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Boosting Land Ownership for Nigerian Women Through the Provision of Sustainable Prefabricated Homes

Ebelechukwu O. Enwerekowe[1*], Sunnom V. Ibrahim[1], Ann M. Katyen[1], Michael O. Ajufoh[1,2]

[1] Department of Architecture, University of Jos, Nigeria
[2] Department of Architecture, Federal Polytechnic, Bauchi, Nigeria

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ABSTRACT

This study examines the prospects of increasing land ownership for Nigerian women using prefabricated housing. Using theoretical data from desk research and case studies on innovative prefabrication samples, the study qualitatively investigates moribund attitudes to land ownership by women and proposes viable retention strategies for redress through the conception of prototyped prefabricated homes. The study reveals the conversion of locally available materials and low-carbon eco-friendly waste into sustainable prefabrication components potentially reduces building costs to support women's land ownership and retention. The study seeks to expand existing prefabricated building practices in Nigeria; and raise awareness among architectural think-tanks and prefabrication providers about advances in prefabrication production for the convenience of potential women landowners. The study recommends the dissemination of findings to designers, prefabrication providers, housing policy-makers and housing study researchers who are working to make the ownership of land assets more inclusive for women.

1. Introduction

One of the biggest indicators of empowerment and financial independence is the ownership of assets. Research findings show that African women significantly lag behind men in the ownership of assets and therefore, end up lacking most of the decision-making power over household resources, societal guidelines and political performance (Aluko & Amidu, 2006; Chigbu et al., 2019; Nevin et al., 2020; UN, 2013). In addition to significant gaps in the ownership of key assets such as mobile phones, bank accounts, modes of vehicular transportation and computers, most African women are trailing even further behind their male counterparts in the ownership of land assets and the property contained therein (Facio, 2017; Farha, 2000; Sone, 2021). Studies still show African women's issues include high attrition (or low participation) rates of women within male-dominated professions, limited participation of women at top levels of industry and commerce and gender-based violence or sexual harassment. Other problems include challenges to establishing a satisfactory work-life balance

*Corresponding author's E-mail address: enwerekowee@unijos.edu.ng

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and the status of women regarding the right to own or inherit land and property (Anthony, 2008; De Graft-Johnson et al., 2003; Enwerekowe & Mangden, 2019).

A key aspect of international development and women's empowerment includes sustaining the global campaign on women's land rights, especially in developing nations like Nigeria. The 1978 Land Use Act of Nigeria grants men and women established equal rights to acquire or inherit land. However, to a large extent, these inheritance and acquisition rights are influenced by interpretation of local customs and native norms that exist in different parts of the country (Kuusaana et al., 2013). Sustaining talking points about the waning attitude towards actualising women's ownership of land through viable interventions is of particular significance to this study. Recent studies still indicate most local customs discriminate against women and persist because the average citizen has poor knowledge of the statutory rights governing the ownership of land (Behr et al., 2023; Halonen, 2023). Less than one in five women globally are legal landowners with statistics dipping negatively in developing countries. Much of the ownership and cession of land in Nigeria is conceded through customary practices, without legal titles or formal documents to prove lawful ownership of the land (Nwapi, 2016, Sadiq, 2022).

In many Nigerian customs, only married women are entitled to inherit land as part of the patrilineal nature of Nigerian society. Even then, the presence of male inheritors (whether offspring, siblings or relatives of a deceased landowner) significantly reduces the woman's ability to inherit, regardless of her marital status (Nwapi, 2016). For example, in the western parts of Nigeria, women are known to inherit property from their husbands or fathers without legal documentation where the woman in question is the first-born of the family – though cases like this depend on a high level of enlightenment by the family on land matters. In the northern parts of Nigeria, a woman will willingly relinquish any possible ownership of land inherited from her father or brothers to her husband as a symbol of familial and matrimonial allegiance. In the eastern parts of Nigeria, women rarely inherit land without resorting to legal redress by the courts (Okafor, 2020). In the absence of a male inheritor who is an offspring, the male siblings or extended family members of the landowner take possession of the land. The presence of male inheritors merely guarantees the land remains in the ownership of the deceased landowner's bloodline, but the wife is rarely seen as the beneficiary of the land and she is not allowed to claim ownership of it.

One of the major reasons why women do not acquire or inherit land in Nigeria is that they are perceived to lack the economic power to develop and maintain any acquired property. It is assumed they are unable to erect the necessary infrastructure needed to increase the property value of the land (Oluwatayo et al., 2019; Onwutuebe, 2019). Women supposedly do not possess the ability to defend and cultivate the land over a large portion for agricultural purposes where food security is a major national concern (Ahmed & Fasilat, 2020; Farnsworth et al., 2020; Salau, 2018; Udegbunam, 2021). In light of these limitations, the driving questions addressed in this study include: Can off-site building practices such as prefabrication provide the much-needed building development to secure land ownership rights for Nigerian women? What then, are the housing desirables of prefabrication which would make them suitable for women in developing countries such as Nigeria? A specific objective of this study is, therefore, to uncover the potential for improving land ownership and retention among Nigerian women using affordable infrastructural tools such as prefabricated construction.

