Exploring sustainability in providing low-cost housing in Khartoum- Sudan

Awad E. Zuhal[1]

[1] Department of Architecture and Physical Planning, Building and Road Research Institute. University of Khartoum, (zuhaleltayeb@yahoo.com).

Abstract: The Sudanese housing policies encompass two main types of programs. The first one addresses the needs of all sectors of the population for the provision of plots through site and services schemes. The second type provides small built core units **(**Incremental housing**)** for the low- income groups. The aim of the paper is to examine the evolution of sustainable design of the core units built by the public sector for low-income families. The research selected some low-cost housing projects provided in different periods of time e.g. Duim project _1949, El shabiya project_1963, Al Iskan Project _1975 and state fund projects _2001 as case studied. The analysis focused on four parameters: the size of the project, the target group of inhabitants, the design of the core unit and the construction including building materials and technologies, these parameters are compared to U.N. Habitat principles of sustainable housing. The research found that old projects had comprehensive approach including socio-_economic surveys of the intended inhabitants, while new projects put more emphasis on quantities of built units than on quality of housing. Former projects used cheap traditional building materials and technologies which is more sustainable than the expensive imported materials used in new projects. The research identified the introduction of mixed housing of different income levels in new projects that guaranteed social sustainability.

Keywords: low-cost housing projects, sustainability, core-unit, building materials and technologies

Introduction

Sustainable Development is a comprehensive process of providing development within the umbrella of the four pillars of sustainability (UNDP 2002): cultural vibrancy, economic prosperity, environmental responsibility and social justice. Social sustainability occurs when the formal and informal systems and structures that support the capacity of current and future generations are linked to create healthy and liveable communities (Hodgson, 2003). In practicing sustainable community development, proposed actions and policies must be judged for their economic value as well as for their ecological and evolutionary affects, moreover following a model of sustainability requires integrating different human values with the multiple dynamics of natural systems (Flint, 2013). One of the main factors of achieving sustainability in a community is the sufficient range, diversity and affordability of housing within a balanced housing market (Egan 2014). Housing projects must be properly integrated into the social, cultural and economic local environments, it is important to connect housing to infrastructure networks and basic services (water supply, electricity, etc.).

UN-Habitat (2012) prepared a policy framework for developing countries to guide provision of sustainable housing, in which cultural and economic impacts of housing contribute to make healthy residential neighbourhoods. To achieve economic sustainability housing policies, design and construction processes should be connected to micro and macro -economic development, and employment and economic generation. Also, production of housing projects contributes to economic prosperity of the community, as stated by Davis (2015) construction of housing creates new opportunities for urban investments at the local level, it privileges the role of private developers and the housing industry and transfers responsibility for housing to smaller municipalities. Social sustainability is a serious issue in housing as it concerns with social equity in providing basic and social services and access to work. Another important factor in providing sustainable housing is the social mix of the

inhabitant of different income-levels and different ethnic groups and distributing 20-50% of the residential floor to low-income families (UN Habitat 2014).

The UN-Habitat clearly stated that it is a priority for all governments to provide adequate and affordable housing taking into consideration residents lifestyle and livelihood strategies. Provision of adequate housing requires number of conditions such as: affordability, habitability, accessibility, location, availability of services, materials, facilities and infrastructures, cultural adequacy and security of tenure (UN 2014). Availability of different types of housing tenure such as freehold, leaseholds, condominiums, cooperatives, shared leaseholds and various forms of rental housing to suit various needs and preferences of different inhabitants provides security of tenure (UN Habitat 2015).

Provision of sustainable housing involves a complex network of components: stakeholders and matters as shown in Figure (1). Each component plays an important role that affects roles of other components e.g. government policies guide urban plans, land-use and other regulations related to housing. Scaling up sustainable housing is a crucial issue in developing countries, which require supportive institutional and regulatory environment, monitoring and evaluating mechanism and appropriate capacity development of the housing sector (UN Habitat 2012). The demand for new housing projects in developing countries is huge e.g. in Nigeria, the rate of provision of new housing stock has lagged severely behind the rate of population growth resulting in staggering housing deficit (Olotuah,2010).

