

# **Planning sustainable cities through nature-based solutions: perspectives from the Global South**

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|                |                  |
|----------------|------------------|
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## **ABSTRACT**

This research considers nature-based solutions as part of the broader sustainability agenda, as perceived from a Global South perspective. Such considerations emanate from a global phenomenon of urban areas experiencing rapid amounts of socioeconomic and environmental decay, calling for an urgent search towards sustainable city planning practices. A literature study was conducted to explore the broader concepts of sustainable city planning and nature-based solutions and, the Global South, as an underrepresented part within academic literature, was explored in terms of the broader sustainability agenda with specific reference to nature-based solutions. Ten purposefully selected cities from around the globe was then analysed to gain an understanding of sustainable city planning practices and perspectives on the sustainability agenda, nature-based solutions and the Global South. It was found that nature-based solutions may prove valuable in the quest towards urban sustainability and that it is important for such approaches to be context-based and included in broader spatial planning approaches.

Sustainability agenda, Nature-based solutions, Global South, Context-based planning.

## OPSOMMING

Hierdie navorsing oorweeg natuur-gebaseerde oplossings as 'n gedeelte van die breër volhoubaarheidsagenda, soos ervaar vanuit 'n Globale Suide-perspektief. Hierdie oorweging spruit uit die globale verskynsel van hoë vlakke van sosio-ekonomiese en omgewingsagteruitgang binne stedelike gebiede, wat sodoende die soeke na volhoubare stedelike beplanning praktyke noop. 'n Literatuurstudie is gedoen wat die breër volhoubaarheidsagenda ondersoek in terme van natuur-gebaseerde oplossings. Tien doelbewus verkose stede van regoor die wêreld is gevolglik geanaliseer om duidelikheid te kry oor volhoubare beplanningspraktyke. Kennerperspektiewe is ook hieroor verkry in terme van die volhoubaarheidsagenda, natuur-gebaseerde oplossings en die Globale Suide. Die studie het bevind dat natuur-gebaseerde oplossings wel waardevol is in die soektog na stedelike volhoubaarheid. Daar is ook bevind dat hierdie oplossings in die breër ruimtelike beplanning benaderings ingesluit behoort te word.

Volhoubaarheidsagenda, Natuur-gebaseerde oplossings, Globale Suide, Konteks-gebaseerde beplanning.

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# CHAPTER 1: INTRODUCTION

## 1.1 Points of departure

The strive towards broader sustainable planning practices and methodologies are gaining importance (Larsson *et al.*, 2007:15). These sustainable planning practices relate to three main dimensions of an urban area, namely environmental, social and economic aspects (Czischke *et al.*, 2015:6). Recent literature suggests that the unique ecology within cities might assist in this quest towards social, economic and environmental sustainability (Anderson & Elmqvist, 2012:269) and as such, environmental considerations have become an integral part of developmental thinking and decision-making. There is an expanded scientific understanding that natural elements within urban boundaries are substantially beneficial to urban communities and cities (Llausàs & Roe, 2012:644; Surma, 2015:4; Wright, 2011:1008).

In the Global South the notion of green cities, green infrastructure and urban greening initiatives is gaining importance, but is not yet fully integrated as part of city planning approaches (Bobbins & Culwick, 2015:34-37). The unique context of this region (Global South) calls for evidence-based research, translating Global North knowledge to Global South interpretation as the current and historical urban reality of the Global South differs from that of the Global North (Pacione, 2009:449). This research argues that nature-based solutions could enhance sustainable cities, but that the local context should be understood and incorporated as part of city planning approaches. The cost-effectiveness and longer-term gain of these nature-based solutions for city planning should be documented and placed in local context, to provide solutions to address societal challenges.

## 1.2 Problem statement and motivation

Cities are globally experiencing social, economic and environmental deterioration and is in desperate need of solutions towards sustainable city planning practices. Research on such planning practices are gaining importance with an expanded scientific understanding that nature-based solutions are substantially beneficial to urban communities and cities. Context-based approaches are increasingly believed to form an integral part of planning for sustainable cities, but the vast majority of literature focuses on sustainable city planning approaches from the Global North. This calls for an urgent consideration of context-based approaches that address the unique challenges and utilises the unique opportunities within the Global South.

### **1.3 Primary research questions**

The primary research question is “How can nature-based solutions guide the planning of sustainable cities in the Global South?”

The secondary questions include:

1. What is the current paradigm regarding sustainable city planning?
2. What is the linkage between nature-based solutions and the sustainability agenda?
3. What are the unique considerations, opportunities and challenges within the Global South regarding sustainable city planning?
4. How can nature-based solutions be implemented in the Global South?

### **1.4 Aims and objectives of the study**

This research aims to consider the planning of sustainable cities through nature-based solutions, as perceived from a Global South perspective.

As such, the research objectives include:

1. Investigating the importance of planning for urban sustainability within the current urban context.
2. Considering the viability of nature-based solutions to address urban complexities regarding sustainability.
3. Investigating the unique considerations, opportunities and challenges for the urban sustainability agenda in the Global South.
4. Concluding on the importance of context-based solutions in planning for urban sustainability, with specific reference to nature-based solutions in the Global South.

### **1.5 Research methodology**

The research methodology refers to the systematic procedure, employed to support the status of the study's findings (Pruzan, 2016:175), as presented in the following chapters. The study was conducted in two parts, namely a literature study and an empirical study, that was collectively considered to ultimately answer the research questions, as posed in section 1.3. Recommendations regarding future research and planning methods was derived accordingly. The methodology employed for the literature and empirical studies is respectively explained in the following sub-sections.

### **1.5.1 Literature study**

The literature study for this research is a written argument based on evidence from previous research, with the aim to contextualise current knowledge on the sustainability agenda, nature-based solutions and the Global South (Machi & McEvoy, 2009:4), by following a thematic analysis.

The concept of sustainable cities was firstly explored through a broad overview of urban planning and sustainable city planning paradigms. This overview comprised of urban models and strategic and policy frameworks from the formative years and the modernistic period, the emergence and development of the sustainable city planning paradigm and urban planning movements from the current, post-modernism period. Nature-based solutions were then considered as a possible solution in the quest towards sustainable city planning. Lastly, the unique considerations of planning in the Global South was considered in terms of nature-based solutions and the sustainability agenda.

### **1.5.2 Empirical study**

For the empirical study, both a qualitative and a quantitative research methodology was employed. As such, the empirical investigation was divided into two phases: 1) a best practice case study analysis (qualitative); and 2) a stakeholder analysis (quantitative).

For the best practice case study analysis, a qualitative research method was chosen as it aims to gain a higher understanding of how the sustainability agenda was practically employed to guide planning initiatives that addresses the current urban complexities (Gillham, 2000:10). Ten purposefully selected cities were considered, and theoretical sampling was employed for the identification of the best practices relating to sustainable city planning, based on the notion of nature-based solutions (Strydom & Delpont, 2011:392). The method of selection was fully explained in Chapter 5.

The quantitative method employed for phase 2 of the empirical investigation aimed to measure the perception on the sustainability agenda, nature-based solutions and the Global South amongst spatial and environmental experts (Delpont & Roestenburg, 2011:171). As such a survey amongst a convenience sample of 91 spatial professionals from both the Global North and the Global South was conducted by means of an e-questionnaire, distributed through online portals with participation being entirely voluntary and anonymous. The collected data was then statistically analysed and presented in Chapter 6.

## 1.6 Delineation of the study area

This research considered nature-based solutions for the Global South, as explained in the previous sections. The empirical investigation included cities and, spatial and environmental experts situated in Bangladesh, Belgium, Brazil, Canada, China, Cuba, Denmark, Ethiopia, Germany, Iran, Ireland, Mexico, New Zealand, Nigeria, Portugal, Romania, South Africa, South Korea, Spain, Sri Lanka, Swaziland, Sweden, the Netherlands, the United Kingdom, the United States of America and Zimbabwe, as illustrated in Figure 1.1.

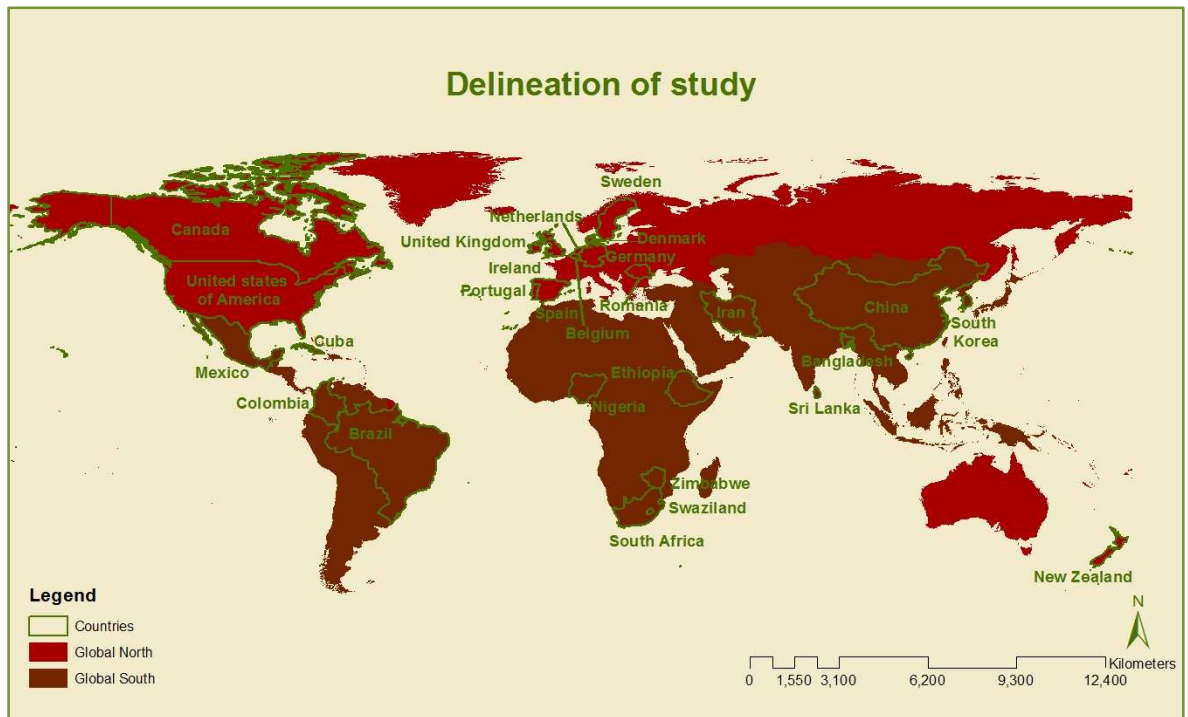


**Figure 1.1: Delineation of the study area**

**Source: Own construction (2018).**

It is evident from Figure 1.1 that the study area includes cities from across the globe, furthering the assumption that this study will generate a diverse perspective on planning for sustainable cities, nature-based solutions and Planning in the Global South.

## 1.7 Limitations of the research

This research focused on the spatial planning approaches linked to broader sustainable city planning practices, viewed from a nature-based solutions perspective. Sustainable city planning approaches entail various impacting factors (social, economic and environmental), but this study was limited to the impact and contribution of nature-based solutions to enhance broader urban

sustainability. The findings of this research contribute to the Urban and Regional Planning profession and guide the planning of future urban areas from a nature-based perspective.

## 1.8 Structure of the dissertation

Table 1.1 summarises the structure and content of the remainder of this dissertation and indicates which research question is addressed by each chapter.

**Table 1.1: The structure of the dissertation**

|                  |                                                                             |                                                                                                                                                                                                           |
|------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Literature study | Chapter 2: The planning of sustainable cities<br><i>Research question 1</i> | This chapter aims to provide an overview of the current and historic planning and sustainability paradigms and movements.                                                                                 |
|                  | Chapter 3: Nature-based solutions<br><i>Research question 2</i>             | This chapter explores the holistic concept of nature-based solutions as part of the sustainability agenda.                                                                                                |
|                  | Chapter 4: Perspectives from the Global South<br><i>Research question 3</i> | This chapter aims to contextualise the Global South as an area with unique considerations in terms of urban history and contemporary urban challenges and opportunities.                                  |
| Empirical study  | Chapter 5: Case study analysis<br><i>Research question 4</i>                | This chapter presents the results of a case study analysis of ten purposefully selected cities to find the practical methods employed towards achieving urban sustainability.                             |
|                  | Chapter 6: Expert analysis<br><i>Research question 4</i>                    | This chapter reflects on the perspectives regarding the sustainability agenda, nature-based solutions and planning in the Global South of 91 spatial and environmental experts from a convenience sample. |
| Concluding notes | Chapter 7: Conclusions<br><i>Research questions 1 to 4</i>                  | Conclusions are drawn, with regards to Global South perspectives of sustainable city planning through nature-based solutions.                                                                             |
|                  | Chapter 8: Recommendations<br><i>Primary research question</i>              | Recommendations are presented, based on the conclusions in Chapter 7.                                                                                                                                     |

Source: Own construction (2018).

## 1.9 Definitions

Table 1.2 contains important definitions of applicable terminology that was used in this research.

**Table 1.2: Glossary**

| <b>Term</b>                         | <b>Definition</b>                                                                                                                                                                                                         |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Economic sustainability</b>      | The ability of an economic system to satisfy present consumption levels without affecting the social and natural environment, negatively (Basiago, 1999:150)                                                              |
| <b>Ecosystem services</b>           | The contribution (i.e. provisioning services, regulating services, habitat and supporting services and cultural ecosystems) natural elements make to urban areas (Haase, 2016:278).                                       |
| <b>Environmental sustainability</b> | The ability for environmental systems to flourish in the midst of human activities (Cilliers, 2010:6).                                                                                                                    |
| <b>Green Infrastructure</b>         | A network of green spaces that provides benefits to society (Anguluri & Narayanan, 2017:59).                                                                                                                              |
| <b>Human well-being</b>             | An environment that adheres to the community's need for safety, health (Todaro & Smith, 2015:19), housing accessibility, recreational activities and provision for cultural and spiritual activities (Pacione, 2009:186). |
| <b>Informal economy</b>             | A useful, productive and necessary part of the economy but does not have formal systems, remuneration or control measurements (Pacione, 2009:679).                                                                        |
| <b>Natural capital</b>              | The parts of the natural system that provides financial and social benefits to society (Nesshöver <i>et al.</i> , 2017:1217-1219).                                                                                        |
| <b>Nature-based solutions</b>       | Solutions inspired by and using nature to address societal challenges by simultaneously providing economic, environmental and social benefits (Fan <i>et al.</i> , 2017:272).                                             |
| <b>Social sustainability</b>        | Social cohesion and social capital (Lategan, 2017:248).                                                                                                                                                                   |
| <b>Sustainable development</b>      | A state where economic development is in harmony with overall human well-being and takes place within the capacity of the natural environment (Robertson, 2012:3).                                                        |
| <b>Urban green</b>                  | All vegetation within an urban area (Lategan, 2017:294).                                                                                                                                                                  |
| <b>Urban sprawl</b>                 | Low density settlement patterns spreading around a growing city (Mörtberg <i>et al.</i> , 2017:338).                                                                                                                      |

Source: Own construction (2018) from Anguluri and Narayanan (2017:59), Basiago (1999:150), Cilliers (2010:6), Fan *et al.* (2017:272), Haase (2016:278), Lategan (2017:248-294), Mörtberg *et al.* (2017:338), Nesshöver *et al.* (2017:1217-1219), Pacione (2009:186-679), Robertson (2012:3) and Todaro and Smith (2015:19).

## 1.10 Acronyms

Table 1.3 contains acronyms used in this research.

**Table 1.3 : Acronyms**

|            |                                       |
|------------|---------------------------------------|
| <b>TND</b> | Traditional neighbourhood development |
| <b>UN</b>  | United Nations                        |

Source: Own construction (2017).

## CHAPTER 2: THE PLANNING OF SUSTAINABLE CITIES

### 2.1 Background

Urbanisation trends suggest an increased disconnect concerning socioeconomic well-being and the natural environment (Pili *et al.*, 2017:71-72). Such urban complexities have been prevailing since the 1800s (Bayulken & Huisingh, 2015a:11) that initiated the development of several models and theories in search of more liveable cities (Sharifi, 2016:2). These urban models displayed a thorough overview of the evolution of urban planning thinking, and the dominant, successive urban planning benchmarks throughout history (Long *et al.*, 2012:60). This provides insight into the current and historic formative processes that influence policy typologies for maintaining or improving cities (Angel & Blei, 2016:21; Xie & Gu, 2015:106) towards higher levels of sustainability.

This chapter investigated the evolution of urbanisation trends and paradigm shifts as summarised in Figure 2.1, to gain a holistic understanding of the sustainability approaches towards city planning during the indicated timeframe.

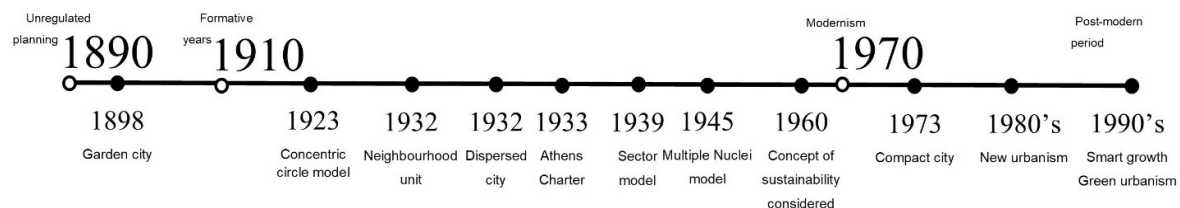


**Figure 2.1: The history of urban planning concepts**

**Source: Own construction (2018).**

The history and development of these planning concepts are discussed chronologically in this chapter, starting from the formative years (late 1800s to around 1910) and moving on to modernist period (around 1910 to about 1970) and concluding with the post-modernist period (around 1970 to present-day).

### 2.2 Formative years (late 1800s-c.1910)

The formalisation of city planning resulted from the challenges within the industrial city (Hall, 2014:5) with the radical and idealistic views of urban visionaries such as Ebenezer Howard aiming to combine the advantages of urban and rural living to create settlements that integrate different social groups (Sharifi, 2016:4-5). This period is mainly referred to as the formative years, dating from the late 1800s to about 1910 (Walters, 2007:20).

Howard proposed the garden city (Figure 2.2) in 1898 as a reaction to the living conditions at that time in London (Allmond, 2017:102). The purpose was to combine the benefits of town and country living (Lewis, 2015:153) using the ancient Greek concepts of 1) a natural growth limit for every organism and 2) fully equipped communities with all the necessary urban functions in place from the start (Mumford, 1961:515). Howard suggested six interdependent garden cities around a central city, connected through a rapid transport route (Bayulken & Huisingsh, 2015a). These garden cities would be self-supporting, spacious settlements (Fook & Gang, 2010:2) centred around a large circular garden (Allmond, 2017:102) and surrounded by a green belt for agricultural purposes and to prevent urban sprawl (Mumford, 1961:516).

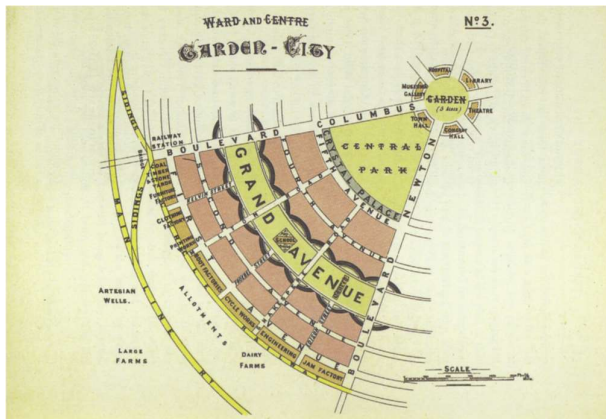


**Figure 2.2: The Garden city model**

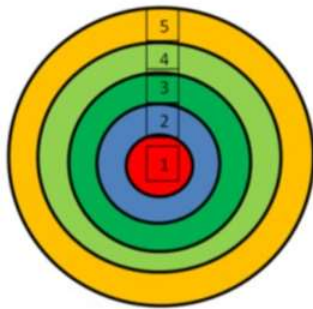
**Source: Allmond (2017:103).**

The Garden city model used urban greening in an attempt to address urban complexities with specific reference to human well-being and may consequently provide a valuable contribution regarding the implementation of nature-based solutions (as explored in Chapter 3) and the sustainability agenda (as explored in section 2.4).

### **2.3 Modernism (c.1910-c.1970)**

The modernist period dates from around 1910 to 1970 (Walters, 2007:20) and was based on the understanding at that time of the functioning of human societies (Le Normand, 2014:5).

In 1923, Ernest Burgess proposed the concentric circle regional structure model (Figure 2.3) (Yaguang, 2011:258), portraying an expanding city to form a sequence of concentric circles, each with a different function (Pekelharing, 2005:12). This paradigm was inspired by the Chicago school of human ecology's perspective of city planning being similar to the spatial configuration as observed in nature (Pacione, 2009:138). Such an expansion in concentric circles may, however, enhance urban sprawl.



1. Central business district
2. Zone of transition
3. Zone of workingmen homes
4. Commuters' zone

**Figure 2.3: Concentric circle model**

**Source: Le Roux (2008:17).**

The first regional plan of New York was published in 1929, introducing the neighbourhood unit as illustrated in Figure 2.4 (Mehaffy *et al.*, 2015:199). It was influenced to a large extent by the garden city model (Brody, 2013:341) and represents the ideal residential neighbourhood with facilities such as schools, churches and recreational spaces at its core. 10% of the land area used for urban green and commercial areas is situated within walking distance for all residents, without obliging them to cross a major arterial road (Lawhon, 2009:112).

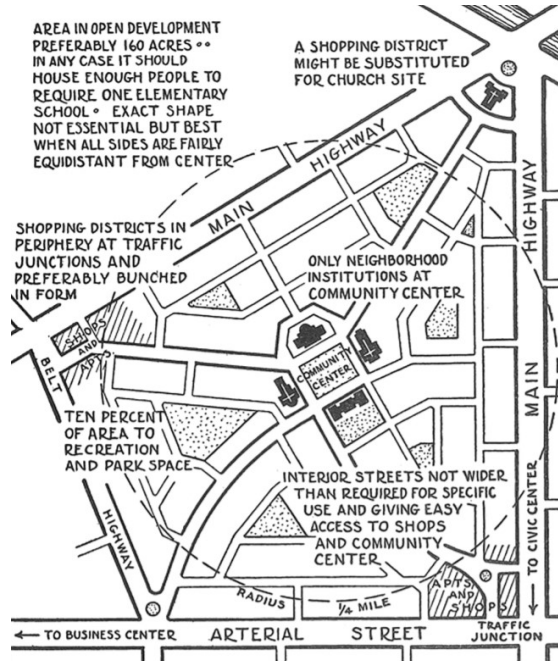


**Figure 2.4: The neighbourhood unit**

**Source: Sharifi (2016:6).**

The concentric circle model and neighbourhood unit depicts the city of the early 1900s as moving away from the traditional compact city with mixed land uses. This contributes to enhanced urban sprawl, that might provide insight into the formation of the current urban reality and complexities. Such levels of enhanced urban sprawl were further supported by the dispersed city paradigm as proposed by Frank Wright in 1932 (Lennon & Scott, 2016:272). Decentralisation was suggested in an emphasis on local economic sustainability (Milder, 2012:263), using recycled and reusable materials (Pacione, 2009:617). The aim was, similar to the garden city model, to reconnect urban dwellers to nature (Lennon & Scott, 2016:272). These modernistic models and paradigms were formalised in 1933 by the widely implemented Athens Charter, promoting an anti-urban approach based on a separation of urban functions and low densities (Lehmann, 2010b:67).

In 1939, Hoyt created the sector model (Barnum *et al.*, 2017:204), as illustrated in Figure 2.5, assuming 1) that the city will grow outwards from the central business district into geographically and socially different sectors, each with different land uses and 2) that the better-quality housing will continually move to the periphery of the city (Moroke, 2009:29-30), emphasising separation of urban function in correspondence to the Athens Charter.

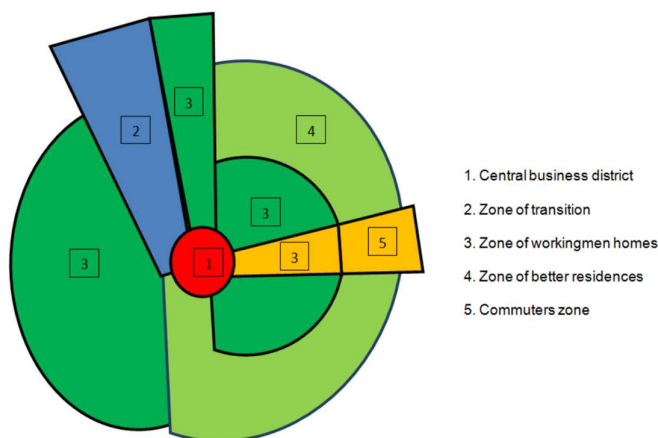


**Figure 2.5: Sector model**

**Source: Le Roux (2008:18).**

Harris and Ullman developed the multiple nuclei concept (Figure 2.6) in 1945 to describe urban areas as an ecological structure (Barnum *et al.*, 2017:204). This model illustrates that city growth does not occur around a single business district, but around separate growth points depending on local context (Pekelharing, 2005:14).

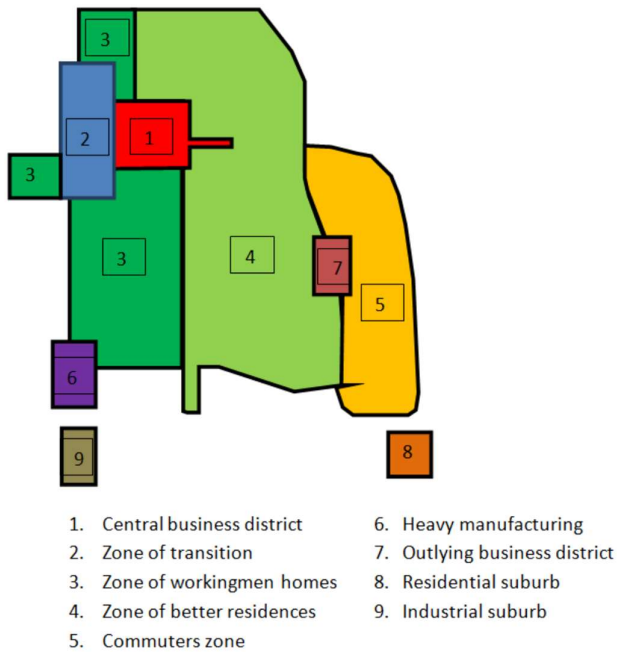


**Figure 2.6: The multiple nuclei model**

**Source: Le Roux (2015:19).**

The sector and multiple nuclei models indicate the development of the modernistic paradigm of decentralisation and separation of function, providing an understanding as to the origin of high levels of urban sprawl within the current urban reality. It is evident that the search towards social sustainability was highly prioritised within this period. This emphasises the importance of urban green and the working of natural systems being considered to explain the functioning of urban systems.

## 2.4 The sustainability agenda

The concept of sustainability as a solution to address current urban problems has been considered since the 1960s (Bayulken & Huisingsh, 2015a:12). Accordingly, such urban complexities were explored in order to gain a broader understanding of the importance of the sustainability agenda.

As explained in the previous section, new sub-centres formed on the edge of cities, attracting (especially) economic activities away from the traditional central business districts (Geneletti *et al.*, 2017:232; Pili *et al.*, 2017:71). This accelerating economic growth is centred around resource intensive processes and causes a depletion in human well-being (social inequality) and ecosystems (environmental decay) (Wu *et al.*, 2014:223), but poverty, inequality and slums continue to exist, despite such growth rates (Suzuki *et al.*, 2010:15). These challenges are further

enhanced by rapid urbanisation trends characterising most modern cities (Hu *et al.*, 2016:77; Robertson, 2012:1). Consequently, one of the key challenges is meeting the needs of the growing urban population while ensuring that the natural environment is protected, and that economic productivity and social inclusion are achieved (Klopp & Petretta, 2017:92).

The spatial form of modern cities has an aggravating impact on the greenhouse effect in that the high-rise buildings constrain air-flow, and high population densities and building materials produce artificial heat (Yaguang, 2011:260). This in turn affects the physical health conditions of community members, resulting in chronic diseases such as diabetes, obesity, gout and fatigue syndrome (Anguluri & Narayanan, 2017:58).

Environmental problems such as increased flooding, stormwater runoff and a decrease in water quality and existing vegetation (Liu *et al.*, 2014:730) affects the well-being of local communities (Villegas-Palacio *et al.*, 2016:297) and therefore also the level of social sustainability. Such challenges leave the urban poor in particular vulnerable, as the decreased water quality deprives them of suitable drinking water and the loss in vegetation leaves them dependant on financial means to meet their needs, rather than to cultivate or trade food produced themselves (Robertson, 2012:7-11). The demand on natural resources also tend to be much greater in urban areas than it is able to (physically) supply (Wu *et al.*, 2014:223) as a result of the accelerating culture of consumerism (Fink, 2016:255) and high urbanisation levels (Cilliers *et al.*, 2014:261). Such a demand results in environmental problems including water shortage and pollution, climate change and biodiversity loss (Fook & Gang, 2010:1).

Cities are, however, increasingly regarded as drivers for sustainable development rather than the source of unsustainability (Säynäjoki *et al.*, 2014:101) as it has the potential to provide valuable opportunities for social, economic and environmental development (Cilliers *et al.*, 2014:261). Such a shift towards sustainable city planning consequently resulted in various conferences, models and policy documents and was explored accordingly.

The United Nations held the first conference fully dedicated to the linkage between development and the environment (Conference on Human environment issues) in Stockholm in 1972 (Fu & Zhang, 2017:114). The Stockholm Declaration (five issue-specific resolutions and an action plan with recommendations) was agreed upon at the conference and numerous environmental protection agencies were established after the conference (Bayulken & Huisinigh, 2015a:16).

Sustainable development became a significant topic amongst academic discussions (Loni, 2016:7) after the Bruntland Commission published their report in 1987, titled *Our Common Future*.

The Bruntland Commission defined sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (United Nations, 1987) as illustrated in Figure 2.7. This diagram suggests that sustainable development is found in the linkage between the three spheres of sustainability, namely the environment, economy and society (O'Riordan *et al.*, 2001:15).

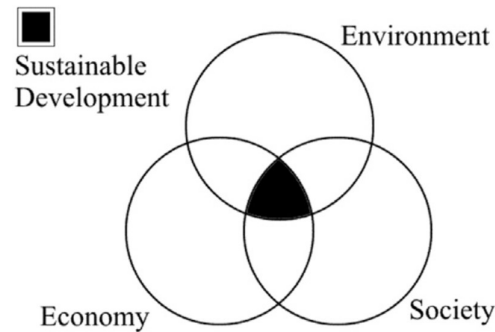


**Figure 2.7: Sustainable Societal Development**

**Source: Bayulken & Huisingh (2015a:16).**

In response to the Sustainable Societal Development model, the Russian Doll model (Figure 2.8) was conceptualised (Dixon, 2006:239). Sustainability is defined as an area where all economic activities are performed within the boundaries of social equity and enabled by the natural environment (Lombardi *et al.*, 2010:4) as it is believed that economic sustainability can only be achieved within a caring society and nurtured environment (O'Riordan, 2001:15).

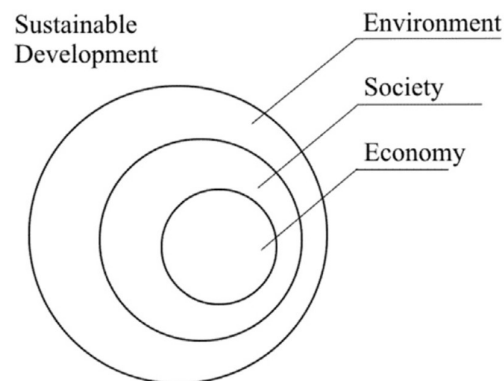


**Figure 2.8: The Russian Doll model**

**Source: Bayulken & Huisingh (2015a:17).**

The Cosmic Interdependence model (Figure 2.9) was constructed in 1996 and is similar to the Russian Doll model, but additionally suggests that all environmental, social and economic dimensions are interrelated and subject to secondary effects as a result of this interaction (Bayulken & Huisingh, 2015a:16).

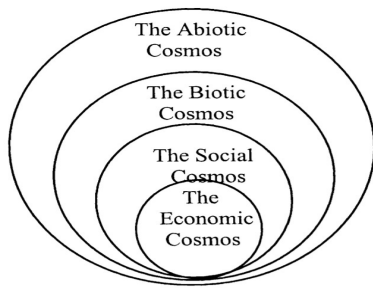


**Figure 2.9: The cosmic interdependence model**

**Source: Mebratu (1998:513).**

Following these conceptualisation efforts, a blueprint for sustainable development was constructed in the Agenda 21 document, compiled after the Earth Summit in 1992 (Loni, 2016:8) with the aim to manage global problems at a local level (Fook & Gang, 2010:3).

In 2000 the Millennium Development goals was constructed by 189 UN member states to be achieved by 2015 (Gaffey *et al.*, 2015:258) and accepted by 9 countries in Africa as a strategy for the reduction of poverty (Ani, 2016:70). These goals lead to numerous worldwide efforts to address social, economic and environmental issues but were not fully successful (Ani, 2016:70). The goals primarily focused on social sustainability, except for goal 7, that focussed on environmental sustainability (United Nations, 2000).

In 2015 the Sustainable Development goals (also known as Agenda 2030 (Loni, 2016:7) or the Sustainable Development agenda) were formulated in New York (Okonofua, 2016:10) by 189 governments (Ani, 2016:69) as successor to the Millennium Development goals (Mugagga & Nabaasa, 2016:216). This new set of goals is described as a wider approach with the aim to protect the planet, end poverty and to ensure prosperity for all while focusing on the interconnectedness of the social, economic and natural environment (Wysokińska, 2017:110). Goal number 11 is specifically directed at urban sustainability, aiming to 'make cities and human settlements inclusive, safe, resilient and sustainable' (United Nations, 2015:12).

The third UN-Habitat meeting was held in 2016, where a set of new goals for sustainability was constructed (Geneletti *et al.*, 2017:240) committing 'to fully harness the potential of sustainable urban development' (United Nations, 2016:5). The New Urban Agenda (constructed during this meeting) is 'grounded in the integrated dimensions of sustainable development', namely the economic, environmental and social components (United Nations, 2016:5). This Agenda specifically commits to 1) sustainable urban development for social inclusion and ending poverty,

2) sustainable and inclusive urban prosperity and opportunities for all and 3) environmental sustainability and resilient urban development (United Nations, 2016:5-9).

