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Green Building Concepts and Town Planning Policy: Assessment of practices in Gaborone, Botswana

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfillment of the requirements for the Degree of Master of Science (Building)

Johannesburg 2012

DECLARATION

I declare that this is my original work, submitted in partial fulfilment of the requirements for the Degree of Master of Science (Building) in the specialised field of Property Development and Management in the University of the Witwatersrand, Johannesburg. It has never been submitted before to the university or any other university.

Signed

Georginah Kgakgamatso Matsila

30 March 2012

DEDICATION

I dedicate this paper to my wonderful husband Lesedi, who took care of the kids and all while I went for study in a foreign land. You encouraged me even when energy levels were low, for that I say I cherish you my love, this could not have been achieved without your support. I also dedicate this to my son Kago, daughter Lejana and baby Mimi who had to part with mum at three months of age, I love you babies more than words can express.

ACKNOWLEDGEMENT

I wish to express my recognition and gratitude to the individuals who made my study and this research achievable. First of all I thank my sponsor and employer (Botswana Government) for offering me the opportunity to further my studies, *ke a leboga!* Special thanks are also worthy to my respondents who offered their time out of their busy schedule to respond to the questions that laid the basis for this report and to my colleagues in class for their moral support during the study period. I also wish to acknowledge my spiritual father, Associate Professor Paul Nleya of the University of Botswana, my two families Matsila and Keetile who provided me with immense support throughout the study. I finally express my gratitude to my supervisor and counselor, Associate Professor Alfred Talukhaba for his unlimited support and guidance for without it, this report would not be what it is. I thank you all.

ABSTRACT

This study examines the inter-related concepts of Green Building and Town Planning using Gaborone, Botswana as a case study. Modern cities are faced with urban and environmental challenges and the major question faced by practitioners trying to plan environmentally friendly development is: what can be done in planning practice to address the identified challenges? Conventional buildings consume huge amounts of construction material, use a lot of portable water, use energy and emit a lot of green house gases during operation which contributes to climate change. Green building is considered as a means of addressing some of the environmental challenges associated with conventional buildings.

The study follows both a qualitative and quantitative approaches to collect data to establish whether GB is practiced in Gaborone and if not what barriers exist. It is established that people in the property development sector in Gaborone are aware of the need to practice GB. However, planning authorities and policy makers are not supportive GB initiatives. Green Buildings have a higher initial construction cost but they also attract higher rental turnover and a high value. This study concludes that an incorporation of Green Building concepts into Town Planning policy and practice can provide meaningful contribution towards safer, more comfortable and sustainable environment for urban communities.

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LIST OF ABBREVIATIONS

DCC	Development Control Code
DTRP	Department of Town & Regional Planning
GB	Green Building(s)
GBCSA	Green Building Council of South Africa
GCC	Gaborone City Council
GOB	Government of Botswana
NCS	National Conservation Strategy
SADC	Southern African Development Community
SB	Sustainable Buildings
SD	Sustainable Development
TCPA	Town & Country Planning Act
TCPB	Town & Country Planning Board

CHAPTER 1: INTRODUCTION

1.1 Introduction

Urban environmental degradation through greenhouse gas (GHG) emissions and massive extraction of natural resources during construction have been identified as challenges facing most cities in the world (UN-Habitat, 2009: Conroy et al, 2004). In order to address the above challenge, the causes have to be identified and currently it has been observed that building of conventional structures and their operations have a contributing factor to the urban degradation (Ding: 2008; UNEP, 2007)

Urban environments are not only affected by issues associated with conventional buildings however, there are problems of rapid population growth, lack of access to shelter, poverty and inability to develop infrastructure and services to match the growing population (Watson 2009; UN-Habitat 2009; Conroy *et al* 2004). These identified urban challenges and climate change are a threat to human life and if left un-abated, can lead to detrimental effects to life (Larson *et al*, 2011). This study was carried out in Gaborone the capital city of Botswana, which has semi arid conditions with shortage of water, energy and land to meet housing demands for its fast growing population (Cavric, 2004).

As a solution to the stated issues, Watson, (2009) advances that mitigation of environmental issues can be achieved through new approaches to urban planning while Ding (2008) and IPCC (2007) considers green building as a way of mitigating issues of conventional buildings. Green buildings are defined by Shiers (2000) and Lucuik *et al* (2005) as buildings which are designed, located, constructed and operated in a way that they render minimal carbon foot print. This is achieved

through careful selection of lower impact building materials and fittings including paints that are not harmful to the environments (Shiers, 2000; Lucuik *et al* 2005).

Town or urban planning is defined in GOB (1997) as "the art and science of ordering the use of land, siting of buildings and communication routes". As stated above, planning has been identified as an important tool to address modern day urban environmental issues (Watson 2009; UN-Habitat 2009; Conroy *et al* 2004). Because green building and town planning are both considered as opportunities for mitigating urban issues, this study recommends that green building concepts should be incorporated in the new planning approach in Gaborone.

While it should be appreciated that initial construction costs for green buildings are higher compared with conventional buildings, the long term benefits are immense and these includes higher rentals and higher property values, reduced energy and water consumption among others, (Kats, 2003).

1.2 Background to the study

Loebel, (2009) observes that rapidly growing world population and economic growth has led to a detrimental level of global environmental stress for which Cavric *et al* (2006) advances that some of the environmental concerns could have been avoided had the idea of environmental sustainable development been taken on board earlier. This situation is manifested by adverse environmental, economic and social consequences which are already being felt but are expected to be far more tangible in the decades to come. Cities in the whole world continue to experience rapid growth and Keiner *et al* (2006) state that currently, the population of urban areas is estimated around half of the entire population with up to 70% expected to live in urban areas by 2025.

1.2.1 Cities and Climate Change

Climate change is affecting the whole world and it comes about as a result of increased green house gas emissions from buildings and the transport sector among others (Larsen *et al*, 2011; UNEP, 2007). According to the above reports, the contribution of the buildings sector is estimated to be a third of the overall emissions of carbon dioxide (CO_2).

African countries are said to be contributing about 10% (ten) of global greenhouse gas emissions however, Gwebu, (2002) fears that the growth of these countries' economies has a potential of raising the level of emissions. Botswana was regarded as a net sink for greenhouse gas emissions by previous reports by GOB (2001). However, the situation might have changed to date. The country is one of those that have a high possibility of being affected by climate change, considering its semi-arid conditions with inadequate water and energy supply (GOB, 2001). There is therefore necessity for proactive response to the same challenges.

1.2.2 Cities and environmental issues

According to UN report, (UN-Habitat, 2009) cities in the world are facing environmental challenges which range from poor waste management, air and water pollution, to lack of access to portable water and energy supply. Although the problems are not homogeneous in all cities, their effect on the environment and human life are immense. Growth of cities in size has led to the reliance on automobiles to reach the city centre and other places, resulting in congestion, pollution and resources consumption (Gwebu 2001; Loebel 2009). These problems have to be abated.

1.3 Potential role of planning in environmental issues

According to Watson (2009), cities are causing detrimental impacts on the environment ranging from deforestation as vegetation is cleared to pave way for development to excessive consumption of naturally occurring materials like sand, gravel and plants. The potential role that town planning can play in addressing the environmental issues is therefore discussed.

Planning plays an important role in addressing urban issues through designating different land uses to land parcels as stated in GOB (1997) and Oduwaye (2009). This role which is achieved through development plans is important in assuring environmental protection, by ensuring orderliness and protection of sensitive land (Oduwaye, 2009). Planning also has an influence in the amount of green house gas emission from the transport sector. When people and services are located in the same vicinity, there is reduced reliance on automobiles as they use non motorised means of transport resulting in lower emissions (Naess, 2001).

Another attribute of planning as stated by Naess (2001) is that planning through regulation of plot ratios and development can influence the type and amount of building materials used for a particular building. The type of materials used has an influence on the surrounding environment as some tend to attract heat islands or may attract more reliance on energy for heating and or cooling.

Urban planning is also critical according to Ebenezer Howard as cited by UN-Habitat (2009) in bringing green back into urban areas through Garden City concept. Through the garden city model, the city is able to grow its own food in the generous open spaces left in the towns and also the spaces clean up the

air. For a city like Gaborone to be able to produce its own food within its vicinity this would reduce sprawl into the outer lying areas.

1.4 The study area Gaborone, Botswana

The study was carried out in Gaborone, the capital city of Botswana, located within the developed peri-urban centres of Mogoditshane, Tlokweng, Kgatleng district boundary and freehold farms in the South East district which hinder future spatial expansion of the city (GOB, 2008).

Urban lifestyle and urban form have taken a different shape in the city and hence there is need for urban planning to respond appropriately. The city is way past the form described by Keiner *et al* (2004) and Mosha (1996) as a small city with few developments but the situation at hand points to the contrary. Indeed, Cavric (2006) states that the city is inundated with overwhelming urbanization and development. There are more people: in fact 227 233 (GOB, 2011) were enumerated in 2011. Also with the advent of imported used cars from Japan and other countries, there are more cars on the road than envisaged (Gwebu, 2002). Gaborone has also seen the development of freehold farms into residential estates like Broadhurst farm, Phakalane, Mmokolodi and Gaborone North (GOB, 2002).

The city draws water from Gaborone dam, which is rather inadequate and despite the additional supply through a 400-km pipeline from Letsibogo dam in the northern part of the country, water is still scarce hence extra water is imported from Molatedi dam in South Africa (GOB, 2006). Building materials are also scarce and thus are imported from the neighbouring countries thereby enhancing the need for sustainable use (GOB, 2008).

Concerning energy, the electricity that Botswana generates internally at the Morupule coal-fired power plant is only adequate to satisfy only 33% of its national demand, (Ketlogetswe *et al*, 2008).The eventuality of the scenario is that the country sources additional electrical energy from Eskom of the Republic of South Africa and NamPower of Namibia (Ketlogetswe *et al*, 2008). The shortage poses a serious challenge, considering the fact that the country has extreme heat and cold weather that calls for heating and cooling (Douglass *et al*, 2004).

All the above outlined concerns including climate change, water and electricity issues, call for means to mitigate them and green building innovation through town planning process is proposed in this study to mitigate these challenges. In addition, studies indicate that "green building is the one mitigation solution that not only reduces carbon emissions, but also is the least expensive and most cost-effective solution", (engineering news, 11 Apr 08).

1.5 Statement of the Problem

Global climate change and environmental degradation are worldwide problems and Gaborone is experiencing the same; this calls for a holistic approach towards the alleviation or addressing of these problems. Town planning as a means of environmental management through zoning of land uses and approval of development plans is considered as key in addressing urban environmental issues (Watson 2009; UN-Habitat 2009; Conroy *et al* 2004). However, Molebatsi (1996) observes that, when going through the planning documents currently in use in Botswana, it is doubtful if the concept of sustainable urban development has been incorporated into the country's planning practice.

Although town planning is regarded as a key factor in environmental conservation, (UN-Habitat, 2009) it is deemed to be lagging behind in incorporating sustainable

urban development concepts in relation to Molebatsi's assertion above. There is limited means if any of assessing how environmentally sustainable a building or development is other than checking its conformity to Development Control Code (DCC), which does not directly appraise sustainability. This may not be very appropriate because of the differences in climatic and geographical conditions, sustainability agenda, national priorities and other factors in the country.

Molebatsi, (1996) also observes that the goals of the National Conservation Strategy (NCS) which was meant to oversee issues of the environment nationally have not been translated for implementation in the urban areas. As a result concerns with sustainable urban development are not yet prominent in local planning concerns. Green building as already alluded to is on the consideration as a promising option to addressing the challenges of the urban form. However, for this to be achieved, the concepts of green building have to be incorporated in the town planning policy.

1.6 Research Questions

The research question is: To what extent are green building concepts incorporated in the physical planning policies and processes in Gaborone, Botswana? The question is further divided into the following sub – questions:

a) Does planning policy and procedure incorporate green building concepts?
b) What are the challenges and barriers towards Green Building development in Gaborone?
c) What effective strategies can be devised in plan approval process to ensure approval for green building alternatives?

1.7 Hypothesis

Green Building concepts are inadequately incorporated in the planning policy which is the reason for non implementation by Town Planners and Property Developers in Gaborone.

1.8 Objectives of the Study

The overall objective of the research is to evaluate integration of green building concepts and resource efficiency into town planning procedures in Gaborone.

The specific objectives are:

(i) To analyze the city planning laws, regulations, policies and procedures in relation to green building concepts.

(ii) To evaluate green building concepts in the planning processes.

(iii) To identify barriers impeding implementation of green building practices in Gaborone city.

(iv) To propose ways of reducing or eliminating the barriers

1.9 Research Methodology

The study follows a case study method with content analysis focusing on the Town Planning Policy and process analysis. It implored a documentary analysis for the policy documents and professionals in the property field were interviewed in Gaborone being the study area. Mixed methods are utilized in this study following the observation by Newman and Benz (1998) as cited in Creswell (2003) that there is no clear qualitative or quantitative situation. The mixed methods are important in reducing the inadequacies of either method.

1.10 Scope and Limitations of the Study

This study covers aspects of national policies governing property development in Botswana. The case study draws experiences occurring within Gaborone, which is the largest city in the country and most development takes place there. The study covers only commercial properties because studies have revealed that their CO_2 emission rate has been growing at a higher rate than that of residential buildings (Levine *et al* 2007). Commercial properties are also the ones mostly targeted by green building assessment methods (van Wyke, 2008).

The fact that the study is based in Gaborone, Botswana, a country that has not yet developed its own green building policy or assessment tool, poses a limitation in the sense that a lot of data might be missing. This therefore means that data will be drawn from international studies and experiences. Nonetheless, their relevance to the Botswana scenario is considered in the study. It is intended that the results of this study can be applied to any urban locality throughout Botswana, including districts and town councils in the country.

1.11 Significance of the Study

The importance of this study is to contribute to the understating of green building concepts and their incorporation into the town planning practices. It is also important to raise awareness of the public on issues of environmental management and the need for collaborative effort (between public and private sector) when addressing issues of the environment. Politicians and the general public need to be appraised on issues of the environment and town planners as well need to be acquainted with mitigation efforts.

The study is also important in proposing ways of achieving the Vision for Gaborone which states that Gaborone will be an environmentally friendly and sustainable city that promotes a culture of sustainable utilization and conservation of natural resources, as well as protection of the environment (GOB, 2008). It seeks to expand on this vision by recommending ways of implementation.

Since the study by Molebatsi (1996) it is important to establish whether the situation as described still prevails that planning does not encompass sustainable urban development. The current situation in Gaborone reflects a substantial need to practice green building concepts in the city, to preserve the limited resources and to respond to environmental challenges.

1.12 Structure of the Report

Chapter one lays the background of the study with an outline of the study objectives and hypothesis. This chapter is important because it highlights the key factors that make the basis for the study. Literature review is contained in chapter two and it discusses issues of town planning, environmental issues, sustainable development, green building and green building tools.

