SUSTAINABLE URBANISM IN NYERI TOWN, KENYA

M.Arch. Thesis

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August 2016

DECLARATION

A Project Report Submitted to the Department of Architecture, School of the Built Environment, in partial fulfillment of the requirements for the award of the degree of Master in Architecture of the University of Nairobi.

This Research Proposal is my original work and has not been presented for a degree in any other university.

Signature…… Date .....

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This Research Proposal has been submitted for examination with my approval as University Supervisor

Signature…… Date .....

Dr. Joseph Kamenju

This Research Proposal has been submitted for examination with my approval as University Supervisor

Signature…… Date .....

Prof. T.J.C Anyamba

DEDICATION

To Whom, Who Without, I am Not.

and

To the good People of Nyeri Town, through the School of The Built Environment, University of Nairobi

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LIST OF ABBREVIATIONS & ACRONYMS

ADHD Attention Deficit Hyperactivity Disorder

BMP Best Management Practices

BRT Bus Rapid Transit

CBD Central Business District

CIAM Congrès internationaux d'architecture moderne – (International Congresses of Modern Architecture)

CNU Congress for the New Urbanism

CSS Context Sensitive Solutions

DEAT Department of Environment Affairs and Tourism

DESA United Nations Department of Economic and Social Affairs

DFID Department for International Development

DPZ Duany-Plater-Zyberk

DPSIR Driving forces, Pressures, States, Impacts and Responses

DSE Department of Sustainability and Environment

EIA Environmental Impact Assessment

EPA Environment Protection Act

EUMM Extended Urban Metabolism Model

FAO Food and Agricultural Organisation of the United Nations

GDP Gross Domestic Product

GHG Green House Gases

HPB High Performance Building

IUSI International Urban Sustainability Indicators

LED Light Emitting Diode

LEED Leadership in Energy and Environmental Design

LEED - ND Leadership in Energy and Environmental Design for Neighbourhood Development

NP New Pedestrianism

NRDC Natural Resources Defense Council

OECD Organisation for Economic Co-operation and Development

PASTILLE Promoting Action for Sustainability Through Indicators at the Local Level in Europe

SDI Sustainable Development Indicators

SDSN Sustainable Development Solutions Network

SuDS Sustainable Urban Drainage Systems

SUI Sustainable Urbanism Indicators

TDM Transit Demand Management

TND Traditional Neighbourhood Design

TOD Transit Oriented Development

UGB Urban Growth Boundary

UK United Kingdom

UNCED United Nations Conference on Environment and Development

UNCHS United Nations Human Settlement Program

UN-HABITAT United Nations Human Settlements Program

USGBC United States Green Building Council

VMT Vehicle Miles Travelled

WCED World Commission on Environment and Development

ABSTRACT

3 out of 10 people in mid-20th Century lived in urban centers, while today, half of the World's population lives in urban areas. All developing regions, including Asia and Africa, will have more people living in urban areas than those in rural areas by 2030, with the tipping point in Eastern Africa anticipated slightly after 2050 (UN-HABITAT, 2010). Locally, 1 out of every 3 Kenyans, live in an urban center and according to the vision 2030, the level of urbanization in Kenya would have reached 44.5% with this percentage set to reach 54% by the year 2030 - the world is inexorably becoming urban.

Urban centers have long been considered as centers of innovation, industrialization, commerce, science and technology, and culture with urbanization being continuously touted as a positive and necessary force for transformation for the world's nations.

However, Kenya's urban development; as evidenced by growth in unplanned settlements in urban areas, urban sprawl, peripherization, congestion coupled with property development in excess of the carrying capacity of available infrastructure; indicates failure of existing urban development strategies, as reported by (Kimani, M. and Musungu, T., 2010)

As a counterweight to these negative possibilities, *urban sustainability* strategies have insistently been suggested at the international and national level as the best approach to guide the present and future growth of urban areas (Rodriguez, R.S and Bonilla A, ED, 2007).

Sustainable urbanism is one such strategy for urban sustainability.

This thesis studies the current state of urbanisation in Nyeri Town, against the elements of sustainable urbanism, converted into 5 sets of sustainable urbanism indicators (SUI) and makes observations and recommendations of strategies to steer Nyeri town into a sustainable urban future.

1 INTRODUCTION

This chapter introduces the concept of urbanisation, both globally and locally. It describes its current state, growth patterns, and its potential for positive transformation, given that it has been reported that the prosperity of nations is intimately linked to the prosperity of their cities (UN-HABITAT, 2008). This is discussed further with the introduction of *sustainable urbanisation*, without which, the mentioned positive transformations cannot be achieved. The chapter concludes with the presentation of the problem statement, objectives, research questions, scope and the study area.

1.1 Background

1.1.1 Worlds Urban Centers: State and Growth Patterns

The importance of urban areas in the economic growth and social well-being of the population lends them a starring role in the discussion of the new development paradigms across the globe, and more importantly in Third World countries such as Kenya.

Towns and cities in the world's developing countries are growing at an unprecedented scale (Rodriguez, R.S and Bonilla A, ED, 2007). The *State of the World's Cities 2010/2011 – Bridging the Urban Divide*, as published by the United Nations Human Settlements Program (UN-HABITAT) reports that the world is inexorably becoming urban. 3 out of 10 people in mid-20th Century, lived in urban centers while today, half of the World's population lives in urban areas. The report continues by stating that by 2030, all developing regions, including Asia and Africa, will have more people living in urban areas than those in rural areas, with the tipping point in Eastern Africa anticipated slightly after 2050. Further, that in the next 20 years, *Homo sapiens*, "the wise human", will become *Homo sapiens urbanus* in virtually all regions of the world with the world's population growth concentrated in urban areas (UN-Habitat, 2006).

Other reports indicate that while twenty years ago, an estimated 40% of the developing world's population – or 2 Billion people – lived in urban areas; their numbers have now expanded almost twice as fast as total population growth, to more than 2.5 billion. By 2025, more than half the developing world's population – 3.5 billion people – will be urban (Rodriguez, R.S and Bonilla A, ED, 2007).

Spurred on by industrialization and steady increases in per capita income, urbanization in Europe and North America took centuries to take form. In great contrast, it is projected that the developing world will experience urbanisation in the space of 2 or 3 generations.

Most of the world's fastest growing cities are found in low-income countries of Asia and Africa with young populations. Over the next 10 years, the current number of urban dwellers in sub-Saharan Africa is expected to grow by almost 45 %, from 320 million to 460 million. Kinshasa, capital of one of the world's poorest countries, is now the world's fastest growing future megacity (DESA), 2013. See Figure1.

Locally, 1 out of every 3 Kenyans, live in an urban center. This implies that 32.3% or 14.8 Million Kenyans out of the total 46.3 Million live in some 108 designated urban centers with populations ranging between 20,000 and 3 Million (70% of whom live in informal settlements) (Government of the Republic of Kenya, 2010). According to the vision 2030, the level of urbanization in Kenya would have reached 44.5% with this percentage set to reach 54% by the year 2030. This will mean nearly 30 Million people inhabiting urban centers.

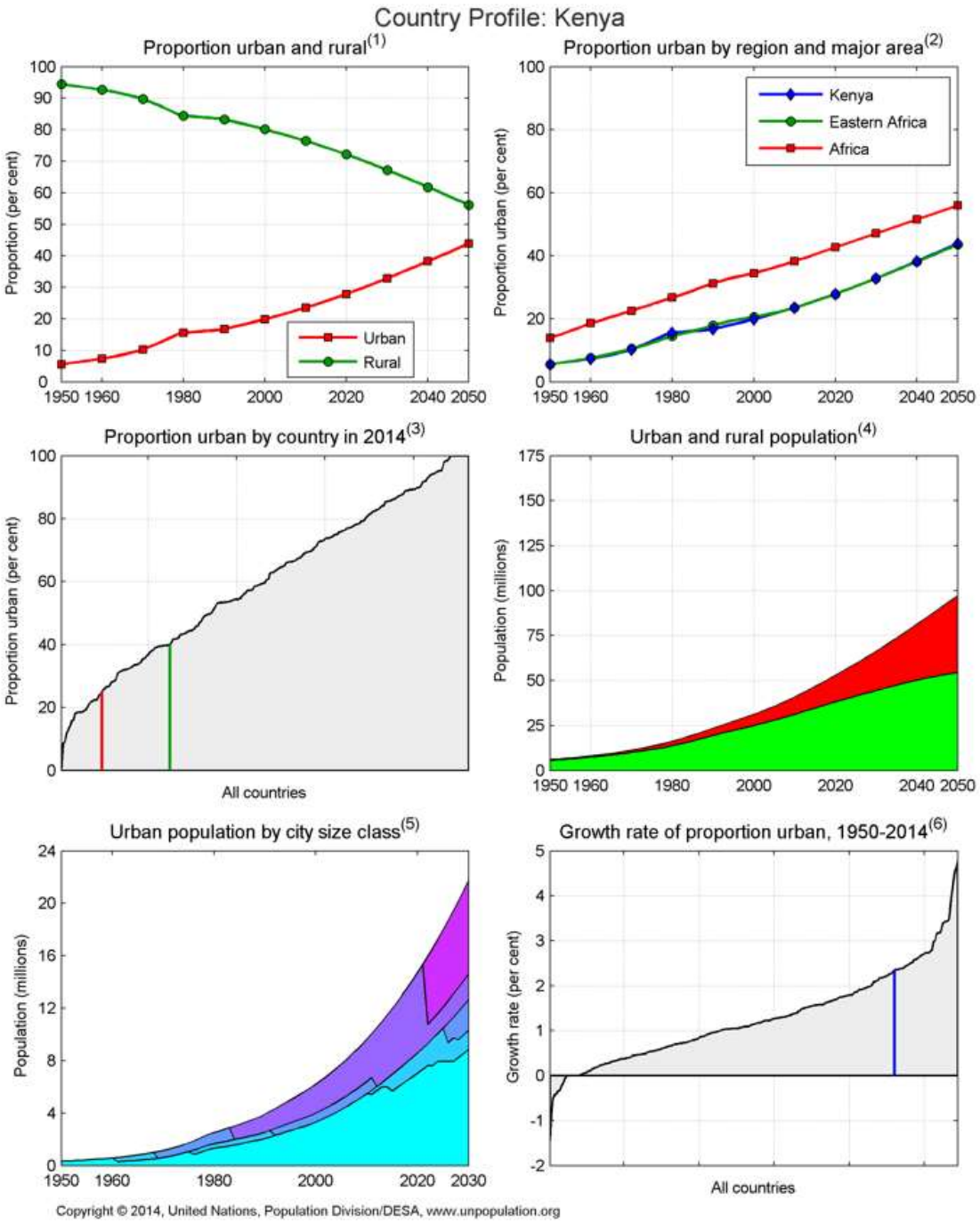

FIGURE 1 KENYA'S POPULATION PROFILE, SOURCE (DESA)

1.1.2 Urban Centers: Positive Transformation and Trends

Urban centers have long been considered as centers of innovation, industrialization, commerce, science and technology, and culture. Urban centers through large and small cities, towns, and neighborhoods, sub urban or peri-urban areas avail human beings the opportunities to share urban spaces, participate in public and private events and exercise both duties and rights. These opportunities in turn allow for the cultivation of Societal values and define modes of governance together with other rules that permit human beings to produce goods, trade with others and get access to resources, culture and various forms of riches or wellbeing (UN-HABITAT), 2008).

Urbanization has therefore been touted as a positive and necessary force for transformation for the world's nations. Whilst many countries have adopted an ambivalent or hostile attitude to urbanization, often with negative consequences, it appears that today this worldwide process is inevitable. Some of the fundamental positive changes include;

1.1.2.1 *Employment sector – from subsistent agricultural based activities to mass production and service industries*

1.1.2.2 *Positive transformations in societal values and modes of governance*

1.1.2.3 *Progression in the configuration and functionality of human settlements*

1.1.2.4 *Growth in the spatial scale, density and activities of cities*

1.1.2.5 *Increase in the composition of social, cultural and ethnic groups*

1.1.2.6 *Extension of democratic rights, particularly women's empowerment*

According to ((UN-HABITAT), 2008), two significant emergent trends in the state and growth of the world cities today are;

1.1.2.7 *The merging of Cities to create urban settlements of massive scale*

These configurations are taking the form of mega-regions, urban corridors and city regions. These regions are now emerging in various parts of the world, turning into spatial units that share territories and functions bound by economic, political and socio-cultural and ecological systems. These corridors, regions and cluster cities are then becoming new engines of both

global and regional economies, and they reflect the emerging links between urban expansion and new patterns of economic activity. However, as this new interconnectivity strengthens there lies the risk of unbalanced regional and urban development via increasingly constricted diffuse spatial development.
In this case, the challenge is upon local authorities and regional governments to adopt policies that maximize the benefits of urbanization while responding to these forms of interconnectivity and interdependence. The rationale ideally would be to promote regional economic growth as well as to anticipate and manage the negative consequences of urban/regional growth such as asymmetrical regional and urban development.

1.1.2.8 *Emergence and growth of Satellite or dormitory cities and sub-urban neighborhoods*

Increasingly, people are moving outside of the city to take advantage of the affordable accommodation, lower densities and often better quality of life. Spatial expansion of cities is triggered not only by residents' preference for a suburban lifestyle but also by land regulations crises, lack of control over peri-urban areas, weak planning control over land sub divisions, improved or expanded commuting technologies and services as well as greater population mobility.
Whether it takes the form of "peripherization[1]" or "sub-urban sprawl"[2], sub-urbanization generates negative environmental, economic and social externalities. In developing countries, it is as a result of escape from inadequate governance, lack of planning and poor access to amenities. Proposed solutions include policies aimed at the current urban challenges of slums, affordable land, basic services and public transport. City expansion should be anticipated with sound planning policies and related actions that control speculation associated with urban sprawl. Cities should also grant rights to the urban poor along with affordable serviced land and security of tenure to prevent further peripherization.

[1] Informal settlements

[2] Residential Zones for high and middle income groups

1.1.3 The wealth of Cities

It has been reported that the prosperity of nations is intimately linked to the prosperity of their cities and that no country has ever achieved sustained economic growth or rapid social development without urbanizing – countries with the highest per capita income tend to be more urbanized than low income countries (UN-HABITAT, 2008).

High urban densities reduce transaction costs, make public spending on infrastructure and services more economically viable and facilitate diffusion of knowledge and information, all of which are important catalysts for economic growth and development. Together with economic growth, urbanization helps reduce overall poverty by providing opportunities, raising incomes and increasing the numbers of livelihood options for rural and urban populations. This is especially possible when urban growth is supported by well adapted policies.

It is reported that Kenya's urban population contributes approximately 65% of the GDP, with Nairobi City alone contributing 60% of the GDP (Government of the Republic of Kenya, 2010). Cities have therefore the potential to make countries rich because they provide economies of scale and proximity that generates enhanced productivity.

However, urbanization when accompanied by weak economic growth, or when distributive policies are non-existent or ineffective, results in local concentration of urban poor rather than significant poverty eradication ((UN-HABITAT), 2008).

1.1.4 The Need for Sustainability

Historically, cities have been places not of misery and despair but of opportunity – for economies of scale, employment and improved living standards, especially for rural people seeking a better life. They have served as engines of social progress and national economic development.

In many developing countries such as Kenya, however, urban growth is being driven not by economic opportunity but by high birth rates and a mass influx of rural people

seeking to escape hunger, poverty and insecurity (FAO, 2010). Urbanization in low-income countries is often consequently accompanied by high levels of poverty, unemployment and food insecurity.

Worldwide, an estimated one billion people live in crowded slums, without access to basic health, water and sanitation services. Around 30 % of the developing world's urban population – 770 million people – are unemployed or "working poor", with incomes below official poverty lines (FAO, 2010). Further, the growth of urban slums outpaces urban growth by a wide margin. By 2020, the proportion of the urban population living in poverty could reach 45%, or 1.4 billion people. By then, 85% of poor people in Latin America, and almost half of those in Africa and Asia, will be concentrated in towns and cities. That prospect has been described as "the new population bomb" and a nightmare for governance: sprawling, degraded and impoverished cities with large, vulnerable populations that are socially excluded, young and unemployed (FAO, 2010).

As a counterweight to these negative possibilities, *urban sustainability* strategies have insistently been suggested at the international and national level as the best approach to guide the present and future growth of urban areas (Rodriguez, R.S and Bonilla A, ED, 2007).

> 'The emerging picture of the 21st Century city fits many descriptions. Some are centers of rapid industrial growth and wealth creation, often accompanied by harmful waste and pollution. Others are characterized by stagnation, urban decay and rising social exclusion and intolerance. Both scenarios point to the need for new, more sustainable approaches to urban development.'
> Ban Ki-Moon. Secretary General, United Nations.

The term *urban sustainability* can be defined as: "the state a metropolitan community reaches once it is able to meet the needs of the present generation without

compromising the ability of future generations to meet their own needs." This paraphrases the most commonly accepted definition of sustainable development in the world today. This definition appeared in 1987 when the United Nation's World Commission on Environment and Development published its famous report entitled "*Our Common Future*" (McGeough, U., Newman D., Wrobel J., 2004).

The overall aim of *sustainable urban development* is to achieve a healthy and high quality of life for all people in this and subsequent generations, with equitable and geographically balanced and socially cohesive economic development, which reduces the impact on the global and local environments (Ed), 2004). The challenge remains therefore, to steer urbanization from its current, unsustainable path, towards sustainable, greener cities that offer their inhabitants choice, opportunity and hope (FAO, 2010).

1.2 Problem Statement

Despite the wide acceptance of *sustainable urbanisation* strategies to guide current and future urban growth and development, little progress has been made in the transition from this information to regulations and consequent operational approaches that promote the desired balance in urban growth, globally, but in particular, Third World[3] countries such as Kenya- and secondary[4] towns such as Nyeri.

As mentioned, Kenya, like many other countries worldwide has been urbanizing rapidly. Nakuru town for instance, has been reported to be the fastest growing urban centre in Africa at 13.3% annually (UN-HABITAT 2009).

The Kenya national government through a myriad of planning and building policy framework; legal framework as well as institutional framework has sought to direct and control this urban growth and development. These include but not limited to the various colonial period planning initiatives beginning with the 1926 Mombasa Municipal Council Plan, which was the first formal Master plan; to the Vision 2030, developed after the expiration of the Economic Recovery Strategy for Wealth and Employment Creation policy document of 2003, amongst many others.

However, Kenya's urban development; as evidenced by growth in unplanned settlements in urban areas, urban sprawl, peripherization, congestion coupled with property development in excess of the carrying capacity of available infrastructure;

[3] The term Third World arose during the Cold War to define countries that remained non-aligned with either NATO (with the United States, Western European nations and their allies representing the First World), or the Communist Bloc (with the Soviet Union, China, Cuba, and their allies representing the Second World). This terminology provided a way of broadly categorizing the nations of the Earth into three groups based on social, political, cultural and economic divisions. The Third World was normally seen to include many countries with colonial pasts in Africa, Latin America, Oceania and Asia. It was also sometimes taken as synonymous with countries in the Non-Aligned Movement. In the so-called dependency theory of thinkers like Raul Prebisch, Walter Rodney, Theotonio dos Santos, and Andre Gunder Frank, the Third World has also been connected to the world economic division as "periphery" countries in the world system that is dominated by the "core" countries. (Tomlinson, 2003)

[4] In this thesis, the term secondary urban centre/town will be used to refer to the non-city urban centres in Kenya that often emerged in the wake of colonisation to later become the immediate former provincial headquarters and now the county headquarters. Examples include, Nyeri, Nakuru, Murang'a, etc.

indicates failure of existing urban development strategies and plans, and to a large extent enforcement of these designated laws and standards. It has been reported that hardly 30% of Kenya's urban centers are planned and even when plans are available, they are rarely enforced (Kimani, M. and Musungu, T., 2010).

Currently, with the new constitutional dispensation[5], the devolved County Governments necessitate the creation of new urban centres and/or rapid increase in growth of existing secondary, urban centers, to accommodate their constitutional mandates; economically, administratively and politically, country wide. All this is in addition to the reported rapid urbanisation trends in the region. This state of affairs is challenging but presents opportunity to positively guide economic, environmental and social development through appropriate sustainable urbanisation strategies – without which only the negative impacts of unsustainable urbanisation will be realized.

Nyeri town, being the Nyeri County headquarters and consequently, centre for the county's administrative, economic and political affairs – mirrors the aforementioned national characteristics as regards urban development, i.e. growth in unplanned settlements in urban areas, urban sprawl, peripherization, congestion coupled with property development in excess of the carrying capacity of available infrastructure.

This proposal seeks to be a stepping stone in the realization of the benefits of urbanisation through sustainable urbanism strategies for Nyeri Town, and by extension, other urban centres in the country.

[5] Refers to the 2010 Constitution of Kenya, currently in force, replaced the 1969 constitution, that itself had replaced the 1963 independence constitution. The constitution was presented to the Attorney General of Kenya on 7 April 2010, officially published on 6 May 2010, and was subjected to a referendum on 4 August 2010. The new Constitution was approved by 67% of Kenyan voters. The constitution was promulgated on 27 August 2010. A key change was devolution that resulted in two levels of Government, National and County.

1.3 Research Objectives

1.3.1.1 *To explore emerging trends in sustainable urbanism.*

1.3.1.2 *To understand the state of urbanisation of Nyeri town.*

1.3.1.3 *To develop recommendations for sustainable urbanism for Nyeri town.*

1.4 Research Questions

1.4.1.1 *What are the emerging trends in sustainable urbanism?*

1.4.1.2 *What is the state of urbanism of Nyeri town?*

1.4.1.3 *What are applicable recommendations for sustainable urbanism in Nyeri town?*

1.5 Justification and Significance of Study

Kenya, as captured in *Chapter 1, 1.1 Background*, is urbanizing rapidly, and this, without adequate sustainable strategies. This proposal would provide a tool in the preparation and implementation of urban development strategies, sustainably; useful to the private sector, public authorities and academics; for implementation, further studies and research. It is envisaged that material extracted from this thesis, in form of charts, assessment tables; etc. would also introduce additional tools for diagnosis of and training in, the sustainability of various urban development proposals and strategies.

1.6 Scope of Study

This study will be limited to principles of *sustainable urbanization and urbanism*, applicable to Nyeri town.

1.7 Study Area

This study will be limited to the extent of Kenyatta Road, Stanley Mathenge Road, Temple Road, Kimathi way and Muhoya Road of Nyeri town's administrative boundaries in particular and within the Nyeri County administrative boundaries in regional context.

1.7.1 Brief History of Nyeri Town

This study as indicated in the scope covers a part of Nyeri Town. The town is the headquarters of Nyeri County. Until recently it was the headquarters of the former central province, one of the then eight provinces in the country, before promulgation of the new constitution. It is therefore one of the major administrative towns of the country as well as a leading commercial, industrial and educational centre in the region.

Nyeri town's history dates back to the early 20th century and is associated with British settlement in Mount Kenya region. At the turn of the century, the area where the built-up area of Nyeri town stands, was an uninhabited forested area; although there were agricultural holdings to the West (Tetu), to the Northwest (Kikuyu and Ihururu) and Gatitu to the south. The area towards Kiganjo (Northwards) was used as grazing land by the Maasai.

The town began as a consequence of military activity. A trading caravan had been ambushed, as a result of which military expedition was sent from Naivasha, through the Nyandarua Mountains, commanded by Colonel Meinertzhagen, and another by Messrs. Barlow, Hinde and Hested came up from Fort Hall (now Murang'a). Meinertzhagen reached the base of Nyeri Hill on 4th December 1902 and found Hinde camped there. On 6th December they moved to the present location of the district and provincial administration offices, where they built a fort. The location was considered better placed for defense and easy to obtain provisions. The fort was surrounded by a deep defensive ditch ("Mukaro" in Kikuyu) leading to the present name of the central area of Nyeri town.

