TIMBER FOR SUSTAINABLE AND AFFORDABLE HOUSING AND BUILDING CONSTRUCTION IN BENIN CITY, EDO STATE, NIGERIA.

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (BSc.) DEGREE IN ARCHITECTURE,
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DECLARATION

I, **Mayone Anselm Oshehor**, hereby declare that this project work titled "**TIMBER FOR SUSTAINABLE AND AFFORDABLE HOUSING AND BUILDING CONSTRUCTION IN BENIN CITY, EDO STATE, NIGERIA"** is a record of an original work done by me, as a result of my research effort carried out in the Department of Architecture, Faculty of Environmental Sciences, University of Benin, under the supervision of Arc. G.E.O. Ekpu. All academic material used in this work and its sources has been duly acknowledged.

_____ _____

Mayone Anselm Oshehor Date

CERTIFICATION

This is to certify that this study titled **TIMBER FOR SUSTAINABLE AND AFFORDABLE HOUSING AND BUILDING CONSTRUCTION IN BENIN CITY, EDO STATE, NIGERIA** was carried out by **Mayone Anselm Oshehor** with Matric Number **ENV2010818** under my supervision and meets the regulation governing the award of the Bachelor degree in Architecture of the University of Benin, Benin City, Edo State, Nigeria. We certify that it has not been submitted for the Bachelor's degree in this or any other university and is approved for its contribution to knowledge and literary presentation.

_____ _____

Arc. G.E.O. Ekpu **Date**
(Project Supervisor)

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Arc. Henry Omorogbe **Date**
(Head of Department)

DEDICATION

This work is dedicated to the love of sustainable development, all architecture students worldwide, my loving family members, and, most importantly, God Almighty.

ACKNOWLEDGEMENT

I wish to express my profound gratitude to God Almighty for His guidance and grace throughout my dissertation.

I am also very grateful to my amazing parents (Mr. & Mrs. Mayone) and siblings for their love and support.

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ABSTRACT

The rising demand for sustainable and affordable housing in Nigeria has drawn attention to the use of environmentally friendly and cost-effective building materials. This study explores the potential of timber as a construction material for sustainable and affordable housing and building development in Benin City, Edo State. Timber, being a renewable and locally available resource, offers significant advantages in terms of energy efficiency, reduced environmental impact, and economic viability. The research assesses the level of timber adoption in the local construction industry, evaluates its suitability in terms of structural performance, cost, and sustainability, and examines the challenges hindering its widespread use. Findings indicate that while timber is perceived positively for its aesthetic and thermal qualities, concerns regarding durability, fire resistance, and regulatory gaps remain key obstacles. The study concludes that with proper treatment, policy support, and awareness campaigns, timber can play a critical role in addressing Nigeria's housing deficit sustainably and affordably. Recommendations are made for policymakers, architects, and developers on strategies to promote timber adoption in future building projects.

CHAPTER ONE

1.0 INTRODUCTION

The increasing demand for affordable and sustainable housing has led to the exploration of alternative building materials that can mitigate environmental impacts while ensuring economic feasibility. Timber, a naturally renewable and biodegradable material, has been widely used in construction for centuries due to its structural reliability, aesthetic appeal, and energy efficiency (Gamage *et al.*, 2020). With growing concerns over climate change, carbon emissions, and resource depletion, timber has gained attention as a viable material for sustainable construction, particularly in tropical regions where its availability and adaptability make it a practical option (Jiao *et al.*, 2021). In Nigeria, rapid urbanization and population growth have intensified the housing deficit, particularly in cities such as Benin City, Edo State. The high costs of conventional building materials, such as cement and steel, contribute to the housing crisis, making it necessary to explore cost-effective alternatives (Ogunbiyi *et al.*, 2019). Timber, when sourced and utilized sustainably, has the potential to address affordability concerns while minimizing the environmental footprint of construction activities. Research has shown that timber buildings have a lower carbon footprint compared to conventional concrete structures, as timber sequesters carbon throughout its lifespan (Churkina *et al.*, 2020). Furthermore, modern advancements in timber processing and engineered wood products, such as cross-laminated timber (CLT) and glulam, enhance its structural performance and durability, making it suitable for large-scale applications (Schmidt & Riggio, 2019).

Despite these benefits, the adoption of timber for mainstream construction in Nigeria faces several challenges, including deforestation concerns, inadequate regulatory frameworks, and public perceptions regarding the durability and safety of timber structures (Adebayo & Adebayo, 2022). Additionally, the prevalence of termites and high humidity levels in tropical climates raises concerns about timber's long-term resilience (Obisesan *et al.*, 2021). Addressing these issues requires a comprehensive understanding of sustainable timber sourcing, appropriate treatment methods, and effective policy interventions to support its use in affordable housing projects. The global construction industry is one of the largest contributors to carbon emissions, accounting for nearly 39% of energy-related CO_2 emissions worldwide (Global Alliance for Buildings and Construction, 2022). The reliance on conventional building

materials such as concrete and steel has led to significant environmental degradation, including high energy consumption, depletion of natural resources, and increased carbon footprints. In response to these challenges, sustainable construction practices are being prioritized globally, with a shift toward renewable materials such as timber. Timber, as a naturally occurring and carbon-sequestering material, presents a promising solution to mitigate climate change while ensuring energy-efficient building solutions (Churkina *et al.*, 2020).

Countries such as Sweden, Canada, Austria, and Japan have embraced timber as a primary material for modern construction, leveraging advanced engineered wood products like CLT and glulam to construct high-rise buildings (Wells, 2019). For example, Mjøstårnet, an 18-story wooden skyscraper in Norway, showcases the potential of timber in urban construction, demonstrating its strength, durability, and environmental benefits (Robertson *et al.,* 2021). However, while developed nations have made significant progress in integrating timber into mainstream construction, many African countries, including Nigeria, have yet to fully harness its potential due to factors such as deforestation concerns, inadequate policies, and technological limitations (Adebayo & Adebayo, 2022).

In Nigeria, the housing deficit remains a major challenge, with an estimated 28 million housing units needed to accommodate the growing population (Federal Mortgage Bank of Nigeria, 2023). The high cost of cement-based construction has made homeownership unaffordable for many, necessitating the exploration of cost-effective and sustainable alternatives. Timber, being locally available, lightweight, and thermally efficient, offers a viable solution for addressing Nigeria's housing crisis while reducing reliance on imported materials (Obisesan *et al.,* 2021). However, its adoption in Benin City, Edo State, has been limited due to perceived durability issues, weak regulatory frameworks, and public misconceptions regarding fire safety and pest resistance. This research investigates the suitability of timber for sustainable and affordable housing and building construction in Benin City, Edo State. It explores its economic viability, environmental benefits, structural applications, and material sourcing while examining strategies to overcome barriers to adoption. Edo State is one of Nigeria's richest regions in forest resources, with vast reserves of tropical hardwood species found in the rainforest belt. Major timber-producing areas include Okomu, Owan, Uromi, Sapele, and Ehor, where species such as Iroko (*Milicia*

excelsa), Mahogany (Khaya spp.), Obeche (*Triplochiton scleroxylon*), and Ekki (*Lophira alata*) are commonly harvested (Obisesan *et al.*, 2021). These species are known for their strength, durability, and resistance to environmental degradation, making them suitable for various construction applications. However, unsustainable logging practices, weak enforcement of forestry regulations, and deforestation threats have raised concerns about the long-term availability of timber for construction. Sustainable forestry management practices, including reforestation programs, timber certification, and regulated harvesting, are critical to ensuring the continued viability of timber as a building material in Edo State (Gbadamosi & Adeyemi, 2022).

Timber is an exceptionally versatile material that plays a vital role in various aspects of building construction. It is widely used for structural elements such as beams, columns, and trusses in residential, commercial, and industrial buildings, offering a combination of strength, flexibility, and ease of construction (Wells, 2019). Its application in structural frameworks not only provides stability but also supports sustainable building practices by reducing the carbon footprint associated with traditional construction materials. Beyond structural purposes, timber is highly valued for its use in doors, window frames, and shutters. Its natural aesthetic appeal, durability, and ease of customization make it a preferred choice for these components, contributing both to the functionality and visual quality of buildings (Schmidt & Riggio, 2019). Additionally, timber is commonly employed in flooring and ceiling panels. Hardwood timber flooring, in particular, is renowned for providing thermal comfort, acoustic insulation, and long-term durability, thereby enhancing indoor living conditions and adding to the architectural character of spaces (Jiao *et al.*, 2021). In interior design, timber panels and composite boards serve as effective solutions for partitioning and wall cladding. These materials are lightweight, flexible, and easy to install, making them ideal for creating adaptable interior environments that promote comfort and efficiency (Churkina *et al.*, 2020). Roofing is another major application where timber is indispensable. Timber trusses and rafters are extensively used in pitched roof designs, especially in low-rise and residential housing, due to their cost-effectiveness, strength, and ease of assembly (Adebayo & Adebayo, 2022).

However, to ensure the durability and reliability of timber, especially in humid climates like Benin City, proper selection, seasoning, and treatment processes are critical. Timber must be adequately dried, treated against pests, and protected against

moisture to enhance its resistance to decay and infestation. These preventive measures significantly extend the lifespan and performance of timber components in construction (Obisesan *et al.,* 2021).

In summary, timber's versatility and environmental benefits position it as an essential material in modern building construction, provided that quality control measures are rigorously applied to address climatic and biological challenges. Timber has the potential to serve as a sustainable and affordable building material in Nigeria, particularly in Benin City, where its local availability and adaptability make it a viable option for addressing housing shortages. While concerns over durability, pest resistance, and regulatory challenges persist, advancements in engineered timber products and improved forestry management practices offer promising solutions. By adopting policies that promote sustainable timber use, enhancing public awareness of its benefits, and incorporating modern treatment technologies, timber can significantly contribute to the development of affordable and eco-friendly housing solutions in Nigeria.

1.2 BACKGROUND OF THE STUDY

The demand for sustainable and affordable housing and buildings continues to rise globally due to rapid urbanization, population growth, and economic challenges. The construction industry, which heavily relies on conventional materials such as concrete and steel, contributes significantly to carbon emissions, environmental degradation, and rising housing costs (Churkina *et al.,* 2020). To address these issues, many countries are turning to renewable and eco-friendly building materials like timber, which offers economic, environmental, and structural benefits for housing and building construction (Wells, 2019).

Timber has long been recognized as a viable construction material due to its durability, thermal efficiency, and aesthetic appeal. Technological advancements, such as cross-laminated timber (CLT) and glue-laminated timber (glulam), have further enhanced its structural performance, making it suitable for both low-rise and high-rise buildings (Schmidt & Riggio, 2019). In developed countries like Canada, Sweden, and Japan, timber construction has gained significant traction, demonstrating its potential for sustainable housing development (Robertson *et al.,* 2021). Economically, timber presents a cost-effective alternative to conventional materials,

particularly in regions where it is locally available. Research indicates that timber-based housing projects can reduce construction costs by up to 20% compared to cement and steel-based structures (Adebiyi *et al.,* 2018). This cost-effectiveness is crucial in developing economies like Nigeria, where a substantial portion of the population struggles with housing affordability (World Bank, 2022). The lightweight nature of timber reduces transportation and foundation costs, further enhancing its economic viability, particularly in resource-constrained settings (Ogunsanmi & Ajayi, 2021).

Despite its advantages, the adoption of timber for large-scale urban housing in Nigeria faces multiple challenges. Cultural perceptions associating timber with low-income and temporary housing remain prevalent, limiting its acceptance among urban populations (Adedeji, 2019). Concerns regarding durability, susceptibility to termite infestation, and fire resistance have also hindered widespread application, despite advancements in timber treatment technologies that significantly enhance its longevity and resistance to environmental factors (Liew *et al.,* 2018). Furthermore, weak regulatory frameworks and the lack of standardized building codes for timber structures contribute to scepticism among developers and policymakers (Federal Ministry of Environment, 2020). In Benin City, Edo State, timber is a widely available resource, owing to the region's location within Nigeria's rainforest belt. Major timber-producing areas such as Okomu, Owan, and Uromi supply high-quality hardwood species, including Iroko (*Milicia excelsa*), Mahogany (Khaya spp.), and Obeche (*Triplochiton scleroxylon*), which are well-suited for construction purposes (Obisesan *et al.,* 2021). However, the lack of sustainable forestry management practices has led to concerns over deforestation and timber shortages, necessitating policy interventions to promote responsible sourcing and reforestation efforts (Gbadamosi & Adeyemi, 2022).

The integration of timber into housing and building construction aligns with Nigeria's broader objectives for sustainable development and climate action. Policies that promote sustainable forestry, coupled with awareness campaigns to shift public perception, can support timber-based housing initiatives in Benin City and beyond (Federal Ministry of Environment, 2020). By addressing technical, cultural, and economic barriers, timber can emerge as a viable solution for affordable and environmentally responsible housing development in Nigeria.

1.3 STATEMENT OF RESEARCH PROBLEM

The housing and building construction sector in Nigeria faces a critical challenge, with an estimated deficit exceeding 22 million units, primarily affecting urban centres like Benin City (National Bureau of Statistics, 2023). Rising construction costs, dependence on conventional materials such as concrete and steel, and environmental concerns have further exacerbated the affordability crisis (Federal Ministry of Works, 2023). These materials not only increase building expenses but also contribute significantly to carbon emissions, highlighting the need for more sustainable alternatives (Adebayo *et al.*, 2023). Timber, as a renewable and cost-effective building material, offers the potential for addressing both affordability and sustainability in housing and general construction. However, its adoption in Benin City remains limited due to concerns over durability, fire resistance, and cultural perceptions that associate timber with temporary or low-cost housing (Owoeye & Popoola, 2023). While studies suggest that timber construction can reduce building costs by up to 30% (Adebiyi *et al.*, 2023) and support eco-friendly development (Nwosu *et al.*, 2023), there is insufficient research on its large-scale feasibility within the context of Benin City's housing and building sector.

This study seeks to bridge this gap by examining timber's role in sustainable and affordable housing and general construction. It will explore economic, environmental, and technical considerations, identify challenges to its widespread adoption, and propose strategies for integrating timber into modern construction practices. The findings will offer valuable insights for architects, developers, and policymakers in advancing sustainable building solutions in Benin City.

1.4 RESEARCH QUESTIONS

The study aims to explore the potential of timber as a material for sustainable and affordable housing and building construction in Benin City, Edo State. To address the research objectives and fill the identified gaps in knowledge, the following research questions have been formulated:

1. What are the environmental benefits of using timber for housing and building construction in Benin City?
2. What are the socio-economic barriers to adopting timber in construction in Benin City?
3. How does timber compare to concrete and steel in terms of cost-effectiveness?

4. What technical challenges limit timber's use in modern construction?
5. How can timber contribute to urban development?

1.5 AIM AND OBJECTIVES OF THE STUDY

The main aim of this research is to assess the feasibility of timber as a sustainable and cost-effective building material for housing and general construction in Benin City. To achieve this aim, the following objectives have been developed:

1. Evaluate the environmental benefits of timber as a primary construction material in Benin City.
2. Identify the socio-economic barriers to adopting timber in urban housing and general construction.
3. To analyze the cost-effectiveness of timber compared to conventional building materials like concrete and steel.
4. To examine the technical challenges and limitations of using timber in building construction.
5. To explore timber's potential to enhance urban development in Benin City.

1.6 JUSTIFICATION FOR THE STUDY

The increasing demand for affordable and sustainable housing and building construction in Benin City, Edo State, highlights the urgent need for alternative building solutions. Conventional materials such as concrete and steel contribute to high construction costs and environmental degradation, making housing less accessible to low- and middle-income earners. As an abundant and renewable resource, timber offers a viable solution that balances affordability, environmental sustainability, and local economic benefits. However, its potential remains underexplored in Nigeria's urban construction sector, necessitating further research. This study is significant for several reasons. First, it aligns with Nigeria's sustainability goals by investigating timber as an alternative construction material capable of reducing carbon emissions and promoting energy-efficient building practices. Research indicates that timber-based construction can reduce carbon footprints by up to 20% compared to conventional methods (Oluwole & Adebayo, 2024). Additionally, utilizing timber in Benin City, where forests are a major resource, could lower transportation costs and encourage local industry growth.

Second, timber construction presents an opportunity to enhance housing affordability.

Studies have shown that timber-based housing can reduce building costs by up to 30%, making it a cost-effective solution for addressing Nigeria's growing housing deficit (Adebiyi *et al.*, 2023). Given that Benin City faces increasing urbanization and rising housing demand, integrating timber into mainstream construction could provide economically viable housing solutions for the city's residents. Furthermore, this research is crucial for addressing the barriers to timber adoption in Nigeria's construction industry. Negative perceptions regarding durability, fire resistance, and susceptibility to pests continue to hinder its widespread use (Adedeji, 2022). By examining these concerns and assessing modern treatment and engineering techniques, this study aims to provide practical recommendations for overcoming these challenges.

Finally, this research will contribute valuable insights to policymakers, urban planners, architects, and construction professionals, offering evidence-based strategies for incorporating timber into sustainable building practices. By filling this knowledge gap, the study will support the development of policies and frameworks that promote timber as a sustainable and affordable building material, benefiting both Benin City and other urban centres across Nigeria.