Chapter three covers the outline of the different research methods that were used to collect the relevant data for the research which include literature review and sampling. Methods used for analysis of data are also discussed in this section. Data analysis and discussion makes chapter four whereby the research results are presented and evaluated. Chapter five presents conclusion and recommendations as deduced from the results followed by the references section where all references used in the study are listed. Finally the appendix section includes all the appended data used in the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The core concepts that underpin the study being green building, town planning and the environment are discussed in this chapter. The discussion extends beyond the definitions, the relationship and life experiences. In this section the study establishes the attributes for green building and whether they are provided in the town planning policies and documents in Gaborone, Botswana. The chapter further expands to consider whether there are instances where town planning encompasses green building. This is important for reflecting if the study is not ambitious in advocating for inclusion of green building concepts in town planning.

2.2 Buildings and the Environment

Buildings are an integral part of mankind by providing the basic need of shelter and protection from external conditions of the weather, as well as providing security. They are usually long term structures with a long lifespan and therefore they require careful planning and design because as Allacker *et al* (2006) state, they have long-term repercussions on the environment and consequently on the climate.

Papanek, (1995) has also observed that buildings have a potential to cause illnesses in people ranging from headache to fatal illnesses due to the materials used for construction and finishing. The materials include paints, plastic, materials for making and gluing carpets, air conditioning systems that circulate the same air that might be carrying bad gases including bacteria which may cause sicknesses (Papanek, 1995). A study by United States Environmental Protection Agency (EPA) also states that

Americans spend 90% of their time in buildings therefore there has to be an acceptable level of comfort and indoor environmental quality.

Building of conventional structures and their operations has been identified by UNEP (2007) as one of the contributing factors to environmental degradation through greenhouse gas emissions. Moreover, analysts accuse the construction of conventional buildings of causing environmental problems which include massive extraction of natural resources during construction (Ding, 2008). It has also been observed that buildings pollute the environment during their lifespan operation of air conditioners and other electronic devices (Papanek, 1995).

2.3 Cities and Urbanisation

Keiner et al (2005), state that, developing countries are faced with rapid urbanization and fast growing economies which in turn bring about challenges to development planning and the environment. Studies indicate that Africa is the hardest hit by rapid urbanization and is estimated that by the year 2025, more than 70% of Africa's population will live in urban areas (UN Habitat, 2009, Keiner *et al* 2006). On the same token, Williams (2000) points out that this growth is as a result of people migrating to urban areas to look for employment and better living conditions. This problem of fast growing cities brings about sustainability challenges like in the case of Botswana where high volumes of building materials are extracted and loads of rubble are dumped (GOB, 2008).

2.4 Cities and Climate Change

Climate change is made more prevalent due to increased green houses gas emissions from building and transport sector among others and is expected to bring about many detrimental effects to global life (Larsen *et al* 2011; UNEP, 2007). The contribution of the building sector which is defined as encompassing the construction and management of residential and commercial buildings (Larsen *et al* 2011; UNEP, 2007) is estimated to be a third of the emissions of carbon dioxide (CO_2). It is upon this basis that green building is considered as a way of mitigating environmental impacts of buildings which contribute a lot to climate change.

Previous studies estimate that around 30% of the baseline CO_2 emissions in buildings projected for 2020 could be mitigated in a cost-effective way globally, if various technological options were introduced, like more efficient heating systems or appliances (IPCC, 2007). There are indications that improved building practices in construction and operation are some of the quickest and cheapest ways to reduce greenhouse gas emissions significantly, also coupled with economic benefit (IPCC, 2007).

Countries on the African continent are said to be contributing about 10% (ten) of global greenhouse gas emissions whereas Botswana contributes about 7% of the African contribution which was almost 0.02% of the global emissions (GOB, 2001). However, because the economies of these countries continue to grow at a high rate, the level of emissions is feared to be growing as well (Gwebu, 2002). Botswana was regarded as a net sink for greenhouse gas emissions by previous reports (GOB, 2001) however; the situation might have changed to date. There is therefore necessity for proactive response to the scourge.

As already stated, it has been established that the greenhouse gas problem is not exclusive to the operation of buildings; construction as well is directly and indirectly responsible for the emission of greenhouse gases (Ding, 2008). Growing cities of developing countries like Gaborone which have a significant construction rate would have environmental challenges as a result of raw material sourcing, site clearance and the construction process itself (GOB, 2008). Also, because buildings and other structures in the whole world have a long life span, their operation will have long-term repercussions on the environment and consequently the climate (Allacker *et al*, 2006). In order to achieve a high-performance, low environmental- impact structure, it is vital to incorporate green building concepts at the beginning of a project.

Some of the possible impacts of climate change are: increased temperatures and occurrence of heat waves, raised sea levels, desertification and diminishing landscapes, wild fires and an increase in rainfall leading to flooding (Larson et al 2011; Gwebu 2002; UNEP 2007). The listed problems have causal effects on other impacts such as precipitation levels affected by increased temperatures and polluted water due to runoffs washing impurities into water bodies (Larson et al 2011; Gwebu 2002; UNEP 2007). Green house gas emissions have to be reduced if human life is to continue to exist.

Climate change effects are not only prevalent in places where emissions originate but are experienced globally. Botswana is said to be one of the countries with a high vulnerability to climate change considering its semi arid / arid conditions with inadequate water and energy supply (Gwebu, 2002). Desertification in the country might increase by 5-8% with a possibility of land degradation (GOB, 2001; GOB, 2002). As identified in GOB (2009), the country already has low and unreliable rainfall, low aquifer recharge and a high evaporative rate thus an increase in

temperature might lead to more detrimental water stress. Since it has been established that buildings have a higher contribution to GHG emission which result in climate change, a proactive shift has to be taken from the construction of conventional buildings to "cleaner" ones.

2.5 Cities and environmental issues

According to Loebel, (2009), a rapidly growing world population and economic growth have led to a dangerous level of global environmental stress. The serious environmental, economic and social consequences of this development are already being felt but are expected to be far more tangible in the decades to come. Below is an indication of the environmental stresses:

Table 2.1: Environmental impacts of urbanization.

Major environmental stress factors		
• Air pollution • Ozone depletion • Climate change • Environmental hazards	• Depletion of natural resources • Loss of biological diversity • Availability of fresh water • Coastal & marine degradation	• Land degradation • Deforestation & habitat loss • Desertification

Source: UTECH, (2009)

The above environmental threats and others are a challenge that needs to be tackled. Environmental threats and climate change are modern day concerns which need to be addressed by the whole world. However, for these to be addressed, the fundamental causes have to be established. Growth of cities in size has led to the reliance on

automobiles to reach the city centre and other places, resulting in congestion, pollution and resources consumption (Gwebu, 2001).

Reports like UN-Habitat (2009) have also revealed that urban growth continues to affect outlying natural areas, consuming agricultural land and destroying habitat needed to sustain biodiversity. Most of agricultural fields in rural places have been occupied by dwellings and several rural spaces have been absorbed entirely. However, Hall (2000) as cited from Cavric (2004) laments that urban growth is not the major problem; instead the lack of interest by city administration, their incompetency and lack of resources for management are the problem.

Environmental degradation is also regarded as a looming problem in urban areas and buildings and construction are considered as major contributors through green house gas emissions and resource depletion (UNEP, 2007). Cleaner ways of both construction and operation of buildings are therefore being considered to avert the detrimental effects on the environment which brings about the issue of green building. However, green building is not considered in isolation as it forms part of the world call for sustainable development.

2.6 Gaborone Urban Issues

Gaborone city came into being in 1963 with the master plan prepared according to the ‘garden city’ model with an initial population of 3855 inhabitants (Mosha, 1996). A garden city model of planning requires that the plan must reflect a distinct form with defined boundaries and an outlying agricultural land (GOB, 1997). The form also provides generous land for open spaces.

The city was expected to reach 20 000 inhabitants by 1983 - the end of the plan period (Mosha 1996, Keiner et al 2006, Kruger, 1998). The plan was designed with a distinctive segregation between high income housing, medium, low-income housing, and the 'mall' which has the shops and offices. To date, the city still has a strong separation of uses with no vertical mixed use (GOB, 2008), yet the lack of mixed use results in complete desertion of the mall after hours as a result of the overemphasis on separate zoning, GOB (2008). Mixed land use ensures that residents benefit from the existing services during working hours and after work for example in the main mall all services are available.

2.6.1 Urbanization in Gaborone

The first challenge to Gaborone has been urbanisation. Gaborone did not follow the growth pattern as expected above; instead more people migrated to the town to seek employment fleeing from drought prone rural areas and other socio-economic reasons (Kruger, 1998). The population of the town escalated from 3855 in 1963 to 133 468 in 1991 which were totally beyond the plan and any contingency (Mosha, 1996; Keiner *et al*, 2006; Kruger, 1998). In its regional and national context Gaborone has better distribution of services, infrastructure, amenities and economic opportunities and these are acting as pull factors for more and more people (Keiner *et al* 2006). This is a problem because the people who migrate into the city for economic reasons need housing and services. However, due to the high growth, the city's services such as sewerage lines and roads have been overwhelmed (GOB, 2008).

As a matter of fact, Cavric (2004) laments that of late, the city is experiencing problems associated with the massive growth that exceeded its space and capacity of the environment thus there is no land for future expansion (GOB, 2008). The growth of the city has eventually been towards the peri urban villages of Tlokweng and Mogoditshane. This has resulted in land for agricultural purposes being taken for

residential purposes as evidenced by the development of freehold farms like Phakalane estates, Mmokolodi and Gaborone North (GOB 2002; Keiner *et al* 2006).

As observed in (Cavric, 2004, GOB 2008), urban sprawl is the obvious result of the city growth despite the fact that about 90% of the structures in the city are low rise unattached buildings. The problem of urban sprawl is that towns grow wider and distant from people's work places thereby resulting in longer travelling distances and green gas emissions from cars as observed by Bramley *et al* (2005). This scenario is also a disadvantage as asserted by Bramley *et al* (2005) because it negatively affects the quality of life of the residents due social exclusion.

As per GOB (2008), Gaborone is inundated with high rate of development and as a result more vegetation is lost. The loss of vegetation is a challenge considering that it is important for ensuring atmospheric air cleanliness. Building materials are also scarce and thus are imported from the neighbouring countries, thereby calling for sustainable use GOB (2008).

2.6.2 Planning failure of Gaborone

Planning failure is defined for this context as current urban challenges in Gaborone that came about as a result of past planning of the city. It is one of the issues observed to be urban challenges of Gaborone. Cavric *et al* (2006) observe that the initial planning did not take into consideration possible growth due to people migrating from the rural areas exerting pressure on land and services. The stated pressures led to flow of the population into neighbouring villages of Tlokweng, Mogoditshane, Gabane, Mmopane and Metsimotlhabe. This is further manifested by the massive growth of Mmopane from 3512 people in 2001 to 14655 in 2011 (GOB, 2011). Even though some people settle in the neighbouring villages, they are still a challenge

because they work, seek medication and attend schools in the city during the day, thereby requiring services.

Low density development and separate zoning type of planning of Gaborone are also regarded as part of the planning failures as they have led to more land being required for expansion of the city whereas a lot of it is underutilised within the built areas (Cavric *et al* 2006; GOB, 2008). It is also observed in GOB (2008) that there is an incidence of uncoordinated farm divisions leading to under provision of certain land uses (GOB 2008). The Town planning statutes including Urban Development Standards and Gaborone City Development Plan do not specify issues like plot coverage and building height which have led to underutilisation of land as observed by Keiner *et al* (2006).

Late or non-approval of plans is another challenge or planning failure lamented by Mosha (1996). For instance, the Gaborone City Development plan for the period 1997 – 2021 was only approved in 2001, which means before then, its provisions could not be enforced since they were taken to be advisory (Keiner *et al* 2006).

2.6.3 Transport

As previously stated, Gaborone is widespread and some of the people working in the city have found abode in the neighbouring villages. This scenario results in people commuting to and from work which leads to another problem of dependence on automobiles. The city does not provide public transport, instead it is provided by private individuals (Cavric, 2008) however this may not be a major problem since Keiner *et al* (2006) state that fuel and transport costs are highly subsidized, therefore making commuting affordable. However, the poor might still not afford the fares.

Another disturbing factor is that, it is still prestigious for the local people to own and drive individual cars (with no car pooling) Keiner *et al* (2006). There is also an increase in the car population partly because of the second hand cars from Japan and other countries that are in the market locally (Gwebu, 2004). Gaborone roads are therefore becoming overburdened. There was a total of 344 719 registered vehicles in 2010 (refer to table 2.2 for spread of vehicle registration) and this results in increased GHG emissions into the atmosphere which is an issue of pollution.

Table 2.2: First Registration of private vehicles from year 2001 - 2010

Year	**No. of registered vehicles**
2001	16 155
2002	20 042
2003	17 091
2004	20 737
2005	20 089
2006	19 442
2007	25 876
2008	33 413
2009	33 325
2010	31 949

Source: GOB, 2012

Out of the total 31 949 vehicles registered in 2010, 56.2% of the total was registered in Gaborone followed by the peri-urban village of Mogoditshane at 3254 vehicles which was more than the vehicles registered in Francistown (the second city in the country). Registration of more vehicles especially passenger vehicles which contributed 65.6% as per the GOB (2012) report may be related to the ascertion by Keiner et al (2006) that the local people prefer their own individual cars.

2.6.4 Air pollution

Air pollution due to industrial and vehicle emissions is also one of the challenges in Gaborone (GOB 2008; Cavric *et al* 2006). Botswana as a country is regarded to be low in emissions (Gwebu, 2004) however, no matter how minimal the emission is, it still contributes to the global emission. The other source of air pollution is dust from construction and quarrying at Kgale hill (GOB, 2008; Toteng 2000). This is one of the challenges that the city is facing that requires redress.

2.6.5 Waste Management

Gaborone also has a challenge of massive generation of solid waste which is all collected to the landfill (GOB, 2008; Cavric *et al* 2006). As stated in Cavric *et al* (2006) and GOB (2008), the volume of the waste dumped in the landfill and some in the open spaces is exacerbated by the fact that it is uncommon to sort waste in the country. This scenario has led to the closure of Gaborone landfill (GOB, 2008) before the forecasted time and to date the city has crossed its borders to dump its waste in a village called Gamodubu which is 30 km from the city.

The failure to sort waste leads to the possibility of dumping hazardous waste indiscriminately hence polluting water and affecting human health (Cavric, 2004). Measures have to be taken to manage the waste because it can be used for city

production of food and building rubble can be used in roads construction which would reduce the burden of mining some more building materials. Frequent blockages of sewerage lines due to oils and other substances is also a problem in the city (GOB 2008).

2.6.6 Water Challenges

The city draws water from Gaborone dam. However, experience and projections previously indicated that the demand could not be met in south-eastern Botswana, where most people live and the country's capital Gaborone is located (GOB, 2009). To augment the supply, Letsibogo dam in northern Botswana was planned and constructed for the transfer of water through a 400-km pipeline to south-east Botswana (GOB, 2006). This so-called North-South Water Carrier (NSWC) became operational in 1999 (GOB, 2006) supplying water to Gaborone and surrounding areas. The above arrangement of water supply is still not adequate, therefore supplementary water is drawn from Molatedi dam in South Africa (GOB 2009).

