Green Architecture: Merits for Africa (Nigerian Case Study)

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Abstract: *A major United Nations' goal for this millennium is to alleviate extreme poverty especially by enhancing developmental policies across developing countries. This paper evaluates the concepts of green designs and the implementation of adoptable policies in Africa. The article contributes to the literature on a sustainable Africa within the framework of global policy of reducing carbon emission through indigenous Architecture. It stresses the importance of indigenous practices involving the use of local resources for low-cost mass housing construction, thereby encouraging innovative indigenous technology for meeting housing needs for low-income earners. The adoption of green Architecture in Africa, it suggests, could enhance the realization of the United Nations' Millennium Development Goal. The paper highlights the merits of indigenous practices and how these may be expedited, while focusing on the building sector. It discusses in conclusion some adoptable strategies as tools for enhancing sustainable developments in developing nations.*

Keywords: Green Architecture, Indigenous Architecture, West Africa, Nigeria; Development.

1. Introduction

In addition to its capacity to providing access to low-cost housing, this study analyzes, in the African context, the role of Green Architecture in reducing greenhouse gas1 and its effects, since buildings play a major role in carbon emission and the use of energy. Alternative energy systems become economical with reduced energy needs. The study seeks to proffer a solution to the housing needs of low-income earners, through its emphasis on indigenous architecture. It indirectly attempts to facilitate the achievement of the United Nations' millennium goal of halving poverty between 1990 and 2015, through low-cost *mud* public housing scheme. It analyzes the merits of green-indigenous architecture in the economic, socio-cultural and technological arena of Nigeria.

Africa is said to be the hottest continent as well as the world's largest consumer of biomass energy, which accounts for two-third of total energy consumption, contributing about 3.7% of total world energy-related carbon emissions. According to UNEP (2008) annual report, "...per capita levels of commercial energy consumption and energy-related carbon emissions tend to be lower in Africa than in developed countries, with the levels projected to remain roughly flat through 2020." Meehl et al., (2007) give a clue to future impacts of climate change:

> In a warmer future climate, there will be an increased risk of more intense, more frequent and longer-lasting heat waves. The European heat wave of 2003 is an example of the type of extreme heat event lasting from several days to over a week that is likely to become more common in a warmer future climate. A related aspect of temperature extremes is that there is likely to be a decrease in the daily (diurnal) temperature range in most regions.

Boko et al, (2007) with reference to the vulnerability of Africa to climate change also argue that:

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1 Atmospheric gas that absorbs and emits radiation within the thermal-infrared range: Emphasis here is "carbon dioxide"

Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity… The situation for the already-vulnerable region of sub-Saharan Africa still appears bleak, even in the absence of climate change and variability. *Considering this, meeting energy requirements for Africa is a bigger challenge* (Italics added)

Global Emissions from Buildings

Studies reveal that the building sector, which consume more than one third of the world's energy, are the single major or largest contributor to global warming. [2] This implies that the building sector uses more energy than other sectors. "Buildings are the dominant energy consumers in modern cities but their consumption can be largely cut back through improving efficiency, which is an effective means to lessen greenhouse gas emissions and slow down depletion of non-renewable energy sources" (Lee and Yik, 2004). "On average between 1980 and 1990, CO_2 emissions from buildings have grown by 1.7 percent per year with rates of growth noted to be four times greater in developing countries" (Wiel et al, 1998). Between 1971 and 1992, annual growth in CO_2 emissions from buildings varied widely by regions: 0.9% for industrialized countries, 0.7% for Eastern Europe/former Soviet Union and 5.9% for developing countries (Levine, Price and Martin, 1996). The building sector emitted more than the industrial or transportation sectors with 36 percent of total emission attributed to it in 1998 (Battles, Burns, and Energy Information Administration (EIA), 2000).

Balanced data and literature on carbon emission from developing countries are scarce (Intergovernmental Policy on Climate Change (IPCC, 2007: 31). Especially in Africa, there are remarkably few studies available that examine the impacts of climate change on energy use (Boko et al., 2007).

