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Sustainability of traditional building practices in Nigeria: The case of Igala traditional architecture

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Abstract

Nigeria's diverse ethnic landscape is marked by distinct traditional building practices, each representing a unique cultural identity. This study delves into the architectural heritage of the Igala people of North Central Nigeria, shedding light on their sustainable building practice. Despite its profound cultural and historical significance, the Igala traditional architecture, like many others in Nigeria, faces challenges due to modernization. This trend is pervasive across Nigeria, where contemporary buildings often disregard indigenous socio-cultural, environmental, and climatic considerations in their design and construction. Consequently, modern buildings in Nigeria tend to be costly and incompatible with the local culture, environment and climate. This study explores the imperatives and values of Igala traditional housing pattern, aiming to enhance the sustainability of contemporary building practices in Nigeria. Employing a narrative approach, the study utilized archival/historical research, field surveys, and interviews with local building professionals, indigenous elders, and environmental experts to explore the Igala traditional building practice. Thematic content and descriptive analysis were used to interpret the gathered data. The study revealed intrinsic features of Igala traditional housing pattern, including the courtyard system, hierarchical spatial arrangement, organic expansion, food storage facilities and the integration of socio-economic and socio-cultural spaces. These features exemplify sustainability through values such as security, privacy, communal living, cultural identity, energy efficiency, resource efficiency, passive solar techniques and environmental conservation. The research emphasized the critical importance of these identified features and values, not only for preserving cultural heritage but also for guiding sustainable contemporary architectural practices in Nigeria.

Keywords: Sustainability; Igala; Traditional Architecture; Culture; Building Practice

1. Introduction

Cities are artefacts of information, technological change, economic growth and cultural transformation. Throughout history cities have been very complex products of human activity. Now there is a growing worldwide attention to sustainable development, where the needs of today's generation do not conflict with the abilities of future generations to fulfill their needs [1]. The construction industry and its activities are responsible for a substantial amount of toxic waste emissions into the atmosphere that cause global warming and climate change. This very phenomenal climate crisis, poses new challenges such as extreme weather conditions, rising sea levels, and heat waves to the built environments. The construction industry has an important role to play in socio-economic development and quality of life. The need was subsequently identified for an internationally agreed upon agenda for sustainable construction to guide the industry in preparing for and implementing the principles of sustainability and support Agenda 21 and the Habitat Agenda [2].

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Nature plays a very crucial role in sustainability as it is efficient and effective in designs that produce essentially zero waste. For instance, a typical traditional building of earth emits fewer greenhouse gases, consumes less energy, and maintains a high level of internal thermal comfort, regardless of prevailing solar radiation outside. To curb the increase in significant global warming and its results beside expensive and limited fossil fuels, adjusted energy consumption in buildings and use of natural resources have become very necessary [3]. This is more so especially as the building sectors consume more than one third of the world's energy, and contribute to global warming [4].

Sustainability must take into account a process that is restorative, regenerative, dynamic and efficient as opposed to energy intensive, resource dependent, extractive and disposable methods. This view is consistent with the study conducted by Salama [5] which posited that sustainability is envisioned as a state in which all humans, now and in the future can live at a decent level of wellbeing within the limits of what nature can and continue to provide. Johnson [6] defined sustainability as being rooted in a spirit of cooperation and commitment to utilize technology in a morally and socially responsible manner so that buildings and cities nurture human spirit and fully respect nature. Furthermore, in order to create sustainable architecture, the architect must holistically mesh the knowledge of the new with that of the old so that a built environment that respects culture, environment and history of the inhabitants can be created and preserved.

In addition, sustainable development could be achieved by architects, engineers, designers, town planners, and manufacturers of building components working cooperatively to produce green buildings that are designed, built, renovated, operated, or reused in an ecological and resource efficient manner. Green Architecture is an approach to architectural design that emphasizes the place of buildings within both local ecosystems and the global environment. Green building is the practice of increasing energy efficiency, while reducing building impact on human health and the environment through better planning, design, construction, operation and maintenance. A similar concept is in natural building which tends to focus on the use of natural materials, renewable recourses, and passive solar techniques [7].

Contemporary building design strategies derive their influence from concepts, practices and cultures peculiar to the western countries. Thus, this has contributed immensely to the production of specific brand of building forms that do not put into cognizance necessary environmental factors in the design, rather, the resultant architecture is often compact airtight residential buildings that tend to rely heavily on mechanical devices and electricity for conducive indoor environment. As a result of this, reliance on air-conditioners during the day appears to have become a norm for most people especially in the tropical region who need thermal comfort in their enclosed spaces [8]. Unfortunately, sustenance of this active means of maintenance for conducive indoor environment, do not seem to be sustainable due to incessant electricity power outages and also as a result of perennial scarcity of fuel to power privately owned generating sets [9]. In developing countries where majority of the people are living in poverty and abject destitution, incessant and intermittent electricity power outage creates additional financial burden on the people's hitherto overstretched income. This is due to the frequent damages the outages caused to household electrical gadgets, fittings and appliances that in turn create the need for unbudgeted repairs including outright replacement in some cases. The situation is further worsened by the inability of the society to curb unwholesome practices in government and the power sector in particular.