The principal military function lasted up to 1905, but in the interim, Asian traders had been attracted to set up business within the area of relative safety i.e. near the fort, and missionaries also moved in at the request of the military officials.

On 15th May 1911, Nyeri was gazetted as a Township, comprising an area of one mile (1.6km) radius from the flag post of what is now the District Commissioner's

office. This is the current Nyeri Town CBD. The year after, the Town became the administrative capital of Nyeri District and also the Headquarters of the Kenya Province of the East Africa Protectorate. The "Kenya Province" constituted only a small part of what is today the Republic of Kenya. It was in 1913 that the old "Town" borders were established, and remained so for the next sixty years.

In 1927, the railway reached Kiganjo, which had been chosen as the Nyeri railroad station, both due to its topographical advantages and its closer proximity to the settlers' farmlands which had developed to the North, after the 1912 relocation of the original Maasai inhabitants to areas around Narok.

After boundary changes in the Kenya colony, Nyeri Town became the capital of the Kikuyu province in 1934. Some more changes occurred, so that in 1933, Nyeri was the capital of the then Central province, which included Nanyuki, Meru to the North, and Nairobi to the south, and the Machakos/ Kitui areas to the East. This remained the case until the boundary revisions in 1961 to 1965, where Nyeri remained the administrative capital of much smaller central region which was later named Central Province.

For all its formative years, the District Commissioner administered Nyeri Town. In June 1954, the Nyeri Urban District Council was created. It was a structure whose function was to assist the District Commissioner, and exercised its functions in Nyeri, Kiganjo and Mweiga. In 1963 however, the Urban Council assumed a representative nature with election of councillors.

Nyeri town fully became a municipality in May 1971, (vide Gazette Notice No. 61, 1971) covering an area of about 73.04 km2 when the first Mayor was elected. Before this time, it existed as an Urban Council covering only 8sq.km, which included areas surrounding the town center (the present Central Business District area, as mentioned earlier. The elevation was accompanied by a ten-fold increase in the Town area, from the area defined by 1913 survey and distribution of plots. Today, Nyeri Municipality covers an area of 200sq. km. Its borders coincide with Nyeri Town constituency boundaries.

As seen from the above brief history, the “birth” of Nyeri was from a military function, but this was quickly replaced by an administrative role. Commercial development started with trading stores located in the shadow of the fort, but this was gradually transformed into the only center of commerce for northern farmlands (until Nanyuki took some of the business), as well as a market center for nearby small scale farming.

Nyeri can be defined as an urban/rural town, as about 50 % of its present area, is rural in nature, with rich agricultural hinterland owned and managed by small scale farmers growing mainly tea and coffee as cash crops. There are vast coffee plantations less than a Kilometer from the Town Center around King’ong’o and Muringato.

1.7.2 Position and Size

The town is situated about 150 km north of Nairobi. It is located in Kenya's densely populated and fertile Central Highlands. It lies between the eastern base of the Aberdare Range and the western slopes of Mount Kenya. The town lies at high altitude of approximately 5,750 feet (1,750 meters) meters above sea level. (Real Plan Consultants, 2014)

Nyeri Town is located in Nyeri County which covers an area of 2, 475.4 KM^2 and is situated between longitudes 36^0 38’’ East and 37^0 20’’ East; and between the Equator and Latitude 0^0 38’’ South. It borders Laikipia County to the North, Kirinyaga to the East, Murang’a County to the South, Nyandarua County to the West and Meru County to the North East.

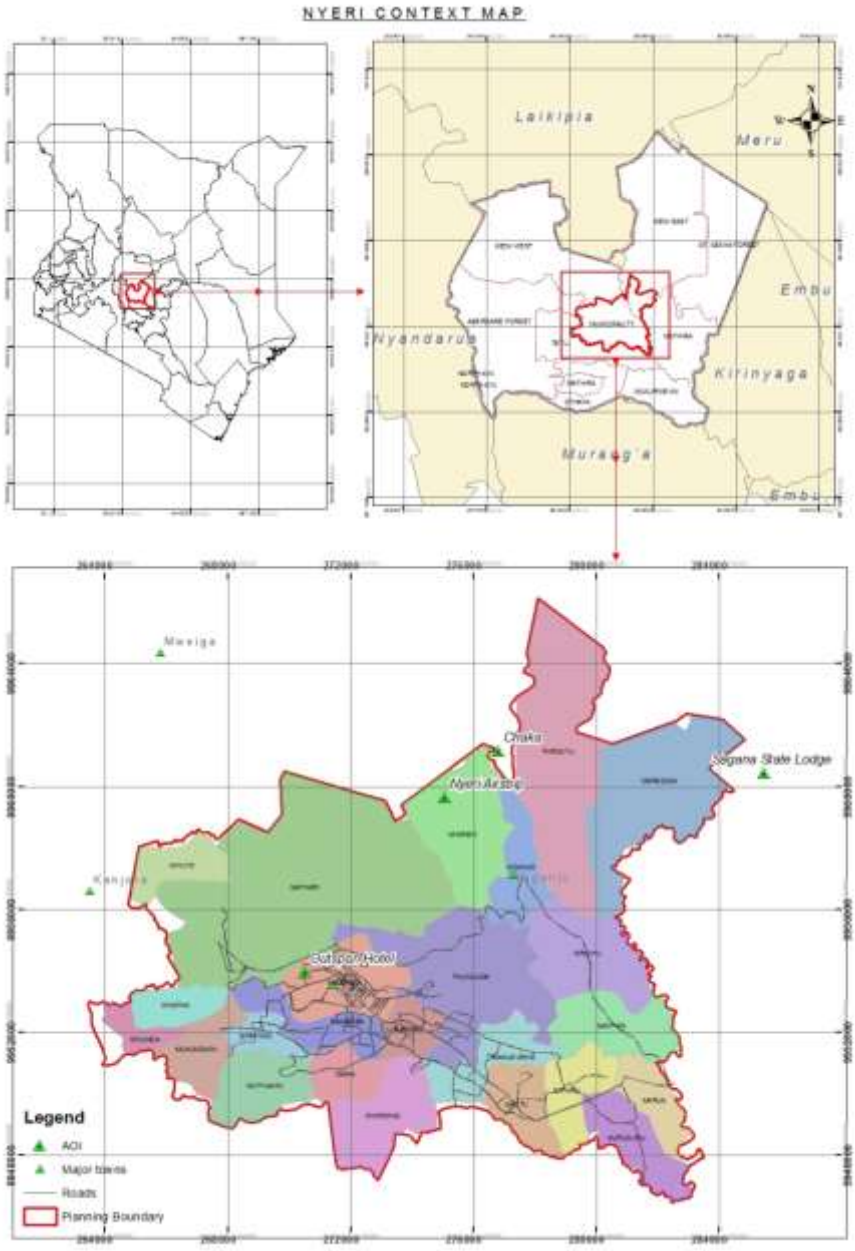

FIGURE 2 NYERI TOWN IN CONTEXT, SOURCE (REAL PLAN CONSULTANTS, 2014)

1.7.3 Physiographic and Natural Conditions

1.7.3.1 *Physical and Topographical Features*

The main physical features of the county are Mt. Kenya (5.199M) to the East and the Aberdare Ranges (3.999M) to the West. The Western part of the county is flat,

whereas further southwards, the topography is characterised by steep ridges and valleys, with a few hills such as Karima, Nyeri and Tumutumu. These hills affect the pattern of rainfall, thus influencing the mode of agricultural production. The major rivers are Sagana, Ragati, Chania, Gura and Nairobi. (County Finance and Planning, 2013)

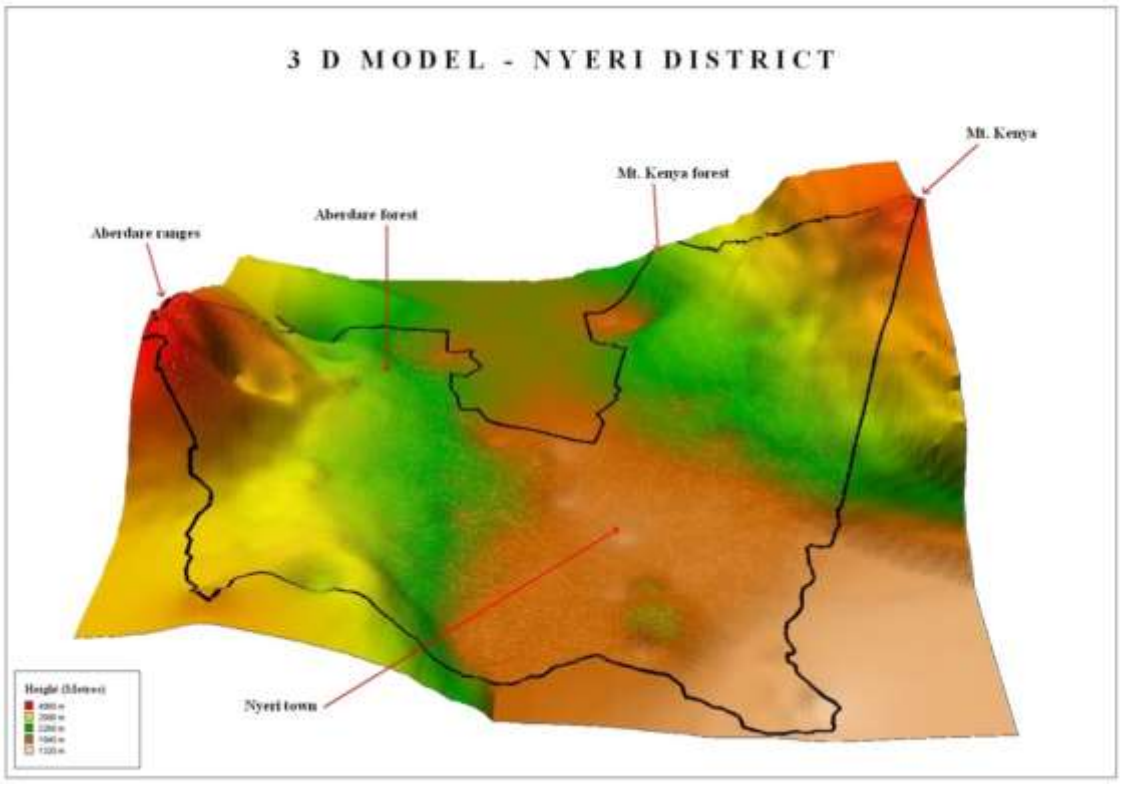

FIGURE 3 NYERI TOPOGRAPHICAL RELIEF MAP, SOURCE D.U.R.P BA 4, 2008

2 LITERATURE REVIEW

This chapter is presented under the 4 broad themes of : Sustainable/Sustainability; Urban Systems and Urbanisation/Urbanism; Sustainability in Urbanisation and Sustainable Urbanism.

The review will encompass literature and research on emerging trends and ideas in the above themes as well as their criticisms – globally, in developing countries generally in Africa and particularly in Kenya. It is envisaged that these will bare critical insights into an adoptable research parameter and methodology.

2.1 Theoretical Review: Sustainability/Sustainable

2.1.1 Intellectual Traditions of Sustainability

> 'Sustainability is a debate about how to live' **(Neumann, 2005)**
> 'It suggests we rethink our relationship to the cultural construct we call "nature," to the earth, and to each other' **(Schama, 1995)**
> 'Sustainability refers to the way things ought to be and how we ought to live. As such, it is the start of a complex dialogue. As a dialogue about how we ought to live, it is a moral dialogue' **(Cronon, 1983)**
> 'Sustainability is a broad, vague term that has many meanings. Sustainability is a Platonic idea, a category of the good. As a new idea, there is not yet a clear, single image of what sustainability is' **(Neumann, 2005)**

Sustainability as we think of it today draws from at least five intellectual traditions.

2.1.1.1 *Capacity*

Capacity refers to carrying capacity of a place to support populations of living beings (Neumann, 2005). Carrying capacity, while being both time and place specific, uses factors that are easily measured and assessed. Further, sustainability may be fathomed as a co-evolutionary process if is viewed as a process of a people adapting to, while simultaneously changing, a place over time (Neumann, 2005).

2.1.1.2 *Fitness*

Fitness, among other things, implies an evolutionary process marked by the mutual interaction between species and environment. It involves adaptation over time—a fit between organism and habitat. Fitness is a local trait stemming from adaptations that respond to immediate context. The biological concept of fitness today trades in other realms under such names as appropriateness and adaptability (Neumann, 2005).

2.1.1.3 *Resilience*

Resilience responds to some shortcomings and complexities of fitness theories specifically with regard to difficulties in measuring the degree of fitness. Resilience addresses these measurement problems by reframing the query of how well an organism or activity fits into a given ecosystem or social community, with how well a place absorbs the presence of an organism or activity. It further inquires how a place respond to the effects and whether there is a range in which an ecosystem or social community can absorb shocks and still retain its health and functional integrity? (Neumann, 2005).

2.1.1.4 *Diversity*

Diversity, as regards sustainability, refers to preserving biological diversity via environmental protection. In urban planning, it may take the form of multiple and mixed land uses instead of a single use whilst inclusionary zoning that accommodates a range of incomes is construed as promoting social diversity. It also appears in process design by including a wide range of participants, or stakeholders (Neumann, 2005).
In biological systems, diversity requires natural selection which is a form of reciprocal learning through competition and cooperation. (Neumann, 2005)

2.1.1.5 *Balance*

Finally, balance refers to balancing the "natural" environment with "human" development (Neumann, 2005). This strand of thinking stems from criticisms of neoclassical economics that held the environment separate from humans and their economic activities so that the environment was reduced to natural resources exploited for human consumption (Schumacher, 1973) and (Daly, 1980). Natural resources were inputs and throughputs to economic processes at the same level with labor and capital. This separation led to the concept of externalities, described as activities that fell outside of and could not be explained by formal economic theory models that placed a premium on elegance, which externalities marred. Moreover, externalities ignored free riding and the tragedy of the commons (Neumann, 2005).

2.1.2 Emergent Themes amongst the Intellectual Traditions of Sustainability

As is common with many classifications, the above five categories overlap and are not mutually exclusive (Neumann, 2005). The Brundtland Report is an example that contains elements of all five perspectives, even in its focus on two (WCED, 1987). The first common thread among the 5 traditions stems from the notion of sustainability itself and is derived from the word's root; *sustain*, whose most common meaning is to keep something going over the long run (Neumann, 2005). This echoes the statement "Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future" (WCED, 1987). Sustainability in biological terms refers to an ongoing process of how to live and perpetuate the species. ***Process***, then, can be described as the first common feature of sustainability. Process is most apparent in the fitness and resilience points of view, as well as diversity and balance (Neumann, 2005).

A second commonality appearing in all 5 categories is ***health***. To sustain an ecosystem or city over the long run assumes that it will be healthy.

A third common characteristic refers to ***place-specific conditions*** by measuring the relationship of a species or a process to a specific locale, e.g. *carrying capacity* is the ability of a particular area of land or water to support a certain level of life. *Fitness* deals with the appropriateness of species and activities to a specific habitat while *Resilience* suggests the adaptability of a certain place to absorb impacts and *Biodiversity* refers to the number of different species in a particular habitat. Lastly b*alance* means the interaction of production and place in a specific locale (Neumann, 2005). This place-specific facet of sustainability can be distinguished because so often references are made to global processes, whether natural (global warming, ozone layer depletion), human (globalization of the economy), or institutional (international treaties and political bodies such as the World Trade Organization and United Nations) and because global or universal approaches adopted by multi-national corporations and national governments are being revealed to be non-sustainable (Schmidheiny, 1992); (Vitousek, P.M., Mooney, H.A., Lubcheno, J. and Melillo, J.M., 1997); (Chapin, F.S.,III, Walker, B.H., Hobbs, R.J., Hooper, D.U., Lawton, J.H., Sala, O.E and Tilman, D., 1997) ; (Matson, P.A., Parton, W.J., Power, A.G. and Swift, M.J., 1997); (Botsford, L.W., Castilla, J.C. and Peterson, C.H., 1997); (Dobson, A.P., Bradshaw, A.D. and Baker, A.J.M, 1997) and (Daily, G. and Ellison, K., 2002). Lastly, ***interrelationships among system components***, borrowing from systems theory and ecology, are a defining feature of sustainability and are common to all the intellectual traditions mentioned above (Neumann, 2005). It is this trait of interrelationships that most closely connects sustainability with the classic and ideal view of city planning, especially comprehensive planning (Nolen, 1916) and (Unwin, Town Planning in Practice: An Introduction to the Art of Designing Cities and Suburbs , 1911). In fact, it has been proposed that all four common themes—l*ong-term process*, *health*, *place specificity*, and *interrelationships*— are closely connected to comprehensive city planning (Neumann, 2005). For this reason, sustainability inherently encompasses the planning of cities and provides a solid foundation for professions concerned with cities (Berke, 2000) and (Campbell, 1996).

2.2 Theoretical Review: Urban Systems and Urbanisation/Urbanism

2.2.1 What is Urbanity?

There is no easy way to define 'urban', either within a country or, especially, for comparing across countries. Urban dwellers are generally taken to be people living in areas which have populations above a certain size and/or density threshold, which varies from country to country and over time. Because demographic data are collected for administrative units, the term 'urban' does not necessarily coincide with densely settled areas dependent on economic sectors other than agriculture; the boundaries of urban settlements may exclude large populations linked closely to the urban economy and may include people who live in villages or on farms and are primarily agriculturalists. In addition, some people do not live permanently in either an urban settlement or a rural settlement but instead migrate periodically and maintain farm−based as well as off−farm economic activities. Enumeration may also exclude people who are not official urban residents and under-counting of transient or homeless urban dwellers is common in many countries (UNCHS, 1996) (UNCHS, 2001).It has been proposed that functionally, a centre becomes urban because most of its economic activities are in the non-extractive sector. Thus, a centre of settlement that relies heavily on manufacturing and service sectors may be considered as urban (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). A place may also become urban because its population size has surpassed a certain threshold. Most countries put this at a minimum of 2,500 people (World Bank, 1999). This classification is often qualified by other criteria, such as compactness and density. It has been argued that alternative classifications based on socio -cultural, economic, administrative and spatial criteria are difficult to establish and not likely to generate consensus. Demographic criteria carry the day when it comes to real decision-making, even though the economic criterion sometimes enters as an important additional factor (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001).

2.2.2 Understanding the Urban System

In order to define *sustainable urbanism*, a clear understanding of the urban system, its subsystems and interactions is required as the basis for making specific policies or strategic plans that will have an effect on the sustainability of these systems.

The term 'urban (eco-) system' may be used to refer to the hierarchy of a city, but in this research it refers to the boundary of a city in terms of its social and physical structures. A city is an open and complex system. The implications of 'urban system' vary in different scopes of urban studies (Yang, 2010).

Among many other models for urban systems, the *extended urban metabolism model* (EUMM)[6] developed by Newman *et al*. (Newman, P., Birell, R., Holmes, D., Mathers, C., Oakley, G., O'Connor, A., Walker, B., Spessa, A. and Tait, D., 1996) offers benefits to studies of the sustainability of cities by providing a unified or holistic viewpoint to encompass all of the activities of a city in a single model, See Figure 4, which makes explicit the notion of livability and reinforces the normative concept of improved environmental outcomes over time.

The EUMM views cities as systems that require inputs of key resources (stocks) which are drawn into their resident domestic, industrial, and governmental urban processes to produce two key sets of outputs. One of these is a human-oriented built environment, which can be characterized through a range of indicators from adequacy of infrastructure, to environmental, health, and social well-being of the inhabitants. Goals for this 'livability' dimension are to improve over time. The second set of outputs relates to emissions and waste flows. The goals for this dimension are to diminish flows over time. The desirable change for the system is improvement of livability and reduction of waste. EUMM is closely aligned with the

[6] In brief, the Extended Urban Metabolism Model, EUMM conceives of a city as a "metabolism", where the inputs are various types of resources such as energy and materials, the desired outputs are human wellbeing and prosperity, and the negative outputs are waste, pollution, etc. Thus in this framing, the goal is to reform cities through behaviour change of residents and better urban planning so the desired benefits of cities can be maintained and increased, while reducing the throughput of physical resources needed and reducing negative externalities.

paradigm of sustainable development where future orientation, sustainability goals and targets, and linkages among different dimensions are made explicit (Newton, 2001).

It has been argued that strategic urban planning systems developed over the last decades based on the urban metabolism concept, mainly focused on land use, transport, energy use, material stocks and flows, and were often understood in terms of carrying capacity or ecological footprints (Yang, 2010). However, an urban environment is both a physical and a social entity in its creation, functioning and future (Pickett, S.T.A., Burch, W.R. and Dalton, S.E., 1997), and therefore consists of the *natural environment*, *built environment* and *human well-being*. These constitute an urban system.

The *built environment* refers to the manmade surroundings that provide the setting for human activities, ranging in scale from personal shelter to neighbourhoods to the large-scale civic surroundings such as transport systems, public spaces and other infrastructure. The term is widely used to describe the interdisciplinary field of study that addresses the planning, construction, management and use of these man-made surroundings and their relationship to the social activities that take place within them over time. (Yang, 2010). The *natural environment* or ecosphere of an urban system encompasses natural resources and physical phenomena such as air, water as well as energy, all of which do not originate from human society. The natural environment is contrasted with the built environment, which comprises the areas and components that are strongly influenced by humans (Yang, 2010). The third component, *human well-being*, characterizes the socio-economic system of cities: it comprises variables such as personal income, education and health (Yang, 2010).

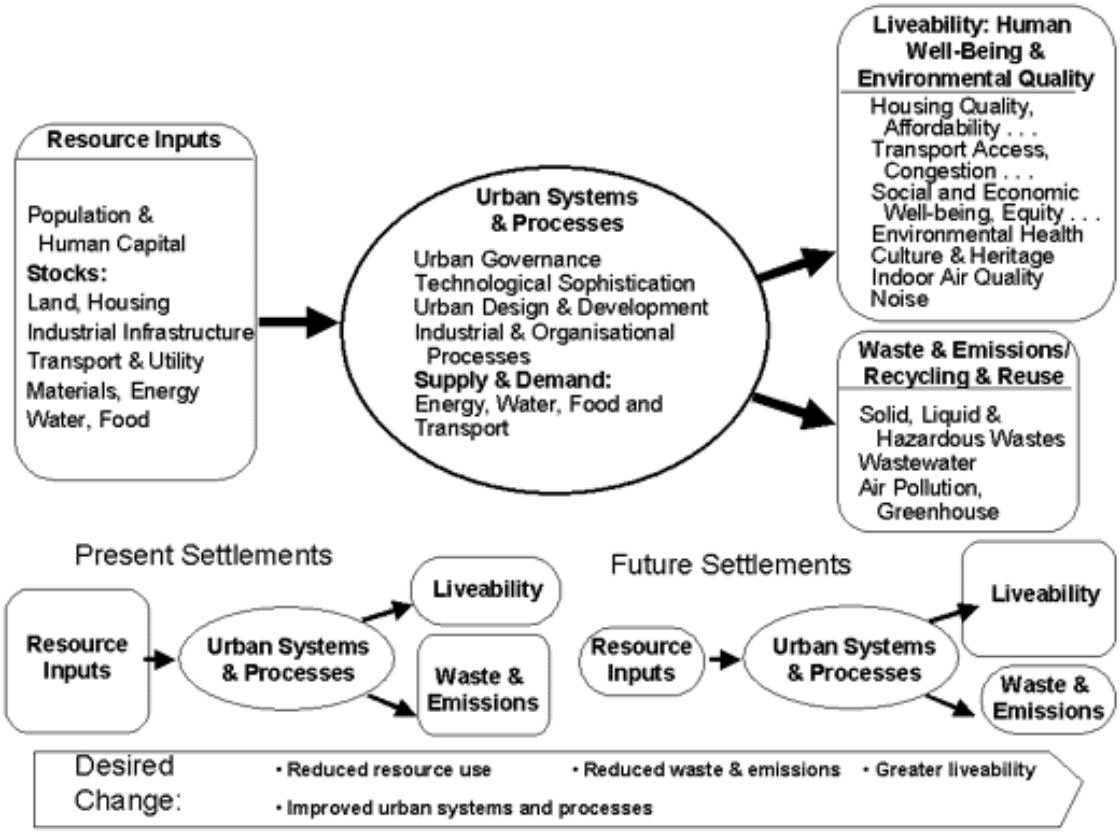

FIGURE 4 THE EUMM MODEL, SOURCE WWW.APROPEDIA.ORG

The interactive loops between the three components of the urban system are based on a system perspective[7]. Both the built environment and the natural environment can be

[7] Taking into account all of the behaviors of a system as a whole in the context of its environment is the systems perspective. While the concept of system itself is a more general notion that indicates separation of part of the universe from the rest, the idea of a systems perspective is to use a non-reductionist approach to the task of describing the properties of the system itself. In the systems perspective, once one has identified the system as a separate part of the universe, one is not allowed to progressively decompose the system into isolated parts. Instead, one is obligated to describe the system as a whole. If one uses separation into parts, as part of the description of the system properties, this is only part of a complete description of the behavior of the whole, which must include a description of the relationships between these parts and any additional information needed to describe the behavior of the entire system. Further, in a systems perspective one should be careful about considering the system in the context of the environment and not as an isolated entity. Thus one should include the interactions and relationships between the system and the environment.(Yaneer Bar-Yam) www.necsi.edu/guide/concepts/system_perspective.html

considered as 'complex, dynamic autopoietic systems'[8] (Moffat, S. and Kohler, N., 2008).

