Role of Information and Communications Technologies (ICT) in Sustainable Housing Development in Nigeria

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Abstract: The main objective of this paper is to identify, examine and highlight the role of Information and Communications Technologies (ICT) in influencing sustainable housing development (SHD) in Nigeria. The concept of SHD is defined as any form of housing that is cheap and socially acceptable in terms of the impact of buildings on the environment. The concept emphasises sustainable building designs, low carbon materials and green building practices. Consequently, the UN SDGs 2030 charter consider SHD as a key component panacea for alleviating numerous societal challenges necessary for socio-economic growth and sustainable development. However, sustainable housing provision is one of the major challenges facing mankind today particularly in developing countries like Nigeria. Hence, many urban dwellers are exposed to poor living conditions which ultimately impacts on their health, safety and environment. The current state of housing development in the country remains poor despite the vast resources expended over the years. Consequently, the paper identified poor planning, inconsistent policy and supervisory regulation, as well as inadequate funding, empirical data, supporting infrastructure and corruption as bottlenecks to SHD in Nigeria. In addition, the high cost of materials, and the local participation of the private sector have hampered SHD in Nigeria. However, these can be addressed promoting public-private participation in future SHD policies and programmes in the country. Consequently, the authors have proposed the integration of ICT tools in the planning, organisation, co-ordination and operation of future housing policies, and development programmes. This is based on the premise that ICT avails policymakers, consumers and the industry experts with the tools to efficiently and effectively address SHD challenges in the future. However, this can be achieved by adopting a holistic approach to housing design, development, and maintenance based on the tenets of socioeconomic and environmental sustainability practices.

Keywords: ICT, SDGs, Housing Development, Sustainability, Nigeria

I. INTRODUCTION

Nigeria is located on the West coast of Africa bordering the Republic of Benin, Cameroon and the Gulf of Guinea on longitude 10 00 N and latitude 8 00 E. The total land area of the country covers an estimated 920,000 km2 comprising 98.59 % and 1.41 % land and water, respectively. As a result, the nation's climate varies from arid in the north to equatorial in southern regions. The northern part of the country is dominated by plain landscapes and lowlands merged to plateaux and hills in the south. The dominance of lowland savannah belts predominantly accounts for agricultural (78 %), forest (9.5 %) and other (12.5%) use of land in Nigeria. The highest elevation in Nigeria is Chappal Waddi at 2420 m located Taraba state whereas the lowest point is the Atlantic Ocean. Consequently, the nation is periodically affected by flooding in the south during the rainy seasons from March to October whereas the arid north is prone to droughts and desertification. In addition, the extremity of the north-south climes, as well as climate change, has resulted in environment issues such as deforestation, desertification, as well as soil degradation.

The social aspect of modern day Nigeria is characterized by diverse cultural, religious and ethnic groups. According to census estimates, Nigeria consists of over 180 million people and over 250 tribes, thus making it the most densely inhabited country in Africa. The population comprises of 29%-Hausa and Fulani, 21%-Yoruba, 18%-Ibo, 10%-Ijaw, 4%-Kanuri, and 3.5%-Ibibio, 2.5%-Tiv, and 1.2%-Idoma. However, the predominantly spoken languages are Hausa, Ibo and Yoruba with the English Language used as the lingua franca. The population is in various percentages along faith lines predominantly distributed along Christianity; Islam and Indigenous beliefs. The high

population density, rural-urban migration and high rate of urbanization have continued to place significant pressure on social infrastructure and communal amenities in the country.

In economic terms, Nigeria is ranked the largest economy and crude oil (petroleum) exporter in Africa with an estimated GDP of US$1.1 trillion buoyed by a real growth rate of 4 % annually. In addition, the nation is blessed with abundant natural resources including crude oil, natural gas, petroleum, coal, tin, bauxite, iron ore, limestone, and gypsum. The economy is diversified with agriculture, financial services, banking, manufacturing and industrial products account for significant proportions of national income and revenues. The agricultural products include rice, groundnuts, sorghum, cocoa, palm oil, rice, rubber and animal products. In addition, the nation's industrial products comprise petroleum, columbite, rubber, wood, hides and skins, textiles, cement, food, footwear, chemicals, fertilizer, steel and ceramic products. In general, the sectional composition of Nigeria's GDP consists of 20.3% agriculture, 23.6% industry and 53.1% services.