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[2] Architecture 2030. The Hidden Sector: Hidden Culprit (www.architecture2030.org) *and* ***World*** Green Building Council Report (2009)http://www.nzgbc.org.nz/documents/greenbuildingreading/2009/World_GBC_Report_Nov09.pdf

However, in South Africa, about 23% of total emissions come from buildings.[3] From the estimated average annual growth of 3.6% energy-related carbon emission from Africa[4], substantial contribution must have been from buildings. All building types consume energy with varying degrees of emission representing approximately 40% of the global primary energy use.[5] Africa needs a unified effort with measurable means to tackle threats to the environment. There is also a need to establish and maintain a comprehensive framework to monitor energy-consumption trends while addressing the gaps in the available data for energy efficiency policy making (Internation Energy Agency (IEA), 2008). Due to increase in urban population and attendant residential pressures, energy consumption is projected to rise in buildings especially in fast growing countries. With increasing building impact on energy consumption, it is necessary therefore to address the challenges of unsustainable building practices by adopting more sustainable housing policies that would cater to the growing impact in Africa.

2. Green Architecture

In the African context, this study views "Green Architecture" as *the indigenous approach of building practices with the goal of sustaining the ecosystem*. It puts into consideration the easily affordable local resources and the development of concepts that sustain the socio-cultural value system within the building sector. Green Architecture approaches building construction (from design conceptualization and construction to its material usage all through its life-span) with *the aim of minimizing harmful effect on human health and environment*. It attempts to conserve environmental factors such as air, water and the earth by employing eco-friendly building materials and construction practices. According to Watson and Balken (2008):

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[4] Energy Information Administration / International Energy Outlook (2007)

[5] The World Business Council for Sustainable Development (WBCSD) on Energy Efficiency in Buildings www.wbcsd.org

The construction and operation of buildings require more energy than any other human activity. The international Energy Agency (IEA) estimated in 2006 that buildings used 40% of primary energy consumed globally, accounting for roughly a quarter of the world green house gas emissions. Commercial buildings comprise one-third of this total. Urbanization trends in developing countries are accelerating the growth of this sector relative to residential buildings, according to the World Business Council on Sustainable Development (WBSCD). Reducing these emissions is therefore a cornerstone intention and responsibility of green building standards and initiatives.

Green architecture focuses on saving energy production and consumption. While buildings could be the highest carbon emitters, they could equally represent the best means of reducing environmental, economic impact and energy use, effectively.

Synonymous with green architecture, *sustainable architecture* focuses on climate responsive or eco-friendly designs and construction techniques in buildings with positive impact on social, ecological economic and environmental sustainability. The consideration of environmental factors, tradition, culture and their effects must be given a high priority. Largely, this study relates the indigenous (traditional) and African-'tropical' architecture with green architecture.

Objectives of Green Architecture

A sustainable/green building is an outcome of a design, which focuses on increasing the efficiency of resource use-energy, water, and materials-while reducing building

impacts on human health and the environment during the building life-cycle, through better siting, design, construction, operation, maintenance, and removal (Frej, 2005). A green building is environmentally responsive and resource-efficient, reducing the impact of the built environment on human and the natural environment as well as waste, pollution, and environmental degradation. This paper identifies three objectives of green Architecture:

Improving Energy Efficiency: Any path to sustainability necessarily includes improving energy efficiency throughout the global economy (IEA, 2008). Green architecture approaches buildings with the basic concept of creating energy efficiency and contributes to global economy by extensively cutting down on energy consumption growth. Energy efficient technologies are imperative for a revolution in every sector.

Environmental sustainability: Green buildings are designed with environment management in mind. It takes drastic measures to reduce wastage as well as environmental degradation to a barest minimum. It also takes into consideration the comfort of the end-users. It aims at total safety and sustainability of the eco-system and advocates the use of materials, methods, and technology that favour this primary objective.

Greenhouse gas emission reduction: The built environment contributes ultimately to global warming by its high rates of emitting greenhouse gases through energy usage (for cooling, heating, and lighting) and for construction. Green architecture projects a possibility of total reduction to a near *zero carbon emission*[6] of buildings. Green buildings take on the initiative of improved technologies, to contribute significantly in mitigating global climate change.

