What Could Future Sahelian Cities Look Like?
A Proposal For Sustainable Housing in Senegal and Burkina Faso

Rugiyatu KANE, Student, University of Florida; Desire ZONGO, Student, Sciences Po
rkane2@ufl.edu, (410) 689 8117, 285 Corry Village Apt. 7, Gainesville, FL 32603

Abstract

The Sahel region is one of the least urbanized of the world but is paradoxically facing an extremely rapid urbanization growth. Historically, movement of populations from urban areas to cities has correlated with economic development but the particular challenges faced by the region - including rapid population growth, food insecurity, political instability, all exacerbated by the effects of climate change – compromise this path. Forecasts by international organizations predict that cities such as Dakar and Ouagadougou will be among the “next big” cities in Africa, expected to triple the size of their economy and double in population size by 2030. The housing sector is in a key position to address the need for adequate living space for a growing population, while also providing sustainable solutions for adapting to climate change. Sustainable housing particularly makes use of natural and locally available materials for construction, clean and renewable energy sources, and also capitalizes on the designs of living spaces to minimize energy needed for lighting and temperature control. Using the cases of Senegal and Burkina Faso, this paper looks into sustainable housing solutions adequate for urban areas in the Sahel. Two housing models are proposed, notably the Nubian Vault and Francis Kéré architecture, in combination with a comprehensive multidimensional approach to address social, economic, and ecological issues faced in the urbanizing Sahel.

Introduction

Currently Africa stands as the least urbanized continent but has some of the fastest urbanization rates in the world. Countries in Africa, and the Sahel in particular, are of the worst affected by climate, but resilience building strategies tend to focus on rural areas where people have been identified as most vulnerable. However, social, economic, and environmental changes are causing these same people to migrate towards cities. How may these cities respond?

Faced with multiple challenges exacerbated by climate change’s effects on fragile agricultural systems, rapid population growth, and political instability and violence in the recent years, the Sahel region of Africa needs to prioritize sustainability in its development agenda. Usually the center poles of modernization in a still very traditional and agrarian region, cities in the Sahel have had to bear the brunt of shifts in resources, livelihoods, and population movements. Senegal and Burkina Faso, like many other countries in the Sahel, have seen a remarkable increase in urban population; projections by the UN Habitat estimate that by 2030 Burkina Faso’s urban population would have doubled and more Senegalese will be living in cities as opposed to rural areas. These changes in demographics present a new set of challenges with
increases in poverty, pollution and insecurity for urban areas. Notably among those challenges is the lack of affordable and adequate housing to accommodate the growing population in Sahelian cities. The rapid urbanization therefore presents a matched need for adequate housing that takes into account environmental sustainability in the face of climate change. Not often prioritized in the agendas for urban mitigation and resiliency building to climate change, sustainable housing is the single most efficient sector that can, without extra costs, address the issue of climate change and tackle social and economical issues at the same time.

Particularly interested in how sustainable housing can have a better impact on people’s living conditions and use of natural resources, using the cases of Senegal and Burkina Faso, this paper looks into sustainable housing solutions that are adequate for urban areas all over the Sahel. We will first assess the main problems related to the growth of urban areas in both Senegal and Burkina Faso especially focusing on the housing sector before we identify existing sustainable housing models already in place to tackle these problems. We will finally end with a concrete proposal on how to overcome the limits of each proposed model and create a winning replication system through policy development and implementation throughout the Sahel.

**Current Challenges in the Sahel: Migration and Rapid Urbanization**

The Sahelian region has a long history of population movements and represents a multitude of migration patterns and trajectories. Mobility has been common in West Africa since prehistoric times and has included both cyclical migrations linked to agricultural production styles, as well as more permanent movements resulting from the search for economic opportunities. Sahelian countries are expected to be amongst the regions most affected by impacts of climate change such as hotter and drier climates, oscillations in precipitation patterns and land degradation. The UNDP estimates that a considerable amount of drylands in sub-Saharan Africa could experience severe droughts. Countries like Senegal could lose up to 50 percent of their agricultural capacity. Such phenomenon will inevitably generate a new wave of population movement from rural towards urban areas.