However, in spite of Nigeria's potential the country is perennially plagued by myriad problems which have contrived the nation's drive for socioeconomic growth and sustainable development. Consequently, successive governments over the years, have battled to alleviate the nation of its socioeconomic, environmental, and geopolitical challenges. The nation is thus beleaguered by pervasive corruption, widespread poverty, inadequate housing, social amenities such as water, health and sanitary facilities, epileptic power supply, dilapidated infrastructure. The lack of basic infrastructure for water, health and sanitary facilities and inadequate housing pose tremendous risks to the welfare of future societies, particularly in developing nations.

In view of this, the United Nations (UN) through its 2030 Agenda for Sustainable Development has set modalities in place to address such developmental challenges. Consequently, the 17 Sustainable Development Goals (SDG) or "Global Goals" are aimed at alleviating poverty, combating inequality and injustice, and addressing climate change by the year 2030. In addition, the SDGs initiative seeks to confront the origin of poverty and deprivation by establishing the ideals that can foster sustainable global development. Critical to this ambition is the need for long-term investments in robust infrastructure that can stimulate sustainable industrialization and innovation.

The UN report posits that investments in transport, mass housing, water and sanitation, sustainable energy and information and communication technology (ICT) are critical for societal empowerment, human and sustainable development. In addition, the provision of infrastructure particularly sustainable housing is critical to creating inclusive, safe, resilient and sustainable cities in the future. Consequently, the importance of housing to long term development in developing countries necessitated studies on the sustainable housing development (SHD). The provision of SHD is directly linked to the provision of water, health and sanitation in the wider society. In addition, SHD can be vital in reducing poverty, promoting good health and wellbeing, quality education, gender equality, infrastructure, and sustainable cities.

However, the lack of sustainable housing is a prominent feature in developing countries around the world. With the global population set to soar geometrically to 8 billion by 2050, humanity urgently needs to address the issue of lack of adequate housing in future cities. Consequently, the SDGs goals 9 and 11 are strategically developed to address sustainable housing through long-term planning, policies and investments for supporting infrastructure. The use of information and communication technology (ICT) can significantly enhance the processes, policies and potential required for SHD in the cities of the future. However, there is limited research on the potential of ICT in the development of policies and programs for SHD in Nigeria. Therefore this paper aims to identify, examine and highlight the role of ICT in SHD in Nigeria. Thus, the study explores the concept of sustainable housing, its role in socio-economic growth and national development and the importance of ICT towards SDGs' goals realization in Nigeria.

II. SUSTAINABLE HOUSING DEVELOPMENT (SHD)

The concept of SHD is based on the twin goals of providing sustainable housing (SH) and national development in developing countries. According to Gilkerson & Sexton, sustainable housing is any form of housing that is cheap, socially acceptable and environmentally friendly [1]. The aim is to reduce the impact of buildings on the environment through sustainable building designs, low carbon materials [2], and green building practices [3]. In principle, SHD is the sum total of all the processes, policies and technologies required for the delivery of sustainable housing as well as water and sanitation for inhabitants of cities. According to the SDGs, the sustainable provision of housing is a panacea for alleviating numerous societal challenges necessary for socio-economic growth and sustainable development [4, 5].

Housing is considered one of the basic requirements for the existence of mankind [6]. As a result, goal 11 (G-11) of the SDGs maintains that sustainable housing and infrastructure are necessary to promote safe, resilient and sustainable societies [7-10]. The process of ensuring access to affordable, safe and sustainable housing and investments in public transport, green public spaces and urban developmental planning is key to creating future sustainable cities which serve as centres for the convergence of ideas, business, culture, science and social development [8]. In addition, the sustainable provision of housing and infrastructural development in world's rapidly developing cities can foster job creation, improve living standards as well as reduce the effect of environmental consequences of human activity [8, 11, 12].