IEA (2008) report asserts that accelerating energy efficiency has the greatest potential for carbondioxide (CO_2) [7] savings at low or negative cost, and with immediate results; and that a large potential remains for further energy and CO_2 savings across all sectors. While IPCC (2007) highlights

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[6] Zero energy buildings are aimed at significantly reducing greenhouse gases as well as energy use in buildings to the barest minimum. See Torcellini et al, 2006. Zero Energy Buildings: A Critical Look at the Definition. National Energy Renewable Laboratory (NREL). Conference Paper NREL/CP-550-39833, June 2006.

the possibility of reducing the global energy CO_2 emission by 50 percent in 2050,World Energy Outlook (WOE) (2008) reports that existing buildings account for 24 percent of the world CO_2 emission, as well as more than 40 percent of the world's total primary energy consumption. It stresses that making buildings more efficient is therefore imperative, as it is a cost effective way to reduce carbon emission. Energy efficient buildings can significantly cut CO_2 emission globally. The Annual Energy Outlook report, in its alternative technology cases between 2000 and 2020, projects that advanced technology could reduce residential energy use by 22% (AEO, 2001). However, the International Energy Agency (IEA), while urging technological revolution, warns that CO_2 emission is expected to rise by 130% by 2050 especially if no serious efforts are made to combat it (IEA, 2008). Urgency to improve energy efficiency in all sectors is a necessity in order to reverse this trend, while careful designs are imperative to keeping the environment sustained, since building itself is a long-term project. Africa therefore could utilize its local resources to enhance environmental sustainability, with enhanced technology.

African Architecture and External Influence

Historically, Africa has a unique sustainable architecture. Its indigenous buildings share the same objectives with "green buildings" since its building materials favour the basic prerequisites of sustainable utilization of environmental resources. In spite of these however:

> The architecture of Africa, like other aspects of the culture of Africa, is exceptionally diverse. Many ethno-linguistic groups throughout the history of Africa have had their own architectural traditions. In some cases, broader styles can be identified, such as the Sahelian architecture of an area of West Africa[8]. *As a result of the exceptional diversity, it is therefore difficult to pin down a particular architectural style or practice as "the" African Architecture. Hence, care*

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[8] See "Early Architecture", Architecture of Africa: Encyclopedia. Retrieved from http://en.allexperts.com/e/a/ar/architecture_of_africa.htm

must be taken not to use an architectural type or style of a particular clan to wholly represent it (Italics added).

Despite the diversity however, one common theme in much traditional African architecture is the use of fractal scaling: small parts of the structure tend to look similar to larger parts, such as a circular village made of circular houses (Eglash, 1999). Indigenous buildings had their typical sustainable features noted in their eco-friendly components. The buildings had a uniform use of materials like wood (as beams, braces or columns), red clay (adobe), thatch or palm leaves/fronds stones and straw.

The rise of kingdoms in the West African coastal region produced architecture, which drew instead on indigenous traditions, utilizing wood. The famed Benin City, destroyed by the Punitive Expedition, was a large complex of homes in coursed mud, with hipped roofs of shingles or palm leaves. The Palace had a sequence of ceremonial rooms, and was decorated with brass plaques[9]. *The various influences on indigenous building practices could be traceable to the era of colonization, regional trades, as well as cross-cultural and religious practices* (Italics added).

African traditional architecture had long been subject to major external influences. In the 20th century, part of the notable trends, in the colonial era, have been identified beginning in early 1930s:

Climate-responsive design constitutes an important phase in the development of passive technology, solar architecture[10], and green architecture. From the early 1930s to the end of 1960s, climate-response design matured as a global phenomenon, developing as bio-climatic architecture in the United

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[9] See "Early Architecture", Architecture of Africa: Encyclopedia. Retrieved from http://en.allexperts.com/e/a/ar/architecture_of_africa.htm

[10] See Cook, 1983.

