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# Condominium Buildings Versus Environmental Sustainability

In the case of Addis Ababa

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By Netsanet Seife

May 2014

**Condominium Buildings**  
**Versus**  
**Environmental Sustainability**  
**In the case of Addis Ababa**

**Advisor: *Dr. Hailu Worku***

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**A Thesis Submitted to EiABC in Partial Fulfillment of the Requirement of  
MSC in Housing and Sustainable Development**

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## **Abstract**

The growth rate of Addis Ababa's population has resulted in a chronic housing problem expressed in the growing slums, unsanitary living conditions and a degraded environment. The Integrated Housing Development Program (IHDP), also known as the condominium housing project launched by the government in addressing this problem, even though it stands to save the city of worse environmental deterioration, has used the open and green spaces of the city; and being solely directed to solve the housing backlog, may lack environmental sustainability initiatives.

In general therefore, the objective of this study is to present the concept of environmentally sustainable buildings, to study ways it has been and can be implemented and to adapt these concepts to the condominium project. To accomplish that, three sites – the Bole Gerji, the Feresbet and the Mickey Leland – were selected as case study samples. To gather data, interviews with the dwellers at the sites, observations of the site and a review of different researches and relevant literature on environmentally sustainable buildings were conducted. The data gathered using these methodologies was then analyzed and interpreted and used to develop a proposal of what could be done to include environmental sustainability concepts in the design and construction of the condominium project.

The questions asked in the interviews were designed to discover how aware of environmental issues such as global warming and climate change the dwellers were. The results show that though dwellers are educated and aware of the issues of global warming and climate change, they have not taken the most optimal environmental sustainable measures they could; i.e., the long-term impacts of the measures taken to meet their immediate needs, such as parking, are not taken into consideration. The results from the site observations show that most open spaces are not used according to the original design; that the design was lacking in areas that could contribute positively to good indoor air quality and to the health and comfort of the dwellers; and that the materials used in construction are not durable.

It is proposed that the condominium buildings should be designed, constructed and used incorporating environmental sustainable building concepts. Several propositions therefore are that additional sources of renewable energy other than hydroelectric power, such as solar power and biogas, be used and that water and waste should be recycled.

In conclusion, it can be said that the Integrated Housing Development Program only addresses the need for housing and that environmental sustainability building concepts were not paramount in the design. After the sites were delivered to the dwellers, in general, it can be said that successful environmental sustainability concepts undertaken by them are limited to greening their immediate surroundings.

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## **Acronyms**

AAEPA	Addis Ababa Environmental Protection Authority
CP	Condominium Project
CHPs	The Condominium Housing Projects
EPA	Environmental Protection Authority/ Agency
ES	Environmental Sustainability/ Environmentally Sustainable
ESB	Environmentally Sustainable Building
ESBs	Environmentally Sustainable Buildings
ESD	Environmentally Sustainable Design
EPBM	Environmentally Sustainable Building Materials
IHDP	Integrated Housing Development Programme
LEED	Leadership in Energy and Environmental Design
MDGs	Millennium Development Goals
OECD	Organization for Economic Cooperation and Development

## **CHAPTER ONE**

### **1. BACKGROUND OF THE STUDY**

#### **1.1. INTRODUCTION**

The comprehensive building project, under the integrated housing development program, is meant to solve the huge housing backlog in the city of Addis Ababa. It will also create job opportunities for a great number of men and women; the construction helps the country's economy. It is home ownership for those the units of the condominiums are delivered to, and is wealth. But considering the environmental sustainability of the condominium buildings and the project in general, and taking measures to that effect in designing, constructing and making selection of sites harmony with nature is needed in relieving the planet of environmentally unsustainable development.

Environmental sustainability requires that we devise ways of how we can build the needed housing and still conserve nature. This can be done in the way we use energy, the needed water and other resources; by relying more on renewable resources; and by observing limits in the exploitation of non renewable resources, understanding the threat to nature and the environment. This is what nature needs from us at a time when our reliance on the environment is proving to have become unsustainable.

Climate change is a growing international problem that threatens the existence of life on this planet. And the urban area, historically, is the major contributor of greenhouse gases. And due to rapid population growth and urbanization, areas that would have offset the damage, and have preserved the biodiversity, are now contributors to climate change. This study endeavors to bring the concept of environmental sustainability to buildings and to develop it for the Addis Ababa condominium housing project.

This paper, therefore, explores the multi-faceted and inter-twined environmental sustainability issues. It also makes the best attempt to resolve, or look for better alternatives to make the environment sustainable.

The research is based on three sample condominium sites in the city of Addis Ababa. Based on analysis made of where the Addis Ababa condominium project is in terms of environmental sustainability the sustainable condominium project was drawn as a proposal.

## **1.2. STATEMENT OF THE PROBLEM**

Erecting buildings have an effect on the environment. This begins with clearing of the land. It doesn't end there. Sadly, although open and green areas are included in the condominium building plan in Addis Ababa, when it comes to the implementation, those areas have been changed into rough surface and used for parking. Since the condominium building project is wide-ranging so as to meet the ever increasing housing demands of the population of Addis Ababa, if strict and meaningful measures aren't taken, its impact on the environment would be negative unless we introduce the concept of environmental sustainability. Moreover the building project is an opportunity to introduce and create the experience for environmental sustainability.

Rapid urbanization means increased use of resources and non-renewable energy and an increased built area. A high rate of rural urban migration accounts for about 40 percent of the growth. Coupled with rapid natural population growth, Addis Ababa has become one of the fastest growing cities on the continent, and faces multiple challenges, including environmental deterioration (UN-HABITAT, 2008).

An example of such deterioration occurred in the clearing of a large green area for a condominium project here in Addis Ababa at the Mickey Leland site where no effort was made to replace the damage, either in environmentally sustainable building form or by creating a park.<sup>1</sup>

There are environmental laws on air pollution, environmental impact assessment and waste disposal. The city of Addis Ababa has requirements and standards such as the Addis Ababa structural plan and the building permit directive. And the condominium housing project is meant, in general, to solve the city's housing problem; on the way, it will improve the urban environment. But the buildings alone are seen as part of the urbanization process of the city.

## **1.3. RESEARCH QUESTIONS**

Moreover, the following research questions will be considered carefully and treated properly:

1. To what extent is the condominium housing project environmentally sustainable? And what are the efforts towards that, and how committed are the stakeholders to that effect?
2. What is the environmental impact of the condominium housing project?
3. What do we need to do to make the condominium buildings environmentally sustainable?

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<sup>1</sup> The researcher of this work had a personal experience, and was a participant in the clearing of the site and in the construction of 11 blocks on this site.

## **1.4. OBJECTIVE OF THE STUDY**

### **1.4.1. GENERAL OBJECTIVES**

The objective of the research is basically to understand the possible ways of the environmentally sustainable building concept and to adapt them to the Addis Ababa condominium housing project.

### **1.4.2. SPECIFIC OBJECTIVES**

- To study those factors that affect the environmental sustainability of the Addis Ababa condominium housing project and to analyze efforts that are being made so far.
- To analyze the impact of the ongoing condominium housing development project on the environment, the health and the comfort of the dwellers.
- To study and adapt the environmentally sustainable buildings concept for the Addis Ababa condominium housing projects.

## **1.5. SCOPE OF THE STUDY**

The research is limited to the study of the environmental sustainability of the condominium buildings despite the multiple factors that could affect the environment. It mainly focuses on the extent to which environmental sustainability factors have been taken into consideration so that the project's footprint on the environment would be minimal. This study suggests some important clues on the conservation of non-renewable resources and the importance of using renewable resources to reduce greenhouse gases emissions among other measures.

## **1.6. ORGANIZATION OF THE STUDY**

This study has **six chapters**. The **first chapter** introduces the subject and provides the background introduction and gives a clue about the purpose and significance of the study. The **second chapter** states how the study was carried out and what methodology was used regarding each objective of the research. The **third chapter** reviews literature on the environmentally sustainable building concept from the definition of that we mean by environmentally sustainable building to its components. The key question: "To what extent is the condominium housing project environmentally sustainable?" is also part of the discussion of chapter three. **Chapter four** provides a brief history of housing in Addis Ababa, discusses the condominium housing project, presents the case studies of selected sites, the analysis and the interpretation of the results, and a comparison of the condominium buildings in terms of how they match up to the concept of

environmentally sustainable buildings. The Bole Gerji, the Feresbet and the Mickey Leland condominium sites are the samples that have been selected for this study. **Chapter five** contains the proposal and suggests ways, based on the research, on what could be done to make the condominium project environmentally sustainable. Finally, in the **sixth chapter**, the conclusion and important recommendations are provided.

### **1.7. LIMITATION OF THE STUDY**

There are several limitations to this study. Firstly, during the interview, the dwellers were careful when answering questions related to the government because it could be perceived as though they were judging the government and could put them in trouble. Another constraint was financial, encountered because of the scattered nature of the sites from one another. One site was on the periphery of the city and the other two sites were in the inner city. Thirdly, Ethiopia does not have a rating system that can be used to evaluate the extent to which a building is environmentally sustainable, thereby allowing a specific environmental sustainable figure to be given at the conclusion of the research.

### **1.8. SIGNIFICANCE OF THE STUDY**

The results of this study will enable stakeholders in the condominium housing project to know how environmentally sustainable the condominium buildings are and to understand ways environmental sustainability can be incorporated in the design and use of the buildings. With the plan to construct 400,000 more condominiums in the next decade, if constructed in a manner that does not have environmentally sustainable features, the toll on the environment would be huge. Hence the importance of knowing how environmentally sustainable the current buildings are so that any changes to be made to future buildings can be known and implemented on future buildings. Secondly, housing being a critical issue and one of interest to the nationals, the government can use the opportunity to present the results of this study as measures that dwellers and the government can work together on to bring about environmental sustainability.

## CHAPTER TWO

### 2. RESEARCH METHODOLOGY

#### 2.1. METHODOLOGY OF THE STUDY

Generally, the research is qualitative in nature and employs related literature review where other countries' experiences and that of Addis Ababa so far in housing and environmental sustainability, are taken as a reference point. Secondly, following the consultation of the different sources, in-depth interviews were conducted. Thirdly, to complement and strengthen the interview and literature review, fieldwork was also carried out to assess and gather relevant data. Finally an analysis of the field work data gathering and interviews was made which led to the proposal based on the findings for environmental sustainability of the condominium housing project.

##### **Selection Criteria for Case Study Sites**

Three sites were purposively (deliberately) selected as case study sites. They were the Bole Gerji Site, the Feresbet Site and the Mickey Leland site. The Bole Gerji was the first site to be opened to the public and the Feresbet site was the most recent site to be opened to the public during the start of the study.

##### *Bole Gerji Site*

The Bole Gerji site was selected for several reasons. Firstly, because it was the first site inaugurated, i.e., to offer services to the public. Secondly, studying it would indicate what environmental sustainable building concepts were considered and implemented in the construction of the condominium units. And finally, because the site had been in use for roughly 10 years since inauguration at the time of the study, the durability of the materials used in the construction would be able to be checked.

##### *Feresbet Site*

The Feresbet site was selected for the following reasons. Firstly, it was the latest of the sites when the research was made and therefore any environmental sustainable building concepts considered and implemented by the government since the inauguration of the Bole Gerji site could be observed. Secondly, the site had once been a horse-riding range, implying that green fields had

once been there. With the construction of the condominium buildings, their footprint would clearly be seen and any forms or methods of replacing the greenery that had once been there to offset the effect the buildings would have on the environment could also be investigated. Finally, the site shows some modifications to the site made by the dwellers after the units were delivered to them.

#### *Mickey Leland Site*

This site was selected because of personal involvement in the construction of the site where the large clearing of a forest to create the space necessary to have the condominiums was personally witnessed. With the knowledge of what had once been there, it would be an ideal site to investigate what positive environmental sustainable measures were being undertaken by the dwellers to compensate for the forest that had once stood there.

#### **Sources of Data and Data Collection Techniques**

Data was collected using three techniques. Primary data was collected using interviews and by observing the sites and taking pictures, while secondary data, which comprises the literature review, was collected by reviewing different research works and texts dealing with the environmental sustainable buildings concept.

#### *Texts on the environmental sustainable buildings concept*

An in-depth study of material describing the environmental sustainable buildings concept and examples of how it has been implemented were consulted to have ideas about how the concept could possibly be adapted to the condominium housing project and will be used in the interpretation of the results.

#### *Interviews*

The interviews were conducted with the condominium unit dwellers. This method was chosen as a primary data collection technique/method mainly because data on several environmental sustainable building concepts, such as indoor air quality and the waste disposal system of the units could only be obtained from the dwellers of the units. In addition, the interviews were conducted in order to check the extent to which the dwellers were aware of environmental issues such as global warming and climate change.

Thirty dwellers from each site were selected randomly and asked twenty-seven 'yes' or 'no' questions with further explanations for those that answered 'yes'. The thirty dwellers chosen from

each site were considered to be a sufficient sample as it was assumed that most would have relatively similar views about the condominiums. The interviews were personally administered to clarify any questions the dwellers had, and were conducted in the dwellers' native language, Amharic.

#### *Site Observations*

Site observations were conducted to gather data on whether any environmental sustainable building concepts had been incorporated in the condominium buildings' construction; whether any environmental sustainable concepts had been initiated by the dwellers; whether the buildings were being utilized according to the plan and to verify the dwellers' answers from the interviews.

#### **Data Validity Assurance**

In order to ensure that the data gathered from the dwellers was concrete, meetings were conducted with the management committee of all three sites. Furthermore, in the interview, in order to verify that the dwellers understood questions, they were given an opportunity to further explain if they answered 'yes' to questions.

## 2.2. ORGANIZATION OF THE THESIS IN FIGURE

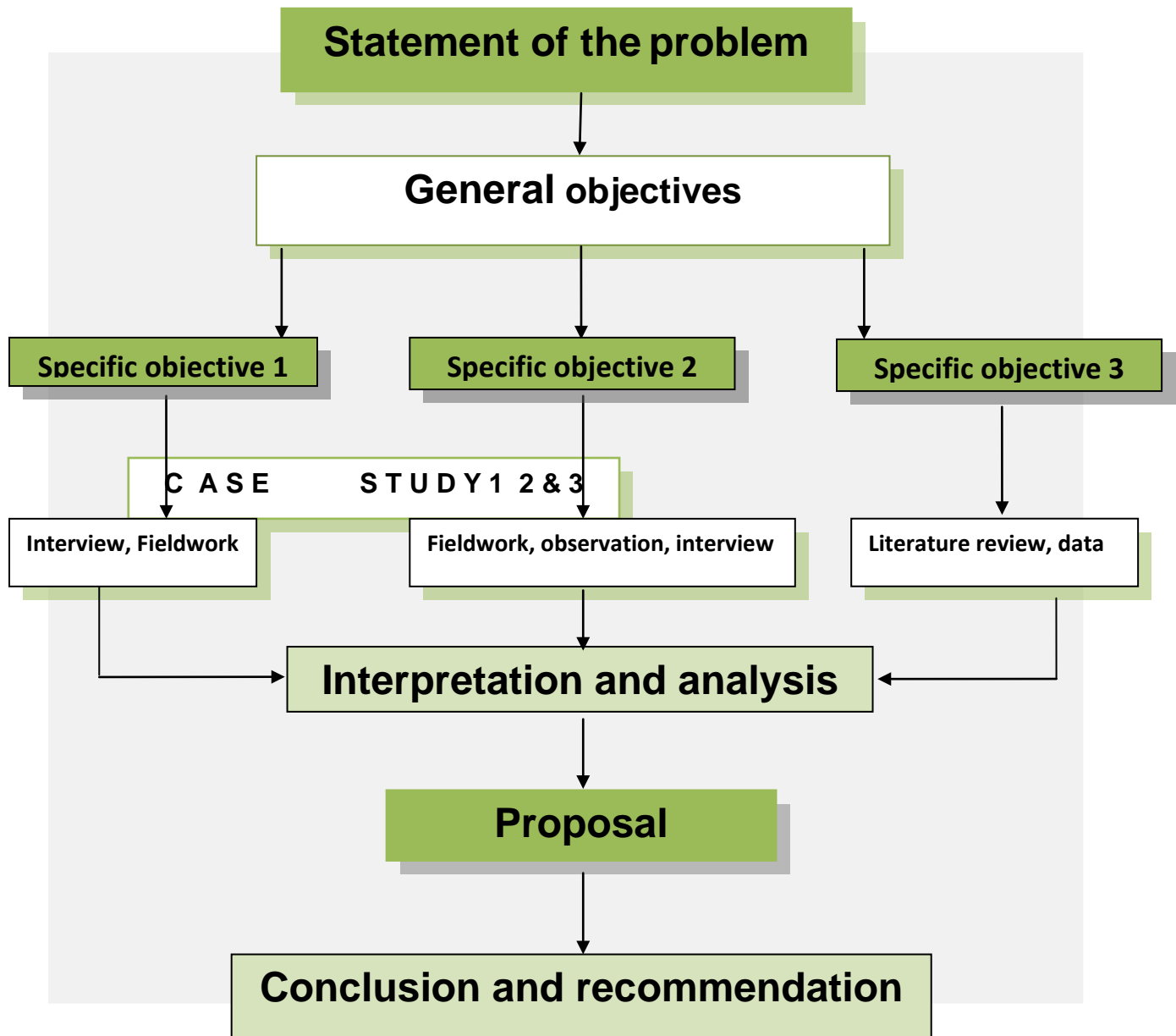


Figure 1: The organization of the study

## CHAPTER THREE

### 3. LITERATURE REVIEW

The literature review focused on what was found out so far on what buildings mean environmentally and in doing so shaped the way environmental consequences of condominium housing project was assessed and solutions were finally suggested.