1.7 THE STUDY AREA

This study focuses on Benin City, the capital of Edo State in southern Nigeria. As one of the country's major urban centres, Benin City plays a critical role in regional economic, political, and cultural activities. Its rapid population growth and increasing urbanization have led to significant housing challenges, including a rising demand for both residential and non-residential buildings. Benin City spans approximately 1,204 square kilometres and lies within the tropical rainforest zone, experiencing a humid climate with distinct wet and dry seasons. The city's built environment consists of a mix of modern structures, traditional buildings, and informal settlements. Despite its expanding urban landscape, the predominant use of conventional construction materials—such as concrete, steel, and clay bricks—limits the adoption of sustainable alternatives like timber. However, with increasing pressure on the housing sector and the environment, interest in sustainable construction methods is growing. With a population exceeding 1.5 million, Benin City faces a severe housing deficit, exacerbated by rapid urban migration and inadequate infrastructure. Many residents, particularly low- and middle-income groups, live in overcrowded or substandard

housing due to high construction costs and limited access to financing. Informal settlements on the city's outskirts continue to expand, often lacking basic services like water, sanitation, and electricity. Addressing these issues requires exploring cost-effective and sustainable building materials such as timber. In summary, Benin City's housing and infrastructure challenges present an opportunity to explore timber as a sustainable and cost-effective alternative for residential and non-residential buildings. This research aims to provide insights that could support its broader adoption within the city's evolving built environment.

1.8 SCOPE OF THE STUDY

This study examines the application of timber as a sustainable and cost-effective material for housing and building construction in Benin City, Edo State. It explores the material's environmental, economic, technical, and socio-cultural implications while assessing regulatory frameworks that influence its adoption. The research covers both residential and non-residential buildings, evaluating timber's performance in comparison to conventional materials such as concrete and steel. The geographic focus is Benin City, considering factors like local climate conditions, material availability, and construction practices. The findings will inform architects, policymakers, and industry stakeholders on the feasibility of integrating timber into urban development strategies.

1.9 LIMITATION OF THE RESEARCH

While this study aims to provide a comprehensive analysis of timber as a sustainable and affordable material for both housing and general building construction in Benin City, certain limitations impacted the research process:

- **Limited data availability**

  A significant challenge was the scarcity of reliable, up-to-date data on timber usage in building construction. Government records, industry reports, and academic studies on timber construction in Benin City were either limited or not publicly accessible, making it difficult to obtain precise figures on material costs, adoption rates, and environmental impacts. As a result, the study relied heavily on secondary sources and expert opinions.

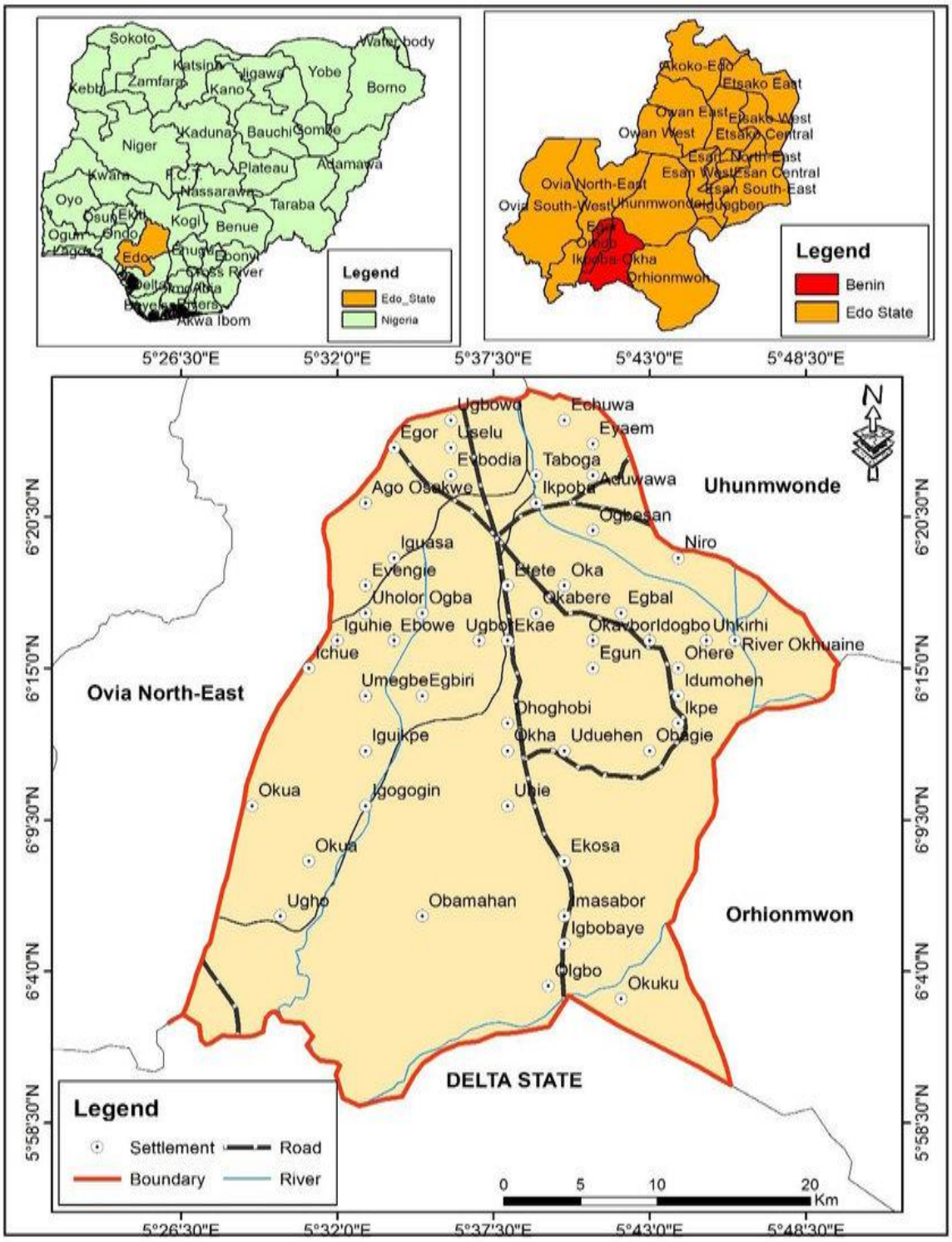

Figure 1: Map of Benin City
Source: Research Gate

- **Time constraints**

The research was conducted within a limited timeframe, restricting the ability to carry out extensive field studies or long-term observations. A longer study period could have allowed for more in-depth interviews, case studies, and site visits to assess existing timber-based projects.

- **Financial and logistical limitations**

  Conducting comprehensive surveys and site assessments required financial resources and logistical support, which were not readily available. This limited the ability to gather primary data directly from builders, homeowners, and timber suppliers, making the study more dependent on literature reviews and expert interviews.

- **Limited awareness and public perception**

  Many people still perceive timber as a less durable or temporary material, particularly in urban areas like Benin City. This cultural preference for concrete and steel made it difficult to gather widespread public opinions and real-world case studies of timber-based structures. Despite these limitations, the study provides valuable insights into the opportunities and challenges of using timber for sustainable and affordable building construction in Benin City.

CHAPTER TWO

2.0 REVIEW OF LITERATURE

2.1 THEORETICAL FRAMEWORK OF RESEARCH

A theoretical framework provides the foundation for a research study by integrating established theories that support its objectives. This research explores timber as a sustainable and affordable construction material in Benin City, Edo State, Nigeria. To establish a strong theoretical grounding, six relevant theories are examined, each addressing a specific aspect of the study: environmental benefits, socio-economic barriers, cost-effectiveness, technical challenges, and timber's role in sustainable urban development. These theories help contextualize the study within broader academic discussions on sustainability, construction economics, and material adoption in urban housing.

2.1.1 Ecological Modernization Theory

The Ecological Modernization Theory (EMT), initially introduced by Huber (1982) and further developed by Mol & Spaargaren (2000), proposes that economic growth and environmental sustainability are not mutually exclusive but can be achieved simultaneously through technological innovation and sustainable practices. This theory is particularly relevant to the use of timber in construction, as it emphasizes how the adoption of innovative, eco-friendly materials can mitigate environmental degradation while supporting urbanization and economic development. Timber, especially in its engineered forms such as cross-laminated timber (CLT) and laminated veneer lumber (LVL), exemplifies the principles of EMT by providing a low-carbon alternative to traditional building materials like concrete and steel. According to research by Churkina *et al*. (2020), timber can sequester carbon dioxide, significantly reducing greenhouse gas emissions throughout its lifecycle. Moreover, the energy required to produce timber products is considerably lower compared to the energy-intensive processes involved in manufacturing cement and steel, further enhancing timber's ecological advantages (Zhao *et al.*, 2023).

Incorporating timber into urban housing strategies presents an opportunity for cities such as Benin City to lower their overall carbon footprint while advancing sustainable development goals. Through the lens of Ecological Modernization Theory, the promotion of timber use in the building industry reflects a practical pathway toward achieving environmental sustainability without hindering economic or urban growth.

2.1.2 Theory of Planned Behavior

The Theory of Planned Behavior (TPB), developed by Ajzen (1991), provides a framework for understanding how human behaviour is influenced by individual attitudes, perceived social pressures (subjective norms), and perceived behavioural control. This theory is particularly useful for analyzing the socio-economic barriers to the adoption of timber in urban construction, where material choices are often driven by a combination of personal beliefs, societal expectations, and perceived ease or difficulty of usage. In the context of Benin City, attitudes toward timber are influenced by deep-rooted preferences for more conventional materials such as concrete and steel, which are often regarded as more prestigious, durable, and reliable (Adebiyi *et al.,* 2023). Subjective norms further reinforce these preferences, as architects, builders, and homeowners are inclined to conform to established construction trends that favour masonry and steel (Owoeye & Popoola, 2023). Furthermore, perceived behavioural control—defined by factors such as limited public awareness, shortage of skilled timber construction workers, and persistent fears of issues like termite infestation—plays a significant role in deterring individuals from choosing timber as a building material.

According to the TPB, overcoming these socioeconomic barriers requires targeted interventions that shift attitudes, reshape societal norms, and enhance perceived control. Strategies such as public education campaigns, government policy incentives, professional training programs, and the promotion of successful timber construction projects could significantly improve public perception and acceptance of timber, paving the way for its broader adoption in the urban construction sector.

2.1.3 Resource-Based View (RBV) Theory

The Resource-Based View (RBV) Theory, proposed by Wernerfelt (1984), argues that organizations and industries can achieve a competitive advantage by effectively utilizing valuable, rare, and cost-efficient resources. Applied to the field of residential construction, this theory provides a strong rationale for the promotion of timber as a strategic material choice, particularly in regions where it is readily available, such as Benin City. Timber's local abundance in Benin City presents a significant economic advantage over materials like concrete and steel, which are often more expensive and, in many cases, dependent on imported inputs. Adebiyi *et al.*, 2023 notes that timber requires significantly less energy for processing and transportation compared to the

high-energy demands associated with the production and distribution of concrete and steel. This not only reduces the environmental footprint of construction but also directly lowers overall building costs.

Moreover, advancements in engineered timber products, such as cross-laminated timber (CLT) and glulam, have enhanced timber's durability, structural performance, and cost-efficiency, making it an increasingly viable and attractive option for modern construction (Zhao *et al.,* 2023). From an RBV perspective, the effective use of timber as a locally sourced and cost-effective material can contribute significantly to reducing housing costs and promoting affordable housing development in Benin City. Thus, timber's strategic value aligns well with the objectives of sustainable urban growth and economic resilience.

2.1.4 Systems Theory

The Systems Theory, introduced by Bertalanffy (1968), conceptualizes construction projects as complex, interconnected systems composed of various interdependent elements, including materials, design processes, labour, and environmental factors. When applied to timber construction, this theoretical lens offers valuable insight into the technical challenges that impede the widespread adoption of timber for urban housing development.

Timber structures, while offering significant sustainability benefits, face technical obstacles such as moisture sensitivity, termite susceptibility, and fire resistance concerns (Adedeji, 2022). These vulnerabilities can compromise the durability and safety of timber buildings, particularly in humid tropical climates like that of Benin City. Furthermore, the use of modern engineered timber products such as cross-laminated timber (CLT) and laminated veneer lumber (LVL) demands specialized skills, technology, and machinery that are not yet widely available within the local construction industry. Owoeye & Popoola (2023) also highlight that gaps in expertise, inadequate or outdated building codes, and insufficient investment in timber-processing industries exacerbate the technical challenges facing timber construction. From a Systems Theory perspective, these issues are not isolated but interconnected, requiring a holistic and coordinated approach to address them effectively. Strategic actions such as updating building regulations, investing in technical training programs, promoting research and innovation, and supporting the growth of local timber-processing industries are critical to optimizing timber's potential in the

construction sector.

2.1.5 Sustainable Development Theory

The Sustainable Development Theory, introduced by the Brundtland Commission (1987), emphasizes the importance of meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. This theory provides a critical framework for evaluating timber's long-term potential in urban housing development, focusing on environmental, economic, and social dimensions of sustainability. Timber supports sustainable development goals by significantly reducing carbon emissions, promoting the construction of energy-efficient buildings, and encouraging renewable resource cycles (Adebiyi *et al.,* 2023). Its use in construction contributes to environmental sustainability by sequestering carbon throughout the material's lifecycle, thereby mitigating the impacts of climate change. Economically, the timber industry creates local employment opportunities in areas such as forestry, processing, carpentry, and construction, enhancing economic resilience and community development in Benin City (Nwosu *et al.,* 2023).

Moreover, promoting responsible forestry practices and incorporating timber into sustainable urban planning can facilitate the creation of resilient and environmentally friendly cities. By balancing environmental conservation with economic growth and social well-being, timber emerges as a crucial material in advancing sustainable urban growth strategies for the future.

2.1.6 Environmental Sustainability Theory

The Environmental Sustainability Theory, introduced by Goodland (1995), highlights the importance of preserving natural resources and minimizing environmental degradation to ensure the well-being of future generations. Within the context of construction, timber stands out as a material that embodies the principles of this theory. As a renewable resource, timber offers significant environmental advantages by sequestering carbon, reducing construction waste, and fostering circular economic practices (Gamage *et al.,* 2022). Research has demonstrated that when forests are managed responsibly, they can continuously supply timber without leading to ecosystem depletion (Zhao *et al.,* 2023). Sustainable forest management practices, such as selective logging, replanting, and conservation planning, ensure that timber remains a viable material over the long term without compromising biodiversity. Furthermore, the use of prefabricated timber components in construction processes

minimizes on-site waste, speeds up project timelines, and reduces the carbon footprint typically associated with conventional building methods. The Environmental Sustainability Theory, therefore, reinforces the argument that timber is not only a practical and affordable building material but also a strategic tool in global efforts to combat climate change. By promoting timber usage within sustainable frameworks, the construction industry can contribute meaningfully to environmental preservation while addressing the urgent need for affordable and eco-friendly housing solutions.

The theoretical framework provides a structured foundation for understanding the key aspects of timber adoption in urban construction. The Ecological Modernization Theory highlights timber's environmental benefits, while the Theory of Planned Behavior explains socio-economic barriers. The Resource-Based View (RBV) Theory supports timber's cost-effectiveness, and the Systems Theory addresses technical challenges. The Sustainable Development Theory emphasizes timber's role in urban sustainability, while the Environmental Sustainability Theory reinforces its long-term ecological benefits.

2.2 CONCEPTUAL FRAMEWORK

The conceptual framework of this study establishes the relationship between timber as primary construction material and its potential to address the challenges of sustainable and affordable housing in Benin City, Edo State. This framework is built upon the research objectives outlined in Chapter One and integrates insights from the theoretical frameworks discussed earlier. It examines how key variables—environmental benefits, socio-economic barriers, cost-effectiveness, technical challenges, and sustainable urban development—interact to influence the adoption of timber for housing and general building construction. This framework positions timber as the independent variable, while the dependent variables include affordability, sustainability, and the feasibility of large-scale adoption. Intervening variables such as government policies, cultural perceptions, and technological innovations mediate the relationship between timber and its potential role in transforming Benin City's housing sector. The framework underscores how these interrelated factors shape the feasibility of timber as a construction material in the region.

2.2.1 Environmental Benefits of Timber in Construction

Timber provides significant environmental benefits, making it a vital material in the global shift toward sustainable building practices. As a renewable resource, timber plays an important role in carbon sequestration, helping to reduce greenhouse gas emissions typically associated with conventional materials like concrete and steel (Adebiyi *et al*., 2023). Unlike energy-intensive materials, timber requires comparatively less energy for processing, manufacturing, and construction, positioning it as an environmentally responsible alternative in the building industry (Zhao *et al*., 2023). In the specific context of Benin City, incorporating timber into housing and building construction can contribute to a lower urban carbon footprint. It also promotes ecological balance by encouraging sustainable forestry practices, which in turn help mitigate deforestation (Owoeye & Popoola, 2023). Through responsible timber sourcing and usage, the city can advance its goals for sustainable urban development while addressing critical environmental issues such as resource depletion and climate change. This framework underscores timber's potential to serve both immediate construction needs and long-term environmental sustainability objectives.