These systems exist in loose, nested hierarchies, each component system contained by the next level up and itself comprising a chain of linked subsystems at lower levels (Yang, 2010). The built environment as a self organizing system functions as a 'dissipative structure' requiring a continuous supply of available energy, material, and information necessary to produce and maintain its adaptive capacity, and continuously rejecting a stream of degraded energy and waste back into the ecosystem (entropy) (Rees, 2002).

The relation between the built environment and the natural environment is constantly changing, reflecting the evolution of social systems and influencing this evolution in turn (Walker, B.H. et al, 2006).

2.2.3 What is Urbanisation/Urbanism?

As with'urbanity', the term 'urbanisation' has also been conceptualised variously. *Urbanisation* is synonimous with *urbanism*. However, *urbanisation* can be thought of as extending over city and town regions, both intra and inter, whilst *urbanism* is limited to the whole or parts of an urban centre.

Urbanisation may be described as the process through which cities and towns develop and grow. It includes the movement of people from rural areas to urban areas as well as movements among towns and cities. It also encompasses the development of urban economies and urban social and political systems. Urbanisation viewed as a process is thus concerned not just with individual cities but with systems of cities, with linkages between urban places, and with interactions between them and the countryside. (UN Habitat/DFID, 2002)

[8] "**Autopoiesis**" (from Greek αὐτο- *(auto-)*, meaning "self", and ποίησις *(poiesis)*, meaning "creation, production") refers to a system capable of reproducing and maintaining itself. The term was introduced in 1972 by Chilean biologists Humberto Maturana and Francisco Varela to define the self-maintaining chemistry of living cells. Since then the concept has been also applied to the fields of systems theory and sociology. (Bourgine, P. and Stewart, J., 2004)

> 'There are 3 mega-trends that are marking our modern society. The first two are Omni-present. They visibly shape our societies and our daily lives. And, they are closely related. These two trends are globalization and information and communication technology. The latter is often referred to as one of the main driving forces of the new economy. The third mega-trend is less talked about and certainly less present in the media. It has nonetheless, an equally and profound impact on the way we live. This third trend is "urbanisation" and the growth of cities. It is the combined impact of rapid urbanisation and Globalisation that is increasingly shaping the development agenda' **(Tibaijuka, 2009)**

Urbanization can also be described as the process of transformation that affects geographic regions when they become more urban. During the urbanization process, a growing share of a region's land and people become included in cities, suburbs and towns. At the same time, the share of land and population in rural areas declines. Urbanization affects the physical shape of a region as well as the social experience of those who live there. Physical urban growth alters the natural and built landscape while population growth reshapes politics and culture (Pivo, 1996). The ways in which urbanization transforms a region depends on the nature of what occurs. Socially, urbanization may increase the richness and diversity of a region's population or cause tension and conflict between competing groups. Physically, urbanization may produce new urban spaces and livable neighborhoods or destroy critical environmental features and important cultural resources (Pivo, 1996).

Urbanisation, it has also been argued, could mean either growth in a physical sense or in a functional sense. The physical sense is the elementary and obvious meaning and with regard to use of land for urban purposes whilst the functional sense is with a focus on people rather than land and with reference to the activities of people (social, cultural and economic) and seeks to determine whether this are urban in character or not (Hall, 1973).

Urbanisation is also a political process – often a consequence and sometimes the cause of political change and even conflict (Watson, 1993) . Further, that Urban areas can only be understood as a result of the conflict between classes – a direct outcome of the capitalist mode of production; urban form, urban issues, urban government, urban ideology can only be understood in terms of the dynamics of the capitalist system. As a result, urban space is socially determined by the outcome of the conflicts between the different social classes (Gilbert, A. and Gugler, J., 1992).

Urbanisation could also be described as "the sociological and spatial counterpart to economic processes that shift workers away from subsistence agriculture to more productive sectors. It is the physical manifestation of all the construction activity that accompanies rapid growth" (Sanyal, 2008).

Omoakin Jelili has defined Urbanization simply as referring to the process of increasing agglomeration of people in a human settlement such that the settlement graduates from a particular level of complexity (economic, social, etc) to the other (Jelili, 2012).

Urbanisation has also been simply defined as the shift from a rural to an urban society and is an essential corollary of industrialization that goes hand in hand with the role of human settlements as engines of growth in the economy and as promoters of scientific, socio-cultural and technological development. Urbanization is the outcome of social, economic and political development. It is a factor of development associated with modernization and is a means of and consequences of modernization and has a positive and accelerating effect on development (Nsiah-Gyabaah, 2003).

Urbanization can describe a specific condition at a set time, i.e. the proportion of total population or area in cities or towns, or the term can describe the increase of this proportion over time. So the term urbanization can represent the level of urban development relative to overall population, or it can represent the rate at which the urban proportion is increasing.

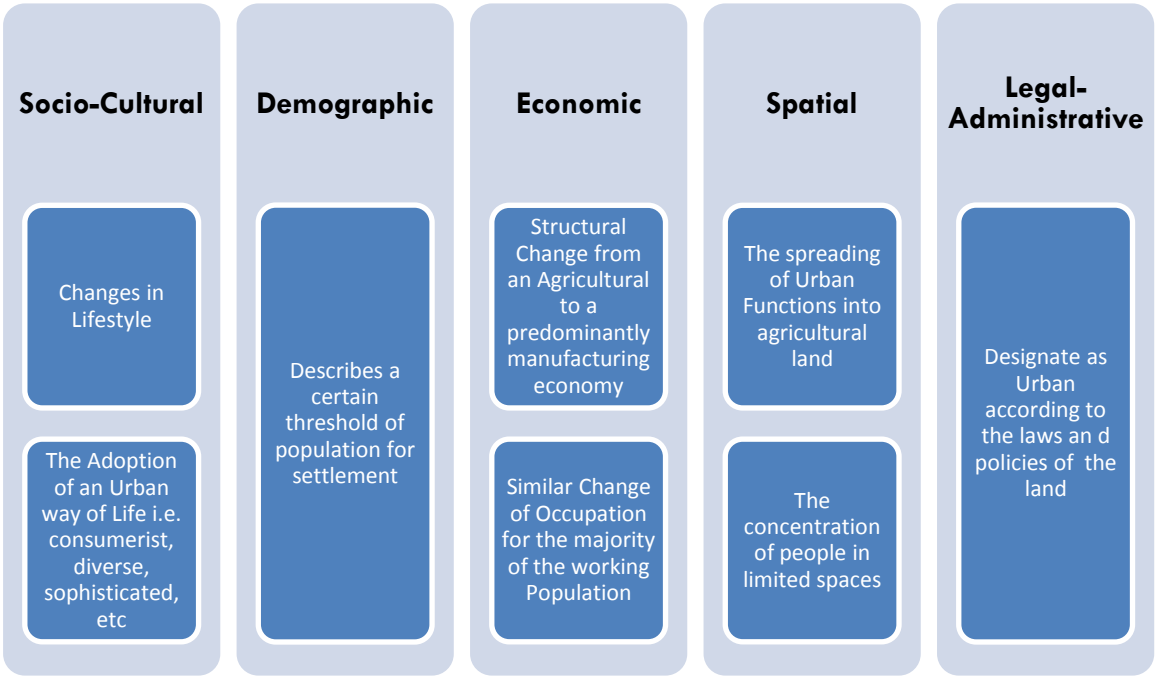

FIGURE 5 PERSPECTIVES ON URBANISATION SOURCE, (KAMETE, A. Y., TOSTENSEN, A. AND TVEDTEN, I., 2001)

2.2.4 The Mechanics and Patterns of Urbanisation

Urbanisation, as has been previously indicated, is a response to economic, social and political forces, but the specific ways in which urban settlements develop and grow, in different countries, change under the influence of new factors. Globalisation, democratisation, new information and communication technology, economic transformation, social and cultural changes − all of these are strongly influencing the pattern of urbanisation in the early 21st Century. Equally, the sheer scale of urban growth is changing the nature of urban settlements (UN Habitat/DFID, 2002).

Urban growth is fueled in two principal ways: by *demographic change* and by *migration*. Demographic trends are well-known: for instance, declining mortality rates in most developing countries have not been matched by a corresponding decline in fertility. Rural areas often cannot accommodate the increasing population and many, especially young single people, migrate to urban areas in the hope of work,

housing and an income, part of which may be intended as support for family members left behind in the rural areas. Young migrants, in turn, will form their own families in their new urban location, further increasing the urban population (Watson, 1993).

Standard structural transformation models distinguish *'labor push'* and *'labor pull'* factors as the main drivers of the rural-urban transition (Alvarez-Cuadrado, Francisco, and Markus Poschke, 2011). The labour push approach shows how a rise in agricultural productivity - a green revolution - reduces the 'food problem' and releases labor for the modern sector (Schultz, 1953). The labor pull approach describes how a rise in non-agricultural productivity - an industrial revolution - attracts underemployed labor from agriculture into the modern sector (Arthur, 1954). Alternatively, a country with a comparative advantage in manufacturing or tradable services can open up to trade and use imports to solve its food problem (Matsuyama, 1992; Teigner, 2011; Yi and Zhang, 2011). These mechanisms all lead to greater non-agricultural employment, and thus greater urban employment as a proportion of total workforce.

Recent studies in the spatial process of urbanisation (e-geopolis, 2014) have further revealed three kinds of urban growth: the densification of existing agglomerations, the spread of existing agglomerations and the emergence of new agglomerations, either based on an existing village nucleus (urbanization in situ) or as specially created new towns (urbanization ex-nihilo), or as unplanned gatherings or concentrations resulting in new agglomerations. Further, it is to be noted that while Europe, North America and Latin America experienced intense urbanization and rapid urban growth through the mid-20th century, the trend has now shifted to the developing regions of Asia and Africa. *In-migration*, *reclassificatio*n and *natural population increase* are contributing to a rapid urban transformation of these regions (UN-HABITAT, 2006).

Traditional geographical and economic explanations of urbanisation, as observed above, tend to focus on population growth induced by internal rural-urban migration

(World Bank, 1995). Until recently, policies and strategies were almost silent on the role of natural increase in urban growth (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). In Africa, most of the factors causing rural-urban migration have been seen to be economic (Todaro, 1994), reduced to the standard 'push-pull' factors. People are 'pushed' out of poverty-stricken rural areas, which depend on low-yielding rural subsistence agriculture, and 'pulled' to the urban areas by the perceived higher wages and better opportunities in these centres (Todaro, 1994). Such economic theories have not gone unchallenged (Tolley, G.S. and Thomas, V. (eds), 1987), but they still tend to dominate the debate.

In addition to the push of rural poverty and the pull of a perceived better life in urban areas, socio -political upheavals (civil strife, civil wars or international wars and natural disasters (principally droughts and floods) in the countryside often result in people seeking refuge in relatively secure urban areas. The continuation of these inflows and the length of the refugees' sojourn in the urban areas depend on the persistence of the original stimuli (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). Continued urban residence also depends on how well the refugees or internally displaced persons fit into the urban ways of life and adopt an urban lifestyle (Gmelch, G. and Zenner, W. (eds), 1996). Some never return to the rural areas, while others adapt to a quasi-urban existence by splitting households and 'straddling' urban and rural areas (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001).

The location and size of urban centres has always responded to changes in the technology and cost of transport and communication, but the rapid technological advances of recent years are enabling cities (even in poor countries) to grow at relatively low densities ever further into the surrounding countryside. Given the scale of urban growth which needs to be accommodated, rural land is rapidly being converted into urban, a worrying trend because the areas surrounding cities are often high quality agricultural land or have important ecological uses. This trend is exacerbated in many middle and low income countries by the Inability of tenure

registration, land use planning, and development regulation systems to keep pace with the demand for land for urban use (UN Habitat/DFID, 2002). As cities increase in size, 'metropolitanisation' becomes a progressively more dominant mode of urbanisation. It takes different forms in different places.

2.2.4.1 *It may refer to a densely settled city region in which villagers commute to work in the nearby city but where many production and service activities are located in villages, while intensive agricultural activities continue in the interstices between urban settlements.*

2.2.4.2 *It may refer to the stagnant or declining population and economic base of a core city when demographic and economic growth shifts to nearby secondary cities because diseconomies of congestion are experienced in the core, as in some of the great metropolises of Latin America.*

2.2.4.3 *Alternatively, it may refer to the development of interlinked systems of cities, as manufacturing assembly and other activities seek out lower cost locations, as in the Hong Kong/Pearl River Delta region of China.*

Notwithstanding the importance of rural-urban migration in urban growth, the contribution of the “natural growth of the existing urban population” (Devas, N. and Rakodi, C. (eds), 1993) to urbanisation is increasingly being acknowledged (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). Indeed, the growth of cities can no longer be regarded simply as a problem of migration (Devas, N. and Rakodi, C. (eds), 1993). It is suggested that the young age of most migrants contributes to higher natural increases (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). According to (Devas, N. and Rakodi, C. (eds), 1993), over 54 % of the urban growth in Kenya is attributable to natural increase. It is now generally agreed that migration is mainly important in the early stages of urbanisation. Thereafter, natural population growth takes over as the dominant contributory factor in urban growth (SIDA, 1995), (SIDA, 1995). Further studies maintain that more than 50 % of the urban growth of the developing world stems from natural population growth within the urban areas. Migration (35–40 %) and boundary changes (10–15 %) account for the remainder. Figure 6 below provides the global picture for the developing regions.

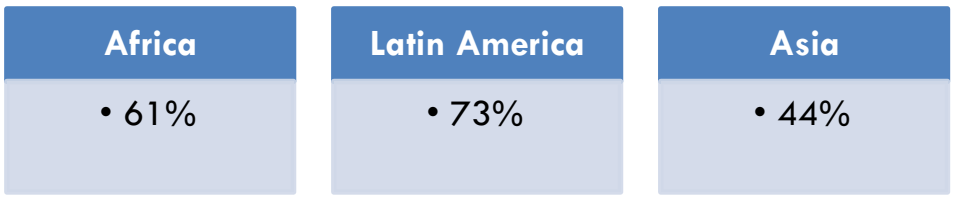

FIGURE 5 THE CONTRIBUTION OF NATURAL INCREASE TO URBAN POPULATION GROWTH IN DEVELOPING COUNTRIES, SOURCE (KAMETE, ET AL)

Changes in the organisation of economic activity, coupled with changes in transport and telecommunications and expectations of an improved quality of life, give rise to diverse pressures on the urban built environment. In the mature cities of the North, facing little aggregate growth, the need for regeneration and renewal now takes priority; changing family and social structures generate changing demands for new dwellings; and modernising economic activities seek a variety of specialised locations, often outside congested city cores. In the cities of transition economies, the priority is tackling the legacy of underused central areas, industrial dereliction, decaying infrastructure, and a deteriorating public housing stock. In the cities of developing countries, the need to accommodate rapid growth, provide essential infrastructure, deal with rapidly deteriorating physical environments, and improve shelter opportunities, especially for the poor, is urgent (UN Habitat/DFID, 2002).

Global economic changes have had particularly dramatic effects on cities and towns; even in highly developed countries, a poor minority has failed to benefit from increased prosperity, while in transition and developing countries, impoverishment and deprivation remain widespread.

Whatever the patterns of urbanisation, activities in urban settlements are inextricably linked to those in rural areas; while many people's lives straddle both urban and rural areas. For instance urban settlements provide markets for rural produce − food, industrial raw materials, construction materials, fuel etc. − as well as many of the services needed by rural populations, such as financial services, farm inputs and health care. On the other hand, the extraction of resources and disposal of urban

wastes can adversely affect rural areas both close to and far away from cities. These inter−linkages underlie many of the challenges to achieving sustainable urbanisation (UN Habitat/DFID, 2002).

2.2.5 Why Urban Centres Continue to Grow

As noted previously, urbanisation has been rapid in Africa. This trend, though perhaps tapering off somewhat and varying from one country to another, is still phenomenal (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). There has to be an explanation why urban areas continue to grow, despite polices designed to reverse the trend in some countries (de Haan, Livelihoods and Poverty: The Role of Migration - A Critical Review of Migration Literature, 1999).

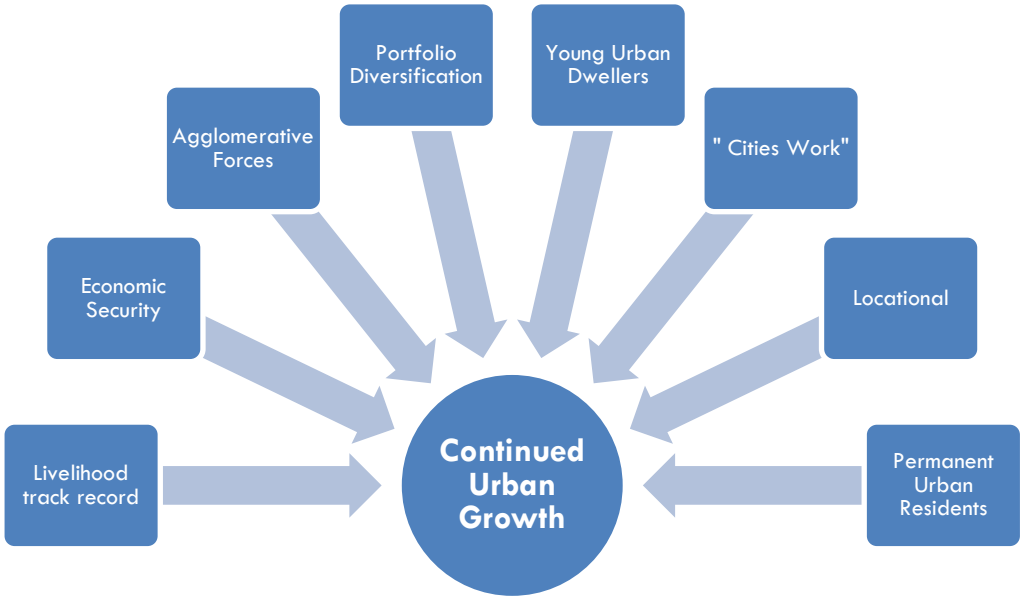

FIGURE 6 WHY URBAN CENTRES CONTINUE TO GROW, SOURCE (KAMETE, ET AL, 2001)

From purely economic and geographical perspectives, internal mechanisms in urban areas promote sustained growth, linked to their position as production zones. It is acknowledged that urban centres produce a substantial proportion of the national income in most countries (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001).

Globally, urban areas account for some 55 %, 73 %, and 85 % of the GNP in low-income, middle-income and high-income countries respectively (World Bank, 1999).

This is explained by the fact that the "…growth sectors of the economy – manufacturing and services – are concentrated in cities where they benefit from agglomeration economies, ample markets for inputs, outputs, and labour and where ideas and knowledge are rapidly diffused" (World Bank, 1999). In urban areas the proximity of all production factors makes economic activity possible and productive. Consequently, because of these locational advantages and agglomeration economies urban centres continue to grow as they attract outsiders and retain and help to expand those economic players who are already in (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). It is a truism that labour is attracted to and retained in areas where economic activities are concentrated (Todaro, 1994). Hence, urban areas continue to grow by virtue of the inherent economic growth dynamic created.

Another complementary explanation is that towns and cities, despite all their negative features, provide a much better option for livelihood than their rural hinterland. In the latter, farms are increasingly becoming smaller, sub-economic and eventually unable to feed the farmers' households. Similarly, mining operations located in rural areas are being adversely affected by low commodity prices on the world market (Rakodi C. , 1994). Left with no better option for their livelihood, the struggling rural-based people move to or remain in the cities, inhospitable though they may be (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001).

In addition, urban areas seem to have established a livelihood track record. The World Bank maintains that people move to the city in expectation of a better life and that the evidence at hand proves that these expectations have largely been met (World Bank, 1995). This fact is well known by those in the rural and urban areas alike. As a result, those already in the cities opt to remain there, and those in the rural areas choose to join the ranks of the urbanites. As a consequence, urban growth continues relentlessly (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001).

The age structure of the urban population explains the boom in natural increase. (Devas, N. and Rakodi, C. (eds), 1993) and (World Bank, 1999) Urbanites are predominantly young, in reproductive age with a wish to have children. This, again,

bolsters natural population increase (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). The foregoing analysis seems to suggest that urban areas have an in –built mechanism to initiate and sustain growth (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). This analysis is perhaps a fitting summary of all the reasons cited above and the World Bank's firm conviction that "cities work" (World Bank, 1991).

2.2.6 State of Urbanisation in Africa

The formation of urban centres, in form of towns and cities is not an altogether new phenomenon in Africa (Krausmann, F., Fisher-Kowalski, M., Schandl, H. and Eisenmenger, N., 2008). One of Africa's present-day megacities, Cairo, can trace its origins back to 3114 BC, where the first known pharaoh, Menes, founded Memphis (Chandler, 1994). Other ancient African towns included Carthage, Aksum, Alexandria, and Meroe. Sub-Saharan Africa remained predominantly rural up until the 9th century. As from around the year 1000 a number of cities were founded in the Niger Basin: Kano, Zaria, Timbuktu, Ife, and Oyo. In Eastern and Southern Africa the old coastal trading towns of Kilwa and Sofala are well known, and above all Great Zimbabwe in the interior (Chandler, Urbanisationin Medieval and Early Modern Africa, 1994). In general, the pace of urbanisation in pre-colonial Africa was slow (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001).

The colonial powers founded new European cities and connected them to the hinterland with railways and roads. The main initial functions of the colonial cities were trade and administration (and army garrisons) (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). Later, mining and manufacturing provided the growth momentum (Christopher, A.J. and Tarver, J.D., 1994).

The main challenge facing African towns and cities today, however, is the achievement of economic growth and its equitable distribution, so that urban economies can contribute appropriately to national economic development and provide sufficient labour market opportunities (World Bank, 1999).