For several decades now, cities in the Sahel have been under increasing pressure following a relatively recent and extremely fast growth in size and population. The impact of further sustained population movements, resulting from climate change, will lead to an unprecedented situation whose consequences if not anticipated, could be catastrophic for the countries concerned. Burkina Faso is one of the least urbanized countries in the world, especially its secondary cities. In 2000, less than 18% of its population was living in urban areas but this situation is changing very quickly with the cities growing at an overwhelming yearly rate of 5.54%. The population of Ouagadougou (estimated at 2 million in 2011) alone is projected to more than double between 2005 and 2020 (UN Habitat, 2008).

As urbanization increases rapidly throughout Africa even as a whole, a range of complex and even contradictory processes expose urban populations to social, economic, and environmental hazards. The convergence of these ongoing hazards with emerging impacts of climate change threatens to increase the vulnerability of these populations, particularly the urban poor, to the
changing conditions of these cities. It also highlights the increasing importance of examining climate change processes and responses at an urban scale (Silver et al, 2013). The housing sector is in a key position to mitigate climate change making environmentally friendly affordable housing strategies opportune and crucial. The UN Habitat states the housing sector is the single most efficient sector that can, without extra costs, address the issue of climate change. Scaling up efforts of making the housing in the urban Sahel more sustainable can make a great difference in terms of climate change mitigation and adaptation as well as improve quality of life and human well being (UN Habitat, 2012).

**Case of Senegal and Burkina Faso: A Comparison of Trends in Urban Areas**

From new and existing constructions, to informal settlements such as building on unregulated territory, occupying vacant buildings, shacks and slums, various housing forms in cities of Senegal and Burkina Faso face a multitude of social, economic, and environmental issues. Pulling from trends and challenges in different coastal and landlocked cities across both countries, the comparison presents diverse realities and allows us to propose housing solutions that may fit the bustling landscapes not only of major capital cities but of smaller and up-and-coming cities especially.

**The Building Boom**

For Senegal’s capital city, Dakar is growing in every direction. At independence in 1960, Dakar’s population was only 300,000, barely 10% of the country’s population, but today Dakar hosts over 3 million people, about 20% of the total population on only 0.3% of the territory. Simultaneously, the city is continually under construction, from new roads and infrastructure, to new and unfinished houses. The unfinished houses, often still inhabited, present an interesting phenomena which contributes to the vertical expansion of the city as Dakar sits on limited space bordered by the Atlantic ocean on three sides. In contrast, Burkina Faso’s capital city, Ouagadougou, has seen a 14-fold increase in surface area since independence in 1960 (NASA, 2008). Although informal settlements from rural to urban migration are said to be the main cause of the urban sprawl, housing constructions in this semi-arid city consists predominantly of single unit houses which also favor the horizontal expansion of the city as new housing districts emerge.

Land and housing affordability thus present themselves on the flip side of this building boom. In Ouagadougou, and in any other Sahelian cities, rapid urban growth has increased competition over the allocation of urban land titles through corruption, rivalries among local elites and lack of transparency in the system of land allocation, which raises questions on the urban planning and physical construction methodologies that influence the development of effective housing systems for cities’ growing poor populations (Abrah-Asiedu et al, 2014). A city such as Dakar, referenced as one of Africa’s top 10 most expensive cities to live in, also faces a housing conundrum. Although land is expensive, constructions in cement persist as people who can afford it build houses to rent out for anywhere between $190 and $1,900 a month. Yet a third of Dakar’s population lives below the poverty line despite 80% of the country’s economic activities
being concentrated in the huge industrial zone that stretches east from the port of Dakar (the ninth biggest in Africa) to Rufisque, along Hann Bay. In informal settlements within and on the outskirts of the city, people from rural areas but also immigrants from Guinea, Mali and Niger move into shantytowns built of wood and iron sheets, or rent rooms in the highly densely populated towns of Pikine and Guediawaye (Cessou, 2014).

