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A Model of Housing Design and Neighborhood Planning in Abuja - Nigeria

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A MODEL OF HOUSING DESIGN AND NEIGHBORHOOD PLANNING IN ABUJA – NIGERIA.

By:

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ABSTRACT

The need for shelter is one of the most important necessities for mankind after sustenance. Over the years, the term ‘shelter’ has undergone series of modification either in shape, space, location or the materials used in constructing them but one thing remains the same; the need for a roof over one’s head is as vital to survival as time in itself. It is an established fact that the early man relied on materials found in his surroundings to provide shelter for him. The techniques employed ranged from earth sheltering to ‘green constructions’ even before the term was coined. The coming of the industrial revolution in the 19th century changed the face of housing in the world forever by creating new possibilities, techniques and materials that were otherwise not readily available. With this came an increase in pollution in the environment which brought about the need for a control system to monitor how much pollution was allowed into the environment in the United States. The world energy crisis led to research into alternative energy creation and conservation options and in 1998 US Green Building Council (USGBC) LEED® was created to serve as a rating system for buildings that complied with their standards.

The lack of affordable housing in the Federal Capital Territory (FCT), Abuja - Nigeria continues to remain unsolved with very high cost of available housing thereby disallowing low-income earners access to decent living. Quite a large number of these people reside in satellite towns where the absence of basic amenities such as potable drinking water, constant electricity, and hygienic sanitary facilities including waste management is not an uncommon sight in these areas. This project develops a model of housing and neighborhood development that can function independently by creating housing from materials locally sourced, creating small industries that can provide jobs, incorporate agriculture to sustain the community and housing for its residents, recycle and manage waste, and grow agricultural products.

DEDICATION

To God Almighty who is always with me.

Special thanks to my father and mother Dr. Etim & Dr. (Mrs.) Aruk Amba, who encouraged me to be the best I can be and not be afraid to try.

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INTRODUCTION

Context of the Problem

Nigeria, officially the Federal Republic of Nigeria, is a federal constitutional republic comprising of 36 states and its Federal Capital Territory, Abuja. The country is located in West Africa and shares land borders with the Republic of Benin to the west, Chad and Cameroon to the east, and the nation of Niger to the north. Its coast to the south lies on the Gulf of Guinea on the Atlantic Ocean. The three largest and most influential ethnic groups in Nigeria are the Hausa, Igbo and Yoruba. In terms of religion Nigeria is roughly split half and half between Muslims and Christians with a very small minority who practice a traditional religion. Nigeria is the most populous country in Africa, the seventh most populous country in the world, and the most populous country in the world in which the majority of the population is black. It is listed among the "Next Eleven" economies, and is a member of the Commonwealth of Nations. The economy of Nigeria is one of the fastest growing in the world, with the International Monetary Fund projecting a growth of 9% in 2008 and 8.3% in 2009. The IMF further projects an 8% growth in the Nigerian economy in 2011. Nigeria, (2012).

Abuja is the capital city of Nigeria. It is located in the center of Nigeria, within the Federal Capital Territory (FCT). Abuja is a planned city, and was built mainly in the 1980s. It officially became Nigeria's capital on 12 December 1991, replacing Lagos. At the 2006 census, the city of Abuja had a population of 776,298. Abuja, (www.wikipedia.com). According to the CIA World Fact book, the population of Abuja as of 2009 was 1.857 million and continues to increase annually. Nigeria (2012).

Abuja is a planned city, originally designed by a group of American firms in the 1970s. It was meant to present an orderly gloss on Nigeria's vibrant but chaotic reputation. No place represents that image more fully than Lagos, the former capital, with its legendary go- slows — or traffic jams — jumbles of shacks next to office towers, and streets overflowing with garbage and sewage. Abuja, by contrast, was to have none of those problems. The master plan would ensure that Abuja would be a tranquil oasis in the center of a cacophonous nation. According to Polygreen, in the interest of cultivating an image of a world-class city, comparable to London, Paris, New York or Hong Kong, the government has been razing unauthorized and unsightly slums, clearing out street hawkers and banishing popular and cheap motorcycle taxis, all in the name of spiffing up the city. Polygreen (2006).

The provision of adequate housing for the growing populace has been an issue for third world and developing countries with such factors as lack of employment, poor economic strength, lack of basic social amenities (potable drinking water, constant electricity supply and access to healthcare) and population explosion amongst others. The FCT has not been spared the effects of population explosion and the issue of efficient and affordable housing. An international labor organization researcher has estimated that the formal housing markets in the Third World rarely supply more than 20 percent of new housing stock; out of necessity, people turn to self-built shanties, informal rentals, private subdivisions, or the sidewalks. Davis (2006).

The high cost of living in Abuja has pushed lower income earners into abject poverty and living conditions that are unhygienic and unsafe. The migration of people in large numbers from rural farmlands to the city in search of white collar jobs in order to provide for their families puts a strain on the available resources in the city. Many of the people forced to dwell in slums are squatters, lacking legal leases or legal title to their homes. To the outsider, ‘many developing-

world slums look unbearably awful' as stated by Eaves (2007); but to their residents they do function, complete with social hierarchies, commerce and a degree of a home-grown government. Still, when one sees a family living in a flyblown concrete cell in Karachi, inside a mud hut in Nairobi or in a cardboard shack in Lagos, one might be inclined to ask, are they really better off than in the villages they fled? According to the U.N., researchers estimate that there were at least 921 million slum dwellers in 2001 and more than 1 billion in 2005, with slum population growing by a staggering 25 million per year in developing countries. These statistics are alarming and should be a cause for concern to governments and leaders.

The term 'slum' whether it be a 'Favela de Rocinha' (a Portuguese language word for Brazilian shantytown), a skid row (a run-down or dilapidated urban area with a large, impoverished population), the Dharavi slum, Mumbai-India, Barrio (A lower-class neighborhood with largely Spanish speaking residents basically the Latino equivalent of a 'ghetto'), Lagos slums or the growing slums in Abuja, they all have similar characteristics and can be defined as a thickly populated, run-down, squalid part of a city, inhabited by poor people. Sethuranam stated that 'By nature, these housing units are constructed using less expensive construction materials (i.e. mud, bricks, bamboo, ordinary wood) and hence tend to have a shorter life' Sethuranam (1985). 'Everyday, around the world' according to public-expert Eileen Stillwaggon, 'illnesses related to water supply, waste disposal and garbage kill 30,000 people and constitute 75 percent of the illnesses that afflict humanity' Stillwaggon (2010).

The characteristics of slums vary from place to place. Many slum dwellers are in fact entrepreneurs, albeit very small. They recycle trash, sell vegetables and basic household items, and do laundry. Some even run tiny restaurants and bars for their neighbors. Slums are commonly seen as breeding grounds for social problems such as crime, prostitution, drug

addiction, alcoholism, disease and death. Smith (2004) stated 'the world can be divided not into two distinctions (developed and developing) but three: developed, developing and fusion. For affordable housing and community development, fusion countries are arguably the place where the most benefit can be delivered because the challenges are huge, but there is indigenous commitment and capacity, if it can be levered. A fusion country mixes first-world financial capacity, at least in small enclaves, that can be applied to certain sectors and third-world housing challenges, often with rapid job or population growth'.

A satellite town or satellite city is a concept in urban planning that refers essentially to smaller metropolitan areas which are located somewhat near to, but are mostly independently of, larger metropolitan areas. (Satellite town, www.wikipedia.com). The City of Abuja consist of eight major satellite towns; Mpape, Maraba, Masaka, Suleija, Lugbe, Kubwa, Dei-Dei and Dutse. Other smaller towns are Karu, Jikwoyi, Nyanya and Madala. In an attempt to beat the exorbitant costs of living in the city, a vast number of people have resorted to living in these neighboring towns from where they embark on arduous commuting on a daily basis. Livings in these satellite towns are not without setbacks which range from poor urban planning and a road network resulting in bad traffic, theft, poor water supply, poor layout, waste management and poor power supply. At the end of the day, one often wonders if it is worth all the hassle.

General Characteristics of Satellite Towns in the FCT - Abuja.

The FCT - Abuja has an average high temperature of 38.2^{o}c (99.1^{o}F) and an average low of 23.2^{o}c (74.1^{o}F). Due to the hilly and mountainous nature of Abuja city, orographic activities bring heavy and frequent rainfall of about 1,500 mm (59.1 in) during the rainy season. Beginning in March and continuing until November, the rainy season peaks in September, during which

time abundant rainfall is received in the form of heavy downpours. The FCT falls within the Guinean forest-savanna mosaic zone of the West African sub-region. Patches of rain forest, however, occur in the Gwagwa plains, especially in the rugged terrain to the south southeastern parts of the territory, where a landscape of gullies and rough terrain is found. These areas of the FCT form one of the few surviving occurrences of the mature forest vegetation in Nigeria. Abuja District. (www.wikipedia.com).

There are five suburban districts in the FCT namely: Nyanya, Karu, Gwagwalada, Kubwa, and Jukwoyi. Along the Airport Road are clusters of satellite settlements, namely Lugbe, Chika, Kuchigworo and Pyakassa. Other satellite settlements are Idu (the main industrial zone), Mpape, Karimu, Gwagwa, Dei-Dei (housing the international livestock market and also international building materials market). Poor road networks, inefficient waste collection and management are not uncommon sights in these areas; causing safety and security issues. Unfortunately, these areas are prone to constant power outages that last as long as 14hours each day. A majority of the residents are not connected to the grid system. Abuja. (www.wikipedia.com). Hence, residents are forced to purchase private generator plants in order to supplement needs. A study carried out by Malachy,(1998) stated ‘The central district which accommodates the seat of power and the eye catching edifices of Nigeria’s super rich is sparkling clean, but not so its satellite towns which are somewhat neglected’.