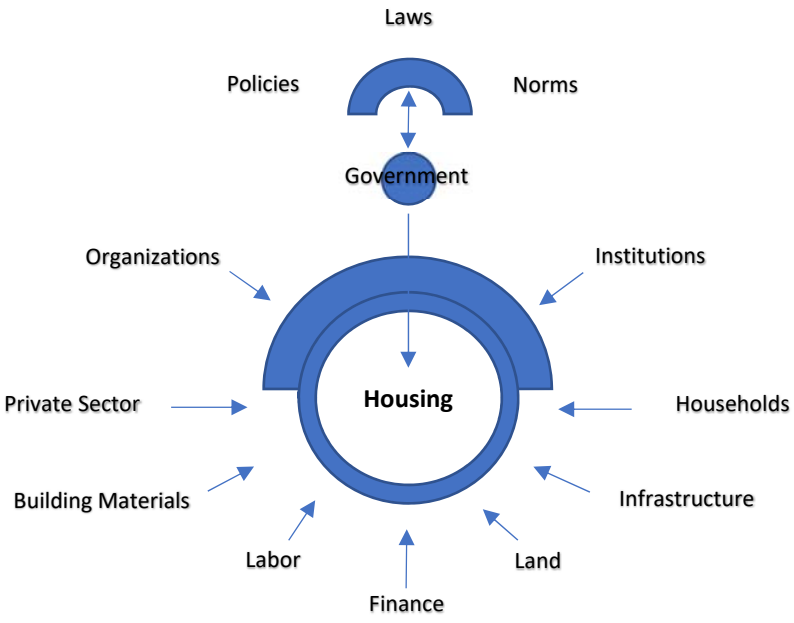

Figure (1): Stakeholders and Matters affecting Housing
Source: UN Habitat 2012 pp 19

There are multiple alternatives of sustainable building materials such as, earth which is widely available, affordable and recyclable. It is well suited for passive solar heating and cooling, and offers a wide range of environmental benefits, including significant reductions in pollution and greenhouse gas emissions (Bayizitlioğlu,2017), one example of a developed sustainable technology of earth is compressed and stabilized earth block (CSEB) which used as low-cost structural systems (Kumar et al,2018). Also, wood as a sustainable building material is durable and its greatest attribute is that it is a renewable resource, it has low carbon impact and low

embodied energy. (Falk,2009) one example of a developed sustainable technology of organic based construction materials is straw based material that used for walls (Goodhew,2012).

Housing in Sudan

Sudan as a developing country experienced changing and urbanising conditions, the population increased from 10.3 million in 1956 to 39.154 million in 2008. Population of Greater Khartoum-the capital- also increased rapidly from just over half a million in 1956 to 6.8 million in 2014 with estimated growth rate as 2.7% (Khartoum State (2015). The population influx caused a severe housing problem and a massive housing demand in a country, 46.5% of its population are under the poverty line (Sudan census ,2008). That means half the population have inadequate income to afford living and housing.

The review of the Sudanese housing policies shows that those policies encompass two main types of programs. The first one addresses the needs of all sectors of the population by provision of plots through site and services schemes -an application of the enabling approach. The second type provides small built core units for low- income families. However, the recorded built core units in Greater Khartoum in the period 1961 -1996 by both public and private sectors are only around 2000 units which represents a few portions of the need for new housing at that time (see table (1)).

Table (1) Public and Private Sector Built Core Units (1961 -1996)
Source: Adam.E.A. (2003).

town	location	Developer	Dwelling Type	Year	No. of Units
Khartoum North	Al Shabiya	Public	Semi-Detached House	1961-1963	1048
Khartoum	Hai Al Hajer	Public	Detached +Semi-detached House	1971-1977	32
Omdurman	Al Omeda	Public	Row Houses	1974	17
Omdurman	Al Omeda	Public	Detached House	-	12
Khartoum	HAJ yousif	Public	Detached House	-	32
Khartoum	Haj yousif	Public	Detached House	1975	107
Omdurman	Al Thoura	Public	Detached House	1975	123
Khartoum	Jebra	Public	Semi-Detached House	1975	200
Omdurman	Daralsalam	Private	Detached House	1990	250
Omdurman	Abu Said	Private	Detached House	1990	100
Khartoum	Jebra	Private	Flat	1993	24
Khartoum	Al Amarat	Private	Flat	1995	80
Khartoum	Al Mamora	Private	Flat	1996	120
Total No. of Units					2145

After 1996 the state of Khartoum took serious actions to solve housing problem and established a new body: The State Fund for housing and development (The State Fund), which is created to address housing deficits through provision of more core units, table (2) shows housing projects built by the State Fund in the three towns Khartoum, Khartoum North and Omdurman (1996-2015). The built core units are more than one million.