With the galloping inflationary trends in the country and other socio-economic disruptions, potential homeowners and developers across the country fear the existing housing deficit by low- and medium-income earners may worsen. Like most effects of downturn, and as is the norm in such situations, women will be the hardest hit considering the already prevailing forces against them. The concluding objective of the study is to propose house forms and spatial

arrangements which may improve domestic public perception about affordable prefabricated housing which have otherwise been driven by discrepancies and commonalities from around the globe. The study reviews emerging technologies in prefabricated and modular houses, and appraises them for their suitability in meeting the cultural and community needs of the women for whom they are intended.

2. Literature Review

Understanding the implementation of prefabricated housing solutions to address targeted national housing shortages requires an appreciation of the concept of prefabricated structures. Prefabrication is a design-construction model that is characterised by the bringing together of a part or the totality of a construction in form of components of some degree, from a place other than its final position to a temporary or permanent site for quick installation (Montjoy, 2021; Steinhardt & Manley, 2016). Prefabricated buildings, or "prefab" as they are simply called, comprises of panelised, modular and manufactured homes – all of which are erected on a fixed foundation. Mobile homes, which in many contexts are considered prefabricated buildings, have moveable bases and can be relocated preferentially by the user. Evidence supports the notion that off-site manufacturing could potentially deliver better quality housing units in a much shorter time frame when compared to traditional in-situ construction (Chippagiri et al., 2022; Wu et al., 2021).

Prefabricated building is not new to Nigeria and has been integrated into the built environment since the mid 1990's (Akeremale, 2020). Consequentially, the revised Nigerian National Building Code [NBC] (2006) contains updated rules, policies and guidelines for the erection of prefabricated homes and the Federal Government offers several tax incentives to developers of prefab models. However, the main uses of prefab in Nigeria today are often limited to portable office cabins on construction and manufacturing sites, food trucks and mobile vendor stands, security outposts, highway patrol stations and outdoor recreational facilities. More recent uses of prefabricated building include the need for emergency medical amenities such as was required in the case of the 2020 coronavirus pandemic. Prefab housing alternatives have largely remained experimental with many providers offering bespoke configurations of single- and double-storey models based on specifications and budget (Kolo et al., 2014).

To satisfy affordable housing needs, prefabricated buildings have to overcome certain challenges stemming from high production costs, lack of awareness among built environment professionals and users, technical know-how, and non-availability of adequate local prefabrication companies (Akeremale, 2020; Azman et al., 2012; Correia et al., 2012). Despite verifiable efforts by some high pedigree architecture, some of the prefab examples of inferior built quality led to the coming into scene of a certain stigma on any kind of construction that one may call "prefab". Questions on durability and lifespan of prefab models have been asked about their suitability in areas prone to extreme climatic disasters or security challenges such as wars, abductions or terrorism (Bras et al., 2020; Chippagiri et al., 2022; Kamali & Hewage, 2016). Also, the use of steel frames, aluminium composite panels, glass-wool and EPS insulation, concrete panels, and Structural Insulated Panels (SIP's) have made prefabricated homes a capital-intensive investment. Nonetheless, the conversion of more readily available materials such as modified mud, coconut husks, wood chippings, single-use plastic, bamboo and pozzolans fed through sophisticated 3D printing machines would appeal to the wider population of home owners and building professionals should the much-desired cost reduction be achieved from the process (Aziz & Abdullah, 2015; Dave et al., 2017; Dooley, 2024).

Several humanitarian agencies have committed to a sustainable housing agenda specifically for low- and medium-income women, many of whom are widows seeking to reclaim ancestral

lands from where they were displaced in cases such as the recent ethnic and terrorist violence experienced across Nigeria. Displaced persons typically find succour in temporary shelters or camps for the internally displaced, many of which are unconducive for long-term habitation (McKnight, 2016). Forced displacement is known to affect women and children more disproportionately (Joireman et al., 2024): nearly half of the estimated 300,000 Internally Displaced Persons (IDP's) in Nigerian camps are women. The government had long since expressed interest in shutting down all such camps since 2022, in favour of more sustainable resettlement schemes which would go a long way in ensuring humane community rehabilitation (Nnodim, 2021; Usigbe, 2021). Without proper intervention, most of the resultant self-help resettlement schemes end up as degenerative informal settlements which become urban slums and pose an even greater menace to urban regeneration. The conversation on affordable housing has always been skewered towards eradicating such urban slums, government intervention and the occasional private-partnership collaboration (Adediran et al., 2020); but the dialogue would change considerably should the focused development of housing be redirected for the economically weak women and their children (Chigbu et al., 2019).

