CHAPTER 4: Understanding the Cityscape: Towards a Systematic Design that Embraces Climate Change and Ecology

Abstract

Rapid urbanisation has caused several changes around urban and rural landscapes in developed and developing regions. These changes have seen the alteration of climate and the environment. This chapter highlights and argues on the significance of designing and managing public urban spaces and city features with the consideration of the current trends in climatic and ecological systems. Growing populations in urban areas mean that on landscapes, there's an increase in deforestation, the environment is changing and so are the atmospheric conditions surrounding urban areas. There is need to consider implementing designs that embrace components such as vegetation in the city centre. The chapter highlights that there is need to promote urban resilience through urban design. Therefore, the chapter bases on the concepts of environmental design and urban ecological design. These concepts help examine the different strategies that can be implemented through urban design that are socially, ecologically and aesthetically engaging with the sustainability of the built environment in the face of climate change.

INTRODUCTION

The world's climate is changing and it will continue to change throughout the 21st century and beyond (Rosenzweig *et al.,* 2015). Rising temperatures, new precipitation patterns and other changes are affecting many aspects of human society and the natural world (Chapman *et al.,* 2017). Cities around the world are facing an ever-increasing variety of challenges that seem to make more sustainable urban futures elusive. In the last 50 years, the valuation and preservation of nature have been the core issues for ecological development and sustainability (Khajurira *et al.,* 2008). Many of these challenges are being driven by and exacerbated by increases in urban populations and climate change. Anthropogenic greenhouse gases (GHGs) are responsible for the current climate change. Living organisms are intimately connected to their physical surroundings (Nyamadzawo *et al.,* 2015). Even small changes in the temperature of the air, the moisture in the soil, or the salinity of the water, can have significant effects. Each species is affected by such changes individually,

but those individual impacts can quickly reverberate through the intricate web of life that makes up an ecosystem. Urban areas are responsible for more than 70% of the emissions, with over half of the world population living in urban areas (While and Whitehead, 2013). It is crucial to develop more sustainable urban areas that will significantly reduce the carbon footprint of cities while at the same time taking into account the rising temperatures and the vulnerability of the urban spaces (Skutsch and Ba, 2010). Considering climate change and ecological changes occurring in the atmosphere helps to create sustainable infrastructure, mobility and housing. Almost all of the impacts of climate change have direct or indirect consequences for urban ecosystems, biodiversity and the critical ecosystem services they provide for human health and wellbeing in cities (Chirisa *et al.,* 2016). These impacts are occurring in urban ecosystems and their constituent living organisms.

Urban planning and urban design have a critical role to play in the global response to climate change (Ren, 2017). Adaptation strategies and actions that simultaneously reduce GHGs emissions and build resilience to climate risks should be prioritised at all urban metropolitan regions, cities, districts/neighbourhoods, blocks and buildings. This needs to be done in ways that are responsive to and appropriate for local conditions (Rosenzweig *et al.,* 2015). Many adaptations and mitigation options can help address climate change, but no single option is sufficient by itself. Effective implementation depends on policies and cooperation at all scales and can be enhanced through integrated responses that link mitigation and adaptation with other societal objectives. Therefore, urban design is a discipline that integrates many other disciplines in adapting to ecological and climatological changes through the use of environmentally friendly urban designs (Tompson, 2017). Thus, the task of anticipating climate change has prompted growing interest in the science (and politics) of urban climatology and its intersection with issues of urban form and design (While and Whitehead, 2013).

There is need to use urban design as an adaptation/ mitigation strategy to various ecological and climatological changes because cities are recognised as the priority source of pollution (Bauer and Scholz, 2010). Most energy consumption is connected to cities, which have to make the greatest efforts to manage sustainable resources under the social, environmental and economic aspects and to improve the quality of life of their citizens (Gujiba *et al.,* 2012). Heat-waves in cities generate serious

inconveniences for the most vulnerable citizens, especially the elderly and children (NASA, 2020). Climate impact requires the use of innovative solutions and the rethinking of urban management and planning. New urban and territorial structures, low-energy consumption buildings and infrastructures, green areas and the adoption of advanced technologies mitigate global emissions and local pollution, promote adaptation to climate change, reduce the energy costs of families and businesses and improve the climate of cities (Ziervogel*et al.,* 2014).

