NIGERIAN HOUSING SCENARIO: RESEARCH INTO LOCAL BUILDING MATERIALS

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ABSTRACT

This paper examines the involvement of Government in housing delivery in Nigeria. It noted that the participation of Government has not been too successful. The low-cost housing programmes have been eluding the target groups because of high unit costs, which make the housing units unaffordable to the intended beneficiaries. Some research findings on local materials that are suitable for low-cost housing schemes are presented. It is recommended that the use of conventional materials and inappropriate construction technologies be discontinued while Government, its agencies and parastatals are enjoined to use appropriate local materials for their projects. Funding of prototypes as a way of ascertaining the real life behaviour of some materials is necessary, and therefore Government and Industrialists should endeavour to contribute towards realization of success of such results.

Keywords: Affordable Housing, Appropriate Technology, Local Materials, Collaborative Approaches.

1.0 INTRODUCTION

There has always been the desire by individuals to own a home for adequate protection from rain, sun and other hazards. This desire is hardly fulfilled by majority of people particularly those in the medium- and low- income groups because of high costs of

construction materials. The housing problem in Nigeria is enormous in the urban centres because of influx of people from rural areas with its attendant overcrowding on infrastructural facilities. The existing housing stock is grossly inadequate and suffers deterioration due to lack of maintenance. In the rural areas, the problem is mainly that of poor quality housing and inadequate infrastructural facilities.

Article 25 (1) of the Universal Declaration on Human Rights states, "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family including food, clothing, housing and medical care". Unfortunately, because of adverse economic situation, majority of the population is engaged in subsistence economic activities without capacity to make savings.

In an attempt to alleviate the housing problem and make it accessible to the citizenry, each succeeding government in Nigeria has been putting in place policies that address the provision of housing to the teeming population especially the medium- and low-income earners.

The objectives of this study are to: a) examine the housing programmes b) present some local materials that have been tested and found appropriate for low-cost housing, and c) make some recommendations on the direction of possible ways to provide affordable housing to the masses.

2.0 HOUSING PROGRAMME

The involvement of Government in the provision of housing can be examined under the following phases (FMWH, 1)

(i) The Pre-Independence Period:

The involvement of Government in the housing delivery dated back to the Colonial era when the housing activities and policies of Government were focussed on the provision of quarters for expatriate staff and some indigenous staff in specialised occupations such as railway and police. This led to the establishment of Government Residential Area (G.R.A). The first attempt to solve housing problem for the workers was the establishment of an African staff-housing fund in 1956. It was meant to encourage

African civil servants to own their own houses. Not much was achieved because of financial constraints.

(ii) **The Post Independence Period:**

After the attainment of independence in 1960, housing came to the focus as a national problem. The Federal Government embarked on Five Year Development plans as vehicle for economic growth. The housing sector suffered neglect in the first two-plan periods. The civil war (1967-1970) worsened the housing problem particularly in the war-affected areas. It was during this period that twelve states were created from the existing four regions. Each state established its own housing corporation. The corporations were to serve as institutions through which the Federal Government could intervene in housing problem. However, the impact of the state housing corporation on housing delivery was not felt because of shortage of fund. In 1972, the National Housing programme was established. The government through a decree proposed to construct 59,000 dwelling units nationwide with 15,000 units in Lagos and 4000 units in each of the other eleven states capitals. The Federal Housing Authority was established in 1973 to coordinate the housing programme. The federal and state Governments withdrew from direct involvement in the provision of dwelling units for workers but decided to expand credit facilities for housing by giving loans to housing corporations.

a) **Housing Programme in the Third National Plan (1975-1980).**

During this plan period the Government decided to participate directly in the provision of housing. A total of 202,000 dwelling units were to be constructed. 50,000 units were programmed for Lagos and 8,000 units in each of the other nineteen states, however, less than 15% of the units were completed. In 1975, the Federal Ministry of Housing, Urban Development and Environment was set up and charged with the responsibility of initiating and coordinating policies on housing related issues. In order to ameliorate the housing problem, government promulgated the land use decree in 1978. The decree vested the ownership of all land in the state in order to make it more accessible to the citizenry.

b) **Housing Programme in the Fourth National Development Plan (1981- 1985).**

During the plan period, an elaborate housing programme was embarked upon by the Federal Government. The programme was based on affordability and public participation.