By overcoming housing and infrastructural deficiencies, inhabitants of the world's future cities can thrive and grow through the efficient utilisation of resources for poverty alleviation as well as the sustainable management of waste to curtail environmental pollution, climate change and global warming [5, 8]. In order to achieve these targets, G-11 aims to ensure access to adequate, safe and sustainable

housing and basic infrastructure by the year 2030. Furthermore, the G-11 charter seeks to emancipate and empower the most vulnerable demographic in today's cities through the provision of sustainable inclusive urbanisation, participatory capacity, and integrated human settlement. It also involves all the activities required for planning, managing and safeguarding the cultural heritage of developing countries. Lastly, it aims to strengthen policies and programmes for the sustainable use of locally sourced materials for future housing provision [5, 8, 10]. In spite of this laudable targets, SHD and provision of infrastructure remains a challenge for developing countries like Nigeria. Consequently, millions of people in developing countries like Nigeria reside in housing lacking water, sanitation, security, and electric power supply [6].

The poor living conditions are characteristic of slums with their antecedent problems of overcrowding, derelict buildings and poor waste management. The lack of adequate housing and basic infrastructure can be directly linked growth of slums as well as high rural-to-urban migration, unemployment, the rate of poverty, as well as economic stagnation, poor planning, political instability, natural disasters and social strife. These factors have led to the growth of slums which according to the UN-Habitat currently accounts for nearly 33% or 860 million inhabitants in developing countries. The UN-Habitat report indicates that 62% of urban dwellers Sub-Saharan Africa reside in slums. In comparison, this demographic accounts for 35% in South Asia, 35% in South Asia, 31% in Southeast Asia, 28.2% in East Asia, 24.6% in West Asia, 24.1% in Oceania, 23.5% in Latin America and the Caribbean, and 13.3% in North Africa [4, 13].

Consequently, strategies are currently being developed by governments, NGOs charities and international organisations to reduce the growth and impact of slums in the future. Most notably, these organisations have adopted numerous approaches through improved urban planning, widespread infrastructure development, and integrated public housing projects aimed at slum removal, relocation, and upgrading; to tackle the global crises of SHD and slum growth. Although the outlined strategies have yielded mixed success, much still needs to be done to arrest the crises particularly in developing countries like Nigeria with its rapidly growing population. Section 2.1 will examine the current status of SHD in Nigeria, whereas the challenges and prospects of SHD will be briefly highlighted in B&C, respectively.

A. Current Status of Sustainable Housing Development (SHD) in Nigeria

One of the major challenges facing mankind today is inadequate housing. This in particular is more prevalent in developing countries like Nigeria due to the high rate of rural-urban migration, lack of infrastructure and pressure on resources in urban conurbations [14]. As a result, the population of urban dwelling Nigeria has soared geometrically over the years. Consequently, over 60% of Nigeria are now categorised as "homeless persons" due to lack of adequate housing. Furthermore, the population of

the nation's slum-dwellers is estimated to be nearly 75% of the entire population [15]. Hence, inhabitants are exposed to poor living conditions, which ultimates impacts on their health, safety and environment due to lack of basic amenities for water, waste management and access to modern energy services [15, 16]. This indicates a palpable lack of sustainable housing in the country and calls for the need to institute more strategic plans, programmes and policies to ensure the sustainable development of safe, affordable and robust housing for the populace.

Currently, Nigeria has numerous housing policies and programmes for SHD with the most notable being; Land Use Act (1978), Mortgage Institutions Act (1989), Federal Housing Authority Act (1990), National Construction Policy (1991), National Housing Fund Act (1992), Urban and Regional Planning Act (1992), Nigerian Social Insurance Trust Fund Act (1993), Federal Mortgage Bank of Nigeria Act (1993), and National Urban Development Policy (1997). To ensure the successful implementation the outlined policies the Federal Government of Nigeria established institutions such as the Federal Mortgage Bank of Nigeria (FMBN), Federal Mortgage Finance Limited (FMFL), the Federal Housing Authority (FHA) and the defunct Urban Development Bank of Nigeria (UDBN). In addition, the Ministries of Works, Housing, Environment and Finance were tasked to supervise, support and promote the objectives of promulgated housing policies [14].