Urban sustainability may consequently be defined as a process where the cycle between human well-being and ecosystems are maintained through the interconnected environmental, social and economic processes in response to urban changes (Barroso *et al.*, 2016:1400). Despite these efforts to conceptualise urban sustainability, urban deterioration is still prevailing (Robertson, 2012:4) that stresses the need for approaches to achieve such goals of planning for urban sustainability. As such, post-urbanism emerged, and new spatial structures have been proposed, incorporating principles including the concept of compact, mixed use, walkable cities with less infrastructure costs, pollution and uncontrolled growth than lower density developments (Pili *et al.*, 2017:71), as will be explained accordingly.

## **2.5 Post-modernism (c.1970 – present)**

The post-modern period (1970s to present) is characterised by environmental concerns (Walters, 2007:21) and a focus on localisation (Dear, 2001:11856). Post-modern urbanism could be described as a rediscovery of the historical compact European city (Lehmann, 2010b:74). Within this period, various movements evolved using principles from earlier urban models to achieve sustainable city planning, namely the compact city model (Bibri & Krogsite, 2017:459), a historic preservation movement (Neo-traditionalism) and an environmental movement (Eco-urbanism) (Song *et al.*, 2017:128). These movements were explored, accordingly.

### **2.5.1 The compact city model**

The compact city was first proposed by Dantzing and Saary in 1973 (Bibri & Krogstie, 2017:459) and is widely viewed as the most effective city model towards sustainable city planning (Säynäjoki *et al.*, 2014:101). The aim of this model is to create social, economic and environmental sustainability (Bardhan *et al.*, 2014:56). This is achieved by 1) enhancing human well-being through increased social interaction and reduced environmental pollution (implementing mixed transportation modes), 2) attaining economic well-being by increased connectedness between areas (Bardhan *et al.*, 2014:56), and 3) improving environmental sustainability by reducing soil consumption for the protection of natural resources (Fatone *et al.*, 2012:217). Bibri & Krogsite (2017:460) list 14 principles of the compact city, as follows in Table 2.1.

**Table 2.1: Principles of the compact city**

| <b>Principles of the compact city</b> |                                                                                 |
|---------------------------------------|---------------------------------------------------------------------------------|
| 1)                                    | High residential and employment densities                                       |
| 2)                                    | Mixed-land use                                                                  |
| 3)                                    | Fine grain of land uses                                                         |
| 4)                                    | Increased social and economic interactions                                      |
| 5)                                    | Contiguous development                                                          |
| 6)                                    | Contained urban development (demarcated urban limits)                           |
| 7)                                    | Urban infrastructure                                                            |
| 8)                                    | Mixed-use transportation modes                                                  |
| 9)                                    | High levels of accessibility                                                    |
| 10)                                   | High levels of street connectivity                                              |
| 11)                                   | High levels of impervious surfaces                                              |
| 12)                                   | Low open space ratio                                                            |
| 13)                                   | Controlled land use                                                             |
| 14)                                   | Sufficient governmental capacity to finance urban facilities and infrastructure |

**Source: Bibri & Krogsite (2017:460).**

It is apparent that this model seeks to enhance the sustainability model and such a compact urban form may prove insightful as to how the environmental sphere of sustainable city planning is approached.

### **2.5.2 Neo-traditionalism**

New urbanism is the most commonly known neo-traditional approach, developed in the 1980s (Murry, 2013:122) in response to the prevailing urban complexities of declining inner cities, urban sprawl, high crime rates, social segregation, poverty and inequality (Sharifi, 2016:7). The new urbanism movement emphasises the enhancement of local human well-being by changing the physical appearance of the urban environment (Jepson & Edwards, 2010:419-420). Such an emphasis on human well-being creates a sensitivity towards the various cultural traditions and lifestyles (local context) within an urban area (Beauregard, 2002:188). The paradigm attempts to emulate the traditional American neighbourhoods (Sharifi, 2016:7) striving to create urban areas characterised by principles of mixed use, mixed transportation modes, walkability, sense of place (MacLeod, 2013:2197) and compact, close-knit communities (Katz, 1994:ix) to integrate the natural and urban environment into a sustainable whole (Duany & Plater-Zyberk, 1994:xx).

The work of Andres Duany and Elizabeth Plater-Zyberk (traditional neighbourhood development (TND)) (Figure 2.10), and Peter Calthorpe (transit-oriented development) (Figure 2.11) are generally regarded as the pioneers for the new urbanism movement as explored accordingly.

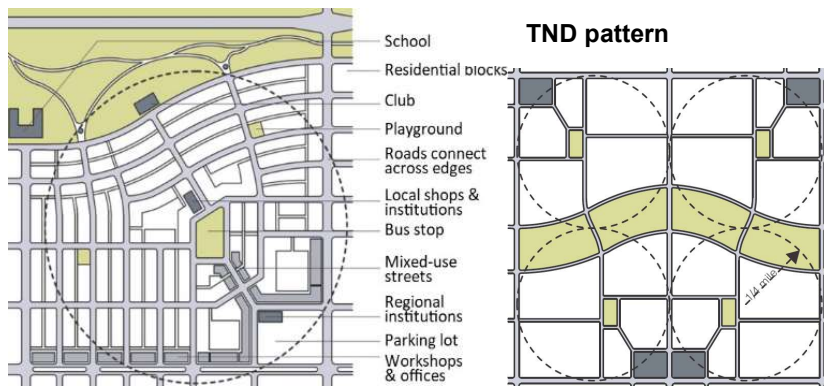


**Figure 2.10: Traditional neighbourhood development**

**Source:** Duany *et al.* (2014) and Sharifi (2016:9).

The traditional neighbourhood development model, as illustrated in Figure 2.10, incorporates the Garden city model (Song *et al.*, 2017:128) and the neighborhood unit (Kwon, 2015:248) to recreate an urban sense of community (Kwon, 2015:249) and the TND pattern illustrates the morphology of new urbanist cities consisting of polycentric metropolises composed of the identifiable neighbourhoods (Plater-Zyberk & Donnelly, 2010:551). This model aims to plan the city environment according to human needs with mixed-uses where everyday facilities are located within a five-minute walk and the number of residents is restricted to 5000 people with a goal of 3000 job opportunities (Kwon, 2015:249).

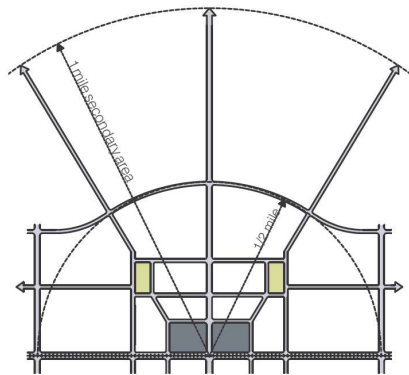


**Figure 2.11: The transit-oriented development**

**Source:** Duany *et al.* (2014).

Figure 2.11 illustrates the transit-oriented development model as is a pedestrian shed, centred upon a rail transit station (Duany *et al.*, 2014) that aims to channel urban growth into discrete nodes along different transport networks (Bressi, 1994:xxv), emphasising mixed-use areas within walking distance between a transit stop and commercial area (Calthorpe, 1993:56).

In the mid 1990s the Congress for new urbanism strategically aligned with the US Environmental Protection Agency and framed the first smart growth policies (Song *et al.*, 2017:129). These policies differ from new urbanism in focus; where new urbanism focuses on design principles for the creation of local neighbourhoods, smart growth policies focus on preventing urban sprawl and on regional planning (Mangara, 2016:33). These two approaches do, however, also have similar principles; smart growths being mixed land uses, compact design, walkability, the creation of a sense of place, the preservation of natural urban elements, mixed transportation modes, economically viable development and public transportation (Mangara, 2016:33-35).

New urbanism and smart growth have a holistic approach towards urban planning and incorporates the three urban sustainability spheres of the social, economic and natural environment (cross-reference to section 2.4). As it focuses on incorporating urban green, it might prove valuable as to the nature-based solutions approach and the sustainability agenda.

### **2.5.3 Eco-urbanism**

Eco-urbanism is an overarching term referring to various movements incorporating natural elements in the quest to achieve sustainable city planning (Sharifi, 2016:10). These (urban design) initiatives are believed to have first been proposed by the UN in 1971 and in 1987, with the concept of eco-cities being coined by Richard Register (Lehmann, 2010b:75). It is also based on the early modernistic approach to incorporate nature within city planning (Hu *et al.*, 2016:77). These cities are planned according to ecological principles, aiming to achieve a simultaneous economic, environmental and social sustainability (Yang *et al.*, 2016:27-28) with principles of mixed use, compact cities on human scale (Joss *et al.*, 2013:55). The cities are used as testing grounds for academics, urban planners and policy makers for the establishment of methods to achieve sustainable cities (Bayulken & Huisinigh, 2015b:154).

In the 1990s the more holistic concept of green urbanism emerged (Lehmann, 2010a:1), with the focus to balance the relationship between the urban and natural environment (Viviers *et al.*, 2017:79). This movement places an emphasis on the role of cities within the creation of a sustainable urban environment and strives to 1) stay within the ecological limits of the city, 2) function analogous to nature and 3) utilise local social, economic and environmental resources for achieving sustainable city planning (Beatley, 2000:5-7). Lehmann (2010b:86;212-213) proposed 15 principles for green urbanism and elaborate further on the holistic nature of green urbanism in a diagram, as presented in Table 2.2.

**Table 2.2: Exploring green urbanism**

| <b>15 Principles of green urbanism</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                            |                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 1) Local context consideration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2) Self-sufficient energy producer                                         | 3) Zero-waste city                                                               |
| 4) Closed urban water management and high water quality                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 5) Maximises urban biodiversity                                            | 6) Efficient low-impact urban transportation system                              |
| 7) Usage of regional materials for city construction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 8) Densification of urban areas                                            | 9) Green building design and solar access                                        |
| 10) Affordable housing and mixed land uses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 11) Local urban food supply and high levels of food security               | 12) High levels of public health and cultural identity                           |
| 13) Sustainable urban procurement methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 14) High levels of education and training in sustainable urban development | 15) Particular sustainability strategies for developing countries (Global South) |
| <b>The holistic nature of green urbanism</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                            |                                                                                  |
| <p><b>GREEN URBANISM</b></p> <ul style="list-style-type: none"> <li><b>ENERGY and MATERIALS</b> <ul style="list-style-type: none"> <li>• Embodied energy</li> <li>• Material specification</li> <li>• Supply chain</li> <li>• Renewable energy solutions</li> <li>• Energy sources and consumption</li> <li>• Construction systems</li> <li>• Prefabrication and recycling</li> <li>• Energy efficiency</li> <li>• Resource management</li> </ul> </li> <li><b>WATER and BIODIVERSITY</b> <ul style="list-style-type: none"> <li>• Urban water management</li> <li>• Water recycling and irrigation</li> <li>• Urban Farming</li> <li>• Urban landscape typologies</li> <li>• Ecosystems' biodiversity maximized</li> <li>• Grey water recycling</li> <li>• Storage of urban stormwater</li> <li>• Climate change impact management</li> <li>• Waste management</li> </ul> </li> <li><b>URBAN PLANNING and TRANSPORT</b> <ul style="list-style-type: none"> <li>• Urban design</li> <li>• Social sustainability</li> <li>• Ecological city theory</li> <li>• Health and walkability</li> <li>• Mobility, public Transport</li> <li>• Infrastructure</li> <li>• Energy efficient buildings</li> <li>• Mixed land use</li> <li>• Housing affordability</li> <li>• Reducing car dependency</li> <li>• Subdivisions</li> </ul> </li> </ul> <p>Interaction between three main pillars</p> |                                                                            |                                                                                  |

Source: Own construction (2017) from Lehmann (2010b:86; 212-213).

Eco-urbanism was perceived as an approach that seeks to utilise the benefits from the natural environment in order to create a sustainable urban environment and may therefore contribute to the search for sustainable planning practices and nature-based solutions (as explored in the following chapter).

## 2.6 Discussion on the sustainability agenda

It is evident from the discussion in the previous sections that there was an urgent need to address the prevailing urban complexities of socioeconomic and environmental decline. As such, the concept of sustainable city planning emerged, followed by various urban movements in the post-modern period, as summarised in Figure 2.1.

Table 2.3 lists the important efforts aimed at conceptualising the concept of urban sustainability from the first conference fully dedicated to the linkage between development and the natural environment hosted by the United Nations in 1972.

**Table 2.3: The evolution of the urban sustainability agenda**

|   | Initiative                    | Focus                                                              | Contribution to sustainable city planning                                                                                                                                                                     |
|---|-------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Stockholm declaration         | Human environment issues                                           | Five issue-specific resolutions and an action plan was compiled, followed by the establishment of various environmental agencies.                                                                             |
| 2 | Our common future             | Defining sustainable development                                   | The still commonly referred to definition of sustainable development coined as development that meets the needs of the present without compromising on the ability of future generations to meet their needs. |
| 3 | Russian doll model            | Defining sustainable development                                   | Sustainable development was defined in more spatial terms as an area where all economic activities are performed within the boundaries of social equity and enabled by the natural environment.               |
| 4 | Cosmic interdependence model  | Defining sustainable development                                   | This model builds on the Russian doll model by adding that all environmental, social and economic dimensions are interrelated and subject to secondary effects as a result of this interaction.               |
| 5 | Agenda 21                     | Context-based planning                                             | A blueprint for sustainable development was compiled.                                                                                                                                                         |
| 6 | Millennium development goals  | Poverty reduction                                                  | Goals were listed to assist in the achievement of social and environmental sustainability.                                                                                                                    |
| 7 | Sustainable Development goals | Interconnectedness of the economic, social and natural environment | A new set of goals was agreed upon for environmental protection and socioeconomic development, with goal 11 specifically aimed at achieving urban sustainability.                                             |
| 8 | New Urban Agenda              | Sustainable urban development                                      | The document commits to socially inclusive urban planning, efforts to eradicate poverty, access to sustainable urban opportunities and environmental sustainability.                                          |

**Source: Own construction (2018).**

It is evident from Table 2.3 that the efforts to achieve sustainable city planning was at first a vague concept and did not entirely combine all three spheres of sustainability (cross-reference to section 2.4), but later developed into a holistic concept incorporating all three spheres

simultaneously and defined by spatial considerations. From these efforts to promote sustainable city planning, various movements begun and is listed in Table 2.4.

**Table 2.4: Urban movements and the urban sustainability agenda**

| <b>Movement</b>    | <b>Focus</b>                                                         | <b>Contribution to sustainable city planning</b>                                                                                                                                                                                                                                |
|--------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compact city model | Social, economic and environmental sustainability                    | This movement aims to create urban sustainability by encouraging an increase in social interaction, decreasing environmental pollution, connecting different areas within the city and reducing soil consumption. This is mainly achieved by high densities and mixed-land use. |
| New urbanism       | Enhancing local human well-being                                     | Human well-being is enhanced by changing the physical appearance of the city to a mixed use, walkable city, characterised by a sense of place, mixed transportation modes and close-knit communities.                                                                           |
| Smart growth       | Preventing urban sprawl and regional planning                        | This movement builds on new urbanism by additionally encouraging the preservation of urban green and economically viable development.                                                                                                                                           |
| Eco-city           | Simultaneous social, economic and environmental sustainability       | These cities are planned according to ecological principles, encouraging mixed-land use, compact cities on human scale.                                                                                                                                                         |
| Green urbanism     | Balancing the relationship between the urban and natural environment | This is a holistic concept aiming to reduce urban sprawl, function analogous to nature and utilise local economic, environmental and social resources                                                                                                                           |

**Source: Own construction (2018).**

From Table 2.4 it is apparent that these post-modernist movements mostly focus on the linkage between the socioeconomic and natural environment and aim to achieve sustainable city planning by creating a space where the benefits from such a linkage could be fully utilised. Most of these movements incorporates principles such as context-based planning, mixed-land use and walkability.

## **2.7 Conclusion**

A search for approaches to create a more liveable city has been ongoing since the late 1800s, during the formative years of urban planning, when the first attempts to reconcile the human and natural environment started. During the modernism period it was evident that there was a higher focus on resolving social problems than on the natural environment, as the urban theories, models and plans generally encouraged a movement away from the economic centres to quiet, residential areas. This resulted in high levels of urban sprawl while urban challenges such as social inequality, poverty, slums, poor health conditions, increased flooding, high levels of stormwater runoff, pollution and a decrease in water quality and in urban green, prevailed.

Consequently, the concept of sustainable city planning emerged and was developed into a notion defined as a process where human well-being and urban ecosystems are maintained through the interconnected environmental, social and economic processes in response to urban changes. As such, various movements emerged focusing on this linkage between the social, economic and natural environment, aiming to create urban sustainability by encouraging the implementation of principles such as context-based planning, mixed-land use and walkability.

Despite all these efforts to plan for sustainable cities, urban deterioration prevails and therefore stresses the need for approaches to address such urban complexities. The concept of nature-based solutions was therefore explored in the following section as a possible method to achieve sustainable city planning.

## CHAPTER 3: NATURE-BASED SOLUTIONS

### 3.1 Introduction

In Chapter 2 it was argued that the increasingly urbanised world results in various urban challenges, including high levels of urbanisation and environmental degradation. The solution to these challenges may, however, possibly be found within urban boundaries. Thus, research on new innovations to address urban challenges is of vital importance. Armstrong and Ali (2012:12) underlines that a possible solution to these urban problems has been recognised in concepts based on natural systems. Within these nature-based concepts, the same element in the city may at times simultaneously benefit the social, economic and environmental dimensions of sustainability (Villegas-Palacio *et al.*, 2016:306) and could therefore prove a valuable asset in the planning of sustainable cities. This led to a paradigm shift in recent years from the notion of economic growth and environmental conservation being two separate concepts towards a belief that a linkage does exist (Clabby, 2016:290). Some even argues that the two concepts cannot be separated (Villegas-Palacio *et al.*, 2016:306).

This chapter therefore explored the concept and implementation of nature-based solutions in the quest to integrate the social, economic and environmental aspects of urban areas in order to plan for a sustainable city.

### 3.2 The concept of nature-based solutions

Nature-based solutions could be described as an umbrella concept for initiatives mimicking or adapting to the multi-functional working of natural systems, utilising the benefits of nature to the advantage of human well-being (Nesshöver *et al.*, 2017:1217-1224). Conceptually, nature-based solutions place the social, economic and environmental dimensions of the city all on an equal level of significance (Fink, 2016:257), creating a linkage between the three elements of sustainable planning (Nesshöver *et al.*, 2017:1220), and in this sense might be considered as a practical method to implement the cosmic interdependence model discussed in Chapter 2.

There is a growing amount of literature that explore the benefits derived from urban green and ultimately from nature-based solutions (Hoyle *et al.*, 2017). These general benefits of urban green are listed accordingly in Table 3.1.

**Table 3.1: The sustainability agenda**

| <b>General benefits of urban green</b>                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Economic benefits</b>                                                                                                                                                                                                                                                                                                                                                                                    | <b>Environmental benefits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Social benefits</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <ul style="list-style-type: none"> <li>• Increased inward investment (Cilliers &amp; Cilliers, 2016:16)</li> <li>• Higher levels of employment (Xing <i>et al.</i>, 2017:156)</li> <li>• Higher property values (Worrall &amp; Little, 2011:570)</li> <li>• Enhanced attention span (Matsuoka &amp; Sullivan, 2011:409)</li> <li>• Enhanced workplace satisfaction (Reeve <i>et al.</i>, 2015:5)</li> </ul> | <ul style="list-style-type: none"> <li>• Conserving nature (Xing <i>et al.</i>, 2017:155)</li> <li>• Habitat provision (Xing <i>et al.</i>, 2017:155)</li> <li>• Increased biodiversity (Niemann &amp; Schädler, 2012:43)</li> <li>• Better microclimate (Niemann &amp; Schädler, 2012:43)</li> <li>• Decreased levels of pollution (Fan <i>et al.</i>, 2017:273)</li> <li>• Decrease in urban heat island effect (Cilliers &amp; Cilliers, 2016:170)</li> <li>• Cooling effect (Fink, 2016:259)</li> </ul> | <ul style="list-style-type: none"> <li>• Higher levels of personal health (Fink, 2016:260-162): <ul style="list-style-type: none"> <li>- Reduced stress levels</li> <li>- Enhanced physiological health levels</li> <li>- Heightened mental capacities</li> <li>- Increased levels of nutrition (Xing <i>et al.</i>, 2017:155)</li> </ul> </li> <li>• Decreased levels of violence (Matsuoka &amp; Sullivan, 2011:411)</li> <li>• Assimilation of positive values and moral attitudes (Cilliers &amp; Cilliers, 2016:22)</li> <li>• Decrease in crime rates (Reeve <i>et al.</i>, 2015:5)</li> <li>• Beautification of the city (Niemann &amp; Schädler, 2012:43)</li> <li>• Increased sense of peace and quiet (Matsuoka &amp; Sullivan:411)</li> </ul> |

**Source:** Own construction (2017) from Cilliers and Cilliers (2016:16-170), Fan *et al.* (2017:273), Fink (2016:259-262), Matsuoka and Sullivan (2011:409-411), Niemann and Schädler (2012:43), Reeve *et al.* (2015:5), Worrall and Little (2011:570) and Xing *et al.* (2017:155-156).

From Table 3.1 it is evident that urban green generally provides various and important benefits to the advantage of the social, economic and environmental dimensions of a city and its local community and may therefore provide considerable advantages for the planning of sustainable cities.

It is however important to explore the different initiatives for the integration of such natural elements into the urban context. Scott & Lennon (2016:268) explain that there are four interrelated goals regarding sustainable city planning when implementing these nature-based initiatives, namely 1) the enhancement of sustainable urbanisation, 2) the restoration of the functionality of ecosystem services, 3) the development of climate change adaption and mitigation and 4) the improvement of risk management.

Consequently, various green typologies were explored and listed in Table 3.2, as practical initiatives that form part of the holistic concept of nature-based solutions. A list of each initiative's individual social, economic and environmental benefits was also included to elaborate on the typologies.

**Table 3.2: The benefits of specific nature-based initiatives**

| <b>Nature-based solutions</b>                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Nature-based solution</b>                                                                                                                                       | <b>Context-specific benefit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Vegetation around buildings</b><br>(De Roo, 2011:78)                                                                                                            | <b>Environmental benefits:</b><br>a) Reduced energy demand (De Roo, 2011:79)<br>b) Reduced air conditioning use (De Roo, 2011:79)<br>c) Improved indoor ventilation (De Roo, 2011:79)<br>d) Reduced stormwater runoff (Reeve <i>et al.</i> , 2015:7)                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Green roofs</b><br><br>Gardens on the rooftops of buildings, either in pots or rolled out carpets filled with compost and soil (Xing <i>et al.</i> , 2017:158). | <b>Economic benefits:</b><br>a) Life of roof approximately 20 years longer (De Roo, 2011:83)<br>b) Government financial savings in preventing and controlling pollution and lower stormwater runoff control cost (Cilliers & Cilliers, 2016:16)<br><br><b>Environmental benefits:</b><br>a) Decreased urban flooding (Fink, 2016:259)<br>b) Building insolation (De Roo, 2011:83)<br>c) Rooftop retention for decreased stormwater runoff (Worrall & Little, 2011:569)<br>d) Reduce building's energy demand (Reeve <i>et al.</i> , 2015:7)<br>e) Increased roof longevity (Reeve <i>et al.</i> , 2015:7)<br><br><b>Social benefit:</b><br>Recreational space (Xing <i>et al.</i> , 2017:158) |
| <b>Green walls</b><br><br>Vegetated façades (Van Bohemen, 2012:62).                                                                                                | <b>Environmental benefit:</b><br>Reduce building's energy demand (Reeve <i>et al.</i> , 2015:7)<br><br><b>Social benefit:</b><br>Serves as a natural sound buffer (Xing <i>et al.</i> , 2017:156-157)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Indoor plants</b><br><br>Potted plants and indoor vertical greenery (Xing <i>et al.</i> , 2017:157).                                                            | <b>Social benefit:</b><br>As people mostly spend their time indoors (Xing <i>et al.</i> , 2017:157), this provides an opportunity for them to experience the health and insulation benefits provided by urban green (De Roo, 2011:87)                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Street trees</b><br><br>'Individual trees planted along streets or in gardens abutting onto streets.' (Dawe, 2011:424).                                         | <b>Economic benefit:</b><br>Increased property value (Dawe, 2011:435)<br><br><b>Environmental benefits:</b><br>a) Decreased urban flooding (Fink, 2016:259)<br>b) Decreased stormwater runoff (Dawe, 2011:426)<br>c) Decreased erosion levels (Llausàs & Roe, 2012:648)<br>d) Decreased wind speeds (Wright, 2011:1008)<br><br><b>Social benefits:</b><br>a) Serves as a natural sound buffer (Xing <i>et al.</i> , 2017:156-157)<br>b) Reduced driver stress (Reeve <i>et al.</i> , 2015:7)                                                                                                                                                                                                  |
| <b>Permeable surfaces</b><br><br>Pervious surfaces such as green roofs as alternative to traditional concrete materials (Tourbier, 2011:572).                      | <b>Economic benefit:</b><br>Government financial savings in preventing and controlling pollution and lower stormwater control cost (Cilliers & Cilliers, 2016:16)<br><br><b>Environmental benefits:</b><br>a) Decreased urban flooding (Fink, 2016:259).<br>b) Decreased erosion levels (Llausàs & Roe, 2012:648).                                                                                                                                                                                                                                                                                                                                                                            |

| Nature-based solutions                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nature-based solution                                                                                                                                                 | Context-specific benefit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Rain Gardens</b><br>A 'low-impact development designed to collect and partially treat nonpoint-source stormwater runoff in urban areas' (Strong & Hudak, 2015:64). | <b>Economic benefit:</b><br>Government financial savings in preventing and controlling pollution and lower stormwater control cost (Cilliers & Cilliers, 2016:16)<br><b>Environmental benefits:</b><br>a) Decreased urban flooding (Fink, 2016:259)<br>b) Decreased erosion levels (Llausàs & Roe, 2012:648)                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Urban agriculture</b><br>Farming within urban boundaries on garden plots, walls and rooftops or indoors (Xing <i>et al.</i> , 2017:155).                           | <b>Economic benefits:</b><br>a) This could serve as an extra source of income, decreasing poverty (Robbertson, 2012:6-7)<br>b) Household financial savings (Robbertson, 2012:6-7)<br>c) Increase food security (Robbertson, 2012:6-7)<br>d) Government financial savings in preventing and controlling pollution and lower stormwater control cost (Cilliers & Cilliers, 2016:16)<br><b>Environmental benefits:</b><br>a) Decreased urban flooding (Fink, 2016:259)<br>b) Decreased erosion levels (Llausàs & Roe, 2012:648)<br><b>Social benefit:</b><br>Educational opportunity for children to learn where food comes from (De Roo, 2011:47)                                                                            |
| <b>Urban parks</b> (Anguluri & Narayanan, 2017:59)                                                                                                                    | <b>Economic benefit:</b><br>Government financial savings in preventing and controlling pollution and lower stormwater control cost (Cilliers & Cilliers, 2016:16)<br><b>Environmental benefits:</b><br>a) Decreased urban flooding (Fink, 2016:259)<br>b) Decreased erosion levels (Llausàs & Roe, 2012:648)<br><b>Social benefits:</b><br>a) Recreational space (Xing <i>et al.</i> , 2017:158)<br>b) Increase in personal health levels, as this provides a space for people to be physically active (Tilt, 2011:395)<br>c) Increase levels of community cohesion (Cilliers & Cilliers, 2016:17), as it creates a safe space for different ethnic and socioeconomic groups to engage (Xing <i>et al.</i> , 2017:156-157) |

**Source:** Own construction (2017) from Anguluri and Narayanan (2017:59), Cilliers and Cilliers (2016:16-17), De Roo (2011:47-87), Fink (2016:259), Dawe (2011:435-426), Llausàs and Roe (2012:648), Reeve *et al.* (2015:7), Robertson (2012:6-7), Strong and Hudak (2015:64), Tilt (2011:395), Tourbier (2011:572), Van Bohemen (2012:62), Worrall and Little (2011:569), Wright (2011:1008) and Xing *et al.* (2017:156-158).

From Table 3.2 it is evident that nature-based initiatives do provide possible solutions to the issues of urban sustainability. Various methods for the implementation of these nature-based solutions exist, namely 1) vacant buildings and wastelands being utilised for implementation purposes (Niemann & Schädler, 2012:45), 2) green walls being created through the traditional climber plants using the façade material to support growth against the wall or through hanging

pots and 3) green roofs being used for various purposes such as urban agriculture and recreational spaces (Xing *et al.*, 2017:158).

Lehmann (2010b:80-81) proposes the following urban planning concepts for the implementation of such green initiatives: 1) mixed land uses, 2) higher levels of public transport, 3) pedestrian friendly urban layouts, 4) compact land uses, allowing space for green public spaces, 5) the implementation of Green Infrastructure, 6) decentralised power, water and waste systems, 7) initiatives to reduce the urban footprint, 8) renewable energy initiatives and 9) development on previously developed land areas. These implementation methods could be described as representative of the holistic nature of nature-based solutions, as the focus is not only on the environment but on the city as a whole.

Challenges towards the implementation of these nature-based solutions were explored in the following section.

### **3.3 The challenges of the implementation of nature-based solutions**

Nature-based solutions are usually well supported by local and international policy, but a gap exists between knowledge and the implementation thereof (Horwood, 2011:964). Accordingly, implementation is often hindered by budget constraints, a lack in the availability of human resources (Cilliers & Cilliers, 2015:2), a need for experienced workforce (Jacobs, 2015:111), a perception of high maintenance costs (Schilling & Logan, 2008:455), a belief regarding urban green being a luxury and a confusion as to the responsible party for environmental management within and between local and national authorities (Cilliers & Cilliers, 2016:22). A major challenge could therefore be perceived concerning the governing authority's application of existing policy.

Nesshöver *et al.* (2017:1224) suggests that nature-based solutions should be implemented in a transdisciplinary manner. Without thorough facilitation, this might develop into a challenge, as conflict situations between professionals from the different disciplines could result due to different paradigms being supported or a difference in belief in the desirable process of implementation may occur (Cilliers *et al.*, 2011:580).

The social perception of urban green may also provide possible challenges as a result of the consumer power of the community (Säynäjoki *et al.*, 2014:102). Research indicates, for example, that many people perceive long vegetation as untidy (Hoyle *et al.*, 2017:143) and that the neatness of an area is more important to most people than achieving sustainability (Bertram & Rehdanz, 2015:196) that ultimately influence the economic viability of an area.

The above-mentioned possible challenges are mostly administrative by nature and may be overcome by proper delineation of roles within the implementation process, through planning and public participation.

### 3.4 Discussion on nature-based solutions as part of the urban sustainability agenda

The sustainability agenda (as explored in Chapter 2) gained importance in reaction to the prevailing urban challenges of increasing urban sprawl, social inequality, slums, poor health conditions, increased flooding and stormwater runoff and a decrease in water quality and urban green. It was found that in order to address these urban complexities the benefits derived from the linkage between the socioeconomic and natural environment should be fully utilised.

Consequently, nature-based solutions were suggested as a possible method to enhance sustainable city planning as these initiatives create a linkage between the social, economic and natural environment. From Tables 3.1 and 3.2 this linkage is evident, as the three dimensions of sustainable city planning are portrayed to be simultaneously benefited. A linkage could be observed between the implementation goals and concepts of nature-based solutions, as listed in the previous sections and the post-modern movements (described in Chapter 2). This linkage was further explored in Table 3.3.

**Table 3.3: The linkage between nature-based solutions and the urban sustainability agenda**

| Sustainability agenda goals                                                                                         | Sustainability agenda movement                                                           | The linkage between nature-based solutions (Table 3.2) and the urban sustainability agenda                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Climate change mitigation initiatives                                                                               | Eco-cities<br>Compact city model<br>Green urbanism<br>Smart growth<br><br>Green urbanism | Nature-based solutions such as green roofs, green walls and indoor plants offer methods to increase urban green (and therefore assist in climate change mitigation, as explained in Table 3.1) while adhering to the principle of low open space ratio as supported by the movements of the compact city model, smart growth and eco-cities (refer to Chapter 2).<br><br>The initiatives of vegetation around buildings, green roofs, green walls, street trees, rain gardens, urban agriculture and urban parks links with the principle of green urbanism to maximise urban biodiversity (refer to Table 2.2) while assisting in climate change mitigation. Such initiatives increase the level of urban green (refer to Table 3.1). |
| Restoration of ecosystem services<br><br><i>Refer to Table 1.2 for a definition of the term ecosystem services.</i> | Compact city model                                                                       | In Table 2.1, principle 11 indicates that the compact city supports an increased amount of permeable surfaces that is also listed as one of the nature-based solutions in Table 3.2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| <b>Sustainability agenda goals</b>                 | <b>Sustainability agenda movement</b> | <b>The linkage between nature-based solutions (Table 3.2) and the urban sustainability agenda</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Restoration of ecosystem services continued</i> | Green urbanism                        | The initiatives that assist in the restoration of ecosystem services include vegetation around buildings, green roofs, green walls, indoor plants, street trees, permeable surfaces, rain gardens, urban agriculture and urban parks. This is in line with the green urbanism principles of maximising urban biodiversity, creating higher levels of food security and creating cultural identity (refer to Table 2.2).                                                                                              |
|                                                    | New urbanism                          | From Chapter 2 it is evident that new urbanism focuses on human well-being and a sense of community. Table 3.2 notes that urban parks assist in creating community cohesion as it creates a safe space for social interaction.                                                                                                                                                                                                                                                                                       |
| Utilising urban green                              | Compact city model                    | Principle 14 of the compact city (refer to Table 2.1) states that governmental financial capacity is important and according to Table 3.2 green roofs, permeable surfaces, rain gardens and urban agriculture prevents and controls pollution and lessens stormwater control costs.                                                                                                                                                                                                                                  |
|                                                    | Green urbanism                        | The initiatives that assist in the utilisation of urban green include vegetation around buildings, green roofs, green walls, indoor plants, street trees, rain gardens, urban agriculture and urban parks and create a linkage to green urbanism by addressing the principles of maximising urban biodiversity, achieving higher levels of food security and green building design (refer to Table 2.2).                                                                                                             |
|                                                    | Smart growth                          | <ul style="list-style-type: none"> <li>a) Smart growth supports the preservation of natural elements. This is also enhanced by the implementation of nature-based solutions, as the concept in itself utilises the benefits of natural elements to enhance human well-being.</li> <li>b) Smart growth also supports economically viable development. According to Table 3.1 an increase in urban green leads to an increase in inward investment, higher levels of employment and higher property values.</li> </ul> |

**Source: Own construction (2018).**

From Table 3.3 it is evident that a linkage between the sustainability agenda and nature-based solutions does exist.