The target groups were the low- and medium- income earners. A total of 40,000 dwelling units were to be constructed annually nationwide. 2000 units were to be located in each State including the Federal Capital Territory. The overall achievement was only 20%. The fourth plan period coincided with the second civilian administration (1979-1983) The Federal Government established 2-phase housing programmes to provide 400,000 housing units nationwide. 160,000 units were planned for the first phase. Each State and the Federal Capital Territory were expected to have 8000 housing units. The scheme was primarily for low-income earners. Only 32,227 out of 400,000 housing units were completed representing about 8% success.

c) **Housing Programme (1983-1988).**

During the plan period, government did not involve itself in direct construction of houses for workers. The policies of Government were tailored towards provision of building materials at moderate prices and getting banks to give loans to applicants for housing projects.

d) **Housing Programme (1989 to date).**

The past policies of the Federal government were reviewed to enable the low- and medium- income groups benefit from the housing scheme. It restructured the Federal Mortgage Bank of Nigeria to serve as the nation's apex housing finance institution. In 1991, the National Housing scheme was launched and charged with the responsibility of providing adequate shelter for Nigerians. Government disengaged from direct involvement in housing delivery.

The New policy introduced site and services scheme, which implies the provision of basic amenities and infrastructure by Government while individuals were to develop their allocated plot within the layouts. The scheme was not too successful because the target beneficiaries could not afford the high costs of building materials. In an attempt to alleviate the financial constraints, the Government, during the 1991 budget proposed the establishment of private Mortgage Institutions to generate savings and grant loans to the prospective owners for housing construction. The Government also removed the tariff imposed on cement with the aim of further reducing construction costs. In an effort to divest the old Federal Mortgage Bank of its retail banking and mortgage operations so that it could concentrate on its role as the nation's apex mortgage lending agency, the

Federal Mortgage Finance Limited was incorporated in 1993. It was charged with the responsibility of ensuring equitable distribution of mortgage lending activities all over the country, operating as an efficient and effective mortgage institution, which will be a role model for the private mortgage institutions and it was also to dictate the level and pace of growth of Mortgage Finance industry. Many of the private Mortgage Institutions have collapsed while the high interest rate on loans has contributed to the widening gap between housing demand and supply.

Table 1 provides a summary of housing delivery by Federal Government through its Housing Authority (FHA) while Table 2 gives the summary of housing stock constructed by some State Housing Corporations. The housing stock comprises mixed development (flats, duplexes and bungalows).

Table 1: F.H.A. Estate Development in some states as at 1992

State	Location	No of Units
Lagos	Festac Town	15,000
	Ipaja new Town	3,044
Abuja	Kuru Estate	251
	Kubwa Estate	1,320
	Maitama District	479
	Ajokoro Estate	125
Benue	North Bank Estate	281
Imo	Egbeda Estate	16
	Aladina Estate	213
Edo	Iguosa Estate, Benin	162
Kaduna	Kaduna Authority Estate	176
Niger	Bosso Estate Minna	260
Rivers	Trans-Amadi Estate	60
	Rumueme Estate	40
Sokoto	Runjin Sambo Estate	175

Iyagba and Asunmo (2)

Table 2: Summary of Housing Units provided by some States Housing Corporations

Name	Period	No of Units
Lagos State Development and property corporation (LSDPC)	1979-92	20,958
Kano State Housing Corporation (KSHC)	1981-1992	1600
Taraba State Adamawa State Urban planning Development Authority	1986-92	890
Ondo State Housing Corporation (OSHC)	1981-92	500
Niger State Housing Corporation (NSHC)	1980-92	382

Iyagba and Asunmo (2)

The quantity of housing stock provided (Tables 1&2) nationwide is grossly inadequate when compared with the enormous housing needs of the masses. The reasons for the low performance of the housing programmes both at Federal and State levels are:

i) The use of imported materials, (ii) lack of municipal services and employment facilities in rural areas, which resulted to consistent migration of rural dwellers to the urban centres and (iii) The deregulation of the economy together with the devaluation of the Naira caused high inflation and subsequent increase in the cost of conventional local building materials to such an extent that they are inordinately costly to low-and medium-income groups.

3.0 LOCAL MATERIALS.

New housing stock is urgently needed to replace the dilapidated ones and cope with the increasing housing demand of the expanding population in the urban centres.

In Nigeria, concrete is widely used for construction work. It comprises cement, aggregate (fine and coarse) and water, which are combined in suitable proportions depending on the required strength. The property of concrete that is of primary importance in design of building structures is its compressive strength at 28-day curing. Its tensile strength is low about 10% of the compressive strength. Reinforcement is therefore embedded in concrete to take tensile stresses to which concrete has low resistance.