#### 3.1. SUSTAINABLE DEVELOPMENT

People who are deeply concerned about their community and think carefully about the long-term implications of their actions are working for sustainability and stewardship (Amory Lovins, 2001). In doing so, they mainly focus on the need for economic development to overcome poverty; environment protection of air, soil, and biodiversity, upon which we all ultimately depend; and social justice and culture diversity to enable local communities to express their values in solving these issues (Sachs, 1999). In a plain language, they strongly work on the three sustainable development pillars (i.e. economic, social and environmental the figure below). In making an attempt to deal with environmental sustainability issue, these are the areas that will directly or indirectly be discussed.

Sustainable development can be defined in technical terms as, “a development path along which the maximization of human well-being for today’s generations does not lead to declines in future well-being. And attaining this path requires eliminating those negative externalities that are responsible for natural resource depletion and environmental degradation,” says OECD. It also requires securing those public goods that are essential for economic development to last, such as those provided by well-functioning ecosystems and a healthy environment.



**Figure 2:** *The three pillars of sustainable development (Source: Jin Kim Jong and Brenda Rigdon, (1998)*

### 3.2. ENVIRONMENTAL SUSTAINABILITY

We rely on nature for our existence. The planet provides us with a habitat and there is nowhere for us to escape that is other than the need for natural resources without which survival will be impossible but nature is not opt with unlimited capacity. Our exploitations not only deplete its resources and impact bio diversity but they also endanger our future on the planet through the damage we cause to the atmosphere. The way development is being undertaken right now, we are challenging the natural cycle of oxygen and carbon through carbon emissions, and the development has cost us deforestation. Our demand for natural resources now exceed nature’s regenerative capacity which means we are exploiting nature more than it is replenishing itself. Our reliance on fossil fuels for energy, urbanization and population growth are the main reasons. Keeping up with our demand for natural resources is exerting pressure on the planet and the natural process in maintaining its habitability for humanity. Sustainability is ensuring that our activities in relation to nature do not put to risk the future of the planet in challenging its capacity to renew and heal. In general, this requires measures of reforestation and greening and resorting to clean energy, both to maintain a balance with its regeneration and healing, so that our green house gas emissions will not exceed the planet’s capacity to absorb them. This is known as environmental sustainability (Yudelson, (2007).

**Table 1:** Millennium development goals, goal 7 (Source: [www.undp.org/mdg](http://www.undp.org/mdg))

<b>Goal 7: Ensure environmental sustainability</b>	
<b>Target 9:</b> Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	25. Proportion of land area covered by forest 26. Ratio of area protected to maintain biological diversity to surface area 27. Energy use (kg oil equivalent) per \$1 GDP (PPP) 28. Carbon dioxide emissions (per capita) and consumption of ozone-depleting CFCs (ODP tons) 29. Proportion of population using solid fuels
<b>Target 10:</b> Halve, by 2015, the proportion of people without sustainable access to safe drinking water	30. Proportion of population with sustainable access to an improved water source, urban and rural
<b>Target 11</b> By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers	31. Proportion of urban population with access to improved sanitation 32. Proportion of households with access to secure tenure (owned or rented)

### 3.3. HOUSING AND THE ENVIRONMENT

Buildings are the source of half the world's green house gas emissions making them the largest contributor even more than manufacturing and transportation. Such emissions would increase by 37% by 2030 if actions in making them sustainable are not taken (Yudelso, (2007)

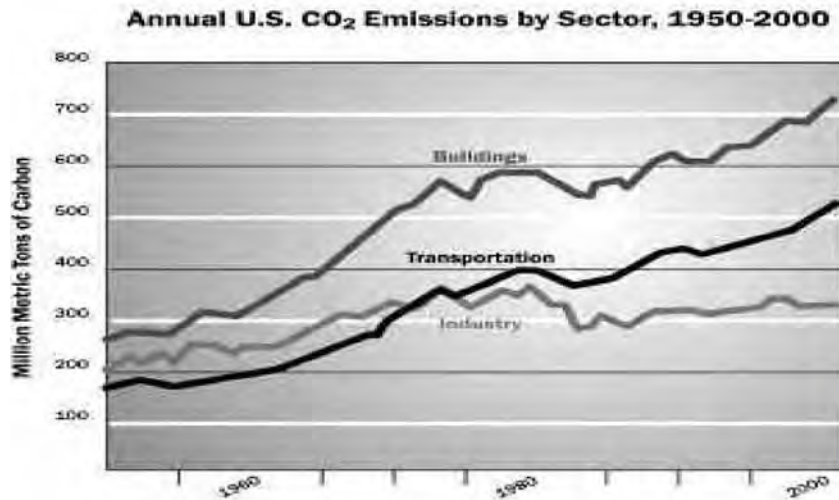


Figure 3: Greenhouse gas emission of buildings, transportation and industry (Source: Yudelso Jerry 2007)

The challenges of the urban environment posed by housing are more pronounced in the developing world. Rapid urbanization, and with it, the large slum areas, deteriorates the urban environment through unplanned and therefore, unsustainable settlements (Emaculate et.al, 2010). Such settlements are characterized by poor water, air and soil quality and lack of access to sanitation, creating a troubled urban environment.

### 3.4. ENVIRONMENTALLY SUSTAINABLE BUILDINGS

Environmentally sustainable buildings are known to have low to none carbon emissions through ways devised to keep them still functional (Yudelso, (2007). This requires resorting to natural measures in heating and cooling; ventilation and day lighting strategies; proper orientation and building shape; placement of glazing; and incorporating natural and clean energy options, such as solar energy and bio fuels in the design of the building (Lauren E Abraham, et. al, 1996). The environmental impact of buildings begins when extraction of raw materials for the construction is undertaken. This is also where the sustainability process should begin. The table below shows how buildings pose challenges to the environment during construction and use:

**Table 2:** *Environmental impact of buildings during construction and use (Source: UNEP environment and construction, 2003)*

• <b>Raw material extraction and consumption; related resource depletion</b>
• <b>Land use change, including clearing of existing flora</b>
• <b>Noise pollution</b>
• <b>Energy use and associated emissions of greenhouse gases</b>
• <b>Other indoor and outdoor emissions</b>
• <b>Aesthetic degradation</b>
• <b>Water use and waste water generation</b>
• <b>Increased transport needs (depending on sitting)</b>
• <b>Various effects of transport of building materials, locally and globally</b>
• <b>Waste generation</b>
• <b>Opportunities for vice</b>
• <b>Disruption of communities, including through inappropriate design and materials</b>

The principle of life cycle design is that the overall carbon emission as a result of the extraction and production of materials needed in the construction of a building, to the energy and resources used and carbon emitted to the air during the construction process should be taken into account (Jin Kim and Rigdon, 1998). The building’s nonrenewable resource and energy conservation during use of the building should also be taken into account so that the building can be considered environmentally sustainable.

**Box 1. Environmentally sustainable building**

The United States Environmental Protection Agency defines ESB as “a practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from sitting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.” (EPA, 2011)

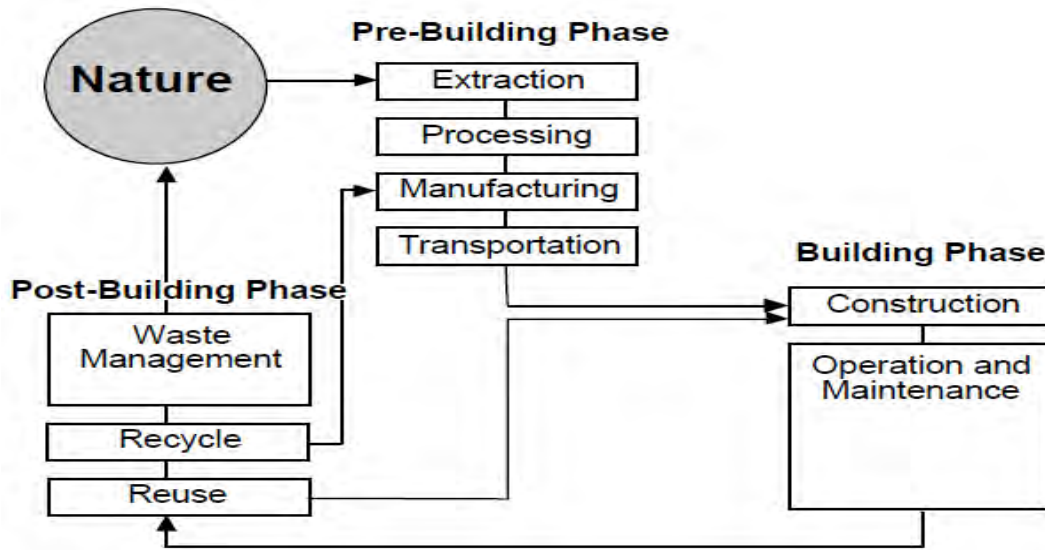


Figure 4: Life cycle of buildings (Source: Jin Kim Jong and Brenda Rigdon, (1998))

### 3.5. COMPONENTS OF ESB

Green buildings are known to have 5 major distinguishing characteristics using LEED method of certification those are ES site development, promote efficient use of water resources, conservation of energy and renewable energy use, conserve building materials and reduce construction waste, and protect and enhance indoor environmental quality (Yudelson, 2007). US EPA adds to those listed above recycling and optimization of operational and maintenance practices under components of ESBs. (EPA, 2011). In general based on the environmental threats and the need to conserve resources and protect natural surrounding the following are agreed up on components of ESBs and they are discussed one by one:

- Optimize Site Potential
- Energy Efficiency and Renewable Energy
- Water Efficiency
- Environmentally Preferable Building Materials
- Recycling
- Waste Reduction
- Indoor Air Quality
- Optimization of operational and maintenances practices

### **3.5.1. OPTIMIZE SITE POTENTIAL**

ES of a building begins with site selection. There are several issues/aspects that should be taken into consideration when selecting a site. These include using a previously used and developed site rather than clearing a new site; exploiting potentials in using renewable and clean energy options; and exploiting naturally cooling, heating and ventilation options. These are factors that should be considered during site selection (Yudelso, 2007).

Other than the more important environmental significance in reduced carbon emission and in saving the non renewable resources such as fossil fuels that could have been used, energy sources that are clean, such as hydroelectric power, solar power, wind power and bio fuel have a long term benefit in being more sustainable. According to Smith, the combustion of fossil fuels and deforestation since the industrial revolution has increased the carbon dioxide concentration in the atmosphere by 26%. Therefore, incorporating the use of renewable sources of energy into the design of a building will lead to energy efficiency and a better environment (Smith, 2005).

### **3.5.2. ENERGY EFFICIENCY AND RENEWABLE ENERGY**

Other than the more important environmental significance in reduced carbon emission and in saving the non renewable resources such as fossil fuels that could have been used, energy sources that are clean, such as hydroelectric power, solar power, wind power and bio fuel have a long term benefit in being more sustainable. According to Smith, the combustion of fossil fuels and deforestation since the industrial revolution has increased the carbon dioxide concentration in the atmosphere by 26%. Therefore, incorporating the use of renewable sources of energy into the design of a building will lead to energy efficiency and a better environment (Smith, 2005).

#### **Box 2. Renewable and non renewable energy**

Renewable resources of energy are those that can be grown or harvested at a rate that exceeds the rate of human consumption. Using these materials is, by definition, sustainable. The wind and the sun are good examples of sources of renewable energy. Currently, non-renewable energy usage is largely and primarily the burning of fossil fuels as a source of energy. This energy is exhaustive and is being exploited at a rate that exceeds its regeneration. Such energy sources are also a prime source of greenhouse gas emissions (Jin Kim and Rigdon, 1998)

### 3.5.3. WATER EFFICIENCY

Another aspect of ESBs is that they are water efficient. As water is a scarce resource, efforts for its conservation are one way of identifying ESBs. Water efficiency also means reduction of the carbon emission that could have been had in the production of the water and also reduced demand for chemicals used to treat potable water. Other measures regarding water efficiency is recycling the used water in the building and using rain water. Measures meant to lessen use of the water using systems that greatly reduce water use could also lead to conservation of the resource (Towers, 2005). Treating waste water and recycling it reusing brings to use the waste water buildings generate other than being disposed off threatening environmental pollution. Gray water a waste water other than from toilet and food wastes (Wudneh, 2009) is treatable at site or could be reused for different purposes such as cleaning, irrigation, floor washing, car washing, gardening, and for construction after treatment.



#### Box 3. Gray water

*"...Water used for washing can be collected from sinks, washing machines, basins, baths and showers. It is then passed through a simple filter to remove any large solid particles, and collected in a tank. Grey water is very suitable for flushing toilets and can be used for other purposes such as watering plants..."*  
(Towers, 2005)

Figure 5: Woman washing clothes at Feresbet, (picture by author)

### 3.5.4. ENVIRONMENTALLY PREFERABLE BUILDING MATERIALS

Another component of ESBs is the use of environmentally preferable building materials (EPBMs), which are characterized by relatively low carbon emissions during production of the materials. Globally, building construction consumes 40% of raw stone, gravel, and sand each year and 25% of the virgin wood raw materials (Lauren E. Abraham, et. al, 1996 p. 25), indicating how much significant reduction in the carbon emissions during production and transportation of these

materials would mean to the environment. The principle of life cycle design encourages recycling materials and reusing materials during demolition/deconstruction. This guarantees reduced carbon emissions and therefore a better environment (Jin Kim and Rigdon, 1998).