Figure 1. Map of FCT-Abuja taken from Google Earth

Statement of the Problem

Exploring an innovative way of reducing slums in the FCT- Abuja Nigeria by developing a model of housing design and neighborhood planning. This will be achieved by incorporating green building principles, USGBC LEED® Homes application principles, LEED® Neighborhood principles and A Pattern Language developed by Alexander et al (1977), as a means to reduce the growth of slums and shantytowns. These neighborhood complexes will include water pumps, adequate sanitary facilities, photovoltaic solar panels, recycling and management of sewage waste and garbage, medical suite, educational suite, agriculture and rainwater harvesting. LEED® application principles and urban planning will be incorporated to utilize readily available building materials and techniques whilst reducing waste.

Objectives of the Study

• Review aspects to improve housing design and neighborhood planning in the following:

- USGBC LEED Homes
- USGBC LEED Neighborhoods
- Look into preliminary aspects of NAHB Green Homes
- A Pattern Language. Alexander et al (1977)

• Create a model housing unit within a model village type neighborhood.

• Determine the aspects needed to improve the quality of life in the satellite towns of the FCT.

• Incorporate new innovations into the proposed housing and neighborhood.

• Create a management structure for the model neighborhood that will include income generation, maintenance, security and regulation policies.

Significance of the Study

• This study aims to improve the plight of the income earners in the satellite towns of the FCT. Seek out new ways to improve their living conditions; as this will have an overall impact on the lives of the people.

• The information provided would be useful to the government, international agencies and nongovernmental organizations. This can lead to major changes made by the government concerning the issue of housing policies for low income earners.

• This could be used as an educational case study that provides information that can be used for further research.

• This is a timely study as the current world focus is on green and also LEED® innovations to conserve energy and reduce the waste of resources (materials, labor, human resources, and energy).

Assumptions and Limitations

- This project proposal is limited to the FCT (Federal Capital City) of Abuja – Nigeria. No further projections will be made due to resource limitation.
- It is limited to the Nigerian environment.
- It is limited to the building materials and construction labor readily available in this region.
- Residents will pay for housing through employment opportunities afforded in the satellite communities.
- The Nigerian Government may need to fund initial neighborhood infrastructure proposed.

Definition of Terms

Energy Efficiency – This means the capacity for vigorous activity and the ability to accomplish a job with a minimum expenditure of time, resources and effort.

Green Building Certification Institute (GBCI) – is an organization founded in the United States that handles the certification process for projects and administers credentialing of LEED® Accredited professionals, basically a subsidiary of USGBC.

Pattern Language – A book by Alexander et al. It gives detailed patterns for towns, neighborhoods', houses, gardens and rooms. The elements of this language are entities called patterns. Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem. The pattern language book by Alexander et al contains 253 patterns which can be used in planning and organizing spaces especially land mass.

Rainwater harvesting – This is the accumulating and storing of rainwater for reuse, before it reaches the aquifer. It has been used to provide drinking water, water for livestock, water for irrigation, as well as other typical uses given to water. Rainwater collected from the roofs of houses, tents and other buildings can make an important contribution to the availability of drinking water. Rainwater Harvesting, (www.wikipedia.com).

Slum – This is a thickly populated, run-down, squalid part of a city, inhabited by poor people. (Slum, www.Dictionary.com)

Solar Panels - A solar panel (photovoltaic module or photovoltaic panel) is a packaged, interconnected assembly of solar cells, also known as photovoltaic cells. The solar panel can be

used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. (Solar Panels, www.wikipedia.com, 2010).

Sustainable architecture - This is a general term that describes environmentally conscious design techniques in the field of architecture. Sustainable architecture is framed by the larger discussion of sustainability and the pressing economic and political issues of our world. In the broad context, sustainable architecture seeks to minimize the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space. Most simply, the idea of sustainability, or ecological design, is to ensure that our actions and decisions today do not inhibit the opportunities of future generations.

USBGC LEED® - Leadership in Energy and Environmental Design (LEED®) is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies intended to improve performance in metrics such as energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. (LEED®, www.wikipedia.com 2010)

United States Green Building Council (**USGBC)** – is an organization that developed the LEED® rating system and is one of the most internationally recognized and accepted green building benchmarks. The rating system provides a framework to design, build and operate green buildings and presents metrics to measure their performance.

CHAPTER II

REVIEW OF LITERATURE

Historical Context

One of the most important survival instincts of the early man throughout evolution was the need for shelter from the varied climatic conditions; whether it was periods of intense cold or heat that existed at the time. Survival was dependent on the ability to protect oneself from the elements. Caves or shelters, found in rocks and mountains, were used before the advent of make shift tents up until the coming of enclosed building spaces. Shelters were considered 'green' even before the term was coined because these structures were adapted by the people to suite the natural surroundings in which they found themselves. Such examples can be seen in the igloo of the Eskimo tribes of the circumpolar region, thatch, stick / wood, mud, mud-brick, and rammed earth of the African regions, and earth sheltering structures of the temperate regions.

Relevant Theory

With the advent of industrialization, a lot of new innovations in building materials and construction techniques have altered the fundamental way in which buildings are designed. The focus of a residential structure in many developed nations has shifted from a source of shelter to tastes that is more refined, aesthetically pleasing and in many cases with higher energy and natural resources consumption than ever before. In developing countries, the scenario is quite different with such economic issues as inadequate social amenities being a major problem for the government coupled with the high growth rate of the populace. The outskirts of the Federal Capital Territory (FCT) house a large number of temporary settlements with a stunning daily influx of people. This population explosion is due to the migration of people from other states

into the FCT in search of jobs and a better life. These settlements consist of poorly built shanties and houses without the following: proper sewage management, constant electricity, waste disposal and running water. These lacking amenities result in deplorable conditions that exist in these slums. A common Nigerian term used to describe this situation is called 'Face me I Face You'. This is a situation used to describe crowded living where privacy is virtually nonexistent. The tenants share cooking spaces, restrooms and makeshift bathrooms. According to Chermayeff & Alexander (1963), 'Privacy is most urgently needed and most critical in the place where people live, be it house, apartment or any other dwellings'. A majority of these houses are illegally constructed and are not in accordance with the state master plan. They are constructed en masse by illegal landlords wanting to make fast money by taking advantage of people desperate for a place to stay because they cannot afford to live in the city due to the high cost of houses. These satellite towns have been known to be breeding grounds for crime, prostitution and other social vices.

Housing System in Nigeria

The housing system of Nigeria consist of the civil service (Federal Government) owning the largest portion of housing in the country. These houses are reserved for government workers. According to a study carried out in 2004 by the Public Administration, the federal government owns 24 percent of the housing sector. Country Profile (2004). Private companies and corporations own the second largest portion of housing followed by individual ownership of properties. According to Olotuah (2000), 'the government's attempts at ameliorating the housing difficulties faced by the populace have mainly been through the provision of low – cost houses directly constructed by it. In the Nigerian construction industry, the cost of building materials in the total expenditure on housing constitutes about 60 percent. By incorporating locally available

materials, the cost of construction is significantly reduced. Olotuah (2000). Moreover, these materials are better suited to the tropics and are environmentally friendly.

Monetization in the Nigerian Civil Service

The term ‘monetization’ in Nigeria came into being during the regime of Olusegun Obasanjo (1999 - 2008) in the Nigerian Civil Service. Monetization can be described as a monetary policy designed, which means benefits being enjoyed by public servants would be paid enbloc (monetized). However, the items listed for monetization include residential accommodation, official vehicles and other allowances. (Mobolaji, 2003). This operation allowed government workers to purchase the houses allocated to them by the government. The occupants had the option of purchasing the house or selling it. The federal government, in an attempt to reduce the burden of providing basic amenities for the public officers and also to curb the abuse and misuse of public facilities, decided to incorporate the monetization policy. According to Ramachandran, (2003), ‘monetization is considered one of the best policy options to attain fiscal prudence consistent with growth and stability’. The problem with monetization in the Nigerian Government is thus; once these properties have been sold off, there are no facilities available for new and incoming government staff and officials. These people are forced to rent houses and are given a housing or vehicle allowance that is too low to cover the actual cost. With the swearing in of top government officials, ministers and political appointees, some properties were repossessed by the government from retired service members because there was no suitable accommodation to house these individuals. Big corporations in the private sector have some housing facilities available for workers but only a small percentage. The rest of the populace is left to fend for itself, hence the increase in slums all over the satellite towns.

Demolition in the FCT – Abuja

A demolition operation began in the FCT between 2003 and 2007 under the Minister of the Federal Capital Development Authority (FCDA) Malam Nasir Ahmed el – Rufai, who launched and implemented a policy of mass forced evictions and demolition of illegal structures in an attempt to restore what he termed as 'restoration of the original Abuja master plan'. An estimated 800,000 people lost their homes, worship places, school and businesses during the exercise with spiraling effects seen in family displacement, health, and income. Some of these evictions were accompanied by massive human rights violations. The result of this operation has not stopped the slums from springing up. It has only resulted in resettlement of the displaced people in new areas, thereby creating a temporary solution instead of tackling the root cause of the problem which is inadequate housing. (Ohaeri, 2010).