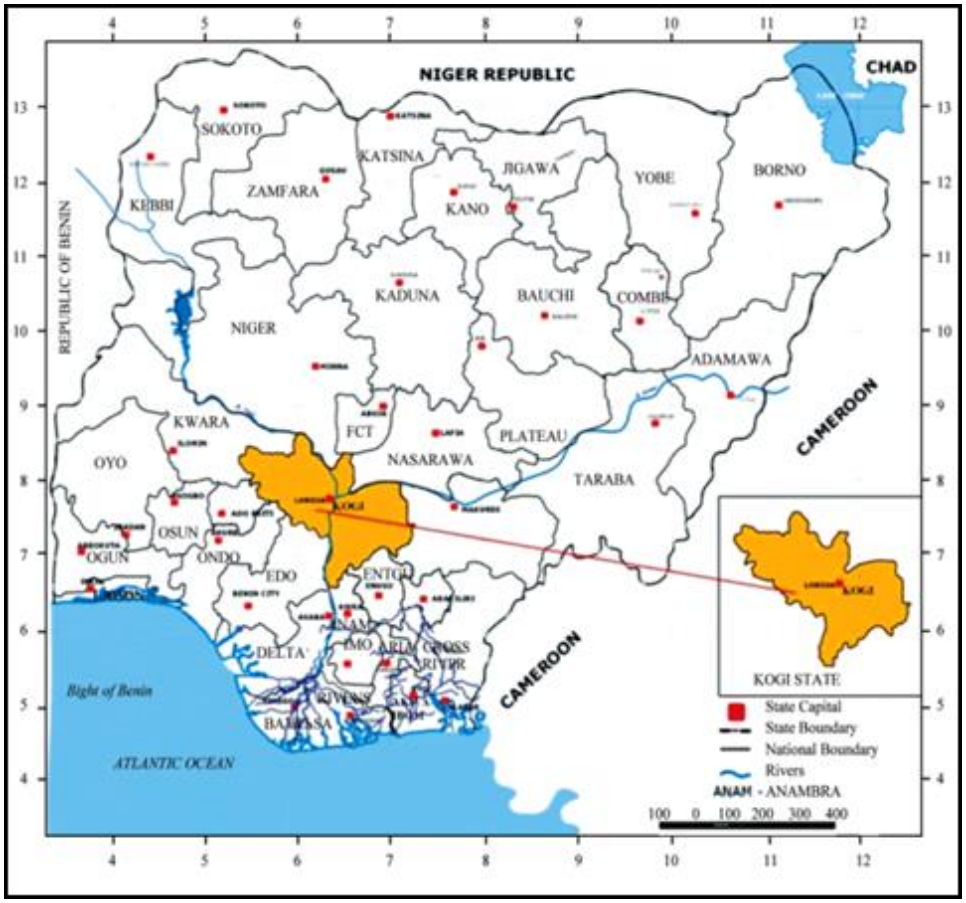
Furthermore, Odum [10] opined that most people in developing countries admire and embrace new alien ideas, materials and technologies, and indeed have developed unprecedented preference and excessive reliance on them, as they are often used to create the type of architecture they consider symbol of progress. They do this to the detriment and total abandonment of vernacular/traditional building design strategies and concepts, which they perceive as reflecting backwardness and poverty [11and12]. Meanwhile, Idakwoji [13] stressed that "vernacular architecture in general and particularly that of traditional institutions is an important aspect of the living culture of a people and should be one of the major parameters used in evaluating the level of development of a people. Yet, little or nothing has been done to preserve indigenous architectural character in Nigeria towards appropriate assessment of the past, present and probably the future". The Igala traditional building practice is not an exception.

Therefore, the goal of this study was to investigate the imperatives and values of the Igala traditional architecture with the view to enhancing the sustainability of contemporary building practices in Nigeria. This is with the aim to drawing the attention of architects and stake holders in the housing development and construction industry to this all important issue. The objectives of the study were to: (i) determine the Igala traditional housing pattern; (ii) determine the Igala traditional building technology (iii) determine the Igala traditional building materials and (iv) determine the key features and values of the Igala traditional architecture.

2. Literature Review

2.1. The Study Area

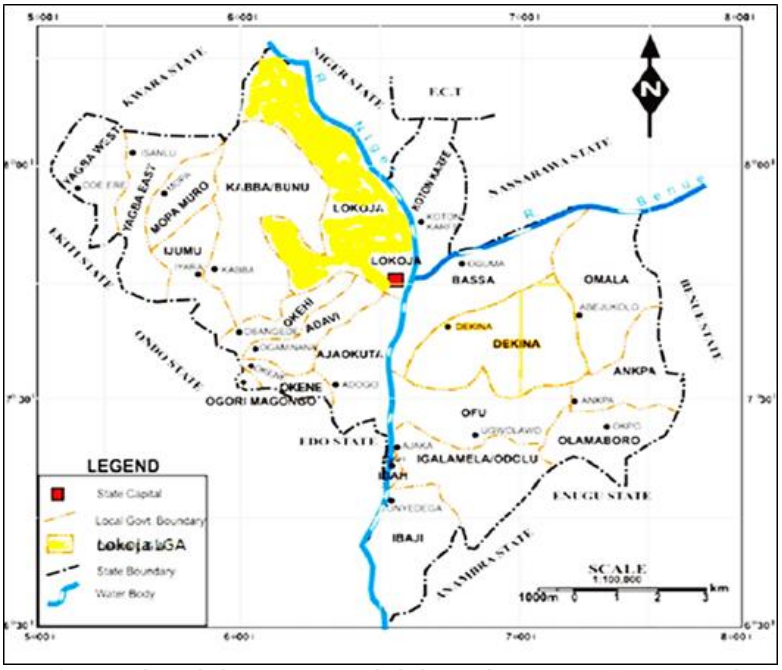
The study area is Igala community in Kogi State, North Central Nigeria. Nigeria is a country in West Africa comprised of thirty six (36) states with Abuja as her capital (Fig. 1). The home of the Igala people is situated east of the River Niger and Benue confluence and astride the Niger in Lokoja, Kogi State of Nigeria. The area is approximately between latitude 6°30 and 8°40 north and longitude 6°30 and 7°40 east and covers an area of about 13,665 square kilometres [14].