### **3.5 Conclusion**

Nature-based solutions is a holistic concept of utilising the multi-functionality of natural elements that provide a possible solution to the significant social, economic and environmental decline of the modern city. It is therefore recognised as a method of sustainable city planning concerning initiatives such as street trees, urban parks, green roofs, green walls and urban agriculture. The benefits of nature-based solutions are summarised in Table 3.4.

**Table 3.4: Benefits of nature-based solutions for broader sustainable planning approaches**

| <b>Economic benefits</b>                                                                                                                                                                                                                                                                                                  | <b>Environmental benefits</b>                                                                                                                                                                                                                              | <b>Social benefits</b>                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Increased inward investment</li><li>• Increased tourism spent</li><li>• Higher property values</li><li>• Increased employment opportunities</li><li>• Lessen vulnerability of poor</li><li>• Lower costs (controlling pollution, stormwater management, piping systems)</li></ul> | <ul style="list-style-type: none"><li>• Improved microclimate</li><li>• Less pollutants</li><li>• Decreased urban heat island</li><li>• Reduced erosion</li><li>• Reduced wind speed</li><li>• Habitat provision</li><li>• Fostered biodiversity</li></ul> | <ul style="list-style-type: none"><li>• Enhanced personal health levels</li><li>• Reduced stress</li><li>• Enhanced physiological health levels</li><li>• Heightened mental capacity</li><li>• Natural sound buffer</li><li>• Facilitates social cohesion</li></ul> |

**Source: Own construction (2017).**

Despite these benefits of nature-based solutions for the planning of sustainable cities, several implementation challenges still exist, referring mostly to the stakeholders, perceptions on urban green and budget constraints. Such challenges differ according to local context and thus perspectives from the Global South is considered in the following chapter.

## **CHAPTER 4: PLANNING PERSPECTIVES FROM THE GLOBAL SOUTH**

### **4.1 Introduction**

The notion of spatial planning is context-driven. This post-modern (refer to Chapter 2) paradigm of context-based planning is gaining importance. It is increasingly believed that it is necessary for literature to focus on the Global South as a unique region with a history of colonialism, differential economic and social change and high levels of social inequality (Watson, 2016:32-36), different from that in the Global North. The division between the Global North and Global South is widely known and largely based on socioeconomic dimensions such as educational and economic considerations and scientific development (Confraria *et al.*, 2017:266). This division has a repressive impact on city planning realities and challenges in the Global South. The Global South generally refers to Latin America, Africa and developing Asian countries (Confraria *et al.*, 2017:266).

The Global South is still predominantly considered as underrepresented in academic literature (Lategan, 2017:118), with a lack in understanding of the context-based solutions to urban challenges. Various studies have, however, indicated that the local socioeconomic conditions influence the spatial outcomes of a project (Shatkin, 2007:10). This limited amount of literature stresses the importance of context-specific research in the Global South, as different urban challenges call for different solutions.

The socioeconomic and environmental challenges and the complexities of current city planning approaches in the Global South, as well as nature-based solutions as part of the sustainability agenda, was thus explored in this chapter.

### **4.2 The urban context of the Global South**

From the fifteenth century, European countries (Global North) colonised areas in America, Africa, Asia and the Middle East (Global South) (King, 2015:29), using city planning as their governing means and to meet their economic needs. This colonisation trend may have caused a historical disadvantage in the Global South (Robertson, 2012:5) as urbanisation occurred in the absence of industrialisation rather than as a result thereof (as it was in the case of the Global North) (King, 2015:32-33).

The exploitation, exploration and administration of the colonised countries varied greatly, since these countries comprised of different traditional societies (local context) and the colonising

countries differed in approach (Drakakis-Smith, 1987:11-12). The processes of urbanisation therefore occurred in unique ways (Pacione, 2009:466). Social hierarchy was, however, generally enforced, and cultural transformation was brought forth through religious buildings and education (King, 2015:35). The colonial cities grew into big urban conglomerations that dominated (especially) the coastal regions of these countries, often leaving an underdeveloped inland, but initiatives such as railway systems helped to breach this gap (King, 2015:29). This legacy of development may offer potential growth opportunities for the post-colonial city (United Nations, 1999:3).

In the last few decades, the post-colonial world has been characterised by economic and social crisis and violence (Trefon, 2009:15) resulting in many different livelihood strategies and in a social quest for identity, definition and meaning (King, 2015:35). Power was mostly handed over to indigenous elites that adopted the existing colonial governmental and development models (Jenkins, 2010:94). A key problem for these new authorities is to maintain the established service infrastructure located in the historically colonial areas and at the same time expand the infrastructure to the historical indigenous areas (Céron-Palma *et al.*, 2013:47). An opportunity to find creative solutions when combining indigenous and contemporary knowledge does therefore exist in the post-colonial city (Akinwale, 2013:3).

Each part of the Global South has its unique socioeconomic and environmental benefits and challenges, but these countries share certain histories and contemporary challenges (Lategan, 2017:119-120). Many nations in the Global South can be characterised as countries with high levels of biodiversity and cultural diversity (Villegas-Palacio *et al.*, 2016:306). According to Geneletti *et al.* (2017:321-322) the current socioeconomic status in the Global South refers to problems such as health issues, safety issues, depletion of natural resources, low levels of social cohesion, major poverty (Cilliers *et al.*, 2014:261), homelessness, inadequate social provision (King, 2015:37), large informal settlements and inadequate bulk services such as sanitation and water supply (Robertson, 2012:2). Accumulated negative environmental and societal conditions are therefore often present in the Global South's urban fabric. The social, economic and environmental challenges within the broader Global South was thus explored accordingly.

The **environmental** problems in the Global South are further enlarged by the global culture of consumerism (especially evident in the Global North), since the environmentally degrading industries are mostly located within the Global South (Robertson, 2012:5) and as a result of overpopulation (Hardoy & Satterthwaite, 1991:157). The process to achieve environmental sustainability in the Global South differs from that in the Global North as there is a difference in

the level of wealth, the economy is more dependent on natural resources and there is generally a large backlog on basic infrastructure provision (Hardoy & Satterthwaite, 1991:157).

The urban **economy** in the Global South is largely informal, especially among the urban poor (Basole & Bhattacharya, 2017:85). The informal sector is not regulated by the government and therefore often does not pay taxes; and labour laws are also rarely enforced (Miraftab & Kudva, 2015:93). The informal economy can, however, not be separated from the formal economy, as formal sector wage earners, for example, buy from street food vendors (Miraftab & Kudva, 2015:93). The informal economy includes occupations such as street trading, small-scale transportation (using three-wheel motorcycles, bicycles, horse-drawn carts and hand carts to move cargo and passengers), personal services (such as shoe repairmen and typing services), security services, gambling services, recuperation (collection of recyclable waste), prostitution, begging and theft (Bromley, 1997:98). The urban poor of the Global South often live in the most polluted areas, as well as areas that are most vulnerable during extreme climate conditions (Hardoy & Satterthwaite, 1991:156). The economy is nevertheless generally growing (Akyeampong *et al.*, 2014:1) and moving towards the privatisation of public services (Steel *et al.*, 2017:134).

The **social** climate in these urban areas is more community based than individualistic and the economic climate is based on social redistribution approaches rather than market exchange (Jenkins, 2009:81). In the Global South, social sustainability is however hindered by the reality of a widening gap between rich and poor (Abebe & Megento, 2016:255); divided ethnicity; high levels of unemployment, poverty, violent crime rates, gender inequality and substance abuse; and low levels of education and physical well-being (Lategan, 2017:118, 252-253). According to Pethe *et al.* (2014:121), this social inequality poses considerable challenges for urban planning, as there is a rising demand for commercial spaces while at the same time slums and informal economic activities are expanding.

From the preceding literature study, it is evident that the Global South is in desperate need of sustainable city planning approaches to address the context-based challenges. The sustainability agenda in the Global South is subsequently explored in the following section.

### **4.3 The Global South and the sustainability agenda**

From Chapter 3 it is apparent that nature-based solutions may provide a valuable contribution towards achieving urban sustainability and therefore form a vital part of the sustainability agenda.

The unique context of the Global South offers various challenges and opportunities for the implementation of such initiatives and was consequently explored in this section.

In Africa and Latin America, the indigenous cities offer established nature-based developments that may provide possible solutions to the urban challenges described in the previous section (Moore, 2015:810). The indigenous African city for example was green and compact with human scale transportation modes (Asomani-Boateng, 2011:253) as explained in Table 4.1.

**Table 4.1: Lessons learnt form the indigenous African city**

| <b>Solution</b> | <b>Method</b>                                                                                                                                                                                                 |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Compact cities  | This was achieved by creating urban growth boundaries such as walls and green buffers to 1) control urban sprawl, 2) share urban facilities, 3) provide physical security and 4) create a sense of community. |
| Mixed use       | There was no separation between home and work. The city was designed to accommodate industrial activities such as tool-making, basket-weaving and pottery within residential space.                           |
| Urban green     | The rural character of these cities was maintained by 1) cultivating all open spaces, 2) building around existing trees and 3) separating residential quarters by green belts.                                |

**Source: Own construction (2017) form Asomani-Boateng (2011:253-256).**

Agro-ecology is an initiative based on indigenous knowledge from Latin America (Moore, 2015:810), described as the 'ecology of food systems' (Martin & Sauerborn, 2013:6). It mimics local ecosystems with the expectation that it will be productive and pest-resistant (Altieri & Nicholls, 2017:232).

Most of the contemporary nature-based solutions applied in the Global South focus on rural or agricultural dimensions (Death, 2015:2208). A shift towards a broader application to such initiatives is however emerging (Brockington & Ponte, 2015:2197) and is promoted by various state-led initiatives (Bek *et al.*, 2017:137) and policies with regards to ecological well-being (Nero *et al.*, 2017:80). Despite this shift, the implementation of nature-based solutions is still hindered by perceptions on such initiatives and by the current urban context of the Global South (Robertson, 2012:1-4) as described in the previous section. According to Cilliers and Cilliers (2016:22) urban green is to a large extent considered a luxury with little to no monetary value and is only prioritised when issues, perceived as more pressing (such as housing demands) are met.

#### **4.4 Conclusion**

The Global South consist of Africa, developing Asian countries and Latin America and primarily differs from the Global North in terms of socioeconomic dimensions. To some extent the history

of colonisation that the countries of the Global South share leads to a socioeconomic and developmental disadvantage with regards to the Global North. The post-colonial city does offer various opportunities for growth in 1) the legacy of development left by the colonial past and 2) the possibility to combine indigenous and modern knowledge. This is often hindered by socioeconomic crises. Various state-driven, green initiatives have recently been established to address the urban challenges of the Global South.

The Global South is predominantly considered as underrepresented in academic literature, that calls for an urgent search to 1) understand the unique considerations and applications of the urban sustainability agenda and to 2) find possible context-based approaches to address urban challenges. An analysis of a) best practice case studies and b) expert perspectives on the urban sustainability agenda, nature-based solutions and the Global South was consequently discussed in the following chapters.

## **CHAPTER 5: CASE STUDY ANALYSIS (EMPIRICAL STUDY PHASE 1)**

### **5.1 Introduction**

From the literature study in the previous chapters it is apparent that there is an urgent need for translating the global knowledge of sustainable city planning to more local applications. This calls for a thorough consideration of the current examples of sustainable city planning (Lehmann, 2010b:65, 97) in order to obtain a greater understanding of development patterns concerning sustainable city planning (Sahu, 2013:72), as was the aim in this empirical investigation.

### **5.2 Methodology employed in the empirical investigation**

The empirical investigation aimed to gain a broader understanding of the practical implementation and perception of sustainable city planning to enhance the sustainability agenda. As such, it was divided into two phases, namely a best practice case study analysis and a stakeholder analysis. These two phases were respectively presented in Chapters 5 and 6.

For the best practice case study analysis, ten purposefully selected cities were considered, and theoretical sampling was employed for the identification of best practices relating to the planning of sustainable cities based on the notion of nature-based solutions (Strydom & Delport, 2011:392). This method of theoretical sampling may serve as a valuable, practical supplement to the descriptive account (Breckenridge & Jones, 2009:115) of sustainable city planning and possible solutions discussed in the previous chapters.

For the purposes of this study, three indexes were purposefully selected based on their linkages to sustainability and nature-based solutions. These indexes were used to identify leading cities concerning sustainable planning practices, namely the global green economy index (Tamanini & Valenciano, 2016), the green city index (Summer, 2012) and the sustainable cities index (Arcadis, 2016). For research purposes, the top two cities per continent (taken as an average of all three indexes) were evaluated as context-based best practices to identify solutions, linked to nature-based solutions, for sustainable city planning. Each of these cities were evaluated in terms of the index criteria to identify specific themes of best practices relating to their high-ranking status. These themes of best practices were ultimately employed to generate a planning approach for nature-based solutions as part of broader sustainable development.

### **5.3 Exploring the index criteria**

Indexes are considered precise instruments with clinical significance that provide reliable and valid results (Delport & Roestenburg, 2011:206-207) and may therefore offer an important contribution to this study concerning the search for best practice sustainable city planning

approaches. These indexes also offer an opportunity for comparison between different regions (Phophalia, 2010:235) and may thus provide further insight into the current question of context-based planning as discussed in Chapter 2 and 4. This section explored the criteria used within each index to identify the top sustainable or green cities for further investigation as to the application of context-based sustainable city planning in the following sections.

Tamanini and Valenciano (2016:6) explains that the global green economy index provides a framework for a better understanding of the current urban reality in terms of the environment and economy and of possible future improvements. The criteria used for the scoring of this index is outlined in Figure 5.1.

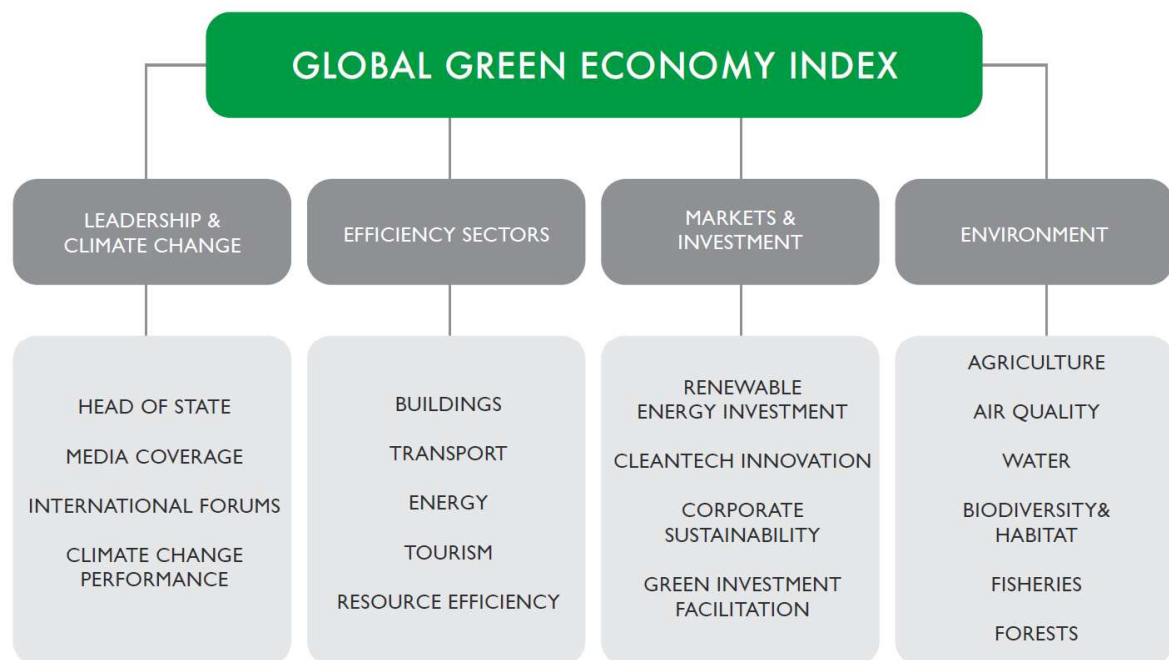


**Figure 5.1: The global green economy index criteria**

**Source: Tamanini & Valenciano (2016:8).**

The higher emphasis on the economic and environmental spheres of sustainable planning within the global green economy index can be perceived in Figure 5.1. It is however evident from Chapter 3 that a focus on urban green may simultaneously benefit all three dimensions of sustainability as urban green generally promotes the economic and social environment as well as the natural environment.

The green city index differs from the global green economy index in that it comprises of individual indexes for each continent. This is due to a difference in the availability of data and of context-based challenges (Summer, 2012:8). Such a context-based approach is important in the search for sustainable city planning (refer to chapter 2) and may therefore contribute positively to gain a

better understanding of sustainability in planning practices. The criteria for the green city index is listed in Figure 5.2 with slight differences in criteria for each continent.

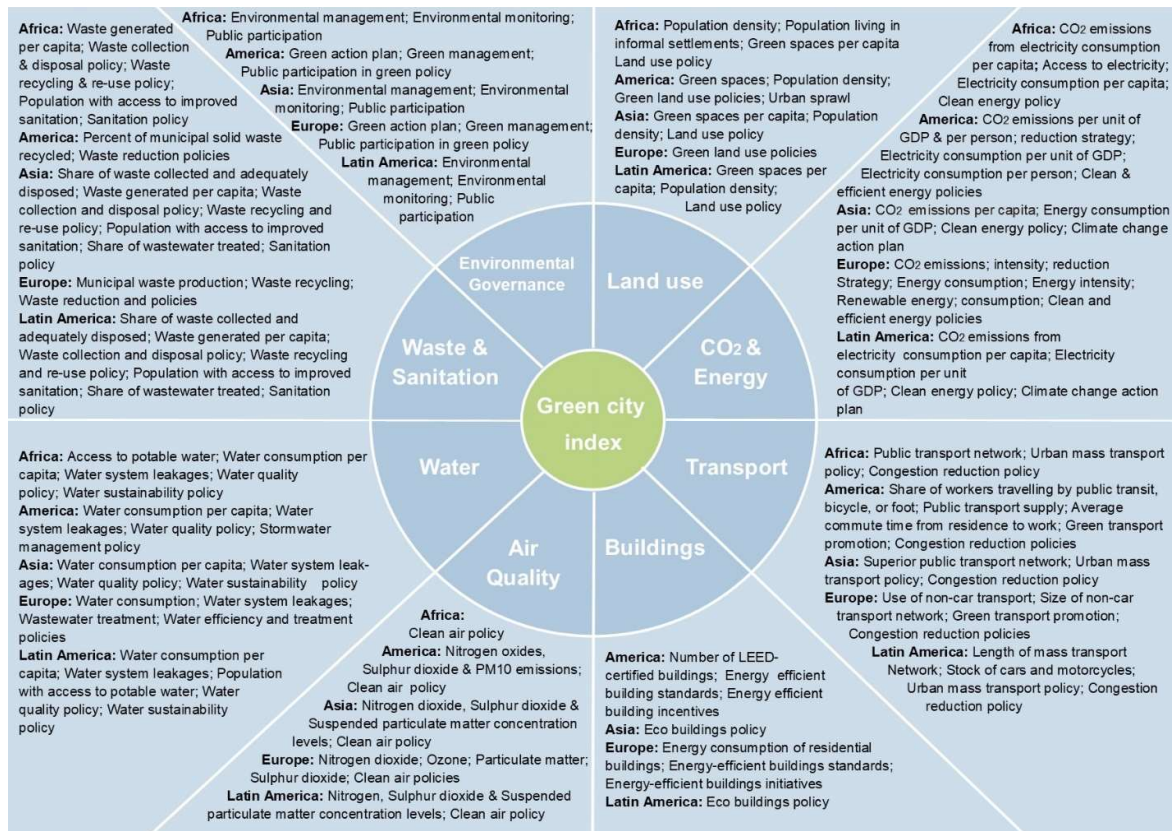


**Figure 5.2: The green city index criteria**

**Source:** Own construction (2018) from Summer (2011:35), Summer & Barchfield (2010:31), Summer & Barchfield (2011a:31), Summer & Barchfield (2011b:31) and Watson (2009:39).

From Figure 5.2 it may be perceived that the green city index focuses to a large extent on the natural environment, neglecting the economy and society. As noted, however, in the previous discussion on the global green economy index urban green in general benefits all three spheres of sustainable city planning and therefore this index might still provide valuable insight into the discussion on best practice sustainable city planning.

In contrast to the first two indexes the sustainable cities index is a compilation of three sub-indexes, each focusing on one of the three dimensions of sustainable city planning (refer to Chapter 2), namely the people sub-index (social), planet sub-index (environment) and the profit sub-index (economy) (Arcadis, 2016). This may prove insightful as to the selected cities' balance between the different spheres of sustainability. The aim of the sustainable cities index is to balance the current needs of society without compromising on future needs and may consequently provide a significant practical linkage to the theoretical definition of the Bruntland

commission's report as explained in Chapter 2. The index criteria for the sustainable cities index is presented in Table 5.1.

**Table 5.1: The sustainable cities index criteria**

| Sub-index: People |                                             | Sub-index: Planet        |                                                        | Sub-index: Profit             |                                                |
|-------------------|---------------------------------------------|--------------------------|--------------------------------------------------------|-------------------------------|------------------------------------------------|
| Education         | Literacy rate                               | Connectivity             | Mobile connectivity                                    | Energy                        | Energy use                                     |
|                   | University rankings                         |                          | Broadband connectivity                                 |                               | Renewable share                                |
|                   | Share of population with tertiary education |                          | Importance in global networks                          |                               | Energy consumption per \$ GDP                  |
| Income inequality | Gini coefficient                            | Economic development     | GDP per capita                                         | Drinking water and sanitation | Access to drinking water (% of household)      |
| Work-life balance | Average annual hours worked                 | Ease of doing business   | Ease of doing business index                           | Air pollution                 | Access to improved sanitation (% of household) |
| Demographics      | Dependency ratio                            | Transport infrastructure | Congestion                                             |                               | Main level of pollutants                       |
| Health            | Life expectancy                             |                          | Rail infrastructure                                    | Waste management              | Share of wastewater treated                    |
|                   | Obesity rate                                |                          | Airport satisfaction                                   |                               | Solid waste management (landfill vs recycling) |
| Affordability     | Consumer price index                        | Tourism                  | International visitors per year, absolute & per capita | Greenhouse gas emissions      | Emissions in metric tonnes (per capita)        |
|                   | Property prices                             | Employment               | Number of people employed, % of city population        | Environmental risks           | Natural catastrophe exposure                   |
| Crime             | Homicide rate                               |                          |                                                        | Green spaces                  | Green space as % of city area                  |

**Source: Own construction (2018) from Arcadis (2016).**

The focus on a balanced sustainable city is evident in the criteria of the sustainable cities index, listed in Table 5.1, and may generate insight into the search for sustainable city planning practices. The top two cities from five continents (Africa, America, Asia, Europe and Latin America) were evaluated in the following sections in view of the index criteria to ultimately gain broader insight into nature-based planning approaches as part of broader sustainable development.

## 5.4 Case study identification based on indexes

Best practice case studies may facilitate the identification of challenges and opportunities within existing urban systems (Llausás & Roe, 2012:643) to provide a linkage between practice and theory. As such, the top-ranking cities from each continent was evaluated to identify best practice examples regarding sustainable city planning.

From the previous section, it is evident that the method of calculating the city rankings differ between the indexes and consequently different cities were considered for the respective indexes and the number of cities analysed also differed. The global green economy index ranked 50 cities (Tamanini & Valenciano, 2016:27) and the sustainable cities index, 100 cities (Arcadis, 2016). The number of evaluated cities differ, however, between the green city indexes with the European green city index assessing 30 cities; the United States and Canada index, 27 cities; the African and Asian indexes, respectively 15 cities; and the Latin American index, 17 cities (Summer, 2012:15-33). For the purposes of this evaluation, the average ranking for each of the top five cities appearing in all three indexes was calculated by adding up the three index rankings and dividing it by three. The two cities with the highest average score from each continent was then

selected for the case study analysis. Table 5.2 indicates the five European top-ranking cities that occur in all three indexes.

**Table 5.2: The European top-ranking cities**

| City       | Global green economy index ranking | Green city index ranking | Sustainable cities index ranking | Average ranking |
|------------|------------------------------------|--------------------------|----------------------------------|-----------------|
| Copenhagen | 1                                  | 1                        | 14                               | 5.33            |
| Stockholm  | 2                                  | 2                        | 3                                | 2.33            |
| Berlin     | 7                                  | 8                        | 17                               | 10.67           |
| Paris      | 9                                  | 10                       | 15                               | 11.33           |
| London     | 11                                 | 11                       | 5                                | 9               |

Source: Arcadis (2016), Tamanini and Valenciano (2016:27) and Watson (2009:11).

From the average ranking, as indicated in Table 5.2, it is apparent that Stockholm and Copenhagen are the top two European cities concerning sustainable city planning practices. Table 5.3 presents the top 5 United States and Canadian cities.

**Table 5.3: The United states/Canada top-ranking cities**

| City          | Global green economy index ranking | Green city index ranking | Sustainable cities index ranking | Average ranking |
|---------------|------------------------------------|--------------------------|----------------------------------|-----------------|
| Vancouver     | 3                                  | 2                        | 23                               | 9.33            |
| New York City | 6                                  | 3                        | 26                               | 11.67           |
| Washington    | 15                                 | 8                        | 33                               | 18.67           |
| Los Angeles   | 17                                 | 7                        | 44                               | 22.67           |
| Toronto       | 26                                 | 9                        | 50                               | 28.33           |

Source: Tamanini and Valenciano (2016:27), Summer and Barchfield (2011b:10) and Arcadis (2016).

Table 5.3 indicated that Vancouver and New York City are ranked as the top United States and Canadian cities. Johannesburg is the only African city occurring in all three indexes and consequently Addis Ababa was selected, as it appears in both the global green economy index and the green city index. Table 5.4 portrays these two cities' index rankings.

**Table 5.4: The African top-ranking cities**

| City         | Global green economy index ranking | Green city index ranking | Sustainable cities index ranking | Average ranking |
|--------------|------------------------------------|--------------------------|----------------------------------|-----------------|
| Johannesburg | 29                                 | 5                        | 90                               | 41.33           |
| Addis Ababa  | 42                                 | 7                        |                                  | 24.5            |

Source: Tamanini and Valenciano (2016:27), Summer and Barchfield (2011a:9) and Arcadis (2016).

The five Asian cities with a top index ranking status are listed in Table 5.5.

**Table 5.5: The Asian top-ranking cities**

| City      | Global green economy index ranking | Green city index ranking | Sustainable cities index ranking | Average ranking |
|-----------|------------------------------------|--------------------------|----------------------------------|-----------------|
| Tokyo     | 10                                 | 6                        | 45                               | 20.33           |
| Seoul     | 19                                 | 4                        | 7                                | 10              |
| Hong Kong | 27                                 | 2                        | 16                               | 15              |
| Mumbai    | 35                                 | 21                       | 92                               | 49.33           |
| Bangkok   | 43                                 | 8                        | 67                               | 39.33           |

Source: Arcadis (2016), Summer (2011:10) and Tamanini and Valenciano (2016:27).

Seoul and Hong Kong are depicted in Table 5.5 as the top-ranked Asian cities. Similarly to the African cities, only three Latin American cities occurred in all three indexes, as listed in Table 5.6.

**Table 5.6: The Latin American top-ranking cities**

| City           | Global green economy index ranking | Green city index ranking | Sustainable cities index ranking | Average ranking |
|----------------|------------------------------------|--------------------------|----------------------------------|-----------------|
| Rio de Janeiro | 24                                 | 5                        | 82                               | 37              |
| Mexico City    | 28                                 | 8                        | 84                               | 40              |
| São Paulo      | 39                                 | 6                        | 79                               | 41.33           |

Source: Arcadis (2016), Summer and Barchfield (2010:9) and Tamanini and Valenciano (2016:27).

Rio de Janeiro and Mexico City is portrayed in Table 5.6 as the leading Latin American cities.

The cities of Stockholm, Copenhagen, Vancouver, New York, Addis Ababa, Johannesburg, Seoul, Hong Kong, Rio de Janeiro and Mexico was consequently selected for the analysis of best practice case studies to gain a higher understanding of the sustainability agenda.

## 5.5 Case study analysis

Accordingly, the selected cities were evaluated in terms of each city's index analysis results and presented in this section. Figure 5.3 indicates the locality of these selected cities, presenting the analysis to include cities from all the regions in both the Global North and the Global South that may provide a context-based understanding of planning for sustainable cities in these regions.

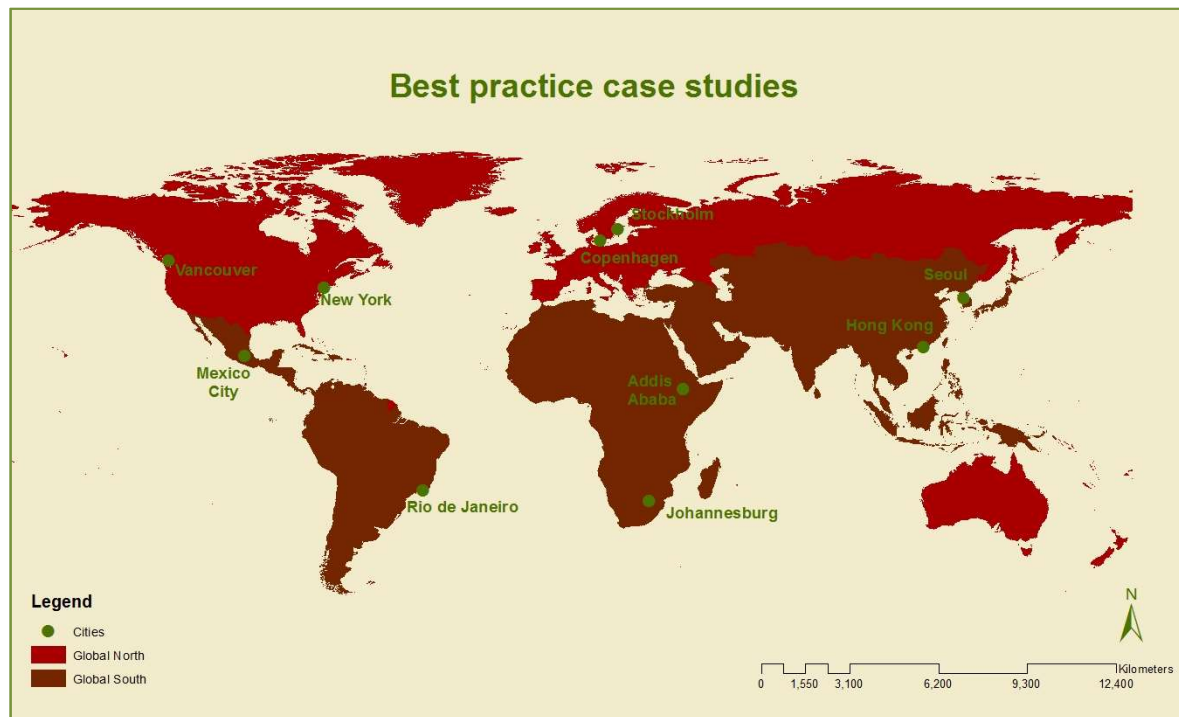


**Figure 5.3: Map of best practice case study locality**

**Source: Own construction (2018).**

Except for the cities' index rankings, as indicated in Tables 5.2 to 5.6, the global green economy index only provides country-related results. Such results may however provide insight into the broader green economy status of the city, as these cities are generally described as major social, economic and environmental hubs within their countries. Possible motivations in practical initiatives as to achieving these index results were additionally explored within literature to identify best practice examples on how to plan for sustainable cities.

From Figure 5.3, it is evident that the scope of the study is relatively broad, providing the possibility of a broad overview to context-based solutions that was applied in the different cities.

### **5.5.1 Stockholm case study**

Stockholm is the capital and largest city of Sweden (Columbia Electronic Encyclopaedia, 2017), located in northern Europe (Levihn, 2017:672). The city is star shaped as it has grown along transportation lines with a dominant city centre containing various commercial, industrial and cultural functions (Mörtberg *et al.*, 2017:341). The number of built areas, urban green and water areas surrounding the city centre are relatively evenly distributed (Samuelsson *et al.*, 2018:8), that may account to some extent for the city's top-ranking status. Energy within the city is mainly used for tap water demand in the summer times and for heating purposes during the winter times, but the city has a long-term climate goal of being fossil fuel-free by 2040 (Blomquist, 2017:7) and

is therefore particularly known for their multi energy systems perspective (Levihn, 2017:671-672). The city's economy is dominated by the service sector and is nearly devoid of heavy industries, that may also contribute to it being highly regarded as a sustainable city (Watson, 2009:87).

The results of the global green economy index's analysis of Sweden is depicted in Figure 5.4.

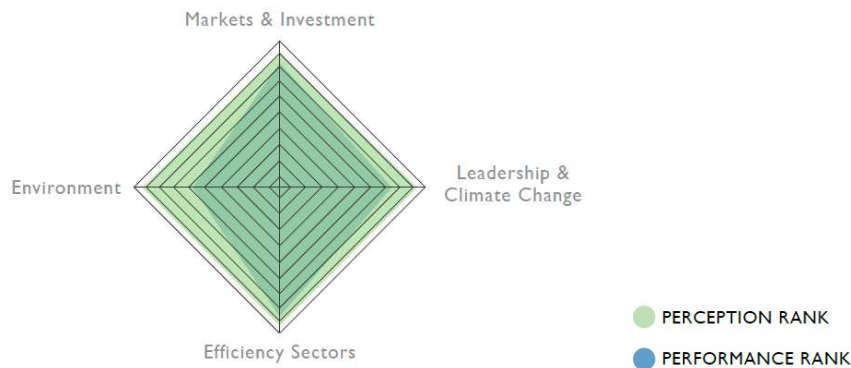


**Figure 5.4: Sweden global green economy index criteria outcome**

Source: Tamanini & Valenciano (2016:54).

It is apparent from Figure 5.4 that the perception amongst experts is that Sweden is completely balanced in all sectors of the global green economy index criteria. From the performance rank it may, however, be observed that the country's strength lies within markets and investments, leadership and climate change and the efficiency sectors. Figure 5.5 indicates the outcome of the green city index's analysis of Stockholm's environmental sustainability.