BACKGROUND OF ECO-FRIENDLY URBAN DESIGNING

In Europe, urbanisation processes are progressing rapidly, causing soil sealing and the reduction of its functions and quality (Van Noorloos and Kloosterboer, 2018, Paranunzio *et al.,* 2019). One of the major consequences of urbanisation, in terms of the impact on human health and environmental quality, is the "urban heat island" (UHI) effect (the phenomenon whereby cities appear to be warmer than the surrounding rural area) (Azam and Khan, 2016; Chapman *et al.,* 2017). It is estimated that climate change will greatly aggravate the extent of the UHI, particularly in hot regions characterised by periods of summer dryness such as the Mediterranean Basin. The UHI effect has caused various changes in climate and climatic regions, for instance, in the Arctic, shrubs are slowly infiltrating the territory where once there was only ice, snow and lichens (Chirisa *et al.,* 2016; Matenga, 2019). Although these unassuming, stunted plants may not seem like much of a threat, their expansion driven by warming temperatures across the Arctic is causing a cascade of ecological impacts through the region's food chain. This has led many regions around the world to implement urban designs that are environmental friendly (Khajurira *et al.,* 2008).

In the 1960s and 1970s, in the context of an increasing focus on environmental issues, scholars and practitioners began to give greater recognition to an ecological approach to urban planning and design (Skiyi *et al.,* 2016). The growth of interest in this area has been particularly noticeable in the past 30 years, with a range of theoretical concepts being put forward, including ecosystem services, landscape urbanism, urban ecology, landscape ecology, biophonic design, resilience planning and regenerative design (UNFCCC, 2007; Kupika *et al.,* 2019; Matenga, 2019).A range of tools, frameworks and assessment systems have also been developed to support the application of ecological principles into building design, landscape architecture and urban planning. Globally, over

the last 15 years, a very significant effort has been made to transform our thinking and, therefore, our language about nature and economic relationships, in particular; for example, the need to recognise the socio-economic value of ecological services (Harrison *et al.,* 2014; Kupika *et al.,* 2019)

The first example of eco-architecture is believed to have been built during the energy crises in the 1970s in Minnesota. What has been regarded as "Ouroboros architecture" was constructed by environmentally friendly principles, minimising the harm on the environment through the emission of its components (Terranova and Tromble, 2016). In 1990, the United Kingdom established the first green architecture environmental assessment method. The United States took the helm in energy and environmental design, building a rating system in 1998 (Azhara *et al.,* 2011). China, with its rapid urban sprawl, began to set up an eco-architecture assessment system after 2006, whereby ecological building sites were to meet the standards of harmlessness in design, construction, use and demolition. China has made eco-city development, eco-restoration and eco-civilisation its legislative priority and its national strategy. By realising the importance of "lucid water and lush mountain" (Wang *et al.,* 2019), China committed to protect natural forest reserves, restore its forest ecosystems and increase the forest coverage rate from 8% in the late 20th century to 22.6% recently.

CONCEPTUAL FRAMEWORK

This chapter is based on concepts of urban design and the environment and its components. These theories are used in this chapter with the intention of bringing out the importance of ecology and climate in spatial planning and urban design. These concepts include urban design, environmental design and ecological civilisation concepts.

THE URBAN DESIGN CONCEPT

Urban design describes the physical features that define the character or image of a street, neighbourhood, community, or the city as a whole. Urban design is the visual and sensory relationship between people and the built and natural environment (Davoudi, 2008). The built environment includes buildings and streets and the natural environment includes features such as shorelines, canyons, mesas and parks, as they shape and are incorporated into the urban framework. Citywide urban design

recommendations are necessary to ensure that the built environment continues to contribute to the qualities that distinguish the City of San Diego as a unique living environment (Gurran *et al.,* 2015). The urban design element addresses urban form and design through policies aimed at respecting the natural environment, preserving open space systems. Urban design can help lower GHG emissions that are causing global climate change. Providing for the needs of pedestrians, bicyclists and mass transit users will help reduce fossil fuel use by personal vehicles. Current design practices often make it difficult to leave the car at home (Salizzoni *et al.,* 2020).