States and tropical architecture in Asia and Africa along the networks of British Empire (Baweja, 2008:11; Cook, 1983; Olgyay, 1963).

The trends in African architecture comprise of three eras: the indigenous (traditional as mentioned earlier), tropical architecture, and the contemporary. Tropical architecture was identified as a description of modernist architecture, initiated by a group of architects who designed new buildings, in West Africa at the end of the Second World War mainly at the behest of the then British colonial government in West African. It was a response of the African Colonial policy to earlier reports of the development needs of the African region[11]. Uduku (2006) categorizes tropical architecture as early-tropical (pre-1955), mid-tropical (1955 to early 1960), and late tropical (late 1960s to early 1970s). Examples include the Ghana schools project, the African premier University of Ibadan, and the student hostels in the University of Lagos, respectively. Other examples include The University of Ibadan complex, Elder Dempster's office building, and Olaoluwakitan House in Lagos[12]. Uduku further identifies the principal contributing factors to the decline of the tropical movement in West Africa in the late 1970s, as the political instability in Nigeria, and Ghana's major economic demise (occasioned by decline in cocoa prices) of 1960s. "This American style architecture (*high maintenance architecture, which gives more significance to styles rather than substance*) is common both in the office arena and at domestic level," (Uduku, 1996; Uduku, 2006). The problem is not the introduction of any new "modern" style architecture but the substitution of traditional architecture instead of facilitating its technology.

While tropical architecture that evolved around the mid 20th century paid emphasis on climatic conditions in the design of housing, we argue in this article that current attention should be on enhancing the suitability of indigenous architecture in providing affordable housing for

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[11]Lewis, 1962; Colonial Office, 1953 as cited by Uduku, 2006.

[12] An example of tropical climate adaptive features is the use of sun breakers, minimizing solar heat load on Elder Dempster's building, Lagos James Cubit, 1952. See Baker, 2003 as cited by Uduku, 2006.

low-income earners. The cost effectiveness, energy efficiency, sustainability, and availability of local resources (like mud, bamboo and timber) call for re-adoption and re-integration of the indigenous values of housing provision in Africa. Acceptance and wide use of these suitable, climate responsive resources, with simple designs for residential buildings, is therefore paramount to African development, in terms of sustainable mass housing. This will require a rethinking of commitment to cultural identity in Africa. A holistic commitment to cultural values could help achieve a sustainable African society.

Growing Housing Problems: Pointers to Urgent Provision

The impact of urban influx includes inadequate infrastructure, increased joblessness rate, poverty, environmental pollution, and housing problems. Inadequacy in housing provision is a major challenge posed by unprecedented urbanization in the developing countries. For decades, Nigeria's Housing Policy has been emphasizing public housing schemes with little success. "Provider-oriented approaches, such as public housing strategies, have failed to meet the housing needs of the vulnerable low-income households who require accommodation most" (Ogu and Ogbuozobe, 2001). Previous low-cost housing schemes meant to provide shelter for low-income earners have failed to impact the housing situation of the majority of Nigerian households. The National Social Housing Scheme (NSHS) (offered as an alternative, for the less privileged citizens across the country) could encounter a recurring problem of effective implementation to make it work according to its stated goals (Etim, Atser and Akpabio, 2007).

> As the National Urnan Development Policy of Nigeria observes, inadequate housing is a major problem facing cities in the country and often manifests in the inability of supply to cope with demand, poor housing conditions, and paucity of basic infrastructure services and amenities (Federal Republic of Nigeria (FRN), 1997; Ogu and Ogbuozobe, 2001) [13].