### **3.5.5. RECYCLING**

Recycling means “resorting to using materials that could have been disposed of”; in other words, it is conservation of resources and avoiding the carbon emissions that we could have had during extraction and production. To ensure overall reduced carbon emissions and resource conservation the use of recycled materials for construction brings to use materials that could have been disposed off at the same time saving energy and resources. Waste recycling is one way of bringing to use the waste that buildings commonly generate with the same effect of resource and energy conservation (Towers, 2005)

#### **Box 4. Recycling building materials**

The use of recyclable materials is one way for reduced carbon emission of buildings avoiding the carbon that would have been emitted during the extraction of resources and also during the production. The use of recyclable building materials brings to another use demolished buildings lowering the overall carbon emission of buildings. (Jin Kim and Rigdon, 1998)

### **3.5.6. WASTE REDUCTION**

Another quality of ESBs is that during construction materials are used efficiently so that waste is reduced. This is done by using less packaging, using recycled materials and reusing building materials and construction debris on the construction site. These not only reduce waste, but also decrease the need for landfills and conserve resources. A further strategy in reducing waste during the construction of an ESB is using prefabricated materials (Lauren E Abraham, et. al, 1996).

### **3.5.7. INDOOR AIR QUALITY**

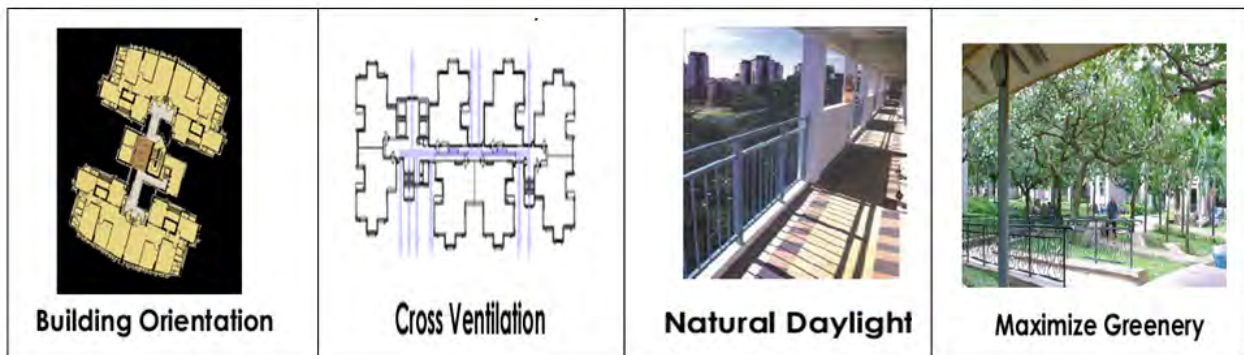
The design and the construction process and building materials used affect the indoor air quality. But other than that the building envelope, ventilation systems, maintenance and occupants are controlling factors that ensure better indoor air quality (Lauren E. Abraham, et. al, 1996).

### 3.5.8. OPTIMIZATION OF OPERATIONAL AND MAINTENANCES PRACTICES

The operation and maintenance cost of a building throughout its life span far exceeds its initial construction and design (Lauren E Abraham, et. al, 1996). ES of the building can only be preserved if operation and maintenance practices in making them sustainable are considered. This requires training of building occupants; using clean products so that no toxic material will be involved that will cause damage to the environment, indoor air quality, conservation of resources, and reusing and recycling.

### 3.6. ENVIRONMENTALLY SUSTAINABLE DESIGN

Sustainable design is one that could bring about a low to none nonrenewable energy use and that conserves resources. In general, ES strategies during construction ensure the health of both the occupants and the environment during the use of the buildings. A high performance building is one that saves at least 50% of the energy use of a standard building (Yudelson, 2007 p. 85). Reducing energy consumption requires utilizing natural site advantages and choices in envelope which will impact cooling and heating and how much we can exploit energy options, such as sunlight or wind.



**Figure 6:** Utilizing natural solutions. (Source: Dr Johnny Wong Liang Heng)

A ventilation system based on the natural movements of air in reducing cooling and heating loads and to ensure indoor air quality, has three components (Towers, 2005):

- air inlets,
- air outlet points and
- an outlet at roof level

Other factors that should be considered in sustainable design are maximum use of natural light and green areas. Green areas is discussed below in case of natural light the building's long axis should be oriented east to west, as this allows maximum sun lighting both from north and south-facing windows (Yudelson, 2007)

### 3.7. THE URBAN HEAT ISLAND EFFECT

The urban heat island effect is the higher temperatures that urban areas experience compared to the surrounding rural areas. As urban areas develop, changes occur in their landscape. Housing complexes, commercial buildings, roads or parking spaces and other infrastructure, replace what was once open land and vegetation. Surfaces that were once permeable and moist become impermeable and dry. These impermeable surfaces absorb heat, which is released back into the atmosphere and which in turn results in the atmospheric temperature of urban areas being higher than outlying areas. During the winter the urban temperature is 5°F to 7°F more than the outlying areas (Yudelson, 2007). Integrating the building with the natural environment through vertical greening and green roofs, reduces the impact the urban heat island effect has.

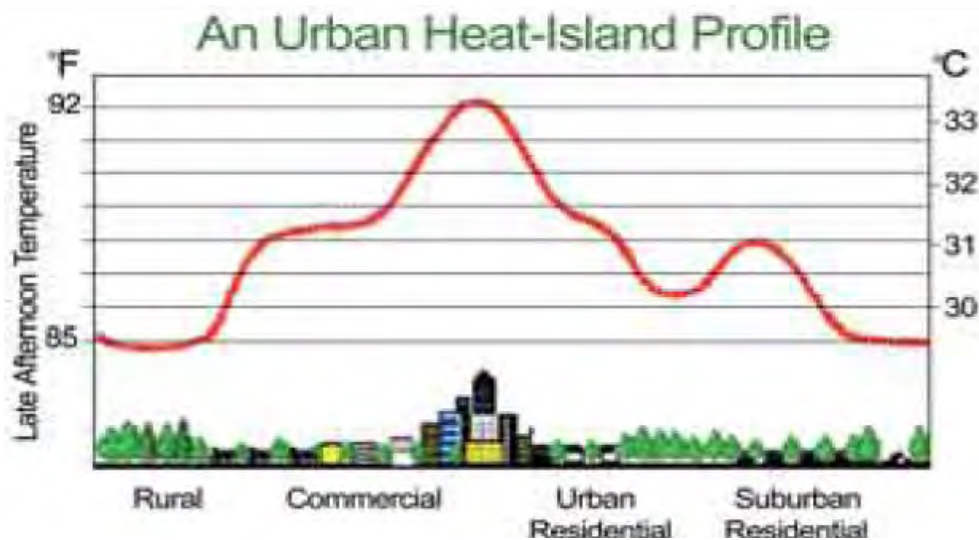


Figure 7: Urban Heat Island Effect (Source: Killingsworth, et al, 2011)

Impacts of UHI effect (Killingsworth, et al, 2011)

- Increased demand for energy for cooling mitigate the resulting high temperature at homes and offices
- Increased air pollution and greenhouse gas emission and Smog as a result of increased use of energy
- Human health effect: excessive heat, increase in temperature and air pollution excessive heat are responsible for death of people more than hurricane, tornados and earth quakes combined
- Decreased water quality: increased water temperature that results from the temperature of the surface that created the run off affects water life

According to US EPA the following measure mitigates the UHI effect (Killingsworth, et al, 2011)

- Material selection for roofs : the use of cool roofs, light colored roofs that reflect sun light
- Material selection for surfaces: replacing dark colored pavements with light colored and heat reflecting materials, using porous surface that allow heat and water to pass through. Using concrete with white cement or any material that gives the surface a light color and reflect heat (pavements make up 40% of the urban landscape)
- The Incorporation of more trees and planting in urban communities: both due to its effect to ease heat increase and as a shade but the urban landscape need to allow a growth of tree roots with porous surface, the evaporation from plants
- The use of solar panel: makes use of the heat and reflects back the rest without absorbing it to gradually release it to the atmosphere

Heat capacity, Thickness, Density, Porosity and Permeability in materials determine the extent of the UHI effect. The thicker the material used for roofing or surface, the more heat it absorbs and releases and porosity and permeability affects if water and heat passes through the ground or the heat increases the temperature and the water hotter now leaves to streams and rivers (Killingsworth, et al, 2011)

### **7.1. Green frame standard**

- Every plot of area upto 150 m sq. should be provided with at least one tree and other tree/s should be provided for every additional 100 m sq. plot area
- Street walkways should be provided with plantation (tree) at every 10 m

### **11. Greenery and Environmental norms and standards**

- One plot one tree for plots of area up to 150 m sq. and 1 tree for every additional 100 m sq. plot area.
- 12-25 % of a plot area should be unsealed (for greenery and natural open space so that rain water should percolate to the ground, decrease water discharge and reduce runoff).
- Green areas of different standards (Neghibourhood-city level) should be provided and developed according to the norms and standards provided in the Social Facilities component.

**Box 5:** *The Addis Ababa structural plan green frame and greenery standards (Source: office for revision of the Addis Ababa master plan, 2002)*

Trees bring different benefits at relatively low cost both in mitigating the UHI effect and other environmental consequences. Trees cool the city, lower energy cost; reduce the amount of flooding, erosion, and pollution. And as a result trees and plants in general are the most effective means to combat UHI effect. (Abof, et al, 2010) The evaporation from the plants has a cooling effect and they serve as a shade protecting the urban surface from absorbing heat. (Abof, et al, 2010). The figure below shows the Addis Ababa structural plan standards regarding trees and greenery in general.

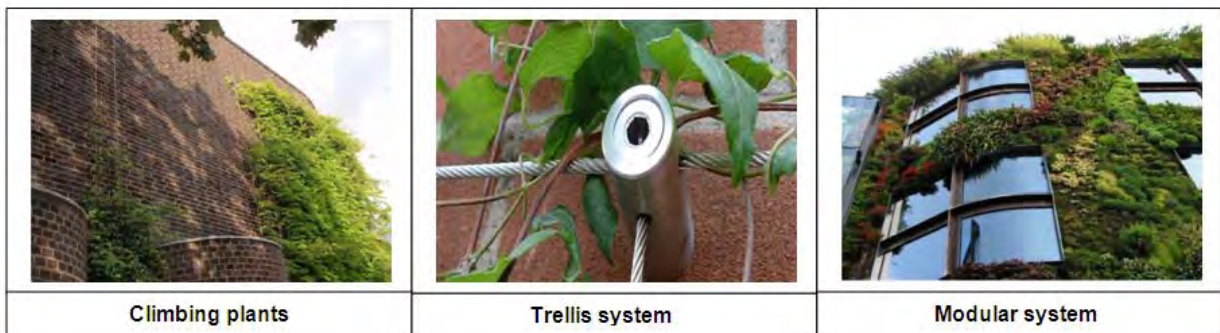
## **3.8. GREEN AREAS**

Green areas provide a natural solution to greenhouse gas emissions and in dealing with global warming. More vegetation means we will be more prepared in absorbing carbon; but housing projects have an impact of destroying the natural environment, emphasizing therefore, the importance of green areas such as space provided for greening, vertical greening and green roofs

### **3.8.1. VERTICAL GREENING**

Vertical greening is the process of replacing a green area that has been lost when erecting buildings. The vegetation on and greening of a side of a building at the façade of each floor, is one way this can be accomplished (Dr Johnny Wong Liang Heng, presentation) and can be used in several ways: as windbreaks, to absorb carbon dioxide and to generate oxygen. If appropriately

integrated into the building structure, it could play a significant role in improving the comfort of the occupants (U.S. Army corps of engineers, et al, 2007). Still, using simple structures buildings could be used for some greening and if it become a culture to save the urban environment from falling into a completely built area. Vegetation plays a role in moderating temperature and its effect can be seen both in the building and in the surrounding area to reduce the urban heat island effect. There are three ways for structural design of vertical greening: Climbing plants with adventitious roots, Trellis system and Modular system. In case of climbing plants with adventitious roots the choice of vegetation is limited to those which can support themselves on the wall. In trellis system plants climb by twining on the curtail effect created through cables attached to the wall. The growing plants and irrigation system as part of the building is supported by the wall through the design of the building devised for the purpose in the modular system (Cheetham, et al, 2012). The figure below is shows vertical greening of each kind in the respective order.



**Figure 8:** *The adventitious, trellis and modular system of vertical greening in their respective order (Source: Cheetham, et al, 2012)*

### 3.8.2. GREEN ROOFS

Turning the roofs of buildings into greening of open space for vegetation could do its part in offsetting the impact the building left on the natural environment that is other than avoiding the heat absorbing effect the building may have. The two types of vegetated roofs are extensive (six inches or shallower) and intensive (more than 6 inches) (U.S. Army corps of engineers, et, al, 2007).



Figure 9: A green roof, Chicago city hall (Source: Killingsworth, et al, 2011)

### 3.9. SUMMARY

Having the knowledge of environmental sustainability (ES) and of what environmental sustainable buildings (ESBs) are and their components along with how they can be implemented, there is direction as to which areas the interviews should focus on. Secondly, knowledge of these concepts can be the criteria for measuring the environmental sustainability of the condominiums or a standard against which the condominiums can be matched against. Furthermore, this compilation of what ES is and what ESBs are will help to give other researchers a picture of what ESBs are and should be like.

## CHAPTER FOUR

### 4. BACKGROUND TO THE ADDIS ABABA CONDOMINIUM HOUSING PROJECTS AND CASE STUDIES

#### 4.1. A BRIEF HISTORY OF HOUSING IN ADDIS ABABA

The Addis Ababa housing crisis began with a large land ownership that amounted 75% of the land by few elites (UN-HABITAT, 2011). Such land ownership and inaccessibility of land by the poor resulted in a housing situation of the city in which more than half of the houses were rental. The insufficiency in local administration and lack policy commitment to address the housing demand led to proliferation of informal settlements (Emaculate et.al, 2010). 1974 brought a change of government in the country in general hopes raised the city's housing condition would change along with the land ownership changes. The government nationalized land and also extra houses the share of the rental housing in the housing market grew to 65%, 93% of them provided by the government. The government lowered rent by 30%. The government became the only body responsible to invest in housing but the low rent made investment on housing unaffordable and the years followed saw the continued deterioration in the city's housing (Yewoinishet, 2007). The market liberalization measures that came with a new government taking power resulted in a dramatic increase in prices of houses and housing became unaffordable (UN-HABITAT, 2011).

Lack of a meaningful involvement for change both by the private sector and the government has made the nationalized houses as extra following the 1974 political change the principal means to address and ease the housing need of the city. Such houses while deteriorated through time they accounted for 70% of the housing stock in the country (Yewoinishet, 2007). The housing stock in general became 80% slum using the UN- habitat definition of slum.

In 2000 the informal housing in the city of Addis Ababa accounted for 60,000 units 20% of the housing stock only 30% of the houses are owner occupied and 53.7% of the rental housing is provided by the government much of it nationalized after the 1974 political change (UN-HABITAT, 2011).

With the informal sector as the largest supplier of housing in the country and 70% of the housing in need of replacement 25% of the housing stock lacked toilet and it is only 38% of the housing that has its own private kitchen and 27% have none. (Daniel et, al, 2010). In addition to its effect on

public health it is the urban environment that has to accommodate such gap between sanitation standards of housing and the existing housing condition besides it is only 3% of the city that have accesses to public sewage system (UN-HABITAT, 2011).

#### 4.1.1. THE ADDIS ABABA CONDOMINIUM HOUSING PROJECT

The chronic housing shortage that is expressed in growing slum, deteriorated urban environment and a large housing backlog and the need for affordable housing and lack of financing finally prompted the intervention of the government through the integrated housing development program (IHDP). The housing backlog in the country was between 900,000 to 1,000,000 when the project was launched and the 70% of the housing stock needed replacement. And 300,000 units were needed in Addis Ababa alone. (UN-HABITAT, 2008).