CONCEPT OF ECOLOGICAL CIVILISATION

Ecology is the study of the relationships between living organisms, including humans and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. The World Bank (2018) defines eco-cities as:

> "cities that enhance the well-being of citizens and society through integrated urban planning and management that harness the benefits of ecological systems and protect and nurture the natural assets for future generations (Mtambanengwe, 2005).

Ecological civilisation differs from sustainable development in the emphasis placed on political and cultural factors and on defining new relationships between people and nature that would permit living well and within the eco-environmental bounds of planet Earth. However, some people term ecological civilisation as sustainable development (Brandl and Zielinska, 2020). As a form of human civilisation, ecological civilisation is based on natural respect and protection takes the harmonious symbiosis among human-human, human-nature, human-society as its purpose, establishing sustainable production and consumption patterns as its content and focusing on guiding people to get on the sustainable and harmonious development path. Ecological civilisation emphasizes human consciousness and self-discipline, stresses interdependence, mutual reinforcement and coexistence between human and natural environment. Ecological civilisation construction is systematic engineering, It needs respective correlative departments to integrate resources, coordinate work such as developing plans, propagandistic education, policy measures and systematic security (Elagroudy *et al.,* 2016).

URBAN ECOLOGICAL DESIGN CONCEPT

Eco-architecture design has been the theory, science and style of building designs and its themes may run through the whole construction process, guiding project feasibility demonstrations, environmental impact assessments, construction, building operation management, building materials recycling and beyond (Sekar *et al.,* 2019). Human ecology attempts to apply biological processes/concepts to the social world and maintains that the city and city life are the product of competition in the natural environment. Urban ecological design is a practice that is socially, ecologically and aesthetically engaging with aims to improve ecological functioning, preserve and generate resources for man use and foster more resilient approaches to design and management of the built environment (Mustapha, 2016). It also presents an interdisciplinary method of transforming urban spaces that considers the issue of ecology and the built environment. It inspires the use of ecosystems in urban design. The role of ecosystems is vital to the sustainability of growing and expanding urban spaces across the globe (Mustapha, 2016).

ENVIRONMENTAL DESIGN CONCEPT

Designing with nature is an approach linking design and ecology, focusing on living with nature, caring for nature and aiming for a sustainable society (Azam and Khan, 2016). This links the urban design and ecology, which focuses on living with nature, caring for nature and aiming for a sustainable society. It is also the process of addressing surrounding environmental parameters when devising plans, programmes, buildings policies or products. The environmental design creates visual solutions to the environment and human activities (Grimmond, 2007). It is used in designing several architectural infrastructures, such as walkways and playgrounds. Environmental design is critical for urban planning as it is an approach that assists in reducing GHGs in the atmosphere as the built environment contributes 50% of all man-made GHGs. Environmental designing includes considerations on the orientation of buildings, type of building materials, use of solar systems, that is, the use of less energy in architecture.

THE CONCEPT OF URBANISM

Urbanism is the patterns of behaviour, relationships and modes of thinking that characterises urban dwellers (Gilderbloom, 2018). The UNDP has projected that developing nations will urbanise faster than the developed world in the 20st century. The year 2007 was announced as a remarkable

point in human history when more than 50% of the world population lived in urban regions. Urbanisation occurs in three broad stages. First, there is an early period when improvements in agriculture lead to population growth and more densely populated settlements. Next comes a period of industrialisation (Bryceson and MacKinnon, 2012).

New jobs associated with industrialisation draw even more people from rural areas, often causing public-health crises as the cities become overcrowded and the infrastructure fails to keep pace with the population. Finally, specialisation of urban space occurs (Gurran *et al.,* 2015). This line of thinking by urban dwellers has contributed significantly to climate and ecological changes occurring in the earth and its atmosphere currently. Urban growth has been associated with polluted rivers, dirty air, contaminated lands and lost ecosystems. Since the early 1980s, a growing group of planners, architects and developers has been rebelling against "conventional" suburban development as it has been practised in the United States since the end of World War II. Instead, they have offered an alternative vision of suburban neighbourhoods and, indeed, an alternative vision of metropolitan areas as a whole. Therefore, new urbanism lies in a set of "neo-traditional planning" principles meant to restore both the physical design and social values. This includes eco-friendly urban planning and urban design (Gilderbloom, 2018).