The water situation in the country is regarded by UN, (1997) as stress of the water sources and is likely to be worse by the year 2025. Evaporation rates are high in the country and it exceeds the consumption of water and this poses many problems for the sustainability of water utilization (Toteng, 2002). Wastewater resource is available but its usage is very limited and currently, only twenty percent of the outflow is being re-used mostly for irrigation purposes **(**GOB 2008).

Storm water harvesting is uncommon in the city and there is lots of pavement leading to volumes of runoff water that is beyond the carrying capacity of the not so well developed storm water drainage system (Toteng, 2002; Gwebu, 2004). This problem can be abated through storm water harvesting and using environmentally friendly

landscaping that allows for water soaking into the ground. It is a known fact that water is scarce in Gaborone; therefore it would be wise to use landscaping that is suitable for the dry hot weather of the city.

The low income neighborhoods in the city, including Bontleng, White City and Old Naledi among others are not connected to the sewer lines hence the inhabitants use pit latrines which have a potential to pollute underground water (Cavric, 2004). This is an issue that should have been addressed to date, considering its importance.

2.6.7 Energy

Another challenge for Gaborone is energy demand, the electricity that Botswana generates internally at the Morupule coal-fired power plant is adequate to satisfy only 33% of its national demand (Ketlogetswe *et al* 2008).The eventuality of the scenario is that the country sources additional electrical energy from Eskom of the Republic of South Africa and NamPower of Namibia, Ketlogetswe *et al* (2008). An increased level of energy use is a problem to the environment due to GHG emission during extraction, transportation and usage.

The imported electricity comes with its own issues and is dependent on adequacy in its place of origin. For example, Gaotlhobogwe (2009) reported that in 2009 the country was affected by load shedding which was due to shortage of supply by Eskom. As part of Botswana, Gaborone is dominated by a hot/dry climate therefore; there is significant demand for cooling and heating which increases the demand for electricity (Douglass *et al*, 2004).

Another observation by Denbow *et al* (2006) is that electricity is expensive for some people hence some families in Gaborone still use firewood for cooking and therefore turn to the green belt around the city for the fire wood leading to deforestation as some of them cut life trees (GOB 2008).

2.6.8 Open Spaces

Due to the initial planning of a garden city as observed by Mosha (1996), there are quite a significant amount of open spaces in the city. The open spaces mostly lack development and are used for uses that they were not intended for; including driving schools, welding yards and some are illegal dumping sites (Nuesch 2005). The open spaces could be used as "breathing spaces" for the city and food production areas if managed appropriately, however, Gaborone City Council has not been able to develop them. They are currently unattractive pieces of land which people envy for other uses. Most of the open spaces that are within the built up area are surrounded by high walls from residences as stated in GOB (2008) which makes them unsafe with poor lighting.

2.6.9 Health

Botswana is one of the countries that have been hard hit by the HIV/AIDS scourge, resulting in close to 35% of the adult population being infected in 2001 (Keiner *et al* 2006; Cavric 2006). Government has however taken steps to address the problem although it is still prevalent as observed in Keiner *et al* (2006) and Cavric, (2006). Gaborone as a major centre with better opportunities for jobs and services including health services attracts more people which exert more stress on all sectors. Climate change has an effect on the health sector considering that ailments that were not prominent in particular locations might start occurring.

2.6.10 Crime

Denbow *et al* (2006), states that the increase in population has led to escalation of crime rates in the urban centres of Botswana even though it is less violent. This according to Mosienyane in GOB, (2008) has resulted in unsightly neighbourhoods due to high boundary walls hiding the beauty of their houses. Crime is still an issue even though it is said to be less violent and this has an effect on the use of open spaces as recreational parks because people fear for their security and that of their valuables.

The listed challenges and others not stated require a means to address them and town planning is considered as an important tool for addressing the modern day challenges alluded to above (GOB 1997; Watson 2009; Conroy *et al* 2004). The idea of town planning being pivotal in alleviating urban and environmental issues is also supported by UN-Habitat (2009).

2.7 Sustainable Development and Town Planning

Sustainable Development is important in this study as a way of mitigating environmental destruction and worldwide environmental crisis. Campbell (1996) and Blowers (1993) observe that there are three goals of sustainable development which encompasses social, economic as well as environmental goals. For the purposes of this research, emphasis of sustainable development is going to be more on the environmental goal with less on the social and the economic goals.

According to Gibberd (2003), the objectives of environmental sustainable development include conservation of energy, water, minimization of resource

extraction, resource and waste or pollution management and green building. This is more relevant to the study as the major concern is in line with the stated objectives for the environment. In relation to Gibberd's assertion, Ali *et al* (2009) advances the argument that green building has become a flagship of sustainable development in this century. This relation of green building with sustainable development is important as it reveals that the two are not separate concepts, however they operate towards the same target. In other words, the concept of green building is an improvement or an implementing sector of environmental sustainable development.

Conroy and Berke (2003) regard the concept of sustainable development as being in conflict while Campbell (1996) argues that conflicts are both inherent and a necessary aspect of planning for sustainable development because of the pursuit and balancing of its three goals. This argument is affirmed by Blowers (1993) who notes that conflict in sustainable development reflects the complexity of coming up with decisions concerning the environment. It is therefore proposed by Conroy (2003) that the best way to address these conflicts is through a community-based collaborative planning process that carries along planners and citizens. Sustainable development objectives are of a noble nature especially when considering that resources are infinite, therefore there is need for balanced exploitation.

Sustainable development is a worldwide phenomenon but it cannot be construed in a similar fashion by all nations. In developed countries, the concern is mostly waste management and regeneration while developing countries are more concerned with using the available resources to improve their economies and the livelihoods of their people (Gibberd 2003; Keiner 2005; Naess 2000).

While it is important for developing countries to implement all the three goals of SD, Gibberd (2005) argues that sustainable development in developing countries should address social and economic issues as a priority. It is however critical that the developing countries should not ignore the environmental issues, the socio-economic

plans they put in place should not have negative effects on the environment. The buildings and structures they construct should not emit GHG which would result in an increase in climate change effects.

In order to achieve sustainability objectives, both public and private sector have to be involved hence Conroy *et al* (2003) assert that the best way to address sustainability is through participatory planning. This involves collaborative approach where planners and citizens are partners and moreover, Conroy *et al* (2003) echo that participatory planning helps to build social capital and support for development. Issues of the environment cannot be resolved by the planners/government only therefore the public has to be consulted so that they can own up and support the management plans.

Keiner *et al* (2005) states that in Botswana there is an established public consultation forum referred to as the Kgotla where communities are able to air their views. The set up can help in the introduction of green building when it is eventually introduced to the communities. Public involvement in the planning process is advocated because planners cannot create sustainable communities without commitment from community residents to change the way they live on the land and their attitudes towards the environment.

For sustainability to be ensured, resource commitment must prevail. Berke *et al* (1994) argue that technical skills from planners and funding sources are necessary to prepare high-quality plans. However, Mosha (1996) and Cavric (2004) lament that in Gaborone; there is general shortage of planning manpower which is a hindrance to proper planning and sustainability. The above authors have also observed that urban councils like Gaborone depend on central government for funding, hence there is a limit to how much can be done due to budget constraints. The eventuality is that there needs to be more resources if the sustainability objectives are to be achieved. Conroy

et al (2004) confirms these sentiments by drawing conclusions that planners need to be trained and supported if any results are to be achieved.

Part of the support required for sustainable development is from the political leaders and the community at large. On the same issue, Cavric (2004) agrees that political and public supports are both important elements in environmental management, otherwise decisions might be taken by what he terms "hidden business forces". He states that where public pressure for improvement of environmental restrictions is missing, governments tend to forego action or consideration for the environment. Political support however should be censored to avoid a situation where there might be interference in planning practices.

UN-Habitat (2009) also caution against political interference in planning which sometimes results in developments on the ground differing with what appears on the plan. This is reflected by the sentiments by Cavric (2004) that in Gaborone, government has recently allocated a piece of land that is now River Walk Shopping Centre within the 50 year flood plain of Notwane River which he attributes to lack of public response to political decisions. Just like with public participation there can be no success if the political leaders view sustainability differently from planning angle - for instance if priority is given to economic and social goals only and the environmental is neglected.

In Botswana according to Cavric (2004), sustainable development has been accepted as depicted through the national vision commonly referred to as Vision 2016 which as he states, is based on Local Agenda 21 principles. The vision is a national position which the nation aspires to have achieved by the year 2016. Local development plans are also prepared with a vision statement contained in the document as depicted by the Gaborone City Development Plan Draft (GOB, 2008). The question that comes to mind is if sustainable development has been accepted locally then what is holding

back the interpretation of National Conservation Strategy and how far is green building being practiced.

Buildings have been identified by Ding (2008) to contribute to environmental degradation through inefficient use of materials and emission of GHG during their operation hence there is need to come up with sustainable buildings. Sustainable buildings are defined the same way as green buildings by Kibert (2009) which means they use materials efficiently while they minimize their carbon foot print. Buildings are not the only ones that need to be adapted; the urban form also needs to be reconsidered if issues of sustainability are to be met.

2.8 Sustainable Urban Planning

Sustainable urban planning concept is derived from the main definition of sustainable development, and it is about conservation of resources, social welfare of the dwellers and environmental management. It can therefore be drawn that sustainable urban planning is planning that ensures achievement of sustainable development in an urban area by ensuring proper land use management.

Sutcliffe (1980) states that past urban development was characterized by free market with no land and resource management. Town Planning came into the picture as a rescuing measure to the situation which was characterized by haphazard location of certain activities with a lot of land conflicts. However Un-Habitat (2009) observes that urban planning is faced with new challenges that it has to respond to accordingly. The challenges include urbanization, urban sprawl, pollution, environmental degradation, in-efficient use of building materials and climate change UN-Habitat (2009).

Urban lifestyle and urban form are taking a different shape nowadays in Gaborone and hence there is need for urban planning to respond appropriately. The city is way past the form described by Mosha (1996) as a small city with few developments but the situation at hand now points to the contrary. Growth of this nature obviously brings along issues of land consumption, green house gas emissions from transport and buildings and resource depletion, to mention a few. It is therefore imperative to device vigilant planning of the city to tackle the urban problems and Bramley *et al* (2005) and UN-Habitat (2009) observed that planning makes a strong difference to urban form outcomes. Planning policies need to be revised where they have weaknesses and they need to be religiously implemented, for instance to encourage city compactness to avoid reliance on vehicles.

One of the goals of new urban planning according to Bramley *et al* (2005) and UN-Habitat (2009) is emphasis on redeveloping areas in the urban area that have been developed before instead of new land that amounts to sprawl and encroachment into land reserved for other uses. Development of brown fields is important because land is a finite resource and Gaborone also has a boundary, which means sooner or later there is going to be no more space for expansion (Cavric 2004).

Compact city type of development is one way of addressing urban sprawl which as Bramley *et al* (2005) explain, adversely affects the quality of life within cities, through a combination of social exclusion, fiscal effects, and the decline of traditional town centers. However caution has to be applied when introducing the concept of compact urban form as an alternative to urban sprawl because it might affect the social and environmental capacity due to what some critics' call 'town cramming'.

Another goal of improved urban form as observed by Bramley *et al* (2005) is promotion of mixed land uses which results in reduction in the need for use of automobiles. This is achieved through interaction of transport plans with other plans. The above characteristics are important drivers to sustainability as they ensure

optimum use of the limited resources while taking care of pollution reduction through use of non-motorized transport that is supported by close proximity to services and use of public transport.

This study however intends to establish the reasons behind the non practice of these concepts or barriers for re - development of previously developed areas like the main mall and the "Village" neighborhoods. It does not only focus on government initiative only but also considers the role of the private sector as to why they are or are not incorporating these concepts in their developments.

2.9 Environmental Management Regulation in Botswana

There are several pieces of legislation that deal with environmental management in Botswana, some of which are national while others are international but interpreted into the local context. In a bid to respond to environmental conservation and sustainable development, GOB (2004) indicates that the significance of Agenda 21 and Local Agenda 21 is to provide one important avenue through which environmental issues are infused into the physical planning processes. Botswana's attempts to address the provisions of this agenda and benchmark it against physical planning is in order to ensure that local physical plans are drawn in accordance with international objectives for the environment.

Botswana as a country has taken a step towards implementation of international environmental policy. However, what is questionable is the interpretation of the policy into the practical local situation and whether the local interpretation addresses the interests of green building. Cavric (2004) laments that the country has a lack of qualified and skilled engineers and planners, so that being the case, implementation of the policies would definitely suffer. Also questionable is, who are the players in

ensuring implementation of the environmental legislation in Botswana? It should be noted that even though the official position as stated above is that Physical Planners should learn and implement these policies, they are in essence the responsibility of other ministries and departments as per Keiner *et al* (2006). This is not peculiar to Botswana, as Watson (2009) observes that planning and environmental management often operate in different government divisions.

A unison law governing green building is necessary in order to combat the ever ongoing environmental challenges brought about by buildings and not only concerned about environmental issues on a broad basis. If introduced, for practice by physical planners, the policy would also remove duplication of efforts as it would be clear as to who does what and when.

2.10 Town Planning and the Urban Environment

Town planning which is defined in GOB, (1997) as "the art and science of ordering the use of land, sitting of buildings and communication routes …", is necessary in this discussion because it is a means of managing the environment whose degradation is the key issue in this study address challenges alluded to above (GOB 1997; Hall 1992; Watson 2009; Conroy *et al* 2004). The idea of town planning being pivotal in alleviating urban and environmental issues is also supported by UN-Habitat (2009). Urban issues identified by Watson (2009) include rapid population growth, lack of access to shelter, poverty and inability to develop infrastructure and services to match the growing population. Environmental issues on the other hand include climate change, resource and energy depletion and others (UN-Habitat 2009; Watson 2009).

Some of the identified problems are however a result of previous spatial or land-use planning. The role of spatial or land use planning is to ensure order in land use and protection of the environment, (GOB 1997). However, Naess (2001) asserts that planning of land uses including buildings and infrastructure can directly or indirectly

cause environmental issues. This is true considering that the location of a building and its orientation have an influence on the amount of building materials used including energy and water required.

Urban sprawl due to low development densities in Gaborone for instance are regarded as an indication of planning failure, (Cavric 2004). People working in the city rely on auto-mobiles to reach the city centre or their place of work which according to Cavric (2004) has an issue of air pollution and impact on oil depletion. Spatial planning therefore has to be reconsidered to ensure that it is in harmony with the environment by designing plans which ensure sustainable developments.

Despite the above mentioned weaknesses, Barton (2005) states that through design of town or neighborhood plans town planning contributes to the improvement of health of the population by the reduction of air and water pollution and greenhouse emissions, combating the threat of climate change. Planning also has the capability of influencing water and solid waste recycling which is important for the environment (Naess, 2001).