Source: Kogi State Ministry of Land and Environment (2008)

Figure 1 Map of Nigeria Showing the Location of Kogi State

The Igala population is estimated at one million, five hundred thousand (1.5 million) according to the National Population Census [15], of which over 70% are vocationally engaged in subsistence farming. The traditional Igala society is largely agrarian, although fishing is also a mainstay of the people especially the Igalas of the river shore town of Idah. The Igalas occupy nine Local Government Areas out of the twenty one Local Government Areas of Kogi State (Fig. 2). These include*; Ibaji, Idah, Igalamela-Odolu, Ofu, Dekina, Ankpa, Omala, Olamaboro* and *Bassa* Local Government Areas [16].



Source: Department of Geography and Planning, Prince Abubakar Audu University (PAAU) Anyigba, Kogi State (2019)

Figure 2 Map of Kogi State Showing the 3 Senatorial Districts and the Local Government Areas Occupied by the Igala People

3. Research Methodology

3.1. Sampling Technique

To choose compounds and houses for the survey, all the nine local government areas that form the study area were considered. From each local government area, a random sample ward was selected. A purposive sampling approach was utilized to purposefully select 50 compounds or houses from each selected ward, resulting in a total of 450 compounds or houses surveyed throughout the study area. This formed the basis for questionnaire distribution and physical observation. The selection process considered the buildings' representation of traditional residential architecture. However, to facilitate the survey process, 50 research assistants were selected and trained in survey techniques, and were engaged in the collection of data.

3.2. Research Design

This study employs a multi-method research design, comprising the following components:

3.2.1. Quantitative Survey Instrument (Questionnaire)

The survey questionnaire was meticulously designed with specific close-ended questions to fulfill the study objectives and to capture essential aspects of Igala traditional architecture. It aimed to gather information about the historical and present building materials and techniques used, housing pattern, features and forms, changes in building designs and materials, factors contributing to the paradigm shift from traditional to modern building styles, and the perceived sustainable advantages or disadvantages of contemporary buildings in comparison to traditional designs. The questionnaires were distributed to the household heads or members of the selected compounds/houses that were willing to participate in the exercise. However, of the 450 copies of the questionnaire that were distributed, 386 copies were retrieved, representing a valid response of 85.8%. To ensure inclusivity, questions were translated from English language to Igala language when the need arose.

3.2.2. Physical Observation

To enhance the interview data, on-site examinations of traditional buildings and construction methods were conducted using an observation schedule. These physical observations provided valuable insights into the materiality, craftsmanship, and practical aspects of Igala traditional architecture. The researchers independently observed compounds and buildings showcasing Igala architecture. The specific elements examined include the spatial

organization of compounds, house forms, the types of building materials used, and the construction processes. The observations were conducted systematically and logically, and the findings were documented through sketches detailing the building plans and elevations.

3.2.3. Archival/Historical Research

Thorough reviews of existing literature were undertaken to elicit pertinent historical documents, texts, photographs, and artefacts related to Igala architecture. This archival research played a vital role in offering valuable insights into the historical background and cultural importance, features and values of traditional building practice among the Igala people. The process of extracting information from these archived materials involved examining scholarly works pertinent to the study, consulting documents maintained by organizations, and conducting a systematic review and analysis of these sources. This approach is aimed at identifying the core themes and issues pertaining to the subject of the study.

3.2.4. Ethnographic Method

A semi-structured interview approach was employed to gather firsthand accounts and insights from significant number of individuals, including environmental experts, traditional building artisans, elders, and members of the Igala community. Akin to the experiences of the Middle Ages construction when buildings were designed by the people that built them, it was gathered that the Igala master brick-layers and master carpenters learnt their trades by knowledge transferred to them through apprenticeship and by words of mouth from father to son. Trade secrets were closely guarded, as they were the source of a craftsman's livelihood. The craftsmen relied on experience, models and rules of thumb to determine the design and sizes of building elements. Contacts with some of these craftsmen were very helpful during the ethnographic approach of the research methodology. The contacts provided invaluable viewpoints on the evolution of Igala traditional building practice; how tradition and modernity intersected in the architectural development of the Igala people; and the sustainable attributes of Igala traditional architecture. The selection of participants was purposive, focusing on individuals with substantial knowledge of Igala history and architectural traditions. The data from these interviews was recorded manually for analysis.

3.2.5. Oral Traditions and Cultural Proclivities

The study incorporated oral traditions and cultural preferences conveyed through storytelling and communal narratives to provide context to the historical and contemporary importance of Igala architecture. This incorporation brought an authentic cultural perspective to the study. The researchers engaged in verbal exchanges with indigenous individuals, recording these interactions by taking notes using pen and paper. Additionally, anecdotal evidences were gathered based on the researchers' own experiences as indigenous members of the study area.

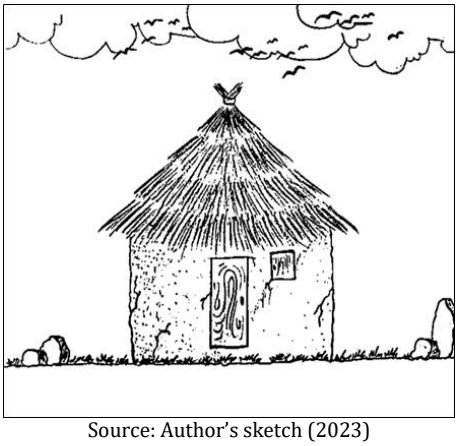
3.3. Method of Data Analysis

The collected data was analyzed, focusing on identifying sustainable practices in terms of building techniques and materials. The interview data was subjected to thematic analysis, which involved identifying patterns within the data and correlating them with structured classifications obtained from the surveys. The narrative was constructed based on the synthesis of these findings, weaving together the historical context, cultural significance, and building practices in relation to sustainability.