2.2.2 Socio-Economic Barriers and Adoption Challenges

The widespread adoption of timber for urban housing and general construction in Benin City is shaped by several socio-economic factors. A significant barrier is the entrenched cultural preference for concrete and brick structures, which are often viewed as more durable and prestigious compared to timber (Adedeji, 2022). This perception is reinforced by existing societal norms and practices that favour traditional materials over newer, sustainable alternatives. Government policies and building regulations further complicate the situation, as they do not adequately promote or support timber as a primary construction material, thereby limiting its potential for large-scale use (Nwosu *et al*., 2023). Economic considerations also influence adoption rates. Fluctuations in timber prices, limited public awareness of timber's long-term environmental and economic benefits and inadequate investment in sustainable forestry practices all present significant obstacles (Ogunbode *et al*., 2023). This framework conceptualizes these socioeconomic barriers as critical intervening variables that must be addressed to enable broader acceptance. Effective strategies could include public awareness campaigns, policy reforms, and financial incentives aimed at encouraging timber-based housing initiatives in Benin City.

2.2.3 Cost-Effectiveness and Comparative Analysis

Cost remains a critical determinant in the selection of materials for construction projects. When compared to concrete and steel, timber is generally more affordable due to its lower processing costs, local availability, and the relative ease of construction it offers (Zhao *et al*., 2023). These factors position timber as an attractive option for builders and developers seeking cost-efficient solutions, especially in emerging urban areas like Benin City. However, the widespread adoption of timber is hampered by perceptions that it incurs higher maintenance costs and has a shorter lifespan compared to conventional materials (Adebiyi *et al*., 2023). These concerns, whether based on actual performance or on long-standing biases, influence material choice and slow the shift towards timber use.

This conceptual framework critically examines timber's financial viability by comparing its initial costs, maintenance requirements, and life-cycle performance with those of traditional materials. It positions timber as a cost-effective alternative for affordable housing and sustainable urban development, provided that strategic investments are made in protective treatments, the use of engineered timber products, and the adoption of innovative construction techniques (Owoeye & Popoola, 2023).

2.2.4 Technical Challenges and Mitigation Strategies

Despite its numerous advantages, timber faces several technical limitations in building construction. Key challenges include susceptibility to termites, vulnerability to moisture, fire hazards, and structural weaknesses, particularly in large-scale applications (Nwosu *et al*., 2023). In Benin City, traditional construction practices have not yet fully integrated advanced timber treatment techniques, engineered wood products, or a fire-resistant coating, which has led to persistent concerns regarding the durability and safety of timber structures (Ogunbode *et al*., 2023).

To address these challenges, this conceptual framework incorporates technological advancements aimed at enhancing timber's performance. Solutions include the use of engineered timber products such as cross-laminated timber (CLT) and glued laminated timber (glulam), which significantly improve strength and durability. The application of fire-retardant and moisture-resistant treatments further extends the longevity of timber structures and mitigates safety risks. Additionally, modern construction techniques, including prefabrication and hybrid systems that combine

timber with other materials, optimize structural performance and reliability. By adopting these innovative strategies, timber can overcome its technical constraints and position itself as a competitive alternative to conventional construction materials in urban housing and general building projects.

2.2.5 Timber Housing and Sustainable Urban Development

Timber-based construction has the potential to drive sustainable urban development by balancing environmental, economic, and social considerations. As cities like Benin City face increasing housing shortages, rising construction costs, and mounting environmental degradation, timber emerges as a low-carbon, cost-effective, and adaptable alternative for large-scale urban development (Kennedy *et al*., 2011). This conceptual framework positions timber as a pivotal material for promoting green buildings, energy-efficient housing, and climate-resilient infrastructure. It underscores the critical role of government support, sustainable forestry initiatives, and research-driven innovations in establishing timber as a viable and mainstream construction solution. By integrating timber into the architectural fabric of Benin City, policymakers and developers can simultaneously enhance housing affordability, promote resource efficiency, and advance environmental sustainability (Nwosu *et al*., 2023).

This conceptual framework also bridges the gap between timber's potential and practical implementation in urban housing and general construction in Benin City. By integrating environmental, economic, social, and technical factors, the framework provides a structured approach to analyzing how timber can contribute to sustainable and affordable housing solutions. It also highlights the need for policy support, public awareness, and technological investments to ensure timber's successful adoption in the region.

2.3 LITERATURE REVIEW

The use of timber as a primary construction material has gained global attention due to its sustainability, affordability, and environmental benefits. In Benin City, the housing sector faces challenges such as high construction costs, unsustainable building materials, and limited adoption of timber. This chapter reviews existing literature on timber's role in sustainable and affordable housing, addressing key themes such as environmental benefits, socio-economic barriers, cost-effectiveness,

technical challenges, and its potential for sustainable urban development. The review identifies research gaps and provides a foundation for the study.

2.3.1 Environmental Benefits of Timber in Construction

Timber is widely recognized for its low carbon footprint and sustainability, positioning it as a viable alternative to conventional materials such as concrete and steel. Research shows that timber not only absorbs but also stores significant amounts of atmospheric carbon dioxide, thus contributing to the reduction of greenhouse gas emissions (Zhao *et al.,* 2023; Geng *et al.,* 2021). Moreover, the production of timber requires substantially less energy compared to the manufacturing processes involved in cement and steel, thereby minimizing overall environmental degradation (Adebiyi *et al.,* 2023; Gustavsson & Sathre, 2011).

Life cycle assessment (LCA) studies further support timber's ecological advantages by demonstrating that timber buildings exhibit considerably lower embodied carbon emissions across their entire lifespan (Owoeye & Popoola, 2023; Churkina *et al.,* 2020). The adoption of sustainable forestry practices, which promote continuous regeneration of timber resources, reinforces timber's status as a renewable material (Adedeji, 2022; Bribián *et al.,* 2011). Nevertheless, challenges such as deforestation and unsustainable logging practices pose significant risks that could undermine the environmental benefits attributed to timber (Nwosu *et al*., 2023; Köhl *et al*., 2015). Consequently, sourcing certified timber and implementing robust reforestation policies are essential strategies to ensure the maximum ecological advantage of timber-based construction.

2.3.2 Socio-Economic Barriers to Timber Adoption

Despite its numerous advantages, the adoption of timber in urban housing remains constrained by several socio-economic factors. Research indicates that cultural preferences for concrete and masonry structures have entrenched resistance to timber-based housing in Nigeria, where timber is often perceived as a material for temporary and less durable buildings (Adedeji, 2022; Arumala & Gondal, 2007). This perception significantly lowers the acceptance rate of timber structures among prospective homeowners and developers (Nwosu *et al*., 2023). In addition to cultural biases, policy and regulatory frameworks have also hindered the large-scale adoption of timber. Adebiyi *et al*., 2023 points out the lack of targeted government incentives, weak building regulations supporting timber construction, and insufficient research

funding as critical institutional barriers.

Economic constraints further exacerbate the situation. Although timber can be a cost-effective material, price fluctuations and high import duties on engineered wood products often reduce its affordability and competitiveness in the local market (Zhao *et al*., 2023; Espinoza *et al*., 2016). Addressing these socioeconomic barriers necessitates a multifaceted approach that includes public awareness campaigns to shift cultural perceptions, comprehensive policy reforms to strengthen regulatory support for timber construction, and the provision of financial incentives to encourage the use of sustainable timber in urban housing projects (Owoeye & Popoola, 2023; Toppinen *et al*., 2018).

2.3.3 Cost-Effectiveness of Timber vs. Conventional Materials

Cost-effectiveness remains one of the primary justifications for promoting timber as a viable construction material. Timber is generally cheaper to source and process compared to conventional materials such as concrete and steel, particularly when locally available (Zhao *et al*., 2023; Mahapatra & Gustavsson, 2008). Adedeji (2022) reports that timber-based housing projects in certain regions of Nigeria recorded up to 30% lower construction costs compared to equivalent concrete structures.

Additionally, timber structures demand less energy for fabrication and transportation, further contributing to reduced overall building costs (Owoeye & Popoola, 2023; Mallo & Espinoza, 2015). However, the extent of timber's cost advantage is influenced by several variables, including timber availability, government-imposed tariffs, and the level of technological investment in engineered wood products (Nwosu *et al*., 2023; Bribian *et al*., 2011). When sustainably managed and strategically sourced, timber offers a promising pathway to affordable urban housing solutions, particularly in rapidly expanding cities like Benin City. Nevertheless, economic evaluations must also consider challenges such as fire risks, susceptibility to degradation, and potential long-term maintenance costs (Adebiyi *et al*., 2023; de Araujo *et al*., 2020). Recent innovations in treated timber and the adoption of advanced engineered wood products provide effective mitigation strategies, enhancing timber's durability while preserving its cost-effectiveness.

2.3.4 Technical Challenges and Innovations in Timber Construction

Technical limitations remain a significant concern in timber-based housing,

particularly in terms of durability, fire resistance, and structural performance. Timber is inherently susceptible to issues such as termite infestations, rot, and moisture damage, which can undermine the longevity of buildings (Owoeye & Popoola, 2023; Jones *et al*., 2021). However, recent advancements in pressure-treated timber, chemical preservatives, and engineered wood products have greatly improved the material's resilience and extended its service life (Zhao *et al*., 2023; Espinoza *et al*., 2016).

One of the most pressing concerns with timber is its fire safety. Untreated timber is highly flammable, which has historically limited its use in certain construction sectors. However, fire-retardant treatments and the use of cross-laminated timber (CLT) have been shown to significantly enhance fire resistance, ensuring timber buildings meet safety standards (Adedeji, 2022; Winter *et al*., 2022). Furthermore, CLT has been successfully employed in high-rise construction in Europe and North America, demonstrating its potential for large-scale and diverse applications (Nwosu *et al*., 2023; Buchanan, 2019). Additionally, the use of prefabricated timber components has improved construction efficiency by reducing waste, minimizing labour costs, and shortening build times (Adebiyi *et al*., 2023; Toppinen *et al*., 2018). These technological advancements emphasize the technical feasibility of timber construction and suggest that with the right treatment and adherence to design standards, timber can serve as a sustainable and practical material for urban housing development.

2.3.5 Timber and Sustainable Urban Development

Timber plays a pivotal role in achieving sustainable urban development goals, particularly in addressing housing shortages and mitigating environmental concerns (Zhao *et al*., 2023; Pomponi *et al*., 2020). Compared to conventional materials like concrete and steel, timber-based construction reduces resource depletion, enhances energy efficiency, and promotes green architecture, contributing to environmentally friendly urbanization (Adebiyi *et al*., 2023; Ramage *et al*., 2017).

Moreover, locally sourced timber can create employment opportunities in forestry, carpentry, and timber processing industries, which in turn stimulates economic growth in regions such as Benin City (Owoeye & Popoola, 2023; Mallo & Espinoza, 2015). Policies aimed at promoting urban reforestation and sustainable timber harvesting can further amplify these economic benefits, creating a positive cycle of local

development (Nwosu *et al*., 2023; Gustavsson & Sathre, 2011). Globally, the integration of timber housing within affordable housing programs has shown success, particularly in Scandinavian and North American cities, where timber-based construction has become a mainstream alternative (Adedeji, 2022; Buchanan, 2019). These examples provide valuable insights into how Benin City can adopt similar strategies to improve urban sustainability and tackle the issue of housing shortages. However, scaling up the use of timber for construction on a large scale requires strong government intervention, policy support, and substantial infrastructure development (Zhao *et al*., 2023; Toppinen *et al*., 2018). Additionally, research suggests that sustainable timber construction should be complemented by circular economy strategies, such as the recycling of timber waste for energy production, to maximize its contribution to sustainable urban development (Adebiyi *et al*., 2023).

Existing research has extensively explored timber's environmental and economic benefits, yet there is limited empirical research on its large-scale adoption in urban Nigeria (Owoeye & Popoola, 2023). Additionally, most studies focus on global case studies, with few localized studies addressing the unique challenges in Benin City (Nwosu *et al*., 2023). This study will analyze timber's feasibility in Benin City, considering local socio-economic, environmental, and technical factors, providing insights for policymakers, architects, and construction workers.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 INTRODUCTION

The research methodology chapter outlines the systematic approach adopted to investigate the use of timber as a sustainable and affordable building material in Benin City, Edo State. This study employs a qualitative research approach, leveraging surveys and case studies to gather insights from various stakeholders, including residents, construction professionals, and other relevant participants. The research aims to explore the environmental benefits, socio-economic barriers, cost-effectiveness, technical challenges, and overall impact of timber in fostering sustainable urban development. A qualitative research approach is suitable because it allows for an in-depth understanding of people's perceptions, experiences, and attitudes toward timber construction (Creswell & Poth, 2018). By utilizing surveys and case studies, the study gathers primary data directly from individuals who interact with or influence the adoption of timber in construction. Additionally, secondary data sources such as academic journals, reports, and policy documents provide contextual backing for the findings. This chapter details the research design, data sources, population and sampling framework, data collection techniques, and analytical methods. The inclusion of case studies strengthens the research by examining real-world applications of timber construction, providing practical insights into its feasibility in Benin City.

3.2 RESEARCH DESIGN/DATA TYPES AND SOURCES

The research design provides the framework for systematically conducting the study on timber as a sustainable and affordable building material in Benin City. This study adopts a qualitative research approach, focusing on descriptive and interpretative analysis of data gathered from primary and secondary sources. A qualitative approach is appropriate because it enables an in-depth exploration of people’s perceptions, challenges, and attitudes toward timber construction (Bryman, 2016). The study will employ surveys and case studies to obtain data from relevant stakeholders, such as residents and building professionals. The data collected will be categorized into two main types:

3.2.1 Primary Sources

Primary data will be collected through structured questionnaires, both online and

physical, to gain direct insights from the target population. The questionnaires will focus on: Perceptions of timber as a construction material, environmental benefits and sustainability of timber, cost-effectiveness compared to conventional materials, technical challenges and solutions for timber use, and timber's potential for urban development in Benin City. Additionally, two case studies will be conducted on existing timber-based housing projects or structures in Benin City to provide empirical evidence supporting the research findings.

3.2.2 Secondary Sources

Secondary data will be obtained from: Academic journals and books on timber construction and sustainability, government policies and reports on housing and construction regulations in Nigeria, industry reports from architectural and construction organizations, online databases, conference proceedings, and institutional research publications. These secondary sources will help contextualize the findings and support the arguments made in the study with existing literature.

3.3 RESEARCH POPULATION

The research population refers to the entire group of individuals from which the study will draw its sample. For this study, the research population consists of residents and stakeholders in the housing and construction sector within Benin City, Edo State, Nigeria. Benin City, as a major urban centre in southern Nigeria, has a diverse population engaged in various socio-economic activities, including construction and real estate development. The city's increasing demand for housing presents a relevant context for examining the adoption of timber as a sustainable and affordable building material (Nwosu *et al.*, 2023).

The target population for this research includes general residents of Benin City, such as homeowners, tenants, and individuals who regularly interact with buildings. It also involves construction professionals like architects, engineers, quantity surveyors, and building contractors who influence material selection and design. Additionally, the study targets skilled and unskilled labourers, including artisans, carpenters, and construction workers involved in both timber and conventional construction. Lastly, the research aims to assess the level of awareness and perception of timber construction among both educated and uneducated individuals across different social groups.

3.4 RESEARCH SAMPLE FRAME

The research sample frame represents a subset of the population from which the study's sample will be drawn. For this study, the sample frame consists of individuals aged 18 to 65 years residing in Benin City, Edo State, as this demographic is actively involved in housing decisions, construction, and material selection, either as homeowners, tenants, or construction professionals. Key groups within the sample frame include general residents (homeowners and tenants) who interact with buildings daily and can provide insights into their perceptions, preferences, and challenges regarding timber housing; construction professionals such as architects, engineers, quantity surveyors, and contractors, whose perspectives on the feasibility and sustainability of timber as a building material are crucial; building construction workers, including skilled and unskilled labourers like carpenters and masons, who have hands-on experience with various materials; and educated and uneducated individuals, ensuring that responses reflect diverse levels of awareness about timber construction. By focusing on this sample frame, the study will obtain a diverse and representative dataset that reflects the attitudes, challenges, and opportunities related to using timber for sustainable and affordable housing in Benin City.

3.5 RESEARCH SAMPLE SIZE

For this study, a total of 100 respondents will be selected as the sample size. This number is chosen to ensure a balanced representation of key stakeholders involved in the use, construction, and perception of timber as a building material in Benin City. The selection will follow a purposive sampling approach, ensuring a mix of residents (both homeowners and renters), construction professionals (such as architects, engineers, and builders), unskilled workers and craftsmen (e.g., carpenters), and policy stakeholders (where applicable). This sample size is sufficient to capture diverse opinions and experiences while remaining manageable for data collection and analysis. Data will be collected through both online and physical surveys, ensuring accessibility for all respondents.

3.6 RESEARCH DATA COLLECTION METHOD

Data collection for this study will be conducted through questionnaires, which will be administered both online and physically. The questionnaire will be designed to gather qualitative insights from respondents regarding their perceptions, experiences, and

knowledge of timber as a sustainable and affordable construction material in Benin City.