The conversation on landownership for Nigerian women should not end at the acquisition of land for agricultural purposes alone as the development of land for housing, industry and recreation purposes significantly impact the economic power of women (Udegbunam, 2021; Halonen, 2023). The achievement of the global Sustainable Development Goals (SDG's) 5, 9 and 11 on gender equality, resilient infrastructure and inclusivity in human settlements requires a larger framework for improved action (UN, 2023). The study intends to open the dialogue for incentivised collaborations between architectural professional bodies, aid organisations, and mortgage institutions for the provision of skilfully designed prefabricated spaces that have eco-friendly architectural footprints. The study considers prefab models that have weather resistant/leak-proof outer envelopes, are solid/secure structures with easily replaceable materials, are convenient, are of green and solar-friendly construction (sustainable), can utilise money saving features even in the long run, and have good reviews and testimonials.

3. Materials and Methods

The research methods for this study are primarily desk researches of over 45 carefully selected and relevant published reports supported by archival documentation on prefab to critically analyse the challenges observed and proffer solutions. The secondary data is retrieved from verified online and hard copy sources, and screened for context based on key indices identified from the introduction and literature review, namely: social impact, sustainability, and innovation. The shortlist of 9 recent, highly-rated matches in the search are narrowed down to 5 based on the accessibility of information and specifications made readily available. The study incorporates extensive case studies and product reviews of the 5 selected prefabricated housing models which comprises of a modular home, panelised home, and hybrid prefabricated homes. The prefabricated house models will be qualitatively assessed for adaptability to local materials and building forms to determine which (if any) would be most favourable as sustainable, affordable and acclimated housing solutions suitable for Nigerian women.

The appraisal includes a review of the adaptability, durability, performance, ergonomics and cost of leading prefab models within the context of the requirements of each of the three classified climatic zones in Nigeria. From these indices of review, a compendium of the findings will be documented and recommendations on prefab desirables made. The study concludes with a review of conceptualised prototypes which could compare favourably to top models of prefabricated buildings used to proffer solutions to the affordable housing options for women. The study findings are presented as an architectural content analysis using

universal criteria that accepts contextual differences of different prefab models (Dudovskiy, 2018).

4. Findings and Discussion of Results

This section of the study presents the analysis on the findings from the case study reports in a bid to address the research objectives. The study investigates the utilisation of prefabricated building solutions to address the housing shortages affecting predominantly women whose access to land ownership is somewhat restricted due to cultural or normative practices. Social architectural interventions of this nature are by no means new: samples and innovations in the world of prefab have witnessed radical progress in recent years in both developed and developing countries, for both transitory and permanent dwellings. A prime example of such innovation is the award-winning proposal for the Hex House® developed by the team of Amro Sallam and others of the non-profit design practice called Architects for Society (AFS) unveiled in 2016. Intended as a rapid-response scalable housing unit by governments or relief agencies, the Hex House is a user-friendly, self-assembled housing unit containing two bedrooms and one bathroom, as well as a living room, dining room and kitchen. The versatility and sturdiness of each module easily transforms individual units of 40m^2 into combined three- or four-bedroom homes or cohousing communities of radial or linear configurations. This feature is vital to socialising displaced people into society in a dignified and comfortable manner (see Figure 1).