Table (2) Housing projects built by the State Fund (1996-2015)
source: (the State Fund archives)

Town	location	Start of construction	Number of units
Khartoum	El Andalus 17	1996	2271
Khartoum	El Andalus 20	2001	2439
Khartoum	El Andalus 23	2001	855
Omdurman	El Thowra 71	2003	984
Omdurman	El Thowra 72	2003	1818
Khartoum North	El Tilal 1	2003	877
Omdurman	El Thowra 75	2004	3600
Omdurman	El Thowra 73	2005	924
Khartoum North	El Wadi AlAkhdar 15	2006	828
Khartoum North	El Wadi AlAkhdar 20	2006	995
Khartoum North	El Wadi AlAkhdar 21	2006	1243
Omdurman	El Thowra North 75	2007	154
Omdurman	El Thowra North 76	2007	638
Omdurman	El Thowra 99	2008	655
Omdurman	El Thowra 101	2009	1371
Omdurman	El Thowra 102	2010	2096
Omdurman	El Thowra 103	2010	1685
Khartoum	El Safwa 4	2011	2686
Khartoum	El Safwa 5	2011	2505
Khartoum	El Safwa 6	2011	2444
Khartoum	El Safwa 7	2011	1664
Khartoum	El Safwa 15	2011	1110
Khartoum	El Safwa 11	2011	945
Omdurman	El Thowra West 80	2012	2422
Omdurman	El Fath 2	2014	2189
Omdurman	El Fath 8	2014	1170
Omdurman	El Fath 13	2014	2149
Omdurman	El Fath 12	2014	2189
Total No. of Units			1,038,911

Research Methodology

The research was based on literature review and field survey, it had followed qualitative and quantitative methods which included: Plans and photos documentation, observation, interviews with senior officials at ministry of Physical Planning and the State Fund, and some inhabitants of the selected housing projects. Four low-cost housing projects were selected as case studied, they are constructed in different periods of time: New Deims in 1949, El Shabyia in 1963-1985, Al Iskan in 1975 and Elthora hara 72 in 2003. Data was collected from secondary data concerning old housing projects (New Deims, El Shabyia and Al Iskan) and primary data –field survey- for the new housing project (Elthora hara 72). The analysis was focused on comparison between the selected low-cost housing projects describing their size of the project, the target group of inhabitants, the design of the core unit and the construction including building materials and technologies.

Presentation of Case Studies

New Deims Resettlement Project

New Deims is located in Khartoum town, it lies outside the Railway Ring, south of the light Industrial area . The resettlement project was carried out in 1949. New Deims comprises 1233 dwellings of 200 square meter. The core unit contains two bed-rooms, a veranda,a kitchen,a toilet and a shower(see figure 2).

Figure (2) plan of the core unit - New Deims.
Source: Ministry of Physical Planning archives

El Shabyia Project

El shabyia is located in Khartoum –North. It was developed between 1963- 1985 to provide housing for the workers from Khartoum- North industrial area. Around 1048 houses were constructed. There were two types of houses: Small Dwelling in plots of 252, 261 or 290 sq. m and large Dwelling in plots of 300, 310 or 340 sq. m. The core unit contains three bed-rooms, two verandas, a kitchen, a toilet and a shower. (see figure 3).