- **Questionnaire Design:** The questionnaire will include both open-ended and closed-ended questions. Closed-ended questions will help quantify responses, making it easier to analyze general trends and attitudes, while open-ended questions will allow respondents to provide detailed explanations, offering a richer understanding of the challenges, benefits, and feasibility of timber construction.
- **Distribution Methods:** The data collection will utilize both online and physical surveys to ensure broad participation. Online surveys will be distributed through Google Forms, social media platforms, and emails to reach a wide audience efficiently. Physical surveys will be conducted in selected neighbourhoods, construction sites, and local communities in Benin City, targeting individuals with limited access to online platforms. This dual approach will ensure diverse and representative responses, enhancing the validity of the study's findings.

3.7 METHOD OF DATA ANALYSIS

The data collected from the questionnaires will be analyzed using a qualitative approach, incorporating descriptive statistics and graphical representations like bar charts and pie charts to highlight trends and patterns in the responses. For the qualitative analysis, responses to open-ended questions will undergo thematic analysis, which involves reviewing all responses to identify key themes and patterns, coding and categorizing responses into meaningful categories such as environmental benefits, socio-economic barriers, cost-effectiveness, and technical challenges, and interpreting the findings by linking them to existing literature and theoretical frameworks to draw meaningful conclusions. Bar charts will be used to compare responses across different demographic groups (e.g., professionals vs. non-professionals), while pie charts will show percentage distributions of responses, such as the proportion of respondents favouring timber construction over conventional materials. This combined approach will make the research findings visually interpretable, facilitating the drawing of insightful conclusions and recommendations.

CHAPTER FOUR

4.0 ANALYSIS, FINDINGS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents an analysis of the data collected from a structured questionnaire designed to explore the potential of timber as a sustainable and affordable building material for housing and building construction in Benin City, Edo State, Nigeria.

The analysis covers respondents' demographic characteristics and delves into their opinions on timber usage across the research objectives, which are five primary thematic areas: environmental benefits, socio-economic barriers, cost-effectiveness, technical challenges, and timber's contribution to urban development. This chapter aims to provide insights into the public's awareness and perception of timber as a building material in Benin City, as well as to identify the factors influencing its adoption. The findings will help highlight both the potential and the obstacles to the widespread use of timber in local construction, offering a clearer picture of the current status of timber housing and its role in urban development.

4.2 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

This is the analysis of the demographic profile of the respondents who participated in the survey. Understanding the background of the participants is essential to interpreting the findings about the diverse experiences and perspectives within Benin City. The participants were diverse in age, gender, occupation, and education. About 64% of the respondents were male, and 36% were female. In terms of age, most were between 18 and 45 years old, with only a small number aged above 55. Occupations included students, architects, engineers, quantity surveyors, skilled workers, and traders. Most respondents had tertiary education, and many had lived in Benin City for over 10 years. This mix of backgrounds helped to give a well-rounded view of public opinion on timber usage in housing.

4.3 ANALYSIS, FINDINGS AND DISCUSSION

This section presents a detailed interpretation of the 25 opinion-based questions grouped under the research questions and objectives.

4.3.1 Research Question One: What are the Environmental Benefits of Using Timber as a Building Material in Benin City?

A. Timber to build houses

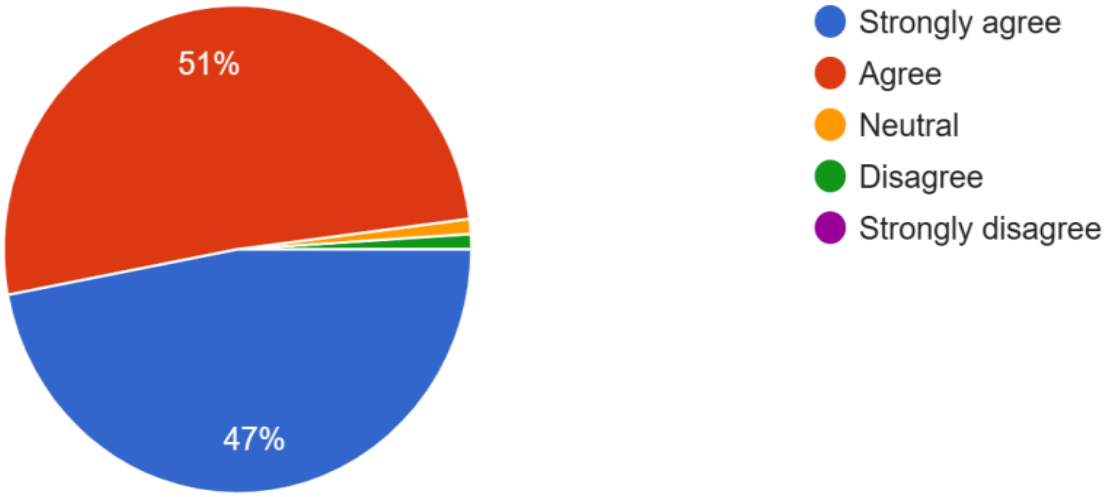

Figure 2: Respondents idea on awareness of using timber to build houses
Source: Researcher's fieldwork, 2025

The survey results indicate high public awareness of timber's environmental relevance. An overwhelming 98% of respondents acknowledged that timber can be used as a building material, and 80% believed its usage promotes environmental sustainability. However, when directly compared to cement blocks, only 58% affirmed timber as the more environmentally friendly option, while a significant 32% remained neutral. This suggests that although timber is seen positively, cement still holds dominance in environmental perception, possibly due to public misinformation or a lack of accessible case studies.

B. Wood for building

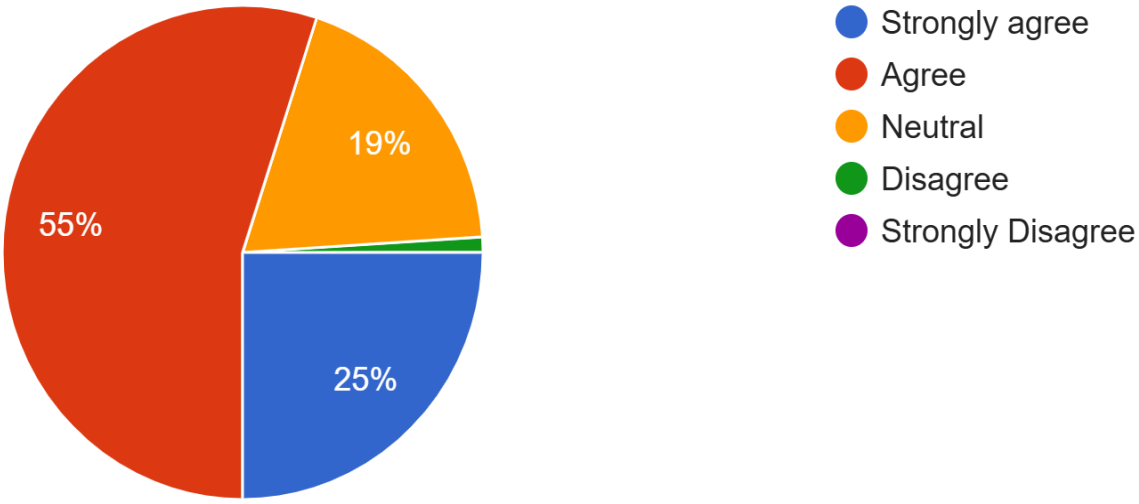

Figure 3: Respondents idea on the protection of the environment (building) with timber
Source: Researcher's fieldwork, 2025

Encouragingly, 91% agreed that felling trees for timber is acceptable if done sustainably, with a commitment to replanting. This strong agreement underscores a

growing awareness of eco-responsibility and sustainable forestry. On thermal performance, 65% affirmed that wood helps control indoor heat, while 31% remained undecided, pointing to a need for public education on timber's passive cooling benefits in tropical climates.

C. Wood for building

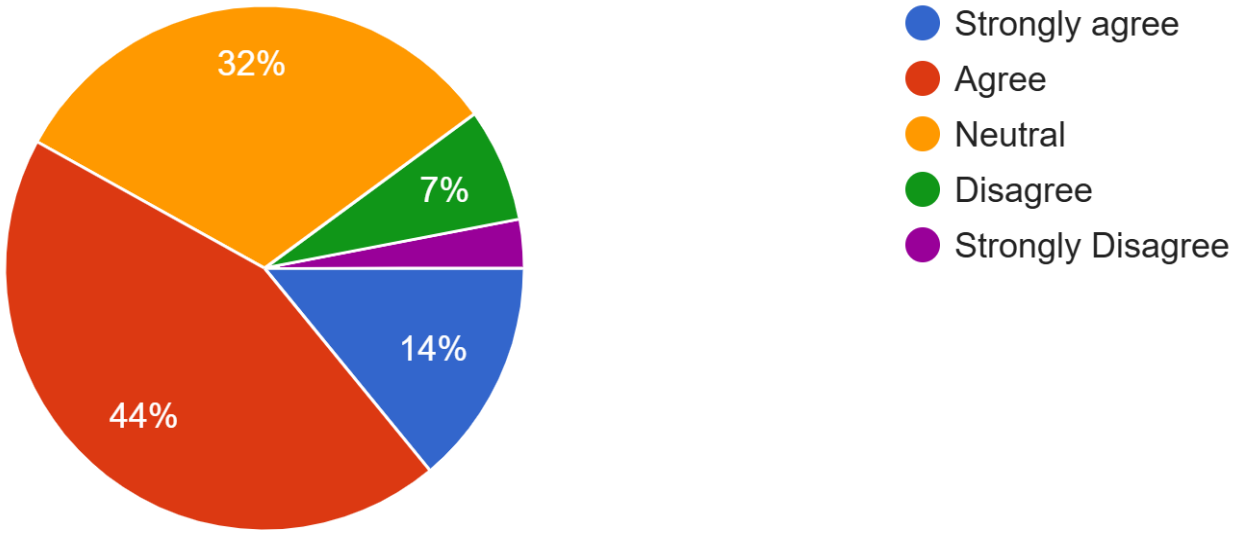

Figure 4: Respondents idea on timber as a better building material to cements and blocks
Source: Researcher's fieldwork, 2025

D. Building purposes

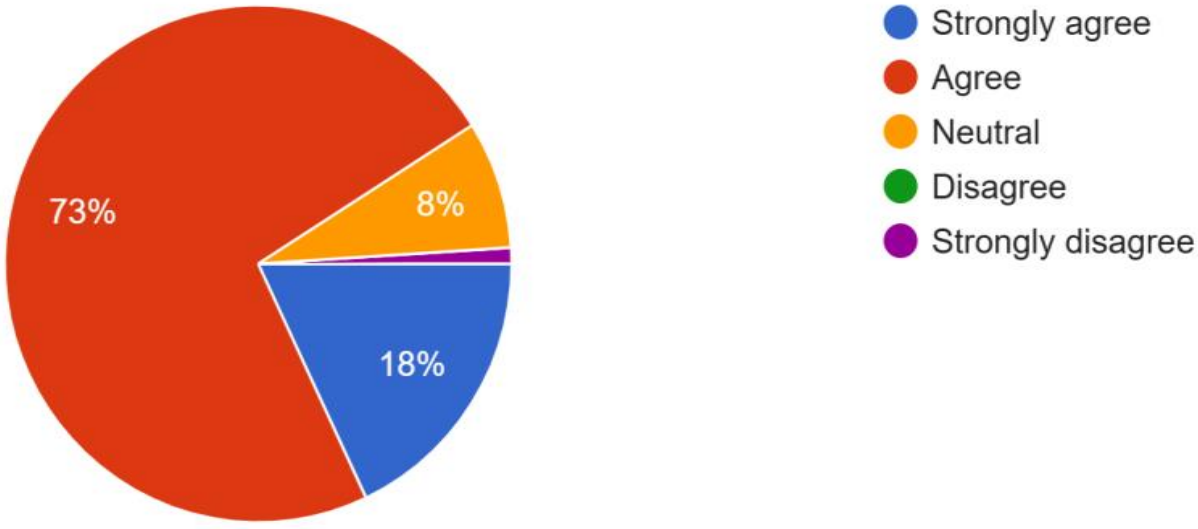

Figure 5: Respondents idea on trees if only they can be replanted
Source: Researcher's fieldwork, 2025

Therefore, the general sentiment reflects strong support for timber as an environmentally sustainable material. However, comparisons with conventional materials like cement still face scepticism, warranting targeted awareness campaigns.

E. Heat control

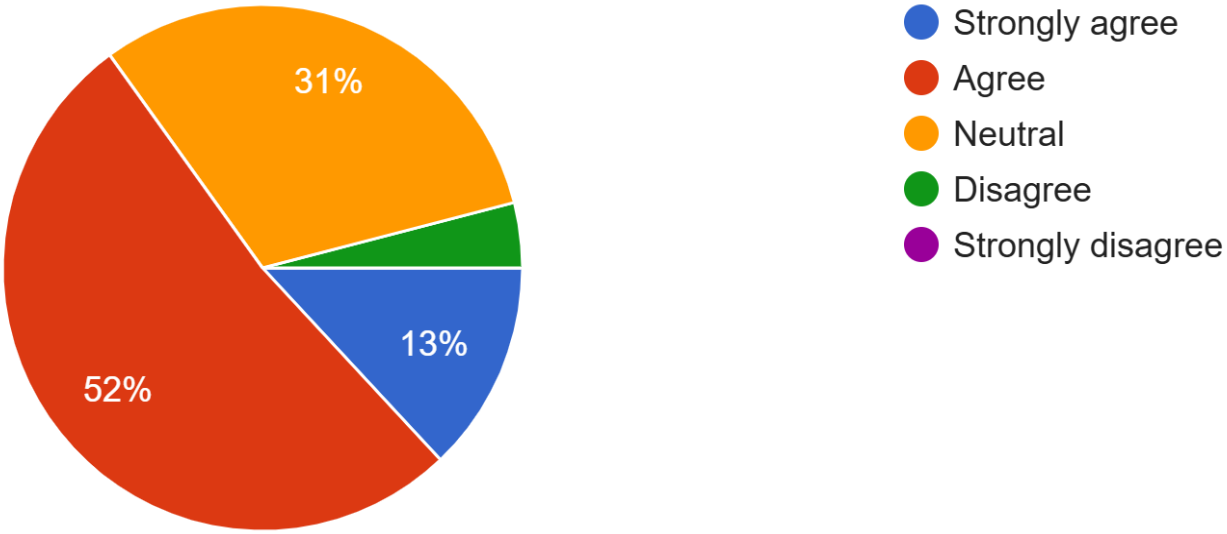

Figure 6: Respondents awareness on heat control with timber
Source: Researcher's fieldwork, 2025

4.3.2 Research Question Two: What are the Socio-Economic Barriers to the Use of Timber in Housing and Building Construction in Benin City?

The socio-economic perception of timber buildings revealed mixed responses. While 40% of respondents were willing to live in timber houses, a close 34% remained neutral, and 26% expressed reluctance. This indicates lingering reservations, likely tied to durability, cultural preferences, or unfamiliarity.

A. House made of wood

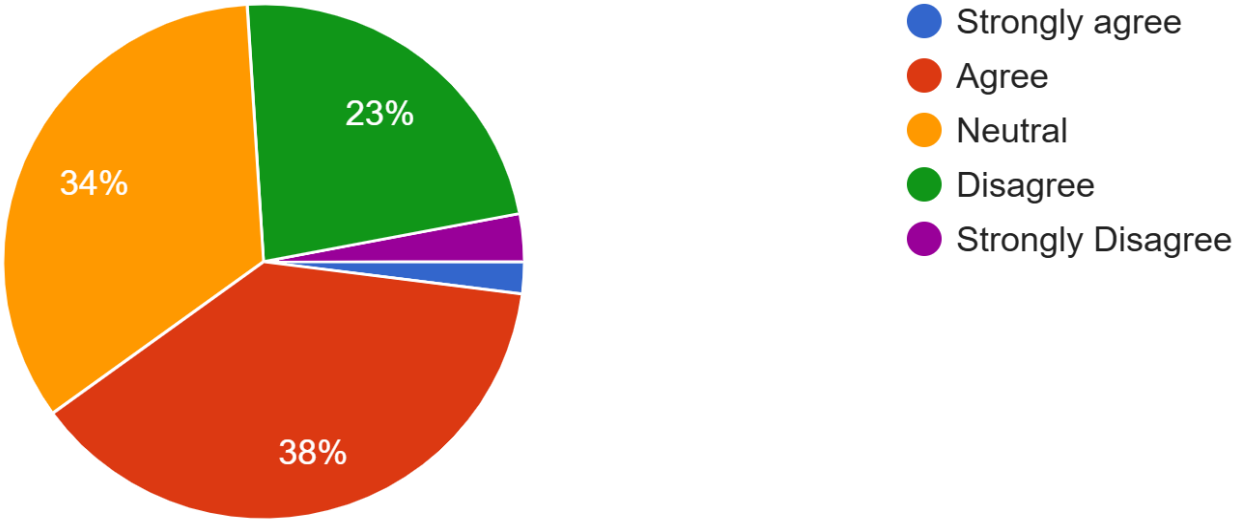

Figure 7: Respondents Preferences to Live In a House Made With Timber
Source: Researcher's fieldwork, 2025

When probed on societal attitudes, 88% agreed that public perception links timber with weakness. Interestingly, 94% also agreed that timber buildings can be comfortable, showing a contrast between perceived structural inadequacy and

personal comfort. Moreover, 73% said they would accept timber houses if the government played a supportive role, and 80% expressed readiness to accept well-built, durable timber homes. Therefore, public hesitation is not due to lack of comfort but rather societal perception and lack of trust in the durability of timber. Government endorsement and stronger regulation appear critical to shift opinions and normalize timber usage.