LITERATURE REVIEW

Urban ecosystems and biodiversity have an important and expanding role in helping cities adapt to the changing climate. Harnessing urban biodiversity and ecosystems as adaptation and mitigation solutions will help achieve more resilient, sustainable and liveable outcomes (Ministry of Environment, Water and Climate Republic of Zimbabwe, 2013; Gurran *et al.,* 2015). Conserving, restoring and expanding urban ecosystems under mounting climatic and non-climatic urban development pressures will require improved urban and regional planning, policy, governance and multi-sectoral cooperation (Skiyi *et al.,* 2016). Despite not having received nearly as much attention as climate change, the reduction of flora and fauna, or the loss of biodiversity, is another major ecological threat that could potentially have comparably significant impacts (Nyamadzawo *et al.,* 2014). Humankind occupies an ever-increasing extent of planetary space and this has resulted in the harmful invasion of all other forms of eco-systemic life on Earth. In and of itself, this increases global risks (African Development Bank, 2011).

Urban planning is a concept that encompasses the entire set of prospective activities aiming at regulating the development of urban territorial systems (i.e. the regulation of land-use, infrastructure planning) (Wekwete 1989; Chirisa, 2014; Chigudu, 2020). Urban and regional planning can also be described as the capacity to manipulate shape and place. Urban planning can include urban renewal, by adapting urban planning methods to the existing cities suffering from decline (Salizzoni *et al.,* 2020). In the late 20th century, the term "sustainable development" has represented an ideal outcome in the sum of all planning goals, including climate change adaptation. The issue of urbanism has been the major factor in pushing urban planning that conforms to environmental standards (Gilderbloom, 2018). This has been because urbanism interferes widely both with the natural environment and the artificial or human-made environments, through complex theoretical and operational relationships, sometimes difficult to define and quantify. The imbalance between human activities and the environment has increased persistently (Zhou *et al.,* 2004; Uttara *et al.,* 2012; Ren, 2017). This has led to the planning system metamorphosing to keep up with changing circumstances such as the vendors' struggles by organising and mobilising them to revive the indispensable informal economy in Zimbabwe (informal economic sector reconstruction) (Gumbo and Geyer, 2011). Therefore, there is need for urban planning and design to also incorporate long-range strategies for climate change that reach across physical scales, jurisdictions and electoral timeframes (Ren, 2017). These activities need to deliver a higher quality of life for urban citizens as the key performance outcome.

Environmental urban design has led to the growth of eco-cities around the globe (Davoudi, 2008; Skiyi *et al.,* 2016; Tompson, 2017). An eco-city is an ecologically healthy, sustainable, energy-efficient, low-carbon, smart energy city and an ecosystem whose structure and function are self-sustaining and resilient. Eco-architecture, also known as "green architecture", "sustainable architecture", or "green building", not only skilfully utilises natural resources, but also brings a new concept of living, which is an important concept of Design with Nature (Elagroudy *et al.,* 2016; Mustapha, 2016; Gilderbloom, 2018). Eco-architecture has attracted

widespread attention in China. Sustainable development and energy conservation will become important . Eco-cities contain environmentally friendly designs that utilise new materials in building infrastructure. For instance, the properties of materials used in building envelopes and insulation values, play an essential role in the thermal response and environmental impact of buildings (Chirisa *et al.,* 2016). Primarily, two effects must be considered. Firstly, the envelope characteristics directly affect the heating and cooling loads generated to ensure indoor comfort and, secondly, the envelopes constitute an essential element in an urban site, transforming the microclimate, which in turn has a substantial impact on building energy demand and outdoor and indoor comfort (Yigitcanlar and Dur, 2010; UN, 2016; Ferrer, 2017).