**Vulnerabilities to Climate Change**

Urban vulnerability to climate change can be considered across a range of different contexts from the physical landscape to social and economic contexts within cities. The housing sector plays a particularly important role in the in the current global environmental crisis, but it also offers one of the largest possibilities of any sector to mitigate global climate change (UN Habitat, 2012).

Vulnerability to climate change varies according to geographical location. For coastal cities such as Saint Louis in Senegal, exposure to sea level rise prompted by climate change is also accompanied by increased frequency and intensity of sea storm surges, floods, gale force winds and tropical cyclones. Landlocked cities such a Bobo Dioulasso, which represents most of the cities in the dry and arid Sahel belt, impacts of climate change include increasing drought and desertification (Silver, 2013). Much like Dakar and Ouagadougou theses secondary cities are also experiencing growth in urban population. Saint Louis, the old capital of French West Africa has increased threefold in the last 30 years to about 190,000 inhabitants, with projected estimated growth to 300,000 people in 2030. As a result of poor planning, much of the rural-to-urban migrants in Saint Louis establish informal settlements in fragile and vulnerable flood-prone areas. Bobo-Dioulasso is the second largest city of Burkina Faso, after the capital Ouagadougou, and its population has also increased dramatically from around 225,000 in 1985, to nearly 400,000 in 2006. This is projected to grow towards 800,000 by 2020 (Silver, 2013). These transformations can become catastrophic for Sahelian countries whose economies are based primarily on climate sensitive agriculture (crop production, pastoralism and forestry) and their cities in particular face a number of development challenges to incorporate a growing urban population within their economy and to improve the livelihoods of its citizens.

It is thus extremely important to build city resilience as well as individual housing resilience to climate change.

In relation to the housing sector, vulnerability to climate change can be determined first by a lack of adequate housing (such as shacks in shanty towns, slums, and informal settlements) and second by housing which does not adopt an environmentally friendly or sustainable configuration. In urban parts of the Sahel, sustainable housing practices are still weak. This is easily determined by the materials and practices used in the construction of houses. In Senegal, and Dakar in particular, the use of cement and beach sand for construction has resulted in environmental issues such as the over-extraction of marine sand and coastal erosion. The practice of mixing beach sand with cement for construction has resulted in the collapse of a couple of buildings as masons are instructed to use more sand than cement to cut back on the expensive costs of building. Combined with the lack of use of architects to design houses that
adapt to the natural environment for maximum energy efficiency as well as social and cultural realities (often times, houses are not designed to reflect the larger families which inhabit them, nor do they comprise of outdoor kitchens which is required for common traditional cooking) housing in urban Senegal can be considered vulnerable to climate change. In Burkina Faso, temperatures over over 45°C are not uncommon and there is an almost constant need to keep the buildings cool to maintain a temperate indoor climate. This often results in a need for Air Conditioning, but it overloads the power grid and it very expensive. The use of concrete for construction as well as flat roofs further increase indoor temperatures as the sun rays heat houses throughout the day and the concrete traps the heat inside. With the risk of temperatures increasing even more under effects of climate change, houses in the urban Sahel need to prioritise on insulation and housing models or designs that best adapt to temperature variability.

Sustainable Housing: The Way Forward
Housing is not considered anymore as simply a roof over one’s head. It has become a convergent element where social, economic and environmental challenges may be faced and efficiently tackled or worsened. If properly addressed, housing can play a crucial role in achieving sustainable development worldwide. However, sustainable housing is still to get the importance it deserved in African governmental policies. In many developing contexts, the so-called pro-poor housing programmes often provide accommodation of poor standards, in remote locations, with little consideration to the residents’ lifestyle and livelihood strategies (UNHabitat, 2012). Considering the challenges faced by Sahelian countries, sustainable housing in the region should take into consideration the environmental, social, cultural, and economic dimensions of housing. The sole physical construction does not fit anymore with needs and expectations of populations and with requirements towards sustainable development. Newly designed policies should necessarily include affordability, social justice, cultural and economic impacts of housing.