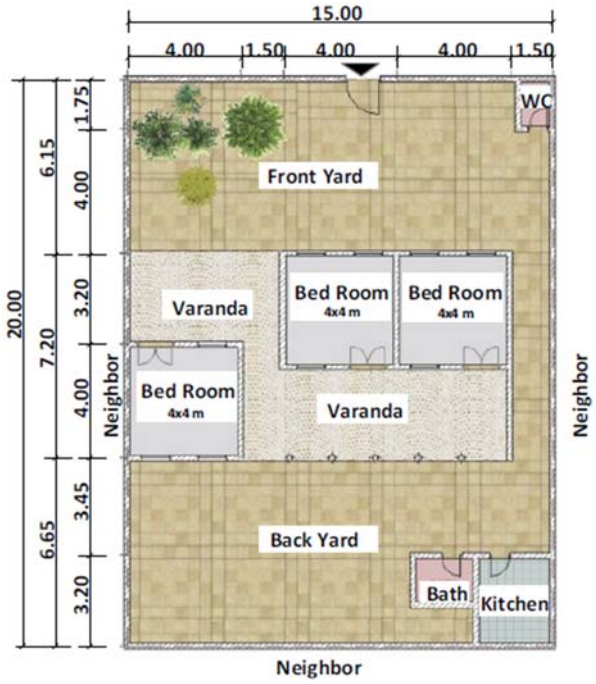

Figure (3) plan of the core unit -El shabyia.
Source: Daiffalla (1998)

Al Iskan Project

Al Iskan Project is located in West-South of Khartoum town-Jebra Block Three. The project started in 1975.It includes about 200 prototypes houses. Plots are 200 m^2. The core unit contains three bed-rooms, two verandas, a kitchen, a toilet and a shower (see figure (4)).

Figure (4) plan of the core unit - Al Iskan Project.
Source: Ministry of Physical Planning archives

Elthora hara 72 Project

Elthora hara 72 is located North- West of Omdurman in Karari locality. The project is constructed by the State Fund, it was started in 2003 and contains 1818 houses. The project contains three types of dwellings:
Low-cost housing (for low income families): A core unit consists of one bed room, a kitchen and a toilet (see figure (5)). This type of housing holds 58% of the project- 674 houses.
Economic housing (for middle income families): A core unit consists of one bed room, a kitchen and a toilet. It holds 37% of the project - 410 houses.
Investment housing (for high income families): A villa consists of two rooms, a kitchen, a bathroom and living area. The construction of the house permits vertical expansion. It holds 5% of the project -62 houses.

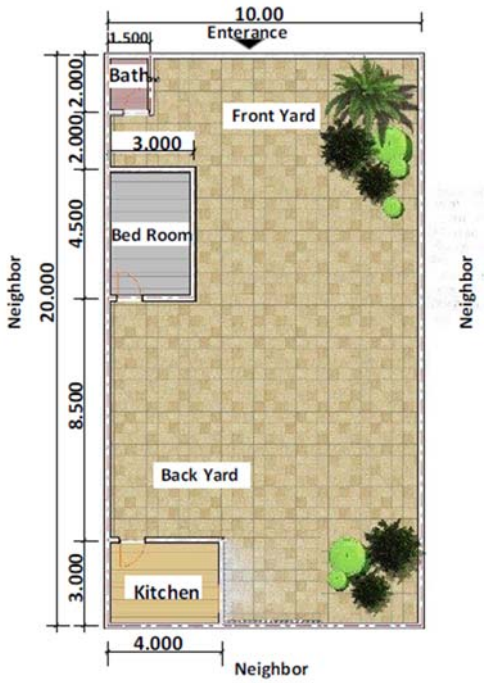

Figure (5) plan of the core unit - Elthora hara 72.
Source: (the State Fund archives)

Discussion

The size of the project

Low-cost housing projects started as resettlement projects in New Deims, which was a native lodging area built to accommodate the working people building the newly occupied Capital-Khartoum. At the time of Resettlement (1949) there were five thousand houses accommodating some seventeen thousand people, who lived in conditions of terrible over-crowding. There were two reasons for the resettlement, firstly, housing condition in the Old Deims were seriously inadequate for the minimum requirements of decent family living and secondly, Old Deims blocked the expansion southward of Khartoum. The district authorities at that time were not equipped for an extensive scheme of housing loans or governments subsides which would have required special funds and organization. In the sixties, the housing authorities-built houses for the poor workers families in El Shabyia, the number of houses was large – 1048 units. In the seventies a small experimental Project- Al Iskan was built for low-income groups, only 200 houses were constructed.

The big change in projects size occurred after the establishment of the State Fund, it had an expanded social housing programme providing more than one million units**.** Those projects held the potential to improve the construction industry and help economic development of the country. The housing authorities became more organised and had reasonable budgets but at the same time the housing problem exaggerated and the demand for housing increased.