B. Avoid using wood for building

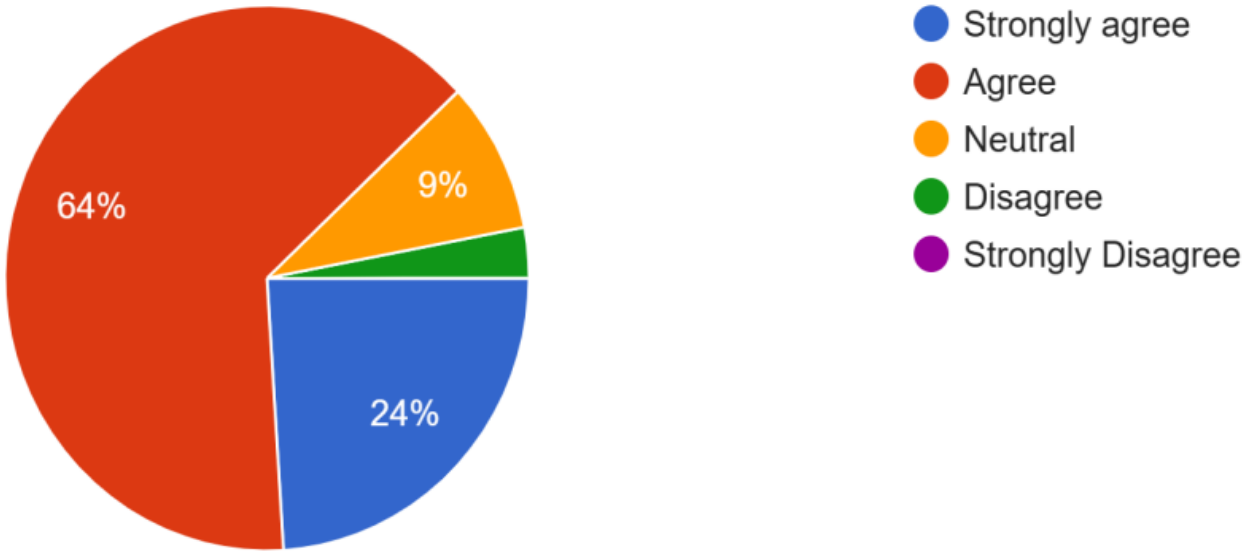

Figure 8: Pie Chart Showing Respondents Avoidance of Using Timber for Building Based On Its Strength
Source: Researcher's fieldwork, 2025

C. Comfortability

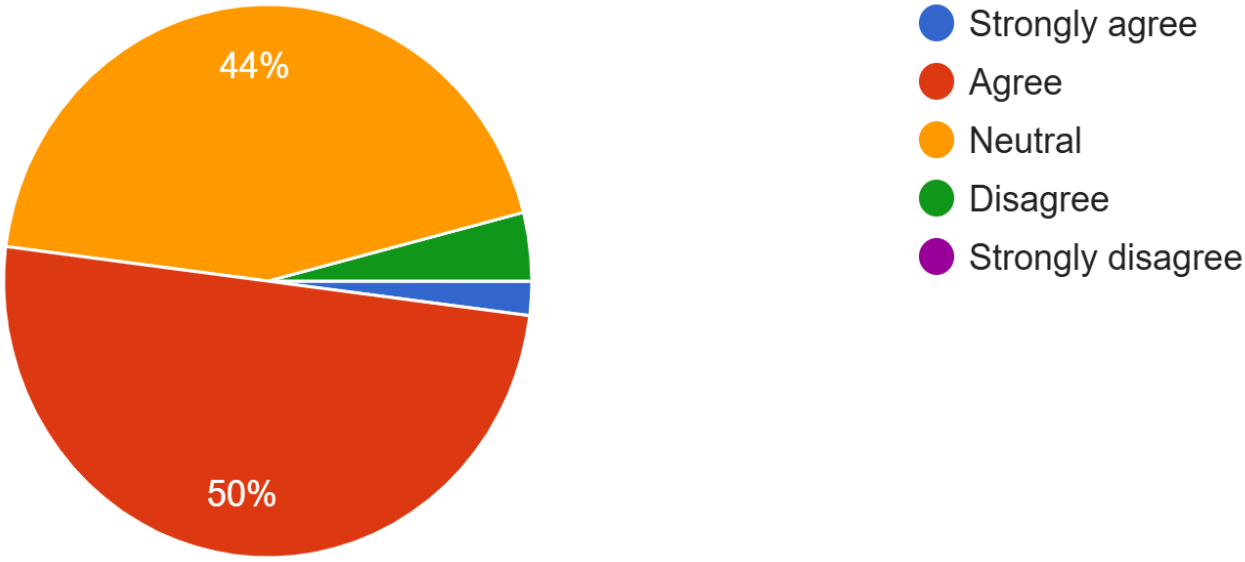

Figure 9: Pie Chart Showing Respondents Idea of Comfort of a Building Built With Timber
Source: Researcher's fieldwork, 2025

D. Timber buildings and construction

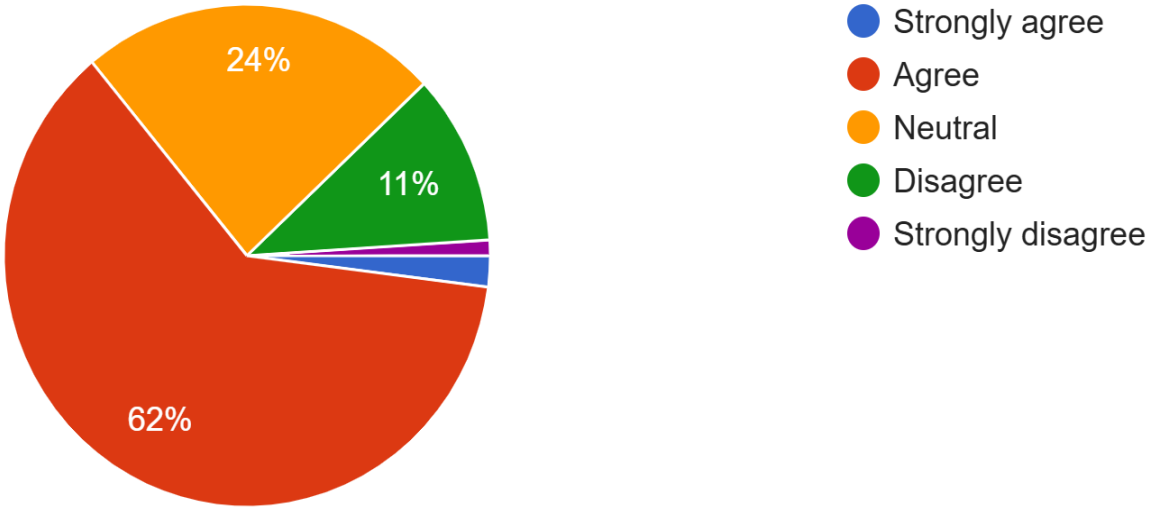

Figure 10: Pie Chart Showing Respondents Living in Timber Buildings If Supported By the Government
Source: Researcher's fieldwork, 2025

E. Timber buildings and construction

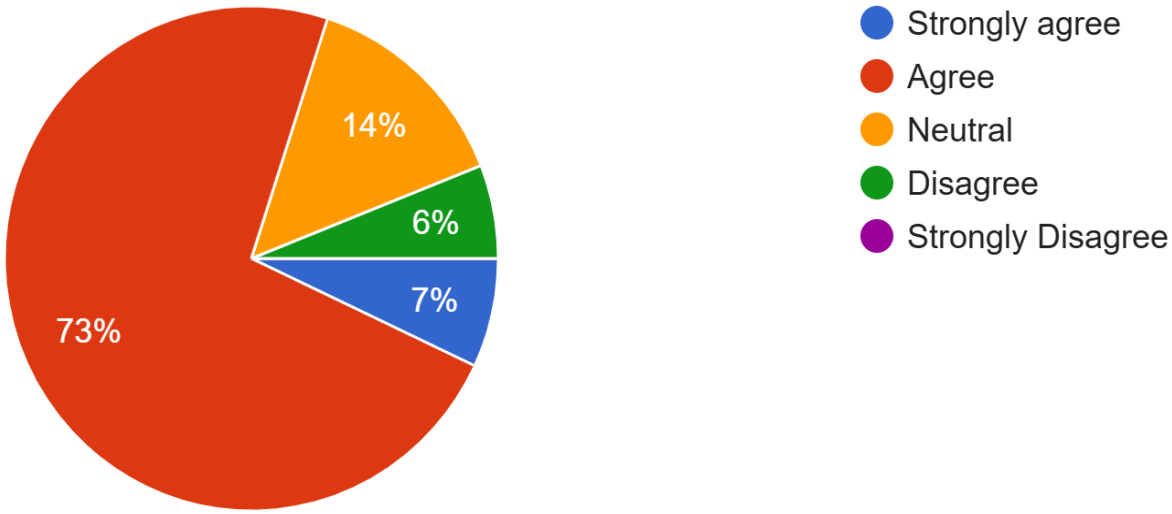

Figure 11: Pie Chart Showing Respondents Acceptance of A Timber Building If Durable
Source: Researcher's fieldwork, 2025

4.3.3 Research Question Three: What is the Cost-Effectiveness of Timber as a Building Material Compared to Cement and Iron in Benin City?

Responses strongly favoured timber's economic viability. 73% believed timber is cheaper than cement, and 97% agreed that cement-related costs significantly inflate construction expenses. A promising 63% of respondents stated they would live or work in timber buildings if they were more affordable. In terms of urban applicability, 75% agreed that increased timber use could reduce housing costs in Benin City. Most notably, 91% agreed that government intervention would make timber housing more accessible and affordable. Therefore the findings solidify timber's reputation as a cost-effective alternative, especially in light of inflation in cement prices. Public

willingness to embrace timber is largely tied to its affordability and the role of supportive policies.

A. Affordability

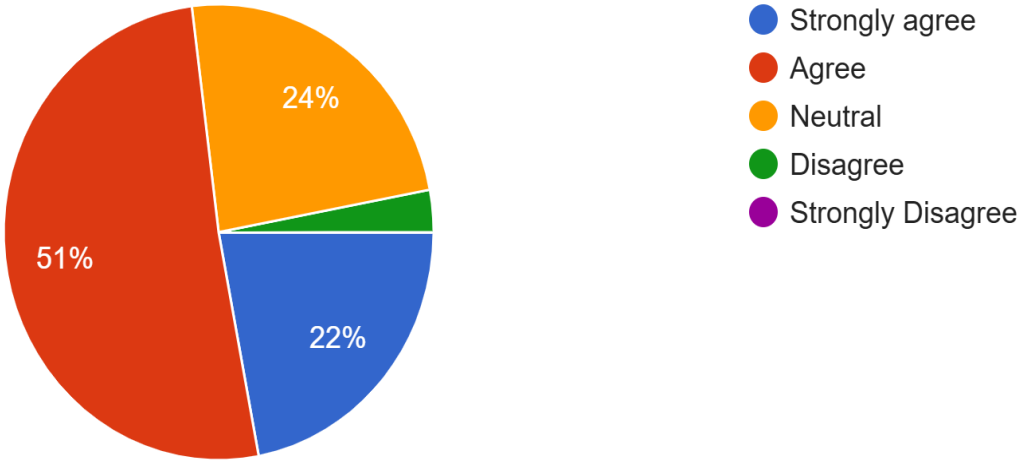

Figure 12: Pie chart showing respondents opinion on the cost effectiveness of timber compared to cement and blocks
Source: Researcher's fieldwork, 2025

B. Cost of materials

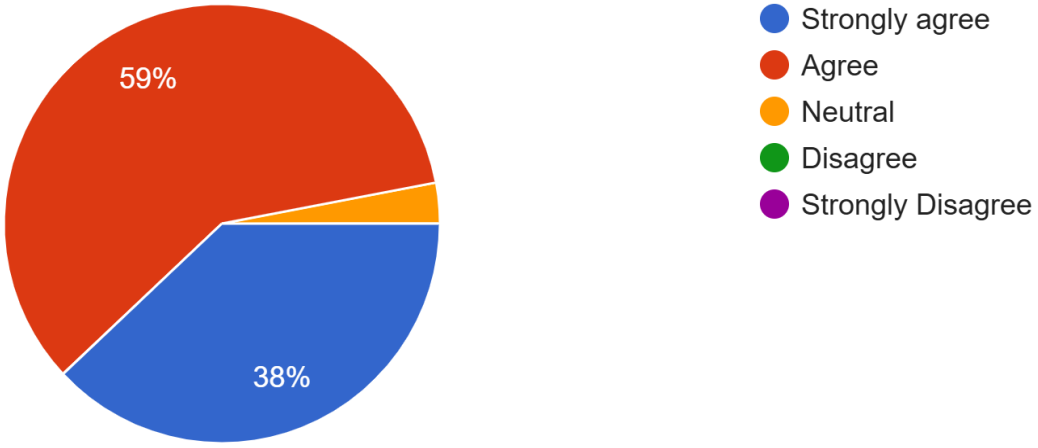

Figure 13: Pie chart showing the cost of materials makes building with cement and blocks expensive
Source: Researcher's fieldwork, 2025

C. Affordability and accommodation

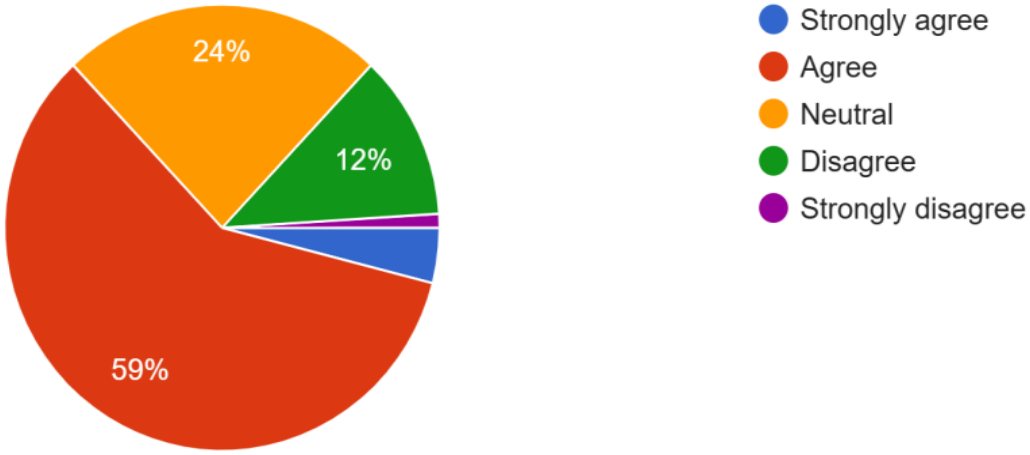

Figure 14: Pie chart showing respondents consideration of living in buildings made with wood if affordable
Source: Researcher's fieldwork, 2025

D. Timber for houses

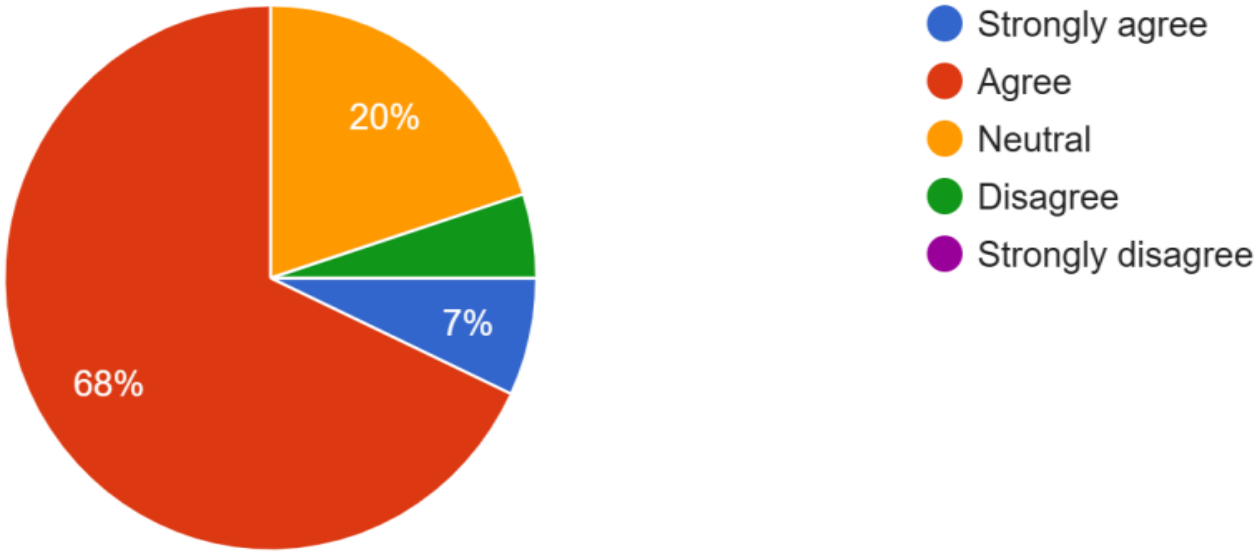

Figure 15: Pie chart showing respondents opinion on reduced cost of housing and buildings by using more timber for construction
Source: Researcher's fieldwork, 2025