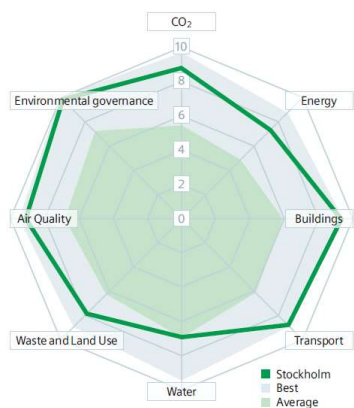


**Figure 5.5: Stockholm green city index criteria outcome**

Source: Watson (2009:87).

From Figure 5.5 it could be perceived that Stockholm’s strong points lie within its environmental governance, CO<sub>2</sub> emission rates, buildings, transport, air quality and to some extent energy, waste and land use. The outcome of the sustainable cities index’s analysis is presented in Figure 5.6.

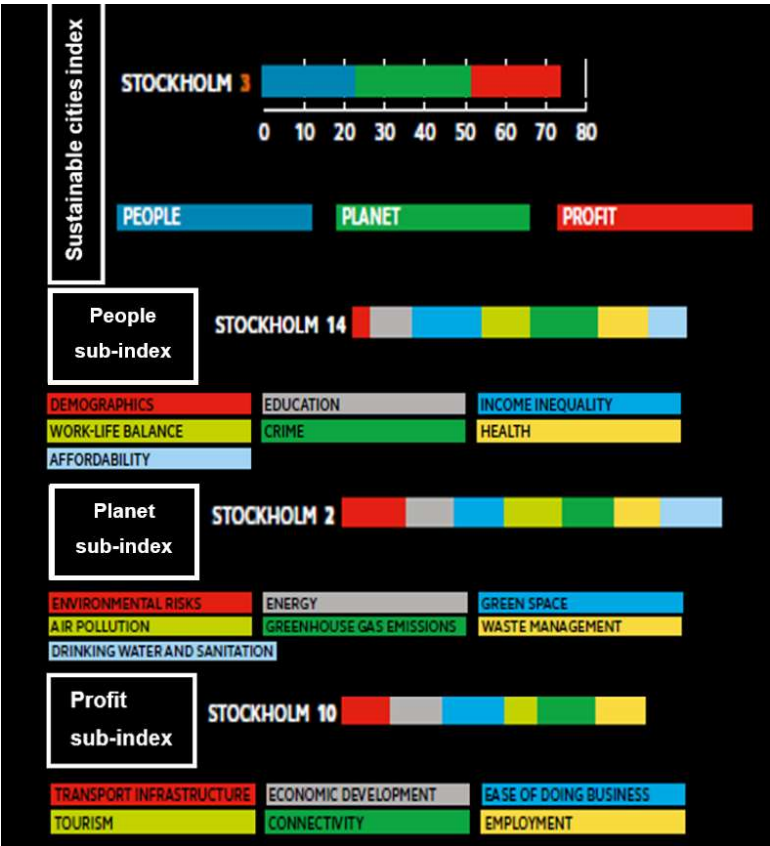


Figure 5.6: Stockholm sustainable cities index criteria outcome

Source: Own construction (2018) from Arcadis (2016).

According to the sustainable cities index, as depicted in Figure 5.6, Stockholm is relatively balanced between all three spheres of sustainability, with the planet sub-index ranking slightly higher than the other two dimensions.

Table 5.7 presents best practice examples on how the results obtained for the index evaluation are achieved. An indication as to what index criteria are met by each initiative is depicted in the criteria indicator column, and a further discussion on the implementation and benefits of the best practice example is also presented in the table.

**Table 5.7: Stockholm best practice examples as motivation for high index ranking**

| Criteria indicator                                                                  | Best practice example           | Discussion on best practice                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Energy</i>                                                                       |                                 |                                                                                                                                                                                                                                                                                                                                                                                    |
|    | Biogas                          | Biogas is produced from sewage sludge, waste from households, food processing establishments and slaughterhouses and is collected from landfills. It is then used for refuelling systems, heat production and electricity (Ammenberg <i>et al.</i> , 2018:71).                                                                                                                     |
|    | District heating                | District heating enable higher emission control, considering that one large boiler, rather than several private boilers, is used for heating purposes. It also provides an opportunity to combine heat and power initiatives that may also facilitate in achieving higher fuel efficiency (Ilic <i>et al.</i> , 2014:188-189).                                                     |
|    | Hydroelectric and nuclear power | The vast majority of electricity production in the city of Stockholm comprises of these renewable energy sources (Blomquist, 2017:9).                                                                                                                                                                                                                                              |
|    | Solar cells                     | Stockholm has over 13 500 square metres of solar cells (Blomquist, 2017:9) to reduce the use of fossil fuels as an energy source.                                                                                                                                                                                                                                                  |
| <i>Land use</i>                                                                     |                                 |                                                                                                                                                                                                                                                                                                                                                                                    |
|    | Densification                   | The densification of the city may lead to shortened intra-city travel distances, lessened car dependence, higher levels of access to public services, the optimal use of land resources (Mörtberg <i>et al.</i> , 2017:339), a decreased amount of energy spending on heating systems and the conservation of natural resources on the outskirts of the city (Samuelsson, 2018:7). |
| <i>Transport</i>                                                                    |                                 |                                                                                                                                                                                                                                                                                                                                                                                    |
|  | Congestion charge               | Congestion charge was introduced in 2007 for traveling in the inner city of Stockholm, resulting in a 30% central city traffic reduction since it has been implemented (Blomquist, 2017:15).                                                                                                                                                                                       |
|  | Green cars                      | Electric vehicles do not release exhaust gasses and its engine is more energy efficient. This leads to lessened local air pollution and in turn have an advantageous effect on the environment and local health conditions (Langbroek <i>et al.</i> , 2017:98).                                                                                                                    |
|  | Increased cycle paths           | In Stockholm, there is approximately 800 kilometres of cycle paths and lanes (Blomquist, 2017:15), providing an opportunity for sustainable transportation and thereby decreasing local levels of air pollution.                                                                                                                                                                   |

| Criteria indicator                                                                                                                                                                                                                                                                                                                                                                 | Best practice example | Discussion on best practice                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Urban green</b><br>                                                                                                                                                                                                                                                                            | Nature reserves       | Nature reserves within the city limits are utilised as providers for the various ecosystem services (Blomquist, 2017:23), benefiting the social, economic and environmental environment by providing climate regulation and recreational space, increasing health levels and preventing erosion (Mörtberg <i>et al.</i> , 2017:338), as explained in Chapter 3. |
| <b>Waste management</b><br>                                                                                                                                                                                                                                                                       | Recycling initiatives | Household waste has to be separated according to the contents in colour-coded bags. Food waste is then used for composting, while park and garden waste are utilised to improve street tree conditions (Blomquist, 2017:19)                                                                                                                                     |
| <b>Key:</b><br> Global green economy index criteria met  Green city index criteria met  Sustainable cities index criteria met |                       |                                                                                                                                                                                                                                                                                                                                                                 |

**Source:** Own construction (2018) from Ammenberg *et al.* (2018:71), Blomquist (2017:9-23), Ilic *et al.* (2014:188-189), Langbroek *et al.* (2017:98), Mörtberg *et al.* (2017:338-339) and Samuelsson (2018:7).

From Table 5.7 it is apparent that Stockholm's main focus towards sustainable city planning is on reducing air pollution through energy efficient initiatives as most of the benefits of these best practice initiatives relate to a reduction in the amount of released greenhouse gasses. This may be regarded in correspondence with their long-term goal of being fossil fuel free by 2040. The city does however utilise nature-based solutions in the form of urban nature reserves to assist in achieving such a goal.

## 5.5.2 Copenhagen case study

Copenhagen is the capital city of Denmark and is situated in the northern part of Europe, with a temperate climate (Madsen *et al.*, 2017:202) that may enhance the social well-being of local community members. The city has a monocentric structure with a high population and employment density in the inner city and a radial pattern of development away from the core in the shape of 'five fingers' (Silva *et al.*, 2014:215) that might result in urban sprawl. Similarly to Stockholm, Copenhagen's focus is on improving air quality and has a holistic climate plan striving towards carbon neutrality by 2025 (City of Copenhagen, 2014:47). This may serve as a possible explanation for their top-ranking status in the three indexes concerning urban sustainability.

The outcome of the Denmark analysis for the construction of the global green economy index is depicted in Figure 5.7.

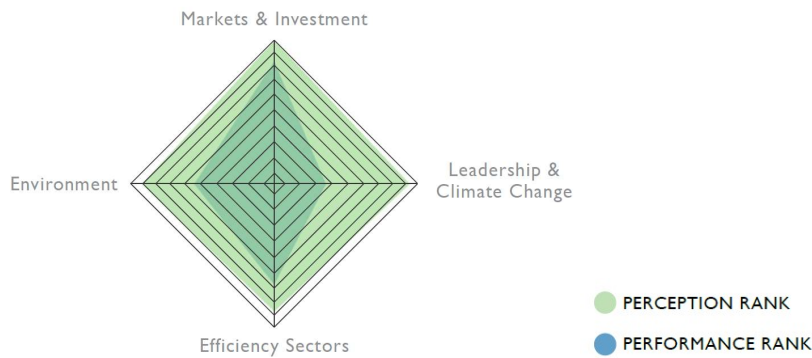


**Figure 5.7: Denmark global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:37).**

It can be perceived from Figure 5.7 that the perception of Denmark's green economy status amongst experts is similar to that of Sweden's, in that the country is believed to be highly balanced between all four spheres of the global green economy index criteria. From the performance rank it is evident that Denmark's strength lies mostly in markets and investment and to a lesser extent in the environment and efficiency sectors. The outcome of the green city index analysis of Copenhagen is depicted in Figure 5.8.



**Figure 5.8: Copenhagen green city index criteria outcome**

**Source: Watson (2009:57).**

Copenhagen is portrayed in Figure 5.8 as relatively balanced between the criteria of the green city index. It is evident that Copenhagen's strength lies mainly in environmental governance, water, buildings and energy, even though all the criteria points are comparatively close to each other. The outcome of the sustainable cities index analysis is presented in Figure 5.9.

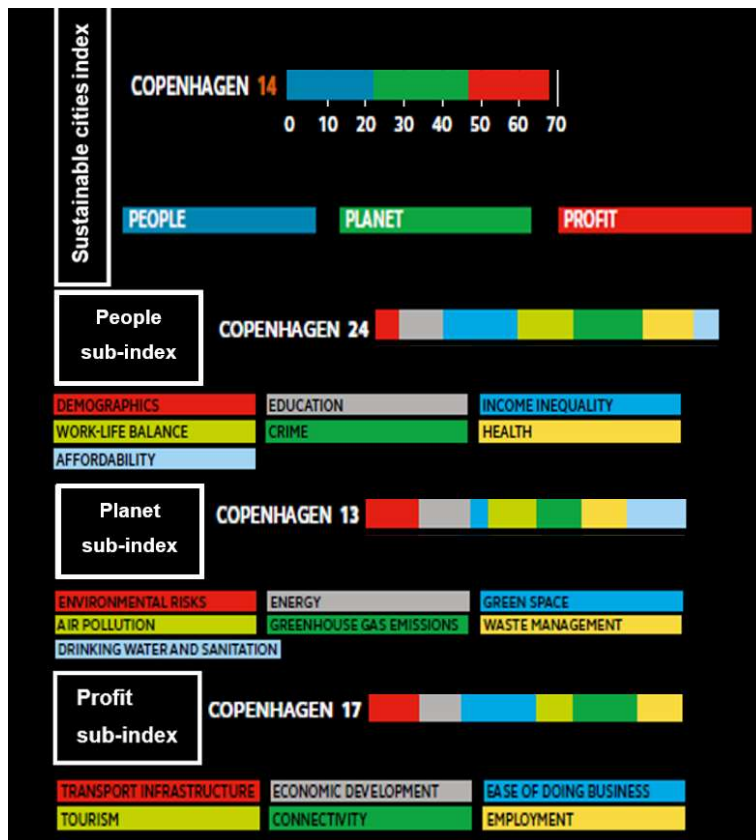


**Figure 5.9: Copenhagen sustainable cities index criteria outcome**

Source: Own construction (2018) from Arcadis (2016).

From Figure 5.9, Copenhagen can be perceived as reasonably balanced between the three dimensions of sustainability. The environmental sphere of sustainability is, however, scoring somewhat higher than the other two spheres and may therefore provide a possible explanation for Copenhagen being depicted as a more balanced city in the green city index outcome graph in comparison to that of the global green economy index's.

A discussion on best practice examples that may assist in obtaining the results as considered for the city's index rankings, along with an indication of what index criteria are met by the best practice example, is consequently presented in Table 5.8.

**Table 5.8: Copenhagen best practice examples as motivation for high index ranking**

| Criteria indicator                                                                  | Best practice example       | Discussion on best practice                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Energy</i>                                                                       |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|    | Biogas                      | Biogas is produced at the two major wastewater treatment plants in Copenhagen (Damsø <i>et al.</i> , 2017:414).                                                                                                                                                                                                                                                                                                                                                                         |
|    | Biomass                     | Currently, one unit of the coal-based power plant is converted to a biomass-based unit, but the aim is to retire the coal-based plant completely by 2020 and to establish a new biomass-based plant (Damsø <i>et al.</i> , 2017:414).                                                                                                                                                                                                                                                   |
|    | District cooling            | Indoor air is cooled by a process of centrally cooling water with cold seawater and distributing it through underground pipelines to industrial and commercial buildings that reduces air and noise pollution (City of Copenhagen, 2014:34).                                                                                                                                                                                                                                            |
|    | District heating            | Since 2016, district heating is entirely dependent on biomass energy (Damsø <i>et al.</i> , 2017:413), assisting in Copenhagen's goal to achieve carbon neutrality.                                                                                                                                                                                                                                                                                                                     |
|    | Wind turbines               | Wind turbines are designed to withstand severe weather conditions. This is a community owned project as shares were sold to the community members, providing both social and environmental benefits (City of Copenhagen, 2014:23).                                                                                                                                                                                                                                                      |
| <i>Land use</i>                                                                     |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|   | Revitalisation              | The Copenhagen harbour was previously polluted by various sources but was transformed by modernising the sewage system, diverting local rainwater and implementing urban design principles to create a recreational space. This lead to an increased value of real estate, higher quality of life and improved the water quality in the harbour (City of Copenhagen, 2014:14).                                                                                                          |
| <i>Transport</i>                                                                    |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|  | Cycling infrastructure      | This is an essential part of urban planning in Copenhagen, with various investments to ensure uninterrupted and broader bicycle lanes, snow clearance during winter months, lanes through green and recreational spaces and train carriages that accommodates bicycles. Such initiatives result in lessened noise and air pollution, low maintenance and travel costs, improved local health conditions and shortened travel time (City of Copenhagen, 2014:6-8).                       |
|  | Fuel switch                 | Electric charges are set up within the city and a natural- and hydro gas station is built (Damsø <i>et al.</i> , 2017:413) to encourage a fuel switch towards renewable energy sources.                                                                                                                                                                                                                                                                                                 |
|  | Integrated public transport | Bus, train and metro services have been integrated through initiatives such as 1) the above-mentioned bicycle-friendly train and metro carriages, 2) the one ticket system where only one ticket is needed for all modes of public transport, 3) online ticket sales and 4) traffic lights being kept green for an approaching bus for faster and uninterrupted movement. It then reduces the amount of car usage and therefore improves quality of life (City of Copenhagen, 2014:11). |

| Criteria indicator                                                                                                                                                                                                                                          | Best practice example                                                                                             | Discussion on best practice                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Urban green</i>                                                                                                                                                                                                                                          |                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|          | Green roofs                                                                                                       | All newly constructed buildings in Copenhagen with a pitch of 30° or less is required to establish a green roof (Brudermann & Sangkakool, 2017:224).                                                                                                                                                                                                                                                                                                                                                                                          |
|          | Urban green elements                                                                                              | Natural elements such as street trees, urban parks and water elements are considered as important components of the city of Copenhagen. Various investment initiatives have been undertook to improve the state of urban green and blue elements. Within Copenhagen, there are currently three public swimming sites and according to policy there should always be an urban green space within 200m (Brüel, 2012 :96-98).                                                                                                                    |
| <i>Waste management</i>                                                                                                                                                                                                                                     |                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                           | Viewing waste as a resource                                                                                       | The city of Copenhagen drafted a waste hierarchy where the most favourable action towards waste is to reduce the amount produced, then to reuse the materials, to recycle it and to recover energy from the waste. Lastly, the least favourable option is to send it to the landfill environment (City of Copenhagen, 2014:26) in order to produce as little waste as possible and to ultimately increase the health of the natural environment.                                                                                              |
| <i>Water management</i>                                                                                                                                                                                                                                     |                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|    | Rain and stormwater harvesting                                                                                    | Rainwater, collected from roofs, and stormwater, collected from the main road, is led to two separate basins. In the stormwater basin, oils are firstly separated from the water, and then solids, PAHs and heavy metals are removed before the water is mixed with the rainwater. The water is then UV-treated and distributed for sanitation and washing purposes. It is found that, due to the nature of this water, the lifespan of washing machines and sanitation infrastructure is also enhanced (Godskesen <i>et al.</i> , 2018:404). |
| <b>Key:</b>                                                                                                                                                                                                                                                 |                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|  Global green economy index criteria met                                                                                                                                 |  Green city index criteria met |  Sustainable cities index criteria met                                                                                                                                                                                                                                                                                                                                                                                                                   |

Source: Own construction (2018) from Brudermann and Sangkakool (2017:224), Brüel (2012:96-98), City of Copenhagen (2014:6-34), Damsø *et al.* (2017:413-414) and Godskesen *et al.* (2018:404).

From Table 5.8 it is apparent that Copenhagen has a holistic approach towards sustainable city planning, as a wide variety of methods for the planning of sustainable cities are employed. Best practice examples relating to nature-based solutions, as implemented in Copenhagen could be identified, for example, as the implementation of green roofs and an increase in the amount of urban green.

### 5.5.3 Vancouver case study

Affolderbach and Schulz (2017:679) describes Vancouver, Canada, as situated in a natural setting that may invoke environmental consciousness in local community members. This could arguably attribute to the city's high-ranking urban sustainability status. A further enhancement to its top-ranking status is the strict provincial legislation that prohibits urban development on valuable farmland, whereby high levels of urban sprawl are prevented (Mendes *et al.*, 2008:442-443). Vancouver's main goal towards sustainable city planning is to achieve the status of being the world's greenest city by 2020, aiming to create a vibrant local economy and inclusive neighbourhoods in an internationally recognised city that is, in correspondence with the Bruntland commission's 1987 report (refer to Chapter 2), viable for future generations (City of Vancouver, 2012:6).

The global green economy index analysis results for Canada is depicted in Figure 5.10.

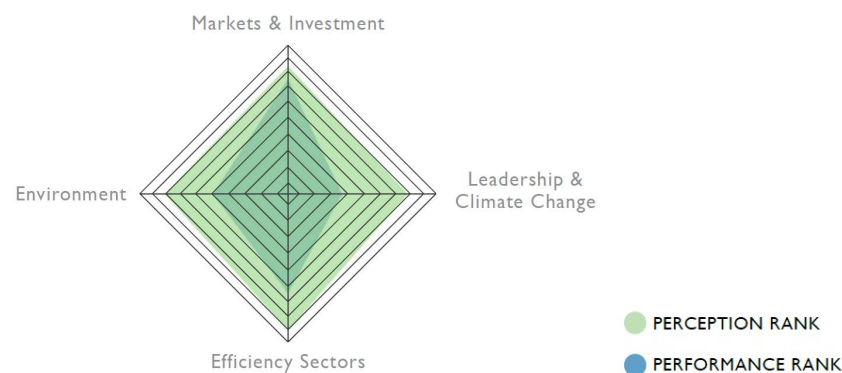


**Figure 5.10: Canada global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:34).**

In Figure 5.10, it is apparent that the perception amongst experts is that Canada has a relatively balanced green economy status. Similarly to the previous two country profiles, there is, however, a definite difference between the performance and perception rank. From the performance rank, markets and investment and the efficiency sectors could be perceived as much more developed than the other two dimensions of this index. According to Tamanini and Valenciano (2016:34) the high-performance ranking for the markets and investment sector is due to high levels of renewable energy development and green innovation initiatives. The outcome of the green city index analysis of Vancouver is presented in Figure 5.11.

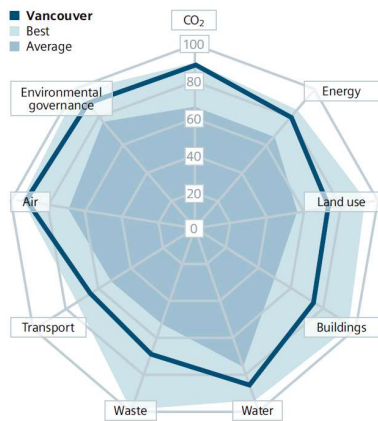


**Figure 5.11: Vancouver green city index criteria outcome**

Source: Summer & Barchfield (2011b:133).

Figure 5.11 depicts Vancouver's strength as lying in air quality, environmental governance, CO<sub>2</sub> emission rates, water management and, to a smaller degree, in energy and land use. The outcome for the investigation towards the sustainable cities index compilation is portrayed in Figure 5.12.

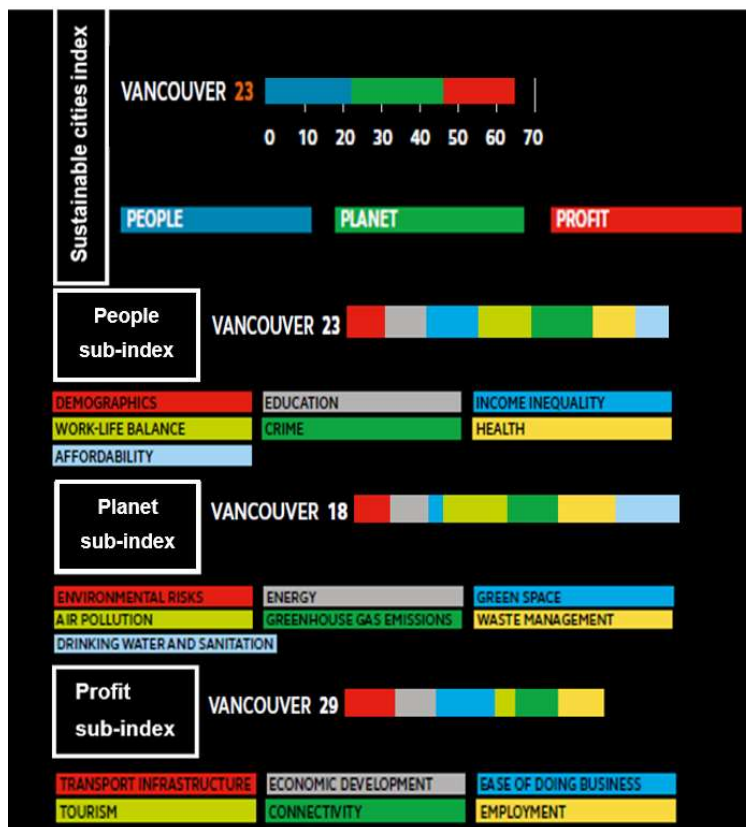


**Figure 5.12: Vancouver sustainable cities index criteria outcome**

Source: Own construction (2018) from Arcadis (2016).

In Figure 5.12 Vancouver is presented as being more focused on the social and environmental elements of sustainability with a somewhat lower score for the economic segment. Possible motivations in best practice examples to achieving these results was investigated and is presented in Table 5.9.

**Table 5.9: Vancouver best practice examples as motivation for high index ranking**

| Criteria indicator                                                                                                          | Best practice example                                                                                             | Discussion on best practice                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Buildings</i>                                                                                                            |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|                                            | Green buildings policy                                                                                            | From 2020, all newly constructed buildings will be required to be carbon neutral (Affolderbach & Schulz, 2017:681).                                                                                                                                                                |
| <i>Energy</i>                                                                                                               |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|                                            | Green energy sources                                                                                              | Due to provincial policy requiring carbon neutral energy supply, 85% of electrical energy supply is sourced from hydroelectricity and the remaining 15% from natural gas and other renewable sources (Moore <i>et al.</i> , 2013:53).                                              |
|                                            | Neighbourhood energy unit                                                                                         | This is an initiative that utilises untreated urban wastewater as a source for locally generating heat and hot water for the local neighbourhood (Summer & Barchfield, 2011b:133).                                                                                                 |
|                                            | Solar system assistance                                                                                           | The city finances about 50% of solar installation costs for residential purposes (Summer & Barchfield, 2011b:133).                                                                                                                                                                 |
| <i>Land use</i>                                                                                                             |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|                                          | Urban green spaces                                                                                                | 12% of the city's land use is considered green space (Summer & Barchfield, 2011b:133).                                                                                                                                                                                             |
| <i>Transport</i>                                                                                                            |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|                                          | Expanded bicycle network                                                                                          | The city bicycle network has more than doubled in size over the past decade (Esawey <i>et al.</i> , 2015:1004) and since 2016 120 bicycle stations have been installed with 1 200 bicycles in the bicycle share programme (City of Vancouver, 2017:7).                             |
| <i>Urban green</i>                                                                                                          |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|                                          | Urban agriculture                                                                                                 | The city's aim to achieve locally-based, sustainable food systems to enhance the economy was re-established in the Vancouver 2020 action plan (Broadway & Broadway, 2011:36). This initiative is based on the encouragement of community gardens (Mendes <i>et al.</i> , 2008:436) |
| <i>Waste</i>                                                                                                                |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|                                          | Gas generation from landfill site                                                                                 | Gas is supplied from the Vancouver landfill site to generate electricity and for heat provision to village farm greenhouses (City of Vancouver, 2017:7).                                                                                                                           |
| <b>Key:</b>                                                                                                                 |                                                                                                                   |                                                                                                                                                                                                                                                                                    |
|  Global green economy index criteria met |  Green city index criteria met |  Sustainable cities index criteria met                                                                                                                                                        |

Source: Own construction (2018) from Affolderbach & Schulz (2017:681), Broadway and Broadway (2011:36), City of Vancouver (2017:7), Esawey *et al.* (2015:1004), Mendes *et al.* (2008:436), Moore *et al.* (2013:53) and Summer and Barchfield (2011b:133).

Table 5.9 depicts the practical methods of sustainable city planning used in the city of Vancouver as being quite holistic and utilising various techniques to achieve a sustainable social, economic and natural environment. Best practice examples relating to nature-based solutions in Vancouver relates to the amount of green open spaces and urban agriculture.

#### 5.5.4 New York City case study

New York City is the largest (Gittleman *et al.*, 2017:131) and most populous city in the United States of America (Faghih-Imani & Eluru, 2016:220). The urban environment could be described as relatively diverse, consisting of high-rise buildings, single family homes, multiple family buildings, along with various forms of urban green and Green Infrastructure initiatives (Kremer *et al.*, 2016:59). Even though this high density and mixed land use demonstrates traces of sustainable urban development, the city is known for a dispersed growth from the city centre (Focas, 2016:82) that may enhance urban sprawl. The city only recently adopted their environmental plan (Slovic & Ribeiro, 2016:7), but aims to generate 50% of electricity supply through renewable sources including solar, hydro and wind energy, and biomass combustion by 2030 (Levy *et al.*, 2017:312-313). The outcome of the global green economy index evaluation of the United States is portrayed in Figure 5.13.

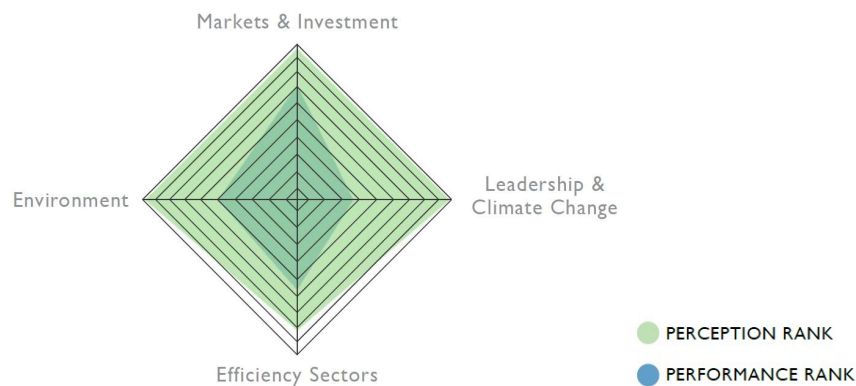


**Figure 5.13: United states global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:56).**

From Figure 5.13, it is evident that the perception amongst experts is that the United States is almost entirely balanced between the different aspects of the index criteria. Similarly, to the previously discussed countries, the perception rank is relatively higher scored than the performance ranking with the country's strength lying in markets and investments, the environment and efficiency sectors. The outcome of the green city index investigation of New York City is depicted in Figure 5.14.

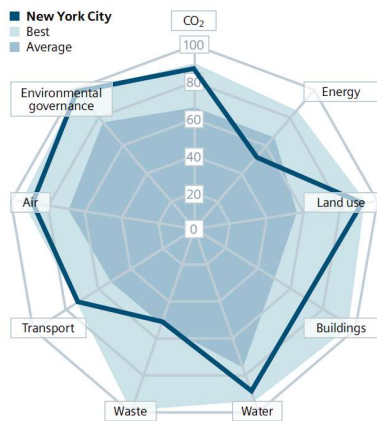


**Figure 5.14: New York green city index criteria outcome**

Source: Summer & Barchfield (2011b:89).

It is apparent from Figure 5.14 that New York city focusses only on specific aspects of green innovation. The city's strengths mainly lie in environmental governance and to a smaller degree in CO<sub>2</sub> emission rates, land use, water management and air quality. The outcome for the evaluation, conducted for the compilation of the sustainable cities index, is depicted in Figure 5.15.

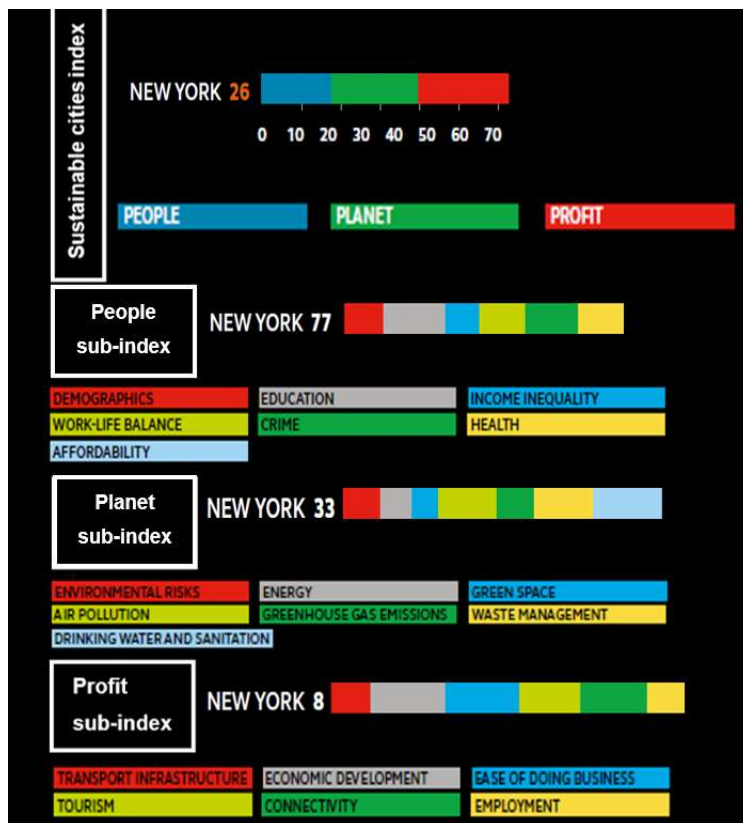


**Figure 5.15: New York sustainable cities index criteria outcome**

Source: Own construction (2018) from Arcadis (2016).

Figure 5.15 depicts New York City as relatively balanced between the three spheres of sustainability in contrast to the previous two indexes' results with the environmental and economic sphere being slightly better developed than the social component. In consideration of these outcomes, possible motivations in best practice examples as to achieving such results are investigated in Table 5.10, with an indication of the index criteria met by each.

**Table 5.10: New York best practice examples as motivation for high index ranking**

| Criteria indicator                                                                                                                                                                                                                                                                                                                                                                      | Best practice example   | Discussion on best practice                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Transport</i>                                                                                                                                                                                                                                                                                                                                                                        |                         |                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                                                                                                                                                                        | Bicycle sharing         | The bicycle sharing programme introduced an increased flexibility for community members to use bicycles as a transportation mode without necessarily owning and maintaining a private bicycle (Faghih-Imani & Eluru, 2016:218). 19.7 Stations per square mile have been established (Campbell & Brakewood, 2017:266). |
|                                                                                                                                                                                                                                                                                                        | Public transport system | New York City has an extensive bus service (Campbell & Brakewood, 2017:266) and an urban rail system (Sharma & Newman, 2017:94).                                                                                                                                                                                      |
| <i>Urban green</i>                                                                                                                                                                                                                                                                                                                                                                      |                         |                                                                                                                                                                                                                                                                                                                       |
|                                                                                                                                                                                                                                                                                                       | Community gardens       | These gardens are green public open spaces managed by local community members for various land uses such as recreational space, urban agriculture and social gatherings (Campbell, 2016:397). There is currently over 500 of these gardens (Gittleman <i>et al.</i> , 2017:131).                                      |
|                                                                                                                                                                                                                                                                                                      | Green Infrastructure    | A broader interest in Green Infrastructure planning has emerged resulting in the small-scale implementation of various initiatives, such as green roofs utilised for urban agriculture and school greenhouses (Campbell, 2016:397).                                                                                   |
|                                                                                                                                                                                                                                                                                                      | Street trees            | Since the establishment of the MillionTrees NYC project, 220 000 street trees have been planted in addition to the 6% of total urban area that street trees have already covered prior to the project (Elliott <i>et al.</i> , 2018:157).                                                                             |
|                                                                                                                                                                                                                                                                                                      | Urban park              | New York City has a major urban park, namely Central Park, providing the urban community with several ecosystem services resulting from interaction between the social, environmental and built environment (Sutton & Anderson, 2016:91).                                                                             |
| <b>Key:</b><br> Global green economy index criteria met  Green city index criteria met  Sustainable cities index criteria met |                         |                                                                                                                                                                                                                                                                                                                       |

**Source:** Own construction (2018) from Campbell (2016:397), Campbell and Brakewood (2017:266), Elliott *et al.* (2018:157), Faghih-Imani and Eluru (2016:218), Gittleman *et al.* (2017:131), Sharma and Newman (2017:94) and Sutton and Anderson (2016:91).