##### **Box 6. Condominium**

**Individually owned apartment:** an individually owned unit of real estate, especially an apartment or town house, in a building or on land that is owned in common by the owners of the units

**Building containing condominiums:** a building or complex containing condominium apartments or town houses.

Condominium is a joint ownership to be managed commonly by the owners. The Ethiopian condominium proclamation establishes a management body to be elected by the owners. Dwellers owning their own units share ownership of the buildings in general and surrounding property. (The Ethiopian condominium proclamation no. 370/2003) In this study, condominium specifically refers to the housing project under the integrated housing development program

The housing program launched in 2004 by the then mayor of Addis Ababa Arkebe Oqubay started with an ambitious target of MDGs regarding housing: a complete replacement of slum with a construction of portion of the housing gap every year for the next ten years and getting the other portion to be met by the private sector. Ethiopia needs to build 225,000 units for the next 10 years to meet MDGs (UN-HABITAT, 2008). As part of the IHDP the condominium project still underway believed on the way of addressing the housing backlog would also improve the urban environment through planned and formal living areas with minimum standards regarding environmental

protection and sanitation has so far used up a large area both in the city and peripheries and environmental issues are to be raised.



**Figure 10:** *The Condominium buildings, a close look of Jemo site (Source: UN- HABITAT 2011)*

Urban redevelopment efforts in Addis Ababa in recent years have taken densification as an option through the replacement of those old and dilapidated houses with condominium housing typologies as a form of decent housing provision and also fulfilling the vertical densification 'motto' (Addisalem, 2009). The densification is being regarded as a solution for resource and energy conservation through reduced transportation and avoiding urban sprawl which consumes land that could be used for agriculture and greening.

There was no regard for the environment during site selection. Land belongs to the government; as such the government provides land for condominium housing projects in order to cut construction costs. Building sites were randomly selected for the project on open spaces in inner city and some on the peripherals of the city.(Emaculate, et al, 2010).

With regard to sanitation and waste disposal the housing project didn't meet it's intended target of creating a cleaner environment fully due to the ever increasing population in Addis Ababa in search of better opportunities and services the drainage and sewer pipes are frequently busting and blocked because they are failing to cope with increasing pressure. Designers did not consider the size of the pipes in anticipation of the proportion of the number of condominium housing units built with average of.5-8 persons per household (Emaculate, et al, 2010).

#### **4.1.2. EFFORTS BEING MADE FOR ENVIRONMENTAL SUSTAINABILITY THE CONDOMINIUM HOUSING PROJECT**

The United Nations Human Settlements Programme states the following as agreed priorities among the concerned government bodies including the federal environmental protection authority and the Addis Ababa environmental protection authority and NGOs such as clean and green initiatives (UN-HABITAT, 2008):

- Increase coordination and decrease overlap among environmental institutions, NGOs and private corporations.
- Undertake sustainable awareness creation campaign.
- Develop a sanitary landfill site that includes separation of wastes and a hazardous wastes disposal system.
- Enforce Environmental Impact Assessment on any new land use activity.
- An intensive promotion of recycling, composting and biomass creation.
- Establish a system for efficient management of open public spaces, in close collaboration with local governments and the community.
- Create a conducive environment for the participation of the private sector, especially in recycling and waste collection.
- Reforestation on mountain and riversides, expansion and rehabilitation of parks.
- Enforce regulation of noise and air pollutants.

This is in addition to the condominium housing project itself which is meant to solve the housing problem in general and if implemented with a degree the environmental problem demands could improve the urban environment. The united nations human settlements programme says The Addis Ababa Environment Protection Authority (*AAEPA*) is in the process of developing policies, regulations and guidelines specific to the city, and thus currently using several federal policy and regulations(UN-HABITAT, 2008).

## 4.2. SELECTED SITES

Three sites were selected in the study for the environmental sustainability of the condominium housing projects. The figure below shows the selected sites with their locations in the city of Addis Ababa.

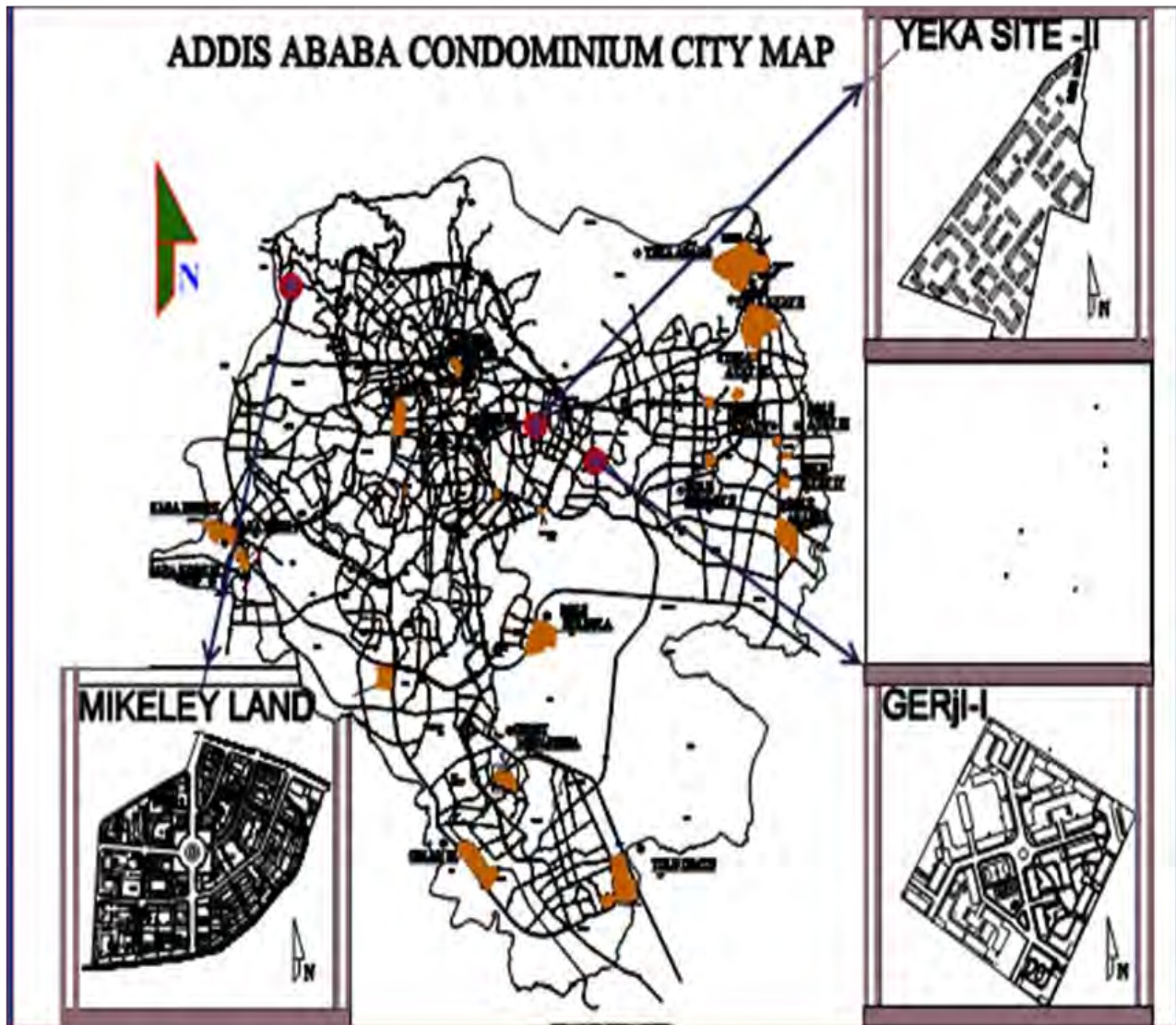


Figure 11: The three selected sites in the map of Addis Ababa (Source: Office of IHDP)

The study focuses on ES of condominium buildings in the ongoing CHPs in Addis Ababa. The housing project launched in 2004 by Arkebe Uqoubay, the Mayor of Addis Ababa, is being built in the inner city and peripheral areas (UN- habitat, 2011). Some have already been distributed to dwellers while others are under construction. The researcher selected three distinct sites in Addis

Ababa as sample case studies that could help us to see the overall picture and progress being made in ES. The sites are: the Bole Gerji condominium site, the Feresbet condominium site and the Mickey Leland site.

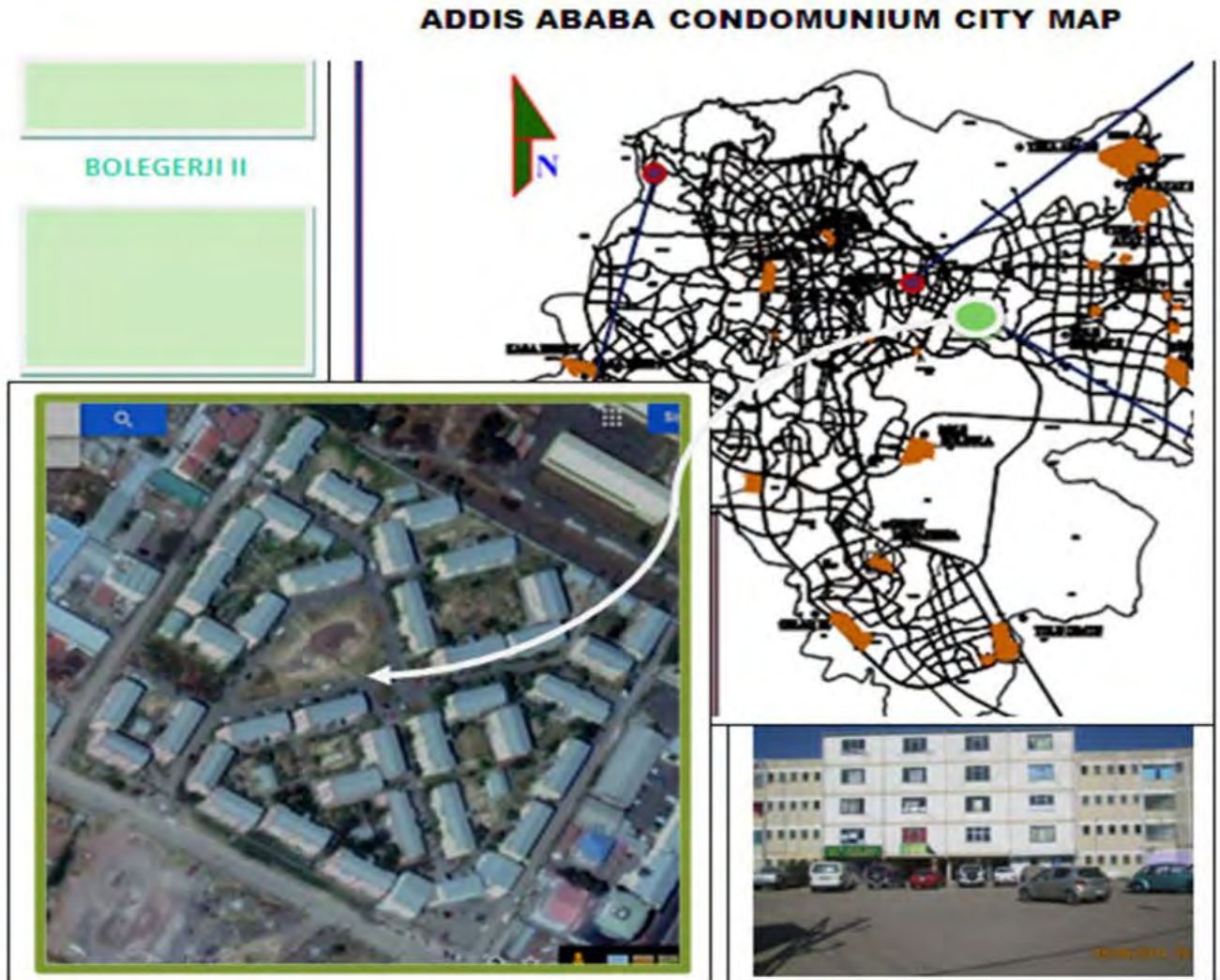


**Figure 12:** Three of the selected sites: the Bole Gerji, Feresbet, Mickey Leland respectively (Source: Google Maps [above]; pictures by author [beneath])

The three sites are dispersed in the city. By studying these three sites, analysis is made as to the environmental consequence the CHPs is having in general; a sample of what is being done for ES; to what extent it is resource and energy efficient; and how much the health and comfort of occupants has been taken into account.

## THE BOLE GERJI CONDOMINIUM PROJECT

The Bole Gerji condominium site was a pilot project for the CHPs, the first to be inaugurated and start to give services. Studying this site could tell us how much ES was taken in to account when the projects began.



**Figure 13:** The Bole Gerji site map and location (Source [from left to right]: Google maps, picture by author)

**Table 3:** The Bole Gerji area household unit and estimated people

BOLE GERJI - I I	Area	Household unit	Estimated people
	45,206 m <sup>2</sup>	700	2,800

## THE FERESBET CONDOMINIUM PROJECT

The Feresbet site was the most recent site at the start of this research. Studying it will show us if any progress was made and how much the government and other stakeholders are moving towards ES.

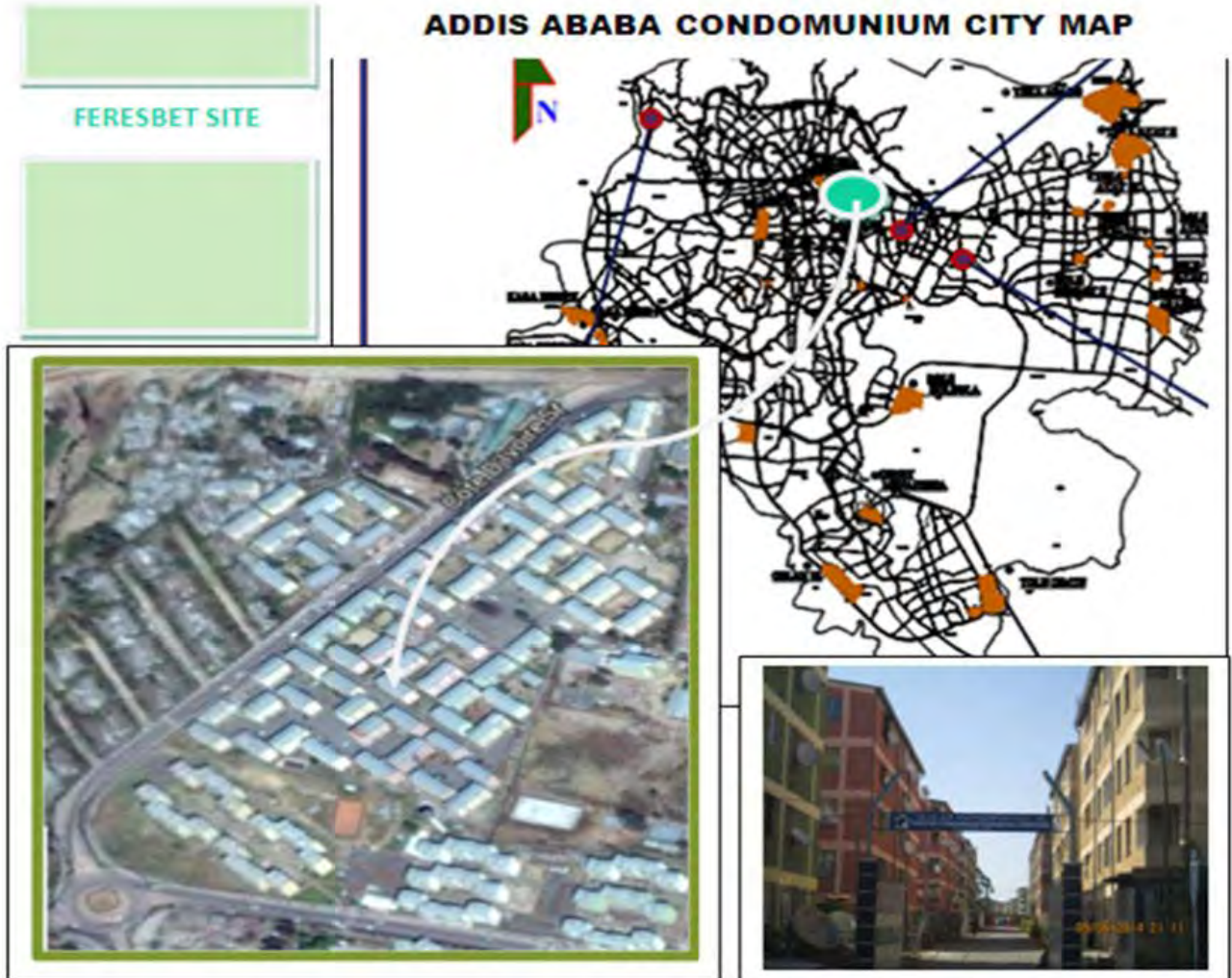


Figure 14: The Feresbet site map and location (Source [from left to right]: Google maps, picture by author)

Table 4: Feresbet site area household unit and estimated people

FERESBET SITE	Area	Household unit	Estimated people
	36,900m <sup>2</sup>	525	2,100

## THE MICKEY LELAND CONDOMINIUM PROJECT

The Mickey Leland site is located on the periphery of the city, and as a participant in the construction, the author witnessed a clearing of a large green area for the project. The study, as a sample, shows how much dwellers understand the impact it had so far on the environment and what measures have been taken in mitigating its effect.