According to (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001), the following issues are often highlighted as regards urbanisation:

2.2.6.1 *Poverty is increasingly an attribute of urbanisation, and urban poverty exhibits specific features that need to be understood better.*
2.2.6.2 *The environmental problems facing developing countries are increasingly associated with cities and urban centres.*
2.2.6.3 *The proportion of women in migration flows to cities is increasing, and the urbanisation process impacts significantly on the status and roles of women.*
2.2.6.4 *Urban areas play a significant role in the democratisation process, through political mobilisation as well as local government.*
2.2.6.5 *There is an unequivocal correlation between urbanisation and economic development and growth.*
2.2.6.6 *There is a close link between urban and rural development, both in macroeconomic terms and through migration and urban-rural links.*

Urban areas have until recently received less explicit attention than the countryside in terms of national development priorities and development aid. (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001) The underlying rationale for this neglect can be traced to two pervasive perspectives:

2.2.6.7 *Urban areas have always been favoured – by design or default – in development policy and in the allocation of resources – the 'urban bias thesis' (Lipton, 1988).*
2.2.6.8 *Urban areas are home to only a small proportion of the national population in the developing world.*

These 'anti-urban' perspectives seem to be changing, as is shared by the United Nations Centre on Human Settlements (Habitat), which predicts that urban areas will "…be the place where compelling social issues such as poverty, homelessness, crime and unemployment will take on a dimension far bigger and more complex than ever seen before". (UN-Habitat, 1994) Habitat goes on to point out that cities will be the home and workplace for most of the world's population, centres of economic activity as well as areas of major pollution and consumption. Such a "major transformation"

has important ramifications. As put forth by (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001) the urbanisation process bears decisively on;

2.2.6.9 *Poverty generation and reproduction*
2.2.6.10 *Livelihoods*
2.2.6.11 *Gender relations*
2.2.6.12 *Governance*

Considerable emphasis has first of all been given to the role of urban areas in the coping or livelihood strategies, of populations in the developing world. (de Haan, Livelihoods and Poverty: The Role of Migration - A Critical Review of the Migration Literature, 1999) and (Jones, S. and Nelson, N. (eds), 1999) Indeed, most traditional explanations of urbanisation dwell on economically motivated migration geared towards improving or maintaining livelihoods. Urban areas still maintain this role in the survival strategies of a substantial section of the rural and urban populations of any African country (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). Linked to survival is the rising phenomenon of poverty (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). The concentration of poor people in urban areas, themselves being run by impoverished administrations in poverty-stricken countries, has obvious negative implications. In this vein, (Nelson, 1999) bemoans the rapid urban growth "…which has made it next to impossible for urban authorities to provide … services or sufficient employment." Special social groups, such as the unemployed, the elders, and the homeless, are often affected particularly hard. These implications transcend urban borders, linking rural well-being closely to urban well-being (Kamete, A. Y., Tostensen, A. and Tvedten, I., 2001). Urbanisation has implications for economic development and occupies a critical position in sustainable development, but this all depends on how well managed the process is (SIDA, 1995) and (World Bank, 1991).

2.2.7 Emerging Urbanisation Issues

The preceding discussion on urbanisation in the developing world, particularly in Africa, has a number of implications for development. This discourse has noted that;

2.2.7.1 *Urbanisation is an irreversible phenomenon in African countries.*

2.2.7.2 *The urbanisation trend is set to continue.*

2.2.7.3 *Urban areas are gaining in influence.*

2.2.7.4 *Urbanisation and the growth of urban areas have multiple repercussions among them economic, socio -cultural and political changes – which could either be beneficial or adverse.*

2.2.7.5 *The most important national and local issues will in the future be played out in urban areas.*

2.2.7.6 *Most of the urbanisation occurring in Africa is not accompanied by economic growth.*

2.2.7.7 *Urban areas have an in -built thrust to continue to grow.*

2.2.7.8 *It is not tenable to separate urban and rural areas as discrete spheres because their fates are inextricably linked.*

2.2.7.9 *Urban areas vary widely not only in location and size but also in functions and substance.*

The question of urban development therefore begs, if urbanisation is inevitable globally, what form should it take in Kenya's rapidly urbanising towns such as Nyeri?

2.3 Theoretical Review: Sustainability and Urbanisation

2.3.1 Need for Sustainable Urbanisation

As has been mentioned previously, rapid urbanisation is arguably the most complex and important socio-economic phenomenon of the 20th and 21st centuries. Generally understood as a shift from a predominantly rural to a predominantly urban society, it also represents major and irreversible changes in production and consumption and the way people interact with nature (Allen, 2009).

The consequent rapid economic growth, social polarization, and the worsening of environmental and health conditions characterize the ongoing urban development processes. The economic growth is connected with enormous urban growth, as well as the increase of industrial and commercial zones and traffic. Industrial production with low environmental standards, individual cars and insufficient housing conditions produce health-endangering environmental loads. Human settlements are material and energy consuming and throughput systems: high amounts of resources (e.g. water, oil, food, building materials and energy) are imported into cities and urbanized regions, partly transformed (energy production), used – and in the end exported as solid waste, wastewater, waste heat, etc. These processes occur not only on a local level, but are also internationally linked, and thus influence environment and health on a global level; they raise global environmental and health risks (Weiland, 2006).

It is now widely acknowledged that the impact of urbanisation will continue to bring about major global and local changes well into the current century, as many countries in the developing world are presently in, or about to enter, the high-growth and rapid-transition phase of the urbanisation process. (Allen, 2009) These global environmental and health risks demand for a sustainable urban development (Weiland, 2006).

‘Humanity stands at a definite moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can – in a global partnership of sustainable development.’ (United Nations, 1992)

A closer look at both the scale and magnitude of contemporary trends of demographics do not simply imply that most of the world population will be living in cities but that urbanisation does and will continue to have a significant impact on the global carrying capacity of the earth and to affect the way in which rural and urban households and individuals straddle between the ‘urban’ and the ‘rural’. (Montgomery, M., Stren, R., Cohen, B. and Reed, H. E. (eds), 2004) The latter is important because decisions about health, fertility, migration, production, natural resources use and so on are increasingly affected by the diffusion power of the urbanisation process, not just spatially but through the global economy, informational spill-overs and social networks (Allen, A., Hofmann, P. and Griffiths, H., 2007).

As global trade has vastly expanded throughout the 20th century, cities have become less reliant upon their hinterland for sustenance and are increasingly importing not only their consumer goods, but also food, energy, water and building materials from distant sources. At the same time, wastes produced in urban areas are increasingly been exported to distant regions. This means that very often the origin of food and energy and the destination of wastes is invisible to urban dwellers, creating dependencies that might not be ecologically or geopolitically stable, secure or indeed, sustainable (Rees W. , 1992). The problem is that the limits imposed by the expansion of the urban ecological footprint do not become evident until they are

translated into local impacts, such as higher food or energy prices, frequent floods or the increment of environment-related diseases such as skin cancer (Allen, 2009).

When taking a more disaggregated look at the ecological footprint of different income groups within fast growing cities in the developing world, significant differences emerge between the wealthy and the poor, revealing a consistent link between income and the demands individuals place on the environment, as regards both their consumption of renewable and non-renewable resources and their patterns of waste production. This implies that the challenge of urban sustainability cannot be addressed without an examination of wider relationships between urban areas and their hinterlands or 'bio-regions', nor without unpacking the inequality that unfortunately prevails in the contemporary urbanisation process, where conditions of hyper and sub-consumption coexist neck-to-neck (Gordon, G. and Satterthwaite, D., 2000).

Indeed, rapid urban change is likely to occur in the world's poorest countries, those least equipped with the means to invest in basic urban infrastructure – water, sanitation, tenured housing – and least able to provide vital economic opportunities for urban residents to live in conditions above the poverty line. In this context, the urban poor face great exposure to biological and physical threats and also more restrictions in their access to protective services and infrastructures. Thus, the contemporary process of urbanisation in the developing world is characterized not just by a shift in the locus of poverty – from rural to urban – but more significantly compounded with the 'urbanisation of poverty and social exclusion' that derive from socio-economic, gender and ethnic inequalities (Allen, 2009).

The above discussion implies that the contemporary process of urbanisation is underlined not simply by rural–urban migration and a rural–urban poverty shift (at least in population percentages) but by a significant transformation of the linkages between the global and the local, the urban and the rural, the rich and the poor, and above all, the systemic conditions that threaten the very possibility of a sustainable future (Adriana, A. and You, N., 2002).

According to Agenda 21 (DESA, 1992), sustainable development shall meet the needs of the present without compromising the ability of future generations to meet their own needs. The general public shall be involved in decision-making and especially urban development processes. Sustainable *urban* development is an integrative process dealing with ecological, economic, social, and cultural aspects of urban development in a long-term perspective, including also good human health conditions. It takes place on the local level while considering regional, national and global interrelationships. Sustainable urban development requires the co-operation of a variety of authorities, stakeholders and social groups on different political levels. Considering the global variety of urban social, economic, cultural, and environmental conditions, it becomes obvious that the above general meaning of sustainable development has to be transferred to the prevailing local conditions. In order to discuss sustainability with various groups, and in order to find out to what extent the real urban development processes comply with the envisaged sustainability, adequate assessment procedures and accordant instruments are required (Weiland, 2006).

Studies have revealed that cities are responsible for the bulk of production and consumption worldwide, and are the primary engines of economic growth and developmen – that roughly three-quarters of global economic activity is urban, and as the urban population grows, so will the urban share of global GDP and investments. The right to development therefore, for low-income and middle-income countries can only be realized through sustainable urbanization that addresses the needs of both rural and urban areas (SDSN, 2013).

While it is a fact that cities are home to extreme poverty and environmental degradation but by getting urban development right, cities can create jobs and offer better livelihoods; increase economic growth; improve social inclusion; promote the decoupling of living standards and economic growth from environmental resource use; protect local and regional ecosystems; reduce both urban and rural poverty; and drastically reduce pollution (SDSN, 2013).

Sound urban development will accelerate progress towards achieving sustainable Urban development goals, including the end of extreme poverty. On the other hand, mistakes made in managing urban growth are very hard to undo. Infrastructure investments, urban land-use systems, and layouts are literally cast in stone – with impacts that may be difficult to alter for many decades (SDSN, 2013).

Without adequate management and investments, slums may expand, and cities may fail to generate the jobs necessary to improve livelihoods. As a result, inequalities, exclusion, and violence may increase. Countries may fail to decouple economic development from resource use, and cities may fail to provide economic opportunities to surrounding rural areas and become vulnerable to climate and other environmental changes (SDSN, 2013).

Cities around the world are struggling to accommodate their rising populations and address the multi-dimensional challenges of urban development. If current trends continue, few countries stand to reap the benefits of sustainable urban development. The stakes are high (SDSN, 2013). Without sustainable urbanisation, sustainable development cannot be achieved (UN Habitat/DFID, 2002).

> ‘I do not wish to seem overdramatic, but I can only conclude from the information that is available to me as Secretary General, that the members of the United Nations have perhaps ten years left in which to subordinate their ancient quarrels and launch a global partnership to curb the arms race, to improve the human environment, to defuse population explosion, and to supply the required momentum to development efforts. If such global partnership is not forged within the next decade, then I very much fear that the problems I have mentioned will have reached such staggering proportions that they will be beyond our capacity to control ’
>
> U Thant, Secretary General, United Nations. (196)

2.3.2 Definition of Sustainability in Urbanisation

Sustainable urbanization occurs when the urbanization process harmonizes with principles of sustainable development. It is sustainable development's urban embodiment and provides an urban manifestation of its fundamental ideas (Pivo, 1996). As a consequence to the very real global threat of devastation; economically, environmentally and socially, if current and future urban areas persist with the same resource consumption practices without due regard to future needs – international organizations e.g. UN Habitat, World Bank, OECD, and European Commission) have committed great efforts in promoting the mission of sustainable urbanization practice and currently the mission is widely addressed among different disciplines. Consequently, many concepts and definitions on sustainable urbanization have emerged (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X.,, 2011). The following ones are between these typical:

2.3.2.1 *Sustainable communities are "communities that flourish because they build a mutually supportive, dynamic balance between social wellbeing, economic opportunity, and environmental quality" (Sustainable Development Task Force, 1997).*

2.3.2.2 *Sustainable city is "a city where achievements in economic, social and physical development are made to last" (Soegijoko, B., Tjahjati, S. and Kusbiantoro, B. S., 2001).*

2.3.2.3 *Urban sustainability is used as a desirable state of urban conditions that persists overtime (Adinyira, E., Oteng-Seifah, S and Adjei-Kumi, T, 2007).*

2.3.2.4 *Urban Sustainability is often characterized by proper use of resources to guarantee a generational equity, protection of the natural environment, minimal use of non-renewable resources, economic vitality and diversity, community self-reliance, individual wellbeing, and satisfaction of basic human needs (Choguill, 1996).*

2.3.2.5 *Urban sustainability is defined as the challenge to "solve both the problems experienced within cities and the problems caused by cities", recognizing that cities themselves provide many potential solutions (European Commission, 2006).*

2.3.2.6 *Sustainable urbanization refers to the well-balanced relationship between the social, economic and environmental agents in society, so as to accomplish sustainable urban development (Drakakis-Smith, 2000).*

2.3.2.7 *Sustainable urbanization is a dynamic process that combines environmental, social, economic and politicaleinstitutional sustainability. It brings together urban and rural areas, encompassing the full range of human settlements from village to town to city to metropolis, with links at the national and global levels (UN Habitat, 2004).*

2.3.2.8 *The terms "urban sustainability, sustainable city and sustainable community" refer to the desirable state, while "sustainable urbanization and sustainable urban development" refer to the process towards the desirable state (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X.,, 2011).*

2.3.2.9 *The principle of sustainable urbanization refers equal concern to environmental, governance, social and economic sustainability, social sustainability is more difficult to define due to its diverse, wide and subjective characteristics (Western Australian Council of Social Services, 2003).*

2.3.2.10 *Social sustainability can be described as "the development and/or growth that is compatible with the harmonious evolution of civil society, fostering an environment that encourages social integration, with improvements in the quality of life for all segments of populations" (Polese, M., and Stren, R., 1999). Social sustainability is considered as one of the indispensable dimensions for measuring urban sustainability (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X., 2011).*

Critics of sustainability point out that the emphasis on minimizing resource depletion and maintaining current resources is inconsistent with the economic principle of substitution which hold that when a given resource becomes scarce, its price will rise which in turn will promote conservation and a shift to lower priced and more plentiful alternatives. However, it may not be necessary to choose between this view and that of sustainable development if one recognizes that the social and environmental consequences of urbanization trends are growing costlier and that sustainable urbanization may be the alternative being produced by the economic law of substitution (Pivo, 1996).

2.3.3 Challenges of Sustainable Urbanisation in Developing Countries

2.3.3.1 *Making Sustainability a Priority*

The non-sustainable results of urban development in third world countries show that adoption of sustainable urbanisation strategies is not yet a priority. This is a concept managed by professionals in certain fields and only recently have governments begun to pay attention to it, due more to international pressure than to internal conviction (Afify, 2006).

2.3.3.2 *Sustainable vs Profitable Land Development*

There is the pre-conceived idea, though often true, that environmentally friendly practices imply extra costs. The need to make additional investments is very often the excuse not to comply with standards and practices based on principles of sustainability (Afify, 2006).

2.3.3.3 *Mobilisation of Resources*

One of the key challenges of sustainable urbanisation strategies is the mobilization of resources in order to support research, technological changes and feasibility studies. In many cases, the issue is not the lack of resources, but the lack of co-ordination in managing them efficiently. Converging resources from different public organizations could help increase the impact of their utilization (Afify, 2006).

2.3.3.4 *Public Awareness*

Participation by the public is key to achieving decisions needed to secure changes in consumption and wasteful patterns of the majority of the population. It is important to develop campaigns that on the one hand relay the benefits and opportunities with regards to the adoption of sustainable urbanisation strategies and on the other, encourages the change of consumer habits towards a more sustainable use of resources (Afify, 2006).

2.3.3.5 *Extending the Scope*

Projects are designed and developed in isolation without thinking about the impacts of the new structure on the surroundings and on the city. Environmental construction is very often identified only with building materials and technologies for the construction of lone projects. The integrated concept of each building development as part of the urban fabric of a city is not often contemplated by the construction industry. In the same way, when talking about sustainability, the scope of sustainability needs to include environmental concepts, not only for individual building developments, but also for the design and development of cities (Afify, 2006).

2.3.3.6 *Dynamics of National and Global Economies*

Urban economic development is often threatened by changes in national and global economies. Even when economic growth occurs, it does not necessarily benefit the poor. Ways must be found of developing urban economies that are diverse, resilient and also provide livelihood opportunities accessible to the poor (UN Habitat/DFID, 2002).

2.3.3.7 *Undermining of Traditional Social Networks*

Urbanisation is associated with social and political changes, which can undermine traditional social networks and result in increased inequity and exclusion: ways must be found of increasing equity and ensuring political and social inclusion (UN Habitat/DFID, 2002).

2.3.3.8 *Deficiency in available Infrastructure*

Infrastructure is often severely deficient, adversely affecting the natural and built environments and exacerbating poverty because of its effects on the health and living environments of the poor: ways must be found of extending infrastructure provision to keep pace with urban growth on a basis which is financially and environmentally sustainable, while ensuring access to an adequate level of services for the poor (UN Habitat/DFID, 2002).

2.3.3.9 *Deficiency in Governance Capabilities*

The governance capabilities of the agencies responsible for achieving sustainable urbanisation are inadequate: ways must be found of enhancing their capacity to deal with the challenges of managing growing towns and cities, in the context of their surrounding regions (UN Habitat/DFID, 2002).

2.3.3.10 *Economic, Environmental and Governance Tension*

Economic, environmental and governance tensions make it difficult to realise the benefits of interdependence between rural and urban areas: ways must be found of developing and implementing economic policies, resource use and waste management strategies, and governance arrangements that recognise and enhance the complementary roles of urban and rural areas in sustainable development (UN Habitat/DFID, 2002).

2.4 Theoretical Review: Sustainable Urbanism

2.4.1 Introduction to Sustainable Urbanism

Sustainable urbanism grows out of three late 20th Century reform movements and highlights the benefits of integrating human and natural aspects. These systems are *smart growth, new urbanism* and *the green building movements*.

While all three share an interest in comprehensive economic, social and environmental reform, they differ greatly in their history, constituencies, approach and focus. According to Douglas Farr, each of these movements, suffer from a certain insularity resulting in myopia when searching for long-term solutions. Further, that amongst the three, there has been an understandable but unfortunate tendency toward self-validation, resulting in unwillingness to engage a larger comprehensive agenda. He gives an example of a certified 'green building' that is really not positive for the environment when it turns out to be surrounded by a large paved parking lot or a walk able neighborhood that is difficult to sustain because its houses are wastefully constructed and energy inefficient (Farr, Sustainable Urbanism- Urban Design with Nature, 2008).

"Sustainable Urbanism", reduced to its most basic principles, is walk able and transit-served urbanism integrated with high-performance buildings and high-performance infrastructure; where compactness and human access to nature are core values and where aspects of sustainability, functionality and interconnectivity are more important than design.

Nevertheless, design aspects play a very important role in Sustainable Urbanism. This makes the movement a strong competitor to other co-existing movements, whose primary focus is on the design quality as a basis for socially sustainable settlements (e.g. contemporary streams in European urbanism which focus on reconstruction of traditional cities). Even more significant is the fact, that "Sustainable Urbanism" is not only the approach of how sites are designed and managed - it is also a comprehensive network and agenda of interdisciplinary focused stakeholders - planners, architects, engineers etc. and thanks to this

characteristic it has - and is likely to continue having - reforming influence on the whole planning and developing community.

Sustainable Urbanism targets critical issues and challenges - not only those of urban design, but social, environmental and economic sustainable community development as well as health and climate on local and global scale; and thereby proposes comprehensive solutions for these interdisciplinary tasks of both present and future meaning.

2.4.2 Smart Growth – the Environmental Consciousness of Sustainable Urbanism

Smart Growth is an urban planning and transportation theory that concentrates growth in the center of a city to avoid urban sprawl. It advocates for compact, transit-oriented, walk-able, bicycle-friendly land use, including neighborhood schools, streets that work for everyone, mixed- use development with a range of housing choices. The term *'smart growth'* is particularly used in North America. In Europe and particularly the UK, the terms *'Compact City'* or *'Urban Intensification'* have often been used to describe similar concepts, which have influenced government planning policies in the UK, the Netherlands and several other European countries.

Smart growth values long-range, regional considerations of sustainability over a short-term focus. Its goals are to achieve a unique sense of community and place; expand the range of transportation, employment, and housing choices; equitably distribute the costs and benefits of development; preserve and enhance natural and cultural resources; and promote public health.

The concept of *"smart growth"* emerged in 1992 from the United Nation's adoption of Agenda 21 at the UN Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil. Driven by "new guard" urban planners, architects, developers, community activists, and historic preservationists, it accepts that growth and development will continue to occur, and so seeks to direct that growth in an intentional, comprehensive way. Smart growth principles are directed at developing

sustainable communities that are good places to live, to do business, to work, and to raise families. Urban growth can be considered as *"smart growth"*, to the extent that it includes the elements listed below (U.S Environmental Protection Agency, 2014).

2.4.2.1 *Compact neighborhoods*

Compact, livable urban neighborhoods attract more people and business. Creating such neighborhoods is a critical element of reducing urban sprawl and protecting the climate. This includes adopting redevelopment strategies and zoning policies that channel housing and job growth into urban centers and neighborhood business districts, to create compact, walk-able, and bike- and transit-friendly hubs.

2.4.2.2 *Transit-oriented development*

Transit-oriented development (TOD) is a residential or commercial area designed to maximize access to public transport, and mixed-use/compact neighborhoods tend to use transit at all times of the day. Many cities striving to implement better TOD strategies seek to secure funding to create new public transportation infrastructure and improve existing services. Other measures might include regional cooperation to increase efficiency and expand services, and moving buses and trains more frequently through high-use areas.

2.4.2.3 *Pedestrian- and bicycle-friendly design*

Biking and walking instead of driving can reduce emissions, save money on fuel and maintenance, and foster a healthier population. Pedestrian- and bicycle-friendly improvements include bike lanes on main streets, an urban bike-trail system, bike parking, pedestrian crossings, and associated master plans. The most pedestrian- and bike-friendly variant of smart growth is *New Pedestrianism*[9] because motor vehicles are on a separate grid.

2.4.2.4 *Preserving open space and critical habitat, reusing land, and protecting water supplies and air quality*

2.4.2.5 *Transparent, predictable, fair and cost-effective rules for development*

[9] **New Pedestrianism** (**NP**) is a more idealistic variation of New Urbanism in urban planning theory, founded in 1999 by Michael E. Arth, an American artist, urban/home/landscape designer, futurist, and author. NP addresses the problems associated with New Urbanism and is an attempt to solve various social, health, energy, economic, aesthetic, and environmental problems, with special focus on reducing the role of the automobile. A neighborhood or new town utilizing NP is called a Pedestrian Village. Pedestrian Villages can range from being nearly car-free to having automobile access behind nearly every house and business, but pedestrian lanes are always in front. (Arth, 2010)

2.4.2.6 *Historic preservation*

2.4.2.7 *Setting aside large areas where development is prohibited, nature is able to run its course, providing fresh air and clean water.*

2.4.2.8 *Expansion around already existing areas allows public services to be located where people are living without taking away from the core city neighborhoods in large urban areas. Developing around preexisting areas decreases the socioeconomic segregation allowing society to function more equitably, generating a tax base for housing, educational and employment programs.*

Reviewing evidence on urban intensification, smart growth and their effects on travel behaviour (Melia, S.B and Parkhurst, G., 2014) found that planning policies which increase population densities in urban areas do tend to reduce car use, but the effect is a weak one, so doubling the population density of a particular area will not halve the frequency or distance of car use. These findings led them to propose the *paradox of intensification*, which states "Ceteris paribus, urban intensification which increases population density will reduce per capita car use, with benefits to the global environment, but will also increase concentrations of motor traffic, worsening the local environment in those locations where it occurs".

