locally produced building materials in Ghana's construction sector is therefore essential (Acheampong et al., 2014). One strategy to support sustainable development on the planet is to employ locally available building materials. Sustainable development is defined as development that satisfies present needs without jeopardising the ability of future generations to satisfy their own.

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The natural way that local materials seem to fit in with the surroundings is one of their attractive qualities. Cow dung and clay are two examples of these materials that can be used

to decorate walls. Bamboo straw can also be planked to the frame of a local home and used as roofing material. Palm branches can also be woven into roofing materials. Amevordzie (1993) claims that different materials are used locally to build barriers. They were mostly made of silt, clay, gravel, laterite, or soil. Certain sections of this kind of wall are strengthened with a framework made of entwined sticks and twigs of recognised species, which can be strong and resistant to worm or insect infestation. a cane-like stick known as "Babadua" that is most suited for thatching walls and roofs since it is resistant to white ants and bamboo. The construction of "Atakwame" walls, in which the base is strengthened and stabilised by the use of oyster shells or stones. On top of this, a wall composed of wet clay, gravel, laterite, or mud is progressively constructed.

It is evident that most real estate developers in Ghana are generally ignorant about the characteristics and types of locally accessible building material deposits. However, I think that if people were made aware of this, they would be more likely to use locally available materials (Badu & Owusu-Manu, 2017).

1.2 Problem Statement

According to UN estimates, there are at least 100 million (100,000,000) homeless people worldwide. The number of homeless people increases to almost one billion (1,000,000,000) if people living in subpar housing are taken into account (Brown, 1999). The demand for housing is predicted to quadruple globally over the next 50 years. It's predicted that the number will rise by more than three times in Africa alone, with Ghana among the nations where there is a significant demand for affordable housing due to the country's severe housing shortage and other social issues brought on by its economic circumstances (Crusades Guide, June 2010). According to a Ghana Statistical Service source, the country's housing

shortfall is estimated to be over 1.7 million, and before 2020, it is projected to increase to about two million.

There were over 480,000 unfilled housing units as of the end of 2009. The yearly gap in demand of over 160,000 dwellings is contributing to this increase (Ghana Statistical Service, 2010). Steel, brick, concrete, cement, and wood are the top five building materials used in modern construction. They have been employed to construct more pleasant dwellings than ever before in the industrialised world. The middle class saw a shift in lifestyle as a result, but the impoverished did not. The average Ghanaian cannot afford the high cost of steel and cement. As per the pricing list published by the Ghana Statistical Service, the cost of a bag of cement ranges from GH¢85.00 to GH¢100.00. Additionally, the cost per tonne of 6mm to 25mm diameter steel rebar ranged from GH¢9,500.00 to GH¢11,500.00 (Ghana Statistical Service, 2020).

Ghana faces significant challenges in obtaining cheap housing due to its over-reliance on imported building materials. This required a significant amount of foreign exchange, which ultimately proves to be the primary reason for the high cost of real estate in the nation. It would appear that employing locally produced building materials is necessary to keep up with housing demand while also lowering construction prices.

A home is an isolated, physically independent place of living where an individual or group of individuals can live away from the hazards of the weather. It is a fundamental requirement that offers privacy and security, all of which are things we see as human rights. Ghana was ranked as a third-world nation by the World Bank in 2006, with only one in three citizens having access to protection (UN Habitat, 2006). Included in the total acquisition expenses were costly imported material components, which resulted in a brief fall in the stock of homes. Therefore, in order to cut costs and thereby improve the supply of housing units, it has been suggested that more locally accessible materials be utilised in construction instead

of imported materials (Lilly et al., 2001). Ghana's government launched a policy push in November 2010 to encourage the use of locally produced building materials, with the goal of using 60% of local resources for public building projects by 2015. Its objectives include showcasing high standards and optimal methods for utilising locally produced building supplies (Danquah et al., 2015).

According to the researcher's observations, local building materials are not widely used in Ghana, despite their abundance and accessibility in many regions of the nation. Participants in the real estate industry have advocated for Ghana's building and construction sectors to consistently and regularly employ less expensive indigenous resources. They think it would increase the value of the nation's natural resources and provide jobless people somewhere to work. Reports from a roundtable discussion on 'Sustainable Real Estate in Ghana' in Accra indicated that the current building system has to be updated because foreign materials are not suitable for our environment and are not environmentally sustainable. "Those who opt to combine the use of foreign and local materials in construction are stigmatised in some way. A design/build consultant bemoaned the misconception that using local products equates to poverty, which is unwarranted (The Chronicle, 2014).

Once more, there is a deficiency in communication between research centres and builders, developers, and artisans who do not know about the availability and calibre of these regional building materials. Using local building materials is hindered by the expense of transportation from their sources. All of this made it more likely that individuals would not be able to buy specially made building materials for homes (Andersen et al., 2006). Therefore, research on the necessity of building homes with locally accessible materials is required in order to understand people's perspectives on the advantages and difficulties of doing so, as well as to offer suggestions for future studies that will further enhance this research. make them the

material of choice for building homes, with Wa township's Chari serving as a research location.

1.3 The Aim of the Study

The study's primary goal is to explore the use of local building materials in Wa Municipality in the Upper West Region of Ghana to produce affordable housing.

1.4 Objectives of the Study

The study aims:

1. To determine the extent to which the Charia locality in the Wa Municipality uses locally produced building materials.
2. To assess the perception of respondents on the use of locally produced building materials.
3. To assess/determine the effect of the use of local building materials on the rural economic of Charia.
4. To determine the relationship between educational level and the use of locally produced building materials in Charia community in Wa Municipality of Ghana.
5. To assess the relationship between income level and the choice of local building materials.

1.5 Research Questions

For the study, the following research questions were developed:

1. To what extent does Charia locality in the Wa Municipality uses locally produced building materials?
2. What is the perception of respondents on the use of locally produced building materials?

3. What is the effect of the use of local building materials on the rural economic of Charia?
4. What is the relationship between educational level and the use of locally produced building materials in Charia community in Wa Municipality of Ghana?
5. What is the relationship between income level and the choice of local building materials.

1.6 Significance of the Study

In order to reduce housing shortages, particularly for rural inhabitants, a major component of the study examines the use of indigenous building materials for the construction of inexpensive homes in rural regions, namely Charia in Wa Municipality in the Upper West Region of Ghana. Ghana's housing crisis has drawn the interest of the government, families, and citizens in general, as well as of workers, farmers, and the impoverished. Nevertheless, the scarcity of conventional building materials or their growing cost prevented any progress from being achieved.

Therefore, the study should inform individuals, groups, and organisations involved in the construction industry about: It aims to raise awareness about the importance of using local building materials for construction. It would assist stakeholders in comparing the costs and ease of use of local versus traditional building materials. It will demonstrate even more how crucial it is economically to use regional building materials for the advancement of the country.

The study's conclusions will help Ghanaian rural areas, particularly Charia in the Wa Township of the Upper West Region, where the research was done, as they will save the locals from financial hardship and the need to construct pricey structures.

The study's conclusions would also lessen the government's enormous expenditures on the purchase of foreign building supplies, which would otherwise contribute to Ghana's growing housing shortage. The state-owned housing corporation would also benefit from the findings since it would be aware of the strength and composition of the materials used in the construction industry.

In conclusion, this discovery would broaden the body of knowledge that scholars in the future may consult when utilising regional building materials.

1.7 Scope of the Study

The goal of the study is to evaluate how local building materials are used to construct inexpensive homes in rural locations. The Upper West Region of Ghana's Charia in Wa Municipality served as the study's location.

1.8 Delimitation

The study is restricted to the Charia community in the Wa municipality in Ghana's Upper West region; experts who are familiar with the local building materials and those who use them were also consulted. There hasn't been much research done on using regional building supplies to produce inexpensive houses.

1.9 Limitation

A few restrictions were applied when carrying out the investigation. Due to time and budgetary limitations, the researcher was unable to conduct a thorough investigation in each of the region's eleven districts, making it impossible to find answers to the research issue. Another issue was getting access to literature that was relevant. Those discovered were extremely ancient and unrelated to the investigation's goal. Nor was the material on the internet very helpful.

1.9.1 Organization of the Study

There are five (5) chapters in the study. The study's background, problem definition, aims, research questions, significance, scope, delimitation, limitations, and organisation are all covered in the first chapter, which serves as an introduction. In keeping with the goals of the study, the second chapter reviews relevant literature on the use of regional building materials. The third chapter, which is devoted to methodology, describes the procedures and resources used in the gathering, analysis, and interpretation of data. Chapter Four discusses the findings and debate. Chapter five, the last chapter, contained the study's results and suggestions.

CHAPTER TWO

REVIEW OF LITERATURE

2.0 Introduction

In this section, an in-depth literature review on the local building materials is conducted followed by the identification of types of local building materials, obstacles to using locally sourced building materials, the impact of educational attainment on the utilisation of regional construction materials. The last aspect of this chapter looked at how income level affects the selection of local building materials.

2.1 The Concept of Local Building Materials

A variety of locally available materials can be treated to satisfy the demands of the building sector. Gbede (1989) reports that in 2014, a number of regional manufacturers in the nation that create high-quality wood products voiced concerns about the flood of inferior goods. The impact on the nation's limited foreign cash, which would be squandered owing to the expenditures associated with producing low-quality goods, worried them the most. The Ghana Management of Estate and Housing Developers spent millions of Ghana cedis on importing construction materials, which has a negative impact on our foreign exchange and consequently puts pressure on the economy. The Central Bank of Nigeria (CBN) recently reported that an importer in the Lagos market was providing letters of credit of up to N100 million to N200 million monthly. "These items are installed, but they're not functional. According to Google's source, the government hasn't really done anything to lessen imports of some traditional building materials. I can attest that the majority of government housing units in our several district towns are constructed using imported building materials (Amfofo, 2020).

A sizable portion of the construction industry's prosperity goes to the building materials sector. This is due to the fact that materials often account for the majority of building project

costs, making them the largest input (Mogbo, 1999). According to Cunningham and Cunningham (2002), a native building material is any material that is abundant, naturally occurring, and produced locally.

Indigenous materials are those that are produced in the same bioregion or regional environment as the materials that will be used, according to Loken et al. (1994). According to Pearce (2001), resources are deemed original only if they are accessible in the same location as their intended purpose.

The widely held but usually false notion that a material is only indigenous if it is "primitive" and, as such, needs little to no processing between harvest and usage also affects indigenous materials (Owusu, 2001). Three different types of construction materials can be distinguished based on how they are produced: 1) Conventional materials that have been produced locally utilising antiquated technology since antiquity for instance, raffia palm, straw, laterite, gravel, thatch, and stabilised mud 2) Conventional building materials, such as concrete, steel, and glass, are made using contemporary production techniques. The third category of materials comprises inventive materials that are created via research endeavours with the intention of offering substitutes for materials that are sourced from outside, including fibre-reinforced concrete, ferrocement goods, pozzolan, and so on (Fadairo and Olotuah, 2013; Adedeji, 2011).