However, the current state of housing development in the country remains poor despite vast resources expended through various schemes over the years. This can be ascribed to the numerous challenges encountered by sustainable housing development programmes in the country as highlighted in section B.

B. Challenges of Sustainable Housing Development (SHD)

The problems of SH provision and development in Nigeria has been explored by numerous researchers in Nigeria over the years [14, 17-20]. The key findings of these studies indicate that sustainable housing (SH) and sustainable development (SD) are closely related. In addition, the consensus amongst housing researchers is also that SH and SHD in Nigeria are largely plagued by poor planning, funding, data or statistics, inconsistent policy, regulation, lack of supporting infrastructure. According to *Olotuah* and *Ajayi* [17], the challenges of SHD can also be attributed to lack of sensitivity to the housing needs of the poor, misplaced policy priorities, improper planning, and poor execution of housing programmes and policies. In addition, the high cost of materials, lack of scientific data as well as efficiency project management procedures have all hampered SHD in Nigeria [17, 19]. This observation is corroborated by *Ogu* and *Ogbuozobe* [20] whose study emphasises that institutional regulations and the high cost of building materials as well as the lack of access to finance, residential infrastructure have conspired against SHD in Nigeria.

In light of this, the study advocates for a global paradigm shift from public or government controlled

housing schemes to an environment governed solely or at least in part by private shelter initiatives. Furthermore, the study calls for governments to create a suitable climate to promote initiatives by householders, small-scale providers, and entrepreneurial private firms investing in SHD [20]. The realisation of this objectives will, according to *Awotona* [19], will greatly foster the elimination of housing inequality across Nigeria. Likewise, the paper advocates for a change in perception of housing policy advocates and stakeholders in the country. Based on this disposition, the challenges of SHD and its antecedent challenges can no longer be simply adjudged in terms of cost, materials and manpower but as a form of structural inequality and failure of society.

C. Prospects of Sustainable Housing Development (SHD)

The United Nations (UN) estimates that the population of urban dwellers will soar geometrically in the years to come. Hence, it is projected that more 60% of the global population will reside in cities resulting in 95% urban expansion by the year 2030. Currently, about 3.5 billion people reside in cities around the world with over 1billion residing in slums or shantytowns that lack access to basic infrastructure and social amenities. These projections are likely to increase pressure on water supply, waste and sewage management as well as public health, sanitation and the environment, particularly in developing countries. However, with proper planning, organisation and implementation of robust SHD policies and programmes future societies will be equipped for the huge influx of future city dwellers. Furthermore, SHD has the potential to foster technological innovation in diverse areas such as green buildings and public spaces, sustainable energy consumption, smart grids and low carbon energy production, greenhouse gas abatement and climate change. In addition, SHD will help promote the use of information and communication technologies (ICT) in the administration, planning, and maintenance of future projects. The role of ICT in SHD will be highlighted extensively in section III.

III. THE INFORMATION & COMMUNICATION TECHNOLOGIES (ICT) AND SUSTAINABLE HOUSING DEVELOPMENT (SHD) NEXUS

The role of information and communication technologies (ICT) in enhancing the numerous processes, policies and its potential improving human existence cannot be overemphasised. Studies have highlighted its role in fostering education, research, health care, politics, environmental management, energy, job creation, among others [21]. ICT is a strategic tool for planning, organising, and managing people, processes and complex systems. Furthermore, ICT can be defined as a complex ecology of communication tools that enable local social interactivity and relationships, information exchange and human capital [22, 23]. Similarly, *Haythornthwaite* [24] corroborates the role of ICT in influencing social interactions, ideas and innovation within any society. This ultimately helps to foster debates, ideas and cultural exchanges necessary for effective and peaceful co-existence between people in the society. In addition, ICT has been identified as an important dynamic in the process of uplifting quality of life, social participation and human living standards [25]. Consequently, numerous ICT initiatives and intervention programmes have been set to help identify, examine and address myriad societal problems [22] such as sustainable housing development (SHD). Consequently, the outlined problems of SHD in developing countries can be addressed using innovative tools such as ICT by adopting innovative approaches, and robust concepts such as sustainability.