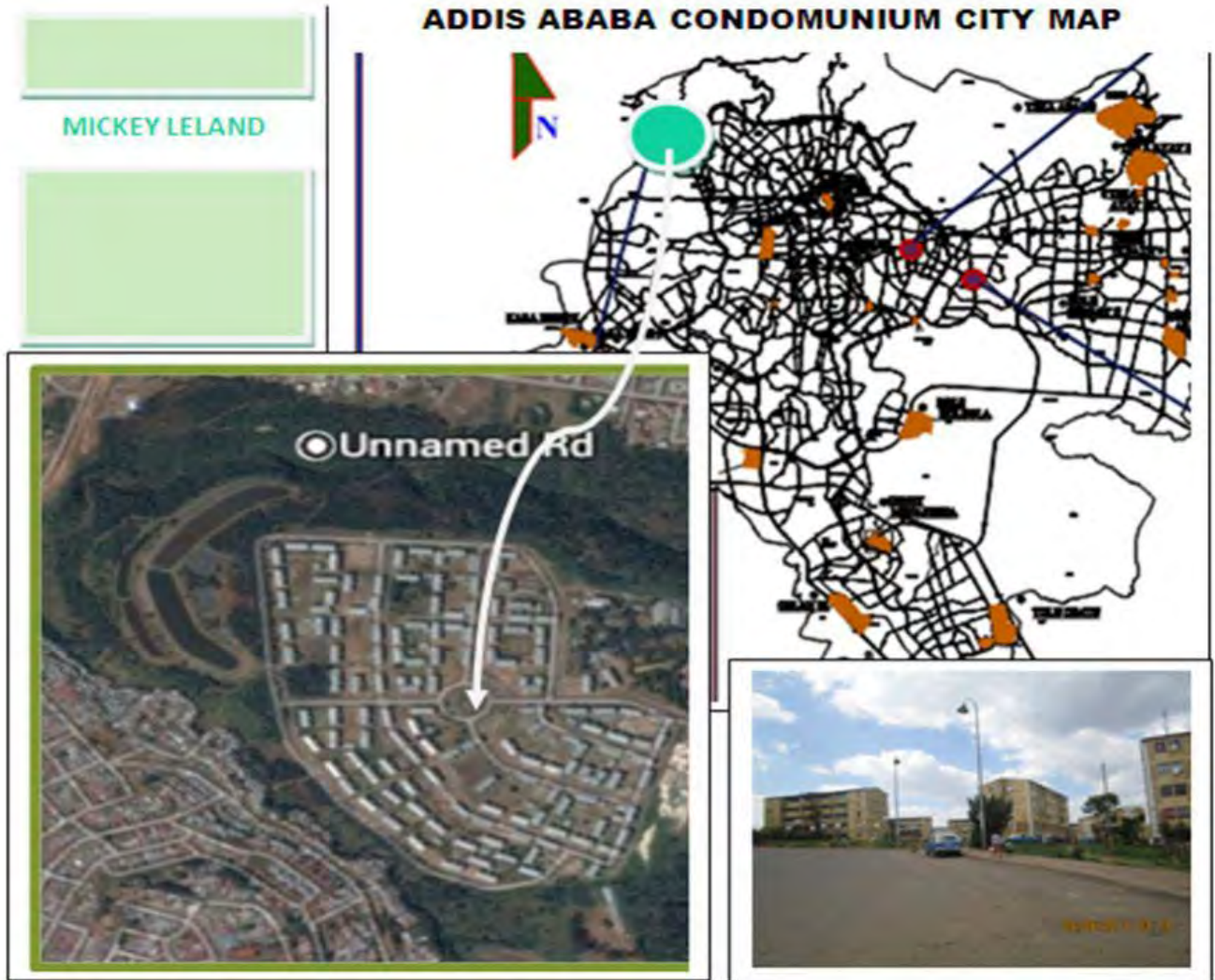


Figure 15: Mickey Leland site map and location (Source [from left to right]: Google maps, picture by author)

Table 5: Mickey Leland site area household unit and estimated people

MICKEY LELAND	Area	Household unit	Estimated people
	273,990m <sup>2</sup>	4,657	18,616

### 4.3. DATA GATHERING AND ANALYSIS

In the study of the ES of the Addis Ababa CBs, during both construction and use, 30 dwellers from each of the three sites – the Bole Gerji site, Feresbet site and Mickey Leland site – were interviewed. The questions were meant to identify what improvements needed to be made to the design of the buildings; how aware of climate change and global warming the dwellers were; and their consciousness of the consequences of their actions and lifestyle. The questions presented, range from what their educational level was, if they are participating in any environmental protection activity, to if they had any energy and resource conservation mechanisms such as, recycling and renewable/clean energy use, their comments on the construction materials used during construction and if they thought there had been a wasteful uses of resources. The findings are indicated as follows.

#### 4.3.1. FAMILY SIZE

The proportions for family size at each condominium site studied are as shown in the figures below. The average family size at the condominiums is 4.

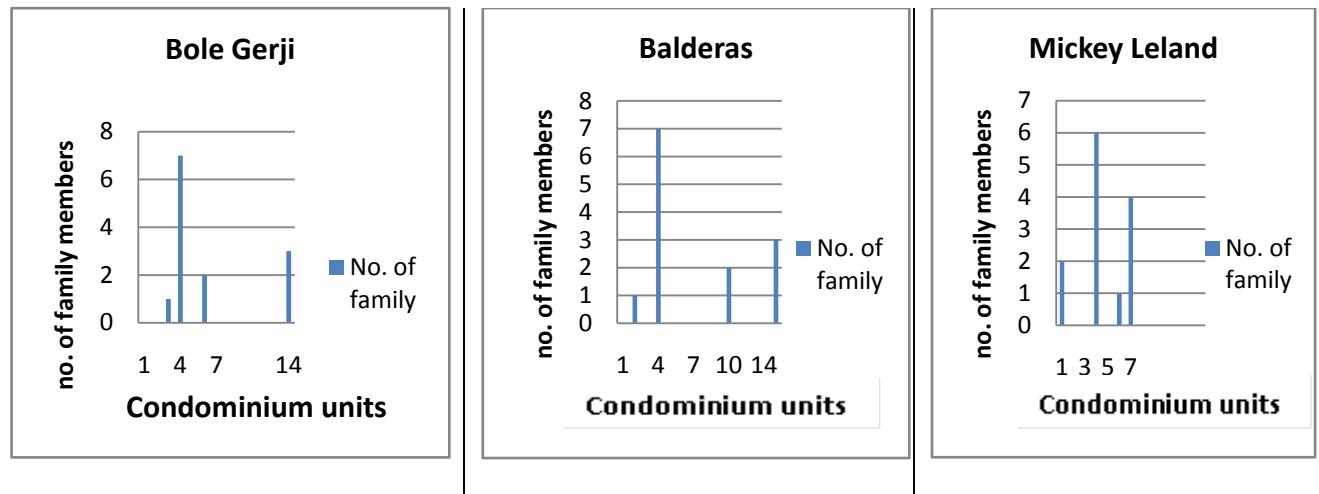


Figure 16: Family size proportions per unit

Table 6: Average family size at the condominiums

Site	Bole Gerji	Feresbet	Mickey Leland	Total average
Average family size	4	4.3	3.45	4

#### 4.3.2. OWNERSHIP TITLE

27% of the dwellers interviewed at the Bole Gerji site were renters, while the remaining 73% were owners of the units of the CBs. 30% of the dwellers interviewed at the Feresbet site were renters, while the remaining 70% were owners of the units of the CBs. 35% of the dwellers interviewed at the Mickey Leland site were renters, while the remaining 65% were owners of the units of the CBs. The average for the three condominium sites studied is 30%.

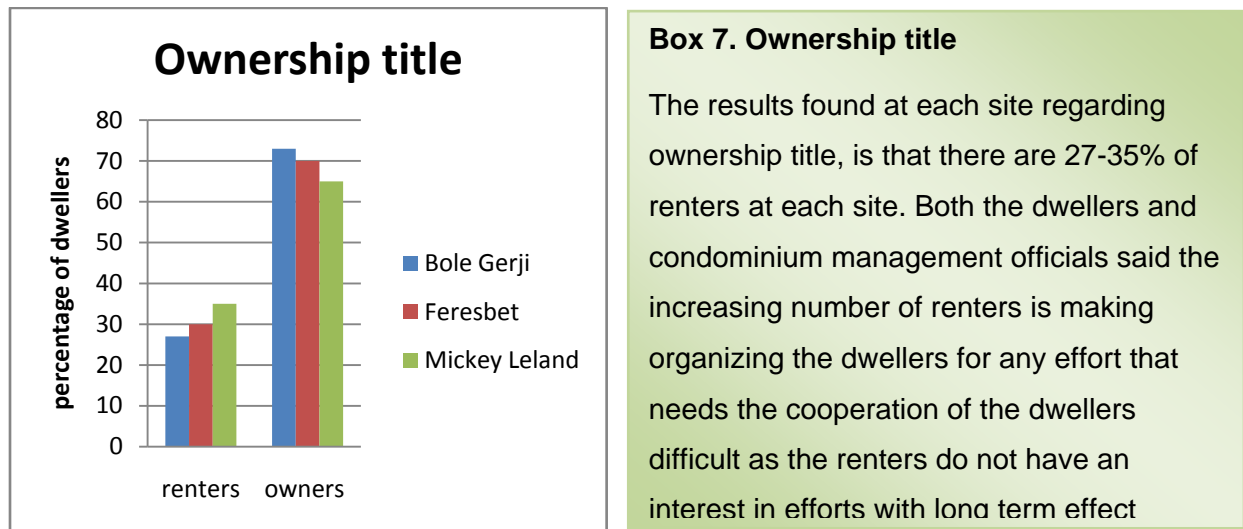


Figure 17: Ownership title

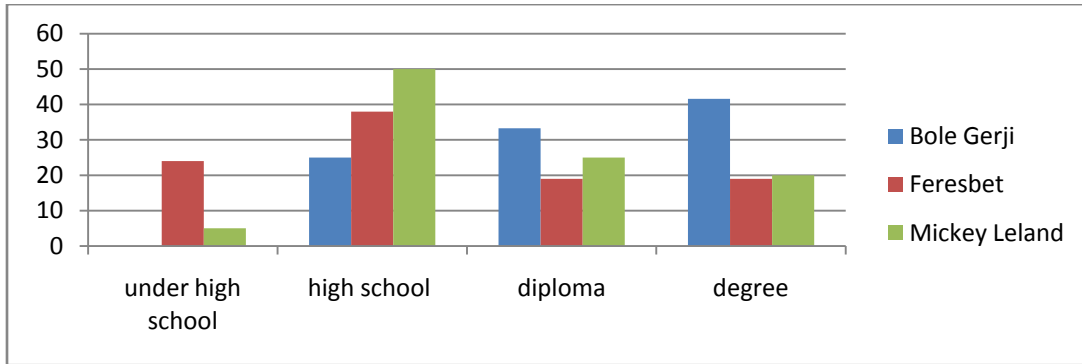
Table 7: Average ownership title

Site	Bole Gerji		Feresbet		Mickey Leland		Average	
	percentage	number	percentage	number	percentage	number	percentage	number
Renters	27%	8	30%	9	35%	11	30%	9
Owner	73%	22	70%	21	65%	19	70%	21

From the ninety dwellers interviewed, 27 of them are renters and the remaining 63 are owners. This shows that on average therefore, 30% of the dwellers interviewed at all three sites are renters and 70% are owners.

### 4.3.3. EDUCATION LEVEL AND AWARENESS

Findings regarding educations level were divided into four: didn't complete high school, high school, some certificate after high school and first degree and above.



**Figure 18:** The percentage of the dwellers of condominium buildings in educational level

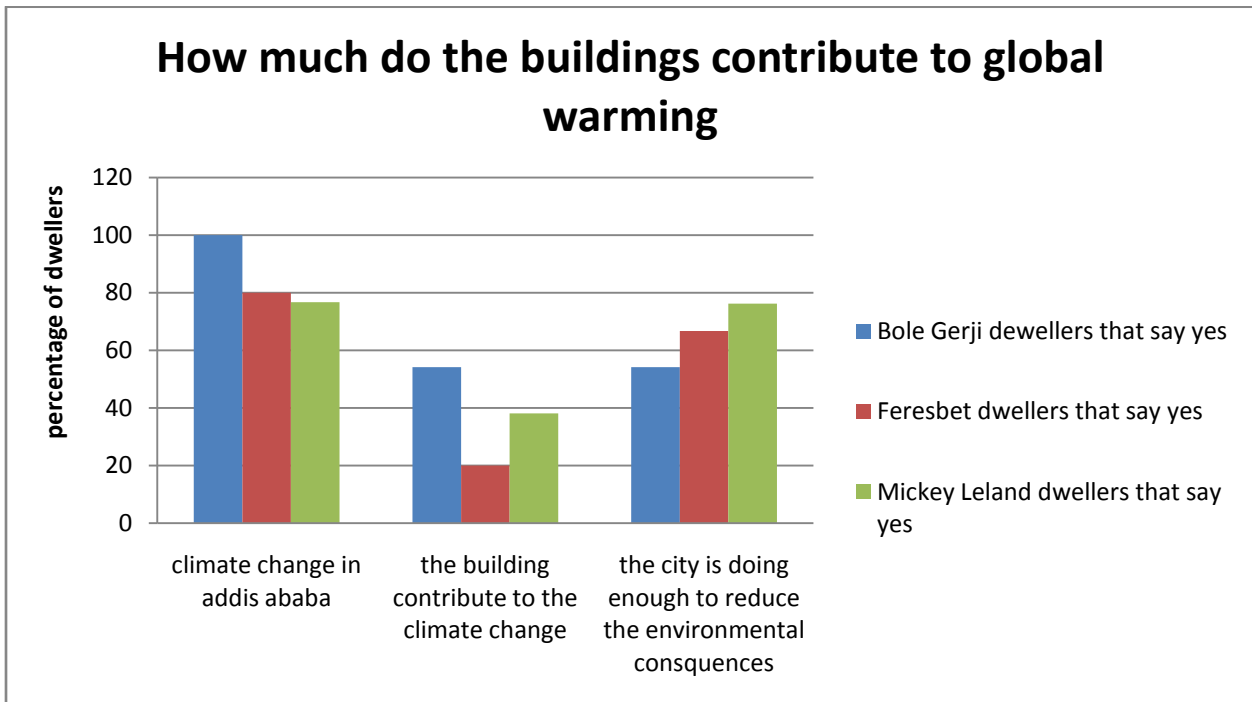
**Table 8:** Average educational level

Sites Unit	Bole Gerji		Feresbet		Mickey Leland		Average	
	percentage	number	percentage	number	percentage	number	percentage	number
Under high school	0%	0	24%	7	5%	2	9.6%	3
High school	25%	8	38%	11	50%	15	37.6%	11
Some certificate after high school	34%	10	19%	6	25%	7	25.7%	8
First degree and above	41 %	12	19%	6	20%	6	26.8	8

From the total 90 dwellers interviewed from all three sites, 9 did not complete high school, while 34 had. 23 have acquired some kind of diploma or certificate after high school and 24 have earned a first degree or more.