Since the attainment of political independence in 1960, Nigeria has adopted several provider-oriented public-driven strategies such as Federal and State housing programs, slum clearance and resettlement, and public but international donor-assisted settlement upgrading and sites and services. These have had very limited impact at best, on housing development and improvement in the country (Ogu, 1996). The economic recession of the 1980s and attempts to restructure the economy under the International Monetary Fund (IMF) stabilization programmes did not help housing provision either. The structural adjustment policies that were formulated to tackle broad economic problems were drawn up with little regard to the adverse effects on the housing sector (World Bank, 1993). United Nations Centre for Human Settlements has observed that there is no evidence of improvement in the housing conditions of lower income groups in terms of affordability, tenure, standards and access to service (UNCHS, 1996)[14]. Despite heavy investment costs, several schemes have failed to reach their goals. Efforts to alleviate housing problems usually focus on cities with little attention paid to rural areas. The failure of urban housing schemes is primarily due to the high costs of non-indigenous technology and imported material usage, making it difficult to reach most intended recipients. The development of low-technological innovations could help alleviate housing problems in the rural communities.

3. Merits/Implications of Green Architecture for Africa

Okwo (2008) identifies socio-economic development and mitigating climate change as two significant yet conflicting challenges facing Sub-Saharan Africa. Green innovations, beside the objective of mitigating climate change, have impacts on various issues that include social-economic, political and technological developments in Africa. It is imperative for developing countries to enhance their developments by concentrating on indigenous practices and values, in order to enhance the economy. There is no better time other than now for Africa to pursue green technologies

to combat present and future challenges. Casing, overall mass, or size, solar devices, shading devices, material, and soil types are all essential factors to consider for designing and planning, from the inception. *Figure 1* illustrates some building characteristics this study identifies as graphical comparison quadrant worked out based on estimates for similar specifications among these two systems: African indigenous and the contemporary building types. The illustration emphasizes the vitality of adopting indigenous architecture in Africa."Energy Efficiency in Buildings" aims at producing a roadmap for reaching energy self-sufficiency in buildings by 2050, while being economically and socially acceptable[15].

FIGURE 1 [L=Low, H=High]

GRAPHIC REPRESENTATION SHOWING COMPARISON QUADRANT BETWEEN INDIGENOUS BUILDING AND CONTEMPORARY BUILDINGS
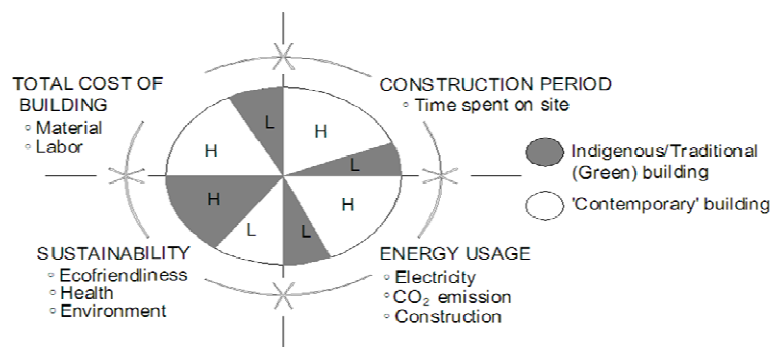
Economic Implication

Studies reveal that building materials generally constitute a large proportion of total capital investment up to 80% of total value of construction. Alemayehu, (1999), while arguing the contribution of building materials in economic development, asserts that:

> The sheer size of its contribution to the economy and the positive correlation between construction and GDP

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[15] See: The World Business Council for Sustainable Development (WBCSD) on *Energy Efficiency in Buildings*. www.wbcsd.org

observed in countries whose GDP per capital increased at fast rate means that the development of construction and building materials industry can enhance the economic development in general.

The use of local materials and building methods will cut costs to its barest minimum. The impact of green technology on the state of economy observed from the standpoints of cost saving/ effectiveness is immense. Household revenue in terms of disposable income increases as housing expenses reduce. Maintenance cost and general bills are minimized. Percentage of house ownership will increase as well as optimization of the national domestic economic performances. Entrepreneurship and multiple employments will result as well as improvements of occupational and institutional productivity, while poverty alleviation is enhanced. There will also be shaping and expansion of market opportunities for green products e.g., circulation within the system, and exports. Considering all factors, green designs within the indigenous framework would help the nation achieve this singular objective of economic prowess.