The increase in the projects size requires more vacant land which is available at the suburb of the capital so that new housing projects were located in remote areas, in which inhabitants are not well connected to jobs and to decent basic and social services Another important disadvantage in providing these large projects is the absence of demonstration projects, all housing projects were constructed without pilot projects to test sustainable practices and after completion there was no evaluation for the implemented housing projects so as to pick out the advantages and avoid the drawbacks.

The Target group of inhabitants

In the first resettlement project- New Deims- housing authorities recognised the important role of the social sustainability; therefore, they conducted a comprehensive social survey. By doing so they emphasized the role of housing as a social structure that considers socio-economic interactions of the inhabitants and their social qualities. The housing authorities tried to conserve the community structure because on the social side, Old Deims comprised of well –integrated communities, sharing certain loyalties, and exchanging certain mutual obligation. The housing authorities distributed plots to the inhabitants Old Deims, according to two fundamental criteria: permanent employment and ten years occupation. It was, however, recognized from the social survey that some families-29- were qualified for plots, but who could not build without substantial assistance, such families were given financial assistants and were left to their own devices. After that eligibility criteria for obtaining a house in El Shabyia project changed to focus on nationality -Sudanese, family size -five persons, employment -public sector and salary. The beneficiaries were required to deposit down payment, equal to 10% of the total cost of the house and the services provided. The balance was to be paid in instalments over a period of 20 years. In Al Iskan Project core housing units were allocated to all low- income families living in the capital without specifying working in the public sector. families were ranked according to certain social and economic criteria (the point system). The beneficiaries were required to pay the total official nominal price of the house without instalments.

The state fund provided housing for mixed inhabitants in most projects, hence Elthora hara 72 project was intended for different income levels but the majority were low-income families - 58% of the total number of the inhabitants (see Figure (6) and (7))). This new policy enables cohesion and interaction of different social classes in the same community, and most importantly all the inhabitants would have equitable access to basic and social services. Most probably the social mix will lead to social sustainability. Distribution of low-cost units were governed by rules- a point system- and a board to insure the merit of the applicant. The beneficiaries were required to deposit down payment, equal to 20% of the total cost of the house and the services provided. The balance was to be paid in instalments over a period of 12 years. Although the down payment was large but the instalments were affordable for the poor families.

Figure (6): Panoramic view of the Investment Houses of Elthora hara 72
source: (the State Fund archives)

Figure (7): Panoramic view of the low-cost Houses of Elthora hara 72
source: (the State Fund archives)

The design of the core unit

Traditionally, the two basic types of dwellings are either houses or flats, in Khartoum the popular dwelling type is the single detached house. The choice of houses as a predominant

dwelling type had led to horizontal expansion and urban sprawl of the capital, low densities, and made basic urban services unaffordable. Although flats permit vertical expansion but they were not popular because of many reasons: the climate, the great desire for privacy, the large size of families, traditional tendencies and lack of supportive basic services especially sewerage.

Most of low-cost projects have semi- detached houses, although the use of raw houses would have many advantages such as saving in areas and building materials. In New Deims and El Shabyia project, the design of the built area is semi-compact. the built area was 64.5 m^2 in New Deims and it was enlarged to 91 m^2 in ElShabyia project. As a new housing experiment, the design of the core unit in Al Iskan Project changed to be compacted and the built area was reduced to 38.4 m^2. In Elthora hara 72 the design of the core unit was scattered and the built area was reduced again to 30.0 m^2.

It is noticeable that although the plot area of the house increased a little from 200 m^2 to 240 m^2, but the built area of the core units decreased from 91 m^2 to 30 m^2 and the percentage of the built area also decreased from 32% to 15% (see table (3)). The reason behind this phenomenon is that the land in Sudan by constitution belongs to the government and its cost considered zero in the financial break down of the cost of the house, while the cost of the construction of the core-unit is considered high according to the financial ability of the public sector, so that the increased demand of housing units leads to provision of large quantities of core units with small built areas.

As the choices made for design and planning need to be derived from the specific context and climate of the community (UN-Habitat 2012), all designs of the core units in the four selected projects tried to their best to respect traditions and lifestyles of the inhabitants by separating the living area of the family and the guests and segregating males and females whenever the size of the built area permits. They also provided (by the location of the built area) possibilities for dividing the courtyard into two sections, front yard for males and back yard for females (see Figure (8) and (9)). The authorities provided proposals for future extensions - incremental development- of the core-unit but most inhabitants didn't follow these proposals and developed houses according to their needs and financial abilities.

