



# The Incentives of Stabilized Interlocking Clay Bricks for Providing Sustainable Affordable Housing in Nigeria

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**How to cite this paper:** Adedeji, I., Deveci, G. and Salman, H. (2022) The Incentives of Stabilized Interlocking Clay Bricks for Providing Sustainable Affordable Housing in Nigeria. *Open Access Library Journal*, 9: e9396.

<https://doi.org/10.4236/oalib.1109396>

**Received:** September 30, 2022

**Accepted:** October 15, 2022

**Published:** October 18, 2022

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## Abstract

Living with a place to call home is one of life's most important aspects, after food. Housing is an essential component of the solution to Nigeria's burgeoning metropolitan population, which poses severe problems for the government as well as the metropolitan population. To address Nigeria's rising population's housing needs, the private and government sector are exploring local alternatives to the regular building materials due to their soaring price. In this article, the incentives of stabilized clay bricks usage as a local and eco-friendly building material for construction are suggested and emphasized; its basic components are easily obtainable locally; it is concluded that the long-term viability and sustainability of this construction material will significantly assist the country in the provision of surplus affordable houses thereby alleviating its housing deficit. Proposals were made on employing this local and eco-friendly building material to offer affordable housing for most Nigerians living in rural and urban areas.

## Subject Areas

Sustainable Buildings

## Keywords

Sustainable Materials, Affordable Housing Provision, Sustainability, Sustainable Housing, Stabilized Clay Bricks

## 1. Introduction

The concept of affordable housing refers to housing that is built to be accessible to everybody, irrespective of their income or age. Affordable housing can also be

defined as housing that is within the reach of those with household incomes that are lower than the average as ranked by the government that maintains the housing affordability index. If the explanation above is placed into context, it demonstrates that Nigeria is struggling to meet its ever-growing population's need for affordable housing [1]. However, it is an indication that the Nigerian government should make stronger efforts to end the transformation phase and focus on methods to better utilize the resources available in a more sustainable way in improving the affordable housing supply. Nigeria, with a growing housing deficit of 17 million housing units, is one of the world's largest markets for new house building aimed at low-income populations. To close the supply shortfall of 23 million units by 2030, 2.6 million homes must be built per year. Yet, optimistic estimates indicate that just roughly 200,000 homes are being created every year [2]. To what extent, then, could Nigeria achieve the goal of balancing the demand for affordable housing with the supply in a developing country? Hence, there is the need to understand exactly what the challenges are, how to solve them, and what is the best strategy to adapt to achieve a suitable result in a short timeframe, identify the obstacles to providing affordable housing in Nigeria as problems of unskilled labour, unobtainable contemporary building standards, housing finance, increased level of urbanization, poor governance programmes, violations of building codes, and substandard building materials. The fact that millions of people cannot afford the price of houses on the market or rent them from their landlords is another reason why tens of millions of people have housing issues, in addition to everything else above [3].

Buildings have an influence on their surroundings, which causes climate change. Collecting so much groundwater and squandering water is required so that the groundwater surface recedes. A great deal of waste effects, such as rubbish, unclean water, and domestic waste, pollute the environment and contribute to the impacts of greenhouse gases, mostly heating from the AC machine [4]. It also has a negative effect on users, such as disrupting health and decreasing activity efficiency. Furthermore, once construction starts, it contributes to a variety of negative environmental effects, including waste materials, noise, smoke, and dust, among other things.

Many architectural professionals and other specialists offered and implemented answers to these problems, beginning with sustainable building materials, designing a house to grow, and constructing a structure that is light and quick. Adopting the notion of sustainable design and construction becomes one of the primary options for achieving environmental balance. The activist sustainability movement began in 1970, and many buildings have used the notion since then. There are numerous energy-efficient structures nowadays. One example of sustainable material is solid interlocking clay brick, where the material utilized consists of rocky clay soil, cement, and water, which are mixed to make multiple modules [5]. After the first impression, it appears that creating sustainable materials is simple and can help to mitigate the effects of global warming. As a result,

studies into the incentives of solid interlocking clay bricks as a sustainable material for constructing sustainable housing in Nigeria are required. This research is being undertaken to educate that solid interlocking clay brick is simple to make and may significantly assist Nigeria in addressing its massive housing deficit. This material is also good for the environment. The research approach was observation, precedent, and literature review.