Political Implication

Regulations and related legal issues pertaining indigenous technology come to play by government agencies. Government in various levels- local, state and the federal could monitor various developments within their jurisdiction that guarantee public interest. All through the nations' regions, there are certain legal regulations to follow whereby local materials and prices are controlled. By so doing, the objectives of these developments could be realized. Government's initiatives will go a long way to implementing policies that are capable of promoting green technologies. It will formulate a basis for regulations and the application of policies that would lead to development.

Socio-cultural Implication

Improvising green technology in buildings in Africa would lead to an improvement in the overall quality of life.

Its occupants admire the insulating property of mud for the comfort of living in a natural, eco-friendly building. Available, affordable, organic and safe buildings, which take care of basic infrastructural needs, like clean water, solar powered (energy)-electricity, and safe environment are what society requires for sustainability. Change in cultural value system is observed in the sense that the shared practice of indigenous potentials is given an expression, which is approved and rewarded accordingly. It is an added value for the cultural system as people become proud of their culture. This will find further expression in the people's satisfaction with their met needs. It revitalizes indigenous practices. Awareness is enhanced as society advances in profitable adventures bringing about productivity through green-indigenous technology. It spurs morale and creativity, while ensued healthy competition results in a revolution.

Technological Implication

The United Nations Environment Programme's Atlas affirmed that "in rapidly globalizing economy, access to scientific and technological information has a critical role to play in sustainable development" (UNEP, 2008). Innovations in science and technology have brought major advancements globally. New discoveries in technology would make tremendous contributions towards sustainability, while making local resources integral in development processes would facilitate innovative ideas in developing countries. The Nigerian Building and Road Research Institute (NBRRI), which integrates applied research and development (R and D) in the building and construction sectors, is making tremendous improvements towards indigenous technology on local building construction. However, larger scale efforts by the government and stakeholders would be needed to enhance conspicuous developments in local technology. Green technology will promote research findings and advance educational values, as researchers, given adequate supports, would go extra miles for new discoveries. Indigenous technology will result in industrialization of Africa.

Environmental Implication

Environmental protective measures ensure reduction of operational energy in construction. Green developments' eco-friendliness, climate responsiveness and organic protective measures safeguard as well as minimize environmental impact of hazards. Healthy in-door and out-door environment is secured. The thermal insulation, energy saving of green buildings, and green roof's ozone pollution reduction capacities all reduce negative environmental impact. Extensive use of recycled materials help conserve, restore, and preserve the eco-system. Green buildings' waste management ensures resources and energy efficiency. The proximity of materials saves cost and reduces pollution by fuel burning through transportation.

4. Adopting Sustainable Strategies: Tools for Developing Countries

The UNMDG report suggests that "successful policies, programs and projects must be expanded wherever and whenever appropriate", including adoption of green building practices (UNMDG, 2008). The report encourages stakeholders to renew their commitment to interrelated activities contributing to progress towards this goal around the world. The African Development Bank reports:

> Information gathered by the African Development Bank (ADB), the World Bank, the International Monetary Fund (IMF), the United Nations agencies as well as other specialized institutions indicate that many African countries are falling behind in providing reliable statistics for guiding government policy and decision-making. These translate into an inability to meet corresponding data demands to support the effective monitoring of progress towards the achievement of Millennium Development Goals (MDGs) and to reach poverty reduction objectives (ADB, 2006).

Strategic principles that stand as guideposts are necessary for a thorough follow-up on Africa's development.

Ingenuity in the use of local resources makes them relevant in economic rating, relative to appropriate policies. This study argues that exclusive adoption of indigenous technology relative to building practices would help Africa achieve or maintain a low carbon society, as well as adequately solve problems associated with shelter. African-indigenous/traditional architecture, which this study finds synonymous with green architecture, is a necessity for its economic and cultural value enhancement. According a high value to a healthy and diversified cultural heritage will preserve Africa's legacy while adopting sustainable strategies will enhance developments. This study identifies and suggests pathways to progress, for developing nations, especially Nigeria.