There are definitely certain issues with using local building materials in the construction business that make it less viable. For two reasons, Mahgoub (1997) is against using the original building materials in contemporary structures. Initially, he believed that these materials were inadequate to fulfil the novel requirements of construction shapes and functions and, subsequently, that the supply of materials could not keep up with the demand. Cassell (1993) asserts that clay construction requires a lot of labour and is consequently costly to build. Cather (2001) pointed out that new information and methods can be used to

improve comprehension of these materials' drawbacks and intrinsic qualities, as well as how to get around them and utilise them securely.

Okereke (2003) divided the resources that were readily available in the area into three categories: naturally occurring raw material deposits like dirt and stone, agricultural goods or residues like mulch, and manufacturing byproducts like mud bricks or concrete blocks. Yeboah (2003), Ofori (1985), and others have sufficiently discussed the nature of building materials, particularly sandstone or sand-cement blocks and residential construction, but their conclusions are primarily characterised by the unfavourable attitudes of users towards earthen building materials and the dearth of technical knowledge as well as building codes and regulations on the one hand. The desire to modernise sand, cement, or concrete dwelling construction technology has made it seem as though there have been few attempts to address these issues (Afrane & Asamoah, 2011).

Building materials based on cement are more readily chosen than those based on earth. To address the housing needs of their populations, especially in developing nations, it is critical to locate and employ locally produced and available resources (sand, stones, grass, thatch, clay, wood, clay bricks, and clay blocks) while building homes (Danso, 2013). To manufacture enough materials of sufficient quality to endure the effects of climatic conditions that range from wet rainy seasons to extremely hot dry seasons, it is generally necessary to stimulate and strengthen the use of local materials. Locally produced bricks and blocks, mud and wicker houses, and mud structures do not survive many seasons and require ongoing maintenance (Danso, 2013).

Ofori (2012) contends that the results and outputs of the construction industry's operations make it significant. By supplying buildings that are used in the manufacturing of all items in the economy, it aids in the socioeconomic growth of the country. Without a doubt, the building sector in Ghana, like that of many other construction economies, is essential to the

country's development. Because it creates a large number of jobs for both skilled and unskilled workers, the construction sector supports the socioeconomic growth of the country (Ahadzie, 2009). Since independence, rural housing developments have also been created to educate and motivate local technologists and contractors to employ locally produced building materials.

These days, the majority of rural housing departments provide building construction and consulting services. As an example, let us cite the Rural Housing and School project in Charia in Wa Municipality in the Upper West Region of Ghana, where the materials are provided by the central government and the citizens provide their own labor (GSS, 2018). Currently, most rural housing departments offer consulting services and the construction of buildings from local building materials. According to him, the researcher wants to talk about several resources available, including teak, cow dung, laterite, thatch, clay, neem trees, and stones.

2.2 Types and Usefulness of Local Building Materials

2.2.1 Stone

In Ghanaian indigenous architecture, stone is usually used as an essential part of foundation preparation. Builders typically choose sites with a solid foundation for substructures and ground floors of residences to reduce foundation requirements. When there isn't enough solid ground, construction workers dig trenches to serve as foundations for vertical wooden posts by digging up the earth until they reach firmer ground. From there, masons will add small stone fragments held together with lime mortar to each unique base (Addo-Atuah, 2017).

Stone is a useful resource for creating wall foundations and is one of the most widely used foundation materials for rural structures, according to Obende (1981). According to research by the Geodetic Survey Department, significant deposits of stone exist in virtually every region of Ghana. At several locations in the Upper West region, including Nanyaare, Zambo,

Tampie, and Kondopie, researchers have also found various deposits of stone. The production of whetstones, sawmills, and bridges uses only a small percentage of the total supply of stone. The beautiful design of the product is visible in the small amount of stone that was used in its production. The stone can be cut into various shapes and sizes to create a variety of goods, including state moulds for pavements, blocks, and Artifacts. Studies look good and do not require plastering. Ghana is blessed with huge stone reserves, but these are underutilised, which could have greatly improved the nation's housing crisis.

Department of Geodetic Surveying, 1978). "The general public should appreciate the efforts of researchers and other bodies, including the Building and Road Research Institute (BRRI) and the Council of Scientific and Industrial Research (CSIR), for coming up with building blocks derived from sedimentary rocks to replace traditional sandstone blocks in the construction industry," states the Journal (report, 2016) of the Research Institute of Land Communications. Instead of more expensive sandstone blocks, stone and mud can be used to create walls in rural housing complexes.

To raise awareness of the need to use local building materials for affordable housing, Ghanaians should also acknowledge the efforts made by the Ghana Education Service in organising a technical vocational and educational training workshop at CEB for all technical and vocational institutions from all sixteen regions of the country in 2011 at the Don Bosco Sunyani Technical Institute in the Bono region. Once again, Ghanaians should be grateful for the efforts of Wayne Nelson on behalf of Habitat for Humanity International (1976), the world's leading provider of housing for the poor, in developing compressed earth clay bricks (CEBs) that are crushed using a hydraulic machine that can be operated by hand. Some of these devices are made with straight-line levers that can easily be made in neighbourhood machine shops; as a result, they are used more among different nations. These types of blocks

may be a better choice than any other type of building material in many regions where they are available for creating CEBs.

A number of variables influence the decision to adopt CEB, including labour force participation, culture, and—most importantly—homeowner preferences (Wayne, 1976).

2.2.2 Usefulness of Stones

Many stones have unique properties that make them valuable and attractive for use in construction. For example, granite is typically generated by a volcanic explosion and has flaky or serpentine features that give it a beautiful appearance (Aboagye, 2011). Stone can also be used as a reliable building material; examples include the production of stone tiles, pavements, and floors. The Geological Survey stated in 1972 that "the cost of building materials such as cement and other conventional materials is a major concern in the construction industry in Ghana". This causes uneasiness for most ordinary Ghanaians who intend to own their own houses. Therefore, the government's initiative to bring in local building materials for use in construction and other industries, such as road construction and other construction works, is good. Below are some of the advantages of using stone:

- Stone is cheaper to obtain.
- Stone buildings have reasonably thick walls to maintain a comfortable temperature for people when covered with mud and wood.
- Stone can be used to make blocks, and some types of stone, such as limestone, can be used to make cement.
- The stone can be shaped into blocks using the labour and machinery available in this country.
- Stone houses can provide a pleasant temperature in summer and winter.

Thus, efforts by the government to instruct and train developers and craftsmen in the use of stone as a local building material should be appreciated by non-governmental organisations, institutions, and stakeholders in the construction industry (Hagar, 1984).

2.2.3 Clay

Mackey (1970) defined clay as "a plastic soil with properties of chalk and iron that make it suitable for building purposes, mainly consisting of sand and aluminium. According to Geodetic Survey Department research, nearly all ten regions of Ghana contain substantial clay deposits. Additionally, the researcher located different clay deposits in the Upper West region, including Kondopie, Yawtoore, Tuori, Zambo, Nanyaare, and Zambo. It takes a lesser proportion of the available clay to make clay dishes and pots. A wide range of goods, including burnt bricks, wall coverings, roof tiles, coatings, and pavements, can be made from clay by processing or manufacturing. These burnt bricks provide a nice appearance, so there's no need to plaster or use plaster. Ghana has an abundance of deposits, but they are not being used, which might help with the housing crisis in the nation.

The research team of the Building and Road Research Institute (BRRI) and the Council of Scientific and Industrial Research (CSIR) should be commended by the local community for their efforts in developing POZZOLAN cement, a construction material made from limestone and clay that can replace ordinary portland cement in the building industry.

Pozzolanic cement and laterite can be used to create concrete blocks in rural house systems instead of more costly sandstone blocks.

2.2.3.1 Clay Classes

Clays are categorised based on their characteristics and commercial applications.

Boadi (1996) classified clays into the following categories:

- 1) ***White burning clay***, sedimentary or residual clay from kaoli-seithite, is used to make whiteware.

- 2) **Refractory clays:** these are clays that don't require white fire and have a melting point of roughly 1200 C. They are employed in the factory of the manufacturer.
- 3) **Heavy clay:** these have a low plasticity level but are made of heavy clay and contain fluxes. They are employed as paving bricks.
- 4) **Brick clay:** commonly used to create facing and common pavement bricks, these polymeric clays include ionic oxide.
- 5) **Earthenware:** mostly used in pottery, earthenware is a type of plastic clay that contains fluxes.
- 6) **Slip clay:** used to make slimes for coatings and manufacturing, it has a higher than average concentration of ionic oxides (approximately 7% of the total composition).

2.2.3.2 The practical uses of clay

According to Mackey (1970), "clay is a fine-grained natural rock or soil material that contains trace amounts of metal oxides, organic matter, and one or more clay minerals. As a result, clay has unique qualities that are advantageous for both human health and the environment and useful for building. There are various applications for clay soil in the house, art studio, science lab, and building site. Clay is also used in construction when it is mixed with straw to create light clay, mud plaster, and wattle and daub. Based on firsthand observations, the nation possesses several hundred metric tonnes of clay deposits, which, with proper utilisation, can yield over a hundred thousand blocks and around millions of tiles for residential and commercial applications.

The majority of Ghanaians who aspire to purchase a home find it unsettling that the cost of traditional building materials in the country is on the rise. Clay can also be used to make other building materials, such as painted surfaces, fired bricks, tiles, and roof tiles. As a

result, the government had to think about bringing in indigenous building materials for the construction sector. For instance, mud brick homes offer the following benefits:

- Homes made of clay are often cool in the summer and warm in the winter.
- It can be used to build cement-fired or cement-free bricks.
- Clay has good thermal mass.
- It maintains temperatures extremely well.
- It costs less to purchase clay.

Report on the Ministry of Rural Housing (1985) Therefore, it is important for Ghanaians and others involved in the building sector to recognise the government's efforts in educating and training developers and artisans in order to encourage the use of clay as a native building material.

2.2.4 Mud (laterite) material for walling

The reddish-brown surface formation known as laterite is found in hot, humid tropical climates and is formed from weathered rock that has heavy amounts of iron and aluminium. When weathered, laterite's clayey nature allows it to retain more water than sandy soils, which makes it an excellent material for flooring and blocks (wall units). Laterites are used as fill for foundations and embankments, floor systems for public places, and foundations for roadways after compression. After being wet, laterite can be shaped by builders into dense bricks that don't require much mortar. Because of their thermal properties, laterite can also serve as construction coolant (Addo-Atuah, 2017).