The study further revealed that at the level of the neighbourhood or individual development positive measures (e.g. improvements to public transport) will usually be insufficient to counteract the traffic effect of increasing population density; leaving policy-makers with four choices: intensify and accept the local consequences, sprawl and accept the wider consequences, a compromise with some element of both, or intensify accompanied by more radical measures such as parking restrictions, closing roads to traffic and car free zones.

Some libertarian groups, such as the Cato Institute[10], criticize smart growth on the grounds that it leads to greatly increased land values, and people with average incomes can no longer afford to buy detached houses (O'Toole, 2001).

Douglas Farr argues that Urban Growth Boundaries[11] (UGBs) do little in ensuring the quality of development within the UGB, leading to what he calls, "well located – bad development", or what would be called *smart sprawl*. In addition, the vagueness of the standards and the *smart growth* movement's decision to lend its name to development projects of sometimes minimal incremental improvement worked to dissolve the 'smart growth' brand (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

2.4.3 New Urbanism

New Urbanism is an American urban design movement that arose in the early 1980s. Its goal is to reform many aspects of real estate development and urban planning, from urban retrofits to suburban infill. New urbanist neighborhoods are designed to contain a diverse range of housing and jobs, and to be walk-able. New Urbanism can include neo-traditional neighborhood design and transit-oriented development (TOD).

In 1991, the Local Government Commission, a private nonprofit group in Sacramento, California, invited architects Peter Calthorpe, Michael Corbett, Andrés Duany, Elizabeth Moule, Elizabeth Plater- Zyberk, Stefanos Polyzoides, and Daniel

[10] The Cato Institute is an American libertarian think tank headquartered in Washington, D.C. It was founded as the Charles Koch Foundation in 1974 by Ed Crane, Murray Rothbard, and Charles Koch. In July 1976, the name was changed to the Cato Institute. Cato was established to have a focus on public advocacy, media exposure and societal influence. The Institute's website states, "The mission of the Cato Institute is to originate, disseminate, and increase understanding of public policies based on the principles of individual liberty, limited government, free markets, and peace." (CATO Institute, 2011)

[11] An urban growth boundary, or UGB, is a regional boundary, set in an attempt to control urban sprawl by mandating that the area inside the boundary be used for higher density urban development and the area outside be used for lower density development. Legislating for an "urban growth boundary" is one way, among many others, of managing the major challenges posed by unplanned urban growth and the encroachment of cities upon agricultural and rural land. (James, P., Holden, M., Lewin, M., Neilson, L., Oakley, C., Truter, A. and Wilmoth, D., 2013)

Solomon to develop a set of community principles for land use planning named the Ahwahnee Principles for Resource-Efficient Communities in 1991. These principles were in three categories (Local Government Commission, 2014):

2.4.3.1 *Community Principles*

a. All planning should be in the form of complete and integrated communities containing housing, shops, work places, schools, parks and civic facilities essential to the daily life of the residents.
b. Community size should be designed so that housing, jobs, daily needs and other activities are within easy walking distance of each other.
c. As many activities as possible should be located within easy walking distance of transit stops.
d. A community should contain a diversity of housing types to enable citizens from a wide range of economic levels and age groups to live within its boundaries.
e. Businesses within the community should provide a range of job types for the community's residents.
f. The location and character of the community should be consistent with a larger transit network.
g. The community should have a center focus that combines commercial, civic, cultural and recreational uses.
h. The community should contain an ample supply of specialized open space in the form of squares, greens and parks whose frequent use is encouraged through placement and design.
i. Public spaces should be designed to encourage the attention and presence of people at all hours of the day and night.
j. Each community or cluster of communities should have a well-defined edge, such as agricultural greenbelts or wildlife corridors, permanently protected from development.
k. Streets, pedestrian paths and bike paths should contribute to a system of fully-connected and interesting routes to all destinations. Their design should encourage pedestrian and bicycle use by being small and spatially defined by buildings, trees and lighting; and by discouraging high speed traffic.

l. Wherever possible, the natural terrain, drainage and vegetation of the community should be preserved with superior examples contained within parks or greenbelts.
m. The community design should help conserve resources and minimize waste.
n. Communities should provide for the efficient use of water through the use of natural drainage, drought tolerant landscaping and recycling.
o. The street orientation, the placement of buildings and the use of shading should contribute to the energy efficiency of the community.

2.4.3.2 *Regional Principles*

a. The regional land-use planning structure should be integrated within a larger transportation network built around transit rather than freeways.
b. Regions should be bounded by and provide a continuous system of greenbelt/wildlife corridors to be determined by natural conditions.
c. Regional institutions and services (government, stadiums, museums, etc.) should be located in the urban core.
d. Materials and methods of construction should be specific to the region, exhibiting a continuity of history and culture and compatibility with the climate to encourage the development of local character and community identity.

2.4.3.3 *Implementation Principles*

a. The general plan should be updated to incorporate the above principles.
b. Rather than allowing developer-initiated, piecemeal development, local governments should take charge of the planning process. General plans should designate where new growth, infill or redevelopment will be allowed to occur.
c. Prior to any development, a specific plan should be prepared based on these planning principles.
d. Plans should be developed through an open process and participants in the process should be provided visual models of all planning proposals.

Calthorpe, Duany, Moule, Plater-Zyberk, Polyzoides, and Solomon later founded the Chicago- based *Congress for the New Urbanism in 1993*.

A major criticism of the CNU is that because of its focus on convincing local regulators to create exceptions to conventional practice in the approval of individual projects, it has not been fully successful in reforming state or national practices. While this approach is pragmatic and effective on a case-by-case basis, it leaves intact a foundation of hostile single-issue standards as well as a built environment that remains dominated by climate changing sprawl.

2.4.4 Sustainability's Building Performance and Certification Movement: United States Green Building Council (USGBC)

The oil shocks of the 1970s jump-started a movement for building energy efficiency and solar heated and powered buildings. In 1993, the American Institute of Architect´s Committee on the Environment, inspired by the 1992 *Rio Earth Summit*, published *The Environmental Resource Guide*. This comprehensive catalogue on the theory, practice and technology of "environmental" buildings drew heavily on the pioneering work that preceded it (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

This confluence inspired the creation of the 3rd founding reform of sustainable urbanism, United States Green Building Council (USGBC) in 1993. Shortly after its founding, the USGBC drafted pioneering standards for green building, completing a "final" version in 1995. The name Leadership in Energy and Environmental Design (LEED) was adopted in 1996. USGBC launched the pilot version in 1998 and its rating system in 2000. The LEED standard combines prerequisites, with optional credits that earn points toward an overall score. As a project's point score goes up it earns LEED certification at increasing levels of performance from "Certified" on the low end to "Platinum" on the high end. This flexibility works well in the marketplace, allowing a project to incorporate only well-suited green building strategies. LEED has become an increasingly mainstream force internationally that has refocused the entire building industry toward more sustainable practices (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

A great criticism of LEED however, was its building-centric focus and the low value it placed on a project's location and context, particularly concerning auto dependency. The prerequisites and credit weightings of the original LEED draft heavily weighted towards the building itself remained nearly unchanged since 2000. However, in the flagship creation of LEED-ND in 2009, as a joint venture of the USGBC, the CNU and the Natural Resources Defense Council (NRDC) - integrates the principles of new urbanism, green building, and smart growth into the first U.S standard for neighborhood design, expanding LEED's scope beyond individual buildings to a more holistic concern about the context of those buildings. It is important to note that while the above organisations are all U.S based, LEED remains the world's best-known third-party verification that a development meets high standards for environmental responsibility (CNU, 2014); LEED-ND can therefore be considered an international benchmark and tool.

2.4.5 LEED for Neighbourhood Development

LEED for Neighborhood Development, or LEED-ND, is a rating system that integrates the principles of smart growth, urbanism and green building into the first U.S system for neighborhood design. LEED certification provides independent, third-party verification that a development's location and design meet accepted high levels of environmentally responsible, sustainable development. LEED-ND as mentioned is collaboration among the United States Green Building Council[12], Congress for the New Urbanism (CNU)[13], and the Natural Resources Defense Council[14].

[12] The U.S. Green Building Council (USGBC), co-founded by current CEO Rick Fedrizzi, Mike Italiano, and David Gottfried in 1993, is a private, membership-based non-profit organization that promotes sustainability in how buildings are designed, built, and operated. USGBC is best known for its development of the Leadership in Energy and Environmental Design (LEED) green building rating systems and its annual Greenbuild International Conference and Expo, the world's largest conference and expo dedicated to green building. USGBC was one of eight national councils that helped found the World Green Building Council (WorldGBC), in 1999.

[13] The Congress for the New Urbanism (CNU) is the leading organization promoting walk-able, mixed-use neighborhood development, sustainable communities and healthier living conditions. The CNU has

LEED for Neighborhood Development recognizes development projects that successfully protect and enhance the overall health, natural environment and quality of life. The rating system encourages smart growth and New Urbanism best practices by:

2.4.5.1 *Promoting the location and design of neighborhoods that reduce vehicle miles travelled (VMT)*
2.4.5.2 *Creating developments where jobs and services are accessible by foot or public transit.*
2.4.5.3 *Promoting an array of green building and green infrastructure practices, particularly more efficient energy and water use*

LEED- ND is designed to certify exemplary development projects that perform well in terms of smart growth, urbanism, and green building. Projects may constitute whole neighborhoods, portions of neighborhoods, or multiple neighborhoods. Projects are often mixed-use; though small single-use projects that complement existing neighborhood uses may also use the rating system. The following credit categories are included in the rating system:

2.4.5.4 *Smart Location and Linkage*
Encourages communities to consider location, transportation alternatives, and preservation of sensitive lands while also discouraging sprawl
2.4.5.5 *Neighborhood Pattern and Design*
Emphasizes vibrant, equitable communities that are healthy, walk-able and mixed-use
2.4.5.6 *Green Infrastructure and Buildings:*
Promotes the design and construction of buildings and infrastructure that reduce energy and water use, while promoting more sustainable use of materials, reuse of existing and historic structures, and other sustainable best practices

met annually since 1993 when they held their first general meeting in Alexandria, Virginia, with approximately 100 attendees.

[14] The Natural Resources Defense Council (NRDC) is a New York City-based, non-profit international environmental advocacy group, with offices in Washington, D.C., San Francisco, Los Angeles, Chicago, and Beijing. Founded in 1970, NRDC today has 1.4 million members and online activists nationwide and a staff of more than 400 lawyers, scientists and other policy experts.

2.4.5.7 *Innovation and Design Process*
Recognizes exemplary and innovative performance reaching beyond the existing credits in the rating system, as well as the value of including an accredited professional on the design team

2.4.5.8 *Regional Priority*
Encourages projects to focus on earning credits of significance to the project's local environment

2.4.6 Elements of Sustainable Urbanism

The traditional neighbourhood is the basic increment of town planning. A neighbourhood alone in the country side is a village, while 2 or more grouped together sharing a specialised hub or Main Street is a town. This concept remains in force even at city or metropolitan scale. Coupled with special districts and corridors, neighbourhoods are the building blocks from which enduring settlements are formed. The dynamism and diversity that characterise attractive cities rely upon a solid foundation of vital and coherent neighbourhoods (Dover, V. and King, J., 2008).

Sustainable urbanism emphasizes that the personal appeal and societal benefits of neighbourhood living – meeting daily needs on foot – are greatest in a neighbourhood that integrates: definition, compactness, completeness, connectedness, biophilia and more recently, sustainable densities, protection of water resources, biodiversity corridors, etc. what may also be aptly described as a sustainable neighbourhood.

A genuine neighbourhood, according to the charter of CNU, is a 'compact, pedestrian-friendly, and mixed use' one. The basic design conventions that provide a common thread linking great neighbourhoods are:

2.4.6.1 *Identifiable Centre and Edge*
One should be able to tell when one has arrived in the neighbourhood and when one has reached its centre. The best centres are recognizable as the heart of the community, where the public feels welcome to congregate. They are within walking distance of the surrounding, primarily residential areas, and typically some gradient in density is discernible from centre to edge. Centres possess a mix of uses and the potential for higher density buildings at a pedestrian scale. (4 stories max, except at the metropolitan

core). Delineating the edge is more a source of psychosocial comfort than the meetings of a physical need, the adjustments made therein therefore are often subtle (Dover, V. and King, J., 2008).

One benefit of defined neighborhoods is that it is a finite social network. The sidewalks and close quarters typical of urban neighborhoods encourage sociability. The consequent possibility of an enlarged network of friends and acquaintances can increase well-being and social capital.

As described in the CNU charter, bounded neighborhoods 'form identifiable areas that encourage citizens to take responsibility for their maintenance and evolution'. Sustainable urbanism holds that a bounded neighbourhood should play a key role in girdling the distance beyond which key social and environmental concerns cannot be shifted. It therefore expands the role of the neighbourhood to address its proportionate share of society's social and environmental needs, e.g. its commitment to filter all its storm water within the neighbourhood and its surrounding open space assigns clear responsibility to a neighbourhood. The bounded sustainable neighbourhood is the physical manifestation of the phrase popularized by environmentalist David Brower[15]: 'Think globally, act locally' (Farr, Sustainable Urbanism: Urban Design with Nature, 2008)

2.4.6.2 *Walk-able Size*

Neighbourhoods range from 40-200 acres. The ¼ Mile, about 402M is a benchmark for creating a neighbourhood unit that is manageable in size and feel and inherently walk-able. Large civic spaces should be situated where they can be shared by other neighbourhoods. Significant centres should be spaced about ½ Mile apart or less, about 804M (Dover, V. and King, J., 2008).

2.4.6.3 *Mix of land uses and housing types with opportunities for shopping*

An assortment of uses gives residents the ability to dwell, work, entertain themselves, exercise, shop, and find daily needs and services within walking distance while an assortment of building types allows people with diverse lifestyles and incomes to live in the same neighbourhood without diminishing of the character or quality of that neighbourhood. The key is to provide great flexibility in land use even while tightening design controls in order to ensure compatibility (Dover, V. and King, J., 2008). It is to be noted

[15] David Ross Brower ;July 1, 1912 – November 5, 2000) was a prominent environmentalist and the founder of many environmental organizations, including the Sierra Club Foundation, the John Muir Institute for Environmental Studies, Friends of the Earth (1969), the League of Conservation Voters, Earth Island Institute (1982), North Cascades Conservation Council, and Fate of the Earth Conferences.

that a primary advantage of TND[16] communities over conventional suburbs is the opportunity to walk to shopping and entertainment venues.

2.4.6.4 *Integrated Network of Walk-able Streets*

The walk-ability of a place is shaped by the physical characteristics of both the public-right-of-way[17] and the adjacent private development. The spectrum of walkability can be classified in two ways: by the components that make up a place and by its overall look and feel (Burden, 2008).
A network of streets allows pedestrians, cyclists and motorists to move safely and comfortably through a neighbourhood. The maximum average block perimeter to achieve an integrated network should be 457M, with a maximum uninterrupted block of ideally 137M and street intervals of no greater than 183M apart along any one single stretch. Further, the slow design speeds, less than 40Km/h that characterise walk-able streets result from a conscious choice of features such as narrow curb-to-curb across sections, street trees, architecture close to the street edge, on street parking and relatively tight radii at the street corners. The highest quotient of walk-ability will result when the buildings that shape the street space are set close enough to front property line spatially define the streets as public space, with a minimum degree of enclosure formed by a building-height-to-street-width proportion of 1:3 or closer (Dover, V. and King, J., 2008).

[16] Traditional Neighbourhood Design (TND).A basic unit of the new urbanism containing a centre that includes a public space and commercial enterprises; an identifiable edge, ideally a 5 minute walk from centre, a mix of activities and variety of housing types, an inter-connected network of streets, usually in a grid pattern; and high priority public space, with prominently located civic buildings and open space that includes parks, plazas and squares. (Farr, Sustainable Urbanism: Urban Design with Nature, 2008)

[17] Right-of-way is a right to make a way over a piece of land, usually to and from another piece of land. A right of way is a type of easement granted or reserved over the land for transportation purposes; this can be for a highway, public footpath, a canal, railway, electrical transmission line, oil and gas pipelines, etc. A right-of-way is reserved for the purposes of maintenance or expansion of existing services with the right-of-way. In the case of an easement, it may revert to its original owners if the facility is abandoned. (Henry Campbell Black, 1910)

TABLE 1 STREET, BLOCK AND BUILDING FORMS THAT COMPLETE THE STREET-DESIGN CRITERIA SOURCE (BURDEN, 2008)

	Sidewalks and Walkways	Trees and Planter Strips	Connectivity	Street Qualities
Platinum	1.8-2.4M Clear walking space, excellent well maintained condition. No barriers or furniture on main walk way.	Trees in planter strip 2.4M – 27M wide. Trees spaced 4.5M-27M apart. Trees provide canopy. No utility lines.	Block connections at 90M-120M	7-9M wide streets, with parking on both sides. Curbing used. Non-mountable curbs.
Diamond	1.5M-2.4M wide clear walking space. Excellent condition, no furniture or barrier in main walk-way.	Trees in planter strips 1.8M-2.4M. Trees spaced 4.5M-9M apart. Trees provide canopy. No utility lines.	Block connections at 90-150M. If blocks are longer, trails or other links maintain connectivity.	6.6M-9M wide with parking on the sides. Curbing is used. Non-mountable curbs.
Gold	1.5M of clear walking Space. Good condition. Few items to walk around. Shrubs, trees maintained. Barrier free.	Trees in planter strips 1.8M wide or more. Trees spaced at 4.5M-9M apart. Trees provide canopy. No utility lines.	Block connections at 90-150M. If blocks are longer, trails or other links maintain connectivity.	6.6M-9M wide with parking on the sides. Curbing is used. Non-mountable curbs.
Silver	1.5M clear walking space, fair condition. Very few impediments to walking but some meandering needed.	Trees in planter strips 1.2M wide or more. Trees spaced at 9M-15M apart. Trees provide canopy. No utility lines.	Block connections at 180M. If blocks are longer, trails or other links maintain connectivity.	8.8M-9.8M wide with parking on the sides. Curbing is used.
Bronze	1.2M-1.5M clear walking space, fair or	Trees in planter strips 0.6M wide or	Block connections at 180M. Some	9M-11M wide with parking on

	better condition. Very few impediments to walking but some meandering needed.	more. Trees spaced at 9M-15M apart. Trees provide limited canopy, some gaps. Overhead utility lines common.	blocks are longer; speed is under control but some complaints possible.	one side. Curbing is used.
Stone	1.5M wide sidewalk placed at back of curb, fair/better condition. Some impediments to walking with some meandering needed.	No planter strips provided. Some or many houses have trees but no street canopy possible.	Block connections at 180M-300M. Speeds high due long block lengths.	9M-11M wide with parking on one side. Roll over curbing is used. Evidence that some people park by mounting on curb.

TABLE 2 STREET, BLOCK AND BUILDING FORMS THAT COMPLETE THE STREET-DESIGN CRITERIA, SOURCE; (BURDEN, 2008)

	Parks and Parking	**Driveways/Alleys**	**Building/Placement**
Platinum	On street parking on both sides. Parking permitted 24 Hours per day. Parks/Plaza or open space within 244M of all homes.	Most blocks are alley loaded. No driveways or overhead wires in most streets. Alleys have accessory dwelling units or other means of surveillance.	10-20 dwelling units/acre. No garages seen from the street. Homes are 3M-9M from the street. Good surveillance to street (windows/porches)
Diamond	On street parking on both sides. Parking permitted 24 Hours per day. Parks/Plaza or open space within 244M of all homes.	Most blocks are alley loaded. No driveways or overhead wires in most streets. Alleys have accessory dwelling units or other means of surveillance.	10-12 dwelling units/acre or more. Few garages seen from the street. Homes are 3M-9M from the street. Good surveillance to street (windows/porches)
Gold	On street parking on both sides. Parking	Many blocks are alley loaded. Few drive ways and	6-10 dwelling units/acre or more. No garages seen from the

	permitted 24 Hours per day. Parks/Plaza or open space within 300M of most homes.	no driveways cross any portion of sidewalks with cross slopes.	street. Homes are 3M-9M from the street. Good surveillance to street (windows/porches)
Silver	On street parking on both sides. Parking permitted 24 Hours per day. Parks/Plaza or open space within 360M of most homes.	Some blocks are alley loaded. Few drive ways or overhead wires across street corridor. And no driveways cross any portion of sidewalks with cross slopes.	6-8 dwelling units/acre or more. No garages seen from the street. Homes are 3M-9M from the street. Good surveillance to street (windows/porches)
Bronze	On street parking limited to one side. Parking permitted 24 Hours per day. Parks/Plaza or open space within 540M of most homes.	Blocks are driveway loaded. No alleys. Drive ways are not overly wide and do not cross any portion of sidewalks with cross slopes.	6-7 dwelling units/acre or more. No garages seen from the street. Homes are 9M from the street. Fair surveillance to street (windows)
Stone	On street parking on one side. No overnight Parking permitted 24 Hours per day. Parks/Plaza or open space within 780M of most homes.	Blocks are driveway loaded. No alleys. Garages are set back. No cars block sidewalks. Some or many cross sidewalks with cross slopes.	3-5 dwelling units/acre or more. Garages seen from the street but do not dominate. Homes are 15M from the street or more. Moderate surveillance to street (windows)

2.4.6.5 *Special sites are reserved for Civic Purposes*

In complete neighbourhoods, the best real estate is reserved for community purposes. These locations are deliberately selected for building sites that will conclude a long view down a street or for anchoring a prominent street corner or neighbourhood square. These unique settings form permanent anchors for community pride. Similarly, special sites should be set aside for parks, greens, squares, plazas and playgrounds. Each neighbourhood should have one special gathering space at its centre such as a village green (Dover, V. and King, J., 2008).

2.4.6.6 *Completeness: Daily and Lifelong Utility*

Neighborhoods exist to meet both one's daily and lifelong needs. To achieve this in addition to supporting robust life choices, neighborhoods necessarily need to include a wide variety of land uses, building types and dwelling types. An increasing number and variety of commercial uses in a neighbourhood centre increases its completeness and its ability to draw walkers to it.

Completeness also refers to the diversity of dwelling types needed to accommodate the varied needs for housing over a lifetime. A neighbourhood that provides a full range of housing types allows people and families to remain in the neighbourhood even as their housing needs change (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

Emerging public health research is revealing an ever-clearer understanding of the relationship between neighbourhood design and the length and share of all trips that people will willingly make on foot. A central idea that has become very clear is that meeting one's daily needs on foot in a neighbourhood is made much more convenient and more likely when many walk to destinations are clustered together (Allen, E. and Farr, D., 2008).