Existing Housing Conditions and Energy Concerns

The existing housing situation in low income areas of the FCT is not a favorable one; with most units lack the following: adequate ventilation, limited power supply, sanitary, water supply and privacy, which are the basic social amenities of life. This situation is not a sustainable one and can only be improved if changes are made as soon as possible. The energy crisis of the 1970s, which occurred in the United States, created the push for energy efficient and green buildings. Also the concern about environmental problems due to depletion of natural resources brought to light the importance of energy conservation. Incentives were made available for research into solar technologies and alternate forms of energy that were more ecologically

friendly. Over the years, there has been a huge increase in consumption of energy in the building sector.

It is stated that buildings in the United States account for 48 percent of the total energy consumption Yellamraju, LEED®-Construction (p.4). With the rising rate of the energy consumption in buildings and how they are contributing in tremendous amounts to the global climate change has now been realized, hence the shift to operate and design buildings in ways that are more energy efficient and environmentally friendly.

Financial Concerns of Low Income Earners

Numerous studies have been carried out on formal and informal traditional sources of housing finance in developed and developing countries (Ferguson and Smets 2009; Okoroafor, 2007; Stein and Castillo, 2005). According to Wapwera (2011), the issue of finance is a huge problem for people living in abject poverty, as some earn very little and others have no income at all. Prior to the colonial period, there existed a number of methods of housing finance that were adopted in different parts of Nigeria. Access to sources of funds through informal means was usually by the following:

Esusu / Asusu and Ajo - This is a term that is used to describe individual or group savings and these names are indigenous to the three main native Nigerian languages; Yoruba, Hausa and Igbo

Age Grade Association - This is an association of people in the same age bracket or age groups coming together and making contributions of funds into the same account for different purposes. This helps individual members get access to funds that they would not otherwise have been able to provide on their own.

Village Development Schemes - These are small scale loan programs that involve family members, relatives, and neighbors all from the same village gathering funds to assist towards housing provisions, building of churches, schools, town halls et cetera.

Town Unions - This comprised of funds contributed by people living outside their place of birth, abroad or in foreign countries. The funds contributed are used for the development of their rural or town community. The natives can borrow from these funds with a very low and affordable interest rate.

Aaro, Owe or Nwuk - These are terms used to describe community self- help processes where contributions are made in the form of providing labor on a member's or native's site until the circle is completed. This involves rotational activities or menial jobs being done by people in their group.

Other informal avenues of finances are through loans from traditional money lenders as the name implies, they consist of social club contributors or barter arrangements. All the above mentioned means of obtaining finances are tedious and unending and are a common practice in poverty stricken areas which are characterized by poor and unhealthy living conditions. Those who reside in low-income settlements have better access to credit, which can be from colleagues, co-operatives or banks. But the sad reality of this situation is that only a small percentage of these people have benefited from the opportunity of borrowing to finance different stages of their housing projects. Smets (2004).

Modern methods of housing finance in Nigeria today include Federal Mortgage Bank of Nigeria, universal banks, specialized development banks, insurance companies, pension funds,

corporate bodies; developers/contractors financed national housing funds etc. These institutions come with a lot of logistics that are not clear enough and not easily attainable. Wapwera (2011).

What is LEED®?

According to the Yellamraju, the concept of USGBC (LEED®) Leadership in Energy and Environmental Design was developed in 1998 as a rating system to catalyze the green building movement in the United States. According to the USGBC (United States Green Building Council), LEED® promotes development and sustainable practices through a suite of LEED rating systems. These systems recognize projects that implement strategies for better environmental and health performances. The aim of the LEED® system is to revive the old traditional architecture that is considered passively green in design and combine them with modern day solutions that are more energy efficient. The advent of HVAC systems in the 20th century was an era which revolutionized the construction industry forever. The emergence of several green rating systems were among the significant factors that brought change including B.R.E.E.A.M. (Building Research Establishment Environmental Assessment Method), Green Star etc.

The Principles of LEED® application are not prevalent in the Nigerian building industry at the time of this project, making this project timely. The decision to incorporate LEED® principles into this project will not only help in energy conservation and management, CO_2 emission reduction, healthy environment which will increase human productivity, but will also reduce housing issues while generating income for the government. This project will incorporate cottage industries (small businesses), thus generating income for the people at close proximity to their dwellings. The review of various prerequisites and credits of USGBC LEED® Homes and

LEED New Neighborhood categories that can be applied to the project during the reviews of the stages of traditional construction methods. Key LEED criteria were incorporated in this project.

LEED® PHASES

Criteria from the following LEED® Phases were considered to develop applicable LEED® categories, prerequisites and credits for selection during this research project. The information given in this section was obtained from 'LEED®-New Construction Project Management from Yellamraju (2010) and includes a breakdown of building processes right from its conception.

Phase 1: Project Definition and Goal Setting

This phase includes data collection and also conducting preliminary analyses that will pave the way for achieving the desired LEED® rating and certification. It begins in the pre-schematic design phase and should be completed before moving to the next phase. This phase can be further broken down into stages that can be further broken down into activities or steps.

i. Collect and compile preliminary data.

ii. Prepare a preliminary LEED® assessment.

iii. Register the project on LEED® online.

iv. Organize a LEED® Vision Workshop.

v. Prepare a LEED® Project Workbook.

Phase II: Design Phase Integration

This stage involves incorporating principles of green building products and the strategies that will be integrated into the design. Also the LEED® credit system will be used as a guide to incorporate this framework into the building process. The activities that relate to the design phase of the project will be considered. They include schematic design, design development and, construction documents. This can be further broken down into stages and then into steps.

Schematic Design (SD) LEED® Phase

i. Perform a credit analysis.

ii. Research and identify green products.

iii. Integrate green requirements into design.

iv. Review schematic design drawings.

Design Development (DD) LEED® Phase

i. Update credit analyses and drawings.

ii. Prepare for construction phase.

iii. Develop building management policies.

iv. Review design development drawings.

Construction Documents (CD) LEED® Phase

i. Prepare documentation for design credits.

ii. Submit to GBCI for design review.

Phase III: Construction Phase Implementation

This phase involves the implementation of green construction practices and procedures on the construction site using the LEED® project management process. Phase activities such as the purchase of green materials, integrating construction measures, commissioning systems and keeping track of information are necessities to achieving the goals set in this phase.

This stage consists of five steps listed as follows:

i. Organize a pre-construction LEED® Kick-off meeting.

ii. Review progress of credit implementation.

iii. Prepare documentation for GBCI submission.

iv. Review final documents for GBCI submission.

v. Submit to GBCI for construction review.

Green Buildings

The concept of LEED® is interwoven with green building systems. Hence, incorporating USGBC LEED® principles into a structure must also contain green building principles because it is one of the fundamentals upon which the concept of USGBC LEED® is based.

The term green buildings according to Wikipedia (2010), is also known as green construction or sustainable buildings. It refers to a structure using processes that are environmentally responsible and resource efficient throughout a buildings life cycle. The life cycle encompasses siting to design, construction, operation, maintenance, renovation and demolition. Green buildings are designed in such a manner so as to reduce the overall impact of the built environment on the health of the occupants and the natural environment.

According to Green Building, (2012), this can be achieved by:

i. Reducing waste, pollution and environmental degradation,

ii. Use of energy, water and other resources in an efficient manner, and

iii. Protecting the health of the occupants and improving employee productivity.

(Green Buildings, 2012).

Pattern Language

The pattern language is a concept of organizing spaces to fit the needs and functions of a geographical area. It gives detailed patterns for towns, neighborhoods', houses, gardens and rooms. The elements of this language are entities called patterns. Each pattern describes a problem which occurs over and over again in our built environment, and then describes the core of the solution to that problem. The pattern language book by Alexander et al (1977) contains 253 patterns which can be used in planning and organizing spaces especially land mass in this case. 'I conceive that land belongs for use to a vast family of which many are dead, few are living and countless members are still unborn' – A Nigerian tribesman (Alexander et al , p37).

Two different necessities govern the distribution of population in a region. People are drawn to cities by the growth of civilization, jobs, education, economic growth and information. In order to establish a reasonable distribution of population within a region, two separate features of the distribution must be fixed: its statistical character and its spatial character. This will ensure equal distribution and avoid high concentration areas. According to Alexander et al, (pg. 43-44), one of the three alternative ways in which people may be distributed throughout a city are the heterogeneous city, the city of ghettos and the mosaic of subcultures. The city of ghettos is the main emphasis of this research project. In a city made up of ghettos, people are usually forced to live isolated from the rest of society, unable to evolve their way of life, and often intolerant of ways of life different from their own. This is very often the case found in the new and emerging ghettos around the FCT – Abuja.

CHAPTER III

METHODOLOGY

Restatement of the Problem

Exploring an innovative way of reducing slums in the FCT- Abuja Nigeria by developing a model of housing design and neighborhood planning. This will be achieved by incorporating green building principles, USGBC LEED® Homes application principles, LEED® Neighborhood principles and A Pattern Language developed by Alexander et al (1977), as a means to reduce the growth of slums and shantytowns. These neighborhood complexes will include water pumps, adequate sanitary facilities, photovoltaic solar panels, recycling and management of sewage waste and garbage, medical suite, educational suite, agriculture and rainwater harvesting. LEED® application principles and urban planning will be incorporated to utilize readily available building materials and techniques whilst reducing waste.