According to Amevorddzie (1998), mud material is more affordable and regarded as a remarkably sturdy and long-lasting substance that the typical Ghanaian can depend on. Currently, mud makes up more than 50% of residential buildings in Ghana, particularly in

rural areas. The ancient cities of Accra, Kumasi, Wa, Tamale, Laribanga in Damong, and so forth all have some examples of mud dwellings.

According to Aku (1998), the majority of settlers in the country live in rural areas where they make their homes out of mud. These locations are the centre of the nation's poverty. "My observations and interviews with researchers demonstrate that these mud houses have survived for over a century and are still incredibly sturdy and functional for the occupants," the speaker stated.

According to Wilson Ijeke (1980), mud has a number of chemical characteristics that make it a very valuable resource for the housing business:

- In a humid atmosphere, it solidifies chemically and rapidly.
- After being heated, they don't swell or crumble in the water.
- It attains tenfold more strength compared to regular compacted dirt.
- It binds securely and takes on several forms.

Laterite is defined as "a long-term tropical weathering of rocks that is enhanced by high rainfall and elevated temperatures" in the International Programme of Geological Cooperation No. 129. There are a number of mud-built homes in Wa municipality's Charia village. My own observations indicate that the poorest members of society can own a home for the least amount of money possible—mud. The majority of our rural residents do, in fact, live below the poverty line and can thus afford mud houses. The majority of these homes have been inhabited for 10 to twenty decades, and based on the researcher's personal observations; the occupants seem content to live happily in them.

Mud was categorised by Bourman (2002) P47 based on its characteristics, strength, and utility in the building sector.

- It is widely accessible throughout Ghana.
- It attains strength several times greater than that of regular compacted earth.

- It bonds with steel, straw, and wood to form decomposing shapes.
- It offers low temperatures and is simple to work with in terms of labour and transportation.

2.2.4.1 The Use of Mud or Laterite

There is laterite material all over the nation, and Charia in the Upper West is comparable to some of it. Whether expert or untrained labour is used, laterite is less expensive to obtain employment for because of lower transportation costs. Although using laterite, or mud, has many benefits, there are drawbacks as well. These include:

- Laterite is easily attacked by termites, worms, and other insects if pesticides are not applied.
- It is easily washed away by rain and attacked by fungi.
- If an apron is available, erosion is simple.

It has also been noted that animals such as goats, sheep, and others will eat laterite walls if they aren't plastered with cement sand mortar. Despite these difficulties, laterite has many more benefits than drawbacks. For this reason, rural residents with limited financial resources should adhere to the following advice in order to build laterite homes that will provide their families with comfortable living quarters:

- Concrete foundations should be used for the building.
- Aprons should be built around drain structures.
- Trees and other ornamental plants should be planted around dwellings to stop erosion.
- Regular care and inspections are necessary to avoid damage and termite infestation.

2.3 Local Roofing Material Types

2.3.1 Materials for roofing (thatch, bamboo, wood, and clay bags)

Roofing materials are composed of metal sheets and rafters, with the metal being either zinc or aluminium alloy. The rafters are typically constructed of wood or timber. An alloy, according to Baja (1972), is a material or metal created by combining two or more metals in order to benefit from the resulting qualities, which can include durability and the ability to be employed in the creation of metal roofing sheets. Local building materials can be used and improved to lessen, if not completely eliminate, a nation's dependence on foreign countries dictating terms of trade in their favour. ALUWORK and VALCO are two of the country's profit-oriented, foreign businesses that also require a lot of energy to operate. The recent energy allocation to these companies has increased the number of downtimes, which has greatly affected production.

On the other hand, our forefathers used the resources that were readily available to them since pre-colonial times, long before white people brought standard building supplies to Africa and, consequently, Ghana. For instance, rafters made of bamboo, mahogany, teak, neem tree, and other trees were used to build roofs. Since then, for countless years, people have been using them constantly in the three northern areas. With the introduction of timber, this was successful because of advancements in technology. However, the cost of timber increases since it has to be bought from the southern part of the nation and hauled to the north. Thus, the majority of northerners still employ roofing materials that are native to the area.

Additionally, after reducing tree limbs to a reasonable size, fire is a traditional means of conserving local rafter stock. The purpose of partially burning them is to drive out or lessen the moisture content of the rafters. They are tied into bundles of ten or fifteen and placed in the fire. The Department of Rural Housing has approved this practise as a senior activity that

has a history of success. Therefore, it prolongs the life of the timber rafter while also flavouring it and protecting it from bacterial growth and insect attack.

2.3.2 Thatch Used for Roofing

It is a kind of grass that grows to a height of roughly 1.8 to 2.4 metres, according to the Rural Housing Authority (Report), along the valleys and tributaries of Lake Volta as well as in the northern savannah regions. In rural areas, it is typically weaved and chopped for roofing and fencing purposes. It is used in rural dwelling systems because of the following factors:

- It is available.
- It is less expensive to obtain and ship.
- When it is used as a roof, it is really comfy, has a room temperature, and makes less noise when it rains or storms.

While thatch offers many advantages, there are drawbacks as well.

- For example, most developers find thatch unsightly and that it breaks down readily over time.
- Easily flammable.
- Easily attacked by termites and insects.

2.3.3. "Neem" Tree

Planting in both the southern and northern regions of the nation, the 'neem' tree spreads by birds and animals and grows on its own, resistant to fungal and insect assault and tasting bitter. Being a semi-deciduous tree that grows quite tall with a large burst of leaves in the summer, it is a savannah tree. Because of its strength and hardness, it can be used for both purlin and rafters in roof construction. (Ministry of Rural Housing Report, 2017).

2.3.4 Teak Tree

One of the strongest and hardest woods is teak, which reaches maturity at several metres. In addition to being heavy, it is resistant to heat, draughts, and insects. Numerous organisations and cooperative groups are involved in teak plantings in the Upper West, particularly in the Nanyaare district. NGOs, women's organisations, associations of smallholder farmers, and schools are active in the teak industry. Dery (2012) (Study).

2.3.5. Bamboo

From a basic pole structure to a more intricate structure, bamboo has been used in building construction (Tekperthey, 2016). A building's complete structure, or a portion of it, can be made of bamboo (Tekperthey, 2016). It is highly regarded as a building material in many Asian and Latin American nations, not only for rural homes but also for private and public structures in cities (Shyamasundar and Vengala, 2008).

Bamboo is used in construction for two purposes: temporary (props, scaffolding, worker shed, ladder, formwork, and pilings) and permanent (bamboo reinforcement, trusses, ceilings, doors, and windows, roofing, bamboo flooring, partitions, and landscaping), according to Malin and Boehland (2006). Fast-growing, renewable bamboo is widely grown and available in Ghana, according to Addo Attuah (2017). Bamboo is located in the forest belt of West Africa and supports 25 known varieties, both native and invasive. The court holds *Multiplex Bambusa* as the authentic original variety. While the running or open (monopodial) form is useful for construction, the clumping (sympodial) kind is effective for ecological and agricultural objectives. In the construction sector, bamboo is used to make scaffolding, furniture, laminate flooring, and roof and floor coverings. It also helps with environmental problems like soil stabilisation, coastline management, and microclimate conditions.

According to Solomon-Ayeh (2005), bamboo thrives in these kinds of circumstances. Nonetheless, the absence of locally derived mechanical and engineering data, the cost-

effectiveness and safety of conservation techniques, and the unavailability of plantation-grown bamboo—which has a tendency to have more uniform dimensions—restrain the development of bamboo as a modern structural material.



Figure 2.1: Bamboo Roof

2.3.6 The Mahogany Tree

Mahogany is a very strong tree that grows alone in both the north and the south. It is a semi-deciduous tree as well, losing its leaves throughout the year. Mahogany reaches a height of approximately 80 metres and matures to a central girth of 350 to 5 millimetres. Mahogany is referred to as "cob" or redwood in local timber markets. Being a tropical tree, it produces exceptionally straight and long branches that are cut and used as rafters. It is also very sturdy, hardy, and resistant to insect assault. (2006's Rural Housing Report)

2.4 Using Cow Dung as Construction Material

This mixture of smooth laterite or mud and fresh cattle excrement is used to plaster dry blocks and "Atakwame" walls. It has long been a staple of the history of rural houses, based on firsthand observation and interviews. People (women) go to the kraal early in the morning to gather fresh manure, which is then combined with laterite and a slick slurry made from the

plant (VUOLU) to the appropriate texture and applied to the wall's surface as a final touch. It has no chemical effects and is inexpensive. The odour vanishes when the plaster dries. Measure-Aid statements made by Ghana (1999) during a farmers' forum in Charia that included farmers from Kaleo, Zingu, Dorimo, Chariley, Siiriyiri, Sombo, and Gbakyie The discussion found that cow poo has a highly beneficial purpose in construction as well as being able to be used as fertiliser on our farms. The following justifies the residents of these structures in favour of their use.

1. Cow dung is accepted as being both economic and ecological and has been present in the monument since its inception.
2. Creates excellent, smooth wall surfaces.
3. To create an extremely powerful wall response, it can be used with clay or laterite.
4. After combining, cow dung reaches an extremely high strength.
5. Give it time to solidify to avoid cracking.
6. It can be used as paint by adding ash or lime to walls to give them an extremely dazzling white finish.



Figure 2.2: Plastering a bamboo-framed house with a cow dug out

2.5 Lime

According to Mackey (1974), lime is made by burning chalk or limestone in a kiln. The kiln is then filled with clay and limestone, which are burned for about four days. The burned lime is then removed, and the lime that is left behind is used to make mortar. Occasionally, the kiln is filled with limestone pieces, and the fire is kept at the bottom for several days until the entire batch of chalk or limestone is thoroughly burned. This process is known as kiln quenching, and a white, colourless lime is formed that is suitable for plastering.

When calcium oxide (CaO) is released when the lime is quenched by adding water, heat is generated, and the carbonate of lime (CaCO_3) expands and crumbles to powder. Pure limestone, or chalk, is made up of this substance. More water does not chemically react with the slaked lime; instead, it converts the lime to a paste called lime putty. When lime putty is exposed to air, it starts to solidify and eventually turns into lime carbonate due to water evaporation and the absorption of carbon dioxide from the atmosphere. This is called carbonation, and it's a crucial characteristic since it determines how hard some lime mortars get.

Lime is not frequently thought of as a building material, but because it has only been used for whitewashing, its advantages are not diminished.

The main factor behind lime's general lack of appeal, according to the Materials Division of the Building and Roads Research Institute (BRRI), is the lack of a local lime industry. While some lime is produced locally, it is manufactured on such a tiny scale that it only supplies less than 25% of the need on the local market.