E. Support for timber

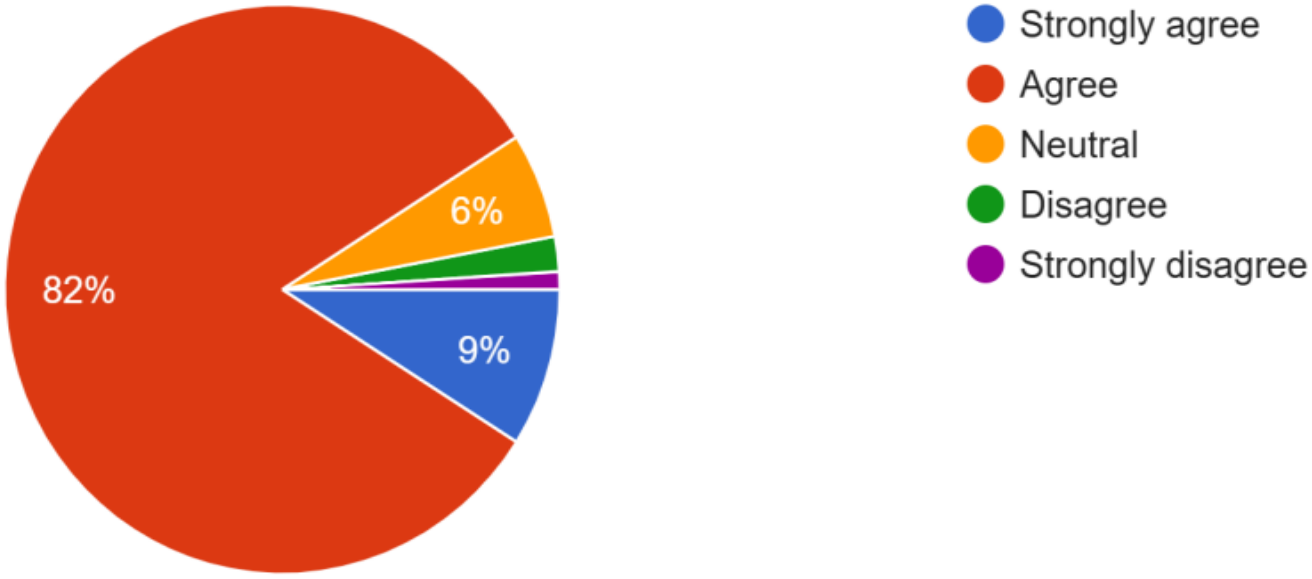

Figure 16: Pie chart showing respondents idea on affordability of timber buildings through government support
Source: Researcher's fieldwork, 2025

4.3.4 Research Question Four: What are the Technical Challenges and Limitations of Using Timber in Building Construction in Benin City?

Every respondent (100%) acknowledged fire risks and termite infestation as key technical challenges. This unanimous concern highlights the severity of these issues in public consciousness and suggests they are major deterrents to adoption. On structural durability, skepticism prevailed. Only 25% believed timber buildings can match the lifespan of cement ones, while 35% were neutral, and 39% disagreed. Similarly, only 16% agreed that builders in Benin City possess adequate knowledge of timber

construction, with 60% neutral and 24% in disagreement. Despite these concerns, 76% said they would trust timber buildings if properly constructed. Therefore, fire and termites represent critical technical hurdles in public perception. Furthermore, there is limited faith in the local workforce's capacity to handle timber projects. However, trust can be regained through proper construction techniques and public demonstration of timber's resilience.

A. Challenges - fire

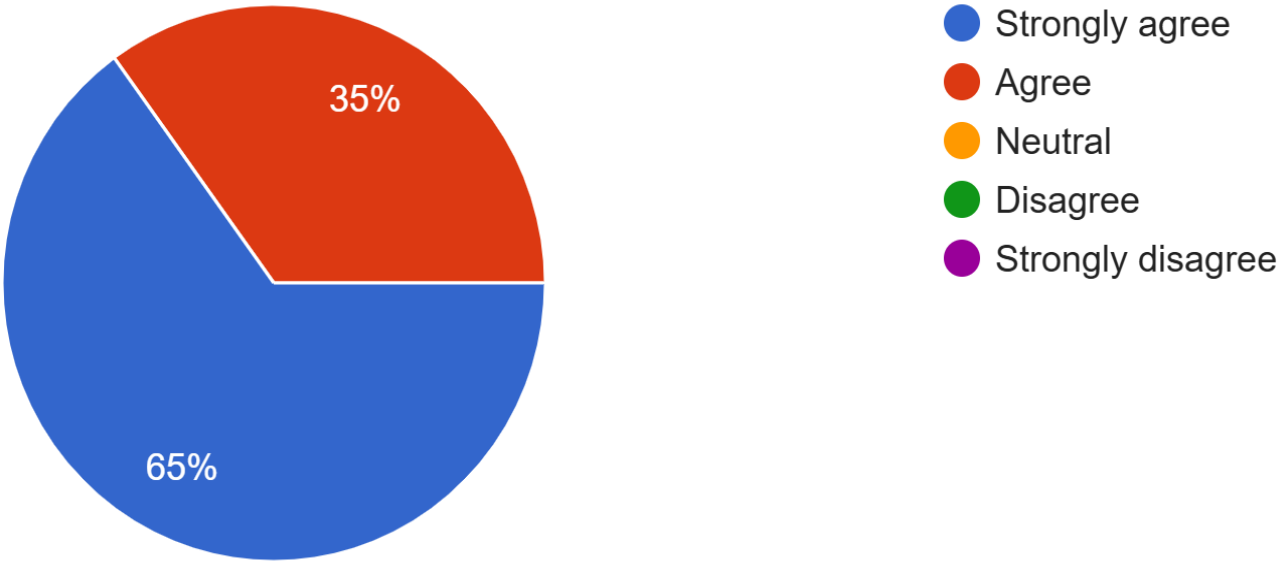

Figure 17: Pie chart showing challenges of timber buildings such as being prone to fire
Source: Researcher's fieldwork, 2025

B. Challenges – termite infestation

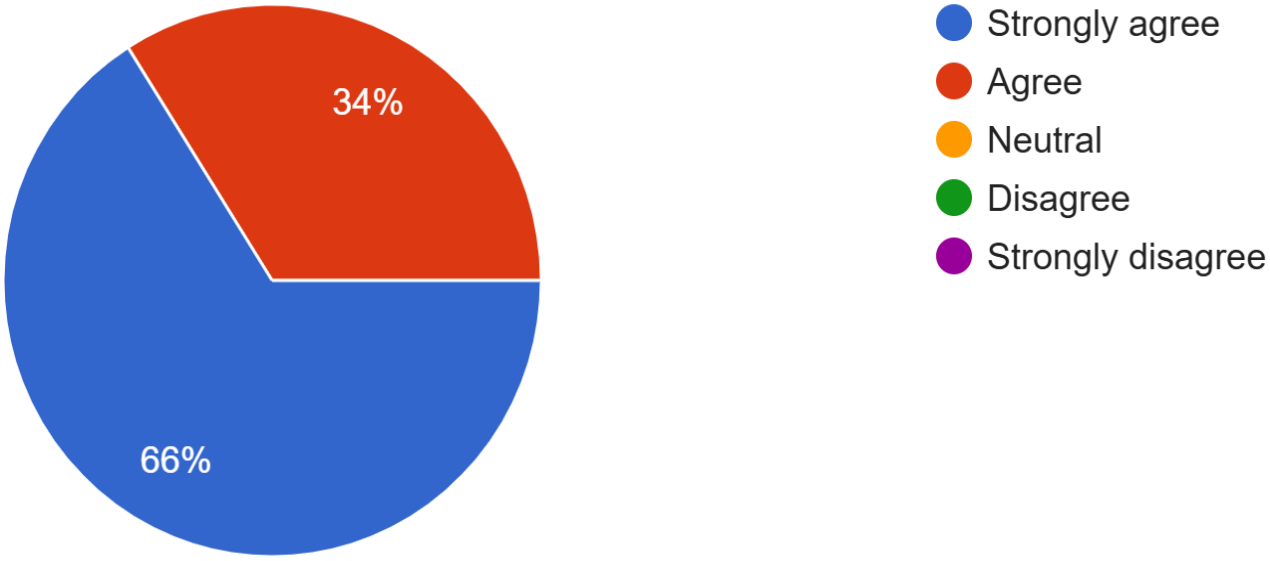

Figure 18: Pie chart showing challenges of timber buildings such as being prone to termite infestation
Source: Researcher's fieldwork, 2025

C. Longevity

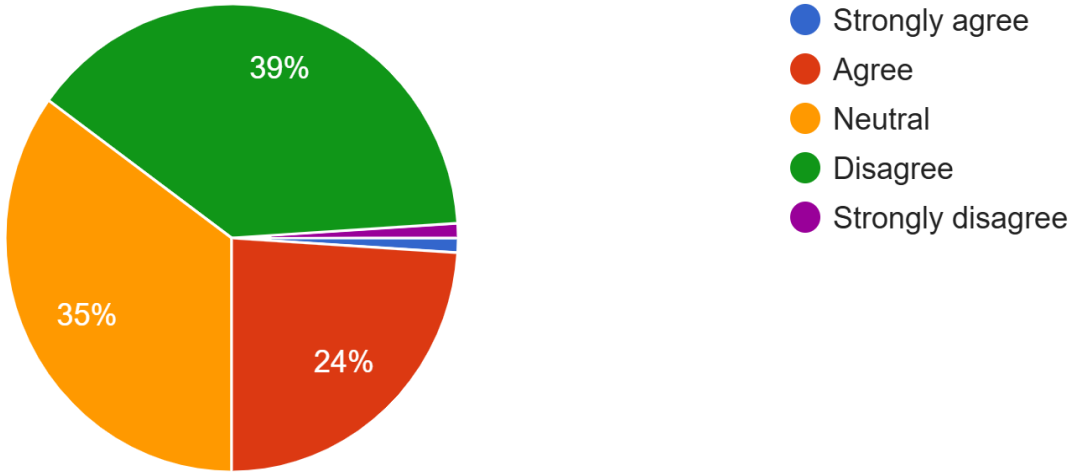

Figure 19: Pie chart showing longevity of wooden buildings with cement and block buildings
Source: Researcher's fieldwork, 2025

D. Knowledge about wood

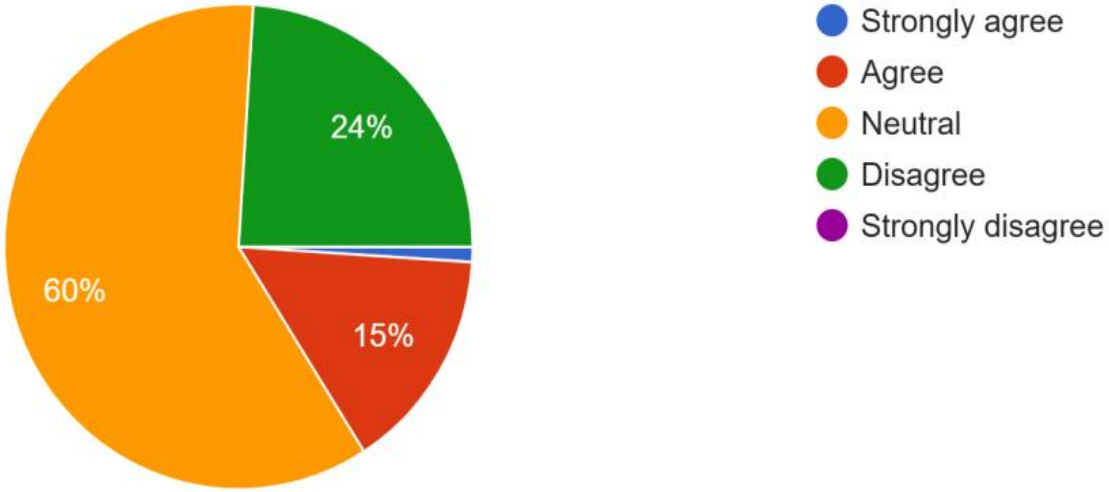

Figure 20: Pie chart showing builders knowledge about using wood for construction
Source: Researcher's fieldwork, 2025

E. Safety

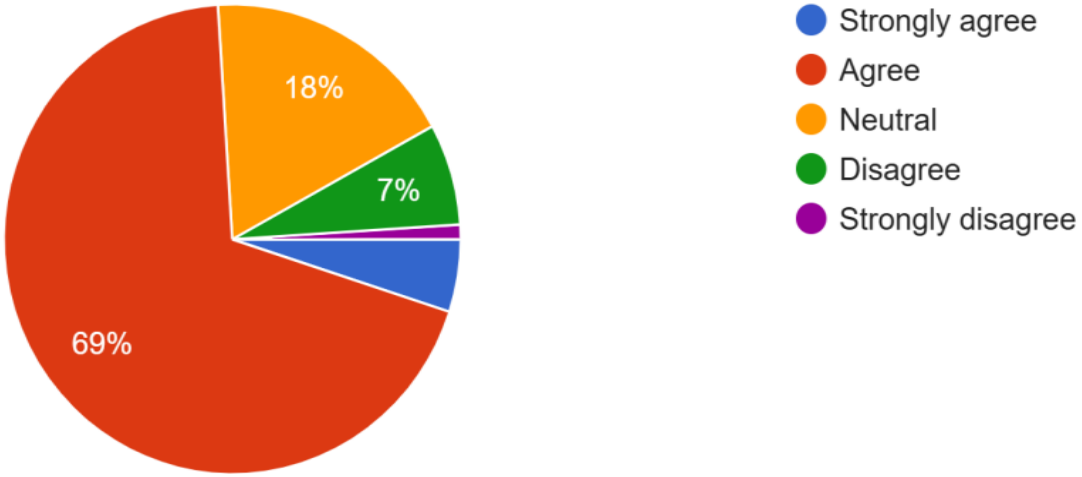

Figure 21: Pie Chart Showing Trust for A Well-Built Timber Building to be Safe for Living or Working
Source: Researcher's fieldwork, 2025

4.3.5 Research Question Five: What are Timber's Contributions to Urban Development?

Respondents widely support timber as a tool for enhancing urban development. A significant 93% believe timber's environmental friendliness justifies greater usage in building construction, and 91% agree that timber can improve the built environment. Furthermore, 85% support government encouragement of timber usage and 89% believe training workers would support broader urban development goals.