Restatement of the Objectives

• Review aspects to improve housing design and neighborhood planning in the following:

- USGBC LEED Homes
- USGBC LEED Neighborhoods
- Look into preliminary aspects of NAHB Green Homes
- A Pattern Language. Alexander et al (1977)

• Create a model housing unit within a model village type neighborhood.

• Determine the aspects needed to improve the quality of life in the satellite towns of the FCT.

• Incorporate new innovations into the proposed housing and neighborhood.

• Create a management structure for the model neighborhood that will include income generation, maintenance, security and regulation policies.

• Identify patterns that can be incorporated into the planning of the proposed site.

Research Procedure

• Identify green building principles.

• Identify applicable prerequisites and credits.

• Develop a generic schematic neighborhood site plan within the LEED® Homes and LEED® Neighborhood rating systems based on criteria identified in LEED® neighborhoods and the book A Pattern language by Alexander et al (1977).

• Develop generic residential building plans showing floor plan layouts.

• Identify green components that can be incorporated into the project.

CHAPTER IV

FINDINGS

Restatement of the Problem

Exploring an innovative way of reducing slums in the FCT- Abuja Nigeria by developing a model of housing design and neighborhood planning. This will be achieved by incorporating green building principles, USGBC LEED® Homes application principles, LEED® Neighborhood principles and A Pattern Language developed by Alexander et al (1977), as a means to reduce the growth of slums and shantytowns. These neighborhood complexes will include water pumps, adequate sanitary facilities, photovoltaic solar panels, recycling and management of sewage waste and garbage, medical suite, educational suite, agriculture and rainwater harvesting. LEED® application principles and urban planning will be incorporated to utilize readily available building materials and techniques whilst reducing waste.

LEED Neighborhood Reference Guide (USGBC LEED – ND®)

According to the Green Neighborhood Development (2009), the U.S. Green Building Council, the Congress for the New Urbanism (CNU), and the Natural Resources Defense Council (NRDC) had come together to develop a rating system for neighborhood planning and development based on the combination of principles that entail smart growth, green infrastructure, new urbanism and building. LEED® for Neighborhood Development emphasizes the selection of the site, design and construction elements that bring infrastructure and buildings into a neighborhood, and relate the neighborhood to its landscape as well as its local and regional context. LEED for Neighborhood Development creates a label as well as guidelines for both

decision making and development, to provide an incentive for better location, design and the construction of new residential, commercial and mixed-use developments.

LEED for Neighborhood Development (LEED-ND) has three environmental categories: Smart Location and Linkage, Neighborhood Pattern and Design, and Green Infrastructure and Buildings. An additional category called 'Innovation and Design Process' addresses sustainable design and construction issues and measures not covered under the three categories. For a LEED-ND project, there is no minimum or maximum size but suggest a minimum size should be at least two habitable buildings and the maximum area that can be considered a neighborhood is 320 acres or half a square mile. A mix of uses is often integral to the vitality of the neighborhood. This can include a combination of residential, commercial including a variety of retail establishments, services, community facilities, and other diverse uses. The sustainable benefits of a neighborhood increase when it offers proximity to transit and when its residents and workers can safely travel by foot or bicycle to jobs, amenities, and services. This creates a neighborhood with a high quality of life and healthy inhabitants. With green building principles incorporated, a reduction in energy use, water use and the incorporation of green infrastructure such as landscaping can protect natural resources. The aim would be to select items that are best suited and can be incorporated into the proposed project design.

Smart Location and Linkage

Smart location and linkages focuses on selection of sites that minimize the adverse environmental effects of new development and avoid contributing to sprawl and its consequences. Sprawl can consume forest land, destroy wildlife habitat, degrade water quality through the destruction of wetlands and increased storm water runoff, pollute air and emit greenhouse gases and often displace agriculture from prime farm land to locations where food production require more energy and chemical input.

The list for credit points available is as follows:

SLL Credit 1	Preferred Locations
SLL Credit 3	Location with Reduced Automobile Dependence
SLL Credit 8	Restoration of Habitat or Wetlands and Water Bodies

Neighborhood Pattern and Design

This emphasizes the creation of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities. Communities with diverse housing types that accommodate a range of incomes, ages, and physical abilities that permit residents to live closer to their work places, help the community retain residents, and allow families to remain in the neighborhood as their circumstances change over time.

The list of credit points available is as follows:

NPD Credit 1 Walkable Streets (Points 1-12)

To promote transportation efficiency, including reduced vehicle miles traveled. To promote walking by providing safe, appealing and comfortable street environments that supports public health by reducing pedestrian injuries and encouraging daily physical activity.

NPD Credit 3 Mixed-Use Neighborhood Centers (Points 1-4)

To cluster diverse land uses in accessible neighborhood and regional centers to encourage daily walking, biking and transit use, reduce vehicle miles traveled and automobile dependence and support car-free living.

NPD Credit 4 Mixed-Income Diverse Communities (Points 1-7)

To promote socially equitable and engaging communities by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community.

NPD Credit 11 Visitability and Universal Design (Points 1)

To enable the widest spectrum of people, regardless of age or ability, to more easily participate in community life by increasing the proportion of areas usable by people of diverse abilities.

NPD Credit 13 Local Food Production

To promote community-based food production, improve nutrition through increased access to fresh produce, support preservation of small farms producing a wide variety of crops, reduce the negative environmental effects of large scaled industrialized agriculture, and support local economic development that increases the economic value and production of farmlands and community gardens.

NPD Credit 14 Tree-Lined and Shaded Streets (Points 1-2)

These were made to encourage walking, bicycling, and transit use, and discourage excessive motoring speeds. To reduce urban heat island effects, improve air quality, increase evapotranspiration, and reduce cooling loads in buildings.

Green Infrastructure and Buildings

This focuses on measures that can reduce the environmental consequences of the construction and operation of buildings and infrastructure. According to the LEED Neighborhood, It is a known fact that globally, building construction uses 40 percent of raw materials, (LEED-ND). Sustainable building technologies reduce waste and use energy, water, and materials more efficiently than conventional building practices.

GIB Credit 1 Certified Green Buildings

To encourage the design, construction, and retrofit of buildings that utilizes green building practices.

GIB Credit 2 Building Energy Efficiency (Points- 2)

To encourage the design and construction of energy-efficient buildings that reduces air, water, and land pollution and adverse environmental effects from energy production and consumption.

GIB Credit 3 Building Water Efficiency (Points – 1)

To reduce effects on natural water resources and reduce burdens on community water supply and waste water systems.

GIB Credit 4 Water-Efficient Landscaping (Points – 1)

To limit or eliminate the use of potable water and other natural surface or subsurface water resources on project sites, for landscape irrigation.

GIB Credit 5 Existing Building Reuse (Points – 1)

To extend the life cycle of existing building stock to conserve resources, reduce waste, and reduce adverse environmental effects of new buildings related to material manufacturing and transport.

GIB Credit 6 Historic Resource Preservation and Adaptive Use (Points – 1)

To encourage the preservation and adaptive use of historic buildings and cultural landscapes that represent significant embodied energy and cultural value, in a manner that preserves historic materials and character-defining features.

GIB Credit 8 Storm water Management (Points 1 – 4)

To reduce pollution and hydrologic instability from storm water, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions.

GIB Credit 9 Heat Island Reduction (Points – 1)

To reduce heat islands to minimize effects on the microclimate and human and wildlife habitat.

GIB Credit 10 Solar Orientation (Points – 1)

To encourage energy efficiency by creating optimum conditions for the use of passive and active solar strategies.

GIB Credit 11 On-Site Renewable Energy Sources (Points 1 – 3)

To encourage on-site renewable energy production to reduce the adverse environmental and economic effects associated with fossil fuel energy production and use.

GIB Credit 12 Districts Heating and Cooling (Points – 2)

To encourage the development of energy-efficient neighborhoods by employing district heating and cooling strategies that reduces energy use and adverse energy-related environmental effects.

GIB Credit 13 Infrastructure Energy Efficiency (Points – 1)

To reduce adverse environmental effects from energy used for operating public infrastructure.

GIB Credit 14 Wastewater Management (Points 1-2)

To reduce pollution from wastewater and encourage water reuse.

GIB Credit 15 Recycled Content in Infrastructure (Points -1)

To use recycled and reclaimed materials to reduce the adverse environmental effects of extracting and processing virgin materials.

Regional Priority Credits

The US Green Building regional councils and chapters in consultation with CNU chapters and membership, developed regional priority in 2009. This new credit allows projects to earn one point each for up to four of six regional priorities it fulfills. RPC's are existing LEED® credits that USGBC regional councils and chapters have designated as being particularly important for their areas. If an RPC is earned, then a bonus point is awarded to the projects total points. A specific location – referenced by zip code – has six RPC's per rating system.

RP Credit 1 Regional Priority (Points 1-4)

To encourage strategies that address geographically specific environmental, social equity, and public health priorities.

LEED® Homes Reference Guide

The LEED® Green Building Rating System was released in March 2000, after years of modification. It addresses the different project development and delivery processes that exist in the U.S. building design and construction market. It evaluates environmental performance from a whole building perspective over a buildings life cycle, providing a definitive measure for what constitutes a green building. The development of the LEED® Green Building System was initiated by USGBC members, and involves all segments of the building industry. LEED® has five environmental categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, and Indoor Environmental Quality. The sixth category being Innovation in Design, addresses sustainable building expertise as well as design measures not covered under the five categories.

LEED® Homes addressed several types of new residential construction. Some of them are single-family homes, low-rise multifamily, mid-rise multifamily, production homes, affordable homes, manufactured and modular housing, and existing homes.

