

Towards Practical Guidelines for the Design of Affordable Net Zero Communities in Peri-Urban Ethiopia

LaKisha T. David

North Carolina Agricultural and Technical State University
Greensboro, NC

Ethiopia, one of the most populous countries in the world, has a housing deficit of about 1 million housing units. Over 2 million housing units would need to be built in Ethiopia's urban areas by 2015 to accommodate the current housing deficit and urbanization. Many people in Ethiopia's urban areas find that they cannot afford even the low income housing provided by the government. Eighty percent of the housing stock available, even those in urban areas provided by the government, is in slum conditions. The purpose of this paper is to provide a historical context for the current housing conditions in Ethiopia. This paper provides some background information that would later become part of a community profile of Addis Ababa. A qualitative research method was used with a limited review of literature and project case studies. Ethiopia requires and desires assistance in developing affordable housing. The guidelines outlined in this paper will be used in developing a comprehensive master plan for the development of an affordable Net Zero neighborhood in peri-urban Ethiopia.

Key Words: Net Zero, Ethiopia, Sustainability, Urban Planning, Design

Introduction

One of the first steps in planning a neighborhood is determining the current conditions of the people and geographical area for whom and in which the neighborhood is planned. This includes understanding the historical and cultural context of the people. This paper is a preliminary exploration of the history of Ethiopia to better understand the current housing crisis, the people, and its geographical context in order to facilitate considerations of options for the design of an affordable Net Zero neighborhood in peri-urban Addis Ababa, Ethiopia. A Net Zero neighborhood "is one that has greatly reduced energy needs through efficiency gains such that the balance of energy for vehicles, thermal, and electrical energy within the community is met by renewable energy" (Carlisle, Van Geet, & Pless, 2009, p. iii). By applying the Net Zero principle, the researcher also desires to improve the quality of life of the inhabitants of the neighborhood without worsening the country's current energy deficit or contributing to a carbon emissions problem in the future. This paper will ultimately become part of a larger body of work that includes a community profile of Addis Ababa, Ethiopia and a master plan for a new neighborhood development project.

The urban areas of Ethiopia house about 17 % of the country's population, representing approximately 15 million people. This urban population is growing by about one half million people each year (CIA, 2011). In fact, according to UN-HABITAT, the Urban Sector Millennium Development Goals Needs Assessment of 2004 states that Ethiopia would need to build 2,250,831 urban housing units by 2015 to accommodate this population growth and to erase current housing deficits (UN-HABITAT, 2010). The capitol city, Addis Ababa, has a population of 2.8 million. This is four times as large as the second largest city in Ethiopia. Addis Ababa has a population growth rate of 3.8% per year and an estimated housing deficit of 300,000 units (CIA, 2011; UN-HABITAT, 2010).

The next section explains the methodology that was used for this paper; an outline of the history of Ethiopia as it relates to the current housing crisis is followed by a section on the current demographics of Ethiopia and Addis Ababa. A description of some of the low-income measures taken to address the housing shortage is also addressed, as are elements that could potentially be part of an affordable neighborhood. A short description of the future work precedes the conclusion and a discussion on the implications of this work.

Methodology

The methodology for this preliminary exploration consisted of reviewing UN-HABITAT reports on informal settlements, condominium housing in Addis Ababa, and housing the poor in Africa. The poverty profile and the population census produced by the Ethiopian government were also reviewed, as well as climate change impacts and project case studies.

Future work consists of course training in urban and regional planning, reviewing the Master Plans and Zoning Ordinances for Addis Ababa, traveling to Ethiopia to conduct interviews of those representing the target market, creating a community profile, evaluating resource and transportation trends, mapping, engaging stakeholder involvement, and designing the neighborhood.