The outcome of the global green economy index and green city index analysis depicting New York City with a limited focus rather than a holistic approach to sustainable city planning may be confirmed by Table 5.10. The initiatives focus mainly on sustainable transport methods and on urban green. From Chapter 3 it is, however, evident that urban green in itself is a holistic approach as it provides benefits for all three spheres of sustainability. This may offer a possible explanation for the sustainable cities index's outcome, reporting the city as relatively balanced.

Best practice examples relating to nature-based solutions in New York City relates to community gardens, Green Infrastructure, street trees and an urban park.

### 5.5.5 Addis Ababa case study

Addis Ababa is the capital city of Ethiopia (Woldegerima *et al.*, 2017:683), located in East Africa (Van Rooijen *et al.*, 2010:54). Unlike most African cities, Addis Ababa, has no colonial heritage (Summer & Barchfield, 2011a:36) that may provide an interesting stance on context-based sustainable city planning. This city is described as currently being quite vulnerable. It has recently suffered under extreme weather events, including river flooding and drought within an already strained socioeconomic environment (Worku, 2017:6). Addis Ababa is characterised by high population density, rapid economic growth (Worku, 2017:6) and urbanisation, high levels of poverty and unemployment, a lack in sufficient housing and infrastructure supply and the pollution of natural resources (Speck, 2010:226). No plan for sustainable city practices could be identified for the city.

As previously explained, only two indexes, namely the global green economy index and the green city index, are used for this city's evaluation, since Johannesburg is the only African city featuring in all three indexes. The Ethiopian global green economy index evaluation is posed in Figure 5.16.

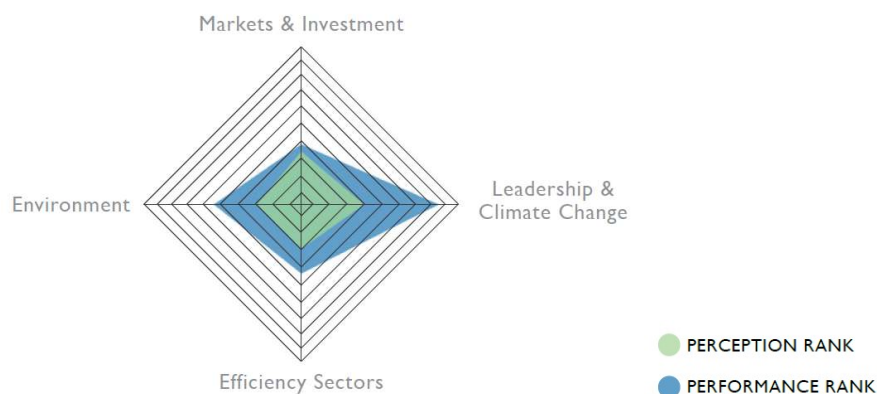


**Figure 5.16: Ethiopia global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:38).**

Figure 5.16 illustrates that, in contrast to the previously explored countries, the perception rank amongst experts of the Ethiopian green economy status is significantly lower than the actual performance rank. The leadership and climate change sector of the index criteria is depicted as the country's main strength. The outcome of the green city index analysis is posed in Figure 5.17.

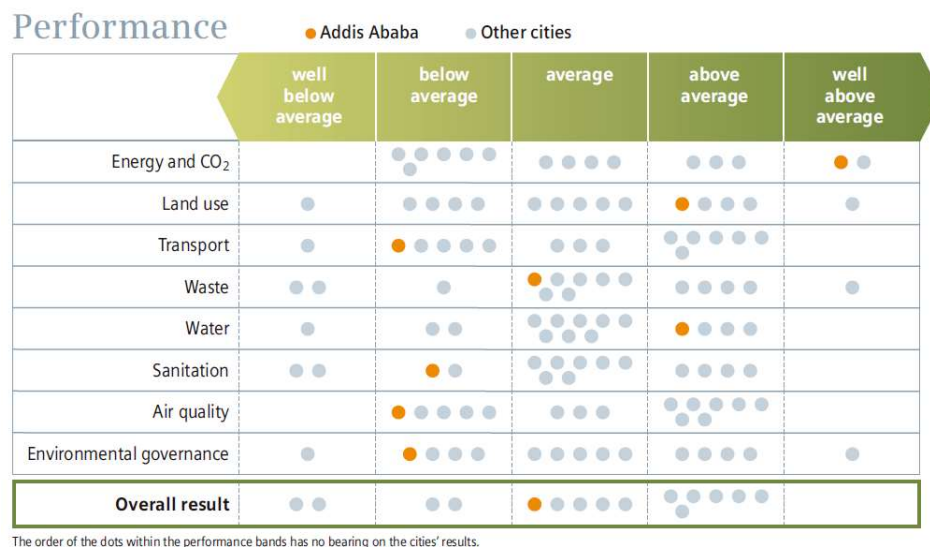


**Figure 5.17: Addis Ababa green city index criteria outcome**

**Source:** Summer & Barchfield (2011a:37).

From Figure 5.17 it is apparent that Addis Ababa's main strengths lie in energy, CO<sub>2</sub> emission rates, land use and water management. In consideration of these outcomes, possible motivations in best practice examples as to the achievement of such results are listed in Table 5.11.

**Table 5.11: Addis Ababa best practice examples as motivation for high index ranking**

| Criteria indicator                                                                  | Best practice example  | Discussion on best practice                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Energy</i>                                                                       |                        |                                                                                                                                                                                                                                                  |
|  | Renewable energy usage | Almost 90% of the city's electricity supply is sourced from renewable energy, with the main source being hydropower (Summer & Barchfield, 2011a:37).                                                                                             |
| <i>Urban green</i>                                                                  |                        |                                                                                                                                                                                                                                                  |
|  | Urban green spaces     | Feyisa <i>et al.</i> (2014:89) identified 21 green spaces in Addis Ababa consisting of official public parks, green spaces around churches and government offices and private parks.                                                             |
|  | Urban agriculture      | Urban farmers in the city mainly grow vegetables, sourcing water informally from the river by blocking waterways that allow water to flow into a system of furrows, without tax charges for such water usage (Van Rooijen <i>et al.</i> , 2010). |

| Criteria indicator                                                                                                                                                                                                                                       | Best practice example | Discussion on best practice                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Urban green continued<br>                                                                                                                                               | Urban forest          | The urban forest is located on the mountains in the northern part of the city and covers about 5000 ha. The initiative was introduced in 1985 in response to the increasing demand on wood to reduce pressure on remaining natural vegetation (Wolgegerima <i>et al.</i> , 2017:684). |
| Waste management<br>                                                                                                                                                    | Recycling initiatives | A small-scale recycling centre is located in Addis Ababa where waste paper and other waste such as banana leaves and pineapples are converted into paper, used to create postcards, photo frames, notebooks and coffee bags (Speck, 2010:226).                                        |
| <b>Key:</b><br> Global green economy index criteria met  Green city index criteria met |                       |                                                                                                                                                                                                                                                                                       |

Source: Own construction (2018) from Feyisa *et al.* (2014:89), Speck (2010:226), Summer and Barchfield (2011a:37), Van Rooijen *et al.* (2010), Wolgegerima *et al.* (2017:684) and.

The practical methods towards the achievement of urban sustainability used in Addis Ababa is depicted in Table 5.11 as focusing mainly on nature-based solutions. From Chapter 3, it is apparent that such initiatives may assist in addressing the previously described socioeconomic constraints present in Addis Ababa. Best practice examples relating to nature-based solutions in Addis Ababa could be identified as green open spaces, urban agriculture and an urban forest.

### 5.5.6 Johannesburg case study

Johannesburg is a South African city located in Sub-Saharan Africa and is regarded as the largest urban concentration in Africa (Rogerson & Rogerson, 2015:347). This may serve as a valuable contribution to the study to gain an understanding of the planning for urban sustainability within a rapidly expanding urban context. Hetz (2016:1175) describes Johannesburg as being prone to environmental risks such as flooding. Mitigation initiatives towards these environmental risks may consequently provide insight into the practice of sustainable city planning. The city has a long-term development agenda, the Joburg 2040 strategy, aiming to achieve sustainable city planning in a holistic manner (Hetz, 2016:1175) and addressing inequality through substantial community investment (Ndhlovu *et al.*, 2017:1).

The global green economy index analysis outcome for South Africa is presented in Figure 5.18.

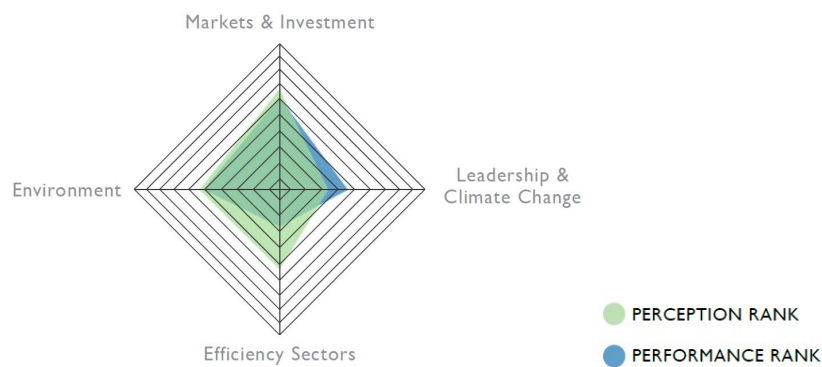


**Figure 5.18: South African global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:53)**

Figure 5.18 depicts the perception on the South African green economy status amongst experts as being relatively balanced and from the performance rank it is evident that, excepting the efficiency sectors, the perception and performance ranking for the South African green economy status is comparably similar. This is in contrast to the previously discussed countries where a definite difference between the perception and performance rankings could be observed. South Africa's main strength is depicted as lying in the markets and investment criteria sector and to a smaller extent in the leadership and climate change, and environmental sectors.

Figure 5.19 illustrates the outcome of the green city index's analysis of Johannesburg's environmental sustainability.

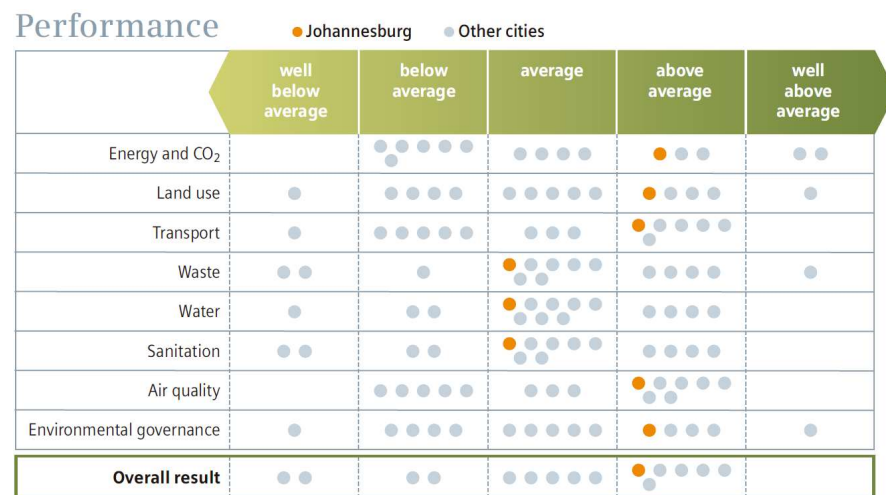


**Figure 5.19: Johannesburg green city index criteria outcome**

**Source: Summer & Barchfield (2011a:65).**

From Figure 5.19, it could be perceived that Johannesburg's strong points regarding green city initiatives lie within their CO<sub>2</sub> emission rates, land use, transportation, air quality and

environmental governance, with waste and water management and sanitation infrastructure receiving an average-ranking. The outcome of the analysis for the Johannesburg sustainable cities index ranking is presented in Figure 5.20.

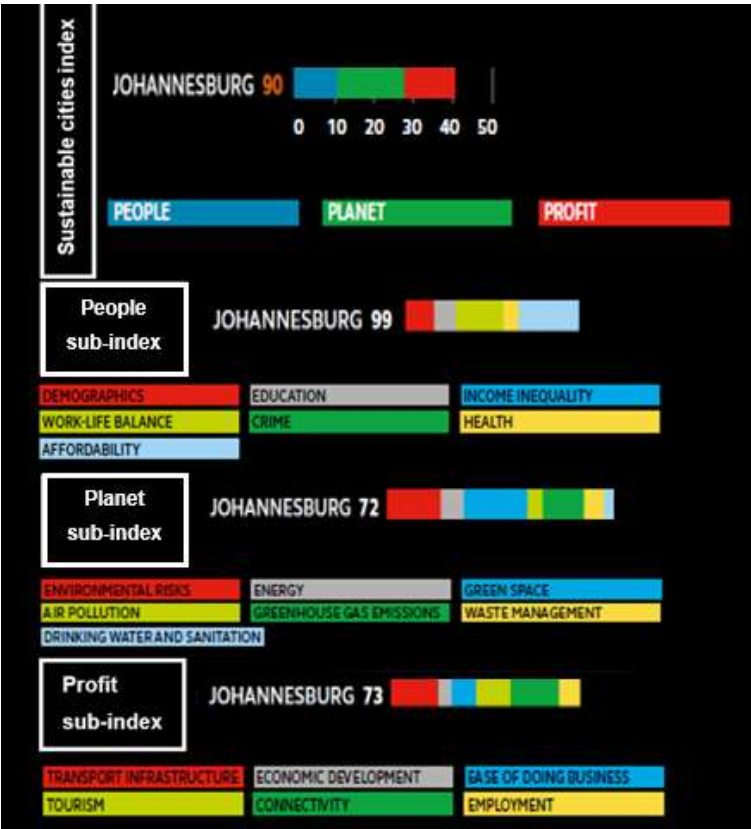


**Figure 5.20: Johannesburg sustainable cities index criteria outcome**  
**Source: Own construction (2018) from Arcadis (2016).**

The environmental sphere of sustainable city planning is represented in Figure 5.20 as the highest scoring sphere of the Johannesburg urban sustainability status. The social and economic sphere follows with a significantly lower score. Table 5.12 presents best practice examples of how the results obtained by the index criteria evaluations for the measurement of the city’s level of sustainability are achieved. An indication as to the index’s criteria met by each initiative is depicted in the table, along with a further discussion on the implementation of these best practice examples.

**Table 5.12: Johannesburg best practice examples as motivation for high index ranking**

| Criteria indicator                                                                                                                                                                                                                                                                                                                                                                       | Best practice example        | Discussion on best practice                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Energy</i>                                                                                                                                                                                                                                                                                                                                                                            |                              |                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                         | Solar energy                 | Solar water heaters were installed in low-cost houses with international financial aid (Summer & Barchfield:2011a:65).                                                                                                                                                                                                                                                                  |
| <i>Land use</i>                                                                                                                                                                                                                                                                                                                                                                          |                              |                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                         | Inner city revitalisation    | Projects to rehabilitate under-populated neighbourhoods within the city centre are implemented, attempting to counter the high urban sprawl levels (Summer & Barchfield:2011a:65).                                                                                                                                                                                                      |
| <i>Transport</i>                                                                                                                                                                                                                                                                                                                                                                         |                              |                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                         | Public transport initiatives | A high speed trainline that links downtown Johannesburg and Pretoria and a rapid bus transit system was installed (Summer & Barchfield:2011a:66).                                                                                                                                                                                                                                       |
| <i>Urban green</i>                                                                                                                                                                                                                                                                                                                                                                       |                              |                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                         | Urban green revitalisation   | The city is investing in rehabilitating existing but decayed wetlands and clearing alien vegetation (Schäffler <i>et al.</i> , 2013:65).                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                         | Urban parks                  | Various parks within the city of Johannesburg serve the surrounding community by providing different ecosystem services, and access to these parks is considered a basic human right (De Vries & Kotze, 2016:124).                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                       | Private gardens              | A significant number of private gardens is situated in the suburbs of Johannesburg (Schäffler <i>et al.</i> , 2013:58).                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                       | Urban forest                 | The city claims to be the world's largest urban forest, with 10 million trees within the city limits (Schäffler <i>et al.</i> , 2013:58).                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                       | Wetlands                     | Johannesburg employs hill slope seepage and valley bottom wetlands, enabling the city to manage heavy rainfall more effectively than with traditional stormwater infrastructure. These wetland areas also provide valuable urban green and thus provide various ecosystem services. Wetlands must be preserved in accordance to the Johannesburg planning guidelines (Hetz, 2016:1177). |
| <i>Waste</i>                                                                                                                                                                                                                                                                                                                                                                             |                              |                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                       | Informal waste recycling     | Informal solid waste recycling within the city of Johannesburg form an integral part of the city's informal economy and serve as a survival strategy for the urban poor, left vulnerable as a result of the rapid urbanisation and a stagnating economy (Simatele <i>et al.</i> , 2017:122).                                                                                            |
| <b>Key:</b><br> Global green economy index criteria met  Green city index criteria met  Sustainable cities index criteria met |                              |                                                                                                                                                                                                                                                                                                                                                                                         |

Source: Own construction (2018) from De Vries and Kotze (2016:124), Hetz (2016:1177), Schäffler *et al.* (2013:58-65), Simatele *et al.* (2017:122) and Summer and Barchfield (2011a:65-66).

Table 5.12 represents practical methods of sustainable city planning used in the city of Johannesburg to achieve a sustainable social, economic and natural environment. Most of the initiatives relate to a utilisation of the benefits of urban green, but projects regarding transportation, energy and land use have also been implemented. Best practice examples regarding nature-based solutions implemented in Johannesburg could be identified as urban green revitalisation projects, urban parks, private gardens, an urban forest and the utilisation of ecosystem services provided by wetlands.

### 5.5.7 Seoul case study

Seoul is the capital city of South Korea (Jang & Kang, 2015:161) and is described as one of the key Asian cities within the global context (Joo & Seo, 2018:128). As with most modern cities, Seoul suffers under high levels of urbanisation (Byrne *et al.*, 2015:835), resulting in shortage of the necessary housing availability and consequently large informal settlements was established in the hillside area surrounding the city (Yoon, 2017:36). Approaches to counteract such urban sprawl may provide a valuable contribution towards this study, as urban sprawl is described in Chapter 2 as one of the major threats towards achieving urban sustainability. South Korea announced its low-carbon and green growth development approach in 2008 (Byrne *et al.*, 2015:834) and considers provision for pedestrians as an integral part of planning for the city (Jung *et al.*, 2017:270).

Figure 5.21 portrays the outcome of South Korea's green economy status evaluation.

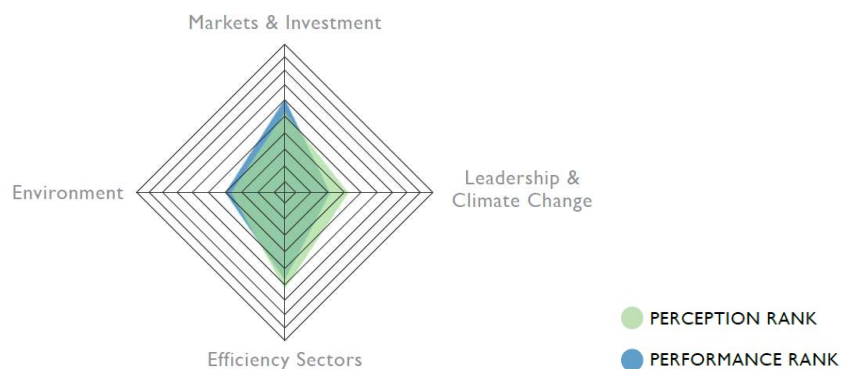
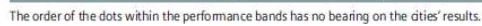


**Figure 5.21: South Korean global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:53).**

From Figure 5.21 it is evident that, similar to South Africa, the perception and performance rank for the South Korean green economy status is comparatively similar. The country's strengths are depicted in markets and investment and in the efficiency sectors. The outcome of the green city index investigation of Seoul is illustrated in Figure 5.22.

● Seoul      ● Other cities



**Source: Summer (2011:97).**

**Sustainable cities index**

**SEOUL 7**

0 10 20 30 40 50 60 70

**PEOPLE** **PLANET** **PROFIT**

**People sub-index**

**SEOUL 1**

DEMOGRAPHICS EDUCATION INCOME INEQUALITY  
WORK-LIFE BALANCE CRIME HEALTH  
AFFORDABILITY

**Planet sub-index**

**SEOUL 26**

ENVIRONMENTAL RISKS ENERGY GREEN SPACE  
AIR POLLUTION GREENHOUSE GAS EMISSIONS WASTE MANAGEMENT  
DRINKING WATER AND SANITATION

**Profit sub-index**

**SEOUL 18**

TRANSPORT INFRASTRUCTURE ECONOMIC DEVELOPMENT EASE OF DOING BUSINESS  
TOURISM CONNECTIVITY EMPLOYMENT

**Source: Own construction (2018) from Arcadis (2016).**

Figure 5.23 depicts Seoul as relatively balanced between the three spheres of sustainability, with the social sphere scoring the highest, followed by the environmental sphere with a slightly lower score.

In consideration of these outcomes, possible motivations in best practice examples was investigated and presented in Table 5.13, with an indication of the index criteria met by each.

**Table 5.13: Seoul best practice examples as motivation for high index ranking**

| Criteria indicator                                                                  | Best practice example       | Discussion on best practice                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Energy</i>                                                                       |                             |                                                                                                                                                                                                                                            |
|    | Renewable energy policy     | Utility companies are obliged to source a certain rate of power production from renewable energy (Byrne <i>et al.</i> , 2015:835).                                                                                                         |
| <i>Environmental governance</i>                                                     |                             |                                                                                                                                                                                                                                            |
|    | Public engagement           | Campaigns such as the Blooming Flower, Seoul, have been launched to encourage local community members to cultivate urban vegetation (Lee <i>et al.</i> , 2017:299).                                                                        |
| <i>Land use</i>                                                                     |                             |                                                                                                                                                                                                                                            |
|   | Greenbelt regulation        | A regulation is enforced, prohibiting urban sprawl along a specifically zoned green belt (Kang & Kim, 2015:260).                                                                                                                           |
|  | Corporate relocation        | To counteract high levels of urbanisation, several public corporations have been relocated to nearby shrinking towns, giving them an opportunity for growth and assisting in lowering urban sprawl levels for Seoul (Joo & Seo, 2018:133). |
| <i>Transport</i>                                                                    |                             |                                                                                                                                                                                                                                            |
|  | Bicycle infrastructure      | The city has added over 100km of bicycle lanes and implements initiatives for example participation in 'world car free day' to encourage bicycle usage (Summer, 2011:98).                                                                  |
|  | Green fuel                  | City busses running on diesel are replaced with natural gas fuelled busses (Summer, 2011:99).                                                                                                                                              |
|  | Mass transit system         | The main means of transport is the Seoul subway that serves as a mass transit system (Kim, 2018:213).                                                                                                                                      |
| <i>Urban green</i>                                                                  |                             |                                                                                                                                                                                                                                            |
|  | Urban agriculture education | An urban agriculture festival has been launched in 2012 as an educational platform, from which several urban farming initiatives emerged (Lee <i>et al.</i> , 2017:299).                                                                   |
|  | Urban agriculture           | Urban agriculture is widely implemented, for example in interior and exterior spaces in residential areas, rooftop gardens and farming on abandoned spaces within the city and open spaces at schools (Oh & Kim, 2017:124).                |

| Criteria indicator                                                                                                        | Best practice example                                                                                           | Discussion on best practice                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Urban green continued                                                                                                     |                                                                                                                 |                                                                                                                                                                                                  |
|                                          | Urban greenway                                                                                                  | An elevated freeway was converted into a linear green space, creating a pedestrian-friendly corridor along a stream (Jang & Kang, 2015:161).                                                     |
| Waste                                                                                                                     |                                                                                                                 |                                                                                                                                                                                                  |
|                                          | Green fines                                                                                                     | The city has set a limit on the amount of distributed disposable goods such as shopping bags, cups, razors and toothbrushes and levy fines on businesses exceeding this limit (Summer, 2011:98). |
| <b>Key:</b>                                                                                                               |                                                                                                                 |                                                                                                                                                                                                  |
|  Global green economy index criteria met |  Green city index criteria met |  Sustainable cities index criteria met                                                                        |

Source: Own construction (2018) from Byrne *et al.* (2015:835), Jang and Kang (2015:161), Joo and Seo (2018:133), Kang and Kim (2015:260), Kim (2018:213), Lee *et al.* (2017:299), Oh and Kim (2017:124) and Summer (2011:98-99).

Table 5.13 portrays the practical methods used in Seoul as being relatively holistic and utilising various techniques to achieve a sustainable social, economic and natural environment. Nature-based solutions are implemented in the form of urban agriculture and the urban greenway project.

### 5.5.8 Hong Kong case study

Hong Kong is located on the south coast of China (Peng & Jim, 2015:555) in Southeast Asia (Xue & Lau, 2016:333). It operates as a city state enjoying high levels of autonomy in domestic policy, as it has only recently been joined to China after gaining independence from Great Britain in 1997 (Higgins, 2013:58). The city is compact and characterised by a high population density and high-rise buildings (Tam *et al.*, 2016:46). These characteristics may pose a threat towards urban sustainability but also provides an opportunity for efficient transport services. As such, Hong Kong is known for holding some of the lowest car-dependency rates in the world (Higgins, 2013:59). In 2000, the city announced its intention to actively develop programmes to increase the amount of vegetation within the city (Tam *et al.*, 2016:46-47) and from 2009 increased building energy efficiency has been encouraged (Peng & Jim, 2015:555). The Hong Kong 2030 strategy commits to sustainable city transformation through efficient governance (Higgins, 2013:60).

The outcome of the Chinese analysis for the global green economy index is depicted in Figure 5.24.

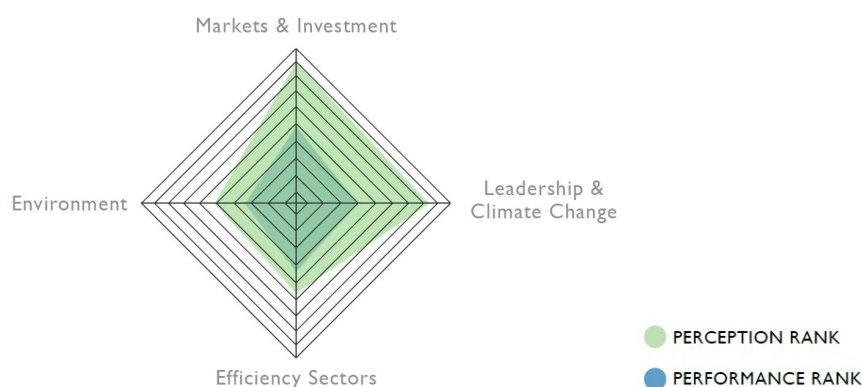


**Figure 5.24: Chinese global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:35).**

From Figure 5.24, it is apparent that the perception of the Chinese green economy status amongst experts is similar to most of the previously evaluated countries in that the perception ranking is significantly higher than the performance ranking. The country's strength lies mainly in markets and investments, but the other three sectors of the global green economy index are also well developed. The outcome of the Hong Kong green city index analysis is illustrated in Figure 5.25.

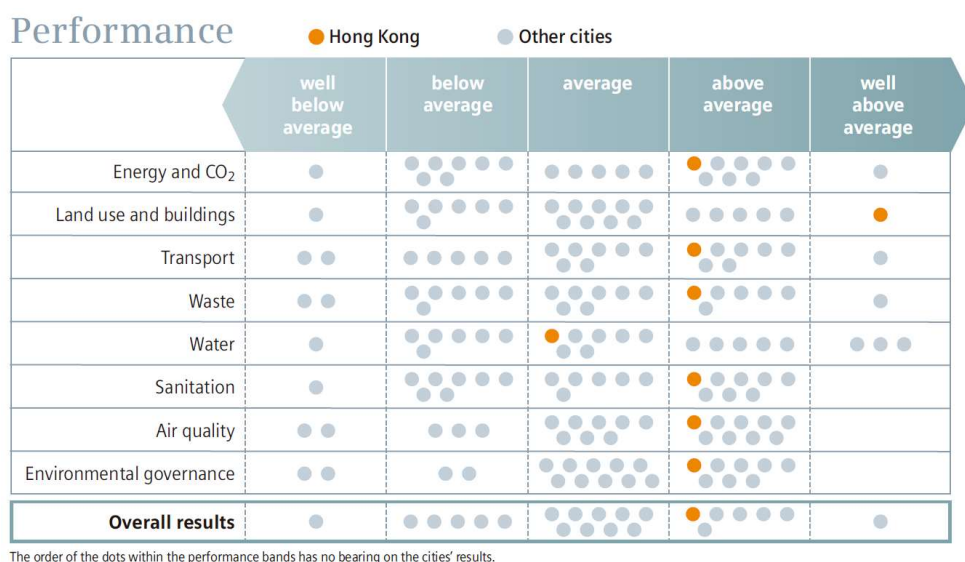


**Figure 5.25: Hong Kong green city index criteria outcome**

**Source: Summer (2011:61).**

Hong Kong is portrayed in Figure 5.25 as relatively balanced between the green city index criteria, with land use and buildings scoring above average; energy efficiency, CO<sub>2</sub> emission rates, transportation, waste management, sanitation, air quality and environmental governance rated as above average; and water management as average. The outcome of the sustainable cities index analysis is presented in Figure 5.26.

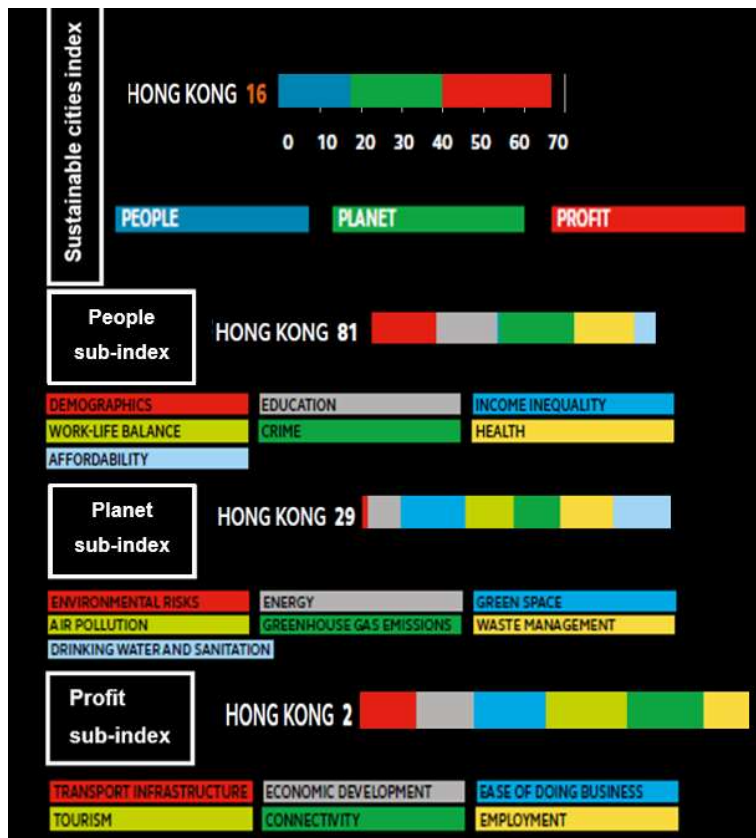


Figure 5.26: Hong Kong sustainable cities index criteria outcome

Source: Own construction (2018) from Arcadis (2016).

It could be perceived from Figure 5.26 that Hong Kong's greatest strength lies within their economic performance, but that their environmental governance is also well developed.

A discussion on best practice examples that may assist in obtaining the results as considered for the city's index rankings, along with an indication as to what index criteria is met by the best practice example, is presented in Table 5.14.

Table 5.14: Hong Kong best practice examples as motivation for high index ranking

| Criteria indicator | Best practice example | Discussion on best practice                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Land use</i>    |                       |                                                                                                                                                                                                                                                                                                                                                                                                      |
| \$                 | Underground network   | The topographical landscape limits the city from expanding outwards and therefore an underground network has been created, that includes parking facilities, utilities such as water and cable tunnels, flood storage tanks, landslide mitigation measures and unpleasant or hazardous government facilities such as a sewage treatment plant and an explosives depot (Ho <i>et al.</i> , 2016:704). |

| Criteria indicator                                                                                                        | Best practice example                                                                                           | Discussion on best practice                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Transport</i>                                                                                                          |                                                                                                                 |                                                                                                                                                     |
|                                          | Mass transit system                                                                                             | An extensive metro system has been implemented in Hong Kong (Sharma & Newman, 2017:94).                                                             |
|                                          | Underground pedestrian network                                                                                  | Underground pedestrian links have been created to connect the mass transit stations (Ho <i>et al.</i> , 2016:704).                                  |
|                                                                                                                           | Underground transportation                                                                                      | Road and railway tunnels have also been established underground in Hong Kong (Ho <i>et al.</i> , 2016:704).                                         |
| <i>Urban green</i>                                                                                                        |                                                                                                                 |                                                                                                                                                     |
|                                          | Green roofs                                                                                                     | Green roofs have mostly been established on government buildings such as schools, hospitals and governmental offices (Tam <i>et al.</i> , 2011:17). |
|                                          | Urban parks                                                                                                     | Hong Kong has various urban parks and small open spaces within the city (Chan <i>et al.</i> , 2015:57).                                             |
| <b>Key:</b>                                                                                                               |                                                                                                                 |                                                                                                                                                     |
|  Global green economy index criteria met |  Green city index criteria met |  Sustainable cities index criteria met                           |

Source: Own construction (2018) from Chan *et al.* (2015:57), Ho *et al.* (2016:704), Sharma and Newman (2017:94) and Tam *et al.* (2011:17).

From Table 5.14, it is apparent that Hong Kong's main focus is on transportation and urban green. Best practice examples relating to nature-based solutions as implemented in Hong Kong could be identified as the implementation of green roofs and urban parks.

### 5.5.9 Rio de Janeiro case study

Rio de Janeiro is one of Brazil's most densely populated economic hubs (Santos & Ribeiro, 2013:256), situated in Latin America and characterised by large informal settlements (Arcidiacono *et al.*, 2017:357-361), high levels of urban sprawl and an automotive-transport-oriented growth pattern (Herzog, 2016:141). From Chapter 2 it is apparent that these challenges characterise most modern cities and therefore mitigation initiatives may provide valuable insight into the planning of sustainable cities. The city released a resilience strategy aiming to address the Rio de Janeiro's main vulnerabilities and to achieve greater levels of urban sustainability (Paes *et al.*, 2016?:16). Veiga and Magrini (2009:654) write that the city does however still struggle to implement these sustainable city planning practices.