Credit Categories

LEED® Homes certification is based on 18 prerequisites and 67 credits. The prerequisites are basic performance standards and are mandated for every project to receive category credits even though points are not awarded for meeting them. In total, 136 credit points are available and are classified in the following eight credit categories:

1. Innovation in Design (ID) Process.

This refers to special design methods, and unique regional credits. The ID Process

encourages project planning and design to improve the integration and coordination of green elements in a home. These elements are shown to produce quantifiable environmental and human health benefits while earning credit points. With the constant evolution of sustainable design strategies and measures, new technologies are continuously being introduced into the marketplace. An aspect of home design that is overlooked often is the long-term durability of technologies utilized in homes. Failures in durability are a significant cost and cause of stress for both builders and homeowners as well.

2. Location & Linkages (LL).

This category is for the placement of homes in a socially and environmentally responsible way in relation to the larger community. Home building projects have substantial site-related environmental effects. The credits reward builders for selecting sites that have better sustainable land-use patterns and offer environmental advantages over other conventional developments. Areas considered well sited should promote sustainable transportation options such as walking, cycling and mass transit thereby reducing dependence on personal automobiles. This category constitutes integrated project planning, durability management process, and innovative or regional design.

3. Sustainable Sites (SS).

This is the use of the entire property to minimize the project's impact on the site. The design of the site and its natural elements can have a significant environmental impact. The credits obtained from this category rewards projects for designing the site to minimize adverse impacts. The protection of native plants and animal species is important. The aesthetic and functional attributes of the site should be considered but also the long-term management needs. This

category constitutes the consideration of landscaping, local heat island effect, surface water management, nontoxic pest control and compact development.

4. Water Efficiency (WE).

This category focuses on water conservation practices, both indoor and outdoor. As communities grow, increased demand for water leads to additional maintenance and higher costs for municipal supply and treatment facilities. New homes that utilize water efficiently have lower water use fees and reduced sewage volumes. Water conservation strategies such as rainwater harvesting and greywater plumbing systems often involve more substantial investment than others. Water efficiency constitutes water reuse, irrigation systems and indoor water use.

5. Energy & Atmosphere (EA).

This is Energy efficiency, particularly in the design of the building envelope, and heating and cooling system. As this project will be designed with special consideration for its location in the tropics, the focus will be on cooling. Conventional fossil-based generation of electricity releases carbon dioxide (CO_2), which contributes to global climate change. The use of coal, natural gas, nuclear fission and hydroelectric generators all have adverse health and environmental impacts. With scientist prediction that greenhouse gases, if left unchecked, will raise global temperatures by $2.5^{o}F$ to $10^{o}F$ during the 21^{st} century. This process must be slowed down, stopped and reversed. The residential building sector is not exempt from contributing to the global carbon emissions. Building green homes is one of the ways to reduce energy consumption and CO_2 emissions. This category constitutes insulation, air infiltration, windows, heating & cooling distribution systems, space heating and cooling equipment, water heating, lighting, appliances, and renewable energy.

6. Materials & Resources (MR).

This is the efficient utilization of materials, selection of environmentally preferable materials, and minimization of waste during construction. The choice of building materials is very important for sustainable home building because of the extraction, processing and transportation materials require. Materials can be reused, recycled or locally sourced. This section constitutes material efficient construction, environmentally preferable products and waste management.

7. Indoor Environmental Quality (EQ).

This category is to improve indoor air quality by reducing the creation of and exposure to pollutants. In the United States, 90% of a person's time is spent indoors where pollution may run two to five times (sometimes 100 times more) more than the outdoors. According to the World Health Organization guidelines for Europe, most of an individual's exposures to many pollutants come through inhalation of indoor air. Also hazardous household pollutants include such things as carbon monoxide, radon, formaldehyde, mold, dirt and dust, pet dander, and residue from candles and tobacco smoke. Many homeowners store various chemicals in their homes including pesticides, fertilizers, solvents, greasers, thinners and oil-based paints. Preventing indoor air quality problems is less expensive that solving them. There are three strategies involved; source removal, source control and dilution.

Source removal and control is the most practical way to ensure harmful chemical compounds are not brought into the home. Also, scheduling deliveries and sequencing construction activities can reduce exposure of materials to moisture (causing mold) and absorption of off-gassed contaminants. Dilution involves using fresh outside air to ventilate a

home, exhaust pollutants to the outdoors, and control of indoor moisture. This category consist of two sections: EQ1 (EPA indoor airPLUS, enhanced outdoor ventilation, enhanced local exhaust, third-party testing, better/best air filters, and indoor contaminant control) and EQ2 (combustion venting, moisture control, outdoor air ventilation, local exhaust, distribution systems, air filtering, contaminant control, radon protection, and garage pollutant protection).

8. Awareness & Education (AE).

This is the awareness creation and education of homeowners, tenants, or multifamily building managers about the operations and maintenance of the green features of a LEED® Home throughout its life cycle. This section consists of two categories, the education of the homeowner or tenant and the education of the building manager.

Regional Materials and Resources that can be easily sought in the FCT

This section presents research into materials common to the proposed project region. The aim was to determine materials that can be used for construction and that will be cost effective in terms of availability and transportation. According to the natural resources and development website of Nigeria, the following naturally occurring resources below were found in the FCT.

Mineral Resources:

There are various types of mineral resources in the FCT which are of high quality and have potentials for both domestic and export markets. Some of the minerals and their various applications are as follows.

Marble:

According the natural resource and development website, marble is perhaps the mineral with the greatest known quantity in the FCT. Marble deposits around the village of Burum alone are more than seven million tons. Indeed, the quality of the Burum marble is excellent. There are other deposits of marble elsewhere in the FCT, especially around the villages of Kusaki, Kenada, Taka Lafia and Ele.

It is estimated that the marble formations run along a narrow band for some seven km in a northeast direction from Ele. Deposits of marble may be found around the village of Kusaki. These marble deposits are truly important and will in the future form an important aspect of the economic development of the Territory.

Figure 2. Showing different types of marble

Tin Deposits:

Tin is probably known in association with Jos (one of the 36 states in Nigeria), but some deposits in the FCT are found mainly around the village of Kusaki, northeast of the Kuje district, and also northeast of FCT. Tin veins in this area may be up to three km in length and some 30m in width. The large veins are feldspathic, containing microsline, albite, and quartz. A little more work still needs to be done there to establish whether mining will be commercially viable.

Figure 3. Showing Tin in its raw form.

Stones:

These are mainly granitic rocks found all over the territory, that may be utilized as industrial materials mica and talc schist's or as rocks that will be of possible use as building materials. For many of the minerals, no detailed studies have as yet been carried out to determine the extent of availability and whether or not they are worth exploiting.

Figure 4. Showing stone manually excavated from rocks.

Wolframite and Tantalite:

Deposits of wolframite and tantalite exist in the FCT along the road between Suleja and Burum. Wolframite is a compound of iron and manganese. Tantalite is a black mineral, also a variety of iron. The extent of the deposits of these two minerals are however unknown and more work is required to establish the quantities and qualities available.

Figure 5. Showing Wolframite and Tantalite

Lead:

Found mainly in Babban Tasha village of the territory.

Clay:

Red clays suitable for house construction and brick making are found in places like lzom, Dangara, Shenagu, Gwagwa, Karu and Kobo. Ceramic clays are also present in places like Rubochi, Yaba and Bwari.

Figure 6. Showing Red Clay deposits

Mica:

White mica, suitable for use as raw material in production of rubber, roofing materials, paint and paper production, exists around the villages of Kabin Mangoro and Kusaki (Natural Resources and Development, (2003). Ample amounts of laterite are available for backfilling purposes, and sharp sand sought from the bed of rivers, tributaries and swampy areas are easily available for construction.

Requirements needed to improve the quality of life in low income areas of the FCT

The needs of residents of low income areas in the FCT require the basic amenities of life such as potable drinking water, sanitary facilities, constant electricity supply, waste management, access to affordable medical facilities and decent housing in a good neighborhood. These needs are seen as primary, but in many low-income residential settlements of developing countries these necessities are non-existent.

New innovations that can be incorporated into the proposed housing design

The energy crisis experienced the world over, has led to research into new innovations in energy conservation, waste reduction, and ecological friendly energy alternatives. The proposed model will incorporate innovations such as; photovoltaic solar panels, orientation and climatology, rainwater harvesting, waste management and recycling along with principles of LEED® and pattern language that can be applied in this environment.

Management structure for the project that would include income generation, maintenance, security, and regulation policies.

This section considered ways in which this project can be maintained throughout its life cycle. One of the major problems with new construction in Nigeria is the lack of maintenance policies and that they are not continuously adhered to. The result is a lot of abandoned dilapidated facilities that are converted into shelters for social vices. The idea of having a facility management plan that would include residential units, cottage industries, and agriculture, maintenance, water and waste treatment plants along with income generated from these sectors.

A facility management is so broad that it will be analyzed on a primary level with minimal details; and would be open for future research and in-depth analysis.

This project will be owned in a joint partnership between the government and a conglomeration of private organizations such as Habitat for Humanity, Facility Managers or other non-governmental organizations. This will ensure accountability and effective management. The reason for this is because the government is capable of providing a bulk of the funds required to set up this project, but a private company or organization would be better at managing the facility. This is due to such aspects as misappropriation of funds and constant maintenance requirements.