2.4.6.7 *Sustainable Corridors/Connectedness: Integrating Transportation, Land use and Technology*

Transit corridors are the backbone of sustainable urbanism, linking neighborhoods together with districts and other regional destinations. From time immemorial, transportation modes have been closely correlated with the settlement patterns of society, with each successive generation building new communities in areas made accessible by transportation investments. Sustainable neighbourhoods need to be located in existing or proposed transit corridors and with sufficient properly-distributed density to support a robust level of bus, bus rapid transit, street car, trolley, or light rail service. The desire for improved accessibility and greater choice in housing and transportation has resulted in the development trend called transit-oriented-development (TOD). While fostering new development was the original impetus for many privately funded transit lines, today, TOD is often seen as an effective means of leveraging transit investments for greater transit ridership. TOD fosters greater use of transit systems by creating neighbourhoods within walking distance of transit stations that offer compact development, a diversity of land uses and pedestrian oriented design (Poticha, 2008). Sustainable urbanism additionally creates environments that people have abundant opportunities to walk, ride and bike and even use a wheelchair around the neighbourhood, as well as having access to good transit service to adjacent neighborhoods and regional

destinations. This is achieved by way of sidewalks on both sides of the street and the distance between intersections to be relatively short, ideally no longer than 90-120M. Majority of the street network needs to be designed for maximum of 40-48 Km/h with the widest streets not having more than 2 travel lanes between curbs. These low speed streets have proved to not only be safer for pedestrians and able to accommodate a shared street network, but they also have the greatest capacity to move vehicles. See Figure 8 Speed Vs Flow.

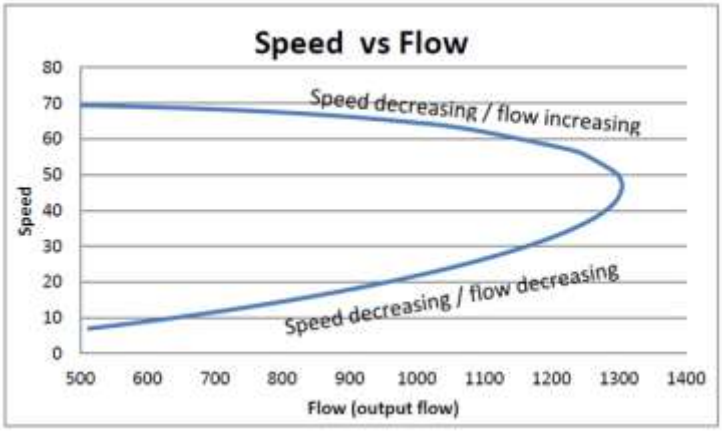

FIGURE 7 SPEED VS FLOW, SOURCE TRANSPORTBLOG.CO.NZ

2.4.6.8 *Biophilia/Biodiversity Corridors: Connecting Humans to Nature*

Biophilia is the name given to the human love of nature based on the intrinsic interdependence between humans and other living systems. Despite the many benefits of urbanism, conventional urbanism obliterates virtually all the systems of nature it comes into contact with. Habitat loss and fragmentation are by far the most significant threats to the conservation of native wildlife. By influencing the amount and pattern of habitat that is fragmented, degraded and destroyed in a landscape, land use decisions made at the local level play a significant role in the conservation of biodiversity. The types, extent and arrangement of land uses within the landscape will influence the viability of habitat patches, the amount of suitable habitats, the severity of edge effects and the utility of buffers and corridors (Kihslinger, R.L., Wilkinson, J. and McElfish, J., 2008). Well planned landscapes include (Kihslinger, R.L., Wilkinson, J. and McElfish, J., 2008): large, high-quality and well-connected habitat patches capable of supporting sustainable populations of native and rare species; well-designed habitat corridors to connect otherwise isolated larger remnant habitat

patches and wide and vegetated buffers to minimize edge effects on habitats in addition to protecting water quality and stream habitat.
Conservative minded landscape plans and community designs also limit development in sensitive ecosystems such as wetlands, riparian corridors and critical habitat.
Sustainable urbanism seeks to connect people to nature and natural systems, even in dense urban environments. As an example: the passive benefits of introducing day light and fresh air indoors are potentially dwarfed by implementing active-living strategies outdoors - people are 3 times more likely to walk along landscaped pedestrian routes. (Simmons, M., Mcleod, B. and Hight, J., 2008) ; mature trees can increase the value of adjacent real estate by 3-6% while dense vegetation provides viable habitat for song birds adding an aural benefit.
Further, studies indicate that home buyers are willing to pay up to 24% premium for a house lot facing a park or natural area (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).
Sustainable urbanism believes that human settlements need to be designed to make resource flows visible and experiential. The ability to see and experience where resources are produced and where they go after they are used promotes a human lifestyle better integrated with natural systems.
Finally, Sustainable urbanism is committed to the ongoing livelihood of non-human species located in habitats close to human settlements. It embraces the interweaving of riparian and wildlife corridors between and through neighbourhoods. This requires the creation of ‘critter crossings’.

2.4.6.9 *High Performance Infrastructure*

High performance infrastructure and integrated design are related areas that merit attention in addition to the other essential attributes of sustainable urbanism. High performance infrastructure is an emerging field that combines many strains of reform; the smart-growth concern about the financial burden imposed by new infrastructure needed to support green field development, the new urbanist’s desire for humane, pedestrian-scaled infrastructure design and the green buildings movement on resource ‘greening’ and consumption efficiencies.
Smart growth studies reveal that low-density, car-dependent development results in higher per capita municipal infrastructure and service costs –both in the physical material necessary to construct them, as well as the fiscal resources necessary to finance and maintain them, compared to more compact development (Transport Cooperative Research Board, 2000).

2.4.6.10 *High Performance Buildings*

Buildings have been shown to be the major source of demand for energy and materials that produce greenhouse gases as by-products. Sustainable urbanism promotes voluntary leadership standards such as LEED as an essential transition step to develop expertise and support for the concept of future mandatory high performance requirements. It concludes that society will inevitably move to require high performance buildings (HPB)[18] (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

Sustainable urbanism is uniquely conceived to achieve per capita building energy efficiencies through both square metre efficiencies and per capita space efficiencies. The reduced building envelopes and smaller floor areas of sustainable urbanism will likely emerge as affordable, integrated design strategies for meeting the high performance building codes of the future (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

2.4.6.11 *Integrated Design*

This is a hallmark of the green building movement. A building's performance can be improved at little or no added cost by simply shifting money within the project through optimizing the performance of the building as an entire system. This, however, requires a high level of interdisciplinary team work and budgetary discipline (Farr, Sustainable Urbanism- Urban Design with Nature, 2008).

Sustainable urbanism is really a call for integration of all the human and natural systems that make up a neighbourhood or corridor. As with an integrated building design, the magnified benefits come at little or no additional costs. The locations with the greatest potential for cross-system integration are dense, mixed-use and served by transit. Failure of integration in contemporary developments contribute to an oversupply of parking, reduces development density and affordability, reduces walking and transit ridership while increasing driving and air pollution. Potentially immense economic and environmental benefits may result from integrating high performance transport, water and sewer, lighting and power systems with high-performance buildings that consume few to no resources and produce little to no waste (Farr, Sustainable Urbanism- Urban Design with Nature, 2008).

[18] Per capita based mandatory performance standards set by public or private codes which contain covenants and restrictions, at levels well above conventional codes

2.4.6.12 *Increasing Sustainability through Density*

Density has been described as the 'hot button' of sustainable urbanism. It is a sustainability silver bullet by providing across the board per capita reductions in resource use – these reductions are found to occur in proportion to increasing development density; with local, regional and global benefits (Farr, Sustainable Urbanism: Urban Design with Nature, 2008). Lastly, it is easiest to attract and retain public transit riders in densely developed corridors. A concentrated population living or working immediately adjacent to a transit stop creates a reliable market of people within easy walking distance of a transit service. Quantifying this relationship between population densities in a transit corridor is essential to sustainable urbanism. (Richards, 2008)

2.4.6.13 *Protecting Water Resources*

There are a lot of components to water shed protection, such as appropriately siting development in the watershed, preserving adequate open space and protecting critical environmental features. Additionally, where and how communities grow can play a critical role in watershed protection (Richards, 2008).

Research shows that impervious cover can degrade water quality – specifically that a watershed may start becoming impaired at 10% imperviousness and that impairment grows worse as imperviousness increases. Globally, this has prompted creation of zoning and development ordinances biased against higher-density development because it typically produces more impervious cover at the site level (Richards, 2008).

However, after the EPA19 modeling storm water runoff at 3 scales – one acre, development site and watershed and at 3 different time periods of build-out to examine the premise that lower-density development better protects water quality - the findings indicated (Richards, 2008); low density development is often not the best strategy for reducing storm water runoff; higher densities may better protect water quality, especially at the lot and watershed levels and higher density developments consume less land while accommodating the same or more number of houses than at lower-density and therefore less impervious cover is created. However, while increasing

[19] Established under the Environment Protection Act 1970, EPA (Environment Protection Authority) is the second oldest environmental regulatory agency in the world. It was established to address environmental problems across the Australian state in a systematic and integrated way, bringing together a range of legislation and powers to be administered by a central authority. Along with the Department of Sustainability and Environment (DSE) and Sustainability Victoria—charged with protecting the Victorian environment. EPA is an administrative office of the DSE, and it reports to the Minister for Environment and Climate Change.

densities regionally can better protect water resources at a regional level, it can create more site level impervious cover which can increase water quality problems at nearby or adjacent bodies of water. Numerous practices exist, which when used in combination with regional techniques, can prevent, treat and store runoff and associated pollutants. These include low impact development techniques such as rain gardens, bio-retention areas and bio-swales. Others include, reducing parking spaces, narrowing streets, eliminating cul-de-sacs, building in range of development densities, incorporating open spaces, preserving critical ecological and buffer areas and minimizing land disturbances. These strategies can have the added advantage of enhancing a neighborhood's sense of place, increase community character and save development costs.

2.4.6.14 *Car-Free Housing*

This is the emerging practice of developing residential buildings that do not provide off-street parking. It is a viable strategy to reduce the cost of housing and to increase development density, walking, biking, and transit use. Car free housing should be developed in concert with public or developer provided shared cars. Each shared car is thought capable of replacing 5 to 8 private cars (Farr, Sustainable Urbanism: Urban Design with Nature, 2008).

TABLE 3 SUSTAINABLE URBANIST THRESHOLDS FOR RESIDENTIAL PARKING REGULATIONS, SOURCE (FARR, SUSTAINABLE URBANISM: URBAN DESIGN WITH NATURE, 2008)

Policy	Conventional Practice	Sustainable Urbanism
Off-Street parking Spaces	Minimum number required per dwelling	Maximum number allowed per dwelling
Reduced parking requirements	Not permitted	Provision for shared car with shared car replacing up to 5 off-street parking spaces
For-sale parking spaces	Sold with dwelling	Sold separately
Shared-car parking and Car	None required	Minimum 1 per every 10 dwellings
On-street parking in front of development	Cannot be used to meet requirements	Can be used to meet off-street or shared car requirements

2.4.6.15 *Third Places*

'Third Places' is a term coined by Robert Oldenburg, author of The Great Good Place. Third places are a must have for complete neighbourhood and key component of sustainable urbanism. These locations can be defined as those outside of home and work, open to the general public and where people informally gather on a regular basis. They become established by people informally designating them as places to go to see and to be seen. Third places need to be (Farr, Sustainable Urbanism: Urban Design with Nature, 2008): easily accessible for a majority of people; comfortable and accessible for a minimum of 16 hours a day, 5 or 6 days a week; should serve food and/or beverages and should encourage people to hang around longer to converse, examples include coffee shops, tot lots, bus stops, dog parks, pubs, alleys, libraries, laundries, churches, etc.

2.4.6.16 *Healthy Neighbourhoods*

Regular physical activity is associated with enhanced health and reduced risk of mortality. Beyond effects on mortality, physical activity has other benefits such as reduced risk of cardiovascular disease, stroke, type 2 diabetes, colon cancer, osteoporosis, depression and fall related injuries. Walking is the most commonly promoted moderate-intensity physical activity among biking, swimming and dancing. The built environments influences on health go beyond individual life choices – urban form impacts active transportation and work-related leisure time activity. Within this context, built environment interventions promote physical activity rather than try to change lifestyle behaviour.

TABLE 4 STREET SCLAE URBAN REDESIGN AND PHYSICAL ACTIVITY, SOURCE FARR, 2008

Effective Street-Scale Urban Redesigns	Outcome
Greenery: Vegetation along streets, public grounds, private grounds and gardens, on facades, windows and balconies	Urban residents were 3 times more likely to be physically active in high-greenery neighbourhoods compared to low-greenery ones
Walkability: High when characterised by higher density mix of single and multi-family residences with non-residential uses, and mostly street grid with good connectivity but low when characterised by single-family residences on curvilinear streets with cul-de-sacs and	People in high walk-able neighbourhoods achieve 50% more moderate-intensity physical activity than those in low walk-able neighbourhoods.

commercial on the outskirts of the neighbourhood.	
Connectivity: Household zones rated on a pedestrian environment scale including ease of street crossing, side walk continuity, local street characteristics and topography.	People in highest rated zones were 3-4 times more likely to walk to public transit and make other trips by foot or bike.
Lighting: Identified poorly lit areas and improved lighting, compared physical activity before and after lighting improved.	51% increase in walking after lighting improvement.
Bike-ability: Promoted biking, converted 4 lane road to 2 lane with biking and parking, narrowed streets and planted trees	23% increase in biking after street design
Aesthetics: Attractive, friendly and pleasant walking near home	70% increase in walking in neighbourhoods with high convenience compared with those with low convenience
Convenience: defined as shops, parks, beach, or bike path within walking distance near home	56% increase in walking

2.4.6.17 *Complete Streets*

Street design as a professional practice has developed over the last 90 years to address safety and mobility for the motoring public. It is based as much on the physics of moving cars as it is on the characteristics of driver behaviour. The safety goals of street design have attempted to engineer driver error out of the equation by improving cars, the drive-car interface and the road and roadside environment to remove obstacle and reduce the effects of curvatures. The results of these approaches have been to create a philosophy of wider and faster being better, which separates streets from the land uses adjacent to them and marginalizes pedestrians, bicycles and transit, modes that are necessary for a sustainable urbanism. Transportation systems that support sustainable communities of compact, walk-able neighbourhoods and urban centres require multi-modal and context sensitive planning and street design. The idea of context sensitive solutions (CSS) has developed recently as a process for bringing a collaborative, multidisciplinary approach to streets that balance the

competing needs of the community, the road user and the environment. CSS requires addressing a wide range of objectives for streets which include (Dock, 2008): support for compact neighbourhood oriented development; walk-ability in neighbourhoods and mixed use areas; multimodal transport (transit, bicycle, walking, driving) choices; improved compatibility with adjacent land uses; provision of high quality public space for activity and aesthetic values; enhanced quality of life and protection of environmental quality. Sustainable street design integrates the street with form and function of the surrounding and advocates for all travel, as per the Complete Streets[20] Movement. The design approach uses a framework that pairs a street typology (modes accommodated, purpose) with place typology of urban context (levels of activity, location of access, and relation to street).

TABLE 5 STREET TYPES APPROPRIATE FOR LOW SPEED URBAN CONTEXTS, SOURCE (DOCK, 2008)

Street Types	Maximum Through-Traffic Lanes	Target Operating Speed	Travel Lane Widths	Transit	Bicycle Facilities
Boulevard	6	48-56 Km/h	3.3M-3.6M	Express and local routes	Parallel paths or bike lanes
Avenue	4	40-48 Km/h	3M-3.3M	Local routes	Bike lanes
Street	2	40Km/h	3M-3.3M	Local routes	Bike Lanes

[20] **Complete Streets** is a transportation policy and design approach that requires streets to be planned, designed, operated, and maintained to enable safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation. Complete Streets allow for safe travel by those walking, bicycling, driving automobiles, riding public transportation, or delivering goods.

TABLE 6 STREET TYPES APPROPRIATE FOR LOW SPEED URBAN CONTEXTS, SOURCE; (DOCK, 2008)

Street Types	Freight	Median	Curb Parking	Driveway Access	Pedestrian	Intersection Spacing
Boulevard	Regional Truck and Routes	Yes	Optional	Limited	Side walk	201-402M
Avenue	Local Truck Routes	Optional	Yes	Yes	Side walk	91M-201M
Street	Local deliveries	No	Yes	Yes	Side walk	91M-201M

2.4.6.18 *Transportation Demand Management (TDM)*

TDM is a broad term used to describe strategies to change travel behaviour. It recognizes that there are physical capacity limits to any transportation system, and it seeks to make the most efficient use possible of limited transportation resources (Tumlin, 2008).

TDM is useful in all development contexts but its effectiveness increases as density increases. Even where transit is not available, TDM can still achieve 25% reductions in traffic. The following factors are noted in calculating the effectiveness of TDM Programs (Tumlin, 2008): residential and employment density – as density increases, trip generation declines significantly since more uses are available within walking distance and transits' market potential increases to the point where frequent service is possible; diversity of land use types/mix of uses – where jobs, housing and services are within walking distance of one another, car use declines, particularly for the 80% of trips that are non-commute related; walk-able design – where walking is a pleasure, travelers will walk greater distances to reach their destinations; access to regional destinations –the intensity of local transit services and the regional destination it serves influence travel behaviour and Transportation Demand Management – parking pricing has greater travel impact than all other TDM measures combined.

2.4.6.19 *Car Sharing*

Car sharing is a short term, membership based auto rental program. Car share members typically reserve a car over the phone or online. Members are then billed each month according to how much they drive, much as they would be billed for other utilities. Shared cars are parked in reserved spaces on the street, public garages and in private facilities – typically scattered throughout Transit-Oriented neighbourhoods. They could also be located at major nodes such as rail stations (Tumlin, 2008).

2.4.6.20 *Open Space*

Walk-to neighbourhood parks and plazas are among the most neglected realms in town planning. Walk-to parks fitted with benches, playground equipment and dog runs can serve as intergenerational third places, allowing recurring casual social encounters and the building of social capital. The following standards should be considered (Farr, Sustainable Urbanism: Urban Design with Nature, 2008): parks or high quality open space should be within 3 minute walk of every dwelling; the minimum park area should be 1/6 Acre; all parks should be bounded on at least 2 sides by public rights-of way and parks may be fenced or locked at night, if necessary, for security.

TABLE 7 PARK PROXIMITY SALES PREMIUM, SOURCE (FARR, SUSTAINABLE URBANISM: URBAN DESIGN WITH NATURE, 2008)

Distance to Park in Metres	Round-Trip Walk in Minutes	Sales Premium
30	1	24%
90	2.5	15%
180	5	5%
390	10	Insignificant

TABLE 8 CHARACTERISTICS OF NEIGHBOURHOOD OPEN SPACE, SOURCE THE LEXICON OF NEW URBANISM

	Type of Open Space	Characteristics
1	Sports Field	An open area specifically designed and equipped for large scale recreation. Should be confined to the edges of neighbourhoods as their size is disruptive to the fine grained network required for pedestrian travel.
2	Green	A medium sized public space available for unstructured recreation, circumscribed by building facades, its landscape consisting of grassy areas and trees, naturalistically disposed and requiring substantial maintenance.
3	Square	A public place, seldom larger than a block at the intersection of important streets. A square is circumscribed spatially by frontages, its streetscape consists of paved walks, lawns, trees, and civic buildings all formally disposed and requiring substantial maintenance.
4	Plaza	A public space at the intersection of important streets set aside for civic purposes and commercial activities. A plaza is circumscribed by frontages; its landscape consists of durable pavement for parking and trees requiring little maintenance. All parking lots of frontages should be designed as plazas with the paving not marked or detailed as parking lots.
5	Community Garden	A grouping of garden plots available for small scale cultivation, generally to residents of apartments and other dwelling types Community gardens should accommodate individual storage sheds. They are valuable for their recreational and communal role, similar to that of club.

2.4.6.21 *Public Darkness*

Public lighting initially began as a way to provide some level of safety along rights of way for pedestrians and encourage night time activities and commerce. However, conventional designs of the same often result in continuous over lighted areas. This can result in glare and light pollution – wasted light directed upward or away from where it is needed. Research is now finding that exterior lighting has a harmful effect on flora and fauna and can cause disturbances of human circadian rhythms that have been associated with insomnia and other sleep disorders (Clanton, N. and Givler,

T., 2008). A better approach uses light where it is most useful – at potential vehicle/pedestrian conflict zones, to accent building facades and to light way finding elements. It can be designed to eliminate glare, over-lighting and light trespass. The level of brightness should be based on the type of place being lit, ranging from rural to urban.

2.4.6.22 *Storm water systems*

Contemporary urban, sub-urban and sometimes rural agricultural practices generate substantial amounts of surface water runoff, directly associated with increased erosion, sedimentation, flooding, and water quality degradation, loss of biodiversity, aquifer depletion and climate change. (Patchett, J. and Price, T., 2008) Historical patterns of hydrology that support the diverse and complex ecology of lakes, rivers and streams are predominantly groundwater driven. Most are sustained by a combination of ground water discharge and precipitation. However, contemporary land uses have drastically altered these historical patterns of stable hydrology and water quality. Today's environments are dominated by erratic forms of polluted surface water runoff (Patchett, J. and Price, T., 2008). Unfortunately, conventional water resource engineering practices directed at the collection, conveyance and temporary storage of storm water runoff generally exacerbate downstream flooding, water quality degradation, habitat loss and system instability due to the cumulative volume and velocity of discharged flows. The loss of infiltration and ground water recharge in the surrounding watershed combines with the depression of normal water levels in the stream system to lower the regional water table and starve the stream during periods of drought. At the opposite extreme, intense periods of rainfall, once mediated by landscapes highly capable of absorbing and using the water as a resource, now regularly result in flash floods in areas that were not historically subject to flooding (Patchett, J. and Price, T., 2008). Conversely, sustainable approaches to site and regional water resource management strive to treat water as a resource, not as a waste product. Such measures revolve around the restoration of stable ground water hydrology on a site-by-site basis through the incorporation of techniques that effectively cleanse, diffuse and absorb water where it falls, thus restoring the historical patterns of ground-water dominated hydrology and water quality. Simply put, the degree to which water leaves land in the form of surface water runoff is the degree to which the area where it fell in the form precipitation will be in deficit and downstream environments will be surfeited (and generally adversely affected) (Patchett, J. and Price, T., 2008).

TABLE 9 NATURAL STORM WATER DRAINAGE SYSTEMS SOURCE (PATCHETT, J. AND PRICE, T., 2008)

Approach	Horizontal Surface	Storm water Facility	Brief Description	Area Served (Lot, Block or Neighbourhood)	Rule of Thumb for Sizing Storm water Facility[21]
Conventional					
	Soil	Centralized detention basin	Excavated basin to temporarily detain storm water runoff		8%-12% of Site Area
Sustainable Urbanist					
	Soil	Bio-retention rain garden	Yard depression with perennial vegetation.	Yard and adjacent to bottom of down spouts	10%-15% of roof area-less for permeable sandy soils
	Soil	Bio-retention Swale	Depressed parking lot or roadside islands planted with perennial vegetation.	Edge of Paving Parkways and medians	10%-15% of impervious area-less for permeable sandy soils
	Soil	Naturalized detention	Detention basin naturalized with shallow side slopes and native vegetation	Storm water parks, parkway medians	8%-12% of site area.
	Hardscape	Permeable paving	Paving designed to allow water to pass	Sidewalks and driveways	Net paved area

[21] Varies based on local storm water standards and site imperviousness

			through surface pavers.	Streets and alleys	
	Roof	Extensive green roof	Vegetated roof with drought tolerant species requiring little or no inputs for vegetative maintenance.	Building roof	Net buildable roof area
	Roof	Intensive green roof	Vegetated roof with a wide range of vegetation, including grasses, shrubs and even trees.	Building roof	Net buildable roof area

2.4.6.23 *Food Production*

In the past century, food production has become industrialized and globalized and in effect unsustainable. To cater to the ever expanding populations, family farms are quickly being overtaken by big business, sprawl and agriculture mono-culture. Sadly, the farm as corporation economic model has become the paradigm for modern food production with a bottom line of volume and efficiency. This low cost food, however, is often of questionable quality, taste and safety. It often harbors residues of pesticides that are both toxic to the environment and the body (Peemoeller, L., Slama, J. and Morgan, C., 2008). New economic models for food production are now emerging that can feed the world more nutritiously. Organic food is the fastest growing sector in food production, while sustainable food production and increased food access are being ingrained into neighbourhoods. This can be achieved by integrating food systems through food production and food access. Proper zoning regulations will allow for communities and individuals to produce their own food. The economic benefits of community based food systems include the creation of jobs and self-sustaining markets. Environmental benefits include less energy use, cleaner air and water and remediated soils. Community benefits include food security, better health and neighbourhood beautification (Peemoeller, L., Slama, J. and Morgan, C., 2008).