The current major challenge for planning is to identify ways of replacing the modern day problems of environmental strain and consumption of resources (Naess 2001, UN-Habitat 2009). Cavric (2004) emphasises that the proactive approach towards development and environmental issues is the basic premise for the existence of planning within the context of scarce natural and social resources. Planning is therefore an important aspect in the issue of sustainability and green building which also base their goals on development that is cautious about resources and environment.

As part of the integrated design process of green building, developers are expected to develop high density residences around transport nodes to ensure reduction of dependence on transport. Another way is through the allocation of mixed land use

rights where for example an office building may be developed with residences at the upper floors then people may occupy the same building they work in. This factor of transport reveals the positive relationship of town planning with green building which promotes non motorized transport and public transport.

However, the question that arises is whether Gaborone City Council Town Planners promote this type of development or perceive green building as independent from their role. Planning as stated above as well contributes to reduction of air and water pollution, greenhouse emissions and combating the threat of climate change but what needs to be reflected clearly is how this is achieved. Croxton (1998) however warns that, many building professionals assume that if a building complies with code, then it must be energy efficient, however for a building to meet the code means that if the building were designed any worse it would be against the law.

After designing building plans, developers or their respective representatives be it architects or project managers, submit the plans to the Local Authority, in this case Gaborone City Council for approval and issuance of planning and or building permission. The plans may either be approved as they are, sent back for variation and resubmission or they may be rejected depending on their conformity with planning standards GOB (1997). Plans for green buildings are also subject to submission and approval. It is deemed critical that the issue of town planning in this regard is of importance.

2.11 Town Planning in Botswana

2.11.1 Town Planning Act

Town planning in Botswana is instituted through the Town and Country Planning Act, 1977, Cap 32 which represents the modified British version by approach and treatment of principal articles, adapted to the conditions in Botswana (Wekwete 1995; Keiner et al 2006; Molebatsi 1996). It is applied in areas of the country that have been declared planning areas (GOB 1997; GOB 1992). In these areas, planning, land use control and development control are regulated through the system of planning and building permits. It is the main regulation that gives rise to establishment and implementation of the Development Control Code and the Urban Development Standards which both regulate development in urban areas Mosha (1996). The initial type of planning in Gaborone was that of a 'Garden City' which was developed by Ebenezer Horward and its objectives were to bring greenery into the urban centers (Hall 1992; UNHABITAT 2009).

As stated, the act is the tool used for controlling land use and development control (in areas declared planning areas like Gaborone which in this case covers both residential and nonresidential land uses. This function is covered through consideration of applications for planning permissions for developments whose scope and scale make the Town and Country Planning Board's approval necessary (GOB 1992). The act is discussed here to point out its relevance or relationship in the practice of green building. It is important to notice that Gwebu (2004) asserts that if the provisions of the act are fully implemented, the environmental challenges may be addressed.

Williams (2000) also echoes Gwebu's sentiments by stating that making plans is important in determining the quality of the environment, therefore effective controls need to be put in place to avoid environmental problems including loss of open space through people occupying areas vulnerable to hazards like flood plains, air and water

pollution. Because of the assertions above, it is therefore critical to consider the provisions of the act which are relevant to the issue of green building and or environmental management.

The main aim of the TCPA is to ensure that physical development of land is done in an orderly manner, including preservation and improvement of amenities through the issuance of permission to develop land (GOB, 1977, UN-Habitat 2009). With this aim which does not clearly state environmental protection, the question is, does the act consider it or can it just be deduced that because the principle of the act is preparation of development plans it means harmonization of conflicting land uses according to the limited land resource and by implication the environment will be protected.

Whereas the act specifically provides for the preparation of plans for settlements, districts and local urban areas in a bid to conserve and improve the development, it does not specifically order decision-makers to take account of environmental factors. However, the act gives powers to the responsible Minister to make a special order applicable to a specified area and to impose conditions or limitations that any development is permitted (GOB 1977, Cavric 2004).

Giving prerogative powers to the Minister is a weakness of the act because it must be seen to be enforcing its principles. There is fear that provision of prerogative powers might lead to abuse even where environmental protection is required (Cavric 2002). It can be concluded that an examination of the planning act gives an impression that it does not fully protect the environment although Gwebu (2004) asserts that if provisions of the act are implemented then the environment would be protected.

Molebatsi (1996) counters the assertion by stating that it is doubtful if the issues of the environment have been fully incorporated into the country's planning practice which covers issues of the act. The countering statement seems to be true because the act (TCPA) itself is too wide on the issue of environmental sustainability except conservation of environmentally sensitive areas, cutting of trees and woodlands and orderly land-uses. Green building is concerned with development of the allocated piece of land in a way that minimizes resource consumption at construction and operation, management of waste including greenhouse gas emissions.

2.11.2 The Development Control Code, 1995

An assessment of the code is critical because it is a major tool used for appraisal of building plans for issuance of planning or building permission. The Botswana Development Control Code of 1995 requires that the design of commercial development should aim at providing for a safe, healthy, useable, serviceable, pleasant and easily maintained environment for all users (GOB 1995).

It would appear that the code endorses the principles of green building, especially where it states in clause 2.1.1 (iv) that there should be reduction in dependence on non-renewable and scarce resources, (GOB, 1995). However it is stated in GOB (1995) that the above objectives of the code are only guiding principles but not legally mandatory, in other words they can be waived. The passiveness of the code therefore makes its effectiveness questionable. Eisenberg et al (2002) state that codes are sometimes regarded as hindering innovation in development, which incidentally extends to environmentally conscious buildings.

These codes are important in this study to assess whether they encompass the principle of green building however, they are not mandatory in their provision which is a disadvantage. Deringer *et al* (2004) argues that while building codes exist in a

number of developing countries, they are often only on paper due to insufficient implementation and enforcement, corruption and other problems. Just like the TCPA, the code plays a passive role as opposed to mandatory on important environmental concerns.

2.11.3 Urban Development Standards, 1992

The Urban Development Standards (UDS) is another town planning tool used as a guide in the preparation of development plans and detailed layouts in urban areas that have been declared planning areas (GOB 1997). Through the UDS, minimum plot sizes for residential, commercial and other uses are recommended. The standards are important in the issue of green building by providing guidance as to what sizes of amenities may be developed in which areas. Another contribution of is providing engineering standards, which deal with guidelines for roads and other amenities (GOB 1992).

When designing green development, consideration is given to transport modes, including provision for public transport lanes. The UDS of 1992 is commendable for reduction of plot sizes from the original sizes although they are still regarded as generous. However, Cavric (2004) raises concern that the current sprawl of Gaborone is partly as a result of the UDS which prescribed big plot sizes.

2.11.4 Building Control Act

The Building Control Act (BCA) of 1962 is an act executed by council Engineers and Architect is used in conjunction with the Urban Development Standards and the Development Control Code, in laying down the platform for engineering guidelines for developing land. The BCA is regarded in UN-Habitat (2009) to be too restrictive

and does not take into account the locally available building materials. This is a weakness considering that imported materials have transport implications which use fuel and emit gases. They also come at a cost and may not necessarily be suitable for use in the new location that they are imported to.

2.12 Green Building

Green buildings are defined as (Shiers, 2000; van Wyke, 2009; Yudelson, 2008) buildings which are designed and located in a way that they render minimal carbon foot print. The lower carbon footprint is achieved as stated in Yudelson (2008) through careful selection of lower environmental impact building materials for construction and operation. These qualities of GBs are important in the sense that they provide an investment platform that reflects the use of materials in a way that assures non-depletion or at least continuity in the supply.

2.12.1 Common design features for green buildings

(i) Green buildings are designed such that there is abundant day lighting (sunshine) getting into the building resulting in reduced or no need for use of energy at all (Shiers, 2000). Natural light is clean and therefore does not produce any detrimental effects like green house gases. This is an important feature because while conventional buildings are known to use a lot of non-renewable energy, GB uses daylight which does not pollute the environment.

(ii) Air quality. The buildings promote air circulation through generous open able windows and atrium which leads to improved indoor air quality (van Wyke, 2009, Yudelson, 2008). The equipment used also be it fridges and air conditioners are selected such that they are a clean type that do not emit GHG (Shiers, 2000).

(iii) Low energy consumption is achieved by a range of techniques including the use of natural ventilation rather than air-conditioning, heat recovery systems and the use of thermal mass, careful orientation and low-energy lighting design, (Shiers, 2000).

(iv) Minimizing site impact through sensitivity to site ecology. The buildings are located in environmentally suitable terrain and are landscaped in line with indigenous vegetation of the site. The landscape is selected carefully with no use of harmful pesticides and grey-water is re-cycling for landscape irrigation (van Wyke, 2009). Green building also promotes environmentalism through green roofs which is growing flowers and vegetables on roof tops. This is a way of compensating the vegetation removed during site clearance to pave way for the building, (Shiers (2000, Yudelson 2008)

(v) Water. The buildings reduce their use of portable water instead they are fitted with water efficient appliances including manual urinals and irrigation systems. Storm water is harvested for irrigation purposes among others (van Wyke, 2009).

(vi) Use of existing transport networks – Green buildings promote densification around transport nodes so that it can be easily accessible for tenants to use public transport including walking. They also have a clear transport policy such as car-sharing, (Shiers, 2000); Lucuik et al 2005).

(vii) Careful specification of lower environmental impact building materials, green building ensure reduced environmental impact through use of building materials that have lower impact including materials like wood which are renewable, (van Wyke 2009) re-use of existing buildings, instead of demolishing and constructing new buildings, existing ones are re-used.

Lucuik et al (2005) understands green building as the typical use of an integrated design process (IDP), from the building project inception to the design stage through operation until after use or normal operation. Through the IDP, how a building would possibly affect the environment is evaluated holistically then a different design which would minimize the impacts is opted for.

2.12.2 Green Building Benefits

Different studies that have been undertaken reveal that Green buildings have more benefits which conventional buildings do not have. The benefits can be grouped as environmental, economic and social and these benefits include;

(a) Benefits related to the environment

By definition, green buildings seek to preserve the natural vegetation and ecosystem that exists at a particular location prior to their construction, Wyke (2009). They are said to be buildings that minimize their ecological foot print and they are not to be built on environmentally sensitive areas. Green building office parks are also characterized by huge chunks of landscape which is usually done using vegetation that existed in the given location or the type that is compatible. They also encourage non-use of pesticides, artificial fertilisers and lead containing paints. These are but means of protecting the environment ibid.

Improvement of out-door air quality is achieved through among others the use of fewer vehicles like car pooling and or public transport as the buildings are to be located along major routes which results in a significant reduction in green house gas emission from use of cars, (EPA; van Wyke, 2009). Green buildings are also designed in such a way that they use grey water for their irrigation and their water closets are set to use non portable water also in minimal amounts as opposed to conventional buildings. Also included in their design, is storm water harvesting appliances which ensure that city polluted water which could be swept by storm water to water bodies is collected. Again through their quality of recycling, re-use and reducing of waste, this prevents pollution and taking of huge land for landfills and massive waste water ponds.

(b) Economic benefits

Kats et al (2003:8), state that green buildings have reduced operating costs: they improve occupant productivity through improved indoor air quality and by optimizing life-cycle economic performance. This quality of green buildings is important as it raises their demand by tenants which leads to higher rentals that are eventually capitalized into higher property values in the long term.

(c) Social benefits

Another benefit of green buildings is ensuring better indoor working environments which have the potential to escalate the profitability of buildings by increasing customer satisfaction, increasing worker productivity by up to 16 percent, and reducing employee absenteeism by as much as 45 percent (Heerwagen 2000, in Richardson et al 200). The buildings also get equipped with systems that are able to control temperature and ventilation along with increased natural lighting. This is attributed to an improved employee attendance and health.

2.12.3 Green Building Rating Systems around the World

In order to ascertain whether a building meets the qualities of a Green Building, there has to be some sort of assessment and Ding (2008) states that there are standards already set to evaluate the buildings. The systems organize concerns throughout the building process from design, construction and operation, ensuring integration of environmental sustainability in the building process.

Ding (2008) explains that the primary role of an environmental building assessment method is to provide a comprehensive assessment of the environmental characteristics of a building using verifiable set of criteria and targets for building owners and designers to achieve higher environmental standards. This group of assessment tools is said to be purely based on a criteria system which according to Ali et al (2009). It is a system that assigns point values to a number of parameters or environmental impacts. It can be noted that after the assessment, projects are awarded certificates indicating the level of achievement of environmental sustainability. However, the motivation part of the system is lacking, which is a way of ensuring that those that are scoreless can reorganize their projects.

The second method which the rating tools are based on is building life cycle and the method can help in solving existing building problems, limiting environmental impacts, creating healthier and more productive places and reducing building operations cost. Ali et al (2009) observe this as an important aspect of the assessment tools because it is a holistic assessment which takes care of not only planned buildings but also existing ones. Life cycle analysis considers the building design, building materials and local utility options, including the cost of acquiring, owning and disposing of a building. Consideration of the whole life of a building is critical

because buildings are normally long term structures which translate into long term environmental impacts if not attended to from the onset (Allacker et al 2006).

Different countries according to Ding (2008) have established Green Building Councils which are voluntary organizations which pioneer the practice of green building. The councils are affiliates of the World Green Building Council. Worth noting is the fact that these councils have either developed a green building rating system in their country or are implementing one which has been developed through modification of another country's system, for instance the South African rating tool is a modified Australian tool, (Ding 2008; Van Wyke 2009). There are several environmental assessment tools in the world and these are discussed below.

2.12.3.1 BREEAM

BREEAM was established in the 1990's and can be said to be the precursor of many tools as most of them were established through modifying the UK version to suit individual countries conditions (Ding 2008). The tool falls into the category which Ali et al (2009) refers to as purely criteria-based and is used to assess new offices. In this method, individual buildings or projects are issued a certificate indicating their rating result (fair, good, very good or excellent) according to Ding (2008) whereas Ali et al, (2009) classifies the rating result from small to large environmental impacts and then issues a certificate.

2.12.3.2 LEED

The US based assessment tool is used to assess both newly built and old buildings that undergo large scale renovation (Ding, 2008). Like the BREEAM, LEED is also criteria-based and the two are methods developed in the developed countries whose environmental issues are different from those of Botswana (as a developing country): in definition and magnitude therefore, they cannot be applied in the former.

2.12.3.3 South African Green Star Rating Tool

The South African method (Green Star SA) focuses on the life cycle of a building and it acknowledges the social and economic issues (Gibberd, 2005). Through the country's green building council, the Green Star SA (which is the office version) was launched in November 2008 as a modified version of the Australian assessment tool (Van Wyke (2009). The Green Star SA has several objectives but the key one is to reduce the environmental impact of developments with special reference to the property sector which is responsible for a large proportion of the world's resource use and waste generation, including greenhouse gas emission, (Van Wyke (2009). It cannot be overemphasized how the building sector is of great importance to a country when addressing environmental issues in the modern day.

Launching of Green Star SA could not have come at a better time, considering the economic position of RSA. It is expected that the country must also be advanced when it comes to Green Buildings. However, Engineering News 2007 considers the concept to be still unpopular in the country. It is also an important innovation for Southern African countries including Botswana which must follow suit.