From this vantage point, cement becomes the apparent choice anytime a binding substance is required because cement is imported and sold for almost twice as much as lime.

Researchers under the direction of Hagan (1984) of the Building and Road Research Institution (BRRI) conclude that it is possible to produce lime from local limestone supplies.

This could result in lime being sold at a reasonable price to reduce the need for cement in construction, which has significantly extended the life of some of our local buildings. Lime is used in plasters, such as masonry plasters. Because cement is now the sole material available for usage, local lime should be used in buildings instead of cement for which of the following reasons, given the high cost of foreign exchange involved in importing cement?

1. Studies have demonstrated that lime can be made in a basic kiln made completely of local resources.
2. This can be carried out nationwide on a small basis.
3. The lime plant is simple to construct and run, and we can get much of the labour and equipment needed from our local resources.

2.6. Obstacles to Using Locally Sourced Building Materials

Obande (1983), p. 2–11, lists the following as the factors influencing the usage of local building materials:

2.6.1. Technical factors

The usefulness and appropriateness of materials for domestic use determine technical considerations. For instance, wood's resistance to buckling or buckling under severe strain and laterite's propensity to hold onto moisture for an extended period of time while losing strength in the process cause laterite to deteriorate quickly when used as a building material. Despite the fact that there are methods and procedures available to enhance the usage of laterite, this has made it challenging for the majority of people or developers to use it as a building material (King et al., 2022). Furthermore, thatch is not a popular choice for house material because it is frequently attacked by termites, prone to eating, and readily biodegrades.

2.6.2 Socio-economic factors

The majority of people in Ghana lack access to the complete socioeconomic development that comes with contemporary homes; therefore, many turn to self-help and group projects that use inexpensive or locally available materials. In this way, the building owner bears a great deal of financial and risky sacrifice.

Thus, one would be mindful of the type of material to use and the approach to take when constructing a home, as well as the dangers associated with the construction collapsing or failing.

2.6.3 Institutional Factors

Due to construction laws, standard standards, and codes of ethics that prohibit the use of native building materials, the majority of Ghanaians are unable to construct homes in cities or urban centres using these resources. If these buildings are not given regular care and upkeep, the local building materials are likewise prone to decay.

However, a lot relies on the state and supply of the material, as well as its level of compaction, seasoning, and stabilisation.

2.7. The Impact of Educational Attainment on the Utilisation of Regional Construction Materials

Learn how to incorporate historic construction materials into contemporary architectural designs, taking into account two distinct ranges. First, there are ethnic communities that still employ these ancient, customary building methods in addition to contemporary methods that have made their way into rural areas. The main reason this practice has come back into vogue is because of its financial advantages. Second, they are modern clients and architects who,

driven by personal ideology or other factors, either individually or collectively promote and employ these materials in novel ways (Lin et al., 2020; Ejiga, Paul, & Cordelia, 2012).

2.7.1 A Look at Society

The use of contemporary technologies, such as concrete slabs and blocks, during the advancement of industrial periods pushed traditional elements and techniques to the background. As a result, wicker and daub workers set out to recreate their creations using the new, trendy material—concrete blocks—despite the evident fact that their species did not provide the same level of thermal comfort. As a result, the indigenous people replaced their cosy, affordable, and environmentally friendly homes with a contemporary style that represented modernity, progress, and the display of wealth and social standing. Ground structures, a building material that can be relatively economical and still satisfy the same modern needs, have recently drawn greater attention in the middle of these unsustainable practices (Abdulai et al., 2018; Dayaratne, 2011).

The only significant changes made to community building methods with unburned soil are the addition of compacted earth blocks (ĈEB) and the retraining of craftsmen. Even so, the substance only gradually wins societal acceptance. While much study is presently being done to fully use the benefits of the original traditional design, urban earthworks are increasingly being used across the nation as a location for the construction of retail establishments, restaurants, and recreational park buildings (Ejiga et al., 2012).

2.7.2 Cities that are Sustainable

It arose as a result of international calls for proactive measures in the management of the nation's resources and represents a progressive return to traditional technology within conventional architectural practices in Africa. Architects across the continent still have the

responsibility to go beyond the box and be innovative. Because of this, many people are forced to use more locally produced materials and technology. One such person who did this was the late Hassan Fathy, who was creative and reimaged several old technologies to suit the needs of modern life (Ejiga et al., 2012; Yin et al., 2009). Reinvention frequently occurs more in the ways that materials and their byproducts are employed to produce architectural wonders in buildings than in the materials themselves. These developments are significant because they collectively created an architectural system that is backed by African construction customs and vernacular. According to Ejiga et al. (2012), African architects must follow this methodology and develop the know-how to employ historical materials and technologies and adapt them to the modern world in a sustainable manner (Ardayfio-Schandorf, 2002).

2.8 How Income Level Affects the Selection of Local Building Materials

According to Nassar et al. (2003), material selection has been recognised as a key design factor that can have a substantial impact on the overall life-cycle energy costs of housing projects as well as the environmental impact of a building over its whole life. Gluch and Baumann (2004) assert that decisions have long-term effects that become apparent after they are made early in the design process. Therefore, compared to decisions made during construction or usage, making wise choices early in the design process increases the likelihood of lowering life-cycle costs and improving the technical, sociocultural, environmental, and economic success of a product in the end (Ding, 2008). Therefore, it's critical that designers become more adept at incorporating sustainability principles and comprehend which material choices have the biggest effects on a building's life cycle impact early in the design process, when there is typically less clarity in the design problem and the greatest opportunity to reduce environmental impacts. Because of this, the Life Cycle Cost

Analysis (LCCA) technique is used in conventional materials assessment methodologies to support this process (Ge et al., 2009; Van Pelt, 1994).

Information systems are becoming more widely acknowledged as a crucial instrument for supporting multi-criteria building design decisions and as a means of mitigating the overall environmental and socioeconomic impact (Agyeman et al., 2019; Trusty, 2003). Information and communication technology (ICT) has been shown to be helpful in evaluating traditional construction materials; however, there are still concerns and uncertainties regarding its applicability when evaluating locally manufactured materials. Systems for evaluating materials that incorporate important sustainability criteria and evaluate locally produced materials using the most appropriate assessment technique for their type have received less attention than other systems (Kibert, 2008; Seyfang, 2010). As a result, when choosing local building materials, a multi-criteria approach is required, one that takes into account the primary factors influencing the principles of sustainable development. In many industrialised economies, new data management technologies are being extensively utilised to manage the integration of data and information from numerous sources to give consumers access to material knowledge. Although numerous integration frameworks have been successful in many developed nations in improving the performance of multi-unit residential complexes (Ellis, 2009), there is currently little evidence of such initiatives in developing countries in the literature (Shenton, 2004; Malanca, 2010).

According to Sebake (2009), the housing industry should aim to achieve a balance between economic, social, and environmental performance when implementing housing projects, and sustainable and green building material selection practices suggest a way to portray this responsibility. Low-cost green building materials and components have been defined as those that, due to their comparatively lower costs and energy requirements in their extraction, production, and transportation processes, have significant positive effects on the

environment, the economy, and society compared to their conventional counterparts (OMUH et al., 2019; Fairlie 2009; Adegboye 2009; Zami, 2010). Oluwakwiyesi (2011) goes on to say that whether or not designers are well-informed about these kinds of items is a major factor in the underlying issue surrounding the material selection process. He discovered that the majority of professionals in charge of making important housing decisions occasionally have very little expertise since their choices are influenced by advice or information from other professionals.

According to him, some designers frequently consult the catalogues of rival manufacturers and suppliers while selecting materials. Nwokoro and Onukwube (2011) also identify a lack of information as a possible contributing factor and provide examples of easily accessible resources, including manuals and consulting services from material suppliers. They learned through interviewing designers that expertise usually plays the biggest role in material selection. They recommend that, in order to help design and construction professionals better grasp the nature and features of the materials and products they specify, the industry establish an information system that makes product information easily accessible. terms of usage.

According to Nassar et al. (2003), material selection has been recognised as a key design factor that can have a substantial impact on the overall life-cycle energy costs of housing projects as well as the environmental impact of a building over its whole life. Gluch and Baumann (2004) assert that decisions have long-term effects that become apparent after they are made early in the design process.

Therefore, compared to decisions made during construction or usage, making wise choices early in the design process increases the likelihood of lowering life-cycle costs and improving the technical, sociocultural, environmental, and economic success of a product in the end. In Ding (2008) Therefore, it's critical that designers become more adept at incorporating sustainability principles and comprehend which material choices have the biggest effects on a

building's life cycle impact early in the design process, when there is typically less clarity in the design problem and the greatest opportunity to reduce environmental impacts. Because of this, the Life Cycle Cost Analysis (LCCA) technique is used in conventional materials assessment methodologies to support this process (Agyekum et al., 2020; Van Pelt, 1994). Information systems are becoming more widely acknowledged as a crucial support tool in the material selection decision-making process as interest in utilising a multi-criteria approach to reduce a building's total environmental and socioeconomic effects grows (Abubakar et al., 2017; Trusty, 2003).

Information and communication technology (ICT) has been shown to be helpful in evaluating traditional construction materials; however, there are still concerns and uncertainties regarding its applicability when evaluating locally manufactured materials. Systems for evaluating materials that incorporate important sustainability criteria and evaluate locally produced materials using the most appropriate assessment technique for their type have received less attention than other systems (Kibert, 2008; Seyfang, 2010).

As a result, when choosing local building materials, a multi-criteria approach is required, one that takes into account the primary factors influencing the principles of sustainable development. In many industrialised economies, new data management technologies are being extensively utilised to manage the integration of data and information from numerous sources to give consumers access to material knowledge. Although numerous integration frameworks have been successful in many developed nations in improving the performance of multi-unit residential complexes (Ackah et al., 2023; Ellis, 2009), there is currently little evidence of such initiatives in developing countries in the literature (Malanca, 2010). According to Sebake (2009), the housing industry should aim to achieve a balance between economic, social, and environmental performance when implementing housing projects, and

sustainable and green building material selection practices suggest a way to portray this responsibility.

Low-cost green building materials and components have been defined as those that, due to their comparatively lower costs and energy requirements in their extraction, production, and transportation processes, have significant positive effects on the environment, the economy, and society compared to their conventional counterparts (Fairlie 2009; Adegboye 2009; Zami, 2010). Oluwakwiyesi (2011) goes on to say that whether or not designers are well-informed about these kinds of items is a major factor in the underlying issue surrounding the material selection process. He discovered that the majority of professionals in charge of making important housing decisions occasionally have very little expertise since their choices are influenced by advice or information from other professionals. According to him, some designers frequently consult the catalogues of rival manufacturers and suppliers while selecting materials.