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<th>Environment</th>
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<td>Housing system to protect natural environments, use natural resources prudently, mitigate and adapt to climate change</td>
<td>Housing system to ensure everyone has access to a decent affordable shelter in a place which is desirable to live in</td>
<td>Housing system to support a strong, responsive and competitive economy at local, regional and national levels</td>
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Policy Orientation Towards Sustainable Housing
Governments in Burkina and Senegal in their respective development plan have identified housing as key priority sector. Nevertheless, concretisation of these plans are still to be seen.
Also, our investigations have not helped us identify holistic policy measures toward sustainable housing in both countries. We, therefore, describe a set of orientations, that when integrated can trigger a movement toward sustainable housing.

1. Affordable and quality construction material
In the Sahel, housing constructions are achieved with nearby available material; improving accessibility to quality material will impact quality of the constructions. Among several reasons, deforestation in the Sahel region has been linked to use of wood as energy source and for housing construction. Also use of clay for fabrication of bricks contributes to land degradation as we observed in the region of Pikine around Dakar and near Ouagadougou (see below picture).

In the entire literature we analysed, use of local material is prescribed as a step towards sustainable housing. However, an efficient policy in the Sahel region should take into account the necessity to define a framework for use of natural resources for construction purpose. Licenses limiting the areas and the extent to which these resources can be used may be granted to private companies or to village communities. On the other hand, private firms of communities granted the right to exploit designated areas should also have the responsibility to maintain or restore the areas in order to maintain a stable biodiversity.

2. Involvement of the community
As obvious as it may appear, involving local community in the thinking, the planning, the construction and the management of housing system will stimulate the sense of ownership essential for people satisfaction. Considering the forecasts, population of Ouagadougou will double in the coming 3 decades. The city is already one the most spread city in Africa with 30 kilometers diameter. Living in an apartment being linked with lack of freedom, how is it then
possible to combine the social need in Ouagadougou for families to access an outdoor yard with the imperative necessity to limit urban sprawl? Only the combination of local know-how, acknowledgement of cultural practice and involvement of technological progress will help define the adequate housing system. Involvement of local population is not simply a social matter; it also plays an economical role as people will investment funds proportional to their level of income. The examples of modern cities constructed and remained empty in Angola and Equatorial Guinea have shown a clear disconnect between families income and cost of housing.

3. Financing Housing
According to the United Nations, there is little likelihood that in many developing countries conventional sources of funds will be available, in the coming two decades, for investment on the scale needed to meet the projected demand for urban infrastructure and housing’ (UNHSP, 2005). With less than 10% of the population having access to a bank account in both Senegal and Burkina Faso, traditional financing such as loans and mortgages are very unlikely to match the local reality. New areas of microfinance are required to help those still excluded from the conventional mortgage process, as will be a continued supply of finance to construct public housing units for rent for the poorest of the poor. This may take the form of community-based shelter funds where a blanket loan is made to the entire community for the development of housing and infrastructure (Choguill, 2007). Also the scope of banking activities can be broaden to include more efficiently the informal sector and the recent development of mobile banking.

4. Standardization
Standards are required to ensure well being of people and protection of the environment. Water, sanitation, drainage, waste management can’t dissociated from housing development. Further more, safety through regulation to reduce risk of fire and measures of protection against natural disasters are important; the he Sahel region being predicted to face serious consequences of climate change. Regulation around sustainable housing should define the standards around design, construction and management to contribute to:
• Healthy, durable, safe and secure,
• Affordable for the whole spectrum of incomes,
• Using ecological low-energy and affordable building materials and technology,
• Resilient to sustain potential natural disasters and climatic impacts,
• Connected to decent, safe and affordable energy, water, sanitation and recycling facilities,
• Using energy and water most efficiently and equipped with certain on-site renewable energy generation and water recycling capabilities,
• Not polluting the environment and protected from external pollution,
• Well connected to jobs, shops, health- and child-care, education and other services,
• Properly integrated into, and enhancing, the social, cultural and economic fabric of the local neighbourhood and the wider urban areas,

Duplicable initiatives
In both Senegal and Burkina Faso, there are several initiatives, all privately funded, that try to address the environmental aspect of housing by including more local material and using traditional (but still well adapted) techniques of construction. Our investigation did not demonstrate any initiative combining all aspects of the holistic vision of sustainable housing stated earlier in this paper. Almost all initiatives focus on the question of environment; addressed at a glance through the use of local material. Indirectly, the participation of population in achieved with the labor contribution to the constructions.