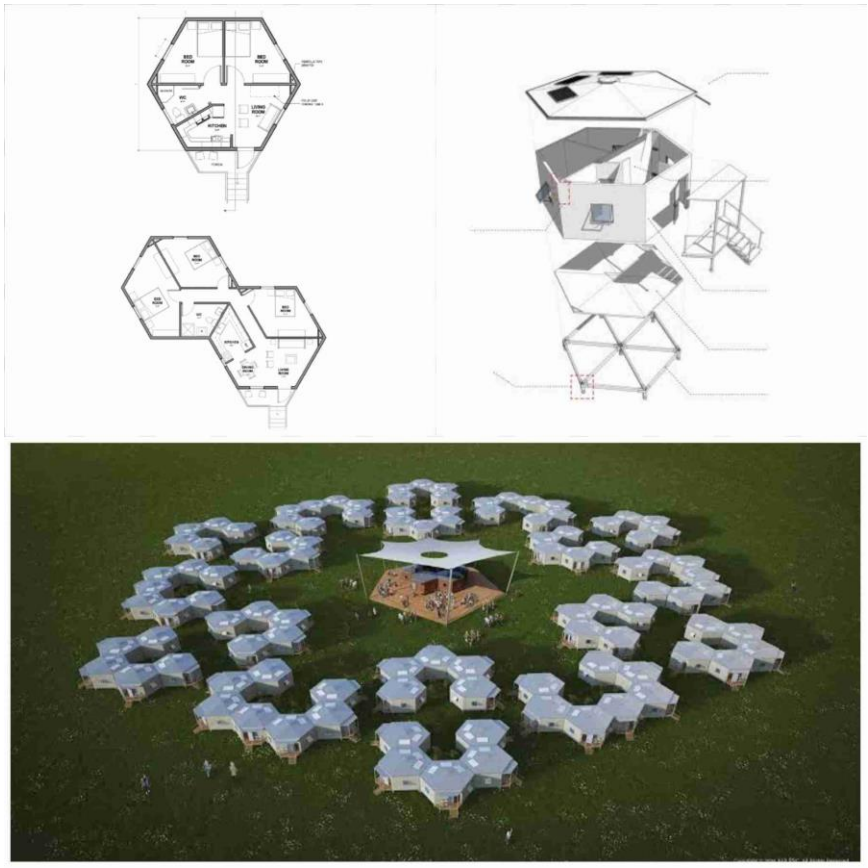

Figure 1. Floor plan, schematic layout and aerial views of the Hex House® prototype
Source: McKnight, (2016)

The Hex House design comprises exterior 150mm thick Structural Insulated Panel (SIP) walls of equal dimension (3m × 4m) with equally standardised floor and roof panels that are packaged and transported to site in flat-packs. The walls are bolt-supported by the hexagonal external

steel supports and one internal centre support on height-adjustable concrete pier foundations. The Hex House earned LEED Platinum certification with a very low carbon footprint as it employs a passive cooling system through two ventilation shafts, a rainwater harvesting system and optimal solar panel placements on the roof. The interiors are finished with sustainable gypsum walls, bamboo plank floors and ceramic bathroom tiles. The Hex House has a projected lifespan of between 15 and 20 years, and is estimated to cost $15,000-$20,000 per two-bedroom unit.

The perceived success of the Hex House has not overshadowed the performance of other renowned prefab solutions. In order to address some of the specific design needs and aspirations of women challenged by low accessibility to ownership of land or the financial ability to develop them (when ownership is not in contention), other noteworthy prefab models have yielded features and qualities of significant value in three key areas, namely: cost, climate sensitivity and cultural significance.

4.1. Cost

Financial capacity is a long-held constraint to the ability of women in developing countries to invest in land ownership and improvement using viable infrastructure. Sub-Saharan women's claim to land rights are affected by multiple systems of diversity and interests which are in dire need of context-specific strategies to protect. Access to land development resources such as affordable buildings, therefore, provides a means by which women are able to obtain and retain land ownership. Prefabrication is a process that is estimated to lower building costs by as much as 45%, however, most of those observed cost savings are enjoyed by the manufacturer and not necessarily transferred to the end consumer. In Nigeria, developers who utilise prefabricated construction benefit from tax deductions and incentives: most of which are not transferred to the end users either. A significant desirable of prefab housing for women should be a low cost of procurement, transportation and installation. Similarly, the prefab will need to be durable to ensure it does not need to be replaced or overhauled within a short period of time. The use of alternative building materials such as recycled waste or eco-friendly composites as base materials for 3D printing offers an exciting new approach to sustainable prefab production for developing countries as it has in most of the Western world, as the composites would be biodegradable and reusable.

4.2. Climate Sensitivity

Nigeria has three distinct climatic zones: the semi-arid Sahel in the north-east and north-west, the tropical savannah of the central states, and the tropical monsoon in the south. The extremities of weather patterns and the climate in these zones have intensified significantly in recent years due to global warming. The effects of global warming and the resultant climate changes have also increased awareness about the need for sustainable buildings which hitherto contributed up to 40% of CO_2 emissions in the atmosphere (Utibe et al., 2023). During the process of prefabrication, carbon emissions are reduced by 60-70% and manufacturers continue research and development into sustainable buildings that will eventually achieve net-zero levels. In order to further reduce the effect of high carbon emissions, other leading desirables of prefab homes include energy efficient performance and circular building solutions which are made from the abundance of recyclable waste from other production processes. These prefab homes become recyclable themselves at the end of their lifespan for the production of more buildings. Non-excavated foundation systems that resist rising damp and ground moisture penetration will suit southern parts of Nigeria prone to hydrological disasters such as floods or limnic eruptions. Integrated water collection systems, solid walls with high thermal capacity

and high-level small window openings (based on time-lag design theory), and ventilated openings on the roof and floors are preferable for arid parts in the north. Engineering and design also explore innovative climate-resilient materials for high performance (e.g., insulated concrete forms and fibre-reinforced polymers), heat-reflective and cool-roof materials, and self-healing materials produced with nanotechnology and biotechnology.