2.4.6.24 *Outdoor Wastewater Treatment*

Wastewater treatment is a complex milieu of environment, politics, culture and science. Early on, waste was by and large ignored. However, as urbanisation increased and the source of disease recognised, sewage treatment began. By the early 20th century, waterborne diseases were in check and the objective of waste water treatment was to minimize nuisance conditions noticeable by sight or smell. Primarily the systems were for the disposal of waste only. In the latter portion of the 20th century, systems emerged that viewed the nutrients and the water as a resource. Constituents in treated waste water effluent such as nitrogen, phosphorus and potassium began to be used for a variety of purposes including the irrigation of golf courses, green spaces, forests and farmland, the creation of wetlands and estuaries and utilization in hydroponics systems (Ennis, 2008).
These advances were however made with little consideration of the offsetting impact of energy consumption, greenhouse gases and societal costs. The only limitations have been the ability of the society to pay for the construction and operating costs. A critical requirement of a sustainable wastewater treatment system is to not harm the receiving waters. Additional goals that should be pursued in wastewater system design should be (Ennis, 2008): reuse of 75% of nutrient energy in the waste stream into beneficial uses which should be calculated on an annual basis; the energy consumption of operation and maintenance, included sludge haulage and disposal should not exceed 80KW hours/year/capita.
Reuse of 75% of water in the waste stream into beneficial uses. This should be calculated on annual basis.

2.4.6.25 *Indoor Wastewater Treatment*

Eco machines are ecologically based wastewater treatment facilities, typically built inside greenhouses that create clean and reusable water from the local wastewater. In a conventional design, wastewater treatment imposes high capital and lifetime operating costs on a community while requiring significant investments in infrastructure and energy for long distance transport. With Eco Machine technologies, a neighbourhood can use its own wastewater to create local green spaces for varied usage, to grow plants and ecologies that sequester carbon and to produce clean, chemical-free water for re-use within the community. This can be achieved in a green house facility requiring very small above ground footprint, with sub-surface constructed wetlands serving a dual use as a park or orchard. (Todd, 2008)
The tertiary quality water that emerges from the eco machine treatment process can be used for irrigation of grounds or tree crops, for water features or for toilet flushing. They offer opportunities to use waste water

within the neighbourhood footprint and watersheds while creating local value. (Todd, 2008)

2.4.6.26 *High-Performance Infrastructure*

The term 'high performance infrastructure' refers to core best management practices (BMPs) applicable to the typical section of the public right-of-way, encompassing street, sidewalk, underground utilities, storm water infrastructure, landscape and streetscape elements. This is achievable through various forms of optimization (Brown, 2008): Component Optimization (standard details or specifications may be improved to optimize performance, minimize environmental impact, use materials more efficiently, improve construction practices or extend lifecycle. E.g. using reclaimed cementitious material to increase pavement strength, using LED for solar street lighting to increase efficiency while reducing energy consumption, designing drought-tolerant, water efficient landscapes to reduce irrigation needs and potable water consumption); multifunctional Optimization (the density and close proximity of components in the right-of-way can lead to unanticipated damage or degradation. Undertaking multifunctional optimization strategies could lead to long term cost savings, improved performance and life cycle, reduced environmental impact and increased returns on municipal investments. Examples include; using structural soils in planters to provide load bearing capacity for side walk pavements while offering a better medium for trees to develop deep roots - this enhances tree health and also minimizes damage to pavements by preventing upward root growth; using pervious pavement to reduce storm water runoff and peak demand on storm water management infrastructure while providing an adequate driving surface for cars; utilizing trenchless technologies to repair water main infrastructure which will minimize trench cutting and subsequent pavement degradation) and integrated Design (this systems-oriented approach focuses on improving the performance of the entire roadway system. It requires cross-disciplinary teamwork at the planning, scoping, design and construction stages. It promotes comprehensive performance improvements, compounds environmental benefits and potentially offers substantial cost savings. Some examples include; designing a roadway with a diversely planted center median that functions as both a traffic calming device and storm water bio-retention area to improve pedestrian safety, minimize storm water runoff, dampen street noise and improve air quality; designing an accessible utility corridor for sub-surface utilities within the roadway to allow for easy maintenance, minimization of right-of-way disruption, extended pavement lifecycle and reduced environmental impact from repeated excavation and disposal of sub-base; designing a right-of-way with reduced impervious pavement area,

high albedo pavements and maximum shading by trees to substantially help reduce local urban heat build-up, improve air quality, increase pavement durability and calm traffic.) In addition to the many health and environmental benefits, financial benefits include (Brown, 2008); decreased first costs, decreased operation and maintenance costs, decreased energy costs with increased real estate values.

2.4.6.27 *Large District Energy Systems*

District energy systems produce electricity, hot water, steam and or/chilled water at a central plant and then distribute the energy through underground wires and pipes to adjacent buildings connected to the system. In addition to fossil fuels, they can utilize a combination of locally available renewable energy sources such as municipal solid waste, community wood waste, landfill gas, wastewater facility methane, biomass, geothermal, Lake or ocean water and solar energy. They could also allow for thermal storage applications that would not otherwise be functionally or economically feasible on an individual building basis (Newman, D., Thornton, R., Kelly, J. and Lund, A., 2008).

The essential advantage of a district energy system over the conventional power plant is a far more efficient use of the input fuel relative to end uses – typically, only 1/3 of the fuel energy input to a conventional fossil fuel power plant is delivered to the end user as electricity. The vast majority of the energy is discharged in the form of heat to adjacent rivers and lakes and to the atmosphere resulting in significant thermal pollution.

3 RESEARCH METHODOLOGY

3.1 Introduction

This research will employ the case study method. The literature review of Sustainable Urbanism conducted will be used to develop interrogative tools specifically 'Sustainable Urbanism Indicators' for use in the field study. These indicators will be structured in line with the proposed International Urban Sustainability Indicators (IUSI) as espoused by the Habitat International Journal (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X.,, 2011). The case study of a part of Nyeri Town will form the empirical heart of the research.

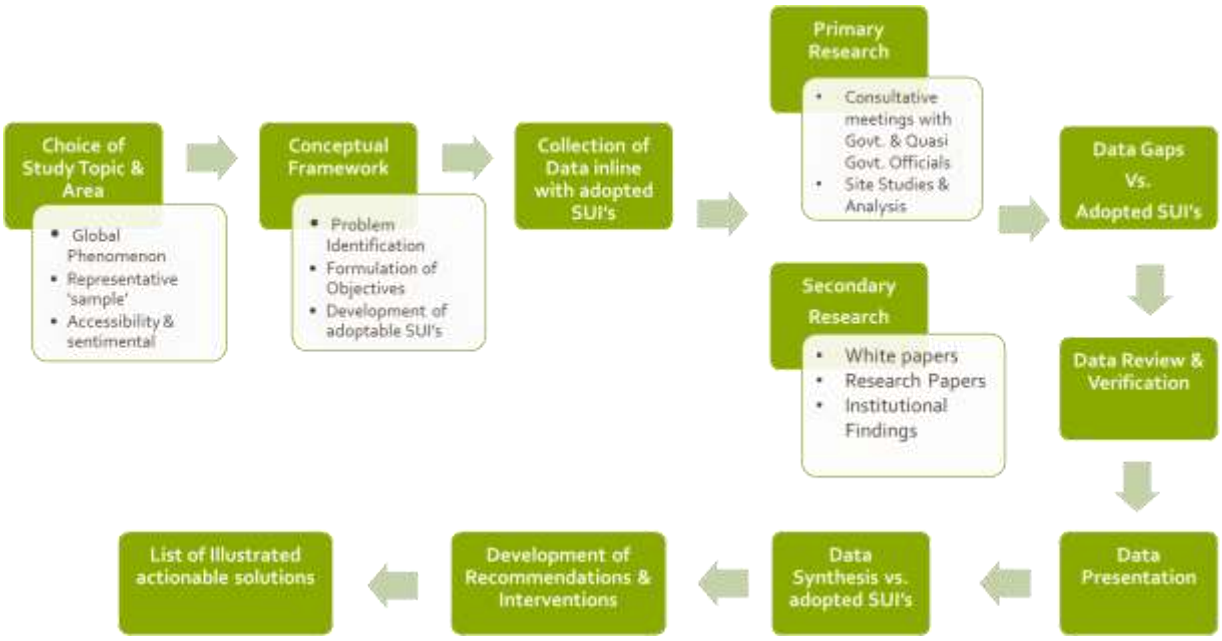

FIGURE 8 STRUCTURE OF RESEARCH METHODOLOGY, SOURCE AUTHOR

3.1.1 Why Sustainable Urbanism Indicators?

Commonly, indicators are parameters that describe situations or circumstances not directly able to be ascertained. An indicator can also be characterized as "a summary and synthesized measure that indicates how well a system might be performing"

(Flowers, J., Hall, P. and Pencheon, D., 2005). Further, indicators can measure quantitative or estimate qualitative data, answer different purposes, and be used in different contexts; hence, various indicator types can be differentiated (Weiland, 2006). It is also to be noted that indicators have the role of measuring performance, and in the process of urban sustainability assessment there is a need of measurable indicators (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X.,, 2011) As such, an indicator or a group of indicators is a tool that can suggest the health of any system (Nathan, H. S. K. and Reddy, B. S., 2008).

The UN defines indicators as not datasets, but rather models which simplify a complex subject to a few numbers that are easy to understand and grasp by policy makers. Indicators can translate physical and social science knowledge into manageable units of information that can facilitate the decision-making process (UNCSD, 1996) (UNCHS, 1997).

3.1.2 Functions and Purposes of Indicators

OECD[22] outlines two major functions of indicators.

3.1.2.1 *To reduce the number of measurements and parameters, that normally would be required to give an exact presentation of a situation.*

3.1.2.2 *To simplify the communication process*

PASTILLE[23] proposes that the main purposes of Sustainability Indicators are,

3.1.2.3 *Understanding sustainability*

They are helpful for the identification of relevant issues, for the analysis of current states and future trends as well as for education and informing (or distributing information to) the public.

[22] The Organisation for Economic Co-operation and Development (OECD)

[23] PASTILLE: Promoting Action for Sustainability Through Indicators at the Local Level in Europe

3.1.2.4 *Supporting decisions*

They provide the information base necessary for the definition of objectives and goals and the identification of action requirements. Furthermore, they can be used for benchmarking processes.

3.1.2.5 *Directing*

They are relevant for urban decision making and planning, especially for monitoring and evaluation, for assessing performance and for guiding and controlling.

3.1.2.6 *Involving stakeholders and empowerment*

Sustainability indicators play an important role in the involving of stakeholders; they can serve for communication, participation, for the initiation of discussions and awareness rising. Thus, they can play an important role in community empowerment. (Fraser, E.D, Mabee, W.E., Reed, M. and McAlpine, P., 2006)

3.1.2.7 *Solving conflicts*

Last but not least they can be useful in mediation processes or generally in discussions with differing values.

3.1.3 Sustainable Development Indicators (SDI) – An Example in Practice

More recently, efforts have been made to construct indicators in different dimensions and domains to keep track of sustainability i.e. the progress towards the goal of sustainable development (Dhakal, 2002). They are popularly known as sustainable development indicators (SDIs). SDIs perform functions of both proactive and reactive nature. They are like early warning systems, which, when carefully designed, closely watched, and wisely interpreted, can not only show the critical aspect of the socio-economic-environmental status of the community but also influence the policy decisions, monitor their effectiveness and facilitate community action (DEAT, 2001). In the case of urban resource dynamics, SDIs guide the resource allocation and use pattern. Indicator development is an ever-evolving process. No set of indicators can be final or definitive. Indicators are adjusted over time to fit the specific conditions, priorities and capabilities (UNCSD, 1996).

3.1.4 Types of Indicators

Different types of sustainability indicators can be distinguished. According to the DPSIR[24] model, driving force indicators as well as pressure, state, impact, and response indicators have been derived. Rate indicators describe a change over time; target, goal or steering indicators specify the objectives strived for; performance indicators evaluate the reaction of a political system. Some examples of different indicator types demonstrate the variety of sustainability indicators:

3.1.4.1 *Driving force indicators: population growth, prosperity level*
3.1.4.2 *State indicators: current air quality, noise level*
3.1.4.3 *Pressure indicators: CO2 emissions*
3.1.4.4 *Impact indicators: percentage of children suffering from water-borne diseases*
3.1.4.5 *Response indicators: percentage of cars with catalytic converters*
3.1.4.6 *Rate indicators: decrease of air quality with time*
3.1.4.7 *Target / goal indicators: standard for desired air quality*
3.1.4.8 *Steering indicators: desired increase in public transport passengers.*

The above depiction of state of the art of sustainability indicators makes clear that indicator sets differ more than would be justified by differing purposes and political levels. All groups, while developing a sustainability indicator set, are confronted with appreciable methodical problems. This is to ascribe to the fact that an approved and comprehensive indicator theory does not exist to date (Weiland, 2006).

[24] **DPSIR** is a causal framework for describing the interactions between society and the environment. This framework has been adopted by the **European Environment Agency.** The components of this model are: **D**riving forces, **P**ressures, **S**tates, **I**mpacts and **R**esponses. This framework is an extension of the pressure-state-response model developed by **OECD**. As a first step, data and information on all the different elements in the DPSIR chain is collected. Then possible connections between these different aspects are postulated. Through the use of the **DPSIR** modelling framework, it is possible to gauge the effectiveness of responses put into place. Source European Environmental Agency.

Several approaches to assess urban sustainability based on indicators have therefore been accordingly developed (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X.,, 2011). One method has involved the examination of available techniques, for evaluating different aspects of sustainability through the use of indicators have been carried out (Ugwu, O. O. and Haupt, T. C., 2007). Another method has adopted the use of methodological foundations of various assessment methods to propose a classification of these Sustainable Urbanisation indicators, which divided them into three different groups: system engineering, monetary evaluation and biophysical (Wong, S. W., Tang, B. S., and Van Horen, B., 2006).

However, and most importantly, the selection process of indicators should not be about gathering the information for all indicators, but rather selectively analyzing the ones which are more fundamental in essence and more likely to produce the most accurate information about the status of practice (Wong, S. W., Tang, B. S., and Van Horen, B., 2006). It has been proposed that indicators must be clear, simple, scientifically sound, verifiable and reproducible (Mega, V. and Pedersen, J., 1998). In addition, an indicator must be SMART (i.e. Specific, Measurable, Achievable, Relevant, and Time-related) (United Nations Statistical Institute, 2007). It has also been proposed that urban sustainability indicators should provide at least the following (Zhang, K., Wen, Z., Du, W. and Song, G., 2008):

3.1.4.9 *Explanatory tools to translate the concepts of sustainable development, and in this research, sustainable urbanism into practical terms.*

3.1.4.10 *Pilot tools to assist in making policy choices that promote sustainable development or sustainable urbanism.*

3.1.4.11 *Performance assessment tools to decide how effective efforts have been.*

Whilst there are various lists of urban sustainability indicators there is no single set of indicators that suits equally to all cities or communities (Shen, L., Ochoa, J.J., Shah, M.N., Zhang, X.,, 2011).

3.2 Adopted Sustainable Urbanism Indicators

A growing number of experts recognize that it is at the local scale, i.e. at the level of municipalities, cities or metropolitan regions, that the challenges of Urban Sustainability and consequently, their indicators are best expressed (Campbell, 1996) and (Camagni, 2002). This study therefore focuses on examining the sustainable urbanism at a secondary town level, in this case Nyeri Town, as this is the level where, to the best knowledge of the author, the application of sustainable urbanism indicators can be best appreciated and compared. The categories adopted are broadly broken down as below, with the relevant indicators outlined below the categories;

3.2.1 Sustainable Neighbourhoods

3.2.1.1 *Neighbourhood Definition – Edge and Centre*

3.2.1.2 *Neighbourhood Completeness – Daily and Life Long Utility*

3.2.1.3 *Sustainable Urbanist Neighbourhood Diagram*

3.2.1.4 *Neighbourhood Retail*

3.2.1.5 *Third Places*

3.2.1.6 *Car-Free housing*

3.2.1.7 *Open Space*

3.2.1.8 *Healthy Neighbourhoods*

3.2.1.9 *Walk-able streets and Networks*

3.2.2 Density

3.2.2.1 *Sustainability through Density*

3.2.3 Sustainable Corridor

3.2.3.1 *Connectedness - Integration of Transport, Land Use and Technology*

3.2.3.2 *Biodiversity Corridors*

3.2.4 Biophilia

3.2.4.1 *Protecting Water Resources*

3.2.4.2 *Food Production*

3.2.5 High Performance Building and Infrastructure

3.2.5.1 *Complete Streets*

3.2.5.2 *Transport Demand Management*

3.2.5.3 *Car Sharing*

3.2.5.4 *Public Darkness*

3.2.5.5 *Storm water Systems*

3.2.5.6 *Outdoor Waste Water Treatment*

3.2.5.7 *Indoor Waste Water Treatment*

3.2.5.8 *High Performance Buildings*

3.2.5.9 *High Performance Infrastructure*

3.2.5.10 *Large District Energy Systems*

3.2.6 Point Award System

The Sustainable Urbanism Indicators (SUI) will be further categorized in an award system to identify areas of greatest need with regard to deficiencies in sustainable urbanism strategies. This will range from 0 – being a deplorable state of the Sustainable Urbanism Indicator (SUI) to 6 – where the Sustainable Urbanism Indicator (SUI) has been planned for, successfully implemented with satisfactory results; as per the table below;

TABLE 10 SUI AWARD SYSTEM, SOURCE AUTHOR

Sustainable Urbanism Indicators Points Award System	
STATE OF SUSTAINABILITY	**POINTS AWARDED**
Deplorable State of SUI SUI Indicator Not Planned for	**0 - 1**
Manageable State of SUI SUI Indicator Not Planned for	**1 - 2**
SUI Planned for SUI Not Implemented	**2 - 3**
SUI Planned for SUI in the Process of being Implemented SUI Implementation results/feedback yet to be determined	**3 - 4**
SUI planned for SUI successfully Implemented SUI feedback/results unsatisfactory	**4 - 5**
SUI Planned for SUI successfully Implemented SUI feedback/results Satisfactory	**5 - 6**

3.3 Nyeri Town Base Study & Analysis

This study of Nyeri town, as outlined in the scope and area of study, will be limited to the extent of Kenyatta Road, Stanley Mathenge Road, Temple Road, Kimathi way and Muhoya Road of Nyeri town's administrative boundaries in particular and within the Nyeri County administrative boundaries in regional context.

The base study and analysis are presented graphically as outlined in Table 10 below and cover photographic reports of the area, formal and informal land use maps, Built up Density studies, Vehicular and Pedestrian mobility patterns, tree/vegetative cover maps, Sustainable neighbourhood studies, Sustainable Corridor Maps, Sustainable Density Studies, Street Transects Networks and their Integration.

TABLE 11 BASE STUDIES & ANALYSIS SHEET NUMBERS, SOURCE AUTHOR

Base Studies and Analysis Sheet Numbers	
SHEET NO.	**DETAILS**
1	**Photo Odyssey of Major Perimeter Roads** ▪ *Captures images of land use along Kenyatta Road, Stanley Mathenge Road, Muhoya Road, Kimathi Way and Temple Road*
2	**Photo Odyssey of Major Internal Roads** ▪ *Captures images of land use along Kimathi Way, Kanisa Road, Moi Nyayo Road, Lumumba Road, Town Hall Road, Gakere Road, Meghji Prushi Road, Macharia Ringare Road, J.M Kariuki Road, Gen. China Road, Gen. Ndungu Gichere Road, Snr. Chief Wambugu Road, Field Marshall Mutugi Road, Gen. Kamwamba Road, Kuku Lane, Wamugumo Road and Kamukunji Road*
3	**Photo Odyssey of Major Landmarks and Monuments** ▪ *Captures images of the Kimathi Way obelisks, landmark hotels and restaurants such as Green Hills, Ray bells Inn, Central Hotel, Kungu Maitu, retail outlets such as Osman Allu, Baden Powell Historical*

	Gardens, Ex Batian Cinema, Diana Centre, the revamped Kamukunji Market, Kamukunji Stadium, Temple Road School, the police HQ and housing, the Catholic Church, Barclays Bank, the mosque, town hall, the mayors parlour, KANU office
4	**Photo Odyssey of the Service Lanes** ▪ *Captures images of the Kimathi Way obelisks, landmark hotels and restaurants such as Green Hills, Ray bells Inn, Central Hotel, Kungu Maitu, retail outlets such as Osman Allu, Baden Powell Historical Gardens, Ex Batian Cinema, Diana Centre, the revamped Kamukunji Market, Kamukunji Stadium, Temple Road School, the police HQ and housing, the Catholic Church, Barclays Bank, the mosque, town hall, the mayors parlour, KANU office*
5	**Photo Odyssey of the 3 Major Bus/Matatu Stages** ▪ *Captures images of the upper stage, middle stage and lower stage*
6	**Formal Land Use Map** ▪ *Captures the formal land use in the study area under the following categories – Institutional, Commercial, Residential, Mixed Use, Green Space, Vacant Building, Vacant Land, Parking Lot and Monument.*
7	**Informal Land Use Map** ▪ *Captures the informal land use/commercial activity in the study area.*
8	**Building Density Study** ▪ *Captures the density of the built up areas in the following categories; Ground only, Ground +1, Ground +2, Ground +3, Ground +4, Ground +5, and 6 Floors and above.*
9	**Vehicular Mobility** ▪ *Studies vehicular mobility under the following categories; Heavy Vehicular route, Light vehicular Route, Public Car Parking, Bus/Matatu Termini*

10	**Pedestrian Mobility** ▪ *Studies routes of light and heavy pedestrian use as well as boda boda stops.*
11	**Tree/Vegetative Cover** ▪ *Studies the proliferation of trees/vegetative cover along the roads, public parks, private gardens, etc.*
12	**Analysis 1: Sustainable Neighbourhoods** ▪ *Studies the centre and edge of the study area, the three distinct centres of the study area and walkability*
13	**Analysis 2: Sustainable Neighbourhoods** ▪ *Studies the maximum perimeter of 457M to achieve an integrated network, Maximum uninterrupted block of 137M, Street intervals of no more than 183M, building to height ratio and roadway reserve sizes.*
14	**Analysis 3: Sustainable Neighbourhoods** ▪ *Studies Third Places under the categories of Restaurant/Cafes, Pubs, Tot Lots, Parks and Beauty Salons/Barber Shops*
15	**Analysis 4: Sustainable Corridors** ▪ *Studies the location of Nyeri Town in relation to the regional road networks.*
16	**Analysis 5: Sustainable Densities** ▪ *Maps the densities of urban visitors throughout the study area from 5am to 9pm.*
17	**Analysis 6: Street Transects, Networks and Integration** ▪ *Maps a sample of the various types of street transects in the study area.*
18	**Analysis 7: Street Transects A & F** ▪ *Study of the Transects A & F*
19	**Analysis 8: Street Transects B & C** ▪ *Study of the Transects B & C*

20	**Analysis 9: Street Transects D & E** ▪ *Study of the Transects D & E*
21	**Analysis 10: Street Transects G & H** ▪ *Study of the Transects G & H*
22	**Analysis 11: Street Transects I & J** ▪ *Study of the Transects I & J*