It is sensible to explore envelope characteristics in a mitigation strategy for climate change and to exploit their direct and indirect effects on indoor comfort (NASA, 2020). Protecting, upgrading and increasing urban and peri-urban forests and street trees through the enhancement of the green infrastructures (GIs) is, therefore, fundamental for the sustainable development of urban areas that represent "demand areas for Ecosystem Services", the goods and services provided to man by nature (Gilderbloom, 2018). The management of climate change risk through adaptation, in particular through the reduction of vulnerability and exposure through development, planning and practices that include "low-regret" measures, i.e. those that produce benefits even in the absence of climate change and with which the adaptation costs are relatively low compared to the benefits of the action is vital to the protection of the environment (Ziervogel et a*l.,* 2014). Lastly, the maintenance of urban green spaces is one of the approaches suggested by SDGs 11 (Sustainable Cities and Communities) of the UN Agenda to 2030.

METHODOLOGY

Research approaches are plans and procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis and interpretation(Creswell, 2014). The study made use of case study analysis, documentary analysis and secondary data analysis in the depiction of recent trends of urbanisation and climate change and in finding the relationship that exists between them. The case study analysis approach allows for an in-depth appreciation of a particular phenomenon

under study. Therefore, through the review of different strategies in urban design that are climatologically and ecologically friendly, the chapter was able to highlight the importance of environmental design. Documentary analysis assists in the enhancement of the reliability of the chapter(de Falco *et al.,* 2019). Documents used include books, journals and websites and newspaper articles. Data obtained were then processed into information and analysed through the use of thematic content analysis. Thematic content analysis is the use of textual material in research reducing it to more relevant, manageable bits of data, It is also a method of analysing the text of social investigation among the set of empirical methods (Kumar *et al.,* 2020). After summarising literature, it was assembled and structured thematically into important concepts.

RESULT AND DISCUSSION

Urban design, through environmental conservation lenses, has led to the development of various eco-cities around the world. Urban waste heat and GHG emissions from infrastructure, including buildings, transportation and industry, can be reduced through improvements in the efficiency of urban systems. Urban designers have influenced environmental designs at micro and macro levels, that is, designing layouts and designing single buildings.

CLIMATE CHANGE AND THE URBAN HEAT ISLAND

Urbanisation reduces green space, increases impervious surfaces and alters albedo and geometry compared to rural surfaces. Human-caused climate change presents significant risks to cities beyond the familiar risks caused by natural variations in climate and seasonal weather patterns. Urbanisation tends to be associated with elevated surface and air temperatures, a condition referred to as the urban heat island (UHI). Urban centres and cities are often several degrees warmer than surrounding areas due to the presence of heat-absorbing materials, reduced evaporative cooling caused by lack of vegetation and production of waste heat. This shows that traditional approaches to urban designing have failed to adapt to climatological and ecological changes occurring in the atmosphere. The heat emitted from insulated buildings has been a contributing factor to changes in climate, thus causing extreme events in many cities such as heatwaves, droughts, heavy downpours and coastal flooding which are projected to increase in frequency and intensity(Chapman *et al.,* 2017).

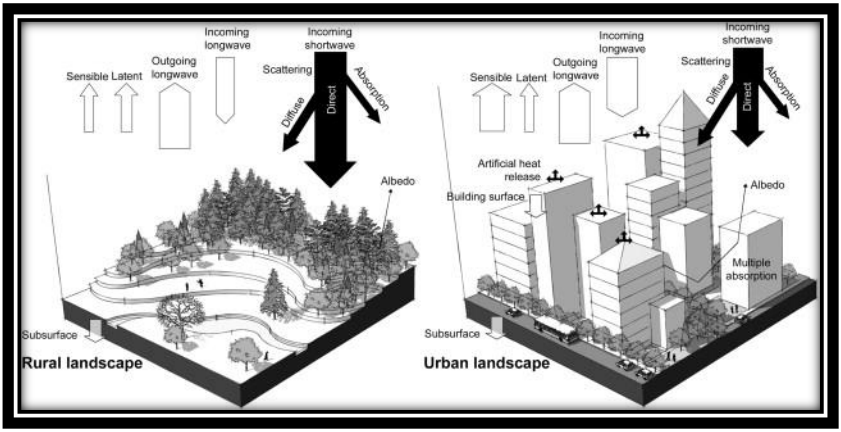

Figure 1: *The Amount of Heat Released for Rural Versus Urban Areas (*Ren, 2015).