#### 4.3.4. DO THE CONDOMINIUM BUILDINGS CONTRIBUTE TO GLOBAL WARMING AND CLIMATE CHANGE?

Majority of the dwellers interviewed agree that we are noticing climate change in Addis Ababa. The figures are shown on the table below:



**Figure 19:** A chart showing the replies of the dwellers to the question do the condominium buildings contribute to climate change

**Table 9:** Replies given to questions presented to dwellers regarding their view on the environmental sustainability of the condominium project

Questions presented	Bole Gerji		Feresbet		Mickey Leland		Average	
	percentage	number	percentage	number	percentage	number	percentage	number
Do you think there is climate change in Addis Ababa	100%	30	80%	24	76.72%	23	85.5%	25
Do you think buildings contribute to climate change?	54.16%	16	20%	6	38.1%	11	37.42%	11
Do you think the city is doing enough to reduce the environmental consequences	54.16%	16	66.7%	20	76.2%	23	65.6	20

From the 90 dwellers interviewed, 77 believed that there is climate change in Addis Ababa. Furthermore, 33 of them believed the buildings contributed to this effect and 59 believed the government was not doing enough to reduce the environmental consequences.

#### 4.3.5. DISCOMFORTS IN THE HOUSE

Odor and leakages were frequently mentioned reasons for discomfort at the condominiums. The figure below shows the percentage of dwellers such discomforts affect

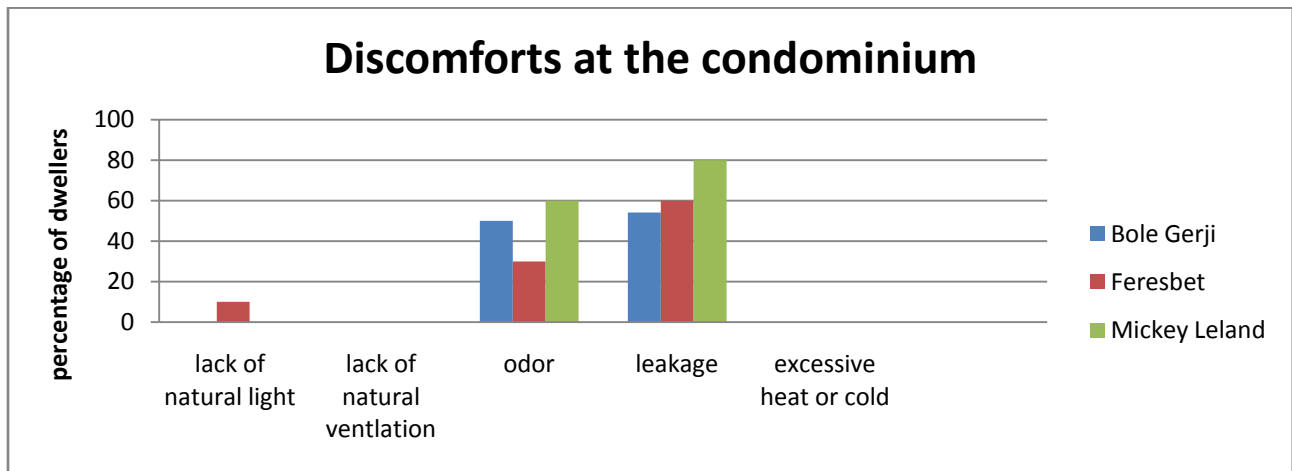


Figure 20: Dwellers mentioning discomforts at condominium

Table 10: Discomforts in the house

Sites	Bole Gerji		Feresbet		Mickey Leland		Average	
	percentage	number	percentage	number	percentage	number	percentage	number
Lack of ventilation	0%	0	0%	0	0%	0	0%	0
Odor	50%	15	30%	9	60%	18	46.6%	14
Leakages	54%	16	60%	18	80%	24	64.6%	19
Excessive heat or cold	0%	0	0%	0	0%	0	0%	0
Respiratory diseases	0%	0	0%	0	0%	0	0%	0

With questions related to any discomforts experienced at the condominiums, none of the dwellers interviewed complained about lack of ventilation, excessive heat or cold and respiratory diseases. But 42 and 58 of them complained about odor and leakages respectively.



Figure 21: A sealed sewage line and leakages in one of the units of the condominium (pictures by author)

#### 4.3.6. WASTE DISPOSAL

Dwellers approve of the door to door waste collection system, but there was also nothing of taking initiative either by the government or management of the condominiums or providing any kind of materials or means that helps in recycling and reusing such as in separating the waste that could be recycled or reused.



Figure 22: Dwellers rating of the Addis Ababa waste collection and a waste collection at Feresbet (pictures by author)

**Table 11: Dwellers rating of waste disposal and collection system**

Site	Bole Gerji		Feresbet		Mickey Leland		Average	
Unit	percentage	number	percentage	number	percentage	number	percentage	number
Approval of Addis Ababa waste disposal system	37.5%	11	30%	9	50%	15	39.7%	12
The Door to door collection system	83.4%	25	70%	21	90%	27	81%	24

**Box 7. ES as a matter of common interest**

Dwellers at the condominiums use greening as something to do in a spare time. Taking greening as a hobby could come from the view one may have of a plant in the fight against global warming but the dispersed endeavors don't suggest that is the goal. Some dwellers say they don't even have a plan in taking part as it is not organized. But common ownership areas are not limited to the green and open spaces and any ES endeavor could be a matter of common interest but the dwellers at this point don't use any natural energy options or resource conservation mechanisms

**4.3.7. MEASURES THE DWELLERS TAKE**

The table below shows ES measures by dwellers

**Table 12: Measures dwellers have taken after occupation**

Sites	Bole Gerji		Feresbet		Mickey Leland		Average	
Unit	percentage	number	percentage	number	percentage	number	percentage	number
Water conservation mechanisms	0%	0	0%	0	0%	0	0%	0
Store rainwater	0%	0	0%	0	46.6%	14	15%	5
Clean and renewable energy	0%	0	0%	0	0%	0	0%	0
Plantation	50%	15	26.31%	8	46.6%	14	40.4%	12
Recycling	0%	0	0%	0	0%	0	0%	0

From the 90 dwellers interviewed, only 14, all of them from the Mickey Leland site, store rainwater. But from all three sites, 37 of the interviewees engaged in plantation of some kind.

#### 4.3.8. RESOURCE UTILIZATION

On average, the thirty dwellers interviewed at the Bole Gerji site, used to pay 39.12 birr for water before they started living in the condominiums. However, they are now paying 41.13 birr on average. Similarly, electricity consumption has increased on average from 83.5 birr per household to 116.5 birr on average. On average, the thirty dwellers interviewed at the Feresbet condominium site used to pay 26.70 birr for water consumption but now pay 31.90 birr. Likewise, on average they used to pay 40 birr for electricity before moving to the condominiums but now pay on average 78.31 birr. Finally, the dwellers at the Mickey Leland, who on average used to pay 14.33 birr for water and 44.73 for electricity, now pay 22.8 birr and 74.17 birr water and electricity respectively. In general, as shown in the table below, the condominium dwellers expenditure on water and electricity utilities have increased by 33.6% and 63.23% respectively.

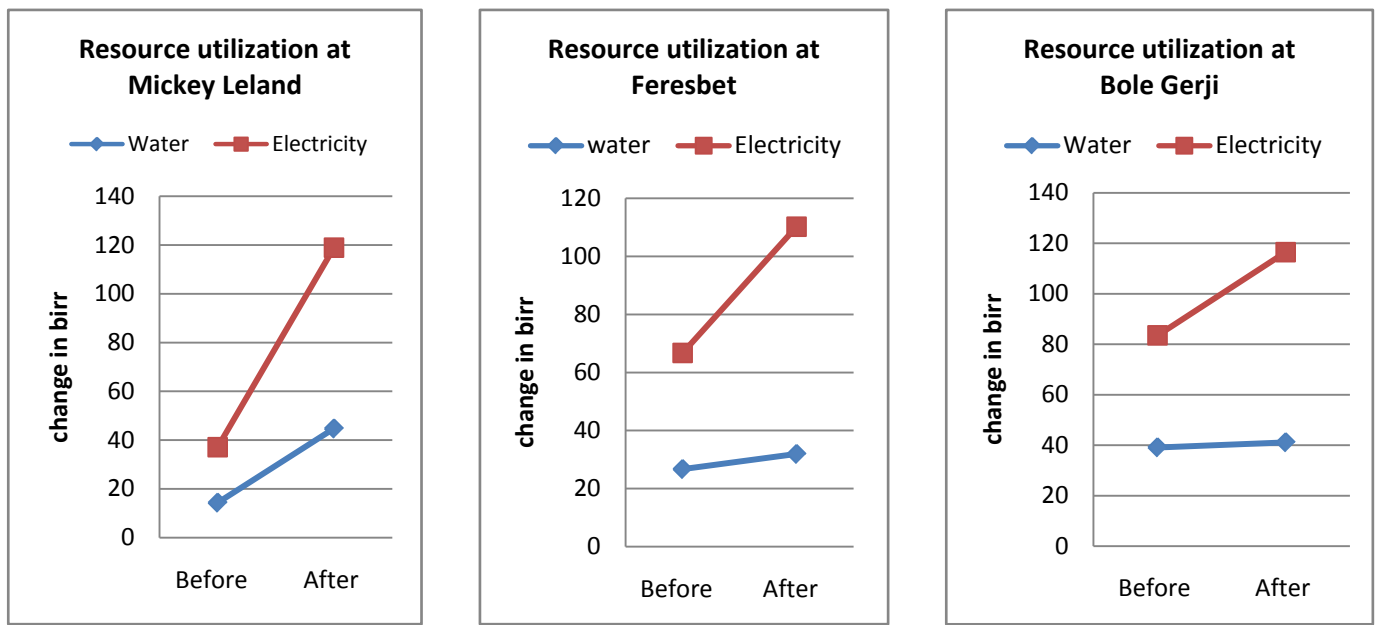


Figure 23: Change in utility fee at Bole Gerji, Feresbet, and Mickey Leland

Table 13: Change in utility fee

Sites	Bole Gerji		Feresbet		Mickey Leland		Average		Difference (%)
	before	after	before	after	before	after	before	after	
Electricity fee	83.50	116.5	40.00	78.31	44.73	74.17	56.07	89.66	33.59
Water fee	39.12	41.13	26.70	31.90	14.30	22.80	26.70	31.93	19.23

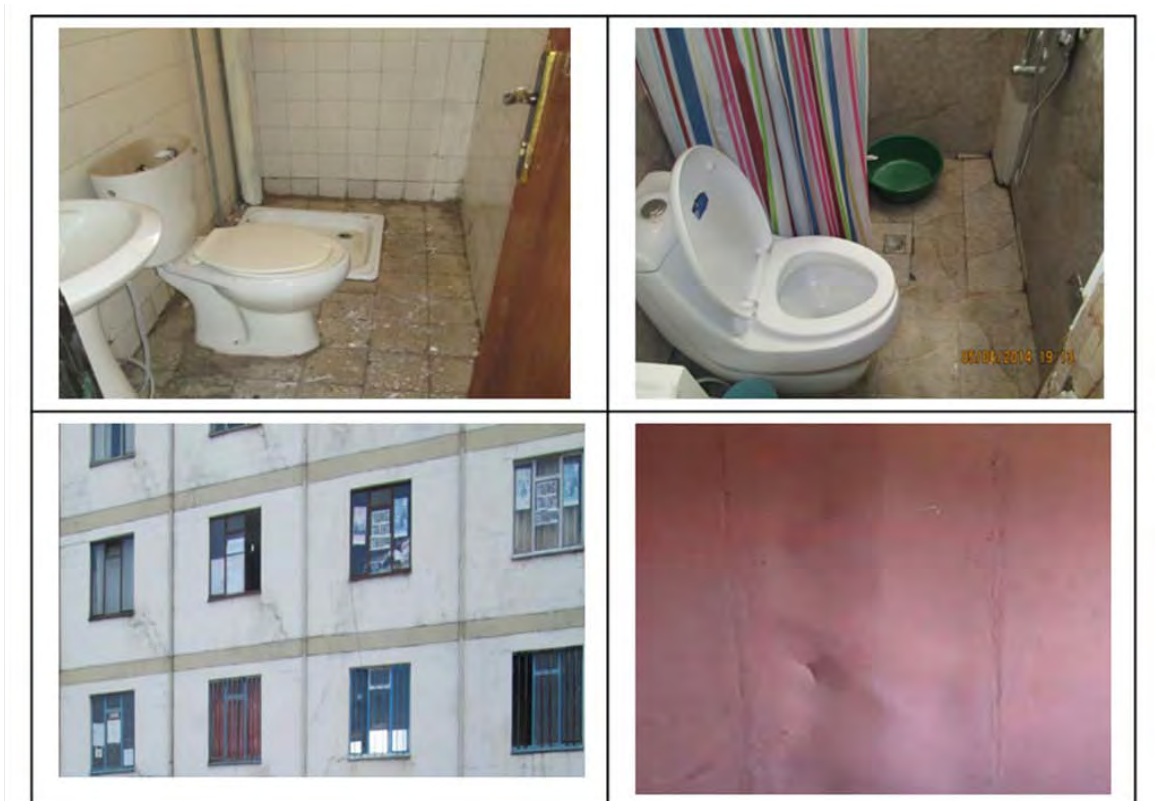
#### 4.3.9. COMMENTS ON BUILDING MATERIALS USED

The comments the dwellers gave on materials used during the construction of the CBs were divided into three parts: building materials used for the construction of the condominiums, sewage line defects and comments given on accessories and fixtures.

**Table 14:** *Comments on building materials*

Sites	Bole Gerji		Feresbet		Mickey Leland		Average	
	percentage	number	percentage	number	percentage	number	percentage	number
Material deterioration	41.6%	12	35%	10	100%	30	58.86%	18
Sewage line defects	54.16%	16	15%	5	2%	1	23.72%	7
Low quality accessories or fixtures	66.6%	20	30%	9	70%	21	55.53%	17

From the 90 dwellers interviewed, 52 of them believed the building materials were deteriorating, 21 of them reported sewage line defects and 50 of them believed the condominium project used low quality accessories and fixtures.



**Figure 24:** *Changes dwellers made to building materials [above] and cracking walls [beneath] (pictures by author)*

## 4.4. INTERPRETATION AND ANALYSIS OF THE RESULTS OF THE CASE STUDY

### 4.4.1. PECULIAR FEATURES OF THE STUDIED CONDOMINIUM SITES

#### The Bole Gerji condominium site

The Bole Gerji condominium site has a green view but dwellers say it is the result of their personal effort and that it is not organized. The Bole Gerji CBs were built on farmland.



**Figure 25:** *The Bole Gerji condominium site gate (picture by author)*

Dwellers of the site give reasons for any inaction regarding ES:

- The condominium life has made communication among the dwellers difficult and
- The increasing number of renters, whom it was claimed, does not consider the site as their own and so lack the motivation to get involved in improvements with a long term effect.