Reinforced concrete is expensive per its unit volume because of the high unit cost of its constituents. For example, in 1981 the cost of one ton of reinforcement was ₦360.00. In 1991, it was ₦ 12,000.00 while in 1995 it was ₦ 31,500.00 per ton and today the cost is about ₦ 53,500.00. The price of cement has fluctuated considerably over the years. It rose from N6.50 per bag in 1986 to N950.00 in 1998 and presently it sells for between ₦ 550.00 and ₦ 600.00. The increase in the cost of cement does not only affect the cost of concrete but also prices of blocks and cement- sand mortar for laying blocks, plastering and screeding. The prices of fine and coarse aggregates also vary depending on their sources and types. Steel reinforcement and cement are imported to supplement the local production, therefore, they are more affected by Government policies than any other constituent materials. The increase in the prices of concrete components has led to research investigations into viability of some locally occurring materials that can be used to substitute partially or wholly these components in concrete mixtures.

The solution to high costs of building materials can be found in the determination of appropriate local materials, through research that can be used to replace the expensive conventional ones. Such research efforts will lead to the development of cheap alternative building materials that would make housing delivery cheaper and affordable to every income group in the country.

i) **Cement.**

The use of cement offers the best and most common method of achieving stabilization of the constituents of concrete or its allied products. Efforts have been made and continue to

be made to replace it partially or wholly in concrete with any cheap and local stabilizer. It was reported by Falade (3) that the replacement of cement with sawdust ash in concrete reduced strength. He noted that the rate of gain in strength was more rapid at curing ages of 21 and 28 days in mixtures with high proportions of sawdust ash content than concrete with 0% ash. The results generally indicated that sawdust ash was not a good substitute for cement but that it possessed pozzolanic property. However, it was recommended that some quantity of sawdust ash could be used as a retarding agent without compromising its other properties. This is to delay the setting time of concrete thus compensating for the effect of hot weather both by helping to offset the lost of workability and minimize the increase in the amount of water to produce the required workability. Okpala (4) reported that the pulverized fuel ash obtained locally from Orji River Power station performed satisfactorily in concrete as a partial replacement of cement. Adepegba et al (5) studied the pozzolanic activities of six waste materials from mines and farms in Nigeria. They found that magnetite and limonite were heavy pozzolanas which could be used as blast furnace slag and riget stone, riget coke, coal ash of palm bunch could be classified as normal weight pozzolanas which when treated could be used to blend the ordinary Portland cement for production of lime pozzolanic cement.

ii) **Fine Aggregate**

Sharp sand is widely used for construction work. It is expensive because of its procurement method. Apart from the cost of its dredging, it may require additional washing to remove some impurities present in it which otherwise will hinder effective bonding of the components of concrete. Laterite exists in practically all the states of the Federation and can be found close to construction sites. Its suitability as an alternative material to sharp sand had been widely investigated. Adepegba (6) compared the strength properties of normal concrete with those of laterized concrete. The conclusion of the study was that a concrete in which laterite fines are used instead of sand, could be used as structural material in place of normal concrete. In another study by Adepegba and Balogun (7) it was reported that when sand is mixed with laterite fines, the most suitable mix for structural application is 1:1.5:3 with a water cement ratio of 0.65 provided that the water content is kept below 50 percent. Since these findings, many investigations

have been conducted on laterized concrete to examine its engineering properties with a view to determining appropriate design parameters for concrete that contains laterite fines. Lasisi (8) reported that about 10% of cement required to produce sandcrete block is necessary to stabilize laterite to produce masonry blocks of adequate strength for low-cost housing. Akinmusuru (9) has shown that in order to achieve optimal strength conditions the soil-cement bricks required much less hard firing than plain bricks. He reported that the addition of cement could result in brick strengths of up to four times that without cement at same temperature and at least 2.5 times the maximum strength with plain bricks at any firing temperature. Falade (10) established that the differences in strength of laterite blocks are statistically insignificant at 5% level irrespective of location from where the samples are procured.

iii) **Coarse Aggregate**

Coarse aggregate in concrete constitutes an economical filler material with good resistance to changing in volume, which takes place in concrete after mixing, and also it improves durability of concrete. Granite chips are highly favoured by consultants for concrete work but the cost is high and unaffordable to low- and medium- income groups. The density of concrete (24kg/m^3) made with granite chips is rather high for some projects especially where lightweight concrete can be used successfully without compromising the safety of the structure.

The research efforts to source alternative materials are in two folds, namely:

(i) Materials that can produce concrete of comparable strength, density etc to normal concrete but cheaper and (ii) Materials that can produce concrete of comparable strength but reduced density (lightweight concrete) and cheaper.