## **2. Literature Review**

### **2.1. Affordable Housing Provision**

In 2005-06, the Office of the British Deputy Prime Minister (BODPM): investigated Affordability and Housing Supply, defining affordable housing as housing that is subsidized for those who cannot afford secure decent housing on the open market, whether renting or buying [6]. Hence, it ensures that housing initiatives will remain stable and are not affected by changes in the country's political situation. Achieving affordable housing requires defining a country's housing needs and ensuring that end-users are satisfied. The general goal of affordable housing is to fill the housing shortages of a nation while ensuring that all residents, regardless of income or age, can afford it. Housing shortages have been documented throughout all African countries, with rural shortages being more prevalent than urban shortages. Nevertheless, housing shortages are a global concern that affects both emerging and developed nations [6]. Against this backdrop, members at the housing summit held by the United Nations in Vancouver, Canada, in 1976 called for a totally different methodology for housing reform. A strong commitment from nations was expected to be made to the strategy, specifically to assist the poorest inhabitants in the world. As a result of increased demand for urban commodities, the rapid growth of urban centres has resulted in higher living costs. In the urban setting, the land is in scarce supply, and housing prices are expensive, making most urban households unable to afford it [7]. Low-wage workers who have irregular employment are a very significant part of the urban population. People living in this area of the city are impoverished and have access to limited, insufficient, overcrowded, dirty, and cold shelter and deteriorated surroundings. They are the cities impoverished, whose lives are marked by insecure diet and health, as well as a lack of or inferior material assets [7]. One of the greatest issues facing humanity in this century is providing affordable housing in urban areas.

Research has shown that affordable housing problems occur everywhere, but they are particularly acute in third-world countries, such as Nigeria. Most people find it difficult to obtain housing in the cities of less developed countries, where a rapid urban population expansion because of substantial migration from rural-urban has exacerbated the dwellings crisis. Most of the cities impoverished dwell in overcrowded conditions, mostly in makeshift shelters in slums and squatter settlements, which puts a burden on decaying city foundations and public facilities [3]. The population of cities in Nigeria continues to rise at its fastest pace

in recent years. In addition, the concentration of this population in metropolitan areas has exacerbated housing shortages, leading to congestion in substandard housing and a situation where 60 per cent of Nigerians are houseless [7]. To reduce the price of construction materials in Nigeria and other third-world countries, huge quantities and low prices of construction materials are necessary. Construction materials are typically more expensive than they need to be due to the construction market's monopoly that often controls the production of cement, roofing, glass, and steel. Governments should also heavily promote the development of local and environmentally friendly construction materials.

## **2.2. The Local Economy and Construction Materials**

A local community may benefit from manufacturing construction materials in terms of employment, tax revenue, and other economic and social benefits. A forward-thinking manufacturing company may also support projects for the community's benefit, including those related to environmental, educational, and cultural issues. Local buying represents a bioregional economics maxim [8]; it may also be regarded as smart economics. The advantages of local products over imported products are that even if the cost of production is higher, more of the revenue stays in the local economy, improving the tax base and reducing the demand for social support. Additionally, it keeps the responsibility of resource management and waste reduction on the local community. Furthermore, local items require less transportation and resources.

## **2.3. Sustainable or Eco-Friendly Building Materials**

Environmentally friendly building materials are those that use resources efficiently, produce less waste, and are safe for humans and the environment. Throughout the last two centuries, human activities have impacted the environment greatly, from resource extraction to manufacturing, use, and disposal of building materials. Increasing urbanization has made finding the raw materials and energy to make construction materials more difficult in the last half-century [9]. Waste generated during their creation, use, and disposal, as well as the need to absorb that waste, have become urgent global problems. According to the World Resources Institute (WRI), manufacturing Portland cement accounts for 8% of all human-induced greenhouse gas emissions [10]. The tremendous amount of deforestation occurring around the world to obtain wood for construction is another prominent example. Due to this, forest diversity, water quality, soil stability, and other long-term ecological and economic values have all suffered.