4. Data Presentation and Analysis

4.1. The Igala Traditional Housing Pattern

The circular curvilinear housing pattern as practiced by the Igala people drew inspiration from the caves that were once inhabited by the Igala ancestors before the development of structured house-building practices. These caves offered circular voids and hollows, some of which occurred naturally, while others were carved, providing warmth, shelter, and defence against wild animals and reptiles. Similarly, the Igala traditional housing pattern aimed to offer these essential requirements for the inhabitants. The houses were constructed with circular plans, mud walls, and thatched roofs covering wooden supports or mud domes, and sometimes wattle and daub walls (Fig. 3).

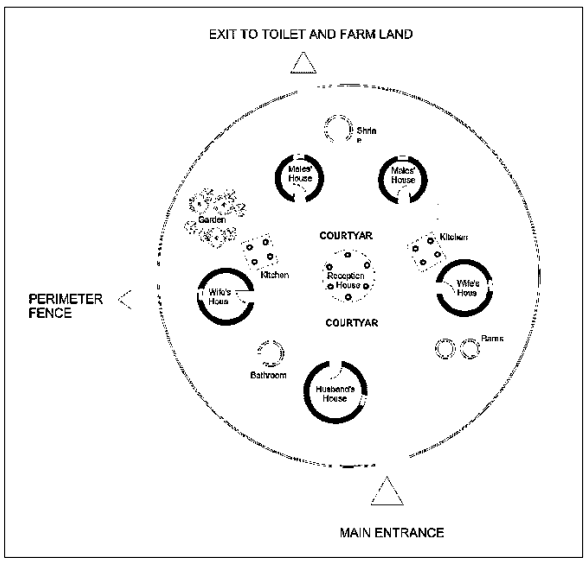


Source: Author's sketch (2023)

Figure 3 Igala Traditional Sleeping House

The Igala traditional houses were characterized by conical roof structures and stood independently, enclosing a courtyard that housed a reception house known as 'atakpa'. These houses were highly adaptable, catering to the daily activities of the people. Farming and animal husbandry were seamlessly integrated into the compound's design, with designated areas for animal pens, vegetable gardens, and barns. The compound had a circular layout, although some regions in Igala land had rectilinear layouts even before the colonial period when rectangular house forms became prevalent. Individual houses within the compound were circular in shape, forming a central courtyard where the reception house was located. This reception house served as a place of hospitality for visitors, aligning with Igala customs and traditions. The courtyard acted as the heart of the compound, connecting all spaces and activities. According to [17], it provided optical and auditory defense to the structure and the built environment. This courtyard, along with the reception house, played a crucial role in the socio-cultural life of the immediate compound and the broader community, serving as a hub for social activities. Shrines were also incorporated into the compound to facilitate religious practices.

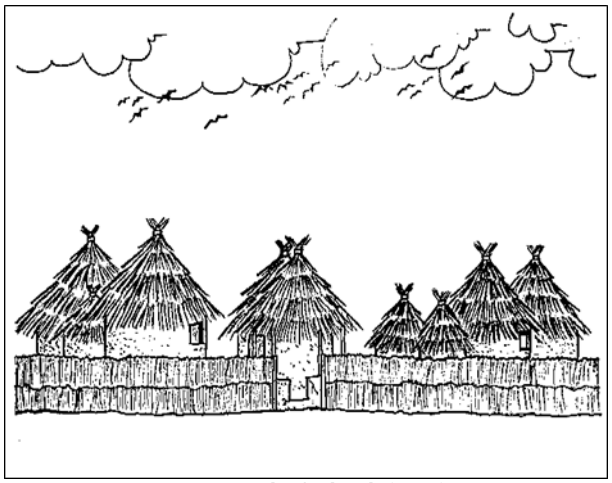
In Igala culture, security and privacy held great importance, and these values were reflected in the architectural features of their homes. To ensure security and privacy, houses were designed with small windows, limited in number. This design choice aimed to safeguard the households. Furthermore, a perimeter fence defined the boundaries of the compound, featuring an entrance or opening known as 'ọna' in Igala. This entrance, usually located close to the head of the compound's house (the husband), allowed him to screen visitors and trespassers effectively (Fig. 4). While each traditional compound exhibited its unique architecture, it was tailored to the specific environment and the needs of the occupants, demonstrating the careful consideration given to both practicality and cultural values.



Source: Author's sketch (2023)

Figure 4 Plan of Typical Igala Traditional Housing Pattern

The traditional Igala housing pattern comprised of several spaces which include; the head of the compound's hut (unyi-udachi enęgbani), wives' huts (unyi-udachi abobulę), adult males' huts (unyi-udachi abokęlę), kitchen/cooking Space (obuka), animal pens (unyi-ęṅu-ǫrę), reception hut (atakpa), courtyard (okolo), bathrooms (unyi ugw'ǫla), food barns (aka), shrine hut (achękwu) and perimeter fence (ǫgba) (Fig. 5). The bushes were used as toilet. These findings are consistent with the submission by [18], in a study conducted on the assessment of the impact of modernization on the Igala traditional house form.



Source: Author's sketch (2023)

Figure 5 Approach view of Typical Igala Traditional Housing Pattern

4.2. Igala Traditional Building Practice

The Igala traditional building practice was shaped by tradition; the extant builders' knowledge in accordance to the cultural norms; practices transmitted by word of mouth or apprenticeship; available building techniques; and the available building materials.

The construction method of traditional houses in Igala land focused solely on buildings supporting their own weight and wind load, without bearing the weight of the roof. Instead of the roof beams resting directly on the mud walls, they were either supported by vertical posts located just outside the walls or embedded within the walls. This design created a space between the wall and the roof, allowing for air circulation and cross ventilation. Additionally, the roofs had overhanging eaves (known as ǫjǫlǫ) that protected the clay seats surrounding the hut from harsh weather conditions. These eaves were supported by vertical posts, some of which were artistically carved, forming a low veranda. This design prevented rainwater from directly affecting the walls and also kept it from entering the house through the eave openings. The steep slope of the roof facilitated rapid drainage, crucial in the face of frequent torrential rainfall in the area.