4.3. Cultural Significance

Blending high-tech composite building practices – such as vapour-releasing 3D printing – and sustainable vernacular architectural patterns provides an avenue for creating truly affordable social architectural solutions with an affinity to endearing cultural values. Traditional Nigerian housing patterns and forms evolved organically in response to the needs and preferences of the society in fractals which permitted the freedom to explore repeated patterns on varying scales. Evidence also suggests that Nigerian traditional buildings experienced a lot of external influences from the West and the Middle East through religion and commerce. These influences have opened the dialogue on housing form evolution in different thematic usage, including prefabrication. Modern usage of vernacular housing forms adds a revolutionary feature to the production of prefab houses that most women and children can identify with and comfortably function in. The integration of the courtyard (or an enclosed backyard), circular- or rectangular-based plans, and multi-room layouts will afford women a sense of belonging, identity and security in enclosed spaces. Prefabrication brings speed, efficiency and cost-saving. Though the concepts of vernacular architecture and modern construction often appear to be diametrically opposed, this study observed several reviewed examples in prefab manufacturing where they complement each other.

Table 1 presents a review of selected notable prefabricated housing models that have been impactful in terms of their cost implication, climate responsiveness and sensitivity, and contextual cultural significance:

Table 1.
Review of selected prefabrication homes – USA, South America and Asia

Specifications	**BioHome3D, Maine**	**Ruca Dwellings, Santiago, Chile**	**Pemulung House (Social Housing), Indonesia**	**Architectural System for Rural Social Interest Housing, Fundación, Colombia**
Designer	University of Maine ASCC	Undurraga Devés Arquitectos	IBUKU	Ensamble de Arquitectura Imtegral
Year	2022	2011	2011	2016
Recommended occupancy	1-2 persons	1-4 persons	1-2 persons	1-2 persons
Description	Living area and open plan kitchen, one bedroom and one bathroom bungalow.	Living area and kitchen are on the ground floor, two bedrooms and a bathroom on the first floor	Modules of main living spaces on the first floor and a mezzanine sleeping space. Incorporation of bathrooms, kitchen, storage and common areas for social interaction	Different configurations of 3 prefab modules – floors, eaves and roof – into two main compartments: rooms and common areas/services.

Specifications	**BioHome3D, Maine**	**Ruca Dwellings, Santiago, Chile**	**Pemulung House (Social Housing), Indonesia**	**Architectural System for Rural Social Interest Housing, Fundación, Colombia**
Total floor area	$56m^2$	$61m^2$	$18m^2$	$41m^2$
Estimated cost of production	$40,000	n/a	$51 per sq. m.	$10,000
Safe/secure goal	High impact-resistance and resilient to harsh weather conditions.	Horizontal grouped housing for security and safety; impregnated wood diagonal is a structural element bracing against earthquakes.	Clustered layout for security and safety of migrant workers and their collections.	Suitable for terrains of different gradients and diverse climates in customised layouts.
Functional goal	Provision of affordable housing using alternative building materials.	Conservation housing for the preservation of the Mapuche culture	Temporary accommodation for migrant garbage/waste pickers.	Easy mass-production, transport and assembly without specialised equipment or skill.
Sustainable goal	3D printed from pellets made of a bio-based wood waste composite of pulverised sawdust and a polymer binder replaces typical concrete and steel prefab. Able to withstand the most volatile weather extremities from rain to snow (-17°C to 40°C).	Adaptation of the "rukas", transient spaces of the Mapuche formed by light structures of branches and tree trunks; camouflaged and biodegradable to return to the earth; use of brick and reinforced concrete frames.	Made of recycled materials (bottles and tetra pack) roof and insulation. Bamboo walls and floors for natural ventilation.	Adaptable to Colombia's diverse societies, climate and geography. Overhead storage acts as a thermal regulator; use of certified timber with minimum site intervention; rain water collection and solar energy systems.
Pictorial				

Sources: Chang, (2023); Ghisleni, (2024); The University of Maine, (2022)

The models reviewed highlighted several insightful features which would be desirable in the production of prefabricated houses in Nigeria. Similarities in constraints faced in the study areas closely resemble those experienced in the Nigerian context and the options for resolution appear mutually effective. These implications of these findings are discussed below:

4.4. Sustainable Prefabrication Practices

Advanced techniques in 3D printing with either cement-based or bio-based composites offers solutions for weather-resistance and recyclable sustainable building practices across the

diversified climatic zones in Nigeria. Documented evidence from the University of Maine's BioHome3D, University of Florida's Vapour-Induced Phase-Separations 3D Printing (VIPS-3DP), and COBOD's Havelar Home initiatives shows the versatility of 3D printing in architecture. Ongoing research and product development on the use of bio-based polymers/composites offers hope that the current high costs of printing will drop even more significantly in the near future, giving optimism to poorer countries and disadvantaged people that the process will become more affordable.