Locally manufactured stabilized interlocking clay bricks are shown in **Figure 1**. These bricks are eco-friendly, fire, heat, and water resistant and can be used for building affordable houses in Nigeria.

All manufactured building materials companies consume raw materials, and energy, and produce waste, so they are major targets for efficiency improvements and pollution reductions all over the world. The quest for ecologically friendly



**Figure 1.** Stabilized interlocking clay bricks.

materials in the building industry is part of a larger effort to lower the environmental impact of construction and the use of structures. Building materials that are environmentally friendly can be made from traditional sources such as earth and stone, from existing industrial processes that are environmentally friendly, or from innovative processes or raw materials such as industrial waste. Materials that are environmentally friendly, irrespective of their source, are just one component of a wide spectrum of measures required to make buildings and communities more economical and environmentally responsible.

### 3. Methodology

This study was carried out using data processing methods such as data retrieval, and various advantages of solid interlocking clay bricks as a sustainable building material, as well as how to process and produce them, will be explored. Quantitative research in a descriptive manner seeks to describe and synthesize diverse community circumstances, situations, or factors. In the case of this research, the descriptive format was used [11]. The descriptive approach is a way of discovering facts with the understanding and interpretation by examining challenges in a certain community's circumstance or era, including interactions, attitudes, and procedures. The goal of descriptive research is to create a structured, accurate, and detailed account of the phenomena under investigation [12].

### 4. Results and Findings

#### **The Incentives of Stabilized Interlocking Clay Bricks as a Sustainable Material for Construction**

Stabilized interlocking clay bricks, also known as hydrator bricks, are a type of eco-friendly building material. Using stabilized interlocking clay bricks instead of traditional burnt bricks reduces energy consumption, greenhouse gas emissions, and waste [13]. Stabilized interlocking clay bricks residences, which are mostly built from local soil, are far more energy-efficient than traditional concrete structures in many Nigerian cities because they are mostly constructed from geological soil.

Buildings made of earth that are stabilized lessen the burden on over-harvested forests around the world. Approximately 80% of the resources required to manufacture stabilized interlocking clay bricks come from clay which Nigeria has in abundance. The materials required for its construction are gathered locally, so no large mines are required for materials, and any blemishes left behind from clay extraction can usually be fixed quickly and easily without causing environmental damage [14]. Nigeria's economy is not robust enough to support the import as well as the use of high-priced construction resources for development projects. Additionally, several of the current local construction materials require a lot of capital to produce since they rely on advanced technology.

The QTJ2-40 manual clay brick building machine shown in **Figure 2** is low cost and sturdy, simple to use and requires no electricity. It is high in product density, rapid in product forming, and powerful in pressing force. People can stand on the brick once it has been remolded. Raw material consumption can be minimized.

The use of stabilized interlocking clay bricks in affordable housing construction is shown in **Figure 3**. These bricks are simple to manufacture, environmentally friendly, long-lasting, aesthetically beautiful, less expensive, and simple to erect.

Newly made stabilized interlocking clay bricks manufactured on-site, Owan West, Nigeria is shown in **Figure 4**. The bricks are made using a consistent mixing ratio of clay, laterite, stone dust, cement, and water.

Buildings constructed using stabilized interlocking clay bricks require little skill to construct and are suitable for owner-builder house projects. The manufacturing process can be learned in a week-long workshop. A major advantage of



**Figure 2.** QTJ2-40 affordable manual clay brick-making machine.



**Figure 3.** Stabilized interlocking clay bricks used in construction.



**Figure 4.** Stabilized interlocking clay bricks newly made.

stabilized interlocking clay brick buildings is that they can be quite cost-effective. The bricks are usually made where the construction is situated using materials that are accessible. Good grain distribution and cohesive performance in clay soil are desirable for the manufacture of the bricks, although the proportion of clay and pebbles must be monitored [6]. Using a simple clay brick-making machine, soil and cement are hydraulically compressed to create the interlocking clay bricks. Waste materials can be recycled and repurposed on-site if they are underutilized.