Brazil's global green economy index evaluation is portrayed in Figure 5.27.

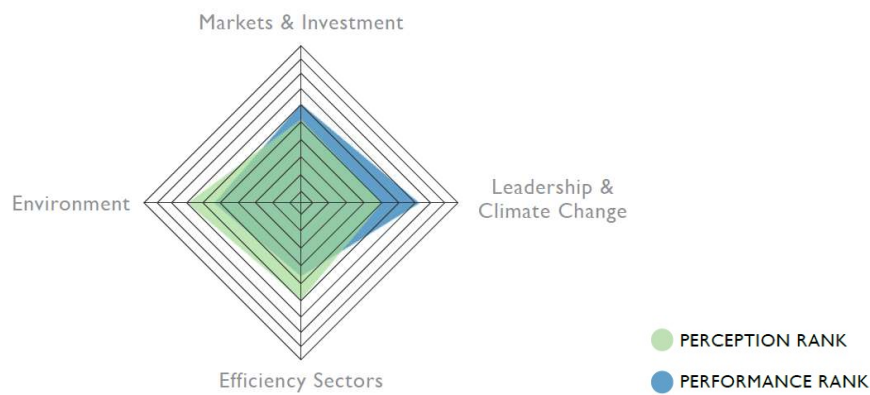


**Figure 5.27: Brazilian global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:33).**

Figure 5.27 illustrates that the perception and performance rank for Brazil is comparatively similar and that the country's green economy status is relatively balanced, with leadership and climate change portrayed as the country's main strength. The outcome of the green city index analysis is posed in Figure 5.28.

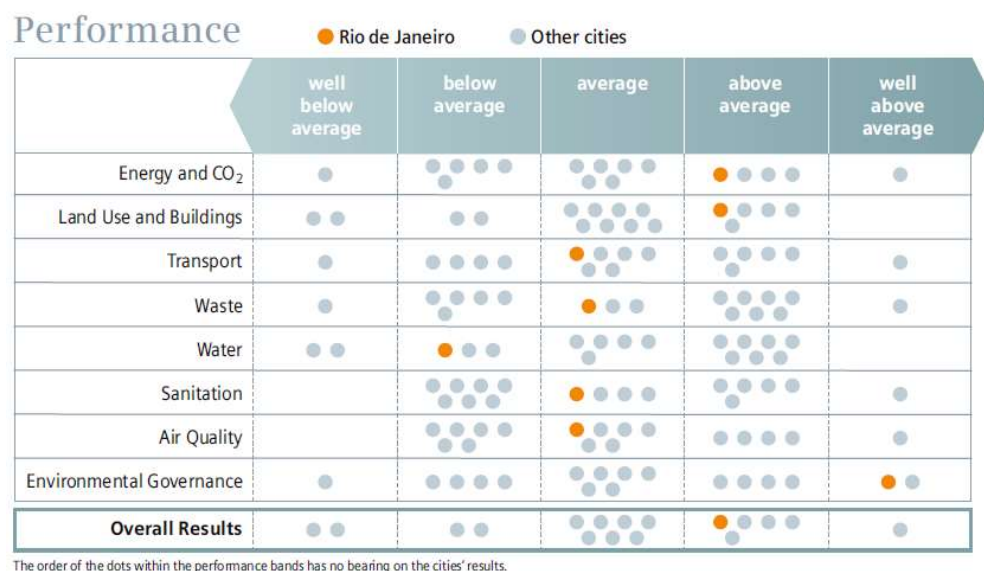


**Figure 5.28: Rio de Janeiro green city index criteria outcome**

**Source: Summer and Barchfield (2010:89).**

Rio de Janeiro's main strength is presented in Figure 5.28 as lying in environmental governance (rated well above average) with energy efficiency, CO<sub>2</sub> emission rates, land use and buildings scoring an above average rating. The results for the sustainable cities index is depicted in Figure 5.29.

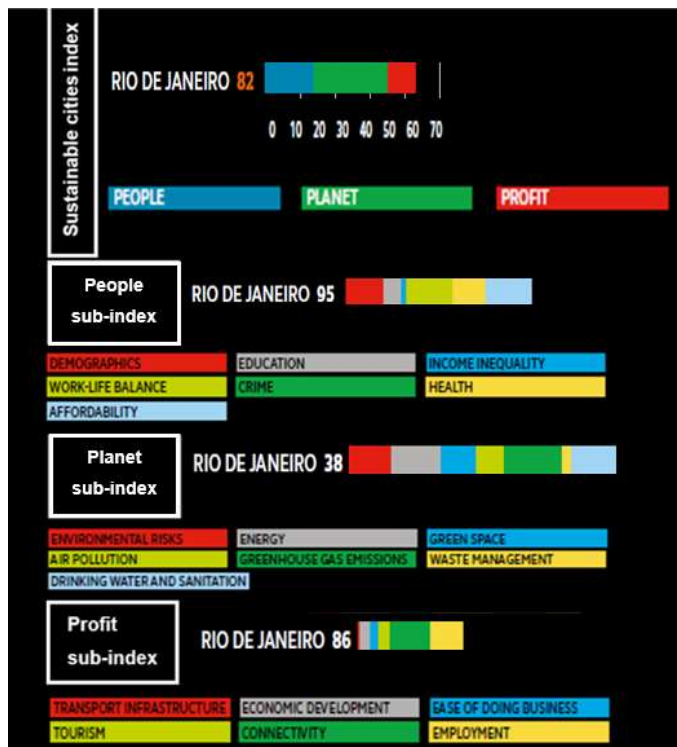


Figure 5.29: Rio de Janeiro sustainable cities index criteria outcome

Source: Own construction (2018) from Arcadis (2016).

The city is posed in Figure 5.29 as focusing mainly on environmental sustainability. Table 5.15 illustrates best practice examples towards urban sustainability, as found in Rio de Janeiro.

Table 5.15: Rio de Janeiro best practice examples as motivation for high index ranking

| Criteria indicator                                                                                                          | Best practice example                                                                                             | Discussion on best practice                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Environmental governance</i>                                                                                             |                                                                                                                   |                                                                                                                                                                          |
|                                          | Protection policies                                                                                               | The city's indigenous ecosystem remnants are lawfully protected by three conservation units (Herzog, 2016:141).                                                          |
|                                          | Emission limits                                                                                                   | An annual emission test is required for all licensed vehicles and vehicles exceeding the set limit are prohibited from using state roads (Summer & Barchfield, 2010:91). |
| <i>Transport</i>                                                                                                            |                                                                                                                   |                                                                                                                                                                          |
|                                          | Bicycle infrastructure                                                                                            | Additional bicycle lanes are built (Summer & Barchfield, 2010:90).                                                                                                       |
|                                          | Public transportation                                                                                             | The city is investing in expanding existing metro lines and increasing metro stations (Summer & Barchfield, 2010:90).                                                    |
| <b>Key:</b>                                                                                                                 |                                                                                                                   |                                                                                                                                                                          |
|  Global green economy index criteria met |  Green city index criteria met |  Sustainable cities index criteria met                                               |

Source: Own construction (2018) from Herzog (2016:141) and Summer and Barchfield (2010:90-91).

The practical methods towards the achievement of urban sustainability used in Rio de Janeiro is depicted in Table 5.15 as focusing mainly on environmental governance and sustainable transport methods. Best practice examples concerning nature-based solutions could not be identified from the case study analysis of Rio de Janeiro.

#### 5.5.10 Mexico City case study

Mexico City is the capital of Mexico (Pérez-Campuzano *et al.*, 2016:130), situated in Latin America (Guibrunet *et al.*, 2017:355). The city is described as one of the largest urban agglomerations in the world (Torres-Lima *et al.*, 2010:3), that may account for its diverse physical environment, ranging from mountain areas to valleys (Pérez-Campuzano *et al.*, 2016:130). The city's climate change action plan was adopted in 2014 with the aim to reduce the social, environmental and economic risks resulting from climate change (Espinosa *et al.*, 2016:14).

The global green economy index analysis outcome for Mexico is presented in Figure 5.30.



**Figure 5.30: Mexican global green economy index criteria outcome**

**Source: Tamanini & Valenciano (2016:45).**

From Figure 5.30 it is evident that the perception ranking amongst experts of the Mexican green economy status is slightly lower than the performance rank. The leadership and climate change sector scored the highest.

Figure 5.31 illustrates the outcome of the green city index's analysis of Mexico City's environmental sustainability.



Mexico City is presented in Figure 5.32 as mainly focusing on the environmental sphere of sustainable city planning, with the social dimension following with a slighter lower score. Table 5.16 presents best practice examples on Mexico City's urban sustainability initiatives.

**Table 5.16: Mexico City best practice examples as motivation for high index ranking**

| Criteria indicator                                                                                                                                                                                                                                                                                                                                                                      | Best practice example            | Discussion on best practice                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Energy</i>                                                                                                                                                                                                                                                                                                                                                                           |                                  |                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                        | Sustainable energy sources       | Public lighting infrastructure is upgraded to receive energy from renewable sources (Espinosa <i>et al.</i> , 2016:41-45).                                                                                                |
| <i>Transport</i>                                                                                                                                                                                                                                                                                                                                                                        |                                  |                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                        | Bicycle infrastructure           | Bicycle infrastructure is established in strategic areas within the city (Espinosa <i>et al.</i> , 2016:41-59).                                                                                                           |
|                                                                                                                                                                                                                                                                                                        | Electric taxi fleet              | An electric taxi fleet has been created to reduce carbon emission rates within the city (Espinosa <i>et al.</i> , 2016:50).                                                                                               |
|                                                                                                                                                                                                                                                                                                        | Bus rapid transit                | A rapid bus transit system has been established in Mexico City (Summer & Barchfield, 2010:65).                                                                                                                            |
| <i>Urban green</i>                                                                                                                                                                                                                                                                                                                                                                      |                                  |                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                        | Conservation zone                | This is an area where hunting, logging, the introduction of foreign species, grass harvesting, river modifications, urban development and urban waste disposal are prohibited (Pérez-Campuzano <i>et al.</i> , 2016:131). |
|                                                                                                                                                                                                                                                                                                      | Green roofs                      | 778,17 ha green roofs have been established within the city limits (Espinosa <i>et al.</i> , 2016:54).                                                                                                                    |
|                                                                                                                                                                                                                                                                                                      | Urban agriculture                | 20% of Mexico City's food is locally produced and is sold at a major, central market (Dieleman, 2017:5158-5159).                                                                                                          |
|                                                                                                                                                                                                                                                                                                      | Urban green revitalisation       | Urban green spaces have been rehabilitated for optimal usage of ecosystem services (Espinosa <i>et al.</i> , 2016:54).                                                                                                    |
| <i>Water</i>                                                                                                                                                                                                                                                                                                                                                                            |                                  |                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                      | Water tariff raise               | Mexico City has raised water tariffs in order to reduce high levels of consumption (Summer & Barchfield, 2010:66).                                                                                                        |
| <i>Waste</i>                                                                                                                                                                                                                                                                                                                                                                            |                                  |                                                                                                                                                                                                                           |
|                                                                                                                                                                                                                                                                                                                                                                                         | Plastic shopping bag prohibition | The distribution of free plastic shopping bags has been prohibited (Summer & Barchfield, 2010:66).                                                                                                                        |
|                                                                                                                                                                                                                                                                                                      | Informal waste recycling         | Informal waste workers collect recyclable waste from the streets, government collection trucks, separation plants and landfill sites (Guibrunet <i>et al.</i> , 2017:358).                                                |
| <b>Key:</b><br> Global green economy index criteria met  Green city index criteria met  Sustainable cities index criteria met |                                  |                                                                                                                                                                                                                           |

Source: Own construction (2018) from Espinosa *et al.* (2016:14), Dieleman (2017:5158-5159), Guibrunet *et al.* (2017:358), Pérez-Campuzano *et al.* (2016:131) and Summer and Barchfield (2010:65).

Table 5.16 presents practical methods of sustainable city planning used in Mexico City to achieve a sustainable social, economic and natural environment. It is apparent that the city approaches sustainable city planning in a holistic manner as it applies mitigation efforts in various areas such as energy efficiency, transportation, nature-based solutions and water and waste management. Best practice examples concerning nature-based solutions could be identified as conservation and rehabilitation efforts, green roofs and urban agriculture.

## **5.6 Best practice case studies and the sustainability agenda**

From the previous section, it is apparent that all the analysed top-ranking cities are either capital cities or major economic centres within their countries. In accordance to the literature findings, most of these cities have challenges regarding urban sprawl and high population densities. The cities situated in the Global South were depicted as struggling with higher levels of urbanisation, large informal settlements and the literature study presented the two African cities as being vulnerable to environmental risks. Most of the cities have policy documents guiding their quest for urban sustainability. The European cities and Mexico City focus on climate change mitigation goals; the North American and Canadian cities and Seoul emphasises urban greening as development strategy; and Johannesburg, Hong Kong and Rio de Janeiro focus on holistic development goals towards sustainable city planning. These ten cities may therefore be described as being contextually different with regards to their historical background and their physical, economic and social environments, but are all seeking methods to plan for a sustainable city, supporting the notion of context-based planning as discussed in Chapters 2 and 4.

This notion of context-based planning is gaining importance in academic literature (Cornelius *et al.*, 2017:419), supporting the sustainability agenda's focus on the social, economic and environmental spheres. Despite this growing interest in context-based approaches amongst scholars, Healy (2011:191) points out that planning practices from the Global North is still often copied in the Global South in attempts to create globally significant cities (explored in Chapter 6).

## **5.7 Conclusion**

A growing amount of literature emphasises the importance of translating global knowledge on the planning for sustainable cities to a more local approach, even though the vast majority of academic literature still focuses primarily on the Global North (refer to Chapter 4). A paradigm shift from global to local applications of sustainable city planning has not yet been fully made amongst decision makers.

In an attempt to identify best practices, ten top-ranking cities regarding urban sustainability was analysed in terms of their planning practices. The results of this analysis regarding the application of nature-based solutions (refer to Chapters 3 and 4) were presented in Table 5.17.

**Table 5.17: Context-based application of nature-based solutions**

| Region       |                                      | Nature-based solution | Context-based application                                                                                                            |
|--------------|--------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Global North | Europe                               | Green roofs           | Policies to force green roof implementation for businesses.                                                                          |
|              |                                      | Street trees          | State investments to improve the state of street trees.                                                                              |
|              |                                      | Urban green spaces    | Policy requirements for planning of high levels of urban green spaces.                                                               |
|              | The United States of America/ Canada | Green roofs           | Small-scale private implementation used for urban agriculture.                                                                       |
|              |                                      | Street trees          | State-driven projects to increase the number of trees.                                                                               |
|              |                                      | Urban agriculture     | Encouragement for the establishment of community gardens.                                                                            |
|              |                                      | Urban green spaces    | Policy requirements for planning of high levels of urban green spaces.                                                               |
| Global South | Africa                               | Street trees          | Encouragement of private planting of trees.                                                                                          |
|              |                                      | Urban agriculture     | Allowing citizens to utilise public resources for farming on private open spaces.                                                    |
|              |                                      | Urban green spaces    | Governmental policy requirements, implementation and revitalisation of urban green spaces and the implementation of private gardens. |
|              | Asia                                 | Green roofs           | Governmental implementation of green roofs.                                                                                          |
|              |                                      | Urban agriculture     | Private implementation of urban agriculture.                                                                                         |
|              |                                      | Urban green spaces    | Governmental establishment of urban green spaces.                                                                                    |
|              | Latin America                        | Green roofs           | Governmental establishment of green roofs.                                                                                           |
|              |                                      | Urban agriculture     | Private farming for economic purposes.                                                                                               |
|              |                                      | Urban green spaces    | Governmental policy and rehabilitation of urban green spaces.                                                                        |

**Source: Own construction (2018).**

From Table 5.17, it is apparent that the majority of initiatives for sustainable city planning in the Global North are state driven initiatives in the form of policy requirements and government investments, while the Global South relies stronger on public-private partnerships in the form of private implementation of nature-based solutions, encouragement projects, permitting the use of public resources, planning policy and governmental investment. It could therefore be perceived that various context-specific applications of generic nature-based solutions are globally

employed. The following chapter presented the perception amongst spatial experts on the sustainability agenda and its application in the Global South.

## **CHAPTER 6: EXPERT ANALYSIS (EMPIRICAL STUDY PHASE 2)**

### **6.1 Introduction**

From the previous chapters it is evident that there is an urgent need for context-based solutions for the social, economic and environmental complexities that characterise the current urban reality. It was also found that nature-based solutions could assist in achieving urban sustainability. Consequently, this chapter aims to evaluate perspectives on 1) the importance of planning for urban sustainability within the current urban context, 2) the viability of nature-based solutions to address urban complexities regarding sustainability, 3) the relevance of such initiatives and 4) the urban sustainability status within the Global South, based on an expert perspective.

### **6.2 Methodology (empirical investigation, phase 2)**

For phase 2 of the empirical investigation, a survey amongst a convenience sample of 91 spatial and environmental experts from both the Global North and the Global South was conducted to gain an understanding of the perceptions of planning for sustainable cities through nature-based solutions in the Global South context.

The data was collected from an e-questionnaire, distributed through online portals and participation was voluntary and anonymous. A consent paragraph was included in the questionnaire, along with a confidentiality statement whereby consent was obtained. Collected data was statistically analysed and presented in this chapter.

Subsequently, the following sections describe the compilation of the stakeholders, and the results of the perception survey according to the four evaluation aims regarding urban sustainability, nature-based solutions and planning in the Global South.

### **6.3 Exploring stakeholder compilation**

The survey was conducted amongst 91 spatial and environmental experts from various countries, as illustrated in Figure 6.1.

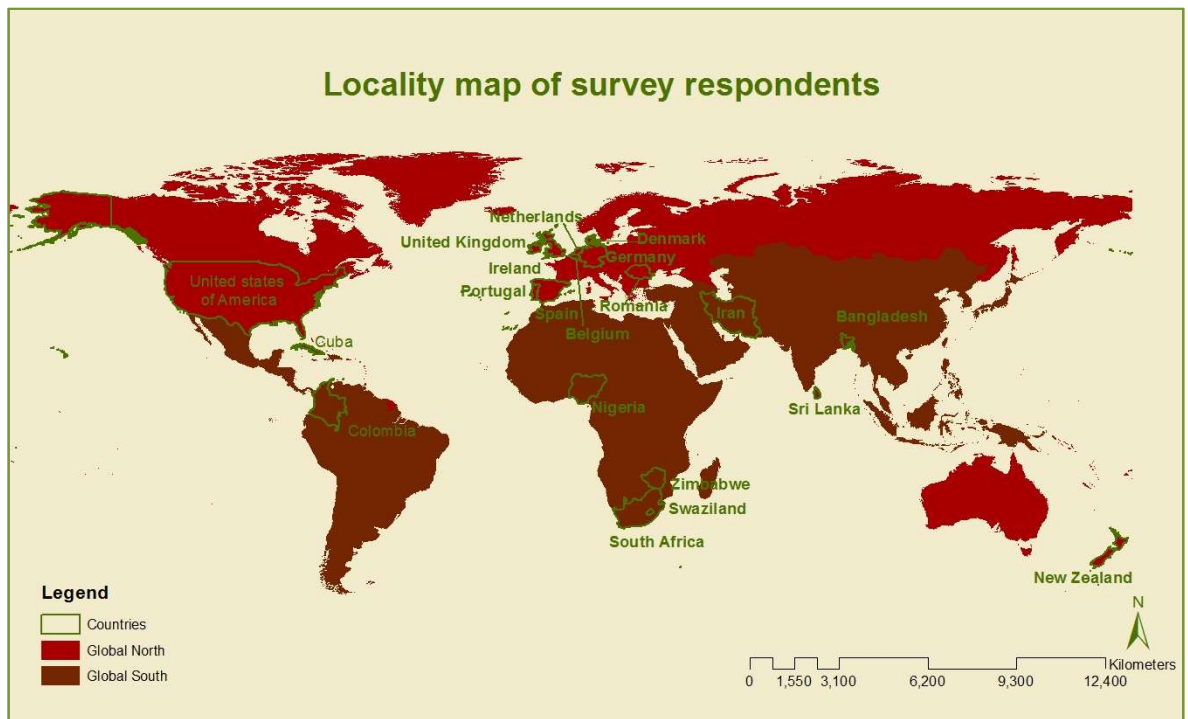
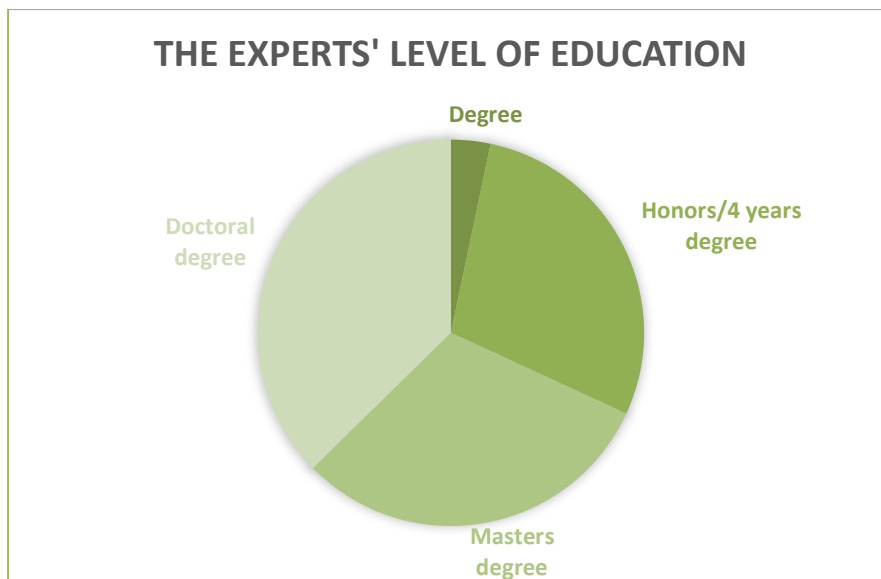


**Figure 6.1: The locality of the spatial experts**

Source: Own construction (2018).

It is evident from Figure 6.1 that these spatial experts are situated all over the world and consequently represent a variety of cultures and nationalities. As such, it is assumed that these spatial experts have diverse knowledge of planning for sustainable cities and may therefore contribute in providing insight to various context-specific perspectives. Graph 6.1 illustrates the level of education of these participating experts.



**Graph 6.1: The experts' level of education**

Source: Own construction (2018).

These experts have between half a year and 50 years' work experience. 41.1% of the participants are academic researchers in the fields of architecture (8.8%), economy (2.2%), environmental sciences (13.2%) and urban planning (17.6%); 2.2% are architects; 1.1% ecologists; 3.3% economists; 2.2% civil engineers; 1.1% environmental managers; 24.2% urban planners; 7.7% participants working in the governmental sector; and 16.5% of the participants are working in the fields of geography, technological science, environmental consultation, electrical and sustainable engineering, urban history and the corporate sector. This wide range of expertise may provide a valuable, transdisciplinary perspective.

Most of these spatial experts (62.6%) primarily work in the Global South region, with 53 participants working in Africa; 2 in China; 7 in Latin America; 2 in South East Asia; and 3 in South Asia. They may, therefore, assist in gaining insight into the general perception of urban sustainability and nature-based solutions within the Global South.

The perspectives of these experts concerning urban sustainability, nature-based solutions and sustainable city planning in the Global South was consequently explored in the following sections.

#### 6.4 Expert perspective analysis

The expert perspective on sustainable city planning, nature-based solutions and planning in the Global South was gained to further inform the findings in the literature study in Chapters 2 to 4. The survey results were evaluated according to the four aims of this research (as listed in section 6.1) and are presented in Table 6.1.

**Table 6.1: Expert analysis delineation**

|                             | Importance of urban sustainability                                                                                                                                                                                               | Viability of nature-based solutions                                                                                                                                                                                                                 | Urban sustainability status in the Global South                                             | Relevance of nature-based solutions in the Global South                                                                                                                                                  |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Sub-section</b>          | 6.4.1                                                                                                                                                                                                                            | 6.4.2                                                                                                                                                                                                                                               | 6.4.3                                                                                       | 6.4.4                                                                                                                                                                                                    |
| <b>Literature reference</b> | Chapter 2                                                                                                                                                                                                                        | Chapter 3                                                                                                                                                                                                                                           | Chapter 4                                                                                   | Chapter 3                                                                                                                                                                                                |
| <b>Main themes</b>          | The importance of: <ul style="list-style-type: none"> <li>- Context-based planning</li> <li>- Improved health conditions</li> <li>- Economic considerations</li> <li>- The planning of socially inclusive settlements</li> </ul> | <ul style="list-style-type: none"> <li>- The extent of familiarity with the concept of nature-based solutions</li> <li>- What nature-based solutions entails and its relevance</li> <li>- Implementation goals of nature-based solutions</li> </ul> | The social, economic and environmental difference between the Global North and Global South | <ul style="list-style-type: none"> <li>- Environmental difference between the Global North and Global South</li> <li>- Planning considerations for nature-based solutions in the Global South</li> </ul> |

Source: Own construction (2018).

The results of the perception survey were consequently discussed, as indicated in Table 6.1.

### 6.4.1 Expert perspectives on planning for sustainable cities

It is evident from the literature study in Chapter 2 that cities are globally experiencing rapid urbanisation trends that lead to a depletion in human well-being and the natural environment calling for an urgent shift to sustainable city planning practices. Such urban sustainability approaches are included in most of the policy documents of the best practice case studies explored in Chapter 5, aimed at climate change mitigation, urban greening and broader holistic sustainability approaches. Accordingly, an expert perspective was gained on how to achieve goal 11 from the Sustainable Development goals that aims to create inclusive, safe and sustainable cities as discussed in Chapter 2.

The stakeholder perspective was gained on where the focus for sustainable city planning should lie in addressing the current urban challenges of social inequality, poverty, physical health conditions and the depletion of natural resources, and was indicated in Table 6.2.

**Table 6.2: The perception on where the focus for sustainable city planning should lie**

|                          | Context-based planning approaches (%) | Improving health conditions (%) | Planning economic hubs (%) | Planning more socially inclusive human settlements (%) | Increased amount of planned green spaces (%) | The protection of ecosystem services (%) |
|--------------------------|---------------------------------------|---------------------------------|----------------------------|--------------------------------------------------------|----------------------------------------------|------------------------------------------|
| Not important at all     | 0                                     | 0                               | 2.2                        | 0                                                      | 0                                            | 0                                        |
| Important to some extent | 16.5                                  | 5.6                             | 31.1                       | 13.2                                                   | 14.3                                         | 3.3                                      |
| Important                | 37.4                                  | 48.9                            | 50.0                       | 46.2                                                   | 42.9                                         | 37.4                                     |
| Very important           | 46.2                                  | 45.6                            | 16.7                       | 40.7                                                   | 42.9                                         | 59.3                                     |

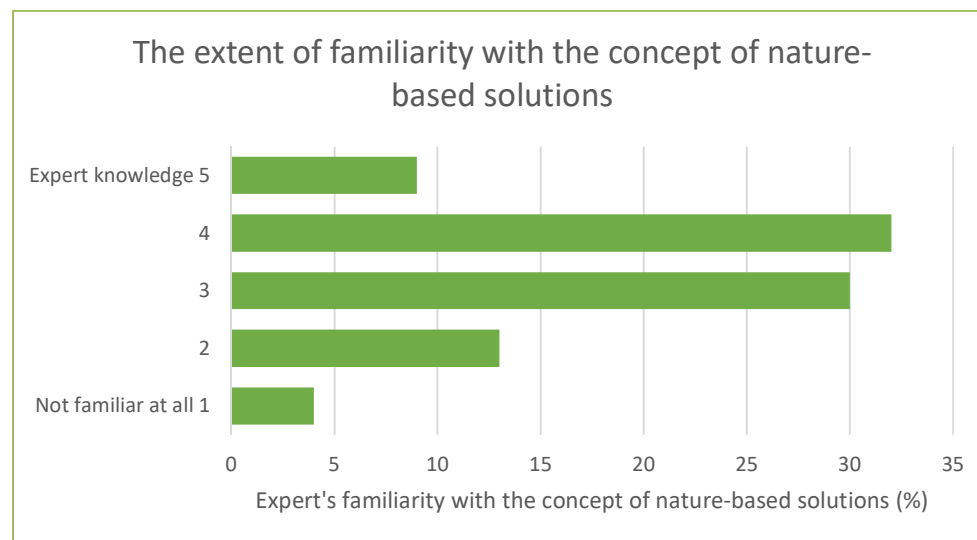
**Source: Own construction (2018).**

From Table 6.2 it is evident that the majority of the spatial experts deem context-based planning, along with social, economic and environmental considerations, important in the planning of sustainable cities. It was evident that the spatial experts perceived the protection of ecosystem services as one of the primary focusses in terms of realising sustainable development, with 59.3% stating that the protection of ecosystem services are very important. Accordingly, context-based planning approaches and improved health conditions were ranked second and third in terms of perceived importance. In this sense, the notion of nature-based solutions to be implemented in context, and to contribute the broader health agenda, is evident. The detailed analysis will be discussed accordingly.

## 6.4.2 Expert perspectives on nature-based solutions and the urban sustainability agenda

It could be perceived from Table 6.2 that an increase in and the utilisation of urban green is considered important in the quest towards urban sustainability. From the literature study in Chapter 3 it is apparent that nature-based solutions may assist in achieving such a goal. Most of the top-ranking cities, analysed as best practice case studies in Chapter 5, utilise nature-based solutions as part of their sustainability agenda.

An expert perspective was consequently obtained on the stakeholder's familiarity with and view of the concept and its relevance within the current urban context. The majority of the participants (N=88) rated the extent to which they are familiar with the concept of nature-based solutions between 3 (n=30) and 4 (n=32) on a scale from 1 (being not familiar at all) to 5 (having an expert knowledge). This is presented in Graph 6.2.



**Graph 6.2: The extent of familiarity with the concept of nature-based solutions**

**Source: Own construction (2018).**

From Graph 6.2, it is apparent that the stakeholders are relatively familiar with the concept of nature-based solutions. These stakeholders (N=87) mostly regard nature-based solutions as being relevant in the current age, with 55.2% agreeing to its relevance; 41.4% indicating that they strongly agree; 2.3% disagreeing and 1.1% indicating that they strongly disagree.

An expert perception on the four interrelated implementation goals of nature-based solutions relating to the achievement of urban sustainability, ecosystem service restoration, climate change mitigation and improved risk management (discussed in Chapter 3) was obtained also and listed in Table 6.3.

**Table 6.3: The perception on concepts that form part of nature-based solutions**

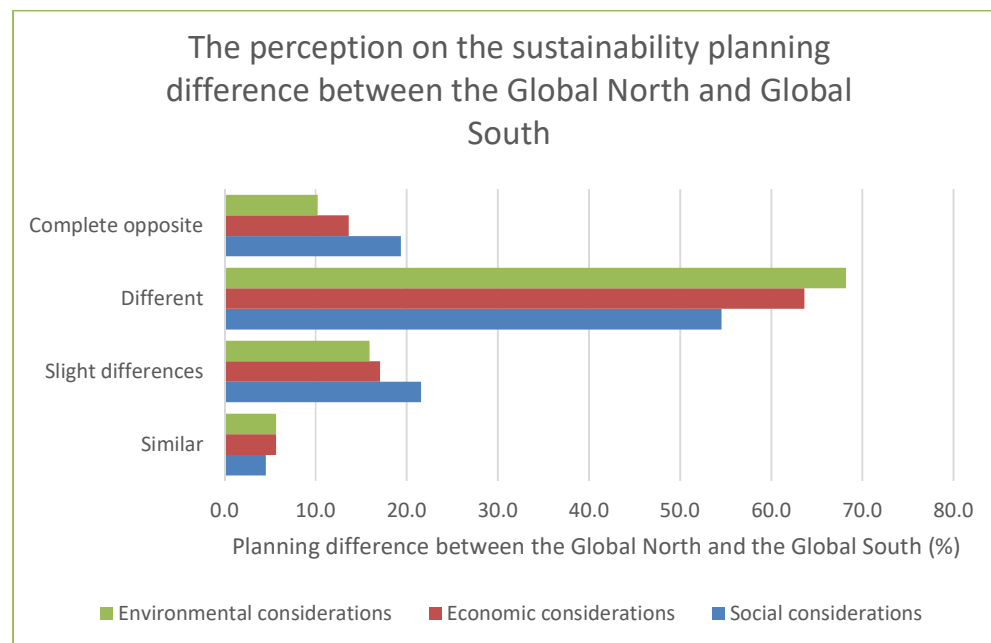
|     | Sustainable urbanisation enhancement (%) | Restoration of ecosystem services functionality (%) | Climate change mitigation development (%) | Improve risk management (%) |
|-----|------------------------------------------|-----------------------------------------------------|-------------------------------------------|-----------------------------|
| Yes | 100.00                                   | 100.00                                              | 95.5                                      | 89.7                        |
| No  | 0                                        | 0                                                   | 4.5                                       | 10.3                        |

Source: Own construction (2018).

It is evident from Table 6.3 that the stakeholders generally believe that nature-based solutions may provide a possible solution to different elements of sustainable city planning.