2.12.4 Attributes for Green Buildings

Different green building rating tools consider several attributes in order to rate building projects. The attributes are as follows:

Table 2.3: Attributes of Green Building

Name of Rating tool	**Developer Year**	**Categories**	**Versions**	**sources**
BREEAM	Building Research Establishment (BRE) in 1990	1. Energy use 2. Transport 3. Water 4. Ecogoly 5. Land use 6. Material 7. Pollution 8. Health and well-being 9. Management	1. Offices 2. Housing 3. Healthcare 4. Courts 5. Industrial units 6. Prisons 7. Retail 8. Schools 9. Multi-residential 10. Neighbourhoods	www.breeam.com
LEED	United States Green Building Council (USGBC) in 1993	1. Energy and atmosphere 2. Water efficiency 3. Sustainable sites 4. Materials and resources 5Indoor environment quality(IEQ)	1. Offices 2. Homes 3. Neighbourhood development 4. Retail 5. Healthcare 6. Schools	www.usbgc.org/LEED

Name of Rating tool	Developer Year	Categories	Versions	sources
		6. Innovation		
Green star	Green Building Council of America (GBCAUS) in 2003	1. Energy 2. Transport 3. Water 4. Ecology and use 5. Emissions 6. Materials 7. IEQ 8. Management 9. Innovation	1. Offices 2. Retail 3. Schools 4. Industrial buildings 5.Mixed use residential 6. Mixed use 7. Healthcare	www.gbcaus.com

Source: Van Wyke (2009)

2.12.5 Green Star SA Categories

The rating system for Green Star is divided into nine categories of environmental impacts (van Wyke, 2009). Innovation is included as one of the categories because of the mere reason that it has to be recognized and encouraged. Global warming and climate change come about with unusual challenges, therefore property developers and planners must be seen to be innovative in their projects - they must not think in a limited fashion. If human beings are to continue coexisting then there has to be innovation.

2.12.6 Botswana Experience

Botswana as a country does not have a green building rating tool and as such this study seeks to establish whether the existing policies and institutions in the country

can be said to be leading in the implementation of green building. The first experience can be drawn from the office of the Botswana Technology Centre (BOTEC) which is a parastatal organization that government established in 1979 and is located in Gaborone.

BOTEC headquarters or Maranyane house as it is referred to locally, is a demonstration project showcasing passive solar design applications to achieve thermal comfort. The applications include solar shading, orientation, evaporative cooling, solar chimneys, natural lighting, efficient fittings, thermal mass and water conservation. The project is a response to concerns from the public about the unbearable environment in buildings due to Botswana's hot and dry climatic conditions (see BOTEC Information leaflet, (2008).

Figure 2.1: BOTEC House picture



Source: BOTEC Information leaflet, 2008

Maranyane house was constructed in 1998, Stucke et al, (2001) and is one office property that can be regarded as designed in line with green building design principles. However, the owners refer to the design as energy efficient; therefore the point of departure needs to be established. It is however unfortunate that Douglas et al 2004 states that the building lacks success, especially in winter, due to what they attribute to failure to design according to the local weather context.

Orapa House built more than 25 years back and belonging to the diamond giant, Debswana is another example of a structure that has followed environmental concern principles. The building has a north-south orientation and was designed to use natural lighting, www.botswana.world-guides.com/botswana_attractions.html

The above stated buildings are a reflection that even though there might not be green building policy in Botswana to some extent, major institutions put into use the principles. The question that arises is why then has government not rolled out the practice of green building which would be evidenced by the number of new government buildings following the principle.

2.12.7 Critique on the environmental building assessment methods

Although the tools are critical aspects of revealing the sustainability of projects, they have their shortfalls. Ding (2008) states that they are less useful for selecting the optimum projects which means that they are not applicable in feasibility analysis of projects. This implies that different project ideas need to be appraised somehow by the investor then the tools can be used to appraise it for environmental soundness. Issues can best be addressed during project selection to minimize waste of resources. This is important in planning purposes because then land will be utilized for the best use with minimal impact to the environment.

Some tools like BREEAM, BEPAC, LEED and HK – BEAM are criticized for their lack of consideration for financial aspects which contradicts investment objectives because developments are undertaken for the purpose of financial return. Ding (2008)

argues that aspects concerning the environment and financing of the project should be considered simultaneously, otherwise, lack of consideration would prove them to be unpopular.

The tools are further criticized by Ding (2008) for being too comprehensive whereas environmental issues are complex, thereby leading to the need for large quantities of detailed information for assembling and analysis. The weighting, measurement scale and evaluation criteria are deemed not to be practical. This is true because environmental issues are quantitative rather than qualitative which means assessing issues on a set scale like fair to good or small to large is not appropriate for the type of issues being assessed - the tools need to focus more on life cycle assessment of environmental issues.

Another critique by Ding (2008) is concerned with applicability of tools in different regions and this is fair because different regions have unique conditions which need to be taken into account. As already alluded to, the methods are applied after project selection but they are important for guiding developers into opting for environmentally clean alternatives. Despite the stated criticism of Green Building tools, they are still critical in the wider promotion of the concept.

2.13 Challenges for Green Building

In this section, the point is to analyse the issues that hinder the wide popularity of the concept as a common building practice. It also considers plans and development procedures that have resulted in the current demise of green house gas emission and sick house syndrome.

One of the major barriers to the popular construction of green building is apathy. This is supported by Papanek (1995) who states that even though people might be experiencing sick building syndrome, some are simply unwilling to take action towards improvement, thus accepting the status quo. Kibert (2009) however attributes the lack of action to lack of awareness by both the society and political sector.

Another challenge for green building outspread according to Gibberd, (2003) is that environmental issues are not a major concern to developing countries except the socio-economic development of these nations. Political leaders and the general public need more information dissemination as to why green building must be embarked on as opposed to conventional building. This would ensure that the available resources that were already designated for building can then be used appropriately. The political sector is also important in enacting change of policy and leading by example in the issues of environment by ensuring that government projects are green.

There is also an issue of awareness, although some people might be aware of issues of climate change, GHG emissions and sick building syndrome, they might not be aware of a living alternative like green building to opt for. Investors might be willing to spend their money on procuring cleaner buildings but lack of adequate information might probably bar them from that. This therefore means that to overcome the problem, heavy marketing activity is required like workshops, seminars, client events, partnerships, advertisements to raise awareness and show the need.

Another issue which is a challenge to the adoption of green building is that of cheaper alternatives as opposed to the principles of green building, for instance quarrying for new sand instead of crushing building rubble and using it as a fill up when

constructing new roads and offices. As long as alternatives are cheaper and there is no law enforcing green building, the status quo will continue for a long time.

Kats (2003) asserts that a challenge to GB is that their construction costs a bit more than conventional ones whereas the financial benefits are more directed to occupants and not property owners. Studies reflect that occupants save on water and electricity bills and also healthy employees who do not spend time in sick off, (Kats 2003). The landlord does not enjoy direct financial benefit unless they charge higher rentals which would capitalize into higher property value but the question is whether consumers are willing to opt for green buildings over conventional ones.

2.13.1 Challenges to green Building in the United States

According to Kibert CJ, (2009:12), barriers to green buildings include financial disincentives, insufficient research and lack of awareness. Financial disincentives include real and perceived higher first costs which are about investor's unfounded perception that green buildings are more expensive to construct than conventional ones. One other factor raised before is that those investors developing for rental purposes usually do not perceive the benefit of green developments because although it is them that incur the high cost of development, the benefits of reduced water /energy and medical costs are enjoyed by their tenants, not them. This cannot be taken as a good enough reason because all these benefits lead to a higher rent which capitalizes into a higher property value for the owners benefit.

Kibert (2009) also attributes lack of sufficient research to the unpopularity of green building which also has a component of inadequate funding. As much as environmentally sustainable development is suffering lack of prioritization over socio-economic goals, green building also suffers insufficient research funds most likely because funds are for other issues. There is also an issue of risk aversion by the

general society which should be developing green buildings. These barriers should be overcome to ensure popular implementation of green building concepts.

2.14 Green Building Concepts and Town Planning

The fundamental policy areas of town planning that engage with green building are discussed in this section. The TCPA of Botswana is an act of parliament that provides for the use of land and protection of the environment and green building is also concerned with protection of the environment. As stated in the act, any planning carried out for a particular area must be weary of sensitive land / environment, (GOB, 1977). Such consideration is important if practiced as no developments would infringe the environmentally sensitive land. The act however does not expand to what levels environmental protection can be achieved which is a weakness.

Re-designation of the previously developed low density areas is one of the attributes for green building and town planning achieves this through plot / neighbourhood intensification. Low density development as per Lehmann (2007) leads to urban sprawl which results in dependency on automobile transport that increases greenhouse gas emissions. The mall area in Gaborone and the surrounding neighbourhoods are possible redevelopment areas which have all the services and are within the transport routes. Lehmann (2007) supports the redevelopment of the city center by stating that high population density and compacted buildings would offer all needs within walkable and cycling distance.

Redeveloping these areas has previously been planned through the Gaborone Central Business District Master of 1995 (GOB, 1995) however, the planning

standards followed the current UDS which are accused of being generous by Cavric (2004). The standards for water ,landscaping, energy and parking are still the ones for 1995 when issues of climate change were not prevalent. The above scenario would reduce the incidence of further urban sprawl, however the current Gaborone City Development Plan restricts plot intensification in the said locations.

As Naess (2001) states, planning has a capacity to influence water and solid waste recycling / reuse. Green building promotes on-site collection of storm water for landscaping and recycling grey water thus if planning could practice these then GB would be achieved. The DCC however promotes storage and collection of waste but does not reflect sorting at source for reuse / reduce / recycling of the waste. It can however be assumed that this might be catered for in other policies nonetheless planning is key hence they should be reflected. On the other hand, the current development plan under review proposes that a regional landfill must be identified but there is no mention of sorting the waste hence it can be concluded that the review plan does not take on board this green building attribute.

It is stated in the plan just like in the UDS that on site storm water retention must be considered in a bid to reduce the volumes that flow into drainage lines (GOB,1992). This provision is important however it is not mandatory in the UDS. For a country with a low rainfall and water problems, it should be enforced to regain storm water to be used for landscaping.

Since the current Gaborone development plan under review is the most recent document that is expected to be prepared under the guidance of international

conventions on climate change and environmental protection. It however appears the plan still follows the national guiding statutes which are outdated and do not match the modern day urban challenges. Development recommendations are wide in addressing environmental issues like "provision of adequate greenery and open space network system for the city", GOB (2008). From the above citation, "adequate" is not defined therefore can be subjective.

Landscaping requirements are not specified in the guidelines and this leaves a possibility of under provision of ground coverage. When considering the Draft Gaborone City Development Plan, clause 5.5.24 (ii) provides that urban agriculture must be permitted within backyards in residential plots for food security (GOB, 2008). This is an important provision considering the previous planning that assumed an autonomous city with food security/provision and it would ensure achievement of sustainable city.

Reduction of dependence on non-renewable energy seems to be promoted by the Urban Development Standards (UDS). The UDS clearly states that Botswana is a country with extreme weather which therefore requires for north / south orientation of plots to reduce the need for indoor heating / cooling (GOB, 1992). It is stated in the UDS that the country has ample sunshine which should be taken advantage of by building such that maximum sunlight is achieved. The above provisions are important however what is lacking is to identify if plans can be rejected on the basis that they do not conform to this standard.

The Development Control Code does not fully engage planning in environmental protection because of its passive provisions, (GOB, 1995). It can be waived as it is only a guide whereas GBs are a requirement in the era of

climate change. The Building Control Act states that all structures must be built with fire resistant materials, (GOB, 1962). This standard for materials limits the use of materials such as grass and wood in Gaborone which could be suitable to the climate.

Urban planning policies and regulations can be regarded as providing for green building attributes to some level however, they are passive and general. The TCPA gives the responsible Minister the power to vary a resolution made by the Town and Country Planning Board which is a team of experts and this could result in the environment being negatively affected. The construction of Molapo Crossing and Riverwalk shopping complexes according to Cavric (2006) are some examples of incidences where the sensitivity of the environment was compromised. Planning policies therefore need to be reviewed in line with current urban and environmental perspectives.

2.14 Conclusion

From the literature review it has been established that cities around the world including Gaborone are faced with urban and environmental challenges. The city is faced with effects of past planning failures, shortage of resources and is vulnerable to climate change. Conventional buildings also contribute to green house gas emissions leading to climate change. However the emissions can be mitigated by building environmentally sustainable buildings which use materials efficiently while their carbon foot print is low. This study also identifies that if not practiced correctly, town planning can also lead to increase in demand for energy and resources whereas it is regarded as the mitigation option for the environmental problems.

Town planning policies in Botswana were adopted from British policies during the colonial period which follows the master plan type of planning. The planning statutes are rigid and behind time which makes them irresponsive to modern day urban challenges. This should be corrected more so that city management and previous studies have revealed that the city is challenged by past planning failures which have an implication on the use of energy and reliance on automobiles that emit green house gases. The public participation is important in town planning and it has been observed that in Botswana there is a set up for consultation in place so planners must engage.

Green building is a subset of sustainable development thereby promotes the achievement of the bigger objective of environmental management. However, the concept has not been addressed by the town planning policies and codes despite the fact that they have more benefits including financial as opposed to conventional ones. The failure to promote the practice through town planning is considered to be a result of lack of awareness by planning authorities and political leaders on issues of the environment. This lack of awareness is not clear considering the fact that urban challenges are being experienced through shortage of land, water and energy as well as well as unreliable rainfalls and heat waves among others. There has to be an in-depth inquiry of what is leading to the lack of action.

The fact that there is no government policy that promotes green building does not stop the public from initiating the process. Green building councils worldwide, were established by non-governmental organisations which can still take place in Botswana. There are examples of resource efficient buildings in Gaborone though not many but if the owners of these buildings could campaign for outspread of the same design then the concepts would be easily internalised.

Green Building tools were established to assist investors to select the best project that is environmentally friendly, however they have their shortfalls. They are criticised for being less useful for selecting the optimum projects which means that they are not applicable in feasibility analysis of projects, however their standards are greatly important in environmental management.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Overview

This chapter describes the framework within which the study was carried out. It describes the research design including the population of study, sampling procedures and data collection procedures. It also describes the data analysis methods used. The study is a case study that focuses on policy and regulation analysis of town planning in Gaborone. It follows content analysis method basically because the planning process practiced is an implementation of what is documented.

3.2 Research Method

The study is guided by three objectives, the first being to analyse Gaborone planning laws, regulations, and policies in relation to green building concepts. In order to achieve this, documentary analysis method was selected. Document analysis refers to a situation where data is collected through analysis of special documentation which might include photographs, art and even television programmes (O'leary, 2004). This should not be confused with literature review which primarily focuses on books and articles in relation to the subject of investigation, and as O'leary (2004) suggests, the researcher's role is limited to gathering, reviewing and interrogating relevant documents.

For this research, the researcher studied some planning documents to reflect whether they embrace any green building concept. The Botswana Town and Country Planning Act, Development Control Code, Gaborone City Development Plan (1997 - 2021) are some of the documents that were studied.