The warming climate, combined with the UHI effect, will exacerbate air pollution in cities. The concentration of people, infrastructure, economic activity and ecology within the coastal zone, merits specific consideration of hazards worsened by a changing climate. Climate change and urbanisation are likely to increase the vulnerability of biodiversity hotspots, urban species and critical ecosystem services (UNFCCC, 2007). Urban Heat Islands are thus vital in the move towards eco-friendly urban design. There is a need to reduce heat in cities and urban centres to adapt/mitigate changing high temperatures in various localities. This can be done through the use of open spaces and green buildings.

OPEN SPACES

Open spaces are green spaces that are incorporated in urban planning and layout designing that allow an area to 'breathe'. An pen space is any open piece of land that is undeveloped and is accessible to the public. In Zimbabwe, the layout designing manual recommends strategic placement of open spaces in neighbourhoods and central business districts (CBD). This has been adopted from various policies and frameworks such as the Public Space Framework by and for local governments of 2016 presented by representatives from Bogota and eThekwini (UCLG, 2016). Open spaces can be in the form of parks, playgrounds, wetlands, public seating areas, schoolyards, vacant lots, cemeteries, community gardens or woodlands.

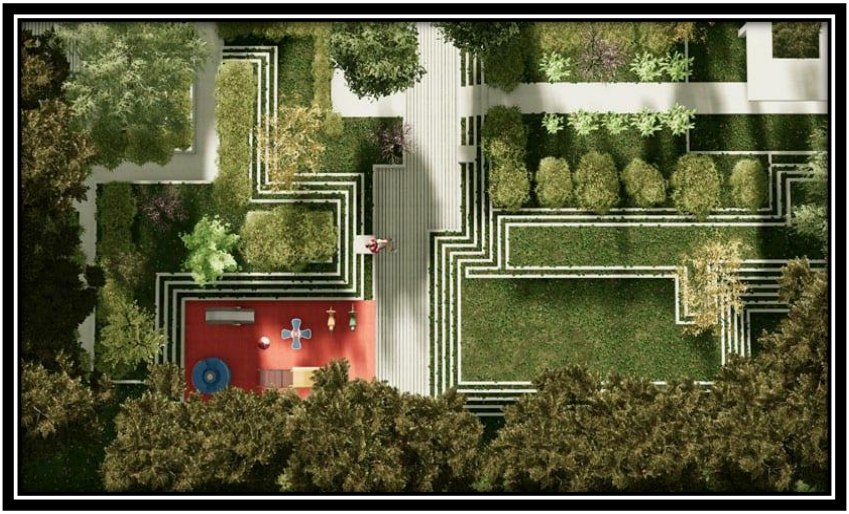

Figure 2: *Open Space in the Form of a Park* (Doucette and Park, 2018*).*

Open spaces allow for recreational areas for residents and help enhance the aesthetic beauty of surrounding neighbourhoods. Proximity to parks and public spaces in residential areas increases property values. Public open spaces are usually characterised as green spaces as they contain vegetation and trees. They are an essential part of environmental design, and these are dated from the formation of cities, i.e. from the garden city movements. They assist in capturing precipitation, allow for infiltration of water, thereby reducing storm water drainage costs, and also protect and preserve underground water. Therefore, including open spaces in urban design helps to adapt to ecological and climatological changes that are occurring in today's cities.

GREEN INFRASTRUCTURE

Buildings are important components of the built environment, influenced both by the long- and short-term changes of climate. Building energy demand will change in response to future climate change, with cooling and heating demand going in opposite directions. Net increases or decreases depend largely on a region's cooling or heating demand dominance. It is thus key to understand how local climate change affects building energy demand, distinguishing between heating and cooling. Modifying the form and layout of buildings and urban districts can provide

cooling and ventilation that reduce energy use and allow citizens to cope with higher temperatures and more intense runoff (Rosenzweig *et al.,* 2015).