Balogun (11) studied the performance of periwinkle and palm kernel shells as coarse aggregate in concrete. According to him, the mixes obtained by mixing the shells with concrete components produced lightweight concrete and that the 28-day compressive strength of the lightweight concrete produced with periwinkle and palm kernel shells as coarse aggregate was 50% of corresponding compressive strength of normal concrete. Falade (12) reported that replacement of granite chips wholly in concrete with periwinkle shells using designed mix proportions compared favourably with those of lightweight

concrete produced from some lightweight aggregates (CEB/FIP, 13). It was reported (14) that reinforced concrete containing periwinkle shells instead of granite chips showed a savings of 24% over its corresponding normal concrete under the same loading arrangement (100% of its moment of resistance) and constant effective span of 4500mm.

iv) **Reinforcement**

The high cost of steel reinforcement has geared researchers to investigate the suitability of some local fibres as replacement for steel in concrete. Adetifa (15) reported that the ultimate load carrying capacity of fan palm reinforced concrete beams increase with increase in percentage of reinforcement though not proportionately. He noted that for the same section and percentage reinforcement the failure load of mild steel reinforced concrete beam was 2.5 times that of its equivalent fan palm reinforced beam. Akeju and Falade (16) investigated the behaviour of bamboo reinforced concrete beams under static load. They reported that the strength of bamboo-reinforced specimens was sufficiently high for minor structural elements. In another study Falade and Akeju (17) compared the economy of using bamboo splints and mild steel as reinforcement in concrete under the same loading arrangement. They showed that bamboo-reinforced beam indicated a savings of 23% above the total cost of mild steel reinforced beams.

v) **Timber**

Timber is a lightweight structural material when compared with dense reinforced concrete. The selfweight of concrete increases the quantity of reinforcement to be used in a structure and therefore causes increase in the construction cost. Timber is ideally suited to a system of prefabrication in new construction and it requires only basic craft skills. Prototype timber frame houses of basic technology can be adopted in different areas based on available wood species. Such houses can be mass-produced and made available for self-help housing groups. In self-help scheme, the low-income dwellers can build according to the pace that they can afford, a fact, which suggests the existence of variation and discontinuities in the construction process since a large proportion of the urban, and rural poor face fluctuation in their means of income.

vi) **Roof and Floor Tiles, Roofing sheets and Ceiling Boards**

There are many types of roof and floor tiles, roofing sheets and ceiling boards of different sizes that are locally produced. They are functional and cheaper than the imported ones. Investigation by Badejo (18) has shown that wood-cement board can be produced from wood particles. The study indicated that cement-bonded particles board of adequate strength can be made from sawmill sawdust of tropical hardwoods depending on the cement to wood mixing ratio used for the panel production.

vii) **Hollow Pots**

Hollow pots are used in concrete floor construction as precast units. When they are used, the quantity of concrete to be poured is reduced and the cost of concrete work, both in terms of savings in concrete, reinforcement and formwork is reduced. They are supplied to the market in standard sizes.

4.0 STATEMENT OF PROBLEMS

Both conventional and alternative materials have their peculiar problems, which hinder the achievement of the required strength and durability when they are used for construction works. Table 3 provides some of these shortcomings associated with each material.

The presence of dust in granite chips and clay and/or silt in gravel will impair effective bond between the components of concrete matrix thus reducing strength of the mixture. Inappropriate grading of both fine and coarse aggregate reduces strength and durability of concrete.

As a result of long period of shipment or storage on site, cement or blended cement may contain nodules or lumps. When the nodules or lumps are allowed in concrete they behave like coarse aggregate thus reducing the quantity of cement available for chemical processes. The nodules, because they do have sufficient strength, disintegrate under pressure thereby contributing to poor strength.

Sand may contain impurities or excessive moisture while laterite can contain clay and / or silt. All these have deleterious effects on the properties of concrete when allowed into the concrete mixtures.

Reinforcement corrodes when adequate concrete cover is not provided. Bamboo has poor bond, absorbs moisture from concrete matrix and because of its low strength has limited use when compared with steel reinforcement.

Table 3: Statement of Problems

Conventional		Alternative	
Material	Defects	Material	Defects
Granite	Dust Grading	Gravel	Clay and/or Silt. Grading
Sand	Impurities Grading	Laterite	Clay and / or Silt Grading
Cement	Nodules or lumps	Blended cement	Nodules or Lumps
Reinforcement	(i)Corrosion (ii) Rust	Bamboo	(i) Poor bond (ii) Absorption of moisture from concrete matrix. (iii)Limited use.
Reinforced Concrete Column	(i) Cracks in concrete (ii) Corrosion of reinforcement (iii) Spalling of concrete	Timber column	(i) Insect damage (ii) Decay (iii) Seasoning degrade
Solid Slab	(i) Cracks in concrete (ii) Corrosion of reinforcement (iii) Spalling of concrete	Timber floor	(i) Insect damage (ii) Decay (iii) Seasoning degrade
Celotex Board	Deteriorates when water Accesses it	Sawdust Board	Deteriorates when water Accesses it
Long Span Roofing sheet	Leaks (i) if there is cut during erection. (ii) if there is opening at the point of nailing	Clay tiles	(i) Breaks during erection (ii) infiltration of water through tiles of poor quality.