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Figure 2.3: A Building Made of Mould Earth Blocks
(Source: Charia, Wa Municipal in The Upper West Region)



Figure 2.4: A Building Made of Compressed Earth Blocks
(Source: The Wa Naa Palace)



Figure 2.5: An Earth mould blocks



Figure 2.6: A Compressed Mould



Figure 2.7: Mud houses built with local building materials in Charia community.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

To address the primary and secondary research questions of the study, this chapter discusses the techniques that were used for data collection and analysis. This research was conducted using both qualitative and quantitative research methodologies and explains the sampling methodology of the research design as well as the data collection methods used and how the data obtained from the research was analysed.

3.2 Research Philosophy

The study took an interpretivist philosophical stance. This paradigm is based on the assumption that access to reality is only possible through social constructions such as language, consciousness, and shared meanings (Myers, 2013). It recognises the importance of understanding the differences between humans as social actors and physical objects, according to Hussey and Hussey (1997). The goal of interpretivism is to understand phenomena through the meanings people assign to them and to understand what these meanings represent (Orlikowski & Baroudi, 1991). This view is consistent with the research objective of understanding the local perspective on the use of local materials for affordable housing in rural Ghana. An interpretivist lens sought to capture the views of insiders and interpret their lived experiences and reality, so they were well suited for this study.

3.3 Research Approach

A qualitative single-case study design was considered most appropriate to meet the research objectives. Qualitative research devices and in-depth investigations of phenomena of interest in natural settings (Denzin & Lincoln, 1995). A case study approach was chosen because it allows for an intensive, holistic account of case analysis (Denzin & Lincoln, 1995)—in this

case, the use of local materials for affordable housing in Charia. The community provides appropriate contexts for in-depth exploration of the perspectives of key stakeholders (Yin et al., 2018).

3.3.1 Study Site

Charia is located in the western part of Wa Municipality and is a suburb in Ghana's Upper West Region. According to the 2022 Census of Population, Houses, and Apartments, there are 200,672 people living in Wa Municipal, of whom 98,493 are males and 102,179 are females. Sissala, Waalii, and Dagaare are the three primary languages spoken in the village. Most residents work in trade and agriculture; the main crops grown are millet, yam, cassava, and maize.

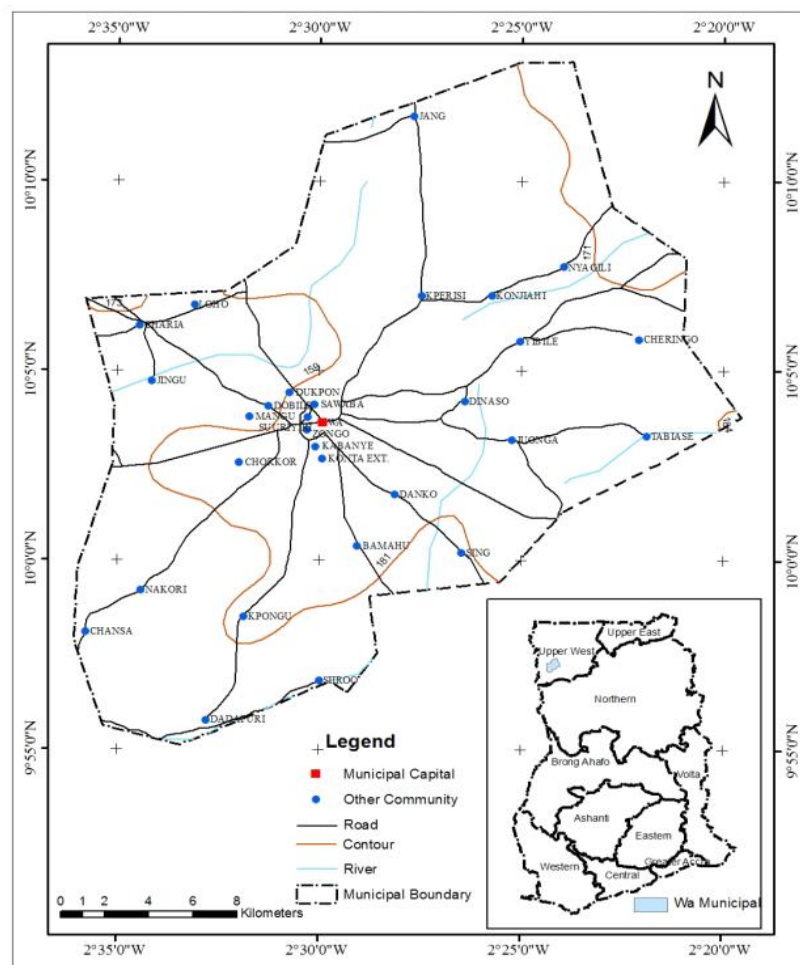


Figure 3.1: A map of Wa municipal with study site been marked Red

3.4 Research Design

A qualitative case study was used as the primary research design. A case study is appropriate when seeking answers to research questions of "how" and "why", gaining a rich understanding of real-world phenomena in contexts or situations where the boundaries between contacts and phenomena are not clear. A single case study was adopted to conduct an in-depth survey of the situation in Charia. The case, Charia, was personally selected as the central unit of analysis based on its unique characteristics and use of original building materials. It represents an internal case with value for better understanding the dynamics present in this locality as related (Stake, 2008). According to Yin et al. |(2018), The final study protocol database underwent maintenance of a formal case study database containing case study documents, narrative reports and tabular data.

This allows other researchers to directly review the evidence and reduces errors and biases in the study process (Yin et al., 2009).

3.5 Research Population

The target population consisted of all stakeholders involved in affordable housing efforts in Charia, including adult (18+) community members, builders or artisans, engineers, and local government officials.

3.5.1 Sample Size and Sampling Technique

A sample is basically a group of individuals, creatures, artifacts, or materials that are used to represent all or a larger portion of the population being studied. According to Ayuekanbey (2016), sample size and sampling method will undoubtedly affect your level of confidence in your data and the degree to which you can draw generalizations. A propulsive sampling

strategy (Stake, 2008) was used to select information-rich cases. An initial sample of 30 participants was selected to represent the diversity in the population. This included:

- 25 community perspective home owners and construction workers.
- 25 local builders or craftsmen for hands-on knowledge of materials and techniques.
- 5 civil engineers or civil engineers in the Wa Municipal Assembly for technical knowledge.
- 5 government urban planners and housing officials for political context.

Additional participants were identified through snowball sampling, with first responders referring others (Noy, 2008). A sample size of 60 was reached at data saturation when no new themes emerged.

3.6. Instrument used for the study

There are two main qualitative tools that were developed based on the literature and research objectives:

- Semi-structured interview guide: An open-ended format guide containing sections on demographic profile, housing challenges, local materials used, techniques, perceptions, and recommendations was used for individual interviews lasting 30–60 minutes. Probes were incorporated to elicit a deep response.
- Focus group guide: A structured guide with an icebreaker, opening questions, main discussion topics, and enough flexibility to explore emerging ideas led four focus groups of 6–8 participants. The discussion lasted approximately 90 minutes.

3.7. Data Collection Procedure

This section describes the specific steps involved in collecting data for the study.

3.7.1 Interviews

Potential interviewees were identified through purposive sampling. They were contacted, the details of the study were explained, and verbal consent was obtained. Interviews lasted an average of 45 minutes, were recorded with permission, and were conducted as needed by the participants, mostly in the local language.

3.7.2. Focus Groups

Four focus groups were conducted by contacting community members. Participants provided consent. Sessions lasted 90 minutes, took place in a local meeting room, and were audio recorded.

In addition, primary data collection took place over a period of three (3) weeks in 2023. The researcher lives with a local family where he works in the field. To increase credibility, community participants were involved in the deliberations on preliminary interpretations. An audit trail documenting the research and decision-making process was also maintained. This systematic process ensured that proper ethical protocols and engagement strategies were followed to gather rich qualitative data from a variety of sources to address the research questions.

3.8 Reliability and Validity of the Study

3.8.1 Reliability

Several strategies were used to increase the reliability of the findings (Anney, 2014). Repeated reading while listening to the audio recordings served as verification for the transcriptions. An audit trail was maintained throughout the research process that documented details of data collection, coding decisions, and emergent findings. Several MPhil researchers, including my project professor, were involved in the coding of a sample of

transcripts with close supervision to check for consistency and discuss any differences until agreement was reached.

3.8.2 Validity

Validity refers to the accuracy and trustworthiness of research findings (Creswell & Miller, 2000). The researcher adopted different strategies: Initial findings and interpretations were shared with participants to check for consistency and identify errors in representation (Lincoln & Guba, 1985). The feedback was incorporated into the subsequent analysis. In addition, detailed contextual information about Charia and the participants was provided to allow readers to assess transferability (Shenton, 2004). The use of multiple qualitative methods, including interviews and discussions, facilitated validation across data sources. As an interpretivist study, the potential influence of the researcher's background, bias, and theoretical orientation on the findings was acknowledged through reflective journaling and discussions (Lincoln & Guba, 1985).

3.8.3 Ethical Consideration

In addition to knowledge and diligence, conducting research also requires honesty and integrity. The study was ethical as it upheld the subjects' rights to sovereignty, privacy, confidentiality, and informed consent, which were maintained throughout the investigation. If any of these ethical principles are violated even slightly, the findings of the study will be primarily biased and factually incorrect. Before the administration of the questionnaire, the respondents were asked for their consent. They were also informed about the aim of the study and the methods that would be used to collect the data to ensure that there would be no potential risk or cost.

3.9 Data Analysis

A thematic analysis described by Brown and Clark (2006) was conducted. The transcripts of the interviews and discussions were read and re-read for familiarity. Initial opening codes (see Appendix D) were systematically assigned to condensed segments, summarising key concepts manually in Microsoft Excel. Codes were then grouped into themes using an iterative process of sorting, comparing, and reworking until a thematic map emerged, capturing important aspects related to the research questions. Selected transcripts were also independently coded by a second researcher and compared to enhance reliability. Member checks with participants further confirmed the credibility of the identified themes. Use of a codebook (see Appendix D) that defined the codes or themes that emerged from the qualitative analysis and their subcodes

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The results of the study are presented in this chapter. Figures and tables were used to present the findings and results. In order to analyse the collected data, the views of all respondent's young people who worked on local building materials for improvements in the construction industry, residents whose houses were built using local building materials, researchers, and opinion leaders were collected with respect to each research objective and question.

4.2 Background of Respondents

Demographic features of the respondents are linked to their origin in terms of gender, age, education, and income group.