The History of Ethiopia and the Current Housing Crisis

Background

Ethiopia is a country located in East Africa. Most people live in the central highlands where there is good rainfall and relatively low incidences of diseases (Comenetz & Caviedes, 2002). Addis Ababa, Ethiopia's capitol city, is located in this highland area. The capitol city has average temperature highs ranging from 69.8 degrees Fahrenheit in July and August to 77.0 degrees Fahrenheit in March and May. The lows range from 57.2 degrees Fahrenheit in November and December to 64.4 degrees Fahrenheit in May. Addis Ababa receives approximately 41.5 inches of rain each year, 29.1 inches of which falls from June to September. Ethiopia's summer planting season monsoons account for 74% of its annual rain, which is very important, since Ethiopia is a largely agricultural society. Eighty-five percent of its people depend on farming for their livelihood. Unfortunately, there is evidence of a decrease in precipitation related to the warm phases of the El Niño/Southern Oscillation (ENSO). Delays or reductions in the summer monsoons cause crop stunting or failure, as well as cattle mortality (CIA, 2011; Comenetz & Caviedes, 2002).

Italian Occupation

Ethiopia maintained its independence since ancient times, with the exception of the Italian occupation in 1936 – 1941. Several days before Italy captured Ethiopia, patriotic locals destroyed several of the city's buildings. The Italians forbade any new construction or renovations until further notice. Because of this, Addis Ababa possibly faced its first major housing shortage (UN-HABITAT, 2007).

With the Italians there, Addis Ababa's economic base changed from dependence on taxes and tithes to relying more on commerce, wage labor, and industry. As a result, the population growth rate increased, worsening the housing crisis. The Italians developed the first master plan for the city. However, the plan did not address urban migration. The population of Addis Ababa doubled during the five years that Italy had rule. By the time the Italians left, they achieved less than 20% of their plan and Addis Ababa was left with a severe housing crisis.

Effects of El Niño

The El Niño events of 1972 caused the planting season rains to be scarce, greatly reducing the harvest. When the rains did not come the following year, drought spread into the northern highlands. By 1974, 60% of Ethiopia was affected by drought and failed summer harvests. Haile Selassie, emperor of Ethiopia during this time period, knew about the famine, but was poorly advised and did not distribute aid to all the needy regions (Comenetz & Caviedes, 2002).

The government also did not address the widening gap between housing demand and supply. Average occupancy rate was four individuals per dwelling unit. A third of the population could not afford ETB 11.25 in monthly rent or the monthly charges on a loan of ETB 1,500 (17.27 ETB = 1 USD). Credit institutions charged high interest rates and required large down-payments. Ninety-five percent of privately owned land was owned by 5% of the

population, which made it difficult for the government to implement public housing programs (UN-HABITAT, 2007).

In September, 1974, a group of Addis Ababa army officers called Derg staged a coup to overthrow Emperor Selassie. Once in power, the Derg distributed food mostly to rural dwellers that supported the regime. The Derg restricted anyone who tried to leave famine areas. In 1975, General Mengistu Haile Mariam issued proclamation No. 47 on Government Ownership of Urban Lands and Extra Houses which nationalized all urban land and rental dwellings in Ethiopia. The Kebeles, government agencies that operated on the neighborhood level, collected rent payments that were used primarily for housing and neighborhood development. The nationalized lands were used to create rural communes. Proclamations that followed focused on improvements in the real estate and construction industry. In addition, the government enacted a forced agricultural program to stimulate productivity, but was met with regional resistance (Comenetz & Caviedes, 2002; UN-HABITAT, 2007).

In 1982 – 1983, an El Niño event that caused a larger drought than the 72-73 droughts, contributed to civic rebellion (Comenetz & Caviedes, 2002). The north was affected by the drought first, followed by the central highlands and then the western semi-arid belt. The Derg government initially denied the conditions, but then quickly distributed stored grain. The government continued to withhold information about the severity of the condition and restricted citizens from leaving their dry lands. In 1984, the third year of drought and harvest failure, the government publically acknowledged the conditions and the need for foreign aid. By the fall of 1984, Ethiopia was characterized by repression and war (Comenetz & Caviedes, 2002).

The El Niño events of 1991-1993, the droughts of 1991-1994 and 1997-1998, as well as the flooding in 1998, compounded the issues of food and housing shortages. Citizens fled from rural to urban areas to find relief (Comenetz & Caviedes, 2002; Office of the Population Census Commission, 2007).