A. Eco-friendly

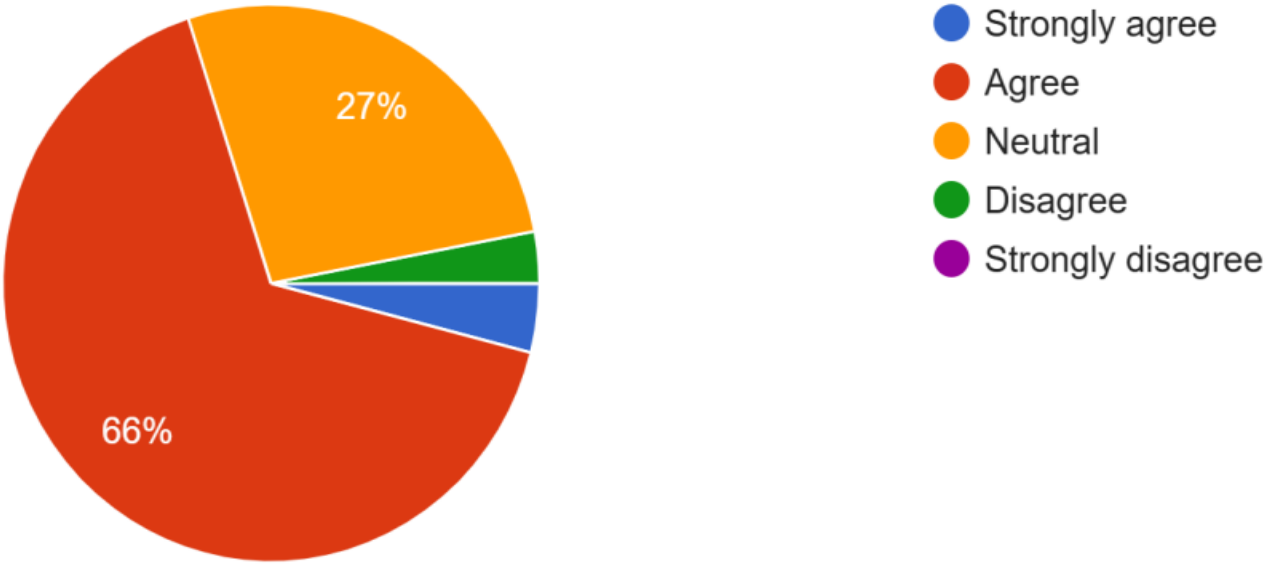

Figure 22: Pie chart showing use of timber because of its friendliness to the environment
Source: Researcher's fieldwork, 2025

B. Environmental improvement

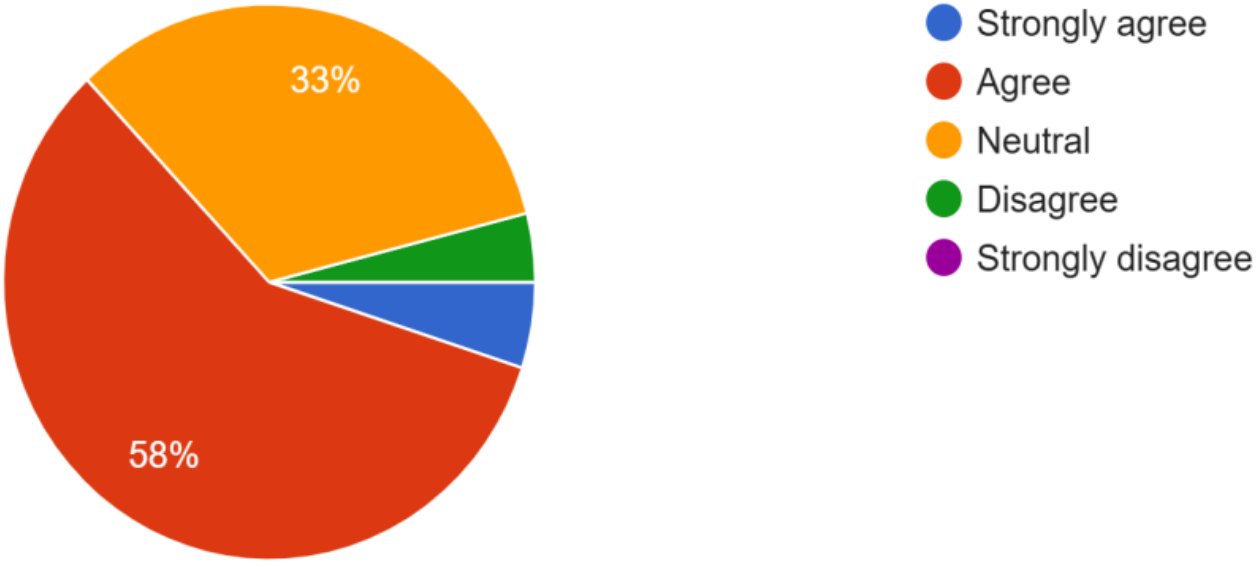

Figure 23: Pie chart showing using more timber in building can improve built environment
Source: Researcher's fieldwork, 2025

C. Government intervention

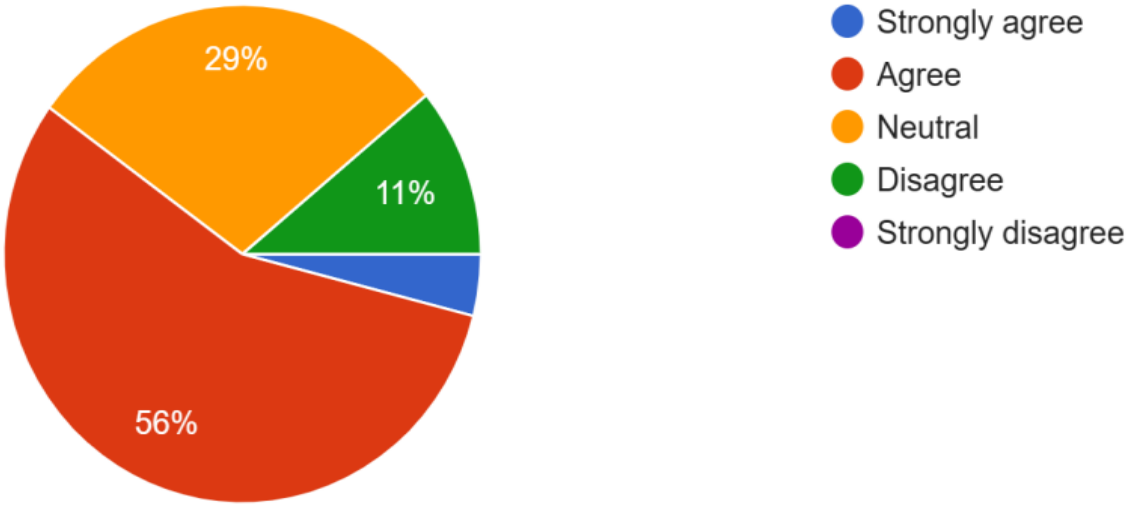

Figure 24: Pie chart showing respondents idea on government encouraging people to use more wood for building
Source: Researcher's fieldwork, 2025

D. Training of workers

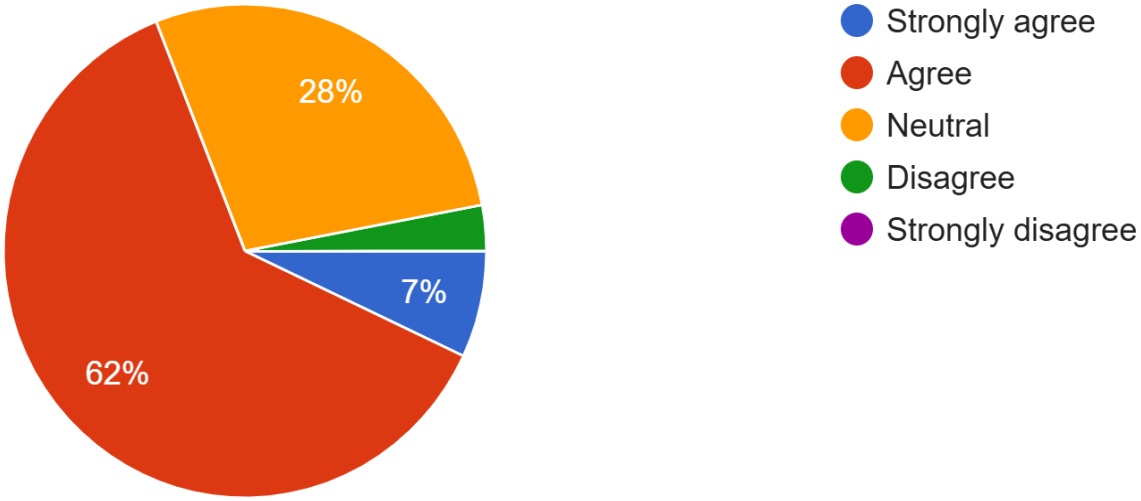

Figure 25: Pie chart showing respondents idea on training of workers to support urban development
Source: Researcher's fieldwork, 2025

E. Urban development

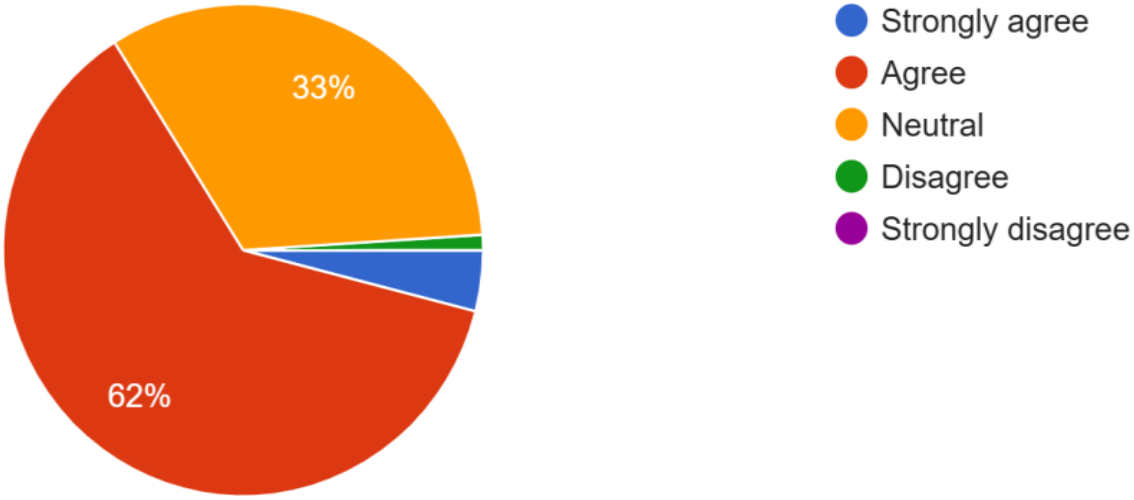

Figure 26: Pie chart showing respondents idea on use of more wood to improve urban development
Source: Researcher's fieldwork, 2025

Most strikingly, 95% agree that increased timber use would positively impact Benin City's development, indicating overwhelming public enthusiasm for timber as a future-forward material. Therefore, there is a clear consensus on timber's potential to transform Benin City's urban landscape. Public backing is high, provided technical and policy barriers are addressed. This lays a strong foundation for timber-inclusive urban development plans.

4.4 CASE STUDIES

To substantiate the research findings and provide real-world evidence of timber's potential as a sustainable and affordable construction material, two case studies will be conducted in Benin City, Edo State. These case studies will focus on existing or ongoing projects that incorporate timber as a primary building material. The aim is to analyze the practical applications, challenges, and benefits of using timber in construction, aligning with the objectives of the study.

4.4.1 Case Study One: Timber Roofing Framework for Residential Building Construction

This case study examines the use of timber for the roofing framework of a residential building located in Benin City, Edo State. The project is a single-family home where wood was chosen as the main material for the roof structure. The roofing system is constructed entirely from solid timber members. These timber pieces were locally sourced and prepared on-site by craftsmen. The wood was measured, cut, and manually assembled into trusses, which were then lifted and fixed into position to create a strong roofing framework. The construction follows a pitched roof style, a common design in the region that supports efficient rainwater drainage and promotes better air circulation. The timber trusses are arranged in a repeated triangular pattern to provide stability and evenly distribute the weight of the roofing sheets. This method not only ensures structural strength but also allows for a faster and more flexible construction process compared to steel or concrete materials.

Several benefits were observed from this construction approach. Timber is cost-effective, reducing overall construction expenses. It is also easier and quicker to work with, requiring less heavy machinery, which speeds up the building process. The local availability of timber helps reduce transportation costs and supports the regional economy. Furthermore, timber is a sustainable, renewable resource, making it an

environmentally friendly option when harvested responsibly. Additionally, timber offers excellent thermal performance, providing natural insulation and helping to maintain cooler indoor temperatures. However, some challenges were identified. Timber must be properly treated to prevent damage from termites and moisture, and regular maintenance is essential to preserve its durability and appearance over time.

The images below show the different stages of the timber roofing framework during construction: This case study demonstrates the practicality and usefulness of timber in housing construction. It proves that timber is not only a low-cost and accessible material but also a reliable option for durable and sustainable building in Benin City's residential sector.

Plate 1: Overall view of the timber roofing structure nearing completion
Source: Researcher Field Work (2025).

Plate 2: Side view of the pitched timber roof framework under construction
Source: Researcher Field Work (2025).

Plate 3: Ongoing construction showing multiple timber trusses in place
Sources: Researcher Field Work (2025).

4.4.2 Case Study Two: St. Albert Catholic Church, University of Benin, Benin City, Edo State – A Public Building with Timber Components.

St. Albert Catholic Church, located within the University of Benin (UNIBEN), is a prominent public religious building in Benin City. One of its most striking architectural features is the extensive use of timber in both its ceiling and door finishes. These timber elements play functional, aesthetic, and symbolic roles in the overall architecture of the space.

The timber ceiling in St. Albert Catholic Church is composed of a series of hexagonal and diamond-shaped timber panels, each carefully fitted together in a detailed, patterned layout. These panels are adorned with symbolic Christian imagery, including keys, lambs, fish, and chalices, all precisely engraved or inlaid into the wooden surfaces. The layout creates a rhythmic and uniform pattern, giving the entire ceiling a warm, sacred, and visually rich character. The wooden doors at the church entrances also incorporate timber artistry. These doors reflect fine craftsmanship and are likely locally sourced and fabricated, showcasing the versatility of timber in

joinery and detailing.

Plate 4: Interior view of the timber ceiling
Source: Researcher Field Work (2025).

Timber contributes significantly to the visual and spiritual ambience of the church. The warm, brown tones of the wood contrast beautifully with the white and marble finishes of the altar and interior walls. The rich grain of the wood panels, coupled with the symbolic religious carvings, enhances the aesthetic appeal and deepens the spiritual resonance of the worship environment. The natural texture and finish of timber also add a sense of tradition, craftsmanship, and authenticity, aligning with the values and atmosphere of a sacred space. Timber is known for its sound-absorbing qualities, which makes it ideal for spaces like churches where clarity of speech and music is essential. The ceiling design at St. Albert Catholic Church not only enhances beauty but also helps control sound reverberation. The layered and jointed timber panels absorb echoes and distribute sound evenly across the space, improving the acoustic quality during sermons, prayers, and choir performances. Compared to suspended ceilings made from concrete, synthetic or metallic materials, the timber ceiling likely offered a more affordable solution, particularly given the availability of local timber.

Timber is relatively easy to work with, reducing labour costs during construction. Over time, wooden elements can be maintained easily through simple polishing or

sealing, unlike some materials that may require complete replacement once damaged. Moreover, in the event of future renovations, individual panels or sections can be

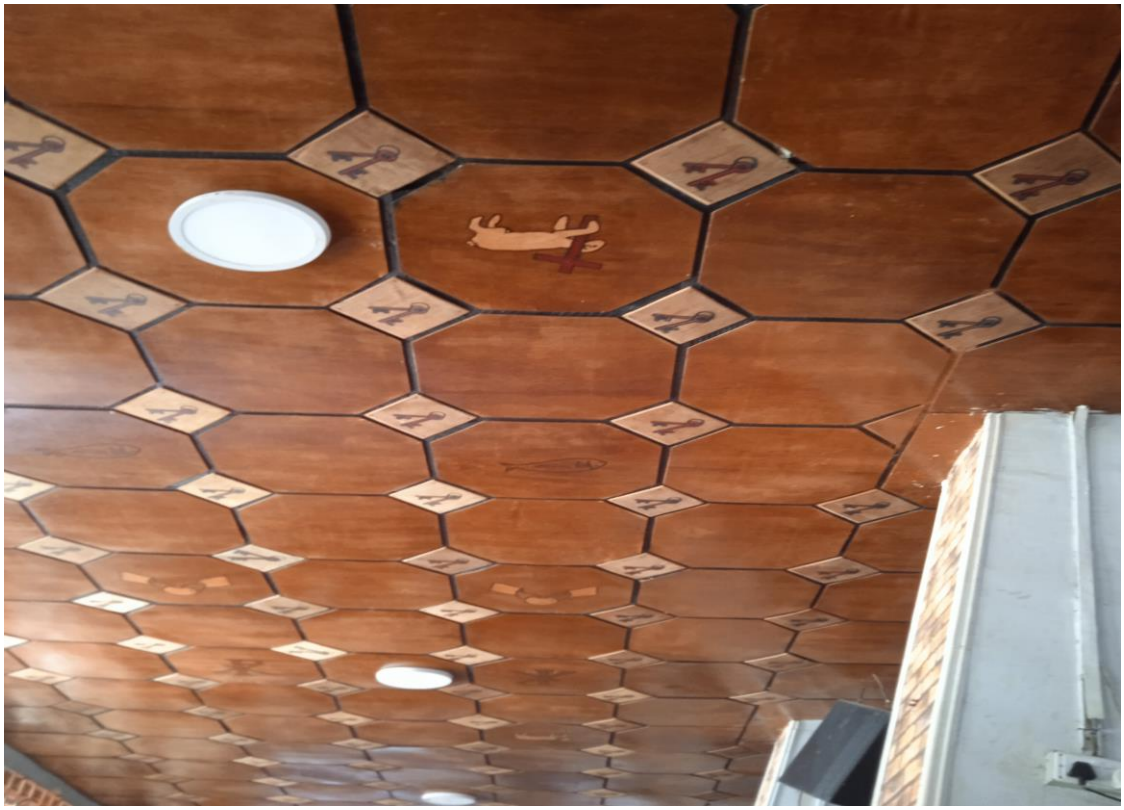

Plate 5: Timber Ceiling with Neatly Installed Light Fittings
Source: Researcher Field Work (2023).

Plate 6: Side View of the Ceiling inside the Church
Source: Researcher Field Work (2023).

replaced without dismantling the entire ceiling system — a feature that makes it economically sustainable and practically efficient. The use of timber in St. Albert Catholic Church serves as a model for integrating wood into public building construction. It demonstrates how timber can provide aesthetic value, acoustic efficiency, cost advantages, and ease of maintenance. This case underscores the relevance of timber in both spiritual architecture and the broader discourse of sustainable and affordable building practices in Benin City.

4.5 SUMMARY OF KEY FINDINGS

The study revealed a generally favourable perception of timber among residents of Benin City. A significant majority recognized its affordability and environmental advantages, acknowledging timber's potential as a sustainable construction material, especially in light of the city's ongoing housing challenges. However, notable concerns remain regarding timber's structural integrity and long-term durability. Respondents frequently cited fire hazards and vulnerability to termite attacks as major limitations, contributing to lingering scepticism about the reliability of timber housing.