4.2.1 Gender of respondents

This part of the study involved the analysis and interpretation of the gender-specific background data of the respondents. Gender was divided into two groups with the following specific result:

Table 4.1: Gender of Respondents

Sex	Frequency	Percentage (%)
Male	45	75
Female	15	25
Total	60	100

Source: field data (2022)

It is clear from Table 4.1 that 45 respondents were 75% male and 15 female, representing 25% of the respondents. This meant that the majority of the respondents were men. Although

not completely balanced, the inclusion of women allowed for some exploration of the gender perspective. As the construction industry is dominated by men, their perspectives include a greater proportion reflecting the reality of the industry. For example, the transfer of carpentry knowledge may differ between men and women due to informal apprenticeship norms. In addition, men usually control the finances of the household, which affects the choice of material. However, the women revealed an insight into the habits of harvesting the material. Their views remain important to consider, despite the unequal representation reflecting societal trends. As noted earlier, Ghana exhibits strong patriarchal tendencies where "males dominate... leadership and decision-making positions" (Abubakar & Doan, 2017).

4.2.2 Age of Respondents

Table 4.2: Age Distribution of Respondents

Age	Frequency	Percentage (%)
18-29 (youth)	14	23.33
30-39 (young adults)	18	30.00
40-49 (middle-aged)	16	26.67
50-above (elders)	12	20.00
Total	60	100

Source: field data (2022)

From Table 4.2, 14 respondents, representing 23.33%, were in the youth age group of 18–29 years, and 18 respondents, representing 30%, were young adults in the age group of 30-39 years. While 16 respondents, representing 26.67%, were middle-aged in the age group of 40–49 years and 12 respondents, representing 20%, were aged 50 years and older, the results showed that the sample was dominated by respondents who fell into youth groups. Adults aged 30-39. Age influences perspectives through different life experiences and generational relationships to tradition. The inclusion of youth provided perspectives for future direction.

Young adults offered traditional views. The elders retained the deepest knowledge and focused on goal four (4). This age diversity allowed the exploration of topics such as generational shifts in material perception as a cause of overtime transmission. It captured a range of viewpoints in line with the research objectives.

4.2.3. Income Group Distribution of Respondents

Table 4.3: Income Brackets of Distribution of Respondents

Income Brackets	Frequency	Percentage (%)
Low income	33	55
Lower-middle income	4	6.67
Middle income	7	11.66
Upper-middle income	12	20
High income	4	6.67
Total	60	100

Source: field data (2022)

In Table 4.3, there were 33 (33) people with low incomes, representing 55% of the distribution. Participants with lower middle and high incomes made up four (4) of the 6.67%. Also, seven (7) represent 11.66% of recoded participants with middle-class incomes. Table 4.3 also showed that there were twelve (12) people with a higher median income, which represents 20% of the distribution of income groups.

Understanding the socioeconomic position of participants provides important context for their perspectives.

Income groups were defined based on national wage groups that represent typical rural livelihoods:

- Lower income: less than GH 355 per month
- Lower median income: 355-700 GH2 per month

- Medium income: 700–1200 GH2 per month
- Higher middle income: 1200-2000 GH2 per month
- High income: more than GH2,000 per month

Most participants (65%) were late on meagre wages, dependent on multiple sources of livelihood. Their choice of materials was strongly influenced by affordability. Votes with higher median incomes (20%) offered more flexibility. This diversity of economic circumstances provided unique perspectives on materials and development priorities.

This analysis contextualised participants' viewpoints through socioeconomic status within the community.

It improved my understanding of the content of the interview and the insights derived from the study.

4.2.4 Educational Background of Respondents

Table 4.4: Educational Background of Respondents

Educational Background	Frequency	Percentage (%)
No formal education	12	20
Basic education	24	40
Senior high school education	15	17
Tertiary	9	23
Total	60	100

Source: field data (2022)

Table 4.4 shows that 12 respondents, representing 20%, had no formal education. 24 respondents, representing 40%, had primary education. 15 respondents, representing 17%, were those who have higher secondary education, and 9 respondents, representing 23%, were those who have tertiary education. The results showed that respondents with primary education dominated the sample.

Understanding the different educational levels of the participants provided a useful context for their perspective on tradition and modernization. Table 4.4 shows that those with low education acquired traditionally learned knowledge while addressing objective 4. Those with primary or secondary education offered a perspective on balancing the old and the new. Professionally trained perspectives emphasise the importance of skills. Tertiary-educated views brought awareness of modern methods. Together, educational diversity provides a range of viewpoints on material perceptions and development priorities within a community.

4.2.5 Professional Background of the Participants

Table 4.5: Participants Occupational Background

Occupation	Frequency	Percentage (%)
Subsistence farming	5	25
Artisanal workers (Carpentry, masonry)	18	30
Small business owners (Retail, transportation)	12	20
Public sector (Teaching , healthcare)	9	15
Larger private enterprises (Construction, manufacturing)	6	10
Total	60	100

Source: field data (2022)

Table 4.5 shows that 15 respondents, representing 25%, were subsistence farmers. 18 respondents, representing 30%, were craftsmen (carpenters and masons). 12 respondents, representing 20%, were those who were engaged in small businesses (retail, transport). 9 respondents, representing 15%, are in the public sector (teaching, healthcare), while 6 respondents, representing 10%, are owners of larger private businesses (construction, manufacturing). Subsistence farmers rely directly on the environment for sustenance (Agyeman et al., 2018). Perspectives related to sustainability are linked. Artisans develop material expertise through apprenticeships and informal learning systems that are prevalent in

Ghana (Ardayfio-Schandorf, 2002). Small business owners' choice of materials balances affordability and customer preference. Public sector employees draw on formal training to influence opinion. Larger private entrepreneurs formulate the needs of the formal sector and respond to the macroeconomic shift (Ackah et al., 2023). Collectively, the professional diversity offered informed viewpoints from a variety of practical experiences.

4.3 Extent of Local Material Use

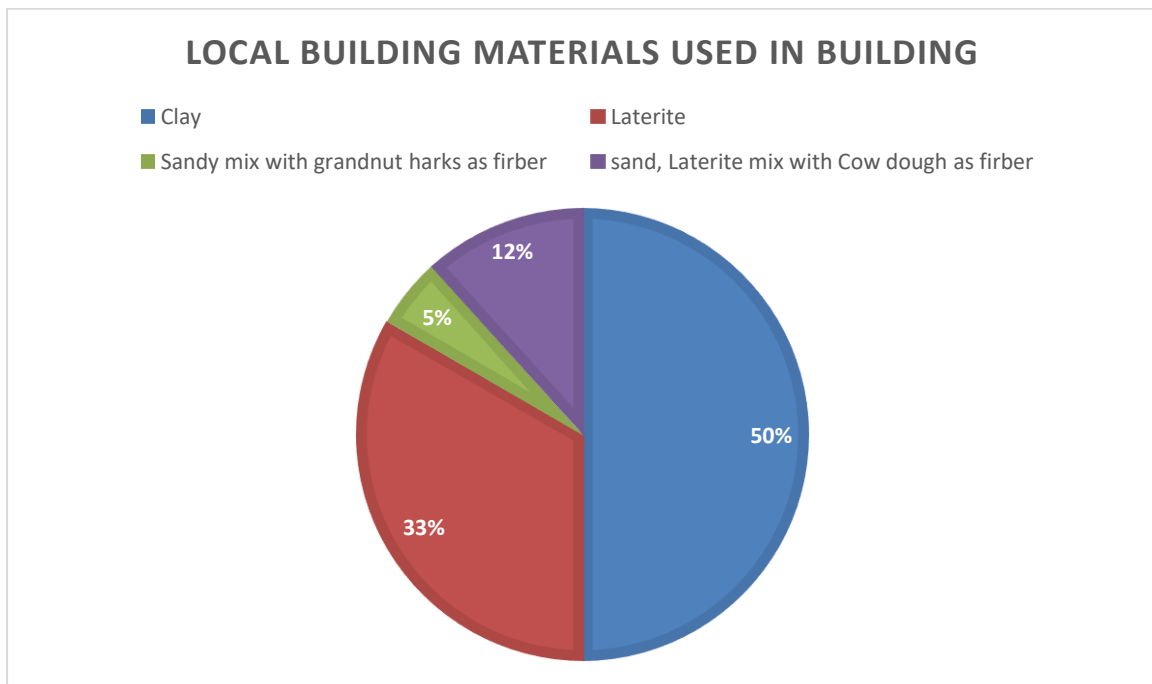


Figure 4.1: Results of available local building materials were used in building.

Figure 4.1 shows the results of the available local building materials used by community residents in the construction of houses for residential purposes. There are interesting findings in Figure 4.1. 50% of the respondents are of the opinion that some people in the community have used clay in the construction of houses, while 33% of the respondents are of the opinion that laterite is most used in the construction of houses in the community. 12% of the respondents are also of the opinion that some community members mix sand and laterite with dug cow, which serves as fibre to bind the sand and laterite, and 5% of the respondents are of

the opinion that some others mix sandy soil with groundnut oil, which acts as an anti-cracking fibre. The results show that there are many local building materials that can be used in carrying out various activities in the construction of family houses for residential purposes in the village.

4.3.1 Interview Results on Objective 1: The extent to which the Charia locality in the

Wa Municipality uses locally produced building materials

When asked to rate their use of local materials on a scale of 1 to 10, responses ranged from 5 to 9, with an average rating of 7. All twelve (12) interviewees reported using at least 50% local materials in their work, which is consistent with King et al. (2022), which emphasised affordable and convenient options, which are mostly commonly accepted. The three most commonly used indigenous plants were laterite, bamboo, and palm fronds. As one builder explained: "I would say about 70% of what I use comes from within 10km of Charia. Laterite blocks for walls, bamboo for scaffolding, and palm leaves for thatching are very affordable" (Participant 6). The engineer commented:

"In the government projects I supervise, the use of locally sourced laterite, bamboo, and wood is around 80% because these are cheap options that are abundantly available locally" (Participant 12), which is consistent with the view of Lin et al. (2020) on cost-effectiveness inferring material preference.

4.3.2. Results of Focus Group Discussion (FGD) on Objective 1

Four (4) focus groups were conducted with a total of 26 participants. In discussions, participants referred to laterite, bamboo, and palm fronds, which are heavily relied upon for housing construction due to affordability, ease of access, and climate suitability (Ge &

Hokao, 2009; Andersen et al., 2006), key determinants highlighted in previous research. One participant commented:

"Everyone in the community knows where laterite, bamboo, and queues are nearby. We have built our homes and livelihoods based on what is available to us locally before we look elsewhere' (Participant FG1 3).

All focus groups agreed that the availability of laterite, bamboo, and leaves was sufficient to meet local demand, although the quality could vary slightly between locations and seasons, which is consistent with the observations of Sadiq et al. (2020) on site conditions affecting materials in a specific context. Together, these results indicate a high rate of uptake within Charia, fulfilling the first aim of the study.