Another Government Overthrow

In 1986, the Derg tried to correct the issues of its failed policies by the introduction of a new housing policy that emphasized standardizing building codes, researching housing design and building materials, encouraging community involvement in housing production, allowing co-dwelling, and regulating the purchase and sale of houses (UN-HABITAT, 2007). However, the government still retained its control of the urban housing industry. Informal squatter settlements began to expand in cities like Addis Ababa. Finally, in 1990, the government relaxed the restrictions on housing production and sale (UN-HABITAT, 2007). This last measure came too late for the people.

In 1991, the Derg was overthrown by the Ethiopian People's Revolutionary Democratic Force (EPRDF). The EPRDF began market-oriented reforms and, in 1994, the Land Reform Programme began. The purpose of the reform was to encourage the development of other cities, in order for them to attract rural migrants and thus detract the latter from the already overburdened areas of Addis Ababa and other major urban areas (UN-HABITAT, 2010).

The EPRDF maintained ownership of the land with the assumption that the private sector would meet the need for low-income housing. However, even with large subsidies, the private sector did not meet this need. Housing costs rose to the extent that even doctors and lawyers could not afford housing (UN-HABITAT, 2010).

Present Day

Most of the Ethiopian urban growth consists of roadside towns catering to commerce activities or public administration. As of 2004, about two thirds of the urban areas, as named by Ethiopia's Central Statistical Authority, were small towns of no more than 5,000 people. Addis Ababa has 26% of the national urban population (UN-HABITAT, 2007). In addition, less than 1% of the population owned 70% of the arable land. The state still plays a dominant role in housing by controlling most of the rental units, as well as by being actively involved in material production and importation, land supply, and housing finance (UN-HABITAT, 2010).

Low-Income Approaches

Because of the high cost of starting and operating a construction company in Ethiopia, the small private construction industry targets only high-income customers (UN-HABITAT, 2010).

The government hoped that housing cooperatives, which were established in 1978 under Proclamation No. 138, would further assist in the housing shortage. Currently, a land development agency is providing up to 73 square meters (786 square feet) free of charge to housing cooperatives. "Plots between 75 and 175 square meters [between 807 and 1,884 square feet] are leased out at ETB 0.50 [USD 0.03] per square meter per year" (UN-HABITAT, 2007; p. 15). Unfortunately, this measure has produced only 40,539 units over a 17 year period. In addition, this approach excludes the poorest sector, whose members does not have the savings for the initial down payment and are unable to secure a housing loan because of having income from informal sources and because of the high interest rate of 16% (UN-HABITAT, 2010).

Slum upgrading, in turn, consists of adding urban infrastructure and services to informal settlements. Officials and local professionals do not agree with the effectiveness of slum upgrading, because these small scale programs are not able to address the housing deficit and because many of the housing units are in such poor conditions that they should be torn down rather than repaired (UN-HABITAT, 2010).

The Integrated Housing Development Programme (IHDP), in turn, is a government approach aimed to increase low-income housing, recognize urban slum areas, increase job opportunities, and improve wealth creation and distribution for the nation. For 2006-2010, the plan was for the Ethiopian government to build 175,000 residential units from studio to 3 bedroom units for Addis Ababa. As of mid-2010, 80,257 units were built.

Although there are success stories for those that were able to maintain residency, there are several issues with the low-income condominiums that should be addressed in future low-income housing efforts. The Ethiopian government estimates that up to 70% of the tenants rent out their condominium and move into housing with lower rents or they rent out part of the unit to pay their mortgage or supplement their income. Many of the poor could not afford the down payment or subsequent monthly service payments. The location of the condominiums along the outskirts of the city also created challenges for dwellers to find or maintain employment. The high-rise style of the building did not have injera bread ovens or large open areas for the customary slaughtering of animals or doing laundry, traditionally done by hand. The occupants felt that their kitchens were too small and there was not enough electricity to operate a heater or an injera oven (UN-HABITAT, 2010).