With more than 350 cars at this site, the management of the site addressed the need for parking space in several ways. Firstly, only 350 are allowed on the site. Secondly, each car is allocated a parking area around a playing field in the site with their plate number. Thirdly, by building a curbstone around the field, cars are discouraged from parking on the grass field and this has saved open areas for a play ground and greening. Furthermore, late comers that do not have a reserved parking space can park at the gate.



**Figure 26:** *The Bole Gerji parking area around square reserved for play ground (pictures by author)*

### **The Feresbet condominium site**

The Feresbet is the site with smaller green spaces. The entire site is covered with cobble stone as shown in the picture, with nothing spared for greening or a children's playground. This was done to attract renters with cars to the site, which is attractive because of its proximity to the city centre. The Feresbet site was once a horse riding field that covered with vegetation. Dwellers raise lack of space and increasing number of renters as an obstacle for ES

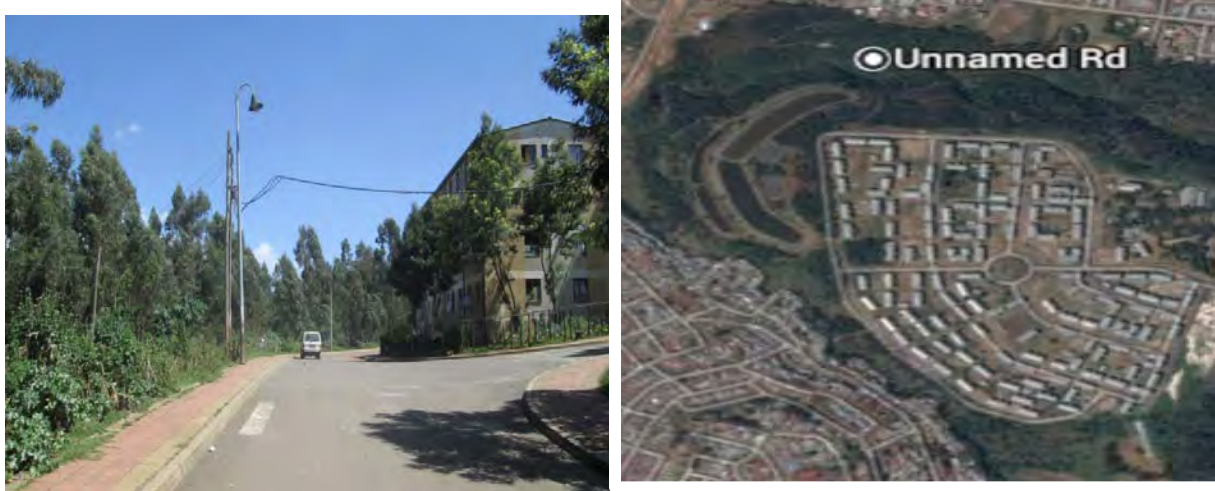


**Figure 27:** *The Balderas condominium site (picture by author)*

### **. The Mickey Leland condominium site**

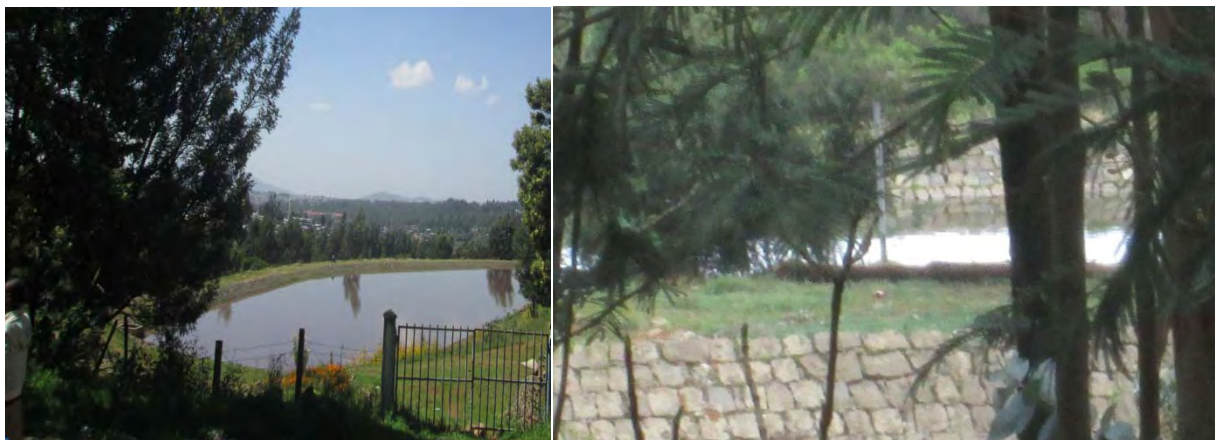
From the three sites studied, the Mickey Leland site is the one situated on the periphery of the city. And it is the site with more open and green spaces than the other sites. Open spaces in the compound have been changed into places where the dwellers dry washed clothes. All of the blocks at the Mickey Leland condominium have rooms reserved for commercial use at their ground

floors. Most have been changed to cafes and shops. It has an internal asphalt road and built pedestrian ways. A large forest was cleared to build it.



**Figure 28:** A view from the streets at the Mickey Leland condominium site and the site map on the side (Source: pictures by author [left]; Google Maps [right])

There is a place that looks like an artificial lake just adjacent to the compound of the condominium, into which waste from the toilets of the entire compound that flow through the sewage lines accumulates. The dwellers mention that this is a major source of bad odor in the compound. The dwellers, particularly those that live on the block closer to the site, mention that they try to avoid the odor while in their units by closing windows and doors. The figure below shows a water treatment facility at the Mickey Leland site:



**Figure 29:** A water treatment facility at the Mickey Leland site (pictures by author)

Currently, the Addis Ababa water authority is responsible for the facility and its employees say an association of around 32 people now uses the water from the facility for agriculture.

#### **4.4.2. THE STUDIED CONDOMINIUM SITES AGAINST COMPONENTS OF ENVIRONMENTALLY SUSTAINABLE BUILDINGS**

##### **A. Site Selection**

As mentioned in the literature review, an ESB is one in which the site chosen is a previously used or developed site and not a new one in which there has to be clearing. All three of the case study sites, the Bole Gerji, the Feresbet and the Mickey Leland, were built by clearing a green area. The Bole Gerji was once farmland; the Feresbet site was once a horse riding field; and the Mickey Leland was once a forest.

##### **B. Energy Efficiency and Renewable Energy**

One component of ESBs is the quality of being energy efficient and of using renewable energy such as hydroelectric power, solar energy, wind power and bio fuel. All three of the condominium sites are powered by hydroelectric power. No other source of renewable energy is used. However, since moving to the site, dwellers report that their spendings on utilities, electricity being one, have increased.

##### **C. Water Efficiency**

Another feature ESBs possess is water efficiency, meaning that the quantity of water used is reduced, that water is recycled, reused and stored and that rain water is collected. Only in one of the sites do nearly half of the people interviewed store rain water. At the other two sites, rain water is not stored. Furthermore, water is recycled at only one of the sites – the Mickey Leland.

##### **D. Environmentally Preferable Building Materials**

EPBMs, another feature of ESBs, are those that have low carbon emissions during their production. One way of including them in the construction of a building is by using precast materials. Precast materials were used in the construction for all the condominiums at all three sites.

A complaint that building materials, particularly fixtures and accessories, were not of proper quality was common at the three condominiums studied and among the dwellers. Dwellers of the Mickey

Leland condominium site say it is less costly to use the more expensive products and saves the time and other costs that using cheap and low quality products bring.

### **E. Recycling**

Recycling is another way to make buildings ES, beginning from the construction. It involves reusing building materials and utilizing everyday waste such as dry waste in order to put a check on pollution and as also a way in using the opportunity for resource conservation. It was found that the material used to partition the units, has some recycled components. However, the dwellers at all three sites do not see waste as something useful and so do not make efforts to recycle it.

### **F. Waste Reduction**

This ESB feature has to do with reducing the waste generated during the construction stage by using less packaging; by recycling; by reusing building materials; and by using prefabricated materials. As has been mentioned, prefabricated or precast materials were used in the construction of the buildings at all three sites.

### **G. Indoor Air Quality**

This quality of ESBs states that the building materials used affect indoor air quality. Ventilation systems and maintenance are factors that control this aspect. At all three sites, it was noted the number of windows were not enough to allow for sufficient natural lighting or air. Furthermore, at all three sites, bad odors, a lot of which came from leakages of pipes in bathrooms and toilets and pipes that passed through their houses, were complained about, indicating that the pipes were not properly bonded together. These pipes are also reported to sometimes explode. At the Mickey Leland site in particular, other than toilet pipes, the water treatment facility was a major source of bad odor.

This odor was the result of a combination of factors such as unavailability of water at the time they needed it, particularly at Mickey Leland site and Bole Gerji site, and leakages from the sewage and pipe lines that passed through their house, maintenance of which is a common task for the condominium's management. These sewage lines at times explode, and it is a common occurrence. But the dwellers don't mention lack of ventilation. They say their houses get enough air. The picture below is from a condominium unit at Feres bet condominium.

## **H. Optimization of Operational And Maintenances Practices**

ES of the building can only be preserved if operation and maintenance practices in making them sustainable are considered. The main issue under this feature of ESBs is that occupants of the building should be given trainings that will help they themselves to carry out maintenance that is environmentally friendly. At the three sites, no dweller reported that they had been given trainings. However, fixing leakages of pipes, which should be carried out by condominium management officials are carried out by the dwellers themselves.

No training was provided or environmental sustainability is being considered in the communities up keep and use of the condominium sites. The Mickey Leland site raises financial constraints as a reason for the failure to make efforts organized at the site level and at the same time remind that with the exception of the land allocated for parking, play ground and greening the rest belongs to the government.

### **4.4.3. THE STUDIED CONDOMINIUM SITES AGAINST COMPONENTS OF ENVIRONMENTALLY SUSTAINABLE DESIGN**

#### **I. Green Areas**

Under this feature of ESD, the importance is in having a natural solution to dealing with greenhouse gases emission and in dealing with to global warming which can be accomplished by having green areas because they will absorb the carbon. As has been mentioned, the Bole Gerji site has a field that is protected from being used as a parking area for cars by a curb. At the Feresbet, green spaces are limited to the fronts of units, while the majority of the site has been covered with cobble stone. At the Mickey Leland site, there are many green areas.

#### **J. Vertical Greening**

Vertical greening is the process of replacing a green area that has been lost when erecting buildings. This feature of ESD can be implemented by greening the side of a building.



**Figure 30:** *Greening on building at Feresbet condominium (pictures by author)*

The Mickey Leland and the Bole Gerji sites were found to be greener than the Feresbet site. There were efforts for greening at the Bole Gerji site when the units of the site were first passed to the dwellers, but the dwellers say that they themselves are the ones that have taken the responsibility for greening the immediate surroundings of their units. The Mickey Leland site gets its green view from the greenery that surrounds the site. Even if the condominium managers themselves admit that, particularly at Feresbet and Mickey Leland, any greening at the sites were not organized by the community, in general, the sites were not completely devoid of plants. Even the site with the smallest green and open space, the Feresbet, is able to reserve some room in a form of a small uncovered area within a few steps of distance for greening on the side of the pavements now covered with cobble stone (the figure from Feresbet site above). No vertical greening or green roofs were found though. The Addis Ababa structural plan provides green frame and greenery standards (see Box 5 in the literature review).

### **Efficient Use And Preservation of Open Spaces**

Much of the open space at Mickey Leland is left as it is with greenery from the time before the construction of the condominium buildings and as it was discussed the feres bet site has covered the entire area with cobble stone. The table below shows the addis ababa structural plan standards for parking.

The Bole Gerji condominium site addressed the need for parking space allocating a parking area around a square in the site for specific cars and now car owners can also use the reserved space for cars around the square in addition to the pavements in the site. The Bole Gerji site is also an

example in discouraging parking in the site the gate to the site doesn't allow someone driving a car to directly drive into the compound rather the option to park around is provided as shown in the picture below.

### **Environmental laws of the country and the Condominium sites**

The environmental impact assessment proclamation provides the possibility to force projects to provide an impact assessment report so that the environmental protection authority may permit, deny or make suggestions based on the report presented. But lack of directives to enforce the proclamation has hindered the growth of ES in construction that could have come with a legal backing. Besides, it would have created a commitment on the side of the government to take necessary measures. The pollution control proclamation which provides standards to be established regarding disposal and which also gives the environmental protection authority an oversight over municipality waste disposal systems is also not being exploited. The law was a potential to create efforts for a cleaner environment. The provisions of the proclamation allows going to the extent of coordinating dwellers for waste disposal, which is considerate of the environment, and includes facilitating ways for recycling the waste. Even if the proclamation is primarily meant to enforce proper handling and disposal of hazardous waste, the definition of which to be determined by another directive, the odor the waste at Mickey Leland creates, for example, is the nuisance the proclamation is there to avoid.

### **Changes dwellers made to their unit**

The inhabitants at the Bole Gerji condominium site had to complete the finishing of the units. They themselves picked the materials they used for the internal design of their units, which actually included opening, flooring, plastering and toilet and kitchen finishing.

### **Resource Utilization**

Resource utilization at the sites, as was found, has increased significantly. At Mickey Leland, they are now using 76% more of the resources of electricity and water than before they moved to the condominiums. The Bole Gerji site did not show much change, only an increase. At Feresbet the dwellers are now using 66%. But, as was indicated earlier, no inhabitant in the selected condominium sites has any kind of resource conservation mechanism, and none of them use clean and renewable energy (other than hydroelectric power), either as a source of electricity or to heat water, the more customary usage. The reasons that the inhabitants gave were that it is expensive

and not accessible and that they were not familiar with it. Lack of communication among the dwellers was also raised. The installation/commencement of these renewable sources of energy could be in the interest of all the dwellers. To store rain water, the dwellers answered that such a facility needed to have been thought about at the beginning, during the construction.

## **CHAPTER FIVE**

### **5. PROPOSAL**

This study was undertaken to discover whether or to what extent the Integrated Housing Development Program were environmentally sustainable buildings by taking three condominium sites and studying them against features of environmentally sustainable buildings. It is believed that the case study sites are representative of the condominiums built in the city in this same period. Therefore, the propositions presented below are those that can be incorporated to existing condominium buildings of the IHDP and to future buildings.

#### **5.1. SITE SELECTION CONSIDERATIONS**

As pointed out in the literature review, a feature of ESBs is that sites are carefully selected for construction. Prime sites are those that have been previously used or brown fields. Virgin land, i.e., land that has not been used, and which will require the cutting down of trees, are avoided. In the case of the condominium buildings, open and green spaces that could have been developed into parks were used for the construction of the condominium buildings. The city of Addis Ababa needs such spaces due to their positive environmental significance and to introduce the concept of environmental sustainability and resource conservation to the dwellers and to have them make it part of their lifestyle. Therefore, the environment should be given due regard during site selection and as intended by the projects that are to replace and develop the substandard housing, using already developed and brown fields would take us towards that target. Other than that, care needs to be taken during site selection so that potentials for clean and renewable energy options are optimally utilized.

#### **5.2. CONSIDERATION OF THE CONSTRUCTION PROCESS**

The uses of environmentally preferable building materials require a commitment in making projects such as the condominium housing project environmentally sustainable. Environmental sustainability does not end with a choice of certain construction materials to be environmentally preferable in relation to others. The friendliness of the materials to the environment and also the environmental sustainability of buildings is to be evaluated in terms of deliberate efforts made to that effect from the extraction process of the materials and in the carbon emitted during the transportation and packaging and in the construction process. It is the choices for the materials

made in meeting a certain prescribed standards that elevates the building in general to the level of environmental sustainability. The government should evaluate the construction process in terms of ES. And contractors should take into account and minimize the carbon emission during the construction process.