Table (3) Relationship between the size of projects, the plot areas and the built areas.
Source: (the researcher)

Project	Size of the project	Plot area (m^2)	Built Area	Percentage of built area	House type	Design type
New Deims	1233	200	64.5	32%	Semi-Detached	Semi-compact
El Shabyia	1048	252 - 290 300- 340	91	30%	Semi-Detached	Semi-compact
Al Iskan Project	200	240	38.4	16%	Semi-Detached	compact
Elthora hara 72	1818	200	30	15%	Semi-Detached	Scattered

Figure (8): View of the back-yard of Elthora hara 72. Source :(the State Fund Archives)

Figure (9): Arial View of the core-unit of Elthora hara 72. Source :(the State Fund Archives)

Sustainable building materials and practices

In New Deims houses were built with sustainable traditional materials and applied indigenous knowledge and techniques in construction of houses which are affordable and environmentally friendly as walls were built with jaloos (i.e. rammed earth or cob) and houses were roofed with timber. The construction of houses was carried out by the inhabitants themselves helping each other's -public participation- without intervention of the housing authorities. The inhabitants were advised to collect all wood work, wooden beams and the like from their demolished houses, and to use them in their new houses, so that the building materials were recycled. Unfortunately, the houses were un-durable and couldn't resist climatic conditions e.g. rains and storms.

In the following projects, design, construction and distribution of the houses were undertaken by the public authorities. In El Shabyia project, the authorities used more durable building materials so that houses were constructed with plain concrete foundations and cement block walls but roofed with asbestos corrugated sheets which was found to be unsafe for health (WHO 2011). More elaborated building materials and technologies were used in Al Iskan Project. The houses were constructed with grade beam of concrete in the foundation and load bearing walls with burned bricks. concrete slabs were used for roofs for the first time in housing projects. In spite of the fact that concrete slabs are more expensive than traditional local types of roofs (corrugated iron sheets or timber) but they are more durable and can resist climatic conditions, therefore increase the life span of the houses.

The first construction technologies for the houses in The Fund projects started with the use of sustainable local traditional materials such as green bricks which has a small ecological impact, afterwards they used materials produced with imported technologies such as cement blocks. Therefore, in Elthora hara 72, the houses were constructed with strip foundations made of stone and cement block walls, roofed with concrete. The planning and design of the core units are prepared by Ministry of Physical Planning and The Fund handles construction and distribution of houses. It is noticeable that Mass production of house units by the fund contributed to the development of the building industry, by establishment and support of on-site factories for building materials manufacturing and provided employment opportunities for local workers from nearby areas (see Figure (10) and (11)). The important question is: In spite of the availability of multiple different sustainable construction materials which are used across the country with smaller ecological impacts than imported materials why the State Fund did not use them in construction of housing projects. One popular example is the

stabilized soil blocks which enable zero consumption of firewood and structural timber, and 60%decrease in water usage. they are used in building houses for refugees in Darfur because they have many advantages such as :30% more affordable than fired brick and faster to build. It is chosen among ten good practices of sustainable construction materials world-wide (UN Habitat 2012).

Figure (10): Supply of building materials for Elthora hara 72. Source :(the State Fund archives)

Figure (11): Construction of the core-unit core-units of Elthora hara 72 .Source :(the State Fund archives)

Conclusion

A comprehensive housing approach should include not only economic, cultural, social and environmental but also institutional sustainability aspects. Sustainable housing projects require comprehensive plans to attain pre-defined goals .It is clearly observed that housing policy for the poor people in Sudan has adopted a separate approach that dealing with housing problem isolated from other development issues, and ignoring the social, cultural, environmental and economic aspects of housing..

In New Deims resettlement project a comprehensive social survey was carried out**.** It covered cultural values, norms and traditions of the inhabitants as well as the life styles and behaviour, so that the proposed design of the core-unit was satisfactory for the occupants. The construction of the houses was made by the inhabitants themselves. Afterwards, in the following projects the inhabitants were excluded from the process of the design and the construction of the houses, their contribution started after settling in the neighbourhoods and participated in providing social services e.g. schools, mosques, health centres, etc. according to their needs.