The green building concept is part of the current movement towards more sustainable societies Green development establishes and reinforces connections and applies ecological thinking by creating places for people to live and work. Green development is more than individual buildings or their components, It seeks to minimise entire life cycle impacts by employing resource-efficient and environmentally and community-sensitive land-use by fitting the site, thus using resources efficiently through the provision of an adaptable healthy indoor environment. It is generally accepted that green building refers to both a structure and the use of processes that are environmentally conscious and resource-efficient throughout a building's life-cycle, from setting up, siting to design and construction.

Figure 3: *Al Shaheed Park, Kuwait Zinco Green Roof Systems* (ZinCo Project Report, 2019)

Green roofs in urban design have been used in various regions as a means to incorporate climatological and ecological changes. Green roofs can be modular with drainage layers, filter cloths and plants. They involve the development of contained green spaces on top of human-made structures.

Therefore, green roofs are complete systems that enhance green roof systems that go beyond the meaning of contemporary architecture and give a new value to the role of buildings in urban planning. They are designed not only to bring back the natural element in the urban environment, but also to provide solutions for important issues such as UHIs and stormwater management.

URBAN GREEN WAYS

Green ways are a general term of showing linear consistency, linking open and green spaces and providing development into the urban texture. There are bicycle passages, wildlife routes, improved watersides or a river far from a city developed along a bay.

Figure 4: *Urban Green Ways in Urban Centres* (Salici, 2013).

Greenways are linear open spaces such as canals and scenic roads that are set along riversides, hillsides or valleys, converted to recreational use along the railways. In Europe, greenways are described as avenues for protecting environmental values and the network of routes that are allocated for the motor less vehicles only (on horseback, bicycling, etc.),to increase the health of environmental life, considering an integrated management approach. The main concept is to keep the corridor "green"

with the natural vegetation and to connect the interesting points along the river and similar systems to a "way" or line. Greenways are formed directly and indirectly for people's benefits and uses. For example, a greenway can provide recreational walks, observing wildlife, recognition and evaluation of the environment, river fishing and riverside protection. There are six types of greenways that can be used in urban design and these are riversides greenways, recreational greenways, natural corridors that are of ecological importance, greenways that are visual and historical in value, greenways that aim to control urban development and greenways systems and networks.

Role of Green Infrastructure in Ecological and Climate Change Adaptation in Zimbabwe

The Green Building Council of Zimbabwe (GBCZ) was launched on the 30th of September 2016 in Harare to spearhead the green building concept in Zimbabwe. This council is still in its infancy. The GBCZ advocates for integrated building designs and a multi-disciplinary approach to design, catering for the Planet, People, Productivity (3 Ps) which, in essence, refers to sustainable green building practices by educating industry players on the best materials to use. This policy was implemented due to the realisation of the importance of urban design in ecological and climate mitigation and adaptation. In Zimbabwe, most materials used in the construction industry in the past have not been environmentally friendly. Central to cost-effective green building and site design is a factor of interrelationships and correlated cost and performance trade costs associated with changing space configurations and greater design flexibility (UN-HABITAT, 2010).

A green building is one whose construction and a lifetime of operation assures the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resources (GBCSA, 2016). Green buildings use environmentally responsible and resource-efficient materials, depending on their quality, availability, access to water in buildings, design, construction, operation. Green infrastructure helps in protecting water sources, reducing pollution, increasing riverside habitat and biodiversity, reducing flood harms, providing recreational opportunity, supplying environmental education, alleviating noise, enhancing micro-climatic effects of both cooling and decreasing pollution and reducing riverside erosion.

CASE STUDIES

ENVIRONMENTAL URBAN DESIGN STRATEGIES: A CASE OF SAN DIEGO

San Diego's distinctive character results from its unparalleled natural setting, including beaches, bays, hills, canyons and mesas that allow the evolution of geographically distinct neighbourhoods. There are several urban design principles relating to the existing city form and achieving a compact and environmentally sensitive pattern of development envisioned in the City of Villages strategy. These principles are identified below to provide a framework for the goals of the Urban Design Element in San Diego.