The role of ICT in sustainable development (SD) has been highlighted by a number of research groups in the literature [26]. For decades, the concern of construction stakeholders has been focused on improving the general practices and productivity of construction industry. Notable among these efforts are the reports on ICT strategies formulated and outlined in the European Construction Technology Platform (ECTP) (2008) and Fully Integrated and Automated Technology FIATECH (2010). Both reports, like those of the Business Round Table report and Egan Report of 1998 in the United States and the United Kingdom respectively are considered "change agents" in the construction industry. Hilty et al., [26] assert that ICT can be pivotal in the promotion of social, economic and environmental sustainability. This according to the study can be achieved through the adoption of Environmental Informatics, Green ICT, and Sustainable Human-Computer Interaction (HCI).

Consequently, various ICT tools, strategies and approaches have been employed in address social and sustainability challenges in many developing societies. ICT can be applied to collect and analyse data on SHD planning and implementation programmes. For example ICT tools such as Geographical Information Systems (GIS), Building Information Modelling (BIM) and Industrialized Building Systems (IBS) have been successfully employed in planning, design and management of SHD schemes. Other tools such as AutoCAD, Environmental Impact Assessment (EIA), Life Cycle Assessment (LCA) and architectural design software play significant roles in SHD and Urban Planning [26-28].

Furthermore, ICT is typically used to process environmental data on pollution, disaster waste management, global warming and climate change. Various researchers have highlighted the role of ICT in environmental monitoring systems, information systems databases, and spatial information processing. Consequently, environmental informatics and tools such as analytical and simulation models are used for environmental protection, research and development (R&D), and disaster management [29]. The concept of Green ICT and Sustainable Human-Computer Interaction (HCI) [26] also have tremendous potential in the design, planning and implementation of future SHD projects. The use of green ICT will help reduce of SHD, construction materials selection and land management processes on the environment [30]. In addition, it is touted as the best

approach to identifying and monitoring the impact of future buildings and construction on the emission of CO2 and other GHGs [31]. Lastly, the concept presents the possibility of energy management, efficiency and conservation and the use of low cost biomass based fuels for future hybrid energy systems [32-35].

In addition, the problem of lack of data for planning, forecasting and low-cost policy implementation can be addressed by employing ICT as a holistic strategy for achieving sustainable housing development. The use of ICT can aid the process of disseminating information, creating awareness and enlightenment. ICT can also be used to address the challenges of poor project management, execution and maintenance in housing programmes and policies development. Lastly, the use of ICT can enhance the processes, policies and potential required for SHD in the cities of the future.

IV. CONCLUSION

The paper was aimed at highlighting the role of ICT in influencing sustainable housing development in Nigeria. The concept of sustainable housing development was identified as a key component of sustainable development as defined by the UN-SDGs charter for 2030. However, the numerous challenges of SHD particularly in developing countries, continue to impede socio-economic growth and sustainable development. The paper identified poor planning, policy somersault and supervisory regulation, as well as inadequate funding, empirical data, supporting infrastructure and corruption as bottlenecks to SHD in Nigeria. In addition, the high cost of materials, local participation of the private sector and inefficient project management have also hampered SHD in Nigeria. However, these can be addressed promoting public-private participation in future SHD policies and programmes in the country. Consequently, the authors have proposed the integration of ICT tools in the planning, organisation, co-ordination and operation of future housing policies, and development programmes. This is based on the premise that ICT avails policy-makers, consumers and the industry experts with the tools to efficiently and effectively address SHD challenges in the future. However, this can only be achieved by adopting a holistic approach to housing design, development, and maintenance based on the tenets of socio-economic and environmental sustainability.

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