Another critical finding was the evident shortage of skilled labour capable of executing timber construction projects to modern standards. This skill gap represents a substantial obstacle to the broader adoption of timber in the local building industry. Despite these concerns, a considerable portion of respondents expressed willingness to accept timber-based housing—provided that safety and durability are guaranteed and that supportive government policies are in place. The findings highlight the importance of strategic interventions, including public education initiatives, builder training programs, and demonstration housing projects, to increase public trust and promote the use of timber in sustainable and affordable housing development across Benin City.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY OF THE STUDY

This study examined the potential of timber as a sustainable and affordable material for housing and building construction in Benin City, Edo State, focusing on addressing the growing demand for urban housing. The primary objective was to assess the feasibility of timber as a cost-effective and environmentally friendly alternative to conventional materials like cement and concrete blocks, especially in the context of rapid urbanization and resource depletion. To achieve this, a structured questionnaire was distributed to 100 respondents in Benin City, representing various demographic groups.

The questionnaire focused on five key themes: environmental benefits, socio-economic barriers, cost-effectiveness, technical challenges, and timber's role in fostering sustainable urban development. The findings indicated a broad awareness of the environmental and economic advantages of timber as a building material, with a significant majority of participants acknowledging timber’s affordability and lower environmental footprint compared to traditional materials like concrete and steel. However, several concerns were raised, including fire hazards, susceptibility to termite damage, and doubts about the long-term structural integrity of timber buildings. Respondents also identified the lack of skilled professionals trained in timber construction as a significant barrier to large-scale adoption, along with concerns about the availability and cost of treated timber products and necessary protective coatings to ensure durability. Despite these limitations, a considerable proportion of respondents expressed a willingness to consider timber-based housing, provided that safety standards and quality control measures were assured.

The study concludes that with proper policy support, public awareness campaigns, and investment in professional training and technology, timber could be a viable solution for affordable and sustainable housing in Benin City. This research contributes to the broader conversation on sustainable construction materials and offers valuable insights into the potential of timber as a key material in promoting sustainable urban development in Nigeria.

5.2 CONCLUSION

The findings of this study confirm that timber has significant potential as a sustainable and affordable building material for addressing the housing challenges as well as for general building constructions in Benin City. Its key benefits, cost-effectiveness, environmental sustainability, and thermal comfort, position timber as a viable alternative for urban development. Despite these advantages, the widespread adoption of timber is hindered by concerns regarding fire safety, resistance to pests, and structural durability. Additionally, the scarcity of skilled labour and the lack of public confidence in timber construction pose further barriers to its acceptance. These challenges highlight the urgent need for institutional support, capacity-building through technical training, and increased public awareness. With targeted interventions from the government, the private sector, and other stakeholders, timber can be successfully integrated into Benin City's housing and building strategy. By addressing these concerns and promoting timber's benefits, it has the potential to become a sustainable solution for affordable housing and urban development.

5.3 RECOMMENDATIONS

To overcome the challenges and promote the use of timber as a sustainable and affordable building material in Benin City, the following strategic recommendations are proposed. These recommendations aim to create a supportive framework that encourages timber use, ensures environmental sustainability, and enhances public perception. By focusing on policy, education, training, and sustainable sourcing, timber can play a key role in affordable housing and urban development. The recommendations outlined below are intended to guide both the government and stakeholders in implementing this change:

1. **Government Support and Policy Intervention**

The role of government is very important in encouraging the use of timber for construction, especially in promoting it as a sustainable and affordable building material. Without government support, it may be difficult for timber to compete with more commonly used materials like cement and blocks, which currently dominate the construction industry in Nigeria.

One of the key ways the government can support timber usage is by creating policies that promote its use in both private and public sector projects. These policies should

clearly state the government's commitment to encouraging sustainable construction practices through the use of natural and renewable materials like timber. A good place to start would be the introduction of tax incentives and financial support schemes. For example, developers and construction companies that make use of certified timber materials should be given tax breaks or reductions. This will make timber a more attractive option financially, especially for those who are constructing houses on a large scale. In addition to tax incentives, the government can offer low-interest loan packages through housing finance institutions to support individuals and developers who want to build with timber. These loans can make it easier for people with limited income to build affordable timber houses. Another important area is the simplification of the approval process for timber construction. At the moment, many building control authorities and urban planning offices are more familiar with cement and block-based structures. As a result, building plans that propose the use of timber may face unnecessary delays or rejections. The government can revise the building code to include clear guidelines and standards for timber construction. This will help reduce confusion and make it easier for architects and builders to get their timber-based projects approved.

Moreover, the government can take the lead by including timber housing in public housing and urban renewal projects. When people see timber buildings constructed by the government, it will improve their trust and confidence in the material. It will also send a clear message that timber is not only a viable alternative but also a material that is being supported and promoted by authorities. In addition, the government should set up monitoring and regulatory bodies to ensure that timber used in construction is of good quality and that forestry practices remain sustainable. By implementing these types of supportive policies and interventions, the government can help address the current housing crisis while also encouraging environmentally friendly construction practices. This will not only reduce building costs but also create jobs, promote local industries, and contribute to sustainable urban development in cities like Benin City and across Nigeria.

2. Public Awareness and Education Campaigns

One of the biggest challenges affecting the adoption of timber in construction is the lack of accurate information among the general public. Many people still believe that timber is not strong enough, that it cannot last as long as other materials, or that it is

easily destroyed by fire and termites. These misconceptions have created a barrier that prevents timber from being seen as a serious option for housing and other forms of building construction. To overcome this, there is a strong need for well-organized public awareness and education campaigns. These campaigns should be spearheaded by government agencies in partnership with non-governmental organizations (NGOs), construction professionals, and environmental groups. The aim should be to inform the public about the true benefits and possibilities of timber construction, while also correcting false beliefs. For instance, many people are not aware that modern timber buildings can be treated to resist fire and termites, and that timber can be engineered to be just as strong and durable as cement-based structures. Public education should be carried out through various means to reach people of different age groups, backgrounds, and locations. Media advertisements on radio, television, newspapers, and social media platforms can be used to communicate short messages about timber's affordability, environmental benefits, and safety. These messages should be frequent and easy to understand so that even people with little or no formal education can relate to them.

In addition, community workshops can be organized in local government areas, especially in places where there is a high demand for housing. These workshops can bring together residents, local builders, architects, and timber experts to share knowledge and answer questions about timber construction. School programs can also play an important role by introducing young people to the concept of sustainable building and the value of using natural materials like timber. When children are taught about sustainability from a young age, they grow up with a more positive view of alternatives to conventional construction. Another effective strategy is to organize open-house events at timber demonstration buildings. These events would allow the public to visit fully constructed timber homes or buildings and experience the comfort, design quality, and durability of such structures firsthand. Seeing is believing, and when people see that timber buildings are attractive, safe, and long-lasting, they will be more willing to accept them as a real option.

Finally, these campaigns must be consistent and continuous. Changing people's perceptions does not happen overnight, especially when negative beliefs have existed for many years. With steady and engaging public education efforts, timber can gradually gain acceptance and be seen as a smart, modern, and sustainable choice for

housing and development.

3. **Training and Capacity Building**

For timber to be widely accepted as a reliable and standard material in the construction industry there must be enough trained professionals who know how to work with it. One of the key reasons why many people in Benin City and other parts of Nigeria hesitate to build with timber is that they do not trust that local builders have the necessary skills to construct durable, safe, and attractive timber buildings. This concern is valid, and it highlights the urgent need for proper training and capacity building in timber construction. To address this gap, technical colleges, polytechnics, and vocational training centres across Nigeria should introduce dedicated training programs focused on timber construction. These training modules should be carefully developed in collaboration with experts in timber engineering, architecture, environmental sustainability, and building sciences. The training should not just focus on the basics of carpentry but should cover a wide range of modern and advanced timber construction techniques.

Some of the key topics that should be taught in these programs include structural design using timber, which will help trainees understand how timber can be used to create strong and stable buildings of various sizes. Another important area is fireproofing techniques, which will teach how to treat timber and design buildings in a way that reduces the risk of fire. Termite prevention and treatment methods should also be part of the training, especially because termite infestation is a common concern in tropical regions like Edo State. In addition, the programs should include lessons on sustainable building standards and green design principles, so that future professionals understand the environmental impact of timber and how to use it responsibly.

These training programs should be practical and hands-on, allowing students to build actual timber structures and test their skills under the supervision of experienced professionals. It is also important to set up certification systems so that those who complete the training are officially recognized as qualified timber construction professionals. These certifications will help improve public confidence in the builders and the quality of their work, while also making it easier for certified individuals to find jobs or win contracts. Beyond training new professionals, existing builders, engineers, and architects should

also be offered opportunities to upgrade their skills through short courses, workshops, and refresher seminars. This will help expand the number of professionals who are confident and capable of handling timber-based construction projects. In summary, by investing in training and capacity building, the construction industry in Nigeria can develop a workforce that is skilled, confident, and ready to support the shift toward sustainable, timber-based housing. This will also lead to better-quality buildings, fewer construction errors, and greater acceptance of timber as a mainstream building material.

4. **Demonstration and Pilot Projects**

One of the most effective ways to change public perception about timber construction is through the creation of real, visible examples that people can experience. Many residents of Benin City may have never seen a well-designed timber home or building, so their opinions are shaped mostly by myths, second-hand stories, or outdated examples. This is why it is important to develop pilot timber housing estates and demonstration projects in different parts of the city. These projects will serve as practical, real-life models to show people the true potential of timber as a building material.

Government agencies, in partnership with private developers and non-governmental organizations, should take the lead in constructing timber-based demonstration buildings. These structures can include residential homes, community centres, health clinics, schools, and other public facilities built using modern timber techniques. When residents can walk through, live in, or work in these timber buildings, they can see for themselves that timber is not only affordable but also beautiful, safe, and long-lasting. This kind of direct experience is far more powerful than any advertisement or campaign message. These demonstration sites should also serve as learning environments. During the construction phase, local artisans, technicians, and builders should be invited to participate. This will allow them to gain hands-on training and apply modern methods for timber construction under the guidance of experienced professionals. Involving local workers will also help build local capacity and create a pool of trained individuals who can take on future timber projects.

Furthermore, these pilot projects can be used to test and showcase different timber construction styles and innovations. For example, some homes can feature treated

timber to resist termites, while others can demonstrate fire-resistant coatings or design techniques that enhance natural cooling. These variations will allow builders, researchers, and the public to compare options and decide what works best for their needs and climate. These demonstration projects must be well-documented and publicized. Open-house events, guided tours, exhibitions, and even short documentary videos can be used to share the outcomes with a wider audience. Schools and universities can also include site visits to these timber buildings as part of their construction and environmental studies curriculum. In the long run, demonstration projects will help break the cycle of doubt and fear that surrounds timber usage. When people see successful timber buildings with their own eyes, and when they know the builders were trained locally, they will be more open to embracing timber as a reliable material for their homes and businesses.

5. **Sustainable Forestry and Timber Sourcing**

For timber to be a truly sustainable building material in Benin City, it is essential that its sourcing be carefully managed to avoid environmental degradation and support long-term availability. The government should prioritize the establishment of a robust regulatory framework that ensures timber is sourced responsibly. This framework should include clear licensing and certification processes for timber producers, enabling traceability of timber from forest to market, and guaranteeing that all timber harvested is done so legally and sustainably. A core component of this strategy is enforcing strict tree replanting requirements for any timber extraction. Timber producers should be obligated to replant a tree for every tree felled, or a similar reforestation program should be introduced to maintain ecological balance. Additionally, the government should provide incentives for landowners and forestry companies that engage in sustainable forest management and support afforestation programs to restore degraded lands and expand forest cover.

To further promote sustainable practices, the government should invest in educating rural communities involved in timber harvesting. This includes providing training on sustainable forestry techniques, such as selective logging and agroforestry, which integrate tree planting with agricultural practices. These educational programs can empower local communities to adopt practices that protect biodiversity, maintain soil health, and prevent deforestation while allowing for the continued harvesting of timber in an environmentally responsible way.

Finally, encouraging the use of certified timber from recognized sustainability standards, such as FSC (Forest Stewardship Council), will help reduce the environmental footprint of timber construction in Benin City. By ensuring the timber used in housing and building construction is ethically sourced, the government can contribute to a circular economy that balances development with environmental protection.

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APPENDIX

SURVEY QUESTIONNAIRE

TOPIC: TIMBER FOR SUSTAINABLE AND AFFORDABLE HOUSING AND BUILDING CONSTRUCTION IN BENIN CITY, EDO STATE, NIGERIA.

BY **MAYONE ANSELM OSHEHOR**

MAT NO: **ENV2010818**

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE,

FACULTY OF ENVIRONMENTAL SCIENCE,

UNIVERSITY OF BENIN QUESTIONNAIRE

Dear Respondent,

I am Mayone Anselm, a student of the department of Architecture, faculty of Environmental Sciences in the University of Benin, Benin City, Edo State, Nigeria. I am working on a research on the use of **'Timber for Sustainable and Affordable Housing and Building Construction in Benin City, Edo State, Nigeria.'**

This survey aims to gather information on the use of timber (wood) for sustainable and affordable housing and building construction in Benin City. Your responses will remain confidential and will be used for academic purposes only. Please answer all questions honestly.

Yours Sincerely,

Mayone Anselm.

SECTION 1: DEMOGRAPHIC INFORMATION

(PLEASE TICK [✓] WHERE APPROPRIATE)

1. GENDER:
   - ☐ Male
   - ☐ Female
2. AGE GROUP:
   - ☐ 18 – 25 years
   - ☐ 26 – 35 years
   - ☐ 36 – 45 years
   - ☐ 46 – 55 years
   - ☐ 56 years and above
3. OCCUPATION:
   - ☐ Student
   - ☐ Architect
   - ☐ Quantity Surveyor
   - ☐ Civil Engineer
   - ☐ Builder
   - ☐ Skilled Labourer
   - ☐ Others (please specify) _____

4. HIGHEST LEVEL OF EDUCATION:
   - ☐ No formal education
   - ☐ Primary education
   - ☐ Secondary education
   - ☐ Tertiary education (University/Polytechnic/College)
   - ☐ Postgraduate
5. HAVE YOU EVER USED OR WORKED WITH TIMBER IN CONSTRUCTION?
   - ☐ Yes
   - ☐ No
6. HOW LONG HAVE YOU LIVED IN BENIN CITY?
   - ☐ Less than 1 year
   - ☐ 1 – 5 years
   - 6 – 10 years
   - ☐ Over 10 years

SECTION 2: SURVEY QUESTIONS

Response Options for All Questions:

Strongly Agree (SA), Agree (A), Neutral (A), Disagree (D), Strongly Disagree (SD)

A. Environmental Benefits of Using Timber as a Building Material in Benin City.

S/N	QUESTIONS	SA	A	N	D	SD
1.	I am aware that wood (timber) can be used to build houses.					
2.	Using wood for building helps protect the environment.					
3.	Wood (timber) is a better building material for the environment compared to cement and blocks.					
4.	Cutting trees for building purposes is acceptable if new trees are replanted.					
5.	Building with wood can help control heat around the environment.					

B. Socio-Economic Barriers Affecting the Use of Timber in Housing and Building Construction in Benin City.

S/N	QUESTIONS	SA	A	N	D	SD
1.	I would prefer to live in a house made of wood (timber).					
2.	People in Benin City avoid using wood (timber) for building because they believe it is not strong enough.					
3.	A wooden (timber) building would be comfortable to stay in.					
4.	If the government supports timber buildings and construction, I would consider living in one.					
5.	I would accept a timber building if it is strong and durable.					

C. Cost-Effectiveness of Timber as a Building Material Compared to Cement and Iron in Benin City.

S/N	QUESTIONS	SA	A	N	D	SD
1.	Building with wood (timber) is cheaper than using cement and blocks.					
2.	The cost of materials (cement, blocks, iron rods, etc.) makes building with cement and blocks expensive.					
3.	If buildings made with wood are cheaper, I would consider living or working in one.					
4.	Using more timber for houses and construction can help reduce the cost of housing and buildings in Benin City.					
5.	Government support for timber construction would make timber buildings more affordable and easier to build.					

D. Technical Challenges and Limitations of Using Timber in Building Construction in Benin City.

S/N	QUESTIONS	SA	A	N	D	SD
1.	Timber buildings may have challenges such as being more prone to fire.					
2.	Timber buildings may have challenges such as termite infestation.					
3.	Wooden buildings can last as long as cement and block buildings.					
4.	Builders in Benin City have enough knowledge about using wood for construction.					
5.	I would trust a well-built timber building to be safe for living or working.					

E. Timber's Contribution to Urban Development

S/N	QUESTIONS	SA	A	N	D	SD
1.	Timber should be used more because it is good for the environment.					
2.	Using more wood (timber) in building can help improve the built environment.					
3.	The government should encourage people to use more wood for building houses and offices.					
4.	Training workers in timber construction can support urban development					
5.	Using more wood in building constructions can improve urban development.					