#### 6.4.3 Expert perspectives on the Global South urban context

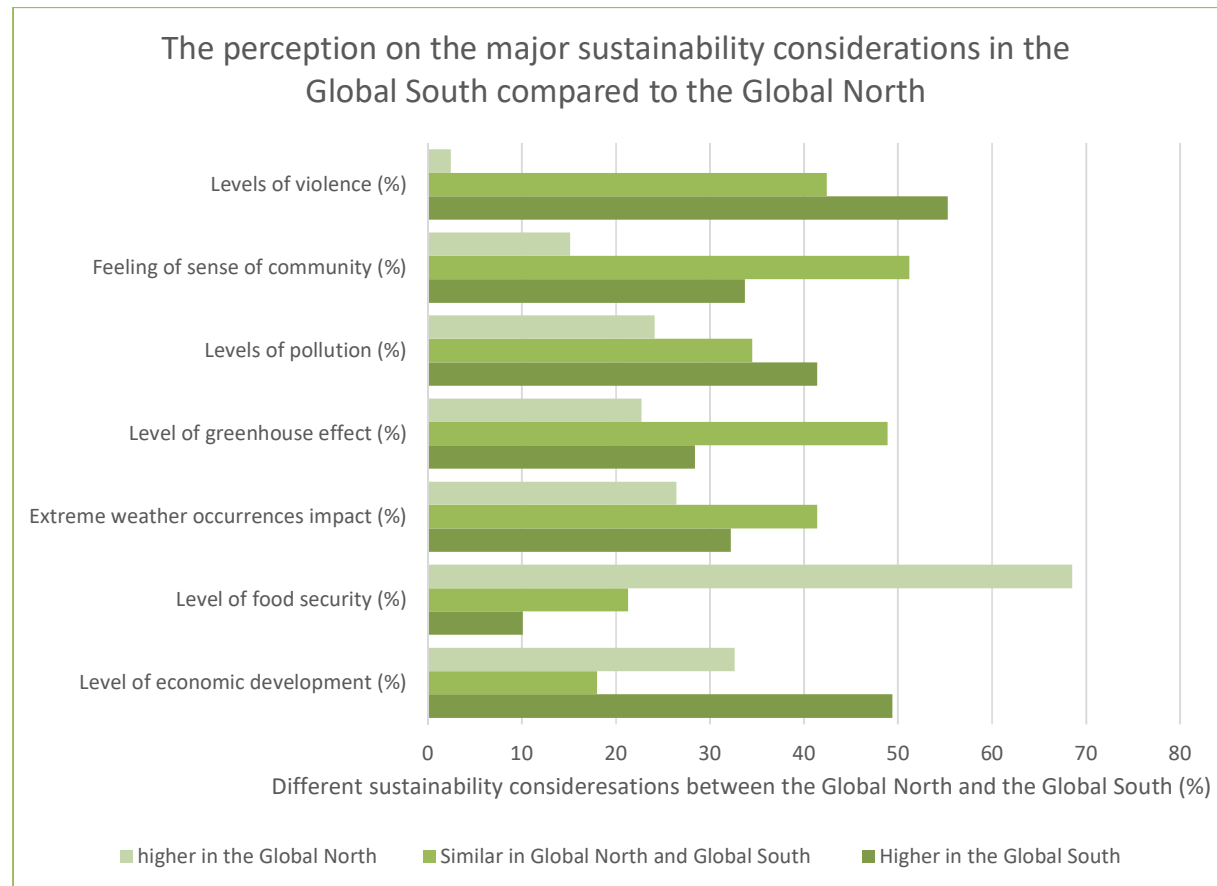
From the previous sections, it is apparent that the spatial and environmental experts regard context-based planning as an important part of sustainable city planning. It was found in Chapter 4 that 1) the Global South is generally underrepresented in academic literature, emphasising the importance of context-based research and 2) the socio-political history of the Global South differs from that in the Global North, resulting in a difference in current social challenges and opportunities including health conditions and levels of violence, social cohesion and diversity. As such, an expert perception was gained on the difference in the social, economic and environmental considerations for sustainable city planning between the Global North and Global South. Planning in the Global North and Global South is generally believed (N=88) to differ in all three dimensions of sustainable city planning, as illustrated in Graph 6.3.



**Graph 6.3: The perception on the sustainable city planning difference between the Global North and Global South**

Source: Own construction (2018).

Graph 6.3 indicates that the perception generally is that the social, economic and environmental considerations for sustainable city planning differ between the Global North and Global South. Environmental considerations were rated as the most different followed by economic considerations and social considerations was ranked the least different. In Graph 6.4 the perception on the major differences in economic, environmental and social considerations between the Global North and the Global South is indicated.



**Graph 6.4: The perception on the major sustainability considerations in the Global South compared to the Global North**

**Source: Own construction (2018).**

From Graph 6.4 it is apparent that the general perception amongst spatial and environmental experts is that the level of food security is higher in the Global North; the feeling of the sense of community, the level of the greenhouse effect and the impact of extreme weather occurrences are similar in the Global North and the Global South; and that the level of the occurrence of violence and the level of economic development is higher in the Global South than in the Global North. It is therefore evident that spatial and environmental experts, in accordance to the literature findings in Chapter 4, generally perceived the socioeconomic conditions as differing depending

on the local context. Most of the similarity between the two regions (Global North and Global South) was believed to lie within the natural environment.

These perceptions were then further investigated by using cross tabulations to determine the association between the expert perspectives of the Global North and Global South. Cramer's V (V indicating a large effect or practical significant association  $V \sim 0.5$ ; a medium effect or practical visible significant association  $V \sim 0.3$ ; and a small effect or practical non-significant association  $V \sim 0.1$ ) (Ellis & Steyn, 2003) determined the effect size and practical significance thereof. The results of this analysis that proved statistically significant was presented in Table 6.4.

**Table 6.4: Global North and Global South expert perceptions on the major sustainability considerations in the Global South compared to the Global North**

|                                    | Global North perspective |                         |                      | Global South perspective |                         |                      | Chi-square test ( $p < 0.05$ ) | Cramer's V Test Value | Cramer's V Test Approx. Sig. |
|------------------------------------|--------------------------|-------------------------|----------------------|--------------------------|-------------------------|----------------------|--------------------------------|-----------------------|------------------------------|
|                                    | Higher: Global South     | Similar in both regions | Higher: Global North | Higher: Global South     | Similar in both regions | Higher: Global North |                                |                       |                              |
| Extreme weather occurrences impact | 53.3%                    | 40%                     | 6.7%                 | 19.6%                    | 42.9%                   | 37.5%                | 0.001                          | 0.404                 | 0.001                        |
| Level of greenhouse effect         | 45.2%                    | 51.6%                   | 3.2%                 | 19.6%                    | 48.2%                   | 32.1%                | 0.002                          | 0.375                 | 0.002                        |
| Levels of pollution                | 61.3%                    | 19.4%                   | 19.4%                | 30.9%                    | 43.3%                   | 25.5%                | 0.018                          | 0.306                 | 0.018                        |

**Source: Own construction (2018).**

The cross tabulation in Table 6.4 illustrated that the experts in the Global North mostly believe that extreme weather occurrences have a higher impact on cities in the Global South than that of cities in the Global North and that the Global South has higher levels of pollution. Experts from the Global South generally believe that such considerations are similar for both regions. This places an emphasis on the importance of context-based planning, illustrating that the perceptions on important considerations for sustainable city planning differ, depending on local context.

A considerable effect or a practical significant association was evident for the perception on the impact of extreme weather occurrences ( $V=0.404$ ), as such occurrences have a substantial impact on human well-being. The perception on the level of the greenhouse effect ( $V=0.375$ ) and of pollution ( $V=0.306$ ) display a medium effect or a practical visible significant association, since this is not an occurrence that one can visibly see even though it has a long-lasting and critical effect on human well-being.

The perception of the crucial constraints of planning for cities in the Global South is depicted in Table 6.5.

**Table 6.5: The perception on the crucial city planning constraints in the Global South**

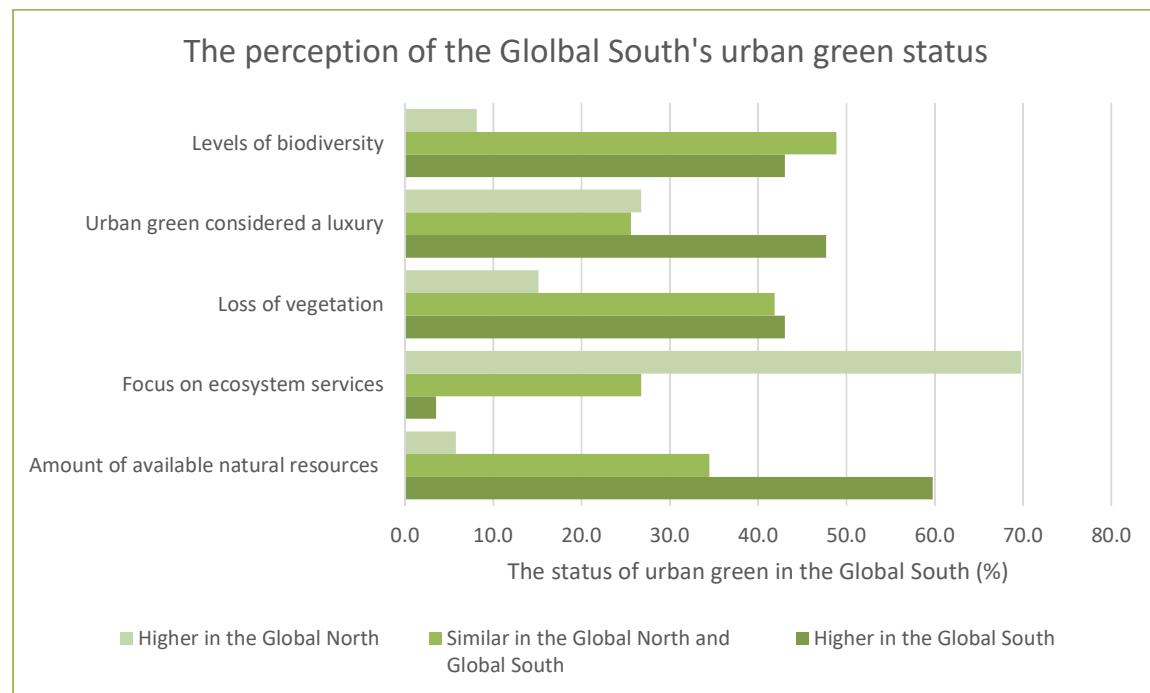
|                   | Difference in economic system and origin (%) | Difference in environmental system and origin (%) | Difference in social system and origin (%) | Lack of expert input (%) | Low budget (%) | Social disconnectedness (%) | Sustainable development (%) |
|-------------------|----------------------------------------------|---------------------------------------------------|--------------------------------------------|--------------------------|----------------|-----------------------------|-----------------------------|
| Strongly disagree | 4.8                                          | 6.0                                               | 3.6                                        | 4.7                      | 1.2            | 1.2                         | 5.8                         |
| Disagree          | 18.1                                         | 24.1                                              | 18.1                                       | 27.1                     | 17.4           | 32.9                        | 34.9                        |
| Agree             | 59.0                                         | 61.4                                              | 57.8                                       | 44.7                     | 44.2           | 54.1                        | 39.5                        |
| Strongly agree    | 18.1                                         | 8.4                                               | 20.5                                       | 23.5                     | 37.2           | 11.8                        | 19.8                        |

Source: Own construction (2018).

From Table 6.5 it is evident that the general perception, amongst the spatial experts, is that the crucial constraints for sustainable city planning in the Global South are 1) the differences between the economic, environmental and social system and origin, 2) a general lack in expert input, 3) low budgets, 4) social disconnectedness and, to some extent, 5) the current status of sustainable development.

#### 6.4.4 Expert perspectives on nature-based solutions and the Global South

From the literature study in Chapter 3 it was evident that nature-based solutions simultaneously provide various social, economic and environmental benefits, but from Chapter 4 it is apparent that it is not yet widely implemented as a result of a perception that nature-based solutions are a luxury rather than a necessity. Graph 6.5 illustrates the perception of the respondents on the current status of urban green within the Global South.

**Graph 6.5: The perception on the current status of urban green in the Global South**

Source: Own construction (2018).

It is apparent from Graph 6.5 that the spatial and environmental experts generally believe that there is a high level of potential for utilising the natural environment for sustainable city planning purposes, but that the Global North has a higher focus on such initiatives than the Global South. Accordingly, 47 respondents agreed that nature-based solutions are relevant in the current Global South context, 34 strongly agreed, 5 disagreed and 2 strongly agreed (N=88). All stakeholders (N=86) agreed on nature-based solutions providing a possible method to create a more sustainable city with 26.7% strongly agreeing and 73.3% agreeing and consequently deems it to provide social (65.1%; N=86), environmental (56.6%; N=87) and economic (57.5%; N=87) benefits.

A cross tabulation was further used to compare the data, presented in Graph 6.5, between the perspectives of experts from the Global North and those from the Global South. The results from this analysis was presented in Table 6.6.

**Table 6.6: Global North and Global South expert perception on the current status of urban green in the Global South compared to the Global North**

|                                 | Global North perspective |                         |                      | Global South perspective |                         |                      |
|---------------------------------|--------------------------|-------------------------|----------------------|--------------------------|-------------------------|----------------------|
|                                 | Higher: Global South     | Similar in both regions | Higher: Global North | Higher: Global South     | Similar in both regions | Higher: Global North |
| Amount of available resources   | 53.3%                    | 43.3%                   | 3.3%                 | 64.3%                    | 30.4%                   | 5.4%                 |
| Focus on ecosystem services     | 3.3%                     | 26.7%                   | 70.0%                | 1.8%                     | 27.3%                   | 70.9%                |
| Loss of vegetation              | 53.3%                    | 33.3%                   | 13.3%                | 38.2%                    | 47.3%                   | 14.5%                |
| Urban green considered a luxury | 58.6%                    | 31.0%                   | 10.3%                | 42.9%                    | 23.2%                   | 33.9%                |
| Levels of biodiversity          | 55.2%                    | 44.8%                   | 0.0%                 | 35.7%                    | 51.8%                   | 12.5%                |

**Source: Own construction (2018).**

From Table 6.6 it is evident that experts from both the Global North and the Global South believe that urban green is generally considered a luxury in the Global South even though this region has high levels of biodiversity. In accordance to this finding, experts from both regions also consider the Global North to place a higher focus on ecosystem services. This indicates the importance of incorporating nature-based solutions as part of sustainable city planning in the Global South.

The perception of the loss of vegetation and the levels of biodiversity differs between experts from the two regions. Experts from the Global North deem these considerations to be higher in the Global South, while experts from the Global South believes these considerations to be similar in both regions. This emphasises the importance of context-based planning, since the experts from the two regions perceive the Global South differently.

Tables 6.7 to 6.9 present the expert perception on what economic, environmental and social benefits are provided by nature-based solutions to address the urban complexities of the Global South.

**Table 6.7: The perception on the economic benefits provided by nature-based solutions**

|                   | Attracts tourist (%) | Create economic opportunities (%) | Create employment opportunities (%) | Increase food security (%) | Increase productivity (%) | Increase property value (%) | Increase trade (%) | Cost savings (%) |
|-------------------|----------------------|-----------------------------------|-------------------------------------|----------------------------|---------------------------|-----------------------------|--------------------|------------------|
| Strongly disagree | 0                    | 0                                 | 0                                   | 0                          | 1.2                       | 1.1                         | 1.2                | 4.6              |
| Disagree          | 6.8                  | 8.0                               | 6.8                                 | 20.5                       | 18.6                      | 8.0                         | 32.1               | 21.8             |
| Agree             | 68.2                 | 76.1                              | 71.6                                | 60.2                       | 66.3                      | 58.0                        | 57.1               | 59.8             |
| Strongly agree    | 25.0                 | 15.9                              | 21.6                                | 19.3                       | 14.0                      | 33.0                        | 9.5                | 13.8             |

Source: Own construction (2018).

From Table 6.7 it is apparent that the spatial experts agree with the literature findings regarding the possible benefits that nature-based solutions could provide. The perception amongst the stakeholders on the environmental benefits as provided by nature-based solutions are listed in Table 6.8.

**Table 6.8: The perception on the environmental benefits provided by nature-based solutions**

|                   | Improves air quality (%) | Improves environmental conservation (%) | Reduced urban heat island (%) | Naturally purified water (%) | Reduced pollution (%) | Reduces stormwater runoff (%) |
|-------------------|--------------------------|-----------------------------------------|-------------------------------|------------------------------|-----------------------|-------------------------------|
| Strongly disagree | 0                        | 0                                       | 0                             | 0                            | 1.2                   | 1.1                           |
| Disagree          | 2.3                      | 3.4                                     | 6.8                           | 9.3                          | 7.0                   | 3.4                           |
| Agree             | 55.7                     | 63.6                                    | 52.3                          | 67.4                         | 54.7                  | 55.7                          |
| Strongly agree    | 42.0                     | 33.0                                    | 40.9                          | 23.3                         | 37.2                  | 39.8                          |

Source: Own construction (2018).

The perception of the environmental benefits of nature-based solutions also generally correlates with the findings from the literature study. The perception on the social benefits that nature-based solutions provide is indicated in Table 6.9.

**Table 6.9: The perception on the social benefits provided by nature-based solutions**

|                   | Decrease crime rates (%) | Improve indoor climate (%) | Increase social benefits (%) | Mental health benefits (%) | Physical health benefits (%) | Provide recreational space (%) | Sense of community (%) |
|-------------------|--------------------------|----------------------------|------------------------------|----------------------------|------------------------------|--------------------------------|------------------------|
| Strongly disagree | 5.9                      | 2.3                        | 0                            | 2.3                        | 2.3                          | 1.1                            | 0                      |
| Disagree          | 58.8                     | 27.9                       | 14.9                         | 3.5                        | 2.3                          | 2.3                            | 9.3                    |
| Agree             | 30.6                     | 59.3                       | 66.7                         | 59.3                       | 59.8                         | 51.7                           | 66.3                   |
| Strongly agree    | 4.7                      | 10.5                       | 18.4                         | 34.9                       | 35.6                         | 44.8                           | 24.4                   |

Source: Own construction (2018).

From Table 6.9 it is evident that the spatial experts also generally agree with the findings from the literature study in Chapter 3 on the social benefits as provided by nature-based solutions. An exception could be observed where 58.8% and 5.9% do not agree that nature-based solutions could assist in decreasing crime rates.

## **6.5 Conclusions**

It is evident from the previous section that spatial and environmental experts believe it is important to plan in a context-based manner to ensure a community's socioeconomic well-being and for the protection and utilisation of the natural environment. This is in accordance with the literature study in Chapters 2 to 4. Such considerations include the improvement of local health conditions, the planning of more socially inclusive settlements, planning for an increase in economic opportunities and the amount of urban green spaces, and the protection of valuable ecosystem services. As such, the majority of the experts deem nature-based solutions as an important approach in achieving urban sustainability. It is generally believed that such an approach may prove valuable in addressing urban challenges within the Global South, such as high crime rates, pollution and climate change, a lack in a sense of community and low levels of food security.

According to the perception survey, the Global South has higher levels of biodiversity and available natural resources than the Global North; this may provide an opportunity for nature-based solutions to be implemented. It is also mainly believed that nature-based solutions, in accordance with the literature study in Chapter 3, would provide various benefits for cities in the Global South. The perception results were divided into benefits that 60% or more respondents believed to be provided by nature-based solutions and those that less than 60% respondents deemed as possible benefits. This percentage was derived from the fact that between 50% and 70% of respondents mostly agree that nature-based solutions provide economic, environmental and social benefits for urban environments.

The perception results were divided into benefits that 1) 60% or more respondents believed to be provided by nature-based solutions and 2) those that less than 60% respondents deemed as possible benefits.

Table 6.10 lists these benefits as perceived from the expert analysis. The perception results were divided into benefits that 1) 60% or more respondents believed to be provided by nature-based solutions and 2) those that less than 60% respondents deemed as possible benefits.

**Table 6.10: The perception on benefits provided by nature-based solutions**

| <b>Perception ranking</b> | <b>Economic benefits</b>                                                                                                                                                                                                    | <b>Environmental benefits</b>                                                                                                                                               | <b>Social benefits</b>                                                                                                                                                                                            |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Agree (<60%)              | <ul style="list-style-type: none"> <li>- Attract tourists</li> <li>- Create economic opportunities</li> <li>- Create employment opportunities</li> <li>- Increase food security</li> <li>- Increase productivity</li> </ul> | <ul style="list-style-type: none"> <li>- Improve environmental conservation</li> <li>- Naturally purify water</li> </ul>                                                    | <ul style="list-style-type: none"> <li>- Induce a sense of community</li> <li>- Increase social benefits</li> </ul>                                                                                               |
| Agree (>60%)              | <ul style="list-style-type: none"> <li>- Increase property values</li> <li>- Increase trade</li> <li>- Induce cost savings</li> </ul>                                                                                       | <ul style="list-style-type: none"> <li>- Improve air quality</li> <li>- Reduce urban heat island</li> <li>- Reduce pollution</li> <li>- Reduce stormwater runoff</li> </ul> | <ul style="list-style-type: none"> <li>- Improve indoor climate</li> <li>- Provide mental health benefits</li> <li>- Provide physical health benefits</li> <li>- Provide recreational space</li> <li>-</li> </ul> |

**Source: Own construction (2018).**

From Table 6.10, it is evident that the perception survey indicates the highest ranking 1) economic benefits as a tourist attraction, higher availability of economic and employment opportunities and an increase in food security and productivity; 2) environmental benefits as improving environmental conservation and air being naturally purified; and 3) social benefits as increased with a higher sense of community. It is therefore apparent that the perception amongst the spatial and environmental experts is that nature-based solutions may provide a valuable contribution for broader sustainable development within the Global South context, as is further explained in Chapter 7.

## CHAPTER 7: CONCLUSIONS

### 7.1 Introduction

From the previous chapters it is apparent that the sustainability agenda forms an integral part of contemporary city planning approaches, especially in response to the prevailing urban challenges of socioeconomic and environmental decay. In Chapter 1 it was stated that the primary aim of this study was to gain an understanding of sustainable city planning through nature-based solutions from a Global South perspective. As such, four research questions were posed in Chapter 1, considering 1) the current paradigm towards sustainable city planning, 2) the role of nature-based solutions within the sustainability agenda, 3) the Global South as a region that offers unique urban challenges and opportunities with regards to the broader sustainability agenda and 4) the implementation of nature-based solutions within the Global South.

In an attempt to address these research questions, Chapter 2 focused on the development of urban planning from urban models in the formative and modern period to planning movements in the post-modern period and of the sustainability agenda (research question 1), Chapter 3 considered nature-based solutions as a method to simultaneously benefit the social, economic and natural environment to ultimately enhance urban sustainability (research question 2), Chapter 4 introduced the Global South as a region with a different historic and contemporary urban context to that of the Global North (research question 3) and the empirical study in Chapters 5 and 6 endeavoured to address research question 4, by evaluating best practice case studies and gaining the perspectives of spatial and environmental experts on the sustainability agenda, nature-based solutions and the Global South.

Subsequently, this chapter aims to provide a synthesis of the findings of the previous chapters to ultimately address the primary research question of nature-based solutions as a possible guide to sustainable city planning in the Global South. As such, the chapter is divided into four sections to thematically conclude in terms of the stated research questions pertaining to 1) the importance of nature-based solutions within the broader sustainability discourse, 2) the viability of nature-based solutions for urban sustainability, 3) the importance of context-based planning as well as the application of unique nature-based solutions within context and 4) the relevance of nature-based solutions for the Global South urban context.

## 7.2 The importance of nature-based solutions within the broader sustainability discourse

The current (global) urban reality suggests a deteriorating socioeconomic and natural environment, calling for sustainable city planning practices (refer to Chapter 2). The search for a more liveable city has been ongoing since the late 1800s with various paradigm shifts on how such urban sustainability could be achieved. The current approach is holistic by nature and regards cities, increasingly, as potential drivers to achieve urban sustainability by simultaneously providing essential social, economic and environmental development opportunities. The literature study in Chapter 2 provided a broad overview on a wide variety of urban movements and policy and legislative frameworks that have been published within the post-modern period in order to conceptualise the notion of sustainability. This notion of urban sustainability was then defined as a process where the cycle between human well-being and ecosystems are maintained through interconnected environmental, social and economic processes, in response to urban change. Chapter 3 consequently argued that nature-based solutions form a vital part of the sustainability agenda. The concept of nature-based solutions was defined as an umbrella concept for initiatives adapting to or mimicking the multi-functional working of natural systems, utilising the benefits of nature to the advantage of human well-being. From this literature investigation certain conclusions could be drawn, regarding the importance of nature-based solutions for planning sustainable cities, as captured in Table 7.1.

**Table 7.1: The importance of nature-based solutions for urban sustainability**

| Reference        | Chapter reference | Nature-based solutions and the sustainability agenda                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Literature study | Chapter 3         | <p>- Nature-based solutions simultaneously provide various and important benefits to the advantage of the social, economic and environmental (three spheres of sustainability) dimensions of a city (cross-reference to Table 3.1 and Table 3.2):</p> <p><b>Economic benefits:</b></p> <ul style="list-style-type: none"> <li>• Increased inward investment</li> <li>• Increased employment rates</li> <li>• Increased property values</li> <li>• Enhanced attention span</li> <li>• Enhanced workplace satisfaction</li> <li>• Roof lifespan lengthened with 20 years when a green roof is installed</li> <li>• Government savings on stormwater management when green roofs, rain gardens, urban parks and permeable surfaces are installed, and urban agriculture is practised</li> <li>• Urban agriculture could provide urban families with an extra source of income, decrease poverty levels and enable household savings</li> <li>• Urban agriculture could increase levels of food security</li> </ul> |

| Reference                            | Chapter reference             | Nature-based solutions and the sustainability agenda                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Literature study<br><i>continued</i> | Chapter 3<br><i>continued</i> | <p><b>Environmental benefits:</b></p> <ul style="list-style-type: none"> <li>• Conserving nature</li> <li>• Habitat provision</li> <li>• Increased biodiversity</li> <li>• Better micro-climate</li> <li>• Decreased pollution</li> <li>• Decreased urban heat island effect</li> <li>• Cooling effect</li> <li>• Vegetation around buildings, green walls and green roofs reduce the energy demand</li> <li>• Vegetation around buildings improves indoor ventilation</li> <li>• Vegetation around buildings, street trees and green roofs reduce stormwater runoff</li> <li>• Green roofs, permeable surfaces, rain gardens, urban parks and street trees assist in a decrease in urban flooding</li> <li>• Green roofs provide building insulation</li> <li>• Street trees assist in decreasing wind speed</li> <li>• Street trees, rain gardens, urban parks and permeable surfaces decrease erosion levels</li> </ul> <p><b>Social benefits:</b></p> <ul style="list-style-type: none"> <li>• Increases personal health levels (reduced stress levels, enhanced physiological health, heightened mental capacities, higher levels of nutrition)</li> <li>• Decreased levels of violence</li> <li>• Assimilation of positive values and moral attitudes</li> <li>• Decrease in crime rates</li> <li>• Beautification of the city</li> <li>• Increased sense of peace and quiet</li> <li>• Green roofs and urban parks provide recreational space</li> <li>• Green walls and street trees serve as a natural sound buffer</li> <li>• Street trees reduce driver stress</li> <li>• Urban agriculture provides an educational opportunity for children</li> <li>• Urban parks increase community cohesion</li> </ul> <p>- Nature-based solutions are aligned with the sustainability agenda goals to find climate change mitigation initiatives, restore ecosystem services and utilise urban green (cross-reference to Table 3.3).</p> |
| Case study analysis                  | Chapter 5                     | <p>- The vast majority of the top-ranking cities utilise nature-based solutions as part of their quest to achieve sustainable city planning. This may serve as evidence of the practical importance to include nature-based solutions to enhance broader urban sustainability.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Expert analysis                      | Chapter 6                     | <p>- The protection of ecosystem services is regarded as the most important principle in the quest for urban sustainability (cross-reference to Table 6.2).</p> <p>- 42.9% respondents (cross-reference to Table 6.2) considered an increased amount of urban green as a very important part of achieving sustainable city planning.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

Source: Own construction (2018).

From the theoretical and empirical investigation, it is argued that, although sustainable development requires a fine balancing act between social, economic and environmental considerations, the notion of nature-based solutions is evidently very important within contemporary planning approaches. The role of nature-based solutions within the broader

sustainability agenda is emphasised by the benefits pertaining to the social, economic and environmental dimensions and the holistic nature (refer to Chapter 2) of sustainable city planning. This notion is further supported by the utilisation of nature-based solutions within top-ranking cities' approaches to sustainable planning and the high-ranking status of urban green initiatives in the expert analysis.

It could therefore be concluded that nature-based solutions have an important role as part of the sustainability agenda, not only as stated per theoretical investigation, but also confirmed from the empirical investigation and practical perspectives.

### 7.3 The viability of nature-based solutions for the urban sustainability agenda

The discussion in the previous section confirmed the importance of natural elements within the urban fabric as an important contribution to sustainable city planning, focusing on the multi-dimensional benefits provided by urban green. These benefits are related to the social, economic and environmental dimensions within cities. The implementation of nature-based solutions is, however, often hindered by a negative perception of urban green and nature-based solutions, budget allocation constraints and administrative issues within and amongst governing authorities (refer to Chapter 3).

It was evident in the case study analysis (refer to Chapter 5) that most of these cities or countries (wherein the cities are situated) have a plan towards sustainable development. Table 7.2, consequently, presents these sustainable development plans and reflects on how nature-based solutions could assist in achieving the goals of such plans.

**Table 7.2: Case studies' sustainable development plan**

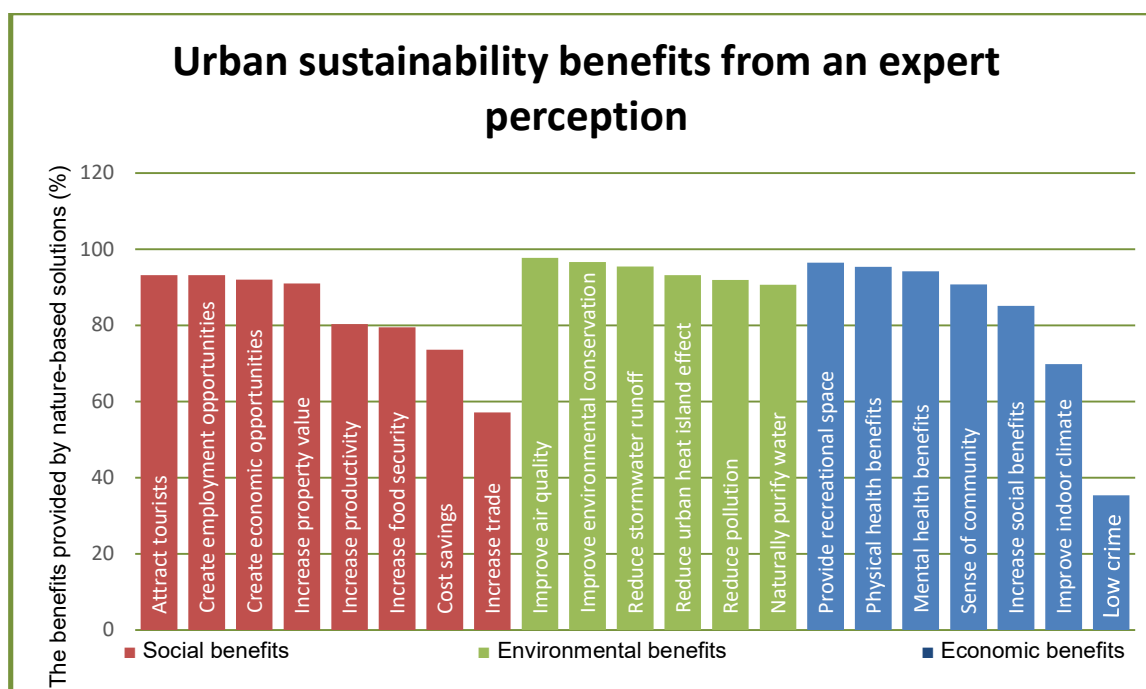
| <b>Top-ranking city</b> | <b>Sustainable development plan</b><br>(refer Chapter 5)              | <b>How nature-based solutions could contribute to the sustainable development plan</b><br>(refer to Chapter 3)                                                                                                                   |
|-------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stockholm               | Long-term climate goal of being fossil-fuel-free by 2040              | Nature-based solutions assist in reducing energy demand (refer to Tables Table 3.1 and Table 3.2) that may assist in becoming fossil-fuel-free as less energy is consumed and the city could lean stronger on renewable sources. |
| Copenhagen              | Holistic climate plan striving towards carbon neutrality by 2025      | Nature-based solutions assist in reducing energy demand (refer to Tables Table 3.1 and Table 3.2) that may assist in becoming carbon neutral as less energy is consumed and the city could lean stronger on renewable sources.   |
| Vancouver               | Goal to achieve the status of being the world's greenest city by 2020 | Since nature-based solutions are, in essence, a green solution to social, economic and environmental constraints within urban areas, it could be argued a pre-eminent method to this goal.                                       |

| <b>Top-ranking city</b> | <b>Sustainable development plan</b><br>(refer Chapter 5)                                                                      | <b>How nature-based solutions could contribute to the sustainable development plan</b><br>(refer to Chapter 3)                                                                                                                                                                                                                            |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| New York City           | Environmental plan aims to generate 50% electricity supply through renewable sources                                          | Nature-based solutions assist in reducing energy demand (refer to Tables Table 3.1 and Table 3.2) that may assist in achieving this goal as less energy is consumed and the city could lean stronger on renewable sources.                                                                                                                |
| Johannesburg            | Long-term development agenda, the Joburg 2040 strategy, aiming to achieve sustainable city planning in a holistic manner      | Nature-based solutions are a holistic approach to sustainable city planning and benefit the social, economic and natural urban environment and could play an important role in achieving this goal.                                                                                                                                       |
| Seoul                   | Low-carbon development approach was announced in 2008                                                                         | Nature-based solutions assist in reducing energy demand (refer to Tables Table 3.1 and Table 3.2) that may assist in reducing the amount of carbon-fuels used within the city.                                                                                                                                                            |
| Hong Kong               | The Hong Kong 2030 strategy commits to sustainable city transformation through efficient governance                           | Nature-based solutions are a holistic approach for sustainable city planning and benefit the social, economic and natural urban environment. It could also play an important role in achieving this goal.                                                                                                                                 |
| Rio de Janeiro          | The resilience strategy aims to address the city's main vulnerabilities and to achieve greater levels of urban sustainability | Nature-based solutions are a holistic approach for sustainable city planning and benefit the social, economic and natural urban environment and could play an important role in achieving this goal.                                                                                                                                      |
| Mexico City             | The climate change action plan aims to reduce the social, environmental and economic risks resulting from climate change      | Nature-based solutions are a holistic approach to sustainable city planning that benefit the social, economic and natural urban environment. It could therefore play an important role in achieving this goal. Its benefits include a decrease in the urban heat island (Table 3.1) that may reduce the climate change effect as a whole. |

**Source: Own construction (2018).**

From Table 7.2 it is evident that nature-based solutions may assist in achieving these top-ranking cities' urban sustainability agenda goals. Graph 7.1 presents the expert perception on the benefits that nature-based solutions provide for broader sustainable city planning (refer to Tables 6.7 to 6.9).

**Graph 7.1: Benefits of urban sustainability from an expert perception**



Source: Own construction (2018).

From Graph 7.1 it is evident that the spatial and environmental experts recognise the multi-functional benefits of urban green. This may account for their high-ranking thereof as part of the sustainability agenda (refer section 7.2). Table 7.3 presents the nature-based solutions as was identified in the best practice case study analysis with the corresponding context-specific benefits (in addition to those listed in Table 3.1, of urban green in general).