3D printing, however, is not the only method of prefabrication adapting to the use of locally-sourced materials. In many parts of the world, the lack of access to the printing equipment and unsteady power supply would render it ineffective in lowering the overall cost of production, transportation and installation. Ongoing trials and experimentation into low-cost housing with sustainably grown wood, wood pulp composites, reclaimed wood, bamboo, plasticised cardboards, recycled bottles, straw bales, and cob have emerged from recent studies. Old tyres that have been earth packed, converted into tyre bricks, pulverised into tyre rubber insulation or used as decorative features provides another useful building alternative. Conversion of some of the aforementioned low-cost materials into usable prefabricated sections has already been seen in countries like Colombia, Chile and Indonesia; most of which can be assembled on site with little or no intrusion to the earth's crust. Overall, sustainable prefabrication based on the principles of repurposing and recycling plays a significant role in the discussion of landownership.

4.5. Durability and Affordability of Prefabrication

Addressing the critical issue of high cost of production (and possible installation) is essential to the adoption of prefab as a housing solution for women in Nigeria. The study findings show that general cost of prefabrication also increases exponentially with the size of the building. The simpler the layout and compactness of the composition, the cheaper the cost of construction. Complex, sophisticated and high-end materials will naturally raise the cost of prefabrication and tip the price-point towards the higher ranges. This would be counterproductive in the desire to achieve housing affordability for women in developing countries like Nigeria. The goal would be to achieve housing cost which compares favourably with local building trends while delivering on improved quality of the finished product. Sustainable prefab building has the potential to attract funding support for women in the form of mortgages and loans.

The perception that prefabricated buildings lack durability and are not weather-resistant has been addressed in several of the prefab models examined in this study. On average, prefabricated houses have a lifespan of 15-25 years which is not too far behind most in-situ models of like specification. Some models have been designed to last for up to 50 years. In addition to high water and fire resistance (<240-minute fire rating), other desirable features of prefab include mould/insect resistance, adequate tensile and flexural strength (5Mpa and 8Mpa respectively), and acoustic sound insulation. Conversion of locally sourced materials into manufactured panels offers the potential to enhance the technical properties of the raw materials to meet the needs of women for secure and durable homes. The improved technical properties of the BioHome3D are some of the biggest selling points of the product which was able to withstand diverse weather extremities over the seasons. Similarly, some prefab made of materials in their natural state also have the potential to offer durable, climate-responsiveness with smart and sustainable passive thinking from the designers/manufacturers. The design of the Pemulung homes in Indonesia used natural bamboo laid deliberately with gaps to significantly improve the indoor airflow in the native hot-humid weather. The design

of the Rural Social Housing in Colombia incorporated a cooling system derived from the vented overhead storage feature; and the Chilean Ruca homes demonstrates a high degree of structural responsiveness to naturally-occurring phenomenon like earthquakes and mudslides using actively or passively modified wooden crossbeams.

4.6. Towards Cultural-Sensitivity for Nigerian Women in Prefabrication

The fusion of cost-consciousness and environmental friendliness have become driving forces observed in the development of prefabricated housing. Recent concerns for the socio-cultural impression prefabricated housing have on their users has shown considerable influence on the way designers incorporate regional and culturally-sensitive architecture. This engenders a sense of belonging and identity by residents. The Ruca houses in Chile paid homage to the civilisation of the indigenous Mapuche people through the impermanence of their homes made of a combination of traditional and modern materials. These homes could be removed, recycled or repurposed electively. The Pemulung houses were also seen to adopt traditional transient features of migrant accommodation provided in secure, clustered communities for seasonal workers. The standardised modular units were designed to encourage community empowerment and participation during assembly as a move towards self-sufficiency and stakeholder collaboration. The design of the Colombian social housing initiative in Fundación took full cognisance of the diverse native terrain and climate in the target rural settings, and devised means to bridge the gap between mass production and regionalisation in prefabricated houses.

The findings from the review prompted the ideation of proposals which incorporate the expected desirables of low construction cost, climate sensitivity and cultural integration into prefabricated housing for women, as summarised on Table 2:

Table 2.
Expected cost, climate responsiveness and cultural desirables in proposed prefabricated houses for Nigerian women