Figure 7. Proposed Facility Management Structure

Water Treatment

Access to clean drinking water is very important to the residents of satellite towns in the FCT. The major fact that these towns are not all planned and thereby not connected to the city water supply makes access to clean water difficult. A lot of people are forced to buy water from local vendors peddling water jerry cans in carts. This water is unsanitary because it is often fetched from drains, streams and tributaries. The methods of collection as seen during a visit in a neighboring town, showed the vendors pouring water fetched from a drain into a jerry can with a cotton cloth serving as a filter for dirt and particles. This water is purchased and used for household activities such as cooking, washing and drinking (especially in poorer households). The presence of treated water will reduce illnesses especially in children such as typhoid fever, cholera, diarrhea, and worm infections. Having clean available water will reduce the cost of medical treatments due to sickness.

Waste Management

A vital signature of slums and poorer parts of the city are the stench from poor waste management and collection services. Visits to the slums of Bosso LGA of Minna – Niger state showed the houses built with no form of order and the waste produced from the toilets and makeshift bathrooms, in these poorly constructed houses, was washed directly into the streets. The house had grooves manually dug outside these conveniences to serve as a means of transporting (gravity flow) these waste away out in the open. Also noted were the children playing in the streets and often times picking up their balls from within the raw sewage. These are breeding grounds for disease causing vectors and show the need for clean and sanitary conditions is so important. Chris Zurbrugg, (1998) SANDEC / EAWAG reports that ‘third

world research reveals that nearly two-thirds of solid waste there is not collected, and is never officially acknowledged. Candy wrappers, cigarette filters, plastic bags, and other items are immediately discarded after use. They collect in clumps and move through the environment in streams and rivers, eventually entering bays and seas. None enters any recycling system'. (p.2). The need to have an effective recycling system that can manage the waste produced by the facility and also the conversion of household compost waste for the farms would be beneficial and to some extent reduce some fertilization cost.

Agriculture

The choice to incorporate an agriculture unit, that will involve the cultivation of land, is based on the need for any settlement of people to be able to feed itself to the best of its ability. This unit will serve as a source of employment for able bodied individuals. Excess proceeds from the farms will be sold to aid in generating income. Growing food would encourage a healthy eating way of life. According to the WHO (world health organization), the problems with a lot of developing countries are high poverty levels with most people living below a dollar a day. Analytical reports by Shah (2010) reflect that at least 80% of the world's population earns less than $10 a day. Even more disturbing is the statistic that the poorest 40% of the world's population accounts for five percent of the global income'. If this facility can provide the basic food staples to be sold at subsidized rates to residents or provide free food to families working on the farms; hunger will soon be a thing of the past to the people. According to Kwa, (2001), perhaps the most important dimension of agro-ecological food production is that they can provide a decent livelihood for small farmers, with fair returns to their labor, if there is a supportive larger policy environment. These systems have the potential to offer economically favorable rates of return since the costs of inputs are not exorbitant. The potential benefits to

small farmers include increases in food supply, increases in incomes, reduction of poverty, reduction of malnutrition and general improvement to small farmers' overall livelihoods.

Maintenance

The issue of facility continuity is very important in developing or third world countries of the world. It is not enough to construct a facility but most importantly, to have a maintenance or facility management structure on ground to extend its life. Until recent reforms were made, there has been a poor maintenance culture in the Nigerian context. The facility maintenance structure proposed in this project will ensure that the facility is maintained throughout its life cycle.

Residences / Cottage Industries

These are housing units and cottage industries combined together. These units are composed of cottage industries (shops) on the ground floor and the residences on the second floor hence, the residents especially the women can have a source of livelihood and can be close to home at the same time. The cottage industries can include such businesses as tailoring, bakeries, restaurants, pubs, vegetables, household groceries, hair salons, etc. The residents will be based according to the size of the families.

This unit consists of standard sized two bedroom apartment consisting of a kitchen, convenience and living space. Here, each unit will house a small family size between 2 – 4 people. The shops are on the first floor and the residents on the second floor.

The Twelve Family Units.

This multi – family unit is designed after the ‘long thin house’ pattern 109 from the pattern language and is a two story structure that consists of a standard sized one bedroom apartment with its own convenience, living space and kitchen. This unit can house twelve families, (six families on each floor).

Selected Patterns from A Pattern Language.

A Pattern Language as written by Alexander et al (1977) serves as a guide that aids in actual design and construction processes. It is extremely practical and has been compiled from years of building and planning practices. The elements of this language are entities called patterns, and each pattern describes a problem which occurs over and over in our built environment. A pattern then describes the core of the solution in multiple ways. There are 253 patterns and each is ordered, beginning with the largest for regions and towns, then clusters of buildings, individual buildings, rooms and alcoves, and ending with specific details of construction. The reason for this sequence is to explain the fact that no one pattern can exist in isolation but must be linked to other patterns and finally the environment and people living there. The project recommends the following patterns for adoption:

Pattern 15 – Neighborhood Boundary.

The strength of this boundary is essential to a neighborhood. If the boundary is too weak the neighborhood will not be able to maintain its own identifiable character. An illustration is given showing the microscopic view of an organic cell wall which in most cases is as large as or larger than the cell interior (Figure 8). It is not a surface which divides inside from outside but a coherent entity in its own right, which preserves the functional integrity of the cell and also provides for a multitude of transactions between the cell and the ambient fluids. Any human group, with a specific life style, needs a boundary around it to protect its idiosyncrasies from encroachment and dilution by surrounding ways of life. From observations of neighborhoods that succeed in being well defined, both physically and in the minds of the townspeople, we have learned that the single most important feature of a neighborhood's boundary is 'restricted access into the neighborhood' (p.87). Neighborhoods that are successfully defined have definite and relatively few paths and roads leading into them. The boundaries not only serve to protect individual neighborhoods, but simultaneously function to unite them in their larger processes.

Therefore, the formation of boundaries around each neighborhood, to separate it from the next door neighborhood is encouraged. By closing down streets and limiting access to the neighborhoods, this pattern is formed. The pattern suggests placement of gateways at those points where the restricted access paths cross the boundary and making the boundary zones wide enough to contain meeting places for common functions shared by several neighborhoods.

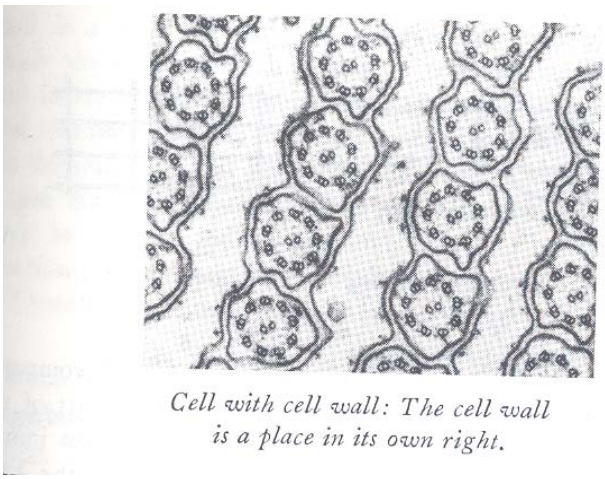


Figure 8 illustrating the neighborhood boundary using a classic microscopic cell wall

(Alexander et al 1977p.87)

Pattern 87 – Individually owned shops.

Where, the first floors will house small cottage industries (shops) and the second floor will serve as residential apartments. When shops are too large, or controlled by absentee owners, they become plastic, bland and abstract. This is the reason why cottage industries give a certain personal quality to the community in which they are located.

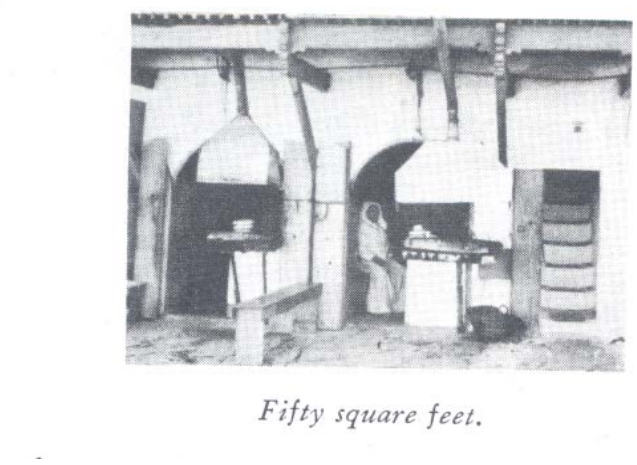
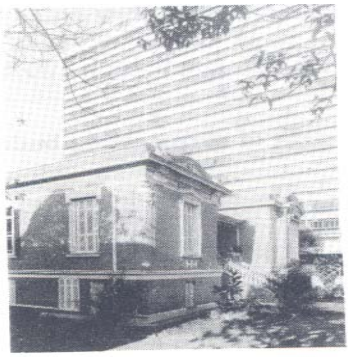


Figure 9 Showing Individually Owned Shops

Pattern 96 – Number of stories.

According to Alexander et al,(1977), ‘To keep them small in scale, for human reasons and to keep costs down, they should be as low as possible. But to make the best use of land and to form a continuous fabric with surrounding buildings, they should be two, three or four stories instead of one’. It is known that very tall buildings may have a negative psychological effect on man and that tall buildings are attributed to a lot of suicidal activities, high cost of construction and increased isolation.



Breaking the rule of thumb.

Figure 10 Showing Numbers of Stories

Pattern 106 – Positive Outdoor Space.