Box1: Urban Design Strategies of San Diego

STRATEGIES

- Contribute to the qualities that distinguish San Diego as a unique living environment;
- Build upon existing communities;
- Direct growth into commercial areas where a high level of activity already exists;
- Preserve stable residential neighbourhoods.

CORE VALUES RELATED TO URBAN FORM

- The natural environment;
- The city's extraordinary setting, defined by its open spaces, natural habitat and unique topography;
- A compact, efficient and environmentally sensitive pattern of development;
- The physical, social and cultural diversity of the City and its neighbourhoods.

GOALS OF URBAN DESIGN

- A built environment that respects San Diego's natural environment and climate.
- Improved quality of life through safe and secure neighbourhoods and public places.
- A pattern and scale of development that provides visual diversity, choice of lifestyle, opportunities for social interaction and that respects desirable community character and context.
- A city with distinctive districts, communities, neighbourhoods and village centres where people gather and interact.
- Maintenance of historic resources that serve as landmarks and contribute to the city's identity.
- Utilisation of landscape as an important aesthetic and unifying element throughout the city.

Source: Adapted from City of San Diego General Plan (2008).

San Diego's topography and year-round climate are ideal for outdoor pedestrian activity of all kinds. Therefore, the urban design element addresses urban form and design through policies aimed at respecting the natural environment, preserving open space systems. Increasingly important are changes in density and intensity occur over time, as San Diego evolves. The urban design principles established in this element are intended to help achieve an identity for the city as a whole, while encompassing its physical, social and cultural diversity. A higher overall quality of urban design is another fundamental goal. The urban design applies at multiple levels from citywide to community, to the neighbourhood and, ultimately, to individual projects. Urban design is a process to foster quality in the built and natural environment as the city changes.

SPONGE CITIES: A CASE OF CHINA

A "sponge city" is a city that is designed to passively absorb, clean and use rainfall in an ecologically friendly way that reduces dangerous and polluted runoff. Associated techniques include permeable roads, rooftop gardens, rainwater harvesting, rain, gardens, green space and blue space such as ponds and lakes. A sponge City is one whose infrastructure passively absorbs, filtrates and preserves rainfall in an ecologically friendly way that reduces soil and water erosion and polluted runoff. In this design, promoted are the development and restoration of city wetland parks, forest parks and rain gardens, which opened new and natural possibilities for city ecosystems based on historical and natural topography. China has made eco-city development, eco-restoration and eco-civilisation its legislative priority and its national strategy. By realising the importance of "lucid water and lush mountain" (Wang *et al.,* 2019), China committed to protect natural forest reserves, restore its forest ecosystems and increase the forest coverage rate from 8% in the late 20th century to 22.6% recently. The country has been advocating the use of "Sponge City Design" in more than 100 cities.

Figure 5: *Sponge City Concepts in Yanweizhou Park in Jinhua, eastern China* (Li *et al.* (2017)

Like many places around the world, Chinese cities are considering ways to combat flooding in the face of climate change. Increased urban development has made flooding worse and turned some neighbourhoods into vulnerable waterfront locations. The Chinese government is now pursuing an idea that could alleviate the problem: sponge cities. Launched in 2015, the Sponge City Initiative invests in projects that aim to soak up flood water. The projects are being built in30 cities, including Shanghai, Wuhan and Xiamen. By 2020, China hopes that 80% of its urban areas will absorb and re-use at least 70% of rainwater. To date, the cities have received more than$12 billion for sponge projects, according to *China Daily (2021).*The central government funds around 15% to 20%of the costs, with the remainder funded by local governments and private developers. Lingang, a planned city in Shanghai's Pudong District, hopes to become China's largest sponge city project.

In early 2016, Shanghai announced the construction of4.3 million square feet of rooftop gardens throughout the entire city. In April, utility company Suezstarted installing a new 7-square-mile drainage system in Chongqing. The system's embedded sensors will allow local officials to monitor their sewer and storm water networks to mitigate the risk of flooding, according to the company. Many of the projects incorporate green space, like wetlands and bio swales, which naturally help absorb water. The efforts seek to reduce the amount of rainwater runoff. Though the Yanweizhou