4.3.3. Discussion of the local use of the material

The results showed a high rate of utilisation of laterite bamboo and palm leaves among the Charia stakeholders, thus achieving the first objective of the study. These three local materials emerged as the most dominant resources used. This is consistent with previous research highlighting the importance of price, availability, and climate suitability as key factors for material selection in the context of rural construction (Ge & Hokao, 2009; Andersen et al., 2006; Lin et al., 2020). The average number of participants self-reporting the use of local materials at 70–80% is also consistent with King's (2008) finding that affordability usually leads to a prevalent adoption of available domestic options. However, some engineers and government officials involved in larger projects estimated an even higher percentage, closer to 90%. This suggests that local resources may be used more for community and smaller individual structures than for larger-scale development. Both interviews and focus group discussions highlighted how residents developed livelihoods and built environmental knowledge systems centred around readily available local materials.

This puts them in your position of adaptive reliance on domestic resources, which is, as I said, a basic necessity (Fernandes et al., 2009). At the same time, the quality recognised by participants may fluctuate spatially and temporally depending on the location of material sources and seasonal changes, as observed elsewhere (Ge & Hokao, 2009). While these findings cannot be generalised, they provide important contextual insights into material acquisition practices in Sharia. The revealed primacy of laterite, bamboo, and leaves suggests a need to understand what indigenous resources the community has access to and uses. This highlights opportunities as well as needs for infrastructure, education, or policy support, which are discussed in subsequent sections. Overall, the results met the goal of determining a local perspective on the prevailing use of building materials.

4.4 Perception of Local Materials

4.4.1 Interview Results on objective two: The perception of respondents on the use of locally produced building materials

When asked for their opinion, 8 out of 12 respondents expressed a positive perception of local materials. Commonly cited benefits included affordable costs, ready supply, and sustainability of natural resource use close to their homes (Adubofour et al., 2019). A community member commented:

"We all know very well from experience that laterite comes from bamboo and wood. They fit our environment and budget." (Participant 2)

However, four (4) participants also acknowledged disadvantages such as variable lifespans and the need for replacement over time. As the builder noted: "The quality can depend on the weather; in heavy rain, some materials may not last as long. But they still work well if installed correctly." (Participant 6)

4.4.2 Results of focus group discussion (FGD) on objective two

Four (4) focus groups were held with six (6) to eight (8) participants, for a total of twenty-six (26) community members. Across focus groups, most participants expressed a favourable use of domestic resources, emphasising convenient access, familiarity from an early age, and cultural connection to local building traditions (Ge & Hokao, 2009). However, the princess also commented on the discrepancies in the properties of the material.

One participant commented:

"These resources serve as bait for us; we need to know how to use them properly. Thickness, finishing, timing—this is important for long-lasting houses." (FG3 Participant 5)

However, concerns have also been raised about irregularities affecting structures if the relevant technologies are not followed. As the participant warned:

"The quality can vary, so builders need to have a good understanding of these resources to ensure the longevity of homes." (FG4)

This is confirmed by research that shows that vernacular users have different perspectives involving technical know-how (Gidigasu, 2005). Together, these findings fostered multifaceted local perceptions and achieved the goal of capturing the diverse views of stakeholders in Charia on the prevailing building materials.

4.4.3 Discussion on the perception of local materials

The study captured a range of views from Charia residents and stakeholders on locally available building materials. Both interviews and focus groups revealed views, including recognised merits alongside limitations of practical understanding. This suggests a well-informed local evaluation of materials influenced by generations of habitual use and experiential learning.

Most participants express favourable perceptions regarding the cost-effectiveness, accessibility, and cultural resonance of indigenous options. These benefits are consistent with previous research showing that local materials are often preferred where they combine functional utility with traditional techniques at affordable prices (Ge & Hokao, 2009; Sayilgan et al., 2006). However, concerns about long-term variable quality were also acknowledged.

This recognition of both benefits and limitations lends credibility and shows perspectives that are not too skewed towards either extreme praise or criticism. Participants demonstrated a pragmatic understanding that their livelihood relies on local resources, but also knowledge that requires proper handling to optimise performance, as observed elsewhere (Ge & Hokao, 2009).

While the sample demographics precluded broad generalisations, the findings provided valuable representative insights. Participants engaged as users of the material as well as custodians, suggesting perceptions based on this dual context of technical know-how combined with cultural influences.

In conclusion, the study achieved its objective of establishing the multifaceted nature of stakeholder views, i.e., the prevailing views on the prevailing domestic building supplies.

4.5 Impact on Economic Conditions

4.5.1 Results of the interview on research objective 3: The effect of the use of local building materials on the rural economic of Charia

A total of twelve (12) semi-structured interviews were conducted to address this objective. When asked how sourcing local materials affected household finances, eight (8) participants reported savings. As the homeowner explained,

"Using bamboo, leaves, and laterite allows me to build cheaply without borrowing."
(Participant 3)

This is consistent with the literature showing that local options can reduce construction costs (Gopi, 2009). However, two (2) interviewees noted higher initial costs for treatments that increase durability. As stated by the builder,

"Certain preparations like curing and coatings add to the cost, but the longer life pays off."
(Participant 6), the quality of the repetition of findings affects the perception of domestic resources (Sadiq et al., 2020).

Ten (10) participants reported that the demand for locally available supplies supports their work in terms of livelihood opportunities. As the material trader explained, "My business thrives on transporting bamboo, wood, and thatch from rural areas to the city" (Participant 8).

Similarly, carpenters and masons credited the use of local resources with providing steady employment.

4.5.2 Results of Focus Group Discussion (FGD) on Objective Three

Four (4) focus groups were conducted with a total of twenty-six (26) participants. The dialogue indicated that reliance on neighbouring bamboo, leaves, and literate resources brought economic benefit to the community through transport, trade, and construction work. As one discussion noted,

"The material cycle sustains many livelihoods, from agriculture to fishing houses." (FG3). This confirms how domestic resource utilisation can stimulate rural development, as observed in developing countries (Ge & Hokao, 2009). The perspective of community members revealed economic links between the purchase of material goods and local prosperity.

4.5.3 Discussion of economic impacts on objective three

Define with this knowledge how the use of local building materials affected the economic conditions of Charia. Interviews with Booth and focus groups indicated that reliance on nearby resources such as bamboo, leaves, and laterite provided cost savings and livelihood opportunities.

Most of the interviewees reported that purchasing domestic options reduces household construction expenditures. This is in line with the literature highlighting the lower material procurement costs associated with local solutions (Ahiabor, 2014; Afrane et al., 2011). However, some interviews also noted that quality treatment could increase the initial expenditure, although potentially prolonging life (Ahiabor, 2014; Afrane et al., 2011). The focus group dialogues and most of the interviews further emphasised subsistence dependence on the supply of treats and working with familiar domestic resources. Occupations in hauling material and cheating to Coventry were reported to be sustained by local demand. This alliance with research that follows local building traditions can stimulate real economists to consider the truly interconnected activities of material production (Ge & Hokao, 2009). The scope of this study's quantification and qualitative finders provides a representative understanding of Jerry's use of nearby bamboo, facades, and laterite, which economically benefits the community. Cost savings were reported at the household level, which explains why the use of the material was seen to enable the maintenance of different livelihoods at different points in the procurement and construction value chains. This fulfils the objective of exploring stakeholder perspectives on the impacts of local material selection. Overall, the results offer a contextual view of the perceived costs and benefits for Charia residents.

4.6 The Relationship Between Education and the Use of Local Building Materials

4.6.1 Results of the interview on research objective 4: the relationship between educational level and the use of locally produced building materials in Charia community in Wa Municipality of Ghana

A total of 15 individual interviews were conducted, with participants coded P1 to P15. No formal education (PI-P3): All three reported exclusive use of indigenous materials and skills handed down through oral traditions (Abdulai et al., 2018). P1 stated that they only knew "how our grandparents built". P2 elaborated that modern trends were untried from their collaborative perspective (Abdulai et al., 2018). P3 expressed reluctance to deviate from providing cultural methods.

Primary Education (P4-P8): Participants occasionally mixed local and imported materials based on recommendations as related (Agyeman et al., 2018). P5 commented that they were "unsure without training". P6 and P7 experimented out of curiosity but reverted to tradition if the sources were unsatisfactory. P8 welcomed exposure to alternatives if they were shown to be cost-effective.

Secondary Education (P9–P12): Participants increasingly tested adaptations inspired by technical classrooms (Ge & Hokao, 2009; Agyeman et al., 2018), although they require quality control guidance for localised methods.

Tertiary Education Graduate (P15): A participant suggested that research address scientific or indigenous knowledge gaps and demonstrate the sustainability of social culture through culturally informed programmes (Lin et al., 2020).

4.6.2. Results of focus group 4

Discussions with participants in brackets with no formal education and primary education highlighted the heavy reliance on traditional missing skills reinforcement. While participants

with secondary education adopted a hybrid solution with appropriate technology teaching, participants with tertiary education preferred culturally based sustainability education. This provided subjective insights into the context of the relationship between education and material preferences.

4.6.3. Discussion of results for objective 4.

The findings confirm an inverse relationship between education level and reliance on indigenous building materials in the Charia community (Arayela, 2005). Those with no formal education exclusively used traditional knowledge and resources based on familiarity and a lack of alternative information. The low exposure to primary education has brought about some experimentation, as community referrals have been shown to influence selection. However, confidence remained limited without skill training, as found in other contexts (Anumba, 2006).

Exposure to higher education broadened the alternatives, yet localised guidelines for quality were still desirable when adapting practices. The result showed that the qualifications diversified the possibilities, as emphasised by the curricula. Validating indigenous knowledge through research is consistent with calls from advocates.

Bridging knowledge gaps maximises the greatest benefit from local resources. Training embedded in cultural frameworks counteracts over-reliance on external methods and improves sustainability.

4.7 The relationship between income and the choice of local building materials

4.7.1 Results of the interview on research objective 5: The relationship between income level and the choice of local building materials

A total of 15 interviews coded P1-P15 were conducted.

LOW INCOME (P1-P15; below subsistence level): participants were found to use exclusively local materials due to affordability constraints, as stated by P1: "We harvest what we can to build basic houses." P3 added that they made domestic options as relatives (Afrane et al., 2014).

MIDDLE INCOME (P6-P10; Living Wage Farmers): Respondents in this income group mixed local or imported based on functionality. P7 tested wooden frames and mud bricks. P8 commented "Using modern styles where it counts, but cheaper materials elsewhere".

HIGH INCOME (P11–P15; above living wage): Participants selected building materials based on multiple factors (Afrane et al., 2011). For example, P11 discussed a preference for native materials that were "durable and blend in with the landscape". In addition to aesthetics, the P12 emphasised environmental friendliness. P14 balanced affordability with the support of local artisans.