The second objective which is evaluation of green building concepts in planning practice involved a case study method through which Gaborone plans were audited to establish the presence of green building attributes. According to Melville (1996) a case study is suitable for researching on a poorly understood situation. This method was found suitable considering that green building is not a widely known phenomenon and the researcher sought to establish how much green building attributes are conceptualized in the city plans.

Questionnaires were also prepared and administered to identified respondents to further evaluate the understanding and incorporation of green building concepts in Gaborone town planning. Questionnaires were also administered to corroborate the findings derived from the literature review and documentary analysis to test if the same views are considered by respondents. Melville (1996) describes questionnaires as a list of questions administered to respondents. White (2002) defines questionnaires as a series of questions, each one providing a number of alternative answers from which the respondents can choose. This definition is however varied a bit by the researcher because of the mixed methods and therefore the questions are both open ended and those with a range of answers to choose from.

The three methods of data collection were applied as a triangulation approach to minimize the shortfalls of each one of them to complement each other. Both qualitative and quantitative approaches were used in line with White's (2002) argument that it is at times important to use both methods (triangulation) to reduce the weaknesses of either whereas benefiting from their combined benefits. Newman & Benz, 1998 as cited in Creswell (2003) also advance that the situation research currently is neither quantitative nor purely qualitative but is rather in the middle of the two approaches.

A further consideration of triangulation by Neuman (2006) is the idea that assessing something through several points of view improves accuracy. Qualitative research concentrates on words, objects, pictures and observations to describe people in natural situations while quantitative deals with numbers. The aim of the quantitative approach is to classify features, count them and construct statistical models in an attempt to explain what is observed.

Ultimately, it is more useful to see these two approaches as complementary rather than as two opposite extremes. Qualitative research differs with quantitative research by its procedure of collecting data in the form of description and through the assumption that any researcher has interest in the field (or is part of it), hence it is difficult to undertake research in an objective manner (White 2002).

The research is also deductive in that it is trying to prove that the implementation of Green building would yield the desired result of sustainable environment among other sustainable issues. Deductive reasoning is a theory-testing process which commences with an established theory or generalization, and seeks to see if the theory applies to specific instances, while inductive reasoning on the other hand works the other way, taking specific observations and expanding them to broader generalizations and theories.

The findings of both the documentary analysis and case study are discussed under the literature review.

3.2.1 Sampling

The primary purpose of sampling according to Neuman (2003) is used for collection of data that can provide a better understanding of specialised attributes or

occurrences. In this particular research the main issue is to establish whether green building concepts are adequately covered in town planning processes. The study focuses on a small group of professionals involved in plan design, assessment, approval, construction and environmental protection. Also it is important to note that due to time and costs, not all of the mentioned stakeholders can be reached, therefore it only makes sense to study a representative sample from the population.

Purposive sampling was employed in this research. This is a method by which the researcher selects the sample they believe will deliver the best information in order to satisfy the research objectives and questions (Neuman, 2003). Purposive sampling enables the researcher to draw a sample of knowledgeable respondents with known or demonstrable experience and expertise in Green building and issues around the concept and its coverage in town planning processes. Architects, town planners, developers, structural and civil engineers, environmentalists, electrical and mechanical engineers as well as building regulatory bodies all make up the purposive sample. Respondents to questionnaires were deliberately selected such that it ensured representation of professionals or stakeholders in the Green building concept.

3.2.3 Questionnaire

A total of 40 questionnaires were administered to property developers and design professionals in Gaborone in order to collect the relevant data for this research. The questions are structured such that they sought to identify whether green building was covered by any policy in Botswana, or barriers (if any) existed towards implementation of GB and relation of green building with town planning and environmental law.

3.3 Data Analysis Methods

Data collected from the field work was analyzed using numeric summary and graphic display to promote quicker understanding as Wegner (2007) states. A rating scale ranging from 1 to 5 was provided for the respondents to indicate their level of consideration for green building attributes when planning buildings. The rating was selected to ensure that all respondents can be able to have an answer and to ensure logical analysis of the responses. The ratings are as follows;

> Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

To reduce short coming of this method, there were open ended questions at the end of the questionnaire and the respondents were requested to add in any other information that they might consider to be relevant to a previous question. In the analysis, a multi – attribute analytical technique was used to interpret the responses. This method, compares related responses through the use of a mean rate (MR) calculated.

The chi-square is then used in this study to test the hypothesis to establish the patterns of result of variables from a population of Gaborone. The chi-square is a measure of the level at which what is expected in the study and what is observed have a difference which leads to the decision to adopt the null hypothesis (Wegner, 2007).

3.4 Reliability

Reliability is a situation whereby the same results are achieved for a test or procedure carried out at different times but under constant conditions. Amaratunga and Baldry (2002) state that, the main target of reliability is to ensure minimized errors and

biases in a study with reference to the accurateness of a selected measurement. Reliability in this research was therefore ensured by administering similar questions to individuals in the property field.

3.5 Conclusion

This chapter describes how the research was carried out. It emphasises that the study was approached through administering of a questionnaire and study of documents that relate to the concept of green building and the extent at which town planning policies have adopted the concept. A total of 40 questionnaires were distributed to respondents involved in the town planning, property development, environmentalists and other stake holders. Purposive sampling was used to identify directly the respondents that this study appeals to. It follows therefore that data analysis aims at interpreting, discussing and summarising data that was collected.

CHAPTER 4: DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

The results of the study as obtained from the field work are presented and analysed in this chapter, including discussion of the major outcomes. The findings are discussed in relation to the objectives of the study and previous studies to establish similarities and or differences.

The focus of this study was to assess whether green building concept has been given a place in town planning policies using Gaborone city, Botswana as a case study. It was stated in the literature review that green buildings have different attributes, however there are some barriers that hinder the major roll out of the practice and these are discussed in this chapter.

4.2 Background of respondents.

A total of 40 questionnaires were distributed and 28 were returned, thereby representing 70% response. Two responses from investors were received which they attributed to their busy schedule. The respondents' average experience on the job relating to property planning and development was 6 years, although most of them did not indicate their overall experience working within their profession.

The engineer group included electrical, mechanical and civil engineers whereas those who are classified as others include investors. The respondents were selected with the focus on their role in property development, including contractors.

Table 4.1: Background / Profession of respondent

Background	Frequency	percentage
Town Planner	7	25.00
Architect	4	14.29
Environmentalist	3	10.71
Contractor	2	7.14
Engineer	7	25.00
Academic	3	10.71
Other	2	7.14
Total	28	100.00

4.3 Respondents' role in property development

Table 4.2 is a summary of the role played by the respondents in the property development process and it is as follows:

Table 4.2: Role in property development

Classification	Frequency	percentage
Assessor	7	25.00
Consultant	2	7.14
Construction Manager	2	7.14
Designer	12	42.86

Developer	4	14.29
Other	1	3.57
Total	28	100.00

From table 4.2, it is evident that all the respondents had a satisfactory level of involvement in the property development market. The importance of this finding is that it indicates that since they are involved in property development, they would naturally be involved with green building in the course of their activities.

4.4 Definition of Green Building

Respondents were asked to express their understanding of what Green Building is and where such an understanding came from. About 70% of the respondents seemed to define green buildings as high performance or energy saving buildings whereas 21% provided a definition to the one accepted for green buildings. The remaining 9% defined green buildings as environmentally friendly buildings. In summary it can be said all the respondents had an understating of some sort about what green building is and their response gave an impression that the sample was correctly selected. However, considering the majority response of what green building is, it can be deduced that the respondents had a narrow understanding of the concept because there are other attributes to green building other than energy.

4.5 Way of learning about Green Building

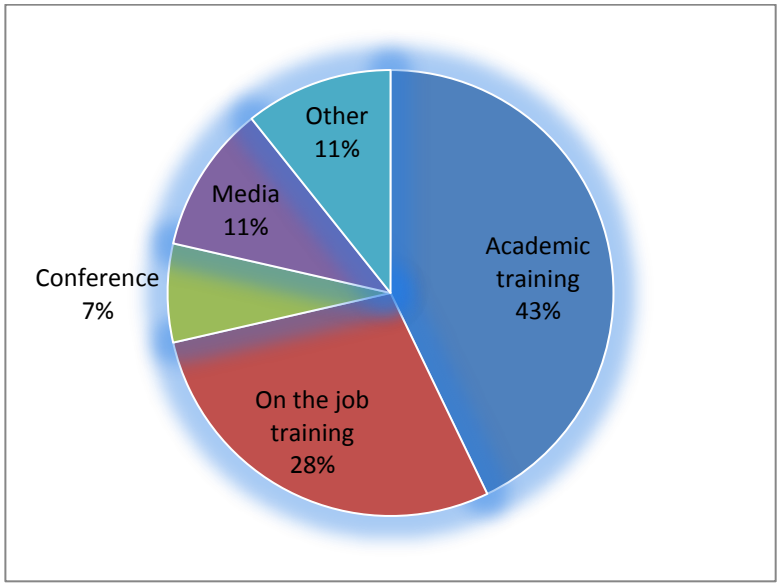
As a follow-up to the respondent's understanding of green building, they were asked to state where they learnt about the concepts and they indicated different institutions as follows;

Table 4.3: Where they learnt about Green Building

Classification	Frequency	percentage
Academic training	12	42.86
On the job training	8	28.57
Conference	2	7.14
Media	3	10.71
Other	3	10.71
Total	**28**	**100.00**

From the table it is clear that schools and academic centers have a major contribution to the learning and understanding of Green Building. It is safe to say that academic training is where most respondents got informed and trained about Green Building initiatives. Other respondents have learnt about Green Building from many other informal sources but they account for a good level of awareness. It should however be noted that about 80% of the respondents were trained outside Botswana which might raise the question as to whether academic institutions locally have incorporated green building in their syllabi. The distribution of the responses is further illustrated by Chart 4.1 below:

Chart 4.1: Where respondents learnt about GB



4.6 Green building attributes

Respondents were asked to rate their emphasis on inclusion of the various types of approaches towards green building. Such approaches include energy, water, land use, environmental quality, transport, materials, emissions and social issues.

4.6.1 Energy

The mean rate for consideration of day lighting reflects that respondents recognize the need for using other alternatives.

Table 4.4: Consideration of energy efficiency

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC 1 *f*	C 2 *f*	AC 3 *f*	C 4 *f*	HC 5 *f*	TR	MR
A	Use of energy saving fittings (lights, geysers, heaters, air cons, etc)	0	2	10	6	10	28	3.86
b.	Safety and security	0	3	9	6	10	28	3.82
c.	Day lighting	0	1	2	12	13	28	4.32

One of the respondents indicated that since minimal electricity is produced locally, energy is a scarce resource in Gaborone and there is great need to use it efficiently and also there is critical need to use alternative energy sources. Respondents also indicated a high consideration for energy fittings which they stated that the market is also supporting through supply of energy saving fittings. They also stated that Botswana Power Corporation undertook a project in 2010 to change all the meters in the houses to "smart" ones and the electric bulbs were also changed to energy saving bulbs. These are initiatives that indicate sectoral steps to address energy issues.

On the issue of safety and security which is rated below day lighting and energy saving fittings, this is attributable to the assertion by Denbow et al (2006) that crime is low and less violent. Generally, respondents understand the concept of energy efficiency and this is derived from the rate of consideration by property developers in Gaborone. It can therefore be concluded that it would not be a new phenomenon if a policy to demand inclusion of such were to be introduced.

4.6.2 Water Issues

Water is scarce in Gaborone hence respondents were asked questions relating to water conservation to ascertain whether they perceive the need to use it cautiously and the response is summed up in table below;

Table 4.5: Water conscious development

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC 1 *f*	C 2 *f*	AC 3 *f*	C 4 *f*	HC 5 *f*	TR	MR
A	environmentally sensitive landscaping	1	3	7	8	9	28	3.75
B	Storm water harvesting and grey-water re-cycling for landscape irrigation	0	3	8	8	9	28	3.82
c	low-flow toilets, water conserving dishwashers	0	3	2	10	13	28	4.17

The average of the mean rates reflects that majority of the respondents give water issues greater emphasis. However, on individual ranking, majority of the respondents emphasize the importance of fitting accessories and finishes that consume less water like low flow toilets and manual urinals. This is in line with the observation by Toteng (2008) that the people in urban areas, including Gaborone, responded to the call by Botswana Water Utilities Corporation for reduction of water use through change of fittings among others. The next important aspect is that of storm water

harvesting which reflects their awareness of the shortage of water in Gaborone and the need to reduce water runoff.

Respondents also recognize the importance of using environmentally sensitive landscape. They acknowledge that water is a scarce resource in Gaborone, therefore landscaping using indigenous species is more sustainable than other types. Indigenous plant species survive better in the hot and dry conditions of the city with minimal watering. The response reflected a good understanding and platform for green building because they indicate a consideration for the environment at the planning stage of the development. On observation around the city offices, there is landscape using stones, concrete and cactus among others.

4.6.3 Land-use and ecology

Land use issues are important in green building because land resource is finite, therefore development has to be carried out in a way that ensures efficient use of the limited space.

Table 4.6: Land use related attributes

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC	**C**	**AC**	**C**	**HC**		
		1	**2**	**3**	**4**	**5**		
		f	***f***	***f***	***f***	***f***	**TR**	**MR**
a	Life cycle cost analysis	0	2	10	7	7	26	3.73

b	Redevelopment of grey sites (previously developed areas)	0	2	5	9	11	27	4.07
c	Environmentally responsible site design	0	3	7	7	9	24	4.17
d	Building commissioning	1	4	7	9	7	28	3.61

Respondents indicated that they highly consider environmentally responsible site design; however they are usually limited by the orientation of the plot. They stated that when neighborhood plans are designed one of the key issues informing the design is the topography of the area. Pieces of land would have the plots pre demarcated by the plan and the development control code determines the setbacks. The described scenario accordingly leaves no room for maneuvering of the building except to follow the plot orientation dimensions. This has led to some buildings having their longest sides facing the sunny orientations of the east and west which results in high requirements for cooling and heating.

4.6.4 Re-development of Grey Sites

The next highly rated attribute is re-development of grey sites of which respondents stated that this is the prerogative of planning authorities to promote redevelopment. They indicated that they wish to redevelop currently developed plots in an intensified pattern. However, they cited resistance by the planning authorities. Plots around the original neighborhoods including the mall are big but have minimal plot coverage but the revised development plan of Gaborone designated those areas to remain as they are with low densities. Parking requirements continue to be generous, leaving a lot of

space. This goes back to the argument by Cavric, (2004) of planning failure and the need for revised planning standards.

Lifecycle cost analysis and building commissioning are not considered as the above two. The respondents related building commissioning to pre-occupation inspection which has always been carried out in conventional buildings. There is need for awareness training.

4.6.5 Indoor Environmental Quality

Indoor environmental quality can be affected by emissions from paint used, glues for upholstery, poor air circulation because of gases from electric gadgets in the building (Papanek1995). It is for this reason that respondents were asked whether they consider IEQ in their designs or buildings.