The houses had limited door and window openings, mostly oval or square in shape. Round openings were strategically used in mud walls to prevent cracks and crumbling that often occurred with rectangular openings. Wealthier households had door entrances with low lintels and raised thresholds, often intricately carved with symbols like alligators (abaji) or leopards (ǫmataina) representing creatures from mythology. This study identified the Igala traditional building techniques adopted in the construction of various elements of the Igala traditional building as discussed below.

4.2.1. Foundation Construction

In traditional Igala building practice, there was a unique approach to the construction of building foundation. Instead of using conventional foundation footings, the builders relied on the natural load-bearing soil as the base for the mud structure. To create the walls, builders dug narrow and shallow trenches along the planned wall positions. These trenches were typically shallow, measuring around 250 millimeters and not exceeding 400 millimeters, mainly due to the lightweight of the building. The width of these trenches was approximately 450 millimeters. For the foundation material, clay was compacted and rammed into these trenches.

By utilizing the natural load-bearing soil as a base, the builders minimized the environmental impact of the construction process by avoiding the need for additional materials. Also, the use of locally sourced clay as foundation material

demonstrated responsible use of available resources. Additionally, the shallow trenches reduced the amount of excavation required, conserving energy and resources. This approach reflects an eco-conscious mind set and aligns with sustainable building practices, making it an integral aspect of traditional Igala architecture.

4.2.2. Wall Construction

The Igala people employed two distinctive methods for wall construction: the framework, wattle and daub method, and the monolithic wet wall construction method. In the framework, wattle and daub method, the primary structural elements include forked posts and vertically placed intermediate sticks. Horizontal components of the framework were crafted from low-diameter sticks, typically sourced from palm fronds or bamboo. These sticks were securely fastened to the vertical supports using natural fibres or ropes obtained from palm fronds. Through meticulous binding, a robust grillage was created, ensuring even distribution of forces across external walls and ultimately to the foundation. The framework was then covered with wet and kneaded mud, forming a protective layer.

In the monolithic wet wall method, the wall was built using well-kneaded and wet mud, carefully prepared for workability. The process began with site clearance, followed by pit excavation until a layer of plastic laterite was reached at a certain depth. The excavated earth was mixed with water and compacted underfoot, forming paste lumps roughly the size of a man's head, ready for walling. The lumps which were oval in shape are called ‘otubęli’. They were diligently prepared from the building earth, clay and fine sedimentary rock pieces plus chopped straw to obtain the required plasticity.

In the construction of multi-story buildings like the ‘odogo’ of Attah lgala Palace located at Idah, a unique and intricate method was employed. Instead of using regular water, the mud was mixed with palm oil. This method served as an effective defence against harsh weather conditions, particularly heavy rainfall, as rainwater is naturally repelled by oil. The incorporation of palm oil not only provided protection but also enhanced the plasticity of the building materials, promoting better cementing action and workability. In this way, it was guaranteed that the buildings constructed with this method would withstand the effects of weather elements over many years.

This Igala traditional building practice of walling promotes eco-friendly buildings, reducing environmental footprint and emphasizing the use of renewable resources. Furthermore, the wall construction method which distributes forces uniformly shows an attempt that do not only enhances the building's structural stability but also minimizes stress on the foundation, contributing to long-term stability and durability.

4.2.3. Floor Construction

In traditional Igala buildings, floors were typically constructed with compacted mud from low anthill laterite, which was firmly rammed using a wooden beater or the lower section of palm fronds while it was setting. This thorough compaction ensured strength and durability, enabling the floor to endure pressure from occupants and resist water penetration from the ground. To enhance the floor's finish, palm oil was occasionally applied to create a sheen. Also, cow dung and ashes were occasionally utilized. Additionally, these floors were elevated to approximately 50 centimetres above the ground level. A properly constructed floor of anthill laterite could be almost as durable as cement/sand floor and quite smooth, durable and strong enough to take relevant occupational pressures. This construction technique demonstrates an understanding of the local building materials and their application to achieve easy and cost-effective building practice.

4.2.4. Lintels

Lintel materials in Igala traditional buildings were timber and bamboo stem. Timber posts were used as lintel for monolithic mud construction. In the case of wattle and daub wall construction where there were internal wall reinforcements, the reinforcements of bamboo stem often served as lintel, holding the mud in position, but sometimes, timber posts were also used. This building technique establishes the peoples’ understanding of timber and bamboo as sustainable building materials, and their application to achieve sustainable building practice.

4.2.5. Ceiling, Window and Door

Ceilings were often omitted in traditional Igala buildings due to two primary reasons. First, the buildings had low headroom, therefore, constructing a ceiling would automatically reduce the available volume. Second, the thatch roof did not conduct heat to an extent that necessitated heat control through the use of a ceiling. Where it was necessary, the ceiling was constructed as part of the roof structure. The bamboo joists which formed part of the roof structure were usually crisscrossed within the space in a regular pattern which was aesthetically pleasing, then the ceiling was placed above it. The ceiling material was ‘ichala’ (long stem grass without leaves) or ‘adugbo’ (stems of millet or guinea corn

plants) or 'uloko' (mat), and were also very aesthetically pleasing in their own way. These indigenous materials were good heat insulators, easy to manipulate and were adaptable. The ceiling which did not cover the entire space also served as a platform for storing perishable food items, utensils, and other kitchen items. This innovative technique did not only maximize the available space, but also reflected the practical and resourceful nature of Igala traditional architecture, demonstrating an intrinsic understanding of the local environment and climate.