Stabilized interlocking clay bricks have several advantages over traditional types. By eliminating binding mortar in the superstructure and thus reducing workmanship, also saves significant construction costs. As a result of the utilization of easily accessible clay or laterite as the primary raw material, they do not necessitate costly combustion, and the bricks are prepared on-site, which reduces transportation costs considerably. Further, the rapid speed of construction makes the system attractive since its construction approach is significantly faster than other methods [7].

Affordable and sustainable housing delivery necessitates the users' participation, and their housing needs to be specified. The major goal of sustainable affordable housing is to address the basic housing necessities of the world's poor without jeopardizing succeeding generations' capacity to achieve their own housing needs. Sustainable housing relies on fundamental changes in society, institutional restructuring, and managerial strategies [15]. To achieve this goal, the government must have the political will, based on a belief in its responsibility to its residents, as well as a desire to create a dedicated and dignified living environment. Providing sustainable housing for Nigerian citizens requires proper prioritization of housing needs, as a result, a well-organized strategy for accomplishing this must be meticulously designed. The government could launch massive support initiatives for the utilization of stabilized interlocking clay bricks in construction, along with housing units at an affordable cost based on the input of local communities. Additionally, it can assist with the purchase of construction materials, which account for around 60% of the total cost of construction. Support should be provided by the government to private investors developing indigenous building materials such as stabilized interlocking clay bricks [16].

The primary raw material in stabilized interlocking clay bricks, as seen in **Figure 5**, is clay soil, which Nigeria possesses in abundance. Clay lasts much longer, retains its colour, weathers better is resistant to fire and harsh weather, and is durable and stable in flood situations.

The easy production process of stabilized interlocking clay bricks is depicted in **Figure 6**, which requires no electricity, less manpower, less labour, and is faster than other traditional methods.

The strength, solidity, and durability of stabilized interlocking clay brick after manufacture are depicted in **Figure 7**. The bricks are being stood on demonstrating their stability and strength.



**Figure 5.** The major raw material is clay soil.





**Figure 6.** The manufacturing process of stabilized interlocking clay bricks.



**Figure 7.** Stabilized interlocking clay bricks after manufacture.

## 5. Conclusions

It has been determined in this article that affordable housing is severely scarce in Nigeria's rural and urban areas. The article acknowledged Nigeria's economy was not strong enough to support the importation and usage of expensive construction materials for development projects. According to Nigeria's National Housing Policy, there were 17 million housing shortages in 2012, and 30 million are expected by 2022 [2]. Additionally, the paper noted that some building materials made locally rely on advanced technologies that are capital-intensive to manufacture. In addition to these expenses, transporting materials to the work-site often increases the total cost of construction. The paper points out that local resources are used for manufacturing stabilized interlocking clay bricks, large mines are not required for manufacturing this sustainable building material, and blemishes resulting from laterite mining can usually be repaired easily and without causing excessive environmental harm [16].

Additionally using stabilized interlocking clay bricks for construction requires less skill, making it ideal for affordable house construction and owner-builder house projects [17]. This paper states that Nigeria has a lot of clay soil and late-

rite resources that are needed to manufacture stabilized interlocking clay bricks, which account for more than 80% of the total resources needed. Because of the relatively low level of technology required in its manufacture, the cost of building walls is sufficiently lowered.

A local and eco-friendly material such as stabilized interlocking clay bricks, when used in the construction of homes, can significantly alleviate Nigeria's housing shortage. Therefore, the report advocates that all levels of government work in cooperation with housing officials and affiliated construction industry expert groups promote and support stabilized interlocking clay bricks' production usage and particularly for affordable housing projects.

To ensure the success of stabilized interlocking clay bricks and eco-friendly building materials, it is also necessary to undertake a fundamental housing reform and to get strong political support at all levels of government. These approaches, it is hoped, will encourage many Nigerians to build their own homes and reduce the amount of foreign exchange that would have been spent by the government on the importation of building materials.

## Acknowledgements

I would like to thank all co-authors for their constructive discussions during the research's progress.

## Conflicts of Interest

The authors declare no conflicts of interest.

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