The Nubian Vault
The Nubian Vault (NV) technique is an age-old method of timberless vault construction, originating in upper Egypt. It uses only earth bricks and earth mortar. The NV technique presently promoted by an association in Burkina Faso and Senegal (and several other West African countries) is based on this ancient technique and has been simplified and standardized to take into consideration modern requirements of esthetic and safety. The association succeed other 2 years of research to adapt the construction to the Sahelian climatic conditions and also included the traditional know-how of the region. The only materials that are needed to build a NV house are: rocks for foundations, earth and water for adobe bricks and mortar. It is estimated that the construction of one NV, instead of a metal sheet roofed house, saves 4 trees and prevent the emission of the equivalent of 2 tons of CO2.
The Nubian Vault (NV) technique uses no timber or formwork in its process, only basic tools (spade, pickaxe, trowel, wheelbarrow, spirit level) are needed, making it accessible to any mason. The level of education in the Sahel remains very low and such technique requiring little engineering skills can represent a good employment opportunity for local population. The bricks used in the NV constructions are standard and are made locally by the people - this does not require any special skills and can represent an income source for women as bricks are usually fabricated not far from water sources. The economical cost of the NV is also minimised as no sheet metal, cement or steel are used; these elements, dominant in the actual constructions also represent the biggest share of housing cost at the moment. Instead the NV requires a more labor intensive input; creating employment opportunities locally.

Francis Kere Approach
Addressed under the scope of sustainability, housing can not be only seen as a shelter for families. The family house needs to part of an entire system including public constructions such as schools, health facilities, administartive halls. In that matter, the approach of the architect Francis Kere, originally from Burkina Faso and installed in Germany, is to be mentioned. In 1999, Francis Kere undertook a project to renovate the primary school of Gando, his village located 200 kilometers south of Ouagadougou. After raising funds in Germany and obtaining the technical support of a governmental agency in Burkina in charge of promoting and fabrication by of bricks with local material, Kere designed a school for 360 pupils, with ancillary buildings for toilets and kitchen, a vegetable garden, a sports field and housing for six teachers and their families. The buildings were adapted to the needs and the economic situation of the people in the region and responsive to the prevalent climatic conditions, and thus capable of achieving sustainability. There was a large amount of help from the local population – men, women and children – all of whom offered labour to the best of their capabilities. The building was ready in
July 2001, and was occupied from October that year. The final building combines passive solar design and cross-ventilation with the use of earth as the basic construction material; the use of concrete is minimized, and there is no wood. The roof was made in a light metal structure, an ingenious solution requiring little skill and only simple tools to execute. The Gando school won the Aga Khan Award for Architecture in 2004 and the project was extended to include a library and a secondary school. The same approach was later used in the construction of several other schools, health centers and cultural facilities in Burkina Faso. Kere’s work towards sustainability has now gained international recognition and his approach was required in the construction of National Park of Mali in Bamako, Zhou Shan Harbour Development in China and International Red Cross and Red Crescent Museum in Geneva, etc.

**Conclusion**

In the sahel there is a need for housing that take into consideration environmental, social, and economic realities in the face of climate change. The two construction models we have studied aim at reducing the increasing urban population and urban territories’ vulnerability to climate change through the use of locally available materials for construction, low cost, and low energy consumption. Given the increasing amount of urban poor, the suggested housing models through the sustainable development approach present housing not only as a mechanism for environmental sustainability, but economic and socio-cultural sustainability as well. From the house serving as a means to pridefully boast traditional or innovative and culturally appropriate construction, to mitigate climate change, and to serve as an economic unit of production in regards to food, the proposed sustainable housing solutions for the urban Sahel may be the key element in shaping future sustainable cities across Africa.
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