Regarding the built area, as the size of housing projects enlarged (e.g. Elthora hara 72) the size of the built unit decreased, so as to serve a large amount of poor families. The reduction of the built unit makes it inefficient since most of poor families have large family size. Former projects (New Deims, Al Iskan Project and El Shabyia) provided one or two proto-types of core-units for low-income families only but new projects of The state fund provides more options of affordable housing across different income levels to offer housing to households with varying needs and abilities.

The experience of Sudan in providing built houses for low-income families is not financially and technically appropriate. Still there is a need for more incentives for the private sector to invest in construction of low-cost housing under the supervision of the public authorities and within the framework of sustainable housing, and new affordable financial mechanisms to support the low level of construction by low interest loans. Moreover, there

are possibilities of application of different sustainable technologies such as: ecological retrofitting, renewable energy and forms of saving water which are essential in providing sustainable housing.

If the public authority is sincerely interested in the sustainable housing development its decision and actions would be flexible, adaptable and creative, to develop a simple and integrated approach regarding how to produce sustainable housing. Production of sustainable housing need to be addressed in three different levels: At policy/authority level to help local authorities to formulate housing polices to match sustainable development goals and objectives, at community level to enable community representative to participate in the project planning and decision making and at family level to enable the inhabitants to upgrade their housing according to their individual needs and capacity.

References

Adam.E.A. (2003). *The Existing Situation of Housing in the National Capital- The land.* Khartoum. Ministry of Science and Technology.

Bayizitlioğlu,B .(2017). Conservation and Maintenance of Earth Constructions: Yesterday and Today. The historic environment: Policy and Practice. Volume 8- Issue 4.

Daiffalla,M.H.(1998).Utilization and Differentiation of space: study of social factors influencing house design in third class area in Khartoum-Sudan. Stockholm.

Davis, D.E. (2015). *Habitat III must rethink the role of housing in sustainable urbanization.* Citiscope.

Egan. J. (2014). *The Egan Review: Skills for Sustainable Communities*. London. RIBA Enterprises Ltd.

Falk B.2009.Wood as a Sustainable Building Material. Forest Products Journal 59(9).

Flint,R.W.(2013). *Practice of sustainable community development*. New York. Springer science +Business Media.

Goodhew.S.(2012). Sustainable building materials. Controlled Environment Users Group 2012 Conference- University of Cambridge

Hodgson, N. (2003). *Social Sustainability Assessment Framework.* Murdoch: Institute for Sustainability and Technology Policy, Murdoch University.

Khartoum State (2015). *Khartoum State Strategic report.* Khartoum: Khartoum State.

Kumar N,Barbato Mand Holton R .(2018). *Feasibility Study of Affordable Earth Masonry Housing in the U.S. Gulf Coast Region*. Journal of Architectural Engineering 24(2)

Olotuah, A. O. *(2010). The Built & Human Environment Review*, *Volume 3*, 88. Evaluation of Public Housing Programmes in Nigeria: A. Theoretical and Conceptual Approach.

Sudan Central Bureau of Statistics. (2008). fifth population and housing Census of Sudan . Khartoum: Sudan Central Bureau of Statistics.

UNDP. (2002). *Melbourne Principles for Sustainable Cities.* United Nations Environment Programme Division of Technology, Industry and Economics.

UN Habitat. (2009). Urban Sector Studies and Capacity building for Khartoum State. Khartoum: UN Habitat.

UN-Habitat. (2012). Sustainable Housing for Sustainable Cities| a policy framework for developing countries. Nairobi: UNON, Publishing Services Section.

UN-Habitat. (2012). Going Green(a hand book of sustainable housing practices in developing countries. Nairobi GPO Kenya.

UN-Habitat. (2014). a-new-strategy-of-sustainable-neighbourhood-planning-five-principles. Retrieved March 2018, from unhabitat.org: https://unhabitat.org/

UN-Habitat. (2015). *Habitat III issue papers:20-Housing*. Retrieved May 2018, from unhabitat.org: https://unhabitat.org/

United Nations. (2014). The Right to Adequate Housing. Fact sheet No.21. Office of High Commission of Human Rights. Retrieved July 2018, from https://www.ohchr.org/EN/PublicationsResources /Pages/Fact Sheets.aspx.

World Health Organization WHO. (2006). *Constitution of the world health organization, Forty-fifth edition* .