A distinctive feature of Igala traditional building practice was the deliberate restricted number and size of doors and windows. Notably, the height of the doors necessitated occupants to stoop when passing through. This design strategy has multifaceted reasons, one of which was the regulation of solar radiation entering the building interior and effectively managing indoor temperature. The design strategy is in consonance with the assertion by Liangdong et al. [19] in the study on the influence of doors and windows on the indoor temperature in rural house, which indicated that larger windows result in higher indoor temperatures due to increased solar radiation. The study concluded that with the increase of window size, indoor temperature gets more and more high. And among five simulated schemes, it was discovered that the bigger the window, the higher the indoor temperature, indicating that solar radiation plays an important role on indoor temperature.

Additionally, the limited size and number of windows and doors in Igala traditional buildings were influenced by security concerns deeply rooted in Igala culture. According to local beliefs, witches, wizards, and malevolent spirits were thought to roam villages at night. The small, rarely opened windows served as a protective measure, preventing these entities from peering inside or gaining access to the buildings. This thoughtful integration of cultural beliefs and environmental considerations underscored the pragmatic and purposeful nature of Igala traditional building practice, reflecting a holistic understanding of local climate dynamics and cultural beliefs.

4.2.6. Roof Construction

Roof construction in Igala traditional buildings followed the completion of wall construction. The skeletal framework for roofs was created using bamboo stems, timber sticks, and midribs from palm fronds, and was covered with thatch material. Igala traditional houses featured conical hipped roofs. The roof truss consisted of wall plates, tie-beams, king posts, purlins, and occasionally, struts. Thatch leaves or pill-grass were commonly used as roof coverings.

The roof structure was supported by forked timber posts, typically four in number, strategically positioned within the walls and driven into the foundation. Roof members were securely fastened in place using robust ropes made from bush twines or fibres obtained by splitting and shredding midribs from palm fronds. In certain cases, when the diameter of the roof structure exceeded its height, a central wooden pillar with forked ends was employed for support. The thatching of the roof was not only functional but also served a decorative purpose. Layers of long-stem grass were intricately arranged, creating a visually pleasing effect. The natural texture of the thatched roof, in stark contrast to the modern corrugated iron sheets, enhanced the overall scenic beauty of the structure. This construction method emphasizes the utilization of locally sourced materials and traditional building techniques, demonstrating a sustainable approach to roofing in Igala traditional building practice.

4.2.7. Plastering/Painting

The plastering material used was the thin laterite covering which can be replaced regularly. Various materials were added to enhance the strength and durability of the plaster. A common practice was to mix animal dung into the plaster, which effectively deterred pests like jiggers. Additionally, waste water from palm oil production was sometimes used to reinforce the mixture. Decorative patterns were created on the walls through deliberate sweeping arm movements. In later stages, paintings were made using colour pigments derived from substances such as chalk, camwood and indigo.

4.2.8. Decoration and Ornamentation

In Igala traditional building practice, decorative elements were not haphazardly applied, instead, specific areas of the buildings were carefully chosen for adornment. High-stress structural points, such as door and window lintels, received significant attention. Entrances held particular importance in Igala tradition, functioning as transitional spaces between public and private or semi-private areas. Consequently, the entrance of Igala traditional houses was meticulously adorned to leave a lasting impression on visitors.

Decoration was not limited to exteriors, it extended to interior spaces as well. While some individuals opted to decorate floors, many covered them with woven mats. Additionally, interior walls were occasionally adorned, demonstrating the attention to aesthetic details within Igala traditional building practice. In various regions of Igala land, the decoration of traditional houses was an intrinsic part of the overall building practice. Often, finishes were seamlessly integrated

with decorations, blurring the distinction between the two, as the finishes themselves were inherently decorative. However, there were certain decorative materials that were not inherently part of the construction process. These materials were added to specific areas of the building designated for decoration. Objects such as pebbles and wood ash were occasionally utilized to enhance decorative patterns. These objects were pressed onto the wet mud or plaster, and once dried, they became integrated into the design. Unlike the Hausas of Northern Nigeria, the Igalas did not have motifs specific to their culture.

This approach to decoration demonstrates the unique creativity and adaptability of Igala artisans, where both inherent and added decorative elements were harmoniously blended into the architectural designs, creating a distinctive visual identity for Igala traditional buildings. It reflects the cultural significance attached to specific architectural elements and spaces in Igala tradition, emphasizing the meticulous blend of functionality and aesthetics in their building practice.

4.2.9. Maintenance

Proactive maintenance culture was an integral part of Igala traditional building practice due to the relatively low durability of local building materials. Continuous upkeep was essential, with cracks on walls and floors regularly patched using mud or plasticized red earth. Floors were periodically washed and polished to preserve their shine and gloss. Roof coverings required periodic replacement, typically after each rainy season. Similarly, fence materials were periodically replaced with fresh ones. Maintenance tasks were typically scheduled before and after the rainy season. This diligent maintenance regimen reflects the sustainable approach of the Igala people in preserving the longevity and functionality of their traditional buildings.

4.3. Igala Traditional Building Materials

Common traditional building materials in Igala land include earth/mud (ikętę), timber/wood (oli), bamboo stem (ǫtachǫ), thatch (egbe), palm frond (im'ękpę), palm stem (oli-ękpę), and vegetable fiber/bush twine (ikwu). The use of these materials reflected the harmonious relationship between the Igala people and their natural environment, showcasing a sustainable and time-tested approach to construction. These materials were easily manipulated, making the construction process straightforward. Moreover, they were environmentally friendly and culturally significant, reinforcing the preference for traditional building practices that preserved the Igala identity. The local materials, mainly obtained from the nearby forests and mangrove swamps, were employed with consistent application techniques.

4.3.1. Earth / Mud (Ikętę)

This is the most abundant local building material in Igala land. Clay or laterite soil is prepared by digging it out of the ground, mixing it with water and puddling it. The derivative is mud. The building earth 'ikętę' was the most common walling material and was usually available even from the worst agricultural soil. The combination of clay, sand and sedimentary pieces of aggregates gave the best quality, and created strong and durable buildings. Similarly, Denyer [20] asserted that "unless the proportion of one of these constituents is not proper, mud which is an extremely versatile and strong material can be used for the construction of up to two-storey building".