4 RESEARCH FINDINGS

4.1 Sustainable Urbanism Indicator Sets

TABLE 12 SUI SET 1 – SUSTAINABLE NEIGHBOURHOODS, SOURCE AUTHOR

SUI Set 1: Sustainable Neighbourhood		
SUI	**PARAMETERS**	**SCORE**
Neighbourhood Definition	▪ *Identifiable Centre and Edge* ***[Sheet 12]***	*2*
	▪ *Walk-able size – 40-200 acres, 402m length and width maximums per block, large civic spaces shareable between neighbourhoods, significant centres 804m apart* ***[Sheet 10, 12, 13, 17-22]***	*4*
	▪ *Integrated Network of walkable streets – for pedestrians, cyclists and motorists, maximum perimeter to achieve an integrated network of 457m, maximum uninterrupted block of 137m, street intervals less than 183m, slow design speeds 40Km/h,* ***[Sheet 10, 12, 13, 17-22]***	*4*
	▪ *building height to street width ratio of 1:3****[Sheet 13]***	*2*
Neighbourhood Completeness: Daily and Lifelong Utility	▪ *Variety and integrated Land Use/ Mix of land uses and house types –dwell, work, entertainment, exercise, shop, etc.* ***[Sheet 6 & 7]***	*4*
	▪ *Variety of Building types* ***[Sheet 6 & 8]***	*4*
	▪ *Variety of Dwelling Types* ***[Sheet 6]***	*1*
	▪ *Accessibility by Foot* ***[Sheet 10, 12, 13, 17-22]***	*3*
	▪ *Special Sites reserved for Civic Purposes* ***[Sheet 3 & 6]***	*3*

Sustainable Urbanist Neighbourhood	▪ *Neighbourhood a building block of a transit corridor* ***[Sheet 15]***	*4*
	▪ *Presence of high intensity transit mode* ***[Sheet 5, 9, 12, 17-22]***	*4*
	▪ *High performance infrastructure including district power, dimmable/solar street lighting and share car per block* ***[Sheet 17-22]***	*0*
	▪ *Mix and density sufficient to support car free housing and a third place* ***[Sheet 16]***	*3*
	▪ *Habitat and infrastructure Green ways* ***[Sheet 11, 17-22]***	*0.5*
Car Free housing	▪ *No off street parking* ***[Sheet 9, 17-22]***	*0*
	▪ *Provision of shared car* ***[No Formal Record]***	*0*
Neighbourhood Retail	▪ *Opportunity to walk to shopping and entertainment venues* ***[Sheet 6, 10 12, 14, 17-22]***	*3*
Third Places	▪ *Easily accessible for a majority of people* ***[Sheet 6, 10, 12, 14, 17-22]***	*3*
	▪ *Comfortable and open for a minimum of 16 hours a day, 5/6 days a week* ***[Sheet 14 & 16]***	*5*
	▪ *Serve food and beverages* ***[Sheet 14 & 16] &*** *Encourage people to stay and converse E.g. coffee shops, tot lots, pubs, etc.*	*5*
Healthy Neighbourhoods	▪ *Walkability/Bike-ability of the neighbourhoods* ***[Sheet 10, 12, 13, 17-22]***	*3*
	▪ *Availability of sufficient recreation facilities* ***[Sheet 6, 11 & 14]***	*1*

Walk-able Streets and Networks	▪ *Components supporting walkability* ***[Sheet 10, 12, 13, 17-22]***	*2*
	▪ *Overall look and feel supporting walk-ability* ***[Sheet 10, 12, 13, 17-22]***	*2*
Complete Streets	▪ *Support for compact oriented development* ***[Sheet 6, 10 & 13]***	*2*
	▪ *Walk-ability in neighbourhoods and mixed use areas* ***[Sheet 10, 12, 13, 17-22]***	*1.5*
	▪ *Multi-modal transport* ***[Sheet 6, 7, 8, 17-22]***	*3.5*
	▪ *Improved compatibility with adjacent land uses* ***[Sheet 6 & 7]***	*4*
	▪ *Provision of high quality public space* ***[Sheet 6 & 11]***	*1*
	▪ *Enhanced quality of life* ***[Beyond Scope]***	-
	▪ *Protection of environmental quality* ***[Sheet 6 & 11]***	*2*
Transportation Demand Management (TDM)	▪ *Existence of a Transport Demand Management* ***[Sheet 9]***	*0*
Car Sharing	▪ *Existence of Car Sharing Program* ***[Non]***	*0*
	Average Score	***2.4***

TABLE 13 SUI SET 2 – SUSTAINABLE DENSITY, SOURCE AUTHOR

SUI Set 2: Density		
SUI	**PARAMETERS**	**SCORE**
Increased Sustainability through Density	▪ *Sufficient Densities* ***[Sheet 16]***	*2*
	Average Score	***2***

TABLE 14 SUI SET 3: SUSTAINABLE CORRIDORS, SOURCE AUTHOR

SUI Set 3: Sustainable Corridors		
SUI	**PARAMETERS**	**SCORE**
Integration of Transport, Land Use and Technology	▪ *Neighbourhood in proposed transit corridor* ***[Sheet 15]***	*4*
	▪ *Corridor density sufficient to support a robust level of bus, bus rapid transit, street car, trolley or light rail service (TOD)* ***[Sheet 16]***	*4*
	▪ *Integration of transport technology with the density and distribution of adjacent land uses* ***[Out of Scope]***	*-*
	▪ *Transit pattern essential to automobile independent lifestyle (pedestrian oriented) e.g. ease in accessibility by walking (TOD)* ***[Sheet 10, 12, 13, 17-22]***	*3*
	▪ *Support utility infrastructure* ***[Sheet 17-22]***	*1*
Biodiversity Corridors	▪ *Supports wildlife corridors and linking habitats within and across the region* ***[Sheet 11]***	*1*
	▪ *Large, high quality and well-connected habitat patches* ***[Sheet 11]***	*1*
	▪ *Wide and vegetated buffers to minimize edge effects on habitats and to protect water quality and stream habitat* ***[Sheet 11]***	*1*
	Average Score	***2.1***

TABLE 15 SUI SET 4: BIOPHILIA, SOURCE AUTHOR

SUI Set 4: Biophilia		
SUI	**PARAMETERS**	**SCORE**
Connecting Humans to Nature	▪ *Landscaped Pedestrian routes* ***[Sheet 10, 11, 17-22]***	*2*
	▪ *Sufficient Public Parks and Gardens* ***[Sheet 11]***	*2*
	▪ *Visibility and experience of natural resource flows* ***[Sheet 11]***	*1*
	▪ *Livelihood of wild flora and fauna* ***[Sheet 11]***	*2*
	▪ *Interweaving of riparian and wildlife corridors between and through neighbourhoods* ***[Sheet 11]***	*0*
Protecting Water Resources	▪ *Appropriate Siting of Development* ***[Beyond Scope]***	*-*
	▪ *Preservation of adequate open space* ***[Sheet 11]***	*2*
	▪ *Protection of critical environmental features* ***[Sheet 11]***	*2*
	▪ *Growth of development with regard to watershed protection* ***[Beyond Scope]***	*-*
	▪ *Proportion of impervious cover****[Sheet -----]***	*3*
	▪ *Use of low impact development and Alternative storm water drains (reduced parking, narrowing streets, etc.)****[Non]***	*1*
Open Space	▪ *Parks or high quality open space 3 minutes' walk of every dwelling* ***[Sheet 6, 11 & 12]***	*3*
	▪ *Minimum park area of 1/6 acre (0.1666 acre/674.21 sq.m)****[Sheet 11]***	*2*
	▪ *All parks bounded at least on 2 sides by public right of way* ***[Sheet 11]***	*1*
	▪ *Lockable at night for security* ***[Sheet 11]***	*3*

Public Darkness	▪ *Appropriateness of location of street lighting – at potential pedestrian/vehicle conflict areas, to accent building facades, to light way finding elements, etc.* ***[Sheet ----]***	*4*
Food Production	▪ *Zoning regulations allowing domestic food production* ***[Sheet 6 & 7]***	*1*
Outdoor Waste Water Treatment	▪ *Effluent does not harm receiving waters* ***[Sheet ------]*** ▪ *Reuse of 75% of nutrient energy in the waste stream calculated annually* ***[Sheet -----]*** ▪ *Energy consumption in operation and maintenance, including sludge haulage and disposal should not exceed 80Kw Hours/year/capita* ***[Sheet -------]*** ▪ *Reuse of 75% of water in waste stream into beneficial uses, calculated annually.* ***[Sheet -----]***	*1* *0* *0* *0*
Indoor Waste Water Treatment	▪ *Existence of indoor waste water treatment****[Non]***	*0*
	Average Score	***1.5***

TABLE 16 SUI SET 5: HIGH PERFORMANCE BUILDINGS AND INFRASTRUCTURE, SOURCE AUTHOR

SUI Set 5: High Performance Building and Infrastructure		
SUI	**PARAMETERS**	**SCORE**
Connectedness: Integrating Transportation and Land Use	▪ *Abundant opportunities to walk, ride, bike, use a wheelchair* ***[Sheet 10, 12, 13, 17-22]***	*2*
	▪ *Easy access to good transit services to adjacent neighbourhoods and regions* ***[Sheet 9]***	*5*
	▪ *Sidewalks on both sides of street* ***[Sheet 17-22]***	*2*
	▪ *Short intersections 90-120m* ***[Sheet 12 & 13]***	*4*
	▪ *Car speed designed for maximum 40-48 Km/h* ***[Sheet 9, 17-22]***	*2*
	▪ *Widest streets not more than 2 lanes* ***[Sheet 13, 17-22]***	*4*
High Performance Infrastructure	▪ *Humane and pedestrian scaled infrastructure* ***[Sheet 13]***	*1*
	▪ *Component Optimization (use of reclaimed material, LED for solar street lighting, drought tolerant water efficient landscaping, etc.)* ***[Non]***	*0*
	▪ *Multifunction optimization – (using pervious pavement, trenchless technologies to repair water mains, etc.)* ***[Non]***	*0*
	▪ *Integrated Design – planter median that is a traffic calming device, a bio-retention area, dampening noise, roadway aesthetics, etc.* ***[Sheet 13, 17-22]***	*1*
High Performance Buildings	▪ *Adherence to environmental leadership standards* ***[Non]***	*0*
	▪ *Integrated Designs* ***[Non]***	*0*

	▪ *All new building developments and major renovations be designed to meet an energy consumption performance standard of 50% of the country average - a goal to be achieved through innovative design strategies, application of renewable energy technologies, etc.* ***[Non]***	*0*
Large District Energy Systems	▪ *Existence of a district energy system* ***[Non]***	*0*
	Average Score	***1.5***

5 SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Nyeri Town Case Study Findings

TABLE 17 SUI SET 1: SUSTAINABLE NEIGHBOURHOOD, FINDINGS & RECOMMENDATIONS, SOURCE AUTHOR

SUI Set 1: Sustainable Neighbourhood	
FINDINGS	**RECOMMENDATIONS**
Average is 2.4. *This means that a majority of the SUIs are at a manageable state, have not been planned for or have not been planned for but are in a manageable state.*	▪ *An enhanced definition of the **Centre and Edge,** by means of urban design strategies is required, especially of the three distinct neighbourhoods of 'up-town', 'mid-town' and 'down-town'. This may be achieved by adopting principles of place making, in addition to better defining the nodes, landmarks and edges of the three neighbourhoods.* ▪ ***Walkability** throughout the urban core, within and around needs improvement. While the major perimeter roads enjoy a measure of pedestrian path allocation, the interior streets do not effectively accommodate the pedestrian. Improvements may be achieved by reallocation of the on-street parking to eliminate congestion while adding the pedestrian pathways beyond the shopfront corridors (which are also shared by shop displays, hawkers, cobblers, newspaper vendors, etc.). Other important elements include introduction of ramps to facilitate universal*

	accessibility throughout; introduction of road safety measures such as traffic lights, zebra crossing and speed bumps and redesigning of the pedestrian path-access from highway transition. ▪ *Current building control and planning ordinances are based on separated –use zoning that does not promote integration and varieties of building and dwelling types. An adoption of a* ***smart-code*** *based that is form based, incorporates smart growth and new urbanism principles that is a unified development ordinance, addressing development at all scales of design is necessary to achieve the sustainable urbanism required for new developments.* ▪ ***Public spaces*** *and especially those for* ***civic purposes and recreation*** *are under provided. While the minimum has been met in 'Whispers Park', it is incapable of sufficiently meeting the needs of the urban visitors and dwellers both by scale and design. It is proposed that a reclaiming of the Town Hall gardens, Kimathi Stadium and the Kenya Scouts gardens/common wealth graveyard would greatly improve the stock of public spaces.* ▪ ***Formalisation*** *of the* ***informal land uses*** *such as hawking, vegetable traders, shacks on service lanes, cobblers, tailors on shopfront corridors, fruit/salad vendors around the few trees in the urban core, etc.; would greatly improve the mix of uses/trades and thereby the economy in the urban space – not to mention collectible revenue for the County. Some proposals would to fully pedestrianize some streets such as Gakere Road, set up infrastructure or actual*

structures such as stalls for the informal traders, pave and install proper storm water drainages on routes that have heaviest pedestrian traffic to promote impulse set up by traders and purchases, etc.

- *The presence of **multi-modal transit modes** such as the three major bus/matatu termini, boda boda stops, pedestrian maneuverability, enhances sustainable urbanism as it is a form of Transit Oriented Development (TOD). This could be however improved by; increasing capacity of the termini so that matatu's, mini-vans and taxis are not taking up majority of available parking, accommodation by way of infrastructure boda bodas/possibly housing them in the improved termini, providing for bicyclists by way of paths and parking slots in the urban core.*
- ***High performance infrastructure** is with particular regard to the public right-of-way that consists of the roadway, sidewalks, sub-grade systems and the landscaped areas. Through employing best practices that treat the right-of-way as a series of linked and interacting systems and by making capital improvements accordingly – Nyeri town can capture a range of environmental, societal and economic benefits. This include reduction in duplication and consequent waste, for instance in the installation of two sets of street lights on Kimathi way, open hazardous storm water drains, poorly and hard to maintain installed power and telephone lines, etc.*
- *A **greenway** according to the Oxford English dictionary is "a strip of undeveloped land near an*

urban area, set aside for recreational use or environmental protection". However, the term can in fact include "a scenic road" (Ashworth, W. and Little, C.E, 1991) *and though many are in urban areas, there are some rural greenways. The major perimeter roads around Nyeri, including the Kenya Scouts gardens, present opportunity for creating effective greenways.*

- ***Third places*** *have become a non-negotiable part of the work place experience. Developing third places should therefore not be a matter of accident or serendipity but of deliberate social engineering. It should be a multi-faceted process, designed to enhance the lifestyle experience throughout the urban community, from dining, to night life, music and performance to exercise opportunities, environmental commune and far more. Responsibility for the development of these third places is thereby diverse and should include the county authorities as well as private enterprise.*
- ***Transportation demand management (TDM)*** *refers to a set of strategies aimed at reducing the demand for roadway travel, particularly in single occupancy vehicles. These strategies address a wide range of externalities associated with driving, including congestion, poor air quality, less livable communities, reduced public health, dependence on oil, reduced environmental health, and climate change and GHG emissions. Some TDM strategies are designed to reduce total travel demand, while others are designed to reduce peak period demand, which may disproportionately contribute to these*

	externalities. A proposal for Nyeri town would be toll roads, parking management and pricing, transit incentives, transit improvements.

TABLE 18 SUI SET 2: SUSTAINABLE DENSITY FINDINGS & RECOMMENDATIONS, SOURCE AUTHOR

SUI Set 2: Density	
FINDINGS	**RECOMMENDATIONS**
Average is 2.0. *This means that a majority of the SUIs are at a manageable state, have not been planned for or have not been planned for but are in a manageable state.*	▪ *By strategically increasing the number of dwelling units per acre, Nyeri town will not only go a long way toward meeting its sustainability objectives, but also become more competitive, resilient, and a great place to live. Density is arguably the most powerful tool controlled by a municipality-to create a more sustainable urban centre while at the same time helping to preserve agricultural land and the open space beyond its borders. Opportunity for Densification in Nyeri town exists in the large tracts of land owned by the Kenya Police through redevelopment of the existing housing estate and the development of the largely underutilized Police yard. Further opportunity exists in the promotion of mixed use development within the urban precinct. The two strategies would also greatly enhance diversity by accommodating residences for different classes and family structures.*

TABLE 19 SUI SET 3: SUSTAINABLE CORRIDORS FINDINGS & RECOMMENDATIONS, SOURCE AUTHOR

SUI Set 3: Sustainable Corridors		
FINDINGS	**RECOMMENDATIONS**	
Average is 2.1. *This means that a majority of the SUIs are at a manageable state, have not been planned for or have not been planned for but are in a manageable state.*	▪ *Nyeri town sits strategically on the proposed B-52 highway that connects to the great A-2 highway. On completion, Nyeri will be on the regional transit corridor and thereby poised to become a Transit Oriented Development.* ▪ *A **transit-oriented development** (**TOD**) is a mixed-use residential and commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership. A TOD neighborhood typically has a center with a transit station or stop surrounded by relatively high-density development with progressively lower-density development spreading outward from the center. TODs generally are located within a radius of one-quarter to one-half mile (400 to 800 m) from a transit stop, as this is considered to be an appropriate scale for pedestrians, thus solving the last mile problem. Nyeri town hosts 3 major bus/matatu termini, which easily form potential centres for the 3 neighbourhoods of 'uptown', 'mid-town and 'down-town. Proposed enhancements include pedestrianisation, Public Square fronting the termini, high density walkable district, accommodation of bicycles and boda bodas as support transport with attendant parking areas, specialised retail at the termini and reduced and*	*4* *4* *-* *3* *1*

	managed parking. ▪ *An **integrated utilities infrastructure** system has been taunted as the foremost model for transforming the ageing public utility infrastructure in urban centres such as that in Nyeri Town. It would consist of an infrastructural integration of power, water, gas, solid waste management and ICT utilities along a sustainable corridor (public right-of-way). This would deliver smart value and efficiency because of its scalability and affordability – making it sustainable.* ▪ ***Biodiversity corridors** allow species to traverse habitat that is not necessarily suitable for permanent residency. Species often rely on biodiversity corridors to disperse from their areas of birth, escape predation, locate better habitat, find a mate or access habitat they need at a specific life history stage – without which many species cannot perform their essential life functions and eventually become extirpated. Nyeri town by enhancing its greenways, habit patches such as the parks and developing wide vegetated buffers. This would ideally be along the major roads, in the parks and gardens.* ▪ ***TDM** as mentioned in SUI Set 1 above.*

TABLE 20 SUI SET 4: BIOPHILIA FINDINGS & RECOMMENDATIONS, SOURCE AUTHOR

SUI Set 4: Biophilia	
FINDINGS	**RECOMMENDATIONS**
Average is 2.1. *This means that a majority of the SUIs are at a manageable state, have not been planned for or have not been planned for but are in a manageable state.*	▪ *Development of **Biodiversity Corridors** as per SUI Set 3 above.* ▪ *Development of **Greenways** as per SUI Set 1 above.* ▪ *Development of **Public places** as per SUI Set 1 above.* ▪ ***Alternative Storm Water Drainage Systems** or **Sustainable Urban Drainage Systems (SuDs)** offer an alternative for the management of storm water through designing for water quantity management, water quality treatment, enhanced amenity and maintenance of biodiversity as opposed to the conventional method that focuses on flow management by collecting run-off and channeling it to the closest water course. Opportunities exist in Nyeri for the adoption of these technologies by way of soakaways, permeable pavements, filter strips, swales, infiltration trenches, bio-retention ponds and sand filters. These could be employed in public places, along major roads, in the islands along Kimathi way specifically, etc.* ▪ ***Protection of the Urban Environment** in Nyeri can be achieved by managing the disposal of solid waste, adoption of alternative storm water drainage systems as above, development of biodiversity corridors, greenways & parks as above, protection of water sources, adoption of green technology and*

	energy such as solar, etc. ▪ ***Light pollution**, also known as **photo-pollution** or **luminous pollution**, is excessive, misdirected, or obtrusive artificial light. Nyeri town does not suffer from light pollution but existing duplication of street light installation may eventually result in light pollution.* ▪ ***Food production** in the urban core, as a strategy for sustainable urbanism is not suitable for Nyeri town as Nyeri enjoys an abundance of fresh agricultural produce from the rural environs.*

TABLE 21 SUI SET 5: HIGH PERFORMANCE BUILDINGS AND INFRASTRUCTURE FINDINGS & RECOMMENDATIONS, SOURCE AUTHOR

SUI Set 5: High Performance Building and Infrastructure	
FINDINGS	**RECOMMENDATIONS**
Average is 1.5. *This means that a majority of the SUIs are at a manageable state, have not been planned for or have not been planned for but are in a manageable state.*	▪ *Develop **Walkability strategies** as per SUI Set 1 above.* ▪ *Develop a **Transit Oriented Development (TOD)** as per SUI Set 3 above.* ▪ *Application of a **Smart Code** as per SUI 1 above.* ▪ ***Component Optimisation** strategies should be adopted especially for new installations and replacements in the development of buildings and infrastructure in Nyeri town. This includes use of reclaimed/recycled material, LED for solar street lighting, drought tolerant and water efficient landscaping, etc.* ▪ ***Multifunction Optimisation** strategies should also be adopted in new installations and replacements in the development of buildings and infrastructure. This includes using pervious pavement coverings, trenchless technologies to repair water mains, etc.* ▪ *Adopt **Integrated Utility Infrastructure** as per SUI Set 3 above.* ▪ *Adopt **Integrated Design** strategies such as a planter median that is at once a traffic calming device, a bio-retention area, a noise buffer, roadways aesthetics, etc.* ▪ *Adoption and promotion of **Sustainable Design Standards** such as LEED, specifically for the approval, assessment and certification of new*

	buildings and infrastructure. These standards use a diverse group of hard measures of environmental quality and impacts to define a holistic approach to sustainable building and assign ratings to individual projects.

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Appendix 1: Institutional Framework for Urban Development in Kenya

Urban development in Kenya is guided by several legal, policy and regulatory frameworks. They include the following:

1. *The Kenya Constitution 2010*

The constitution emphasizes public participation in development and decision making and that also gives the power of the state to regulate the use of any land, or any interest in or right over any land, in the interest of land use planning.

2. *The Physical Planning Act, Cap 286*

This act regulates all physical planning activities in Kenya. It gives power to local authorities to regulate development within their areas of Jurisdiction. It also stipulates the planning preparation and approval processes which has been adopted in this project. The act is however overdue for the view to make it in harmony with other recent laws.

3. *The Urban Areas and Cities Act*

The Act outlines the broad contents, submission and approval process of which the integrated city and urban area development plan will go through, citing that the County Assembly has the responsibility of approving the plans. It also emphasizes on the need for Public participation in planning process which is now mandatory.

4. *The County Government Act*

With the new government system in Kenya, all the 47 counties are required to prepare County Integrated Development Plans (CIDP). The County Governments Act under section 107(2) states that the County plans shall be the basis for all budgeting and spending in a county. The Act outlines chapters that constitute the CIDP and spatial plan is one of them.

5. *Other Acts*
6. *Vision 2030*
7. *Public Health Act, Cap 242*

8. *Survey Act, Cap 299*
9. *The Water Act, 2002*
10. *Physical Planners' Registration Act, No. 3 Of 1996*
11. *Environment Management and Co-Ordination Act (EMCA), 1999*
12. *Draft National Urban Development Policy*
13. *The Building Code*
14. *The Physical Planning Handbook, 2005*
15. *Sessional Paper No. 3 of 2009 On National Land Policy*