When reinforcement is exposed in reinforced concrete structural elements as a result of cracks, corrosion of reinforcement begins, further deterioration results in spalling of concrete.

Timber structural elements suffer seasoning degrade, decay and insect damage if not adequately seasoned or treated. Celotex and sawdust ceiling boards deteriorate considerably when water accesses them through the leaking roof. Long span roofing

sheets and roofing clay tiles suffer erection problems. The latter may have additional problem of poor quality control during its preparation.

In order to achieve the required strength and durability from either the conventional or alternative materials, good quality control, good workmanship and adequate supervision must be ensured on construction sites.

5.0 CONSTRUCTION TECHNIQUE

The implementation of individual projects is based on labour intensive option, which requires that labour be used extensively in a project whereas most corporate projects are equipment based, supported with few labour. The best approach is labour based where its use is feasible. The method optimizes the use of labour. Labour based method describes an approach where the bulk of the activities are undertaken by properly trained, organised and supervised work force with equipment introduced in a step wise manner from the very light to heavy if this is necessary to obtain good quality output or maximize cost effectiveness objectives. The simplicity of technology of prefabricating timber structural units shows that non-skilled persons can be quickly trained to construct adequate housing units for the low-income earners as well as upgrading shanty towns thus making the environment more habitable.

6.0 CONCLUSIONS

From this study, the following conclusions are made:

1 The housing programmes of Government have not been too successful
2 Research findings have shown that some local materials are suitable for the provision of affordable housing to different groups in the society.
3 Appropriate technology is only relevant if it is formulated based on available materials.
4 Standardization of building components will reduce construction cost.
5 If local resources are well harnessed, it is possible to provide affordable housing scheme.

7.0 RECOMMENDATIONS

The new housing policy states that the ultimate goal of the Housing Policy is to ensure that all Nigerians have access to decent housing at affordable cost by the year 2000.

From all indications this dream has not been realised keeping in view that we are already in year 2000 AD with many people still searching for adequate accommodation. However, it is pertinent to suggest some measures that can be adopted to aid housing delivery, namely:

i) In order that the consistent increase in the costs of building materials can be stemmed, locally occurring materials should be used in place of imported ones

ii) Expansion is required in the cement industry to produce sufficient quantity for local needs. Some of the identified pozzolanic materials can be blended with cements in appropriate proportions without compromising its properties.

iii) Government should encourage both the manufacturers of building materials and building/civil engineering contractors through adequate patronage to enable them assist in the provision of financial support to carry out training and research activities relevant to appropriate building materials for low-cost housing.

iv) Government should promote the establishment of small-scale industries that produce building materials, for example, blocks, burnt bricks, concrete and allied products with adequate standardization and quality control, which is currently lacking.

v) Training Programmes should be developed to assist in the transfer of technology directly to small-scale contractors, craftsmen and other beneficiaries through pilot projects, seminars, workshops audio-visual materials, on the job training and appropriate materials and guidelines, especially for low- and medium- income groups.

vi) Provision of technical and financial support for improved assessment of raw materials through the establishment/strengthening of laboratory and field-testing facilities and development of requisite indigenous expertise.

vii) The responsibility of the Nigerian Building and Road Research Institute to include coordination and marketing of research results of building related research findings.

viii) Some research results on construction materials require the development and testing of prototypes to assess the behaviour of the materials in real life situation. This requires a lot of money to accomplish, contributions of the Government and industrial sector will assist immensely.

ix) The adoption of appropriate construction techniques, which requires limited skill for most tasks will reduce construction cost.

x) The building codes and regulations need to be re-examined to accommodate the properties of local materials.

(xi) In order to reduce the pressure on the urban centres, government should upgrade and provide infrastructural facilities in the rural areas and create job opportunities in the areas to stem the influx of people to the urban centres.

xii) There are many research findings in the universities and other research institution that are largely unknown and therefore not included in this paper, it is therefore suggested that the proposed research results coordinating centers should endeavor to access all research institutions to obtain their inputs and such result should be made public.

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