Mud has several advantages as a construction material. It is a versatile material and can be molded into a wide range of shapes and forms. Its use in rectilinear and curvilinear buildings, as well as the creation of massive structures and thin shell structures are examples of the wide range of its use. Also, mud can be quite durable if adequately stabilized and maintained. It regulates indoor temperature thereby ensuring good indoor thermal comfort.

From a hygrothermal point of view, raw earth behaves as a thermal and hygrometric regulator that slows and attenuates heat waves and stabilizes indoor relative humidity faster than other building materials [21]. This is also consistent with the view of Bollini [22] that due to its thermal and hygrometric properties, raw earth creates comfortable interiors historically described as "cool in summer and warm in winter". This description tends to simplify the physical and technical behaviour of a massive porous material in which coupled hygrothermal mechanisms coexist at a microstructural scale and depending on the pore network geometry [23].

4.3.2. Vegetable Fibre / Bush Twine (Rope) (Ikwu)

The mid-stem of palm fronds were cut and the leaves removed to obtain stiff coarse fibre material used as ropes for tying frameworks. They can withstand tensile stress, but can easily become brittle when exposed for too long before use. Bush twines were alternative binding materials. According to Onyegiri and Ugochukwu [24], vegetable building materials are reusable, biodegradable and ozone friendly, making them sustainable traditional building materials.

4.3.3. Timber (Oli)

Igala land has rich rain forest which provides different types of timber for construction purposes. Abundant supply of Iroko and Mahogany from the rain forest provided strong wood used as beams and posts in Igala traditional building construction. Timber also performed major role as columns. Fork posts were used to support roof framework, they were strong enough to transmit the roof load to the ground. They measure about ten centimetres or more in diameter with the gable roof carriers being taller than the rest. They were also used along perimeter walls as columns. They could either be tall or short depending on the slope of the roof. The sustainability of timber was demonstrated in a study conducted by Ferguson et al. [25] and John [26] by comparing its impact on the environment with three other common building materials. It was discovered that rough sawn timber uses 750 MJ/m3, while steel uses 266,000 MJ/m3, concrete uses 4,800 MJ/m3 and aluminium uses 1,100,000 MJ/m3 of fossil fuel. When fossil fuel is burnt, greenhouse gases such as carbon dioxide, sulphur dioxide, carbon monoxide and methane are emitted into the atmosphere. They have negative impact on the environment. It is obvious from the study that timber requires less fossil fuel to manufacture than steel, concrete and aluminium. Therefore, it is more environmentally friendly and sustainable.

4.3.4. Bamboo Stem (Ọtachọ)

The thick vegetation of the guinea savannah provides Igala land with abundant vegetation of bamboo. Bamboo stems (ọtachọ) were widely used in Igala land in its natural condition as longitudinally split strips, halved culms or as solid culms. The most common application of bamboo in Igala traditional building construction was for wall frames, roof frames and general structural framework. Bamboo is strong, resilient and light weighted, they bear the dead loads and live loads of buildings and the weather. Vertical strips filled between horizontal framing members were required to complete the wall. The function of the vertical filling was to shield against elements of weather and animals, to offer privacy and to ensure the overall stability of the entire building when subjected to horizontal forces. The structure of a bamboo roof was comprised of purlins, rafters and struts. A study conducted by Auwalu and Dickson [27] indicated that the use of bamboo as a sustainable building material in Nigeria is highly encouraged due to its environmental sustainability, physical and aesthetic qualities, workability, and flexibility of space arrangement, its dry construction, and comparative cost-effectiveness. These properties make it a sustainable building material, which can be used for various construction purposes like foundations, floors, walls and partitions, doors and windows, scaffolding, trusses, roofing, as well as other purposes like disaster mitigation and bridge construction.

4.3.5. Grass (Egbe)

The most available thatching material was pill-grass (imperata cylindrica) or (iwọ) in Igala. It is a long growing grass that grows in the fine humus soil of the guinea savannah region of Nigeria. Pill grass grows from 0.6 metres to 3 metres tall. The leaves are as wide as 2 centimetres at the base of the plant and narrow at the top end, the edges have fine teeth and are finished with sharp silica crystals. Pill grass provided roof covering and good indoor thermal comfort for Igala traditional buildings.

According to Haas and Schmid [28], matrix on galvanised steel, thatched and concrete tile roof covering, it was concluded that thatch is the most environmentally friendly. By calculating the embodied energy of the different materials, it was also revealed that thatched roofs are the best choice as discovered from environmental impact assessment. Similarly, according to study conducted by Snell [29] on embodied energy factors, the findings showed that, where only 398.55 million joules are needed for thatched roofs, galvanised sheet metal needs 26, 790.46 million joules and concrete tiles needs 9,478.76 million joules.

4.3.6. Palm Frond (Im'ękpę)

Igala land has an abundant availability of palm trees. Palm trees are the largest contributors of local building materials in the region. Palm fronds (Im'ękpę) are obtained from palm trees. Palm fronds were used for fence construction, the leaves were used for thatching while the midribs after scrapping off the leaves, served as rafters in roof construction. The midribs of palm fronds were among the principal building materials in Igala land. They could be split and used as cross bars in wall construction and in the roofs to serve as purlins. Palm frond has similar characteristics as thatch in terms of factors such as embodied energy. Palm frond as a traditional building material is also readily available, reusable, biodegradable and ozone friendly, making it a sustainable traditional building material [24].

These findings are consistent with the submissions of several authors [4, 30, 31, 28 and 32] which reiterated the sustainability of traditional building materials and their application techniques.