Low-Cost Housing Construction and Demographics

The Ethiopian poor have come up with some ingenious ways to handle their own housing needs, such as using soil as a building material. Ethiopian traditional earth architecture includes wattle and daub, cob, and adobe. "Buildings are constructed entirely, or partially of soil, depending on location, climate, available skills, cost, building use and local tradition" (Tadege, 2007, pp. 7-8). Soil is used extensively in the traditional mud walls in certain regions within Ethiopia. The wall material, called *chika*, is a mixture of clay, fine and short straw from Ethiopian common cereal, teff (*Eragrostis Abyssinica*), and water. The mixture is treaded with human feet and is either immediately used or left to ferment. Later, it is used as a filling material between the openings of wood poles. The mixture is also used as a plaster. This form of construction is susceptible to shrinkage cracks and erosion by rain. The walls are covered with a protective coating that includes animal dung. The coating requires continuous maintenance and possible renewal every year. Because of this, many associate earth architecture with inferior quality (Tadege, 2007).

For low-income housing, the most common building materials are wattle and daub for the walls, round tree lengths (usually Eucalyptus) covered with corrugated iron sheeting for the roof, and skim concrete or compacted earth for the floor (UN-HABITAT, 2010). Ceilings primarily consist of fabrics, polythene sheets, or no ceiling material at all. Most of the housing units have one or two bedrooms while the average number of persons per household is 4.2. One-third of the heads of the household are female (Office of the Population Census Commission, 2007).

Only a quarter of the housing units have a drinking water supply from a private tap located in the compound and most housing units have kitchens located outside the housing unit. Most rely on a shared pit latrine for a toilet, and only 12.4% of the 628,986 housing units in Addis Ababa have private areas for bathing (Office of the Population Census Commission, 2007). Furthermore, municipal sewage only covers 3% of Addis Ababa (UN-HABITAT, 2010). Most rely on kerosene, charcoal, or firewood for cooking. Lighting generally comes from metered

electricity, but slightly over half access shared metered electricity, which means that the homeowner's name is not on the electric bill (Office of the Population Census Commission, 2007).

Preliminary Findings

In the design of an affordable Net Zero community in peri-urban Ethiopia, provisions would need to be made for clean water, food, energy, housing, employment, transportation, sanitation, health care, education, culture, community priorities, and recreation – as in any other new community. Of emphasis in this case is that the community should be able to accommodate urban migration and community expansion without foreign aid. The design should also add to the community's resilience against climate change events, ideally reversing some of the effects such as deforestation and soil erosion. Perhaps most importantly, the community should be affordable to the low-income population of Addis Ababa. The following section, based on literature review, explores possible measures that could address affordable access to clean water, food, housing, and fuel.

Water Resource

The UN has determined that Ethiopia is one of nine countries that could adapt Rain Water Harvest (RWH) technologies. RWH could supply water for 520 million people, which represents more than enough water to supply Ethiopia's 90.8 million people and population growth for years to come (CIA, 2011; Waktola, n.d.). RWH ponds could be used with low-tech drip irrigation for crops. Rooftop catchment systems could be used to supply the home with water. Cisterns would need to be at least large enough to supply water to home and crops throughout the growing season dry spells, which last up to three weeks. There is great potential to have a year-round water supply through RWH (Waktola, n.d.).

Food Resource

Space in these planned neighborhoods should be allocated for community farms. The urban sector tends to spend about half of their household budget on food. The largest food expenditure is generally on cereals (Office of the Population Census Commission, 2007). Other crops for consideration are vegetables for consumption during the traditional non-growing season and cash crops. With the assistance of RWH and drip irrigation, Ethiopian farmers would be able to harvest vegetables for consumption during the traditional dry season. Crops to be considered are cereals, coffee, oilseed, Jatropha, sugarcane, and potatoes. Live animals include cattle, sheep, goats, and fish (CIA, 2011). Since "Ethiopia is among the three...countries of the world affected by massive soil erosion," great care must be taken in farmland location, diversity in crops, and tree planting relative to the farmland (Waktola, n.d.). In addition, structures similar to vertical greenhouses could assist in crop density and diversity.