There are fundamentally different kinds of outdoor space: negative and positive space. According to Alexander et al, (1977) ‘An outdoor space is negative when it is shapeless, the residue left behind when buildings are placed on the land’, or the shape of the building is not convex because the lines joining its two end points cut across the corner and therefore go outside the space. A positive outdoor space is one that has a distinct and definite shape that is convex.

The positive outdoor space is seen as a figure against the ground of the building while in a negative outdoor space, the building is seen as a figure and the outdoor space as ground. Figure 9 illustrates positive and negative outdoor spaces.(p.518).

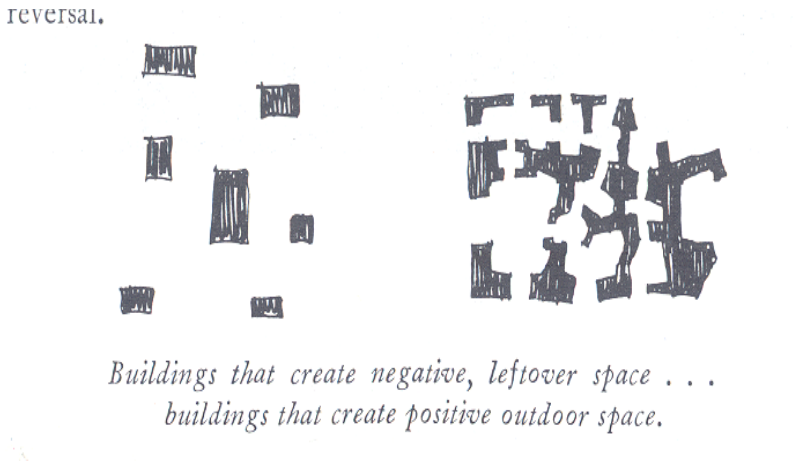
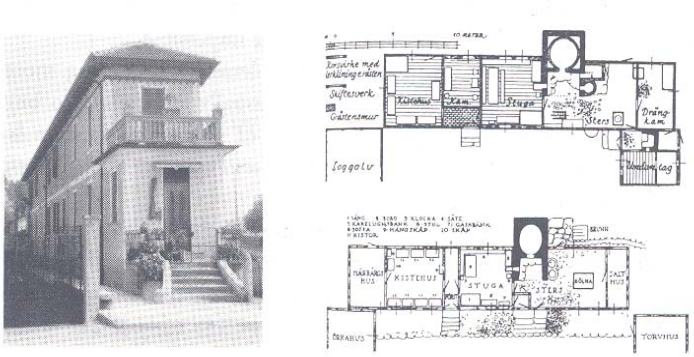


Figure 11. Illustrating positive and negative outdoor spaces as seen in plan view.

Pattern 109 – Long Thin House.

According to Alexander et al, (1977) the shape of a building has a great effect on the relative degrees of privacy and overcrowding in it. This in turn has a critical effect on people's comfort and well-being. The main aim of this pattern is to maximize small spaces by giving them a feeling of spaciousness. The author states that the 'feeling of overcrowding is largely created by the mean point-to-point distances inside a building'. This should be higher in long thin rectangular buildings; a building that is rectangular in shape increases the privacy of its occupants and the ability to get within a given area.



Long thin houses.

Figure 12. Showing an example of the long thin house.

NAHB GREEN HOMES

According to research, the name NAHB Green is a term used to describe a United States based organization that constructs green homes. That is, homes that are energy and resource efficient, water conserving, design considerations and indoor environmental quality; all of these taken into consideration. NAHB is another name for the National Green Building Program of the National Association of Home Builders. The concept behind this organization is to build homes that are green, each home incorporated with green building principles, each unit constructed with respect to the geographic location and climate. Also the existing market preferences of the areas in which they are built are considered.

The NAHB has been a success with a steady growth of certified homes in the United States of more than 115,000 homes in the local HBA green building programs that took place between 1995-2008. These green building programs have contributed in transforming the industry by pulling together the builders, elected building officials and environmentalists without mandates or overbearing regulation. A visit to the NAHB conference of 2012 held in Florida showcased

new and innovative materials and finishes in the market, new green concepts and better building practices.

The NAHB is divided into four different sections:

1. National Green Building Certification to the National Green Building Standard and the NAHB Model Green Home Building Guidelines.
2. The Certified Green Professional Educational Designation
3. The NAHB National Green Building Conference
4. The NAHB National Green Building Awards. NAHB Green, (2012).

DESIGN MODELS FOR THE PROJECT

Residential Unit/Cottage Industry

These units consist of a two storey semi-detached duplex. The ground floor will serve as a small shop and the first floor will serve as the residence for the family. It comprises of two bedrooms of standard size, a kitchen, living area and convenience. Each unit has a total floor area of 63.65m^2.

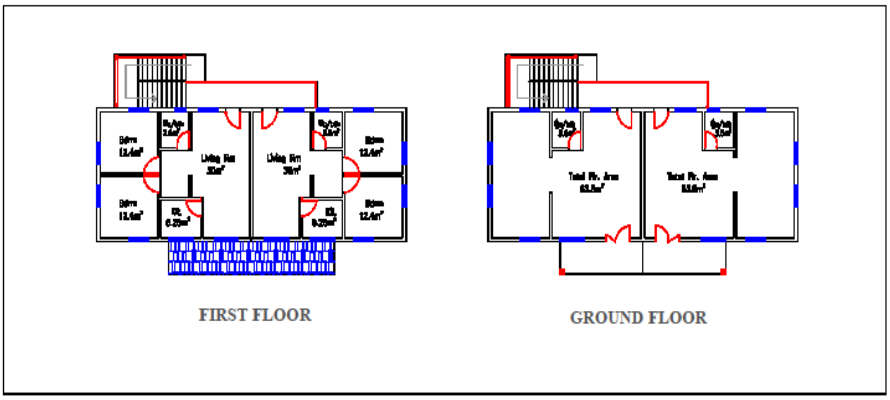


Figure 12. Showing the floor plans of the Cottage Industry / Residential Unit

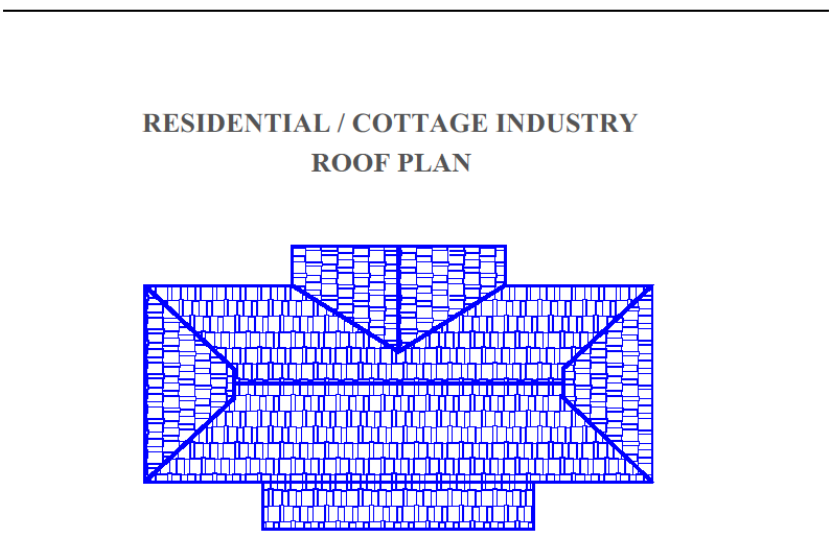


Figure 13. Showing the roof plan of the cottage industry.

The 12 Family Units

These units were designed based on the ‘Long thin house’ pattern 109 by Alexander et al. It consists of a living area, kitchen, bedroom and convenience. The total floor area of each unit is 55.17m2. The first floor houses six small sized families, also the second floor. Hence, the name ‘the twelve family unit’.