Policy Development and Implementation: Adopting green practices could be a key success factor for achieving sustainable environment and meeting housing needs. Policies that uphold intellectual enhancement and environmental protection through green innovations must be developed to enhance national growth. Well-targeted development-oriented housing policies' with sustainable measures could result in three effects. Firstly, capacity building at institutional levels, that strengthens links between human security and environmental protection. It strengthens efficiency level. Secondly, partnership reinforcement with the public with information about relevant activities that enhance full participation. Thirdly, concerted investment in development oriented research (R and D). The problem however, is necessarily not policy development, but lack of appropriate implementation of policies. Policy enforcement becomes easy for public adherence when the government is committed to its goals especially by keeping to ethical values.

Resource and Energy Use: "Energy (or rather the lack of it) represents Africa's greatest stumbling block to sustainable development. While 50 per cent of the rest of the world has access to electricity, in Africa that figure is only half" (UNIDO, 2008). The generation of electricity in Nigeria for instance, from geo-thermal, nuclear, solar and wind sources

are absent[16], while the hydro-generated power functions intermittently. *Africa holds the ace with technology for solar energy to enhance development.* Capacity development for solar convertible devices, low-energy products like home appliances as well as local, non-combustible cooking devices with low-energy will enhance energy efficiency.

Government-citizen Partnership: Government initiatives will enhance community development. Partnership in adopting indigenous practices could result in communal unity. For instance, a synergy in co-operative practices is formed to achieve economy of scale and low cost which would result in mass production of shelter especially, in the rural arena. Government should encourage community role-play and provide suitable infrastructure at near zero costs. This democratic relationship will solve housing problem, but promote unity, enhance productivity, increase rate of employment, and build trust, as part of key-development-factors (KDF). Indigenous building practices with improved technology will bring positive impacts, if adopted within this framework.

Education/Awareness: The United Nations Industrial Development Organization (UNIDO) (2007) asserts:

> For African Governments, information is indispensable in the design of effective investment promotion policies. The problem is that the information and data publicly available is usually too sketchy and fragmented to allow for informed decisions by the main players in the investment promotion process.

A re-orientation of societal awareness of the resource-wealth found in the African culture will make a difference in making advanced development a reality. Citizens must be given education and awareness not only to observe but participate and completeley engage in issues/matters that enhance resourcefulness right from the cradle. The adoption into the institutional system is a pointer to advanced development.

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[16] Data from 2002 estimate. Microsoft Encarta, 2006.

Incentives and Penalties*:* Incentives will enhance morale and motivate hearty participation geared towards development as well as healthy competition that will bring about improvement in local products and construction technology. Strategies mapped out by government for 'green technology and products' with public appraisal through incentives could unlock potentials for advancement. Instituting measures that prosecute violators will constitute citizens conscious, pro-active participation for a change. Wide-open opportunities for scholarships, fellowships and other grants for indigent, promising students will foster ingenuity within the academia, as researchers are compelled to pursue deeper knowledge in their respective fields. The consequent competitiveness will multiply achievements geometrically.

5. Conclusion

The construction industry is one of the largest industries that contribute to global warming, traceable to various human activities. This study intends to identify means to solving the basic shelter needs of local residents of developing nations, with specific reference to Nigeria. The paper observes the conservation process of indigenous building materials as a means of economic recovery and improvement for Nigeria and the sub-Saharan Africa. It finds a very close relationship between green architecture and African indigenous architecture in terms of objectives. Policy makers need to realize the implication of green developments in relation to economy, technology and socio-cultural structures. This study advocates the adoption of sustainable policies that ensure the sustainability of local resources through development strategies in reaching primary objectives of low-cost housing schemes, as well as reduction of environmental impact, by mid 21st century. It brings to light the need to embrace of local materials and suggests Africa could experience development with a high value accorded its culture. Alongside, advancement in indigenous technologies and proper resource management are necessary for economic growth of the continent. Heavy investment in green technology via research and development is a key

success factor to unlocking potentials in Africa. It is also matter of urgency for Africa to catch up with the pace of technological developments to complement its repertoire of indigenous technology and enable an inclusive and fair development process.

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