Specifications	**Studio apartment**	**1-bedroom unit**	**2-bedroom unit**	**3-bedroom unit**
Recommended occupancy	1-2 persons	1-3 persons	2-5 persons	3-7 persons
Description	Single large room serving as a bedroom and living room; one separate bathroom and a kitchenette; open yard.	Living room, one bedroom, one bathroom, one kitchen/dining room; open yard.	Living room with two bedrooms ensuite bathrooms (option of one bathroom only); kitchen with separate dining room; open yard.	Living room with three ensuite bathrooms (option of 2 bathrooms only); dining room and kitchen; open yard.
Total floor area	$25m^2$	$45m^2$	$65m^2$ (one bathroom) $70m^2$ (two bathrooms)	$91m^2$ (two bathrooms) $96m^2$ (3 bathrooms)
Desirable cost of production	*$65 per sq. m.*	*$80 per sq. m.*	*$95 per sq. m.*	*$120 per sq. m.*
Functional goals	Single occupant dwelling for unmarried individual or senior citizen.	Multiple occupancy dwelling best suited for young families (with	Multiple occupancy dwelling; suitable for larger or polygamous family	Multiple occupancy dwelling; suitable for larger or polygamous

Specifications	Studio apartment	1-bedroom unit	2-bedroom unit	3-bedroom unit
		children who may be minors) or senior citizen with assisted living support.	sizes. Generous outdoor spaces improve the PPR and USMPP measure, preventing overcrowding.	family sizes, or multi-generational families. Additional outdoor spaces improve the PPR and USMPP measure, preventing overcrowding.
Pictorial				

Source: Authors (2024)

Each of the models proposed above takes into consideration the potentials for lowering the cost of prefabrication by maintaining a modest-sized floor plan to avoid overcrowding based on traditional standards. These standards include the use of the person-per-room (PPR) of 1 person per room, the person-per-bedroom (PPB) of 2 persons per bedroom (or sleeping space), the unit-square-metre-per-person (USMPP) of $15m^2$ per occupant, or the cross-tabulation of the persons-per-room-by-unit-square-meter-per-person of 1 person per $15m^2$ (Blake et al, 2007). The proposals shown in Figure 2, feature economical use of well-lit and ventilated spaces for efficient circulation and indoor activities. The provision of demarcated exterior spaces (illustrative of traditional Nigerian courtyard layouts) provides possible accommodation for outdoor seating, cooking, subsistence farming activity, religious rites or worship, or entertainment.

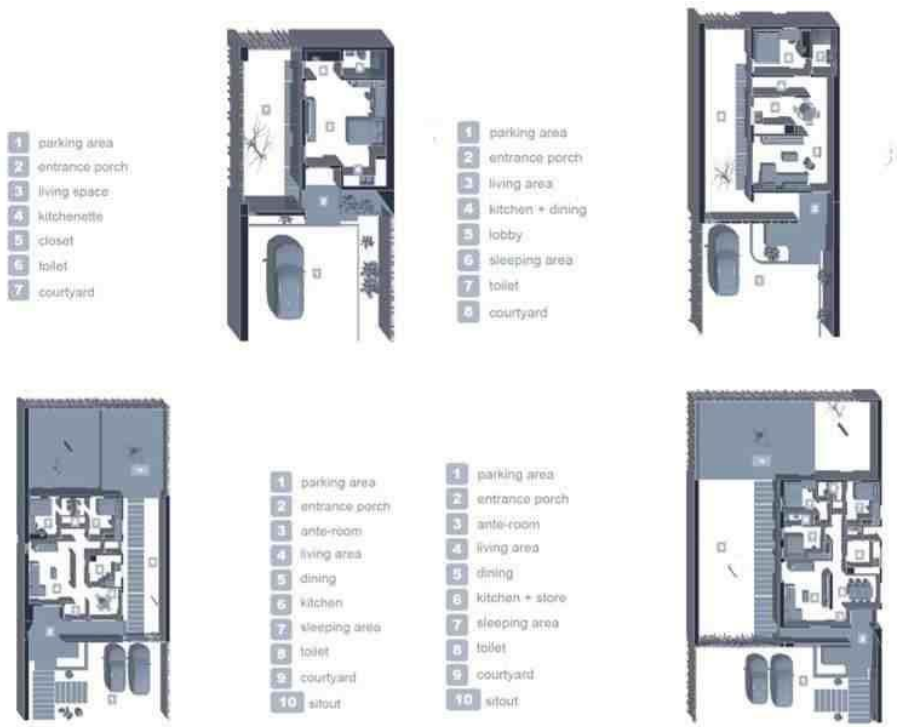

Figure 2. (Clockwise from top left) - proposed floor plans for the prefabricated studio apartment, 1-bedroom, 3-bedroom and 2-bedroom homes suitable for Nigerian women
source: Authors, 2024