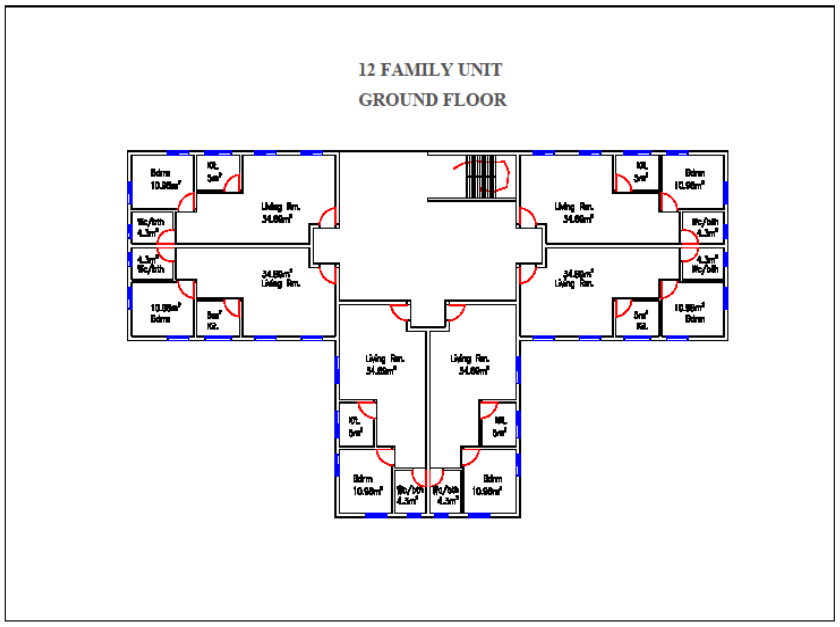


Figure 14. Showing the Ground floor plan of the 12FU

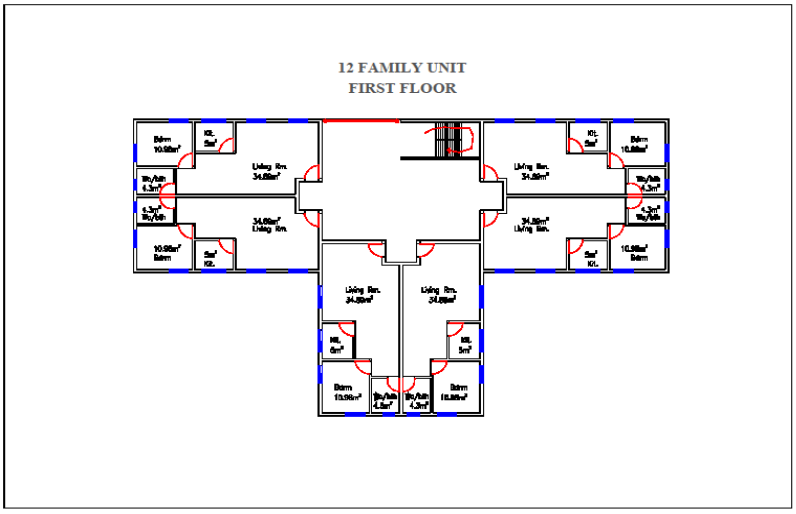


Figure 15. Showing the first floor plan of the 12FU.

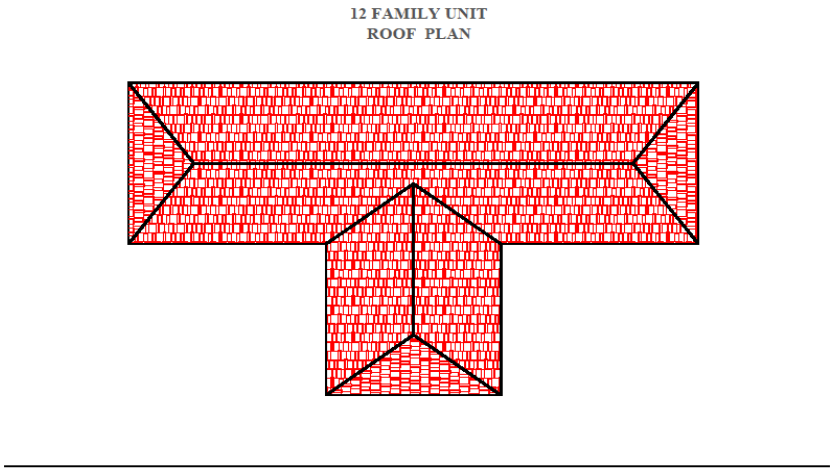


Figure 16. Showing the roof plan of the 12FU.

Site Plan for Proposed Residential Facility

This is a depiction of the neighborhood layout and all the units to be incorporated in the project. There exists land area for agricultural production; as this is a sustainable site, the two residential units. Also existing are the water treatment unit, the farm house, water treatment facility and a vocational center.

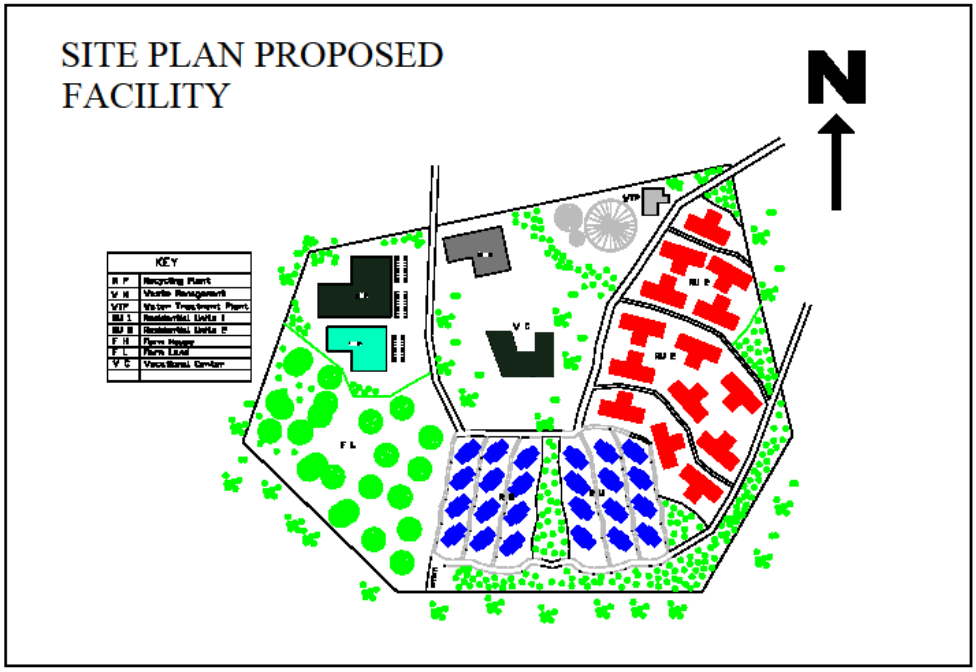


Figure 17. Showing the site plan for the project.

Rainwater Harvesting Collection

The rainwater harvesting and collection layout is shown below. The direction of pipework and linkage to the water treatment plan from all of the buildings is shown. This will consist of rainwater collection pipes that will serve as collection off roof run-offs. These will be transported underground through a network of pipes to the treatment plant.

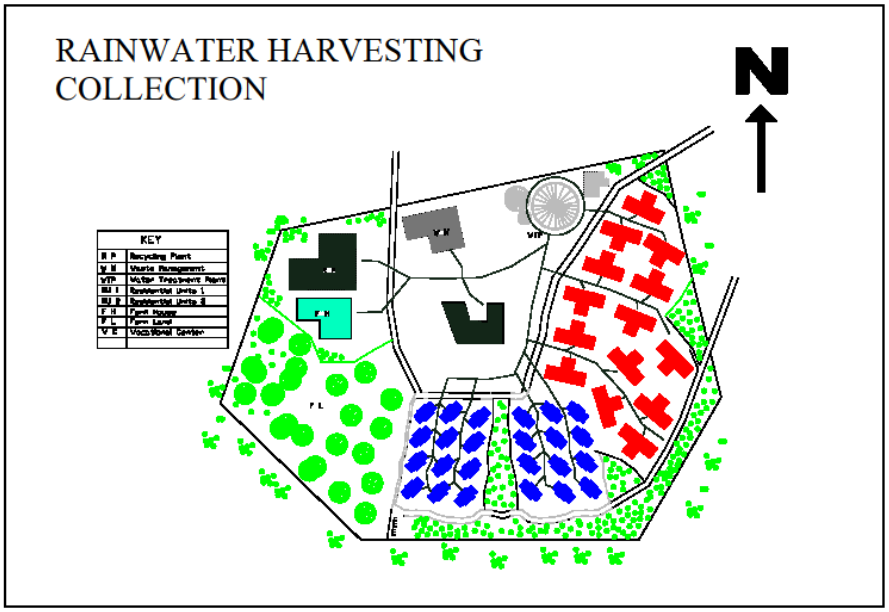


Figure 17. Showing rainwater harvesting layout.

CHAPTER V

SUMMARY AND CONCLUSION

Summary

The purpose of this research project was to develop a model of housing and neighborhood planning in Abuja – Nigeria. The model was developed by Ekanem Amba and includes information gleaned from

- USGBC LEED® Homes
- USGBC LEED® Neighborhood Development
- Application of a Pattern Language by Alexander et al (1977)
- Ideas from Community and Privacy by Chermayeff and Alexander

Housing is one of the most important needs for man. The need for decent housing at an affordable price is a luxury that most low income earners in the FCT-Abuja cannot afford. This project intends to construct housing using materials that are regionally sourced and built to be cost effective at the same time. By incorporating LEED ® and green building principles, this facility intends to conserve energy and generate income.

Conclusion

The purpose of this study was to create a housing model for low income earners in the FCT-Abuja by incorporating LEED® and Green building principles. The residential units will be energy efficient, providing opportunities for jobs, a decent life and access to living conditions that are hygienic and safe. The complexity of model application success due to the limited income of prospective residents to the model housing and neighborhood.

Future Research

The term ‘slum’ as described, is a thickly populated, run-down, squalid part of a city, inhabited by poor people. Whether it be a ‘Favela de Rocinha’ (a Portuguese language word for Brazilian shantytown), a skid row (a run-down or dilapidated urban area with a large, impoverished population), the Dharavi slum, Mumbai-India, Barrio (a lower-class neighborhood with largely Spanish speaking residents basically the Latino equivalent of a ‘ghetto’), Lagos slums or the growing slums in Abuja, they all have similar characteristics. These are areas that need to be focused on for future research:

- Further research in applying the model developed in this research to slum areas in other parts of the world.
- A look into different sizes of residential housing units. A wider variety of housing that caters specifically to the needs and family sizes of the residents.
- An in-depth research into the National Association of Home Builders (NAHB) Green Building Guidelines.
- Research into rainwater harvesting.

- Research o low – cost, affordable housing units.

- Research individual components of the proposed model neighborhood:

    (i) Agriculture (farming)

    (ii) Housing

    (iii) Water supply systems

    (iv) Sanitary systems.

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