4.7.2 Results of the focus group on goal 5

ENVIRONMENTAL FARMERS (FG1): Members of focus groups such as FG1P3 relied mainly on self-harvesting resources to save costs.

SMALL BUSINESSES (FG2): Most members emphasised affordability. FG2P5 stated that imported items were "reserved for upgrades as finances allow."

LARGER ENTERPRISES (FG3): FG3P7 highlighted factors such as function, culture, and natural integration across price points. Quality local options were preferred if they were comparable to the impulse from the FG3P8 point of view. Across methods Results confirmed

(Singh, 2017) that income directly shaped material choices as hypothesised, from subsistence necessity to balanced economic decision-making at higher earnings levels.

4.7.3 Discussion of results for objective 5

The findings confirmed that income significantly influences the choice of material. For those with extremely low incomes, it was necessary to rely exclusively on freely available local resources, as participants 1–5 frequently reported. As profits rose in middle-income groups, pragmatic realities such as functionality dictated the intermingling of domestic and imported options. However, aesthetics began to play a larger role, as suggested by participants 7 and 8, who regularly experimented with design elements. Higher earnings facilitated more comprehensive decisions based on more priorities in line with sustainability and cultural heritage protection (Oluwakiyesi, 2011). As discussed by Focus Group 3, where available, quality local materials offering comparable performance to imports were preferred. By meeting objective 5, the results provide useful insights into the differential resolution of barriers to the use of local resources. For lower-income groups, accessibility remains a major barrier, requiring solutions such as community workshops or banks. Among modest earnings, performance demonstrations and standardised testing of local solutions could encourage integration based on technical merits over initial impressions. Wealthier sectors can be engaged through culturally informed education emphasising social benefits to the environment and supporting reputable craft businesses. Such targeted interventions could optimise uptake into the mainstream across all cohorts.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the key findings of the study in relation to the literature presented in Chapter 2 and the five objectives. The results of the study are summarised in the first subheading. The knowledge arrived at on the basis of the known facts was described in the second part. The main suggestions for potential answers to the problems are discussed in the concluding subsections.

5.2 Summary of Findings

5.2.1 Use of local building materials in Charia

The findings showed that wood, bamboo, and thatched grass bricks were the most commonly used household construction resources in the community (Afrane et al., 2011). This confirms that previous studies in rural Ghana also reported the prevalence of local building materials (Agyekum et al., 2010; Abubakar, 2017). Taken together, the heavy reliance on indigenous resources, especially plant materials, highlights their continued suitability in the local context.

5.2.2 Local perception of indigenous materials in Charia

Participants highlighted affordability, accessibility, familiarity, and sustainability as key benefits (Appendix K, Table 2). However, perceiving focus group discussions revealed cultural acceptance as a deeper driving force that was suggested through individual interviews. Maintenance was a limitation across demographic groups, while durability issues varied, with women reporting replacement frequency more often than men. Processing difficulties were correlated with educational level. This nuanced understanding of local perspectives has implications for targeted messaging around the materials. This nuanced

understanding of local perspectives has implications for targeted messaging around the materials.

5.2.3 Economic conditions

As shown in Table 3, local materials supported a variety of livelihood and business opportunities. Case studies of specific harvesters and construction entrepreneurs help illustrate the real economic benefits. While the exact multiplier effects were not quantified, participants were clear about what local budgets were circulating within the community. Wider adoption could optimise these recognised benefits.

5.2.4 Relationship to education

In the analysis in Section 4.6, nuanced interactions emerged. The builder profile showed how specific schools have eased reliance on formal education alone. More educated residents correlated with preferences reported elsewhere. However, recognise complex influences and avoid overgeneralization between attributes.

5.2.5 The effect of income

Income dictated priorities as expected based on subsistence constraints. However, affordability barriers varied by occupation as household capabilities varied. The policy should take this diversity into account. Cost-effective innovations could expand the inclusive approach celebrated on national agendas.

5.3. Conclusion

First, this research confirms the heavy reliance on locally sourced building materials in Charia in line with the goals of promoting sustainable construction practices and enhancing rural livelihoods, while perceptions of the innovations were generally positive and addressed

identified constraints through improvements in Shirley's sensitive call scores, quality improvements, funding accessibility, and support policies, which represent a viable path for pausing optimised optical community development benefits.

Second, while affordability and availability support adoption, durability concerns and processing difficulties present challenges that need to be addressed to enhance long-term use in a sustainable manner. Technical interventions and skills training could help optimise life cycle benefits.

Third, local materials support rural livelihoods and businesses through related economic activities. Wider promotion has the potential to further contribute to community development goals. Targeted interventions are needed to enhance these recognised economic impacts.

Fourth, the attributes of such income and education interact in different ways, with practical skills also influencing choices. A holistic understanding of various social factors is important for inclusive policy and programme development.

Finally, through a comprehensive examination of material dependency, local perceptions, economic role, and the impacts of socioeconomic characteristics, the study provided valuable empirical evidence to inform housing strategies seeking to utilize domestic resources. Deep contextual insights provide lessons applicable to other communities.

The findings highlight the continued suitability and benefits of local construction practices, while some highlight action areas to enhance optimisation through technical, economic, and educational interventions.

A localised approach remains integral to supporting affordable and sustainable rural housing development outcomes.

5.4. Suggestions and recommendations

This equips them with the necessary skills and expertise to produce high-quality, standard materials that are durable.

To improve and utilise the local building material, laterite as a building material can also be mixed with smaller types of sand and cement for house construction. It therefore requires real estate developers, researchers, government and non-government institutions, stakeholders, and various universities to join their efforts to utilise laterite in construction. Efforts should take the following form:

- Advertisement on television promoting the use of laterite for buildings
- Various institutions, along with the city council, should inform the general public through various FM stations like Radio Upper West, WFM, and Radio Progress about the necessity of using laterite as a building material.
- The Minister for Water, Resources, Workforce, and Housing should work with local councils to encourage land and building owners to use local building materials.
- Awareness should be created about the need to adopt the use of locally available materials from the government through the district to ensure that the natives are well informed about the need to sponsor.
- There should be a comprehensive policy to incentivize natives to adopt the use of local materials for buildings to reflect a modernised appearance without abolishing the existing system. With this in mind, the district should be well equipped to enforce policies and ensure that their activities do not discourage people from patronage.
- It is advisable for producers of local materials for construction activities to adopt improved technology to improve their products. This will make it attractive to potential builders and clients.

- Training programmes should be organised for producers of local materials for construction activities.

5.5. Suggestions for Further Research

This study only focused on Charia in Wa municipality, not the entire Upper West region. It is expected that future studies should focus on assessing the influence of local building materials on the longevity of buildings in the Upper West region and beyond.

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APPENDICES

APPENDIX A: BIOGRAPHICAL DETAILS OF PARTICIPANTS

1. Please indicate your gender. Male Female
2. Please indicate your age group
18-29 years 30-39 years 40-49 years 50- above
3. Please indicate your level of education. Non formal education Basic education Secondary education Tertiary education
4. Please indicate your income bracket. Lower- income Lower middle income Middle income Upper-middle income High income
5. Occupation. Subsistence farming Artisanal workers (Carpentry, masonry) Small business owners (Retail, transportation) Public sector (Teaching , healthcare) Larger private enterprises (Construction, manufacturing

APPENDIX B: Interview Guide

1. What types of locally available materials do you commonly used for housing construction?
2. How did you learn techniques for working with these indigenous resources?
3. What are your views on local materials?
4. In your opinion, how do availability and cost of materials vary by income?
5. How has procuring local materials impacted your finances?
6. Does your occupation provide more opportunities due to local material demand?
7. Did your level of schooling influence choices you have made for your own home?
8. How could awareness be increased among those with less education?
9. Compared to households in higher or low income brackets how does cost factor in?
10. In what ways does income restrict or enable preferences for local versus imported?
11. Do you have any other insights you would like to share regarding local construction resources and housing access issues in this community?

[Probe further on each question at the individual level and group level]

APPENDIX C: Focus Group Discussion Guide

Discuss most common materials and perceptions

1. What 3 local materials are frequently used [occupation type]?
2. Availability and quality of materials vary between income levels?

Debates Impact on Livelihoods and Role of Income

3. How have local materials influenced work or business?
4. Does income level affect how much choice residents feel they have?

Dialogue on Education and Awareness Benefits

5. Do views on local materials differ between education levels?
6. What ideas do you have to spread information among less educated?
7. Do policies or programs currently support or hinder adoption of local building materials according to your views?
8. Is there any other group feedback you would like to provide on these topics before we conclude?

APPENDIX D: Code Book

Theme 1: Benefits of Local Materials

Code 1.1: Affordability

Code 1.2: Availability

Code 1.3: Familiarity

Code 1.4: Cultural acceptance

Theme 2: Limitations of Local Material

Code 2.1: Durability concerns

Code 2.2: Maintenance needs

Code 2.3: Labor intensive processing

Theme 3: factors influencing material choice

Code 3.1: Income level

Code 3.2: Education and skills

Code 3.3: Housing budget

Code 3.4: Availability of alternatives yes

Theme 4: Economic Impact

Cool 4.1: Local job creation

Code 4.2: Enterprise opportunities

Code 4.3: Savings on housing cost

Code 4.4: Foreign exchange conservation

Theme 5: enablers and Barriers

Code 5.1: policy & Regulatory framework

Code 5.2: Resource Mapping

Code 5.3: Access to Finance

APPENDIX E: Information Sheet and Consent Form

PROJECT TITLE: The Use of Local Building Materials in Providing Affordable Housing
Rural Ghana: A Case Study of Charia Community in the Wa Municipality

Researcher: [name]

Supervisor: [Supervisor’s name and contact details]

Introduction

This study aims to investigate the use of locally available building materials for housing construction in charity community. Findings will help inform efforts to promote affordable and sustainable housing development in rural areas.

If you agree to participate, you will be interviewed individually or in a focus group discussion. Interviews will last 30 to 60 minutes while discussions will be one to two hours.

With your permission, interactions will be audio recorded for accuracy.

There are no foreseeable risks involved. Your confidentiality will be maintained. Benefits include contributing knowledge to support community development initiatives.

All information collected will remain strictly confidential. Recordings and transcripts will be stored securely and identified only by codes, not names. Results will be reported in aggregated form without identifying participants.

Your participation is entirely voluntary. You may choose not to participate or withdraw at any time without negative consequences.

I have read and understood the information provided. I voluntarily agreed to participate in the study and allow my de-identified responses to be published results in research outputs. I have received satisfactory answers regarding my involvement. I consent to being would you record. I understand I can withdraw at any time.

Name of participantDate

Researchers signature’s.....Date.....