4.4. Features and Values of the Igala Traditional Housing Pattern

The Igala traditional housing pattern is unique and of great value to virtually all aspects of life of the Igala people; culturally, traditionally, morally, spiritually, socio-economically, socio-politically and environmentally. Some of the identified valuable features of the Igala traditional housing pattern are discussed below.

4.4.1. Cultural Identity

The Igala traditional mud houses were reminiscent of cave shelters and were arranged in a manner that suited the people's activities and cultural identity. Through trial and error, the Igala people developed their building technology, incorporating abundant building materials into a distinctive and culturally rich architecture. This traditional housing pattern was seamlessly integrated into the traditional Igala village setting, with the "Ceremonial Square" serving as a cultural core for various social and ceremonial events.

4.4.2. Spatial Organisation and Cultural Hierarchy

The Igala traditional housing pattern was structured based on the traditional principle of zoning, incorporating three major zones:

- The domestic zone, which encompassed the dwelling area and spaces for leisure activities like sleeping and rest; domestic activities like cooking preparation and cooking area (obuka); waste disposal or refuse dump (ojęta); and open defecation area (ugwęręchę).
- The socio-cultural zone, which comprised the courtyard, reception house, and shrine. These spaces were utilized for socio-cultural and religious activities, including meetings, plays, chores, ceremonies, and religious worship.
- The socio-economic zone, which included the animals' pen, garden, and barns. This zone was dedicated to activities like food crop storage, gardening, and animal farming.

In adhering to these zoning principles, the Igala traditional housing pattern effectively organized and optimized the usage of space within the compound, accommodating various aspects of daily life and cultural practice. The spatial arrangement of individual houses reflected the cultural roles and responsibilities of family members. The man's house, positioned at the entrance of the compound, symbolized his protective role and full control over the family. The wives' and females' houses were placed on both sides of the man's house, while the males' houses were situated at the rear of the compound. This arrangement allowed adult boys to have easy access to the farmland through the rear exit, with the women positioned securely between their husband and male children.

This zoning principle in Igala compound architecture was also mirrored in the socio-spatial setting and traditional village settlement pattern of the Igala people. The traditional village setting encompassed the Administrative/Residential Zone, housing the Village Head's quarters and residential settlement; the Socio-economic Zone, accommodating the market and other commercial activities; and the Public Space, designated for socio-cultural and religious activities.

4.4.3. Communalism

Organic growth was an important character of the traditional Igala housing pattern, making adequate provision for family expansion and inclusion. This axial and sometimes radial arrangements of houses encouraged communal association which was an integral part of the Igala family and larger society. Extended families lived together in one compound. More so, the Igala society is agrarian and farming was the mainstay of the people. Consequently, the more the number of wives and children a man possessed, the greater the manpower to cultivate his farm, and this increased his economic status. So, as the number of family members increased, the size of the compound subsequently increased. In most cases, a male member of the family continued to live in the compound with his parents even after marriage, and a divorced daughter was accommodated in her mother’s house. Therefore, new houses were constructed as the need arose. This flexible and adaptable nature of the traditional Igala housing pattern facilitated the communal association and dynamic growth within the larger Igala society.

4.4.4. Security and Privacy

The Igala traditional compound featured a perimeter fence enclosing the area, with the man's house placed at the entrance for better scrutiny of visitors. The fence provided privacy for family members, while visitors were received only in the reception house. To ensure security and privacy, the windows and doors of the traditional Igala houses were

intentionally kept small, also especially because the people believed in the presence of malevolent spirits during the night-time.

4.4.5. Spiritual Symbolism

The typical Igala man is deeply religious and shows complete dedication to his deity. The deity serves as a mediator between the man and his ancestors, providing answers to his questions and protection from diseases and enemies. The deity also acts as the judge over the affairs of his family. Also, morality is rooted in the Igala culture and preserved through the influence of the deity. As a result, the shrine is an essential and integrated part of the Igala traditional housing pattern.

However, with the advent of religious pluralism in Africa, particularly in Nigeria, and the widespread acceptance of foreign religions introduced by Europeans and Arabs, the presence and significance of shrines in Igala traditional architecture have gradually diminished. Presently, the Igala man feels disconnected from his ancestors and relies on foreign religions, even though he harbors doubts about their authenticity and potency.

4.4.6. Environmental Adaptation

The Igala traditional building materials and construction method were designed to create sustainable and environmentally friendly buildings. These materials were used to construct various building elements such as walls, floors, posts, lintels, doors, windows, rafters, struts, purlins, ceiling and roofs among others, which collectively formed the Igala traditional building. In the building interior, the furniture and fittings typically consisted of a bamboo frame bed, timber logs used as seats, and clay water pots. The Igala traditional building materials were abundant and economically viable in the region. They were also reusable, biodegradable, and easy to manipulate and maintain. As a result, they contributed to the construction of environmentally friendly buildings that were well-suited to the climate of the area.

5. Conclusion

This study on sustainable practices in Igala traditional architecture has shed light on the sustainability of the Igala traditional building techniques and materials. The Igala traditional housing pattern embodied essential features and values that demonstrate sustainable building practices.

Preserving this local architectural heritage is paramount for ensuring sustainability for future generations. By understanding and assimilating the principles embedded in Igala traditional building practice, we can tap into the wealth of knowledge derived from generations of experience. This knowledge is crucial in enabling us to create contemporary spaces that are not only functional but also culturally relevant and sustainable.

Therefore, it is imperative to continue studying and documenting traditional building practices in Nigeria. This study serves as a bridge between the past and the present, allowing us to preserve the invaluable wisdom of our ancestors. By integrating these traditional practices into modern architectural practices, we can foster a harmonious coexistence between tradition and innovation. This synthesis of old and new not only enriches our cultural heritage but also paves the way for sustainable practices in architecture, ensuring a legacy that can be passed down to future generations. In doing so, we contribute not only to the preservation of architectural heritage in Nigeria, but also to the creation of a sustainable future built upon the foundations of our past.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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