Construction Materials and Methods

Housing should be affordable, durable, and easily maintained. Compressed Stabilized Earth Blocks (CSEBs), used extensively by Habitat for Humanity Ethiopia, could meet this need. The blocks consist of soil found on the construction site, sand, water, and limestone, which are all local materials. Halmstad University conducted research in affordable housing in which the researchers built a 26 square meter, two bedroom house with separate kitchen and bathroom buildings out of compressed earth blocks for about \$1,534 total. These homes were built approximately 186 miles south of Addis Ababa (Johansson & Wartanian, 2008). Efforts will need to focus on overcoming the Ethiopians' stigma associated with soil construction.

Construction methods can be taught to the new home owners, allowing them to assist in the construction of their new home. This would further reduce the cost of constructing the home. Habitat for Humanity Ethiopia, for example, operates according to this model. In this way, there would be a relatively small increase in cost due to an increase in number of bedrooms or square footage per room. Special accommodations would need to be made for the elderly, sick, or disabled.

Sanitation

Wastewater, in turn, could be dealt with naturally by using wastewater ponds or technologies such as the Worrell Water Technology's Living Machine, which treats wastewater and converts it into clean water for reuse. The Living Machine is based on a tidal flow wetland system that uses constructed wetlands containing gravel, microorganisms and plants to treat wastewater from the home. The cleaned water could then be reused for irrigation, which would reduce the amount of potable water required for the community. Care would need to be taken to avoid increased exposure to malaria.

Way of Life

Culture and the Ethiopian way of life should be incorporated into the design of the community. For instance, the community would need large open areas for large group dinners, injera bread preparation, hand-washing laundry, slaughtering goats, and participation in ceremonies and holidays. Consideration should also be made to ensure that tenants are able to maintain home-based businesses by providing adequate space in the home, adequate options to live on the ground level, and adequate sidewalk area for potential customers.

Future Work

Future work for this project includes literature review, interviews, stakeholder involvement, and the design of the neighborhood. As part of the literature review, the researcher will review the current Master Plan for Addis Ababa as well as relevant research and publications in urban planning, particularly from Addis Ababa University and other Ethiopian sources. This also includes evaluating trends in resource supply and use, transportation, and migration patterns.

In addition, representatives of the Ethiopian community will be interviewed about the priorities, goals, and concerns for Ethiopian neighborhoods. Among those interviewed will be members of the low-income population, women, and the youth. The researcher will seek the assistance of this same group during the design of the neighborhood to ensure that the values, priorities, and desires of the people for whom the neighborhood is intended are being reflected in the design.

Others that would have a stake in the development of these communities will be contacted. This group includes the mayor of Addis Ababa, the Ministry of Works and Urban Development, and community associations. Organizations that have shown strong support in affordable housing in the past will also be contacted. These include the Network of Ethiopian Women's Association that collected USD 61,500 for 200 women in the government condominium projects, Women at Risk, and the International Crisis Aid.

Finally, the neighborhood will be designed and submitted for review by the community participants and stakeholders.

Conclusion

This paper outlined the history of Ethiopia as it pertains to the current housing crisis. This work serves as preliminary research for the design of an affordable Net Zero neighborhood located in peri-urban Addis Ababa. Ethiopian urban areas need an affordable housing solution to address their current housing deficit of approximately 1 million housing units and anticipated population growth. This solution would need to address the immediate need for quality housing and infrastructure without creating worse problems for future generations to tackle. Some possible components of an affordable neighborhood include rainwater harvesting, urban farming, local construction materials, and wastewater ponds. However, these components are but a few of several possibilities that will be evaluated during a future neighborhood planning phase. This work is part of a larger body of work that will be concluded with the design and construction of an affordable Net Zero neighborhood in peri-urban Ethiopia. This neighborhood could then serve as a model for other locations throughout Africa, other developing countries, and other locales interested in Net Zero neighborhoods.

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