Table 4.7: Consideration for Internal Environment Quality

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC 1	**C 2**	**AC 3**	**C 4**	**HC 5**		
		f	***f***	***f***	***f***	***f***	**TR**	**MR**
a.	Indoor environmental quality	0	2	8	8	9	27	3.89
b.	Open able / air tight windows	0	3	4	9	12	28	4.07

The respondents reflect their realization that the quality of the indoor environment has to be taken seriously. Openable windows rated almost the same as day lighting

which shows a trend of regard for alternative lighting and cooling / heating. According to Gwebu (2004) and Douglas et al (2004), air conditioning is still prestigious in Botswana however; the above results are showing a bit of a difference. This raises a question of whether power outages of 2008/9 might have changed the landscape.

4.6.6 Transport

Urban sprawl in Gaborone is one of the factors that have led to more cars being used thereby overflowing the road network and this has the causal effect of more GHG emission into the atmosphere from the vehicles. Table 4.8 below presents the responses to whether transport issues are considered when designing or assessing plans for development

Table 4.8: Consideration for transport related concepts

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC 1	**C 2**	**AC 3**	**C 4**	**HC 5**		
		f	***f***	***f***	***f***	***f***	**TR**	**MR**
a	Access routes for non-motorised traffic (walkways and cycle ways)	2	10	5	3	3	23	2.78
b	Promotion of public transport as opposed to own vehicles	3	3	4	9	2	21	3.19
c	Population densification around transport nodes	10	5	6	2	1	24	2.13

Table 4.8 suggests that the use of public transport is highly favored by respondents who even suggested that using public transport as opposed to own vehicle could help reduce traffic on urban roads and enable people to save on time spent on traffic for other duties. It has to be noted that the respondents were concentrating more on the design of buildings rather than what is practically on the ground, which led to a question of whether their plans are usually approved in the same design which embraces green aspects.

The respondents reflected a low consideration for non-motorized traffic and population densification around transport modes stating that these were dependent on the provisions of Gaborone development plan. One respondent stated that they design and plan buildings on their allocated plot which might not necessarily be nearer to transport modes. However, they stated that it is necessary to consider them because they reduce traffic congestion and emissions.

The observation here is that the roads that were under construction or had been constructed within the past two years had accesses for walkways and bicycle routes which were encouraging. One environmentalist however complained of the safeness of the routes because they were not separated from the motorized routes which could pose danger to the users. Bolaane et al (2005) also complains that the sidewalks are not evenly distributed in the whole city also making their use unsafe. Gaborone City Council has undertaken a project on non-motorized transport in Gaborone and the recommendations are to be implemented.

4.6.7 Building Materials

Building materials also have an effect on environmental quality, which is why emphasis has to be made for choice of materials that are "cleaner" and most importantly renewable.

Table 4.9: Building materials properties

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC 1 *f*	C 2 *f*	AC 3 *f*	C 4 *f*	HC 5 *f*	TR	MR
a	specification of lower environmental impact building materials	0	3	3	12	9	27	4
b	Recycled / renewable building materials	5	4	10	5	2	26	2.81

Consideration for the use of specifications of lower environmental impact building material is very high among respondents relative to the mean rate most respondents emphasize on the practice. This still leads to the question of evidence on the ground to see if low impact materials are used. The issue of use of recycled building materials is still low in consideration, reflecting the unpopularity of the practice and it is not clear whether this is due to cheaper alternatives or lack of knowledge and or acceptance.

4.6.8 Emissions

Buildings and the materials used in buildings have the possibility of emitting toxic substances into the environment and green building seeks to eliminate or reduce these emissions. Because of the mentioned possibility, respondents were asked to rate the level at which they use emission free materials and they responded as follows:

Table 4.10: Consideration of removal emissions

Level of consideration of green attributes: 1 – Not considered (NC); 2 – less consideration (LC); 3 – Average consideration (AC); 4 – Considered; 5 – High Consideration (HC)

		NC 1	**C 2**	**AC 3**	**C 4**	**HC 5**		
		f	***f***	***f***	***f***	***f***	**TR**	**MR**
a	Elimination of toxic materials and substances	0	2	1	12	11	26	4.23
b	Recycled / re use / reduce waste	1	6	9	6	6	28	3.35

Table 4.10 illustrates that respondents highly consider using materials with low toxic substances more than they promote re-use of waste. This is in line with previous studies which reflected that Batswana are still lagging behind when it comes to issues of waste separation and reduce/re-use/ recycle waste. It is also stated in GOB (2008) that more raw materials including sand and concrete are still mined in large volumes yet loads and loads of building rubble are brought to the landfill daily. This situation also calls for public education and leading role by government on projects that promote the above.

4.7 Existence of government policy that encourages green building initiatives

In table 4.11, respondents identified if there is government policy that encourages green building.

Table 4.11: Government policy that promotes Green building

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Is there a government policy that encourages Green building in planning	2 1	2 2	3 2	7 0	4 0	18 5
Total	3	4	5	7	4	23

Almost all respondents point to the fact that there is government policy that encourages green building. On further inquiry, it was noted that the understanding of policy on encouraging green building was derived from the understanding about energy use, saving power usage at home and commercial areas. This is not correct because green building is much more than the energy saving. Energy saving is always a part of the general concept of green building and not green building itself. It can therefore be concluded that a mixed awareness of green building does exist.

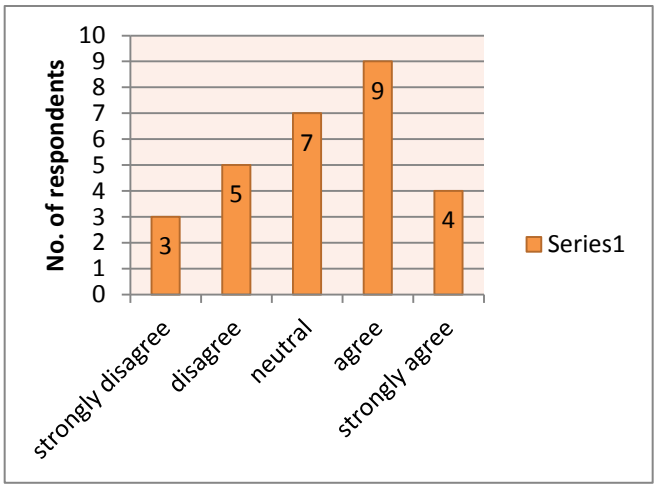
4.8 Development Control Code and Innovation

Respondents consider Development Control Code as a hindrance to innovation; in fact 81% stated that the code does not allow innovation. They stated that the code is rigid, it has to be observed or the building plan would not be approved. Perhaps the issue of flexibility has to be upraised because openness might lead to disorderliness whereas on the other hand its rigidity might be leading to detrimental effects on the environment.

4.9 Practice of Green Building in Gaborone

Respondents were asked whether green building is practiced in Gaborone. Chart 4.2 shows the responses:

Chart 4.2: Existence / practice of GB in Gaborone



The respondents who indicated that green building was not practiced in Gaborone reasoned that including one attribute of greenness does not result in the building being classified as a green building. This however is not in line with green building

rating tools which give different rating to building according to their level of achievement.

4.10 Barriers to green building

Considering the above green building attributes and the definition for green building, it can be concluded that the respondents have an understanding of the subject. However, the question that remains is why the practice has not gained popularity in Gaborone. The responses are on table 14below:

Table 4.12: Barriers to Green Building

	Barriers to the adoption of Green Building. 1 = strongly disagree (SD); 2 = disagree (D); 3 = neutral (N); 4 = agree (A); 5 = strongly agree (SA)							
		SD	**D**	**N**	**A**	**SA**		
		1	**2**	**3**	**4**	**5**		
		f	***f***	***f***	***F***	***f***	**TR**	**MR**
a.	Green designs have significantly higher cost of construction costs than conventional ones	4	5	2	10	7	28	3.39
b.	Lack of political support	0	2	6	5	13	26	4.12
c.	lack of awareness by designers and developers	0	2	6	5	13	26	4.12
d.	Lack of support by Planning authorities (rejection of plans due to inclusion of green concepts)	1	2	3	7	15	28	4.18
e.	Lack of adequate skills	7	9	10	1	0	28	2.10
f	Green building cannot work in Gaborone	14	12	2	0	0	28	1.57

Majority of respondents indicated lack of support by planning authorities as the major barrier to the adoption of green building practice. This could be possible due to the fact that the current planning policies were designed for conventional buildings and it was also observed in EPA 2005.

4.11 Ways of addressing Green Building Barriers

The responses above indicate that respondents believe that green building can work in Gaborone if only planning authorities and political wing could support green building efforts. Although they cited lack of adequate skills and awareness by designers/developers it seems that is not where the major challenge is. Planning authorities need to be trained on green building and the issues of the environment in order for them to be seen to be supportive. On the other side the political arm is concerned with socio-economic issues hence environmental issues are not priority (Cavric 2004). The issue of higher building costs for green building should not be taken as a major challenge because the return on investment is high; therefore the investors can still recover their money back.

4.11 Correlation of results

On trying to establish whether the hypothesis was realized in this study, the following tables sum up the working;

Table 4.13: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Do you think there is government policy that encourage Green building * Do you think Green building is practiced in Gaborone	23	82.1%	5	17.9%	28	100.0%

Majority of respondents believe there is government policy that encourages green building however; they are not really convinced that GB is practiced in Gaborone. They also do not specify which policy they regard as encouraging green building.

Table 4.14: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.150[a]	4	.188
Likelihood Ratio	7.991	4	.092
Linear-by-Linear Association	3.837	1	.050
N of Valid Cases	23		

The chi square shows that planners have negative attitude towards green building and government has not had much interest in developing and enforcing green building policy. The value is .18 which is higher than .05.

Table 15: Symmetric Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval	by	Pearson's R	-.418	.152	-2.106	.047[c]
Interval						
Ordinal	by	Spearman	-.440	.140	-2.246	.036[c]
Ordinal		Correlation				
N of Valid Cases			23			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

The results for the correlation indicate that the hypothesis that green building concepts are inadequately incorporated in the town planning policy has been proven.

4.12 Summary

This chapter presented the data, discussed and analyzed its findings. A total of 40 respondents formed the purposive sample of study. However 28 actually gave responses. The respondents cut across disciplines and professions that have direct bearing on property development and town planning issues. The focus of this

research was to assess Green Building concept and town planning policies using Gaborone city in Botswana as a case study.

The study among others found that the majority of the respondents regard the concept of green building as more to energy efficiency in buildings than it is about other attributes. Respondents raised concern that planning authorities and political leaders do not support the efforts of green building however, evidence is required to prove the point. Planning authorities themselves do not seem to be acquainted with green building concepts thus there is need for awareness campaign. Also, the planners work within the provisions of the current planning statutes of the Town and Country Act of 1977 which can only be reviewed by parliament hence while it is still unrevised they just have to abide by it.

What also came up is that the respondents who were not working for government seemed to expect change from government more than they could initiate it themselves. Green building councils internationally were established by non-governmental bodies therefore these respondents need to realize their importance in coming up with campaign bodies for environment. The higher cost of procuring green building is another hindrance to the practice but it still goes back to the issue of awareness that they are more valuable than conventional buildings which pays for the initial costs.

4.13 Lessons learnt from Gaborone

The lessons learnt from the Gaborone study include the fact that urban environmental challenges and issues of climate are a reality. Traffic volumes continue to grow in the city and the population is also growing. These call for additional housing and services including water, energy, roads and others which however can only be provided at

particular levels. Following green building concepts can assist in addressing the situations like collecting run off water for landscape purposes and recycling water.

Government is currently sourcing water from as far as Republic of South Africa to augment the shortfall of water in Gaborone when only around 20% of grey water is utilised. The City Council needs to engage in city intensification or city compaction campaigns but which would ensure benefit from the existing services.

4.14 Conclusion

Green building practices are a necessity in Gaborone due to the current urban challenges. Currently there is no single government policy that promotes the practice however there are uncoordinated attempts to practice like water and energy efficient ways. All the respondents for this study reflected a relation to issues of the environment and green building which forms a good platform for the introduction of the practice. However the practice is still not popular, this raises concern of whether individuals have awareness if there is no practice.Green Building is still at infancy stage in Botswana and there is need to fast track some activities so that Botswana can be at par with other developing countries that are considered to middle income countries.

There is a need to act now as failure to address identified issues will exacerbate environmental degradation which is becoming a reality in Botswana. Green building concept can indeed be part of the overall strategy of reversing the ills of global warming.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Introduction

The main objective of the study was to evaluate integration of green building and resource efficiency into town planning procedures in Gaborone. From the literature review and the questionnaire, it has been established that green building concepts do not differ from the objectives of town planning and environmental management. However, the implementation is the one that indicates the recognition provided by the society.

5.2 Conclusions

The study sought to establish if green building concepts have been incorporated in the town planning policies and processes in Gaborone, Botswana. Through literature review, it has been established that the practice has not been incorporated in town planning which is a gap. There are provisions in the planning policies which relate to green building attributes but are only advisory guidelines therefore might be waived. From the field study through questionnaires, respondents also consider planning authorities and codes to be a hindrance to innovation and environmental issues. The planning practice in Gaborone is considered by respondents and previous related studies to be a major hindrance to the practice. However through interview with key planning authorities it can be concluded that the officers are confined by the existing statutes and they lack knowledge.

It can be concluded from the literature review and questionnaire that indeed green building practices have not been incorporated in Gaborone town planning, which implies that the practice is lagging behind legally. However green buildings are not to

be construed as out of this world structures but they can be achieved through planning in Gaborone.

The study has also realized that although there is no single policy that is called Green Building policy, there are some regulations in place which relate to the practice which however lack procedures. Also policies relating to management of the environment and resources are scattered in different departments and ministries which results in lack of coherence and benefit of combined effort. Most of the policies are advisory, which means they can be waived, thereby having a possibility of compromising the environment including green building practice. If the policies were not advisory they could otherwise be helpful or one would safely say there is no need for an absolutely new policy to promote the practice.

There is no incentive that attracts developers into practicing green building. This can also affect the roll out of the practice. Although there is some level of awareness of green building and the need for environmental management, developers need to be attracted into changing the 'usual way'. Incentives can be in the form of lower interest loans, tax rebates, relaxed setbacks and plot coverage ratios. It can be concluded that the level of awareness needs to be raised to a level of activism to ensure that developers and tenants do not forego the chance to take care of the environment.

Conserving energy such as electricity and water in conventional building is seen mostly as green building. While it is clear that Gaborone is affected by scarce water and energy, it should be appreciated that green building is wider than the two only. This observation leads to the conclusion that the conventional buildings in the city continue to affect the environment in other ways without intervention because the responsible people do not recognize the problem. The meaning and approach to green building is yet to be accepted as available regulations and procedures do not as yet support a complete fully fledged Green Building policy.

The barriers to the practice have been identified and they include lack of support by planning and political authorities and lack of knowledge. These barriers are in line with international barriers and they need to be addressed. The implication of lack of support is that good initiative would be blocked. The solution to this challenge is to raise awareness to ensure that while political leaders are faced with provision for the socio-economic goals of sustainable development, the environment should be taken aboard as well. If developers realized that the green buildings might be expensive to construct but are of higher value in the long run and also cheaper to operate, they would switch to them.