**Table 7.3: Nature-based solutions as applied in the best practise case studies**

| Nature-based solution | Context-specific benefits<br>(refer to Chapter 3)                  | Stockholm | Copenhagen | Vancouver | New York City | Addis Ababa | Johannesburg | Seoul | Hong Kong | Mexico City |
|-----------------------|--------------------------------------------------------------------|-----------|------------|-----------|---------------|-------------|--------------|-------|-----------|-------------|
| Green roofs           | <b>Economic benefit</b>                                            |           |            |           |               |             |              |       |           |             |
|                       | a) Extended roof life                                              |           | x          |           | x             |             |              |       | x         | x           |
|                       | b) Savings in pollution mitigation and stormwater management costs |           | x          |           | x             |             |              |       | x         | x           |
|                       | <b>Environmental benefit</b>                                       |           |            |           |               |             |              |       |           |             |
|                       | a) Decreased flooding levels                                       |           | x          |           | x             |             |              |       | x         | x           |
|                       | b) Building insulation                                             |           | x          |           | x             |             |              |       | x         | x           |
|                       | c) Reduced building energy demand                                  |           | x          |           | x             |             |              |       | x         | x           |
|                       | <b>Social benefit</b>                                              |           |            |           |               |             |              |       |           |             |
|                       | Recreational space                                                 |           | x          |           | x             |             |              |       | x         | x           |

| <b>Nature-based solution</b>     | <b>Context-specific benefits</b><br>(refer to Chapter 3)              | <b>Stockholm</b> | <b>Copenhagen</b> | <b>Vancouver</b> | <b>New York City</b> | <b>Addis Ababa</b> | <b>Johannesburg</b> | <b>Seoul</b> | <b>Hong Kong</b> | <b>Mexico City</b> |
|----------------------------------|-----------------------------------------------------------------------|------------------|-------------------|------------------|----------------------|--------------------|---------------------|--------------|------------------|--------------------|
| Street trees                     | <b>Environmental benefit</b>                                          |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | Decreased flooding, stormwater runoff, wind speeds and erosion levels |                  | x                 |                  | x                    |                    | x                   |              |                  |                    |
| Street trees<br><i>continued</i> | <b>Social benefit</b>                                                 |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | a) Natural sound buffer                                               |                  | x                 |                  | x                    |                    | x                   |              |                  |                    |
|                                  | b) Reduced stress for drivers                                         |                  | x                 |                  | x                    |                    | x                   |              |                  |                    |
| Urban agriculture                | <b>Economic benefit</b>                                               |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | a) Extra source of income, especially for urban poor                  |                  |                   | x                | x                    | x                  |                     | x            |                  | x                  |
|                                  | b) Increased food security                                            |                  |                   | x                | x                    | x                  |                     | x            |                  | x                  |
|                                  | d) Household financial savings                                        |                  |                   | x                | x                    | x                  |                     | x            |                  | x                  |
|                                  | c) Savings in pollution mitigation and stormwater management costs    |                  |                   | x                | x                    | x                  |                     | x            |                  | x                  |
|                                  | <b>Environmental benefit</b>                                          |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | Decreased flooding and erosion levels                                 |                  |                   | x                | x                    | x                  |                     | x            |                  | x                  |
|                                  | <b>Social benefit</b>                                                 |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | Educational opportunity                                               |                  |                   | x                | x                    | x                  |                     | x            |                  | x                  |
|                                  |                                                                       |                  |                   |                  |                      |                    |                     |              |                  |                    |
| Urban green spaces               | <b>Economic benefit</b>                                               |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | Savings in pollution mitigation and stormwater management costs       | x                | x                 | x                | x                    | x                  | x                   | x            | x                | x                  |
|                                  | <b>Environmental benefit</b>                                          |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | Decreased flooding and erosion levels                                 | x                | x                 | x                | x                    | x                  | x                   | x            | x                | x                  |
|                                  | <b>Social benefit</b>                                                 |                  |                   |                  |                      |                    |                     |              |                  |                    |
|                                  | a) Recreational space                                                 | x                | x                 | x                | x                    | x                  | x                   | x            | x                | x                  |
|                                  | b) Increased health levels                                            | x                | x                 | x                | x                    | x                  | x                   | x            | x                | x                  |
|                                  | c) Increased sense of community                                       | x                | x                 | x                | x                    | x                  | x                   | x            | x                | x                  |

**Source: Own construction (2018).**

The practicality and implementability of nature-based solutions (discussed in Table 7.2), as well as the noticeable support for these solutions provided by the case studies and expert perspectives (presented in Graph 7.1 and Table 7.3), is an indication of the linkage that exists between the theory of sustainability and the range of possibilities nature-based solutions offer for its successful application in practice.

## 7.4 Context-based planning in the application of nature-based solutions

The importance of context-based planning is evident from the literature study and supported by the case study and expert analysis. In Chapter 2 it was noted that the post-modern period is characterised by a focus on localisation and in Chapter 4 that various studies have indicated that the local socioeconomic conditions influence the spatial outcome of a project. This notion of context-based planning was further supported by the expert analysis where context-based planning as a focus for sustainable city planning was deemed important by 83.6% of respondents (refer to Table 6.2), ranking as the (perceived) second most important focus for creating a sustainable city. Table 7.4 presents the context-specific applications of nature-based solutions within the top-ranking cities.

**Table 7.4: Context-based applications in case study cities**

| <b>Nature-based solution</b> | <b>City</b><br>(refer to Chapter 5) | <b>Context-based application</b>                                                                                                                                 |
|------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green roofs                  | Copenhagen                          | Green roofs are a requirement for newly constructed buildings.                                                                                                   |
|                              | New York City                       | Small-scale application of green roofs used for urban agriculture.                                                                                               |
|                              | Hong Kong                           | Green roofs on government buildings such as schools, hospitals and offices.                                                                                      |
|                              | Mexico City                         | A large percentage green roofs has already been established within the city.                                                                                     |
| Street trees                 | Copenhagen                          | Investments to improve the state of street trees.                                                                                                                |
|                              | New York City                       | Trees are planted in the city as a result of programs such as Million Trees NYC.                                                                                 |
|                              | Johannesburg                        | The city has over 10 million trees within the city limits.                                                                                                       |
| Urban agriculture            | Vancouver                           | Encourage the establishment of community gardens.                                                                                                                |
|                              | New York City                       | In the form of community gardens.                                                                                                                                |
|                              | Addis Ababa                         | Farming on private open spaces within the city, drawing water informally from the rivers flowing through the city.                                               |
|                              | Seoul                               | Urban agriculture is implemented in interior and exterior residential spaces, rooftop gardens, on abandoned spaces within the city and on school grounds.        |
|                              | Mexico City                         | Urban agriculture is used for local food production and is distributed from a major, centrally located market.                                                   |
| Urban green spaces           | Stockholm                           | Nature reserves within the city limits.                                                                                                                          |
|                              | Copenhagen                          | Policy requirement that green spaces should always be within a 200m radius.                                                                                      |
|                              | Vancouver                           | 12% land is allocated for green spaces.                                                                                                                          |
|                              | New York City                       | Green space in the form of a major park (Central Park).                                                                                                          |
|                              | Addis Ababa                         | a) Green spaces in the form of official public parks, private parks and around churches and government buildings.<br>b) A planted forest within the city limits. |

| <b>Nature-based solution</b>           | <b>City</b><br>(refer to Chapter 5) | <b>Context-based application</b>                                                                                                                                                                                                                                                                                  |
|----------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Urban green spaces<br><i>continued</i> | Johannesburg                        | <ul style="list-style-type: none"> <li>a) Clearing alien vegetation.</li> <li>b) Rehabilitating existing vegetation within the city limits.</li> <li>c) Green spaces in the form of urban parks.</li> <li>d) Private gardens.</li> <li>e) Utilising wetlands in the city limits.</li> </ul>                       |
|                                        | Seoul                               | A linear green space creating a pedestrian corridor along a stream.                                                                                                                                                                                                                                               |
|                                        | Hong Kong                           | Various urban parks and open spaces has been established in Hong Kong.                                                                                                                                                                                                                                            |
|                                        | Mexico City                         | <ul style="list-style-type: none"> <li>a) Rehabilitating existing vegetation within the city limits.</li> <li>b) A conservation area has been zoned where hunting, logging, introducing foreign species, grass harvesting, river modification and urban development and waste disposal are prohibited.</li> </ul> |

**Source: Own construction (2018).**

From Table 7.4, it is evident that, even though various similarities in the quest for sustainable city planning might be identified, the sustainability agenda is approached differently in each city (context-based planning). These different approaches to the implementation of nature-based solutions provide unique advantages in addition to the general benefits of urban green (refer to Tables 3.1 and 3.2) and consequently addresses the unique socioeconomic and environmental challenges within local context.

It could therefore be concluded that nature-based solutions cannot be properly and effectively implemented without a thorough consideration of the local context. It should, therefore, be considered as an integral part of sustainable city planning in order to address unique urban challenges and utilise unique opportunities within different regions.

## **7.5 The relevance of nature-based solutions for the Global South urban context**

For the purposes of this study a focus was placed on context-based sustainable city planning within the Global South as this region is generally considered underrepresented in academic literature.

The Global South is commonly believed to mostly differ from the Global North in socioeconomic factors (refer to Chapter 4). Considering that this is a large region, the different parts of the Global South does each have its own, unique socioeconomic and environmental benefits and challenges, but the region as a whole share certain histories and contemporary challenges and opportunities (refer to Chapter 4). These pressing issues often result in local authorities focusing more on socioeconomic considerations than on conservation of the natural environment. Such a

focus poses a challenge to balance the natural, economic and social environment, highlighting the importance of the sustainability agenda and nature-based solutions within the Global South.

The expert perception on the major differences between the Global North and the Global South (as presented in Tables 6.4 and 6.5) with regards to nature-based solutions is subsequently indicated in Table 7.5.

**Table 7.5: Global South urban context from an expert perspective**

|                                    | Global North perspective |                            |                         | Global South perspective |                            |                         |
|------------------------------------|--------------------------|----------------------------|-------------------------|--------------------------|----------------------------|-------------------------|
|                                    | Higher:<br>Global South  | Similar in<br>both regions | Higher:<br>Global North | Higher:<br>Global South  | Similar in<br>both regions | Higher:<br>Global North |
| Extreme weather occurrences impact | x                        |                            |                         |                          | x                          |                         |
| Level of greenhouse effect         |                          | x                          |                         |                          | x                          |                         |
| Levels of pollution                | x                        |                            |                         |                          | x                          |                         |
| Amount of available resources      | x                        |                            |                         | x                        |                            |                         |
| Focus on ecosystem services        |                          |                            | x                       |                          |                            | x                       |
| Loss of vegetation                 | x                        |                            |                         |                          | x                          |                         |
| Urban green considered a luxury    | x                        |                            |                         | x                        |                            |                         |
| Levels of biodiversity             | x                        |                            |                         |                          | x                          |                         |

**Source: Own construction (2018).**

From Table 7.5 it is evident that the perception on the local challenges and opportunities differ. The general perception from both regions is that the level of the greenhouse effect is similar in both regions; that the Global North focus on ecosystem services; that urban green is considered a luxury in the Global South and that the Global South consist of a high amount of available resources. Experts from the Global North do, however, consider the impact of extreme weather occurrences, the level of pollution, the loss of vegetation and the levels of biodiversity as higher in the Global South than in the Global North, while the experts from the Global South deems these considerations to be similar in both regions.

It is evidently important to exploit the opportunity to find creative solutions within the local context. This could be done through a combination of indigenous and contemporary knowledge and found in the high levels of biodiversity and cultural diversity, that characterise many regions in the Global South. Table 7.6 consequently reflects on the difference in application of nature-based solutions between the top-ranking cities of the Global North and the Global South (in reference to Chapter 5).

**Table 7.6: Nature-based solutions and the Global South**

| <b>Nature-based solution</b> | <b>Global North application</b>                                                                                              | <b>Global South application</b>                                                                                                                                                            | <b>Reflection</b>                                                                                                                                                                                                                                                                |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green roofs                  | <ul style="list-style-type: none"> <li>- Building regulations</li> <li>- Private implementation</li> </ul>                   | <ul style="list-style-type: none"> <li>- Implemented on government and public property</li> </ul>                                                                                          | The implementation of green roofs in the Global North cities was enforced by building regulations, whereas in the Global South it was implemented on government property.                                                                                                        |
| Street trees                 | <ul style="list-style-type: none"> <li>- Government investment</li> <li>- Local authority project/ implementation</li> </ul> | <ul style="list-style-type: none"> <li>- Trees in private gardens and on public land</li> </ul>                                                                                            | Street trees were planted by the local authorities in the Global North and found in private gardens and on public land in the Global South.                                                                                                                                      |
| Urban agriculture            | <ul style="list-style-type: none"> <li>- Governmental encouragement projects</li> <li>- Community projects</li> </ul>        | <ul style="list-style-type: none"> <li>- Permitting the use of public resources</li> <li>- Implemented on government property</li> <li>- Private implementation</li> </ul>                 | In the Global North urban agriculture was encouraged by the government, while governments in the Global South implemented it on their property and permitted the usage of public resources by individuals. It was also found in private gardens in the Global South.             |
| Urban green spaces           | <ul style="list-style-type: none"> <li>- Government implementation</li> <li>- Planning policy</li> </ul>                     | <ul style="list-style-type: none"> <li>- Implemented on government and public property</li> <li>- Private gardens</li> <li>- Rehabilitation projects</li> <li>- Planning policy</li> </ul> | Urban green spaces were implemented by the government and enforced through planning policy in the Global North. In the Global South it was found on government property and private land. Urban green spaces in the Global South were also increased by rehabilitation projects. |

**Source: Own construction (2018).**

From Table 7.6 it is apparent that nature-based solutions in the Global South are mostly implemented through public-private partnerships in the form of 1) private implementation of nature-based solutions, 2) the government permitting the use of public resources, 3) planning policies and 4) government investment.

It could therefore be resolved that the Global South is a unique region with a different approach than the Global North for implementing nature-based solutions as part of the urban sustainability discourse. Table 7.7 presents unique considerations for the Global South with regards to nature-based solutions.

**Table 7.7: Unique considerations for the Global South regarding nature-based solutions**

| Unique consideration                                 | Reflection                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Opportunities</i>                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Rapid economic growth<br>Chapters 4, 5 & 6           | Nature-based solutions were proved throughout this research to provide, among other things, various economic benefits (refer to Chapter 3).                                                                                                                                                                                                                                                                                                                                          |
| Government savings<br>Chapter 3                      | Nature-based solutions assist in decreasing costs for stormwater management (refer to Chapter 3).                                                                                                                                                                                                                                                                                                                                                                                    |
| High levels of biodiversity<br>Chapters 4 & 6        | The Global South is generally considered to possess high levels of biodiversity.                                                                                                                                                                                                                                                                                                                                                                                                     |
| Social climate: community-based<br>Chapter 4         | It could be noted that the Global North's governments launch encouragement projects in order to gain public awareness and participation. This could prove a valuable enhancement within Global South sustainable city planning, since it already leans on public-private partnerships for the application of nature-based solutions.                                                                                                                                                 |
| Utilisation of nature-based solutions<br>Conclusions | Various nature-based solutions that were found in Chapter 3 could not be identified in the Global South case study analysis (limited to selected case studies), such as vegetation around buildings, green walls, indoor plants, permeable surfaces and rain gardens. These initiatives were proved to provide various, vastly important benefits that could address the challenges of the Global South urban context.                                                               |
| <i>Challenges</i>                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Wide gap between rich and poor<br>Chapter 4          | The Global South, especially, experiences high levels of disparity between the rich and poor. This research indicated that nature-based may serve as a tool for poverty mitigation (refer to Chapter 3).                                                                                                                                                                                                                                                                             |
| Pollution of natural resources<br>Chapters 4, 5 & 6  | It was noted throughout this research that nature-based solutions assist in mitigating environmental degradation issues (refer to Chapter 3).                                                                                                                                                                                                                                                                                                                                        |
| Prone to environmental risks<br>Chapter 5            | In the literature study it was evident that nature-based solutions lessen the effects of urban environmental risks such as flooding (refer to Chapter 3).                                                                                                                                                                                                                                                                                                                            |
| Urban green considered a luxury<br>Chapter 6         | A unilateral focus on socioeconomic considerations causes an imbalance between the socioeconomic and natural urban environment (refer to Chapter 4). It was, however, proved throughout this study that nature-based solutions simultaneously benefit all three these dimensions of sustainability (refer to Chapter 3). Cost-saving may be argued as the most important of these benefits, since this region was found to experience high levels of poverty and budget constraints. |
| Health issues<br>Chapter 4                           | Nature-based solutions provide various benefits for the improvement of local health conditions (refer to Chapter 3).                                                                                                                                                                                                                                                                                                                                                                 |
| High levels of poverty<br>Chapters 4 & 5             | Nature-based solutions provide benefits for poverty mitigation (refer to Chapter 3).                                                                                                                                                                                                                                                                                                                                                                                                 |

| Unique consideration                                                                                                                                                | Reflection                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Challenges continued</i>                                                                                                                                         |                                                                                                                                                                                                                                                                                                                 |
| Divided ethnicity<br>Chapter 4                                                                                                                                      | The Global South, especially, has divided ethnicity. This research has, however, indicated that nature-based solutions, for example urban parks, create a safe space for people from different ethnicities to engage (refer to Chapter 3).                                                                      |
| Violent crime rates<br>Chapters 4 & 6                                                                                                                               | Nature-based solutions were proved, from the literature study, to assist in decreasing crime rates and levels of violence (refer to Chapter 3).                                                                                                                                                                 |
| Inadequate infrastructure provision<br>Conclusions                                                                                                                  | It was notable throughout this research that nature-based solutions provide a cost-effective alternative to traditional infrastructure for especially stormwater management and could be utilised in the Global South (refer to Chapters 3 and 4), since this region generally suffers from budget constraints. |
| <div> <div>■ Economic considerations</div> <div>■ Environmental considerations</div> <div>■ Social considerations</div> <div>■ Planning considerations</div> </div> |                                                                                                                                                                                                                                                                                                                 |

**Source: Own construction (2018).**

Table 7.7 presents current gaps, as identified from this research, within the Global South's approach to nature-based solutions as part of the broader sustainability agenda.

## 7.6 Conclusion

Based on the literature and empirical studies presented in the previous chapters, the secondary research questions of 1) what the current paradigm regarding sustainable city planning is, 2) what the linkage between nature-based solutions and the sustainability agenda is, 3) what the unique considerations, opportunities and challenges are for sustainable city planning in the Global South and 4) how nature-based solutions could be implemented in the Global South, were addressed in this chapter.

From the discussion in this chapter it is evident that nature-based solutions could be described as a crucial part of the Global South sustainability agenda, since this region is generally described as a region with high levels of biodiversity. This creates an opportunity to utilise the various social, economic and environmental benefits derived from such nature-based initiatives. It was also found that these nature-based solutions are a cost-effective way to create a sustainable city that may prove valuable in a socioeconomic climate of poverty, unemployment and low budgets. The importance of context-based methods in the implementation of such nature-based solutions was stressed. It was found that these initiatives are usually implemented through public-private partnerships in the Global South rather than state driven projects as in the case of the Global North.

It is thus concluded that nature-based solutions form an important part of the sustainability agenda with various benefits to forward the ultimate goal of planning for a sustainable city and that there are various examples around the globe where such initiatives have been successfully implemented.

It was, however, found that nature-based solutions are currently not 1) implemented to its full potential and 2) prioritised well enough by governing authorities in the Global South. The following chapter will therefore endeavour to address these issues by means of recommendations on how the Global South could implement nature-based solutions within their unique urban context.

## CHAPTER 8: RECOMMENDATIONS

### 8.1 Introduction

This study investigated the current paradigm of sustainable city planning (research question 1), the linkage between nature-based solutions and the sustainability agenda (research question 2), the unique considerations, opportunities and challenges that the Global South offer for sustainable city planning (research question 3) and how nature-based solutions could be implemented in the Global South (research question 4). From the conclusions it is evident that the research objectives (cross-reference to Chapter 1) for this study were met. The sustainability agenda was found to be important for socio-economic and environmental well-being to address urban complexities within modern cities (research objective 1) and it was concluded that nature-based solutions are a viable method to address these urban complexities, since it forms part of the sustainability agenda (research objective 2). It was further concluded that nature-based solutions are currently not comprehensively implemented or prioritised well enough in the Global South. Unique considerations, opportunities and challenges for urban sustainability in the Global South were, therefore, identified (research objective 3). It was also found that the implementation of nature-based solutions should be done in a context-based manner (research objective 4).

Therefore, this chapter aimed to make recommendations for planning sustainable cities through nature-based solutions in the Global South, in response to the primary research question of how nature-based solutions could guide sustainable city planning in the Global South. These recommendations are primarily drawn from the current gaps within the Global South's approach to nature-based solutions, as was identified from the conclusions in the previous chapter and presented in Table 7.7. The main themes of these challenges and opportunities are indicated in Table 8.1.

**Table 8.1: Identified opportunities and challenges with regards to the implementation of nature-based solutions in the Global South**

|                                                                   | <b>Planning economic sustainable cities</b>                                                       | <b>Planning environmentally sustainable cities</b>                                                                                | <b>Planning social sustainable cities</b>                                                                             | <b>Sustainable city planning practice</b>                                                                        |
|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Opportunities to utilise</b><br>(Cross-reference to Table 7.7) | <ul style="list-style-type: none"> <li>- Economic growth</li> <li>- Government savings</li> </ul> | <ul style="list-style-type: none"> <li>- High levels of biodiversity</li> </ul>                                                   | <ul style="list-style-type: none"> <li>- Community-based social climate</li> </ul>                                    | <ul style="list-style-type: none"> <li>- Public-private partnership</li> <li>- Nature-based solutions</li> </ul> |
| <b>Challenges to address</b><br>(Cross-reference to Table 7.7)    | <ul style="list-style-type: none"> <li>- Wide income gap</li> </ul>                               | <ul style="list-style-type: none"> <li>- Pollution</li> <li>- Environmental risks</li> <li>- Perception on urban green</li> </ul> | <ul style="list-style-type: none"> <li>- Health levels</li> <li>- Divided ethnicity</li> <li>- Crime rates</li> </ul> | <ul style="list-style-type: none"> <li>- Infrastructure provision</li> </ul>                                     |

**Source: Own construction (2018).**

Since the concept of nature-based solutions reach across these opportunities and challenges, the planning recommendations were discussed thematically in an integrated manner with six identified themes, as presented in Table 8.2.

**Table 8.2: Planning recommendation themes**

| <b>Theme</b>                                      | <b>Utilised opportunities</b> (cross-reference to Table 7.7)                                                                                            | <b>Addressed challenges</b> (cross-reference to Table 7.7)                                                                                                                                                                           |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Urban biodiversity                                | <ul style="list-style-type: none"> <li>- Utilise benefits of nature-based solutions</li> <li>- Government savings</li> </ul>                            | <ul style="list-style-type: none"> <li>- Violent crime rates</li> <li>- Health issues</li> <li>- Environmental risks</li> <li>- High levels of pollution</li> </ul>                                                                  |
| Measures in support of nature-based solutions     | <ul style="list-style-type: none"> <li>- Utilise benefits of nature-based solutions</li> <li>- Government savings</li> <li>- Economic growth</li> </ul> | <ul style="list-style-type: none"> <li>- Violent crime rates</li> <li>- Health issues</li> <li>- High levels of pollution</li> </ul>                                                                                                 |
| Urban greening in the private and business sector | <ul style="list-style-type: none"> <li>- Economic growth</li> <li>- Poverty mitigation</li> <li>- Utilise benefits of nature-based solutions</li> </ul> | <ul style="list-style-type: none"> <li>- Wide income gap</li> <li>- High levels of pollution</li> <li>- Health issues</li> </ul>                                                                                                     |
| Education on nature-based solutions               | <ul style="list-style-type: none"> <li>- Utilise benefits of nature-based solutions</li> </ul>                                                          | <ul style="list-style-type: none"> <li>- Perception that urban green is a luxury</li> </ul>                                                                                                                                          |
| Urban greening on public and government property  | <ul style="list-style-type: none"> <li>- Government savings</li> <li>- Utilise benefits of nature-based solutions</li> </ul>                            | <ul style="list-style-type: none"> <li>- Environmental risks</li> <li>- High levels of pollution</li> <li>- Health issues</li> <li>- Divided ethnicity</li> <li>- Violent crime rates</li> <li>- Infrastructure provision</li> </ul> |
| Public-private partnerships                       | <ul style="list-style-type: none"> <li>- Community-driven social climate</li> </ul>                                                                     |                                                                                                                                                                                                                                      |

**Source: Own construction (2018).**

Planning recommendations are subsequently discussed according to these themes.

## **8.2 Recommendations to guide sustainable city planning in the Global South through nature-based solutions**

Nature-based solutions provide the opportunity to utilise the opportunities and address the challenges identified in Table 7.7. It could further urban economic growth and provide a sustainability factor to the Global South economic climate, be utilised to improve the socioeconomic state and the high levels of biodiversity could be utilised to create context-based nature-based solutions to further the sustainability agenda.

Planning recommendations were posed in this section to address the primary research question of how nature-based solutions could guide sustainable city planning in the Global South. These recommendations are presented in Tables 8.7 to 8.8, according to the themes listed in Table 8.2. The corresponding cross-reference to similarities in the literature and empirical studies are also listed in these tables.

It was evident from this research that urban biodiversity could contribute to the planning of a sustainable city and may provide a valuable enhancement for climate change mitigation and protection against environmental risks. It is therefore recommended that urban biodiversity be protected and form an inclusive part of broader spatial planning approaches, as proposed in Table 8.3.

**Table 8.3: Recommendations to protect and plan for urban biodiversity**

| <b>Protect and plan for urban biodiversity</b> |                                                                                     |                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cross-reference</b>                         | <b>Recommended approach</b>                                                         | <b>Reflection</b>                                                                                                                                                                                                                                                                                                                                           |
| Recommendation drawn from research             | Set design and planning measures in place to protect existing natural biodiversity. | From the conclusions it is evident that the Global South is widely considered a hub for biodiversity. It is evident from this research that biodiversity provides various and important benefits for sustainable city planning. It is, thus, important to protect the existing biodiversity in order to utilise the benefits that could be derived from it. |
| Chapter 5                                      | Implement nature-based solutions in grey and brown areas to further biodiversity.   | As explained in the reflection above, nature-based solutions provide important benefits for the Global South. Urban spaces in this region could be enhanced by adding it to grey and brown areas within city limits. Detailed planning frameworks should be developed to guide such interventions.                                                          |

**Source: Own construction (2018).**

It is further recommended that measures be set in place to support the implementation of nature-based solutions in order to further the sustainability agenda in the Global South, as posed in Table 8.4.

**Table 8.4: Recommendations for regulations to support nature-based solutions**

| <b>Provide regulations to support implementation of nature-based solutions</b> |                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cross-reference</b>                                                         | <b>Recommended approach</b>                                                                      | <b>Reflection</b>                                                                                                                                                                                                                                                                                                                                                                                                      |
| Chapter 5                                                                      | Set regulations for new developments and buildings to implement specific nature-based solutions. | In Copenhagen regulations in terms of provision for nature-based solutions were introduced for new buildings. This would assist the city as a whole to be more sustainable in terms of the multifunctional benefits derived therefrom. It also serves as an encouragement for the business sector to incorporate nature-based solutions. Similar regulations should be developed and considered for the local context. |

| Provide regulations to support implementation of nature-based solutions |                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cross-reference                                                         | Recommended approach                                                                                                        | Reflection                                                                                                                                                                                                                                                                                                                                                                 |
| Recommendation drawn from research                                      | Set regulations for government and public property in terms of minimum requirements for implemented nature-based solutions. | From this research it is evident that nature-based solutions provide various benefits to forward the sustainability agenda. Such regulations may serve as an encouragement for local authorities to utilise the opportunities provided by these benefits. Transdisciplinary approaches should be employed to develop the regulations in support of nature-based solutions. |
| Chapter 5                                                               | Plan urban spaces to enhance the implementation of nature-based solutions such as urban agriculture and urban greening.     | Urban green spaces (such as parks or urban agriculture spaces) provide, among the various economic and environmental benefits (as explored throughout this research), a space for people from various ethnicities to engage in a safe environment that might breach the divide between them (refer to Chapter 3).                                                          |

Source: Own construction (2018).

Nature-based solutions provide various cost-saving benefits, amongst other things, for the urban environment that may prove especially valuable in the Global South's socioeconomic environment whilst conserving valuable natural assets. It is therefore recommended in Table 8.5 that nature-based solutions be utilised on government and public property and that the valuation of nature-based solutions be translated to financial costs, in order to strengthen the case for nature-based solutions within the broader spatial planning decision-making processes.

**Table 8.5: Recommendations to strengthen nature-based solutions from a financial perspective**

| Apply nature-based solutions on government and public property |                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cross-reference                                                | Recommended approach                                                                                       | Reflection                                                                                                                                                                                                                                                                                                                                                            |
| Chapter 5                                                      | Implement green roofs, rain gardens, urban parks and permeable surfaces on public and government property. | These initiatives may serve to enhance the socioeconomic and natural environment in the Global South, whilst providing financial gains for the local authorities. The financial benefits of nature-based solutions should be quantified and translated to a monetary value in order to strengthen the case for nature-based solutions in the decision-making process. |

Source: Own construction (2018).

Nature-based solutions provide various benefits (refer to Chapter 3) that could empower the urban poor, especially, and thereby assist in narrowing the gap between rich and poor, whilst conserving

nature. The implementation thereof is thus important and community members and government officials should be educated on its benefits in order for it to be utilised to its full potential (refer to Table 8.6).

**Table 8.6: Recommendations for education on nature-based solutions**

| <b>Encourage education on benefits and opportunities provided by nature-based solutions</b> |                                                                                                          |                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cross-reference</b>                                                                      | <b>Recommended approach</b>                                                                              | <b>Reflection</b>                                                                                                                                                                                                                                                                                                                                 |
| Recommendation drawn from research                                                          | Organise briefing sessions for private and business sector and for local government officials.           | Nature-based solutions provide many benefits to forward the sustainability agenda and it is, therefore, important that those that may benefit from it be educated in order for it to be utilised to its full potential. Transdisciplinary approaches should be employed to ensure adequate transfer of knowledge between the related disciplines. |
| Chapter 5                                                                                   | Plan for spaces where urban agriculture could be implemented at public schools for educational purposes. | Urban agriculture provides benefits such as heightened levels of food security and a method for urban poor to combat hunger and save on household expenses. It is, therefore, important that children be educated on such initiatives.                                                                                                            |

**Source: Own construction (2018).**

Nature-based solutions may empower community members to assist in the quest for sustainable city planning and it is therefore recommended that urban greening be encouraged amongst the private and business sector, as proposed in Table 8.7.

**Table 8.7: Recommendations for nature-based solutions in the private and business sector**

| <b>Encourage urban greening in the private and business sector</b> |                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cross-reference</b>                                             | <b>Recommended approach</b>                                                                                                                                                                                      | <b>Reflection</b>                                                                                                                                                                                                                                                               |
| Chapter 5                                                          | Government incentives such as tax reduction should be explored and quantified within broader spatial planning approaches.                                                                                        | Throughout this research it was proved that nature-based solutions provide various cost-saving benefits. When the private and business sector implement such initiatives, local authorities could also benefit therefrom in the sense that they may receive financial benefits. |
| Chapter 5                                                          | Permit the use of public resources, for example water from the river, to implement nature-based solutions such as urban agriculture in an attempt to encourage private implementation of nature-based solutions. | In Ethiopia, local residents are permitted to utilise public water resources to grow their own food that may serve as a relief to urban poor. Such initiatives should be explored in local context to orientate private and business sectors to include nature-based solutions. |

**Source: Own construction (2018).**

It was evident in Table 7.7 that governments in the Global South lean strongly on public-private partnerships and, therefore, the community-driven social climate in this region should be utilised to further context-based planning. Recommendations to utilise public-private partnerships in the implementation of nature-based solutions are, thus, posed in Table 8.8.

**Table 8.8: Recommendations to utilise public-private partnership for the implementation of nature-based solutions**

| <b>Utilise and build public-private partnerships</b> |                                                                                                      |                                                                                                                                                                                                                              |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cross-reference</b>                               | <b>Recommended approach</b>                                                                          | <b>Reflection</b>                                                                                                                                                                                                            |
| Chapter 5                                            | Establish city greening initiatives such as tree planting day and rehabilitation projects.           | From this research it is evident that the social climate in the Global South is community-driven. Projects where the community is actively involved and brought together may assist in forwarding the sustainability agenda. |
| Table 8.7                                            | The encouragement of urban greening for the private and business sector                              | Encouragement projects, as posed in Table 8.7, might assist in strengthening the public-private partnerships to effectively implement nature-based solutions for creating a sustainable city.                                |
| Table 8.6                                            | The encouragement of education on the benefits and opportunities provided by nature-based solutions. | Public-private partnerships may be enhanced when stakeholders are educated on the benefits that such initiatives may provide for their socioeconomic well-being and the natural environment.                                 |

**Source: Own construction (2018).**

It is apparent from Tables 8.7 to 8.8 that nature-based solutions could guide sustainable city planning in the Global South.

### **8.3 Conclusions**

From this research it is evident that nature-based solutions form an integral part of the sustainability agenda in the Global South, addressing social, economic and environmental urban complexities. The research further indicated that the implementation of nature-based solutions should be done in a context-based manner, but that nature-based solutions are currently not comprehensively implemented or prioritised well in the Global South. The Global South was, however, found to be generally considered a hub of biodiversity that could (and to a large extent) benefit from nature-based solutions.

This chapter provided recommendations as to how nature-based solutions could guide the sustainability agenda in the Global South. These recommendations broadly refer to 1) planning

specifically for urban biodiversity and nature-based solutions, 2) utilising the financial benefits from nature-based solutions, 3) educating communities and planning authorities on benefits from nature-based solutions, 4) encouraging the private and business sectors to implement nature-based solutions and 5) utilising public-private partnerships.

This research provides a valuable foundation for further studies on the unique context of urban planning in the Global South as well as the implementation of nature-based solutions within this region. Even though it is evident that the Global South experiences a wide range of unique challenges, it is within these challenges that a copious amount of unique opportunities and potential lie. These unique opportunities, as well as their development potential, should be investigated in more depth to gain a broader understanding of their application within the unique contexts of the Global South. Additionally, it is important to investigate and develop methods for the practical application of nature-based solutions within the respective unique contexts of the Global South in order to provide for the practical expression of sustainable city planning.

The notion of transdisciplinary planning should be further explored in support of finding nature-based solutions for the Global South context.

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