Typical Nigerian architecture – particularly for the Hausa and the Ibo tribes – used small but efficiently-placed fenestration, more for privacy and the exclusion of insects and rodents than actual ventilation and lighting. The proposed designs in Figure 2 suggest the use of more evenly sized windows which are to be screened off with shading devices which not only restrict intrusive stares but also maintain a healthy indoor environmental quality. The mono-pitched roof serves as a hybrid feature between the distinctive northern flat roof and the southern pitched roof. This feature maximises rainwater collection and the efficient placement of solar panels as an off-grid solution to energy generation. The proposed rectangular-based plans align with several vernacular architectural features spread across Nigeria making them versatile enough to adapt to the diverse cultural and climatic landscapes in different parts of the country. This was a key observed feature in the Rural Social Housing project in Fundación. Not all samples of Nigerian vernacular architecture adhere strictly to the privacy and separation of women from other menfolk (including adult children and aged parents). However, the proposed designs honour the universal need for distinct separation of functions in Nigerian households maintaining public and private domains in the homes. Aesthetically, the proposals are deliberately muted and limited in ornamentation which would allow for the use of preferred motifs and decoration as a means of customising the otherwise standardised modular units and structural panels. The units are designed to be erected as stand-alone homesteads or in a series of linked buildings sharing common perimeter fences depending on the need to establish secure communities observed in many social architectural prefabricated projects including the Hex House, the Ruca homes, and the Pemulung dwellings.

4.7. Delimitations and Contributions of the Study Findings

Summarily, the findings from the study draw many parallels between prefabricated social architectural needs in both developed and developing countries as useful tools to attain global sustainability goals. The selected case studies provided common data on the need to integrate prefabricated building models into sustainable development roadmaps designed to address equitable housing and land acquisition needs. The existing models reviewed showcased many of the desirable features that would make prefabricated homes accessible and acceptable to women in Nigeria who seek to acquire land and consolidate possession through property improvement. Contextually, these findings yielded many shared design performance objectives and focuses between the case study sites and Nigeria. However, the case studies drew attention to the dearth of information about the status of prefabrication practices and examples in Nigeria and the lethargic attitudes towards widespread adoption.

With a shortage of previous research linking prefabrication and women's land rights, this current study places itself in a strategic position where connections could be made between two recurring themes in equity and the built environment. Most studies on prefabrication highlight production techniques and performance, most of which have yet to be fully explored in Sub-Saharan Africa, specifically in Nigeria. The current study attempted to apply the information on prefabrication to the cultural antecedents, biases and preferences of housing needs for Nigerian women. Utilising an exploratory research design, the study paves the way for further measured assessments of prefabricated social housing which could potentially change the way women approach home ownership in developing countries.

5. Conclusion

This study embarked on an investigation of the importance of utilising prefabricated homes as a means of obtaining (and retaining) landownership for the women of Nigeria. The study carried out an extensive review of recent developments in prefabrication, both locally and

internationally, before proposing a conceptual brief of homes that contain many of the building desirables for Nigerian women. Overall, the ideal prefab options will need to be low-cost and readily available since Nigerian women (and those in other patrilineal societies) often lack the economic capacity to own and improve land assets through the erection of buildings. Accessible mortgage plans and other forms of long-term capital provision for home ownership among low-income earners would be a much-needed incentive for women acquire, develop and retain land in Nigeria. In order to cope with the hazards of climate change and external security concerns, the prefab options will also need to be durable, secure, sustainable, climate-friendly and leave a very small carbon footprint, either through the use of recycled components and/or alternative building materials. Most importantly, it is required that the advocated prefab solutions are culturally-sensitive to the needs and aspirations of the users, to ensure they provide a sense of identity and are relatable.

The findings from the study should be of significant interest to new and existing manufacturers of prefabricated building components who wish to transform locally available materials into sustainable, affordable housing for economically- and socially-disadvantaged women. This would contribute greatly towards achieving the Sustainable Development Goal (SDG) 11 which aims to provide safe, affordable housing and upgrade slums for those in vulnerable situations, notably women and children. As a matter of urgency, this study recommends the expansion of innovative social architectural research under sponsorship by designers, humanitarian aid agencies, civil societies and international organisations beyond mere lip service, into prototype development and rigorous testing to produce efficient and sustainable models. The findings will inspire further research into options for affordable housing and be instrumental to the policy changes that may make home ownership accessible to hundreds of women who could not have achieved such otherwise.

This study may be limited by virtue of certain publication bias due to the over-reliance of more positive than negative reviews about prefabrication, and the application of such building strategies towards addressing the housing needs of developing countries. The study may also be limited in the generalisations made of social housing needs from diverse contexts. The study relied on subjective methods of data collection and interpretation made from a largely theoretical framework and methodology. Additionally, the study was somewhat limited in the long-term evaluations and cost-benefit analysis of the conceptual proposals developed by the authors which would ordinarily require adequate longitudinal research to justify the research process and the output. Despite these limitations, the aim of the study was not lost as the data gathered was analysed within a credible and ethical framework. Furthermore, the study contributes to the growing body of research on prefabrication and its application to sustainable housing needs of women in developing countries like Nigeria. This viewpoint makes a case for deliberate interventions by collective and individual stakeholders.

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