One of the envisaged limitations to the study was shortage of local information in Gaborone and indeed not many sources were available which has an implication in providing local examples. For instance the report on Botswana Initial National Communication to the UN Framework Convention on Climate Change GOB, (2001) and State of the Environment Review Report GOB, (2002) both do not document the amount of GHG emission from buildings. The conclusion that is drawn is that there is still an opportunity for more research to be carried out.

Finally, the objectives of the study have been achieved and the hypothesis has been proven. If practiced in Gaborone, green building can ensure improved environmental quality and efficient use of resources. The vision of Gaborone being an environmentally sustainable city can be met if policies are in place and through collaborative participation between planners, political leaders and the public. Without incorporation of green building concepts in town planning statutes and processes, the practice would continue to be sidelined.

5.3 Recommendations

The overall objective of the research was to evaluate the integration of green building and resource efficiency into town planning procedures in Gaborone. The evaluation has identified gaps that need to be addressed in order to operationalize principles of green building in Gaborone and Botswana at large. The recommendations below seek to address specific gaps and to come up with remedial actions overall.

a) Government must revise the planning instruments because the current ones are outdated and therefore not responsive to new urban issues which are complex and require appropriate interventions. The planning approach that is recommended is that of the Spatial Development Framework and Integrated Development Plan and this can benchmarked in South Africa where they are in practice. Plot coverage and densities have to be defined to ensure that no space is left under-utilised.

b) Gaborone City Council must audit all the existing plans for approval and inclusion of green building concepts.

c) Government has to come up with a green building legal instrument that is mandatory. This will go a long way in ensuring that property developers are obliged to protect the environment as they construct commercial buildings. Energy Efficient guidelines and Water Management Framework have been developed but are inadequate, as long as they remain guidelines, their effect will not suffice. The envisaged law must be all encompassing and also enforce efficient use of energy and water.

d) The private sector must be involved in the formation of Green Council of Botswana. Such a council will formulate a Botswana specific tool to monitor

implementation of green building concepts in Botswana. The council must not only be formed but should spearhead advocacy for climate change mitigation through Green Building.

e) Government must take a lead in spearheading Green Building through constructing buildings that use materials that are environmentally friendly (no heat island forms), including landscaping. This includes reduction of concrete paved yards which increases the runoff. Other stakeholders will certainly follow the example of the Government and this will certainly have a positive spin off.

f) Old buildings must be audited and renovated to reduce their carbon footprint. Integrated efforts yield better results than sector specific because gaps can be realized and addressed. In this regard government could come up with renovation master plan that will include elements of green building.

g) Personnel must be trained on Green Building which includes taking them on refresher courses to appraise them on the latest developments. Having trained them there must also be staff deployment focusing on issues of sustainability and planning because where staff is left to carry out everything there is less efficiency.

h) Curriculum must also be reviewed or monitored in schools including the university so that personnel and the public can be acquainted with the requirements of green building.

i) Incentives must be given to those developers who include green building concepts. The incentives can be in the form of increased plot coverage in exchange for a reduction in energy use. Banks can also provide special mortgages to developers showing green building initiative.

5.3.1 Areas for further research

It is seen that a gap still exist in the legislation for Green Building initiative. A study is still needed on the policy and implementation of Green Building. The implementation stage should look at the long term effect of a new city developed on Green Building.

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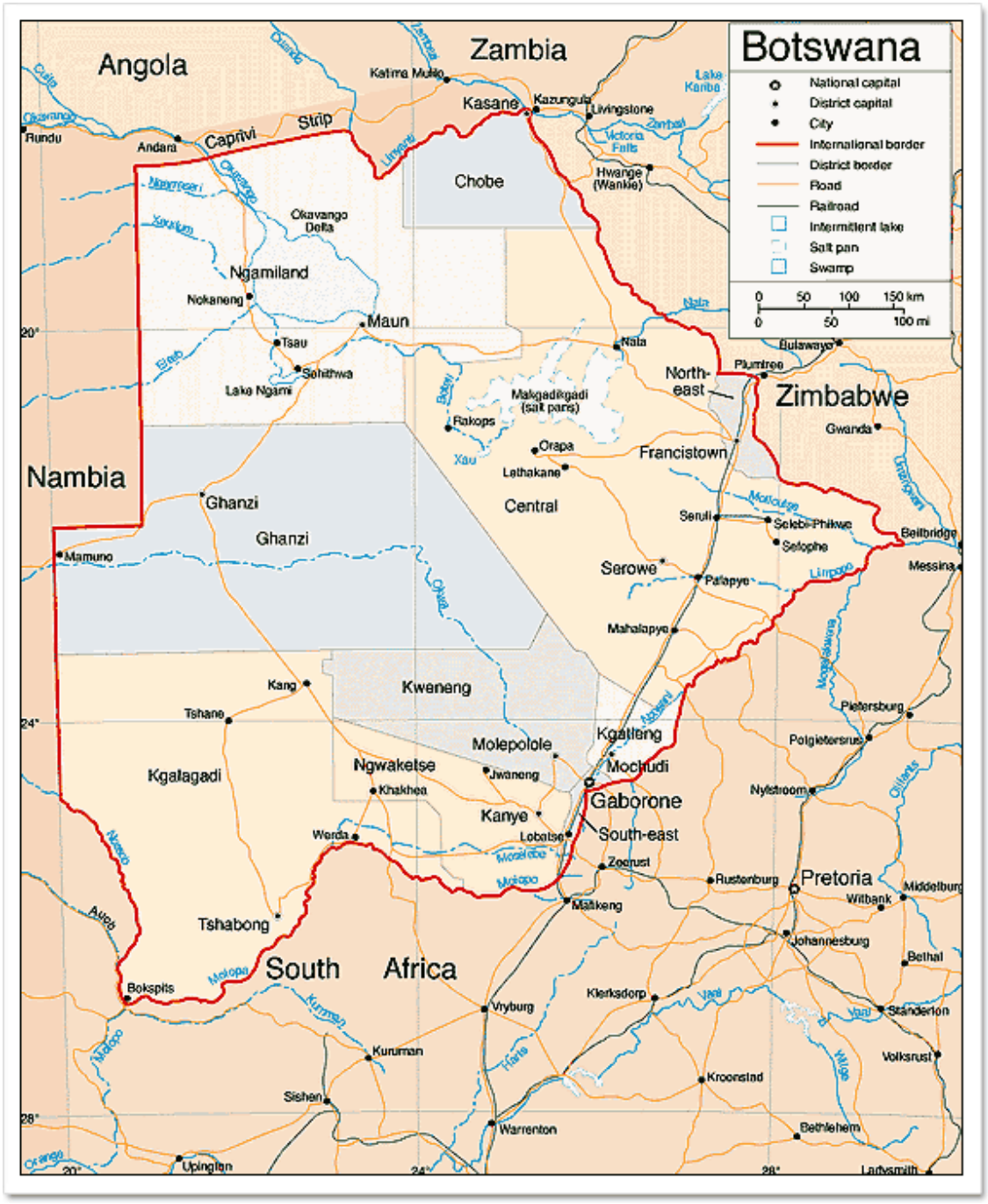
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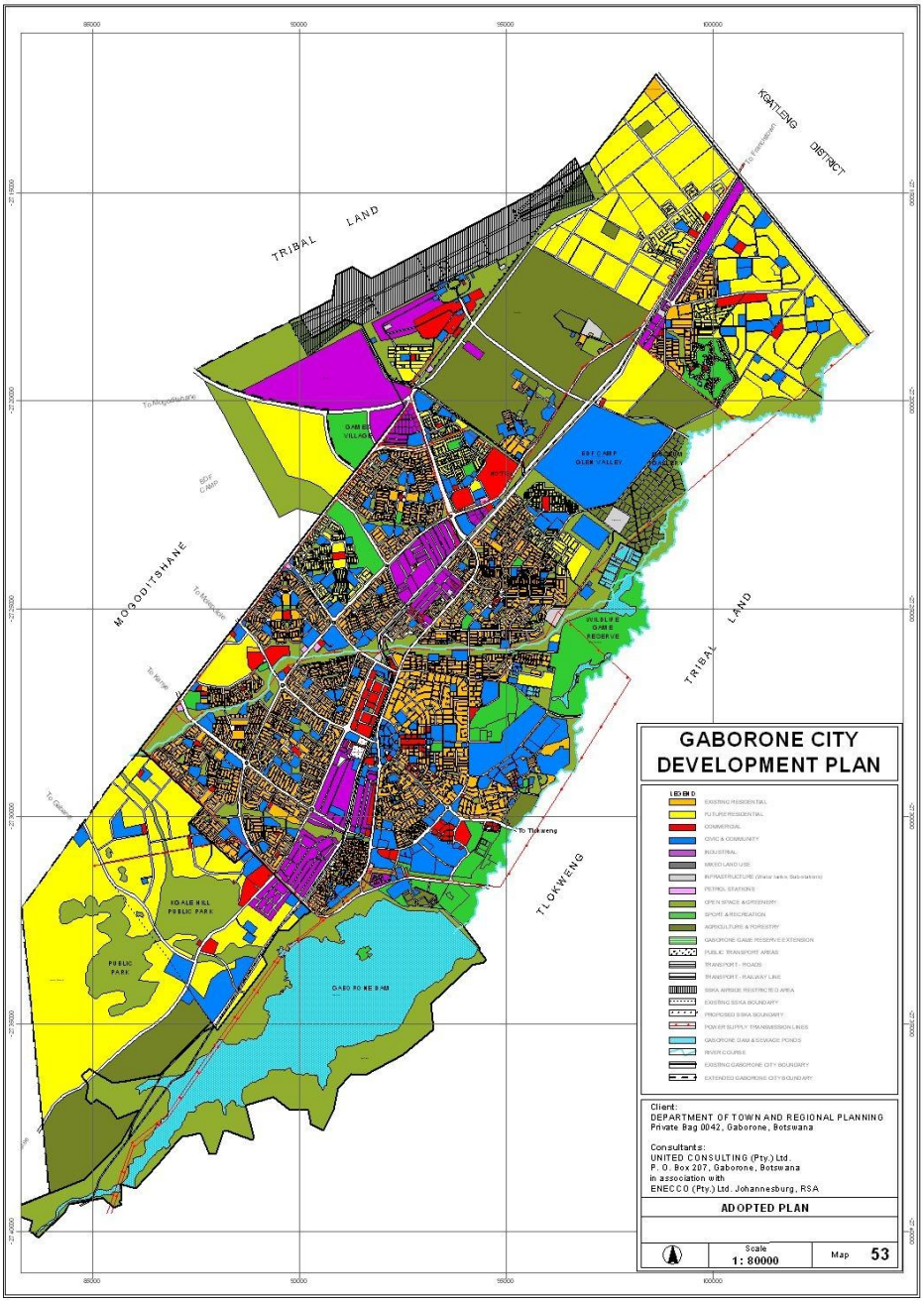
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APPENDIX 1: Map of Botswana



Source: GOB, 2008

APPENDIX 2: Gaborone City Development Plan



Source: GoB, 2008

APPENDIX 3 The Questionnaire

Name of Institution---------- Date----------

Position of respondent---------- Qualification----------

Work experience--------Yrs Experience at present institution-

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What is your role in office development process?

Investor / Designer / Assessor / Builder / other (circle the applicable role)

GREEN / SUSTAINABLE / HIGH PERFORMANCE BUILDING AWARENESS

1) In your own words, what do you think Green Building is? ----------
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2) If familiar, where did you learn about Green / sustainable / high performance building?
Academic training / conference / Govt policy / other (specify)

3) In your design / assessment of office plan, how would you rate your emphasis on the following green aspects: *(Please tick the appropriate answer* (√). (4 – High consideration, 3 – considered, 2 - Average consideration, 1 - little or no consideration)

Energy

		1	2	3	4

A	Use of energy saving fittings (lights, geysers, heaters, air cons, etc)				
b.	Safety and security				
c.	Day lighting				

Other (elaborate)----------

Water

A	environmentally sensitive landscaping				
B	Storm water harvesting and grey-water re-cycling for landscape irrigation				
c	low-flow toilets, water conserving dishwashers				

Other (elaborate)----------

Land-use and ecology

		1	2	3	4
a	Life cycle cost analysis				
b	Redevelopment of grey sites (previously developed areas)				
c	Environmentally responsible site design				
d	Building commissioning				

Other (elaborate)----------

Indoor Environmental Quality

		1	2	3	4
a.	Indoor environmental quality				
b.	Openable / air tight windows				

Other (elaborate)----------

Transport

		1	2	3	4
a	Access routes for non-motorised traffic (walkways and cycle ways)				
b	Promotion of public transport as opposed to own cehicles				
c	Population densification around transport nodes				

Other (elaborate)----------

Materials

		1	2	3	4
a	specification of lower environmental impact building materials				
b	Recycled / renewable building materials				

Other (elaborate)----------

Emissions

		1	2	3	4
a	Elimination of toxic materials and substances				
b	Recycled / re use / reduce waste				

Other (elaborate)----------

<u>TOWN PLANNING POLICY/ PROCESSES AND GREEN BUILDING</u>

1) In which plans do you include the above listed concepts? (circle the appropriate answer)

   Residential / Commercial / Office / Industrial

2) How often do you incorporate the concepts in plans? (circle the appropriate answer)

   Always / seldom / never

3) Were the plans approved by GCC/ TCPB in the same design?

   Yes / No (circle the applicable answer)

   If no, was the inclusion of green aspects the reason for the non approval of the plan?

   Yes / No (circle the applicable answer)

   Elaborate. ----------

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4) Did you change the design & was it then approved? ----------

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5) Is there any government policy that encourages Green Building in Botswana?

   Yes / No (circle the applicable answer)

6) If Yes, which one? ----------

   ---

7) If No, what is lacking and what are your suggestions for improvement? --------

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8) How has the Development Control / Building codes impacted on your work designing Green / sustainable Buildings?

   A. They allow innovation

   B. They limit innovation

   Please elaborate:----------

GREEN BUILDING BARRIERS

9) Is Green / sustainable / high performance building is practiced in Gaborone?

   a) Yes

   b) No

10) What do you regard as the greatest barriers to the adoption of Green / sustainable Building? (1 = strongly disagree, disagree, 3= neutral, 4= agree, 5 = strongly agree, NA – do not know) *(Please tick the appropriate answer* (√))

		1	2	3	4	5	NA
a.	Green designs have significantly higher cost of construction costs than conventional ones						
b.	Lack of political support						
c.	lack of awareness by designers and developers						
d.	Lack of support by Planning authorities (rejection of plans due to inclusion of green						

	concepts)						
e.	Lack of adequate skills						
f	Green building cannot work in Gaborone						

Other (elaborate)----------

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11) What steps need to be taken to integrate Green Building into the mainstream?

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12) What can Urban Planners do to promote green / sustainable / high performance building? ----------
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13) Any other relevant comment on Green Building and Botswana? ----------
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