The Environmental sustainability i.e., if they were made with the lowest carbon emission possible and their significance in resource conservation, of the materials used, before and during the construction process needs to be considered. The use of prefabricated materials that is already there is to be encouraged due to the conservation of resources as opposed to the use of the other alternative that is the commonly practiced construction process.

Cobble stones have advantages over asphalt in that rain water is not carried away from the site, but sinks through the spaces between the stones back into the ground. Hence, reducing the use of asphalt and reserving cobble stones for parking and motor and pedestrian ways, could offset the effect a large built area may have on the environment. But though cobble stones have advantages over asphalt, open green areas still need to be left to have a balanced natural environment.

### **5.3. WASTE REDUCTION AND EFFICIENT USE OF RESOURCES**

Waste reduction and efficient use of resources is one to be achieved with a simple will with people involved in the implementation of the condominium project and with the knowhow on environmental sustainability. Environmental sustainability needs a deliberate involvement and when it comes to the condominium projects everyone from the delivery end of the construction materials to those who are directly involved in the construction process and while the will and determination is what brings it in the first place it is what it looks like the little efforts that will have the cumulative effect and that requires the policy on the side of the government and the guidelines and standards to evaluate the actions being taken and to create the norm. Waste reduction requires the use of recyclable construction materials, efficiency during the construction process and avoiding excesses in packaging and transportation.

### **5.4. BALANCING THE BUILT AREA WITH THE GREEN ENVIRONMENT AND OPEN SPACES**

Protecting and creating green spaces are part of any positive environmental endeavors both in replacing the lost vegetation due to urbanization and modernization, and considering the fact that vegetation is nature's way of healing itself and maintaining a healthy eco system: vegetation

absorbs carbon dioxide and produces oxygen. Considering the impact the condominium project may have on the environment – the addition of a built area with its urban heat island effect and the destruction of the natural environment – including an area for greening during the design stage and coordinating/informing the dwellers of its purpose during use should be thought about. If given the proper training the dwellers and condominium administrations would be empowered to go as far as cultivating vegetation/flora in any unused area or planting trees. The large open areas of the condominium could significantly contribute positively to the city in general. In addition Open spaces serve the communal needs of dwellers providing such as play ground and park and for car parking.



**Figure 31:** *A vertical greening and green spaces (design by author)*

## **5.5. DESIGN IMPROVEMENTS**

The involvement of professionals on environmentally sustainable design would bring immense potential to the condominium projects for resource conservation and protection and preservation of the natural environment. In addition to that, evaluating project designs from environmental sustainability even if it means taking into account current issues cannot be compromised, such as cost efficiency it would introduce the environmental sustainability norms into the projects and what could be done with consciousness on environmental effect of our actions and if that is brought to

the national level the environmental sustainability measures also have a way in adding cost effectiveness to projects.

Making buildings suitable for the installation of renewable and natural energy sources considering factors in building orientation and site potential for renewable energy resources such as wind and sunlight, are all to be considered at the designing stage. Green roofs require the construction of roofs that can structurally hold greening and that can stand seasonal changes. Though this would play a part in environmental sustainability, it would be considered unaffordable right now, given the interest to make the CHPs as low cost as possible. It would require making changes especially to the way roofs are built thereby adding to the cost of the project. But the addition of more capital would make having green roofs on the buildings affordable now. But there are still measures that can be taken that would ultimately have a positive environmental effect. Apart from using green and open spaces, getting structures for vertical greening greatly reduces the urban heat island effect of the condominium project and absorbs greenhouse gases. Using vertical greening, by creating simple structures on the sides of the buildings and using green boxes at the back and in the front of the buildings, plus measures such as proper utilization of areas reserved for plantation, are all means of escaping a poor environment.



#### **Box 8. Vertical greening**

Flora, such as grass, trees, shrubs, climbers this lost green area could be had on the buildings themselves.

This picture shows how the condominium buildings could be used in such a way the lost green area could be recovered, while considering cost effectiveness and structural limitations of the condominium buildings.

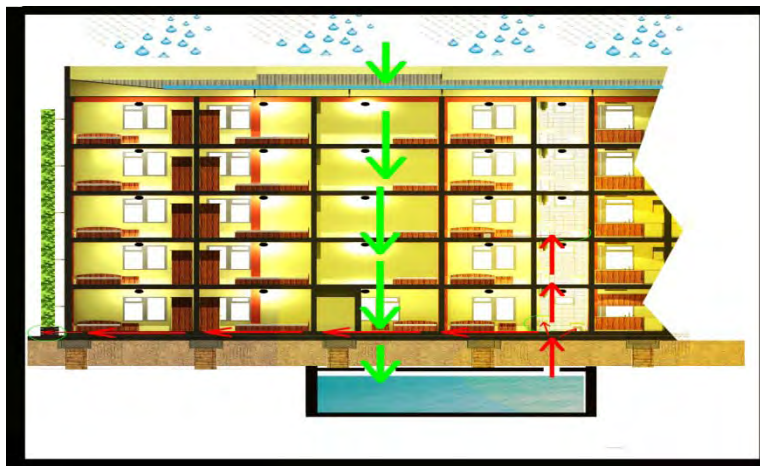
**Figure 32:** A vertical greening design proposal for condominium buildings (design by author)

Even if ventilation and natural light were not concerns for several of the inhabitants, increasing the size of windows not only guarantees more ventilation and lowers the risk of suffocation, but also provides more natural light.

During the design of the buildings, their orientation, with respect to the sun and the light it provides and the wind, should be taken into consideration so that these sources of energy can be used. Thereby, the natural ventilation and natural heating and cooling of the buildings can be undertaken. This aspect could be made an integral part of the design.

## 5.6. WATER CONSERVATION

If the roofs are made in such a way that they can hold rain water, this water can then be collected and stored in a facility in the ground and used for washing and flushing toilets in the units. Not only could it be one way of reducing the bill that is paid for water, but it would greatly conserve resources and reduce the carbon that could have been generated in the production of water. Added to measures meant to conserve resources, specifically in improving toilet flushing using less water, this could significantly reduce the amount of water used at the condominiums, thereby resolving the water shortage issue at the condominiums raised by the dwellers and the odor issues caused by it. The potential in using low flow fixtures needs the proper appreciation as they greatly reduce water use.



### Box 9. Solar design

The design of the roof allows the storage of rain water underground the slope of the roof string the water before it leaves the ground. At the same time the roof also integrates the use of solar energy

**Figure 33:** A roofing design that is meant to store rain water for further use in the building (design by author)

Another means of achieving water efficiency by conservation, would be to use gray water, which is water used in washing which undergoes a simple filtration process, and which can be achieved in the design stage by installing separate pipes for waste water from toilets. This water can then be stored in a tank and used in flushing toilets.

## 5.7. RENEWABLE ENERGY CONSIDERATIONS



**Figure 34:** *The use of solar power for energy (design by author)*

The use of solar energy is now becoming popular, with even small projects making use of it for heating water, to give one example. The country enjoys thirteen months of sunshine, but there are no efforts to utilize it for the condominium project. This should be thought about not only due to its significance in cost reduction, but also for its environmental contribution in saving nonrenewable energy and in its reduction of greenhouse gas emissions.

## 5.8. WASTE DISPOSAL CONSIDERATIONS AND RECYCLING

The waste the condominiums generate can be easily recycled. Since they are household waste, instead of disposing of them in the city's sewage lines, they could be treated at the sites for compost and biogas, and the rest of the dry waste can be collected for recycling. This could be done with cooperation among the dwellers. It is also crucial to provide the inhabitants with waste boxes: one for the dry waste and the other for the waste that could be used at the sites for compost. Rather than relying on door-to-door collection, even if the jobs it would create is to be encouraged, such a mechanism guarantees the recycling of the wastes. Making arrangements

with organizations that engage in recycling could bring the concept of recycling of waste to the condominiums.

Currently, the condominiums do not have any mechanism for sewage treatment of any kind at the site, but given the scale of resources used and the number of dwellers at each site, it is an opportunity for conservation of resources/optimal utilization of resources. The sites are conducive for such measures and cooperation among the dwellers could be achieved through the managers of the sites. The Government should give the necessary guidance to the dwellers and administration of the condominiums on how to change it to function.

### **5.9. EXPLOITING THE POTENTIAL AMONG THE DWELLERS FOR OPTIMUM OPERATIONAL AND MAINTENANCE PRACTICES**

One way to bring optimization of operational and maintenance practices for environmental sustainability is giving trainings to the dwellers as to what environmentally sustainable buildings are and how environmental conscious they should be during use and maintenance of the buildings. Our view of the environment and its importance has to be in understanding the challenges the planet is faced with in our age and has to come from the need for the harmony with nature in our life, otherwise much of the efforts we can take do not require much capital investment.

The findings from the three selected condominium sites suggest that there is a potential for sustainable development of the Addis Ababa condominium housing project among the inhabitants. They are relatively educated with know-how on global warming. It would not be difficult to make environmental sustainability a matter of common interest that the dwellers rally behind. Among the reasons that deters them from taking action is lack of communication and design drawbacks. Organizing the inhabitants and encouraging them to take an active role in the matter not only reduces the burden for the government, but also ensures the sustainability of the environment, the condominium community making it part of their lifestyle. Taking initiatives in giving trainings, even going as far as ensuring easy accessibility to necessary products which are meant to bring environmental sustainability would enable the dwellers to exploit the potential.

Collective measures, taken as part of the proper upkeep of the condominiums by the inhabitants in keeping the sustainability of the environment, may cultivate a sense of ownership of the sites. Environmental sustainability also ensures long term use of the buildings and low maintenance costs. However, the community's willingness and determination to carry out their responsibilities

are also significant in its realization. In addition to the increase in resource utilization, the discomforts at the condominiums should have led to a conservation of resources. The main reason for odor, a common problem at the condominiums, was unavailability of water on a daily basis.

## **5.10. INDOOR AIR QUALITY AND ENHANCING DWELLERS HEALTH**

Increasing the size of the windows would result in greater indoor air quality. They should be proportional to the interior space. Therefore, windows should be made wider. Furthermore, even if not an issue mentioned by the dwellers, increasing window size would increase the potential for day lighting.

## CHAPTER 6

### 6. CONCLUSION AND RECOMMENDATION

#### 6.1. CONCLUSION

This research undertook to investigate whether the Addis Ababa condominium housing project buildings were environmentally sustainable, after observing that the sites selected had once been green areas, and that nothing was done to replace the greenery removed.

Features of ESBs are, optimal site selection, energy efficiency and renewable energy, water efficiency, environmentally preferable building materials, recycling, waste reduction, indoor air quality, optimization of operational and maintenances practices, and green spaces. Though there are more ESB features, these were those that the case study condominium buildings were judged against and that are believed to be low cost to include in the condominium buildings.

There are some noteworthy efforts (whether deliberate or otherwise) towards environmental sustainability at some of the sites studied. Firstly, in the construction stage for all the condominiums, precast materials were used. Secondly, at the Mickey Leland site, the water conservation measures of recycling water and storing rainwater, is a noteworthy feature of ESBs. Another noteworthy measure of the studied sites, is the decision to limit the number of cars that enter the site and the protection of the field from becoming a parking lot with a curbstone, at the Bole Gerji site.

After reviewing literature on what ESBs are, and after comparing the results of the interview and observation of the three Addis Ababa condominium building sites with these concepts, it can be concluded that to a large extent efforts towards environmental sustainability at the sites are confined to limited attempts by the stakeholders. Therefore, to a large extent they are not environmentally sustainable buildings.

## **6.2. RECOMMENDATIONS**

As was seen from the results and from the conclusions, some features of ESBs are incorporated in one, several or all the condominium buildings. One of the objectives of the study was to present the features of ESBs and to adapt those that could be implemented at a low cost to the Addis Ababa condominium buildings. The following are some recommendations to make future condominium buildings environmentally sustainable including creating the awareness of what ES is; by involving experts in environmental sustainability and making them part of the practical construction process; and by sites imitating ES measures carried out by other sites.

The huge scale of the condominium housing project, which is of significant interest to nationals, is an opportunity for environmental sustainability to also be introduced. While informing the public of the progress made in the buildings, the government can also take the time to present some environmental sustainability concepts to the dwellers. Then, similarly, when the units are being handed over to the owners, they could be made to agree to standards concerning the environmental sustainability of the sites.

Moreover, involving specialists in environmental sustainability in the early stages of the construction of the buildings is another way to incorporate special environmental sustainability features in the buildings. Features such as green roofs and vertical greening could be incorporated in the buildings if experts in environmental sustainability are involved. It would also lead to the establishment of a framework for any efforts to be made and also encourage an establishment of influential standards that are considerate of the environmental sustainability realities of the country. Not only can the features of ESBs presented in the literature review be adapted to the condominium buildings, any ES efforts that were and are observed at any site, can be introduced to other sites. This would be another effective way to get dwellers to implement such measures.

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- **UNDP millennium development goals**, website [www.undp.org/mdg](http://www.undp.org/mdg)

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- **Proclamation no. 370/2003** “*The Ethiopian condominium proclamation*”

- **Proclamation no. 300/2002** “*The Ethiopian environmental pollution control proclamation*”
- **Proclamation no. 299/2002** “*The Ethiopian environmental impact assessment proclamation*”



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1. How do you evaluate the city waste disposal system?

Good

Bad

What are your reasons.....

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2. Are there measures you take to reduce the environmental consequence of your actions?

Yes  if yes what.....

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No

3. Do you have methods in which you participate in environmental protection activities in your area?

Yes  if yes what and how.....

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No

4. Do you think the city is doing enough to reduce the undesirable environmental consequence of the condominium buildings?

Yes

No

What are your reasons

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5. Were you given trainings or guidelines on how you conserve energy and resources before you started living in the condominium buildings?

Yes

No

6. Do you think the city have put the environment in jeopardy with the construction of the condominium buildings?

Yes

No

7. Do you think there were other options of reducing the housing shortage?

Yes  if yes what.....

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No

8. Do you use waste recycling? How do you use the recycled output

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9. Do you face shortage of water?

Yes  If yes how do you manage them .....

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No

10. Do you face shortage of energy?

Yes  If yes how do you manage them.....

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No

11. Does the dry waste picked up timely?

Yes

No  if no how do you explain it and what do you think is the problem?.....

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12. Do you think there is enough natural light in your house?

Yes

No

13. Do you think there is enough air in your house?

Yes

No

14. Do you have water conservation mechanism such as recycling?

Yes  if yes what.....

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No

15. Do you know about global warming and climate change?

Yes  if yes what.....

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No

16. Do you think you are doing your part to tackle global warming and climate change?

Yes  if yes what and how much of them are in your residence?.....

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No

17. Do you have a plan to plant trees and vegetables either in green box or on common ownership areas of the building? How do you plan to start it

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18. Do you use hot water in your shower?

Yes  if yes do you use a renewable energy to heat the water.....

No



23. Do you take the environment in to account in the management of areas common ownership of the condominium

Yes  If yes how?.....

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No

24. Do you have a plan to use renewable energy either to fully or partly power your unit? how and what are you doing towards that

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25. Have you or any of your family ever had respiratory diseases and breathing problems since you moved to the condominium houses and what did you do to cure it and how are you coping with that

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26. Do you think there is a climate change in the city of Addis Ababa?

Yes

If yes what do you think is the reason?.....

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No

27. How much do you think the condominium housing contribute to the climate change and why

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28. Do you think there is a wasteful use of resources during construction and use of the condominium buildings? How do you explain it

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29. What are you doing on your part to reduce energy use and for responsible resource utilization?

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**Ethiopia Institute of Architecture,  
Building Construction and City Development**

**Condominium Buildings  
Versus  
Environmental Sustainability  
In the case of Addis Ababa**

By Netsanet Seife

**Approved By: Board of Examiners**

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**Advisor**

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**Signature**

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**Date**

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**Examiner**

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