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**Sustainable Urban Development and Management: A case study of Nelson
Mandela Bay Metropolitan Municipality (Gqeberha)**

University of Cape Town - Faculty of Engineering & the Built Environment

Department of Construction Economics and Management

MSc Property Studies Minor Dissertation: CON5010Z

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Acknowledgements

I wish to acknowledge my Supervisor Associate Professor Kathy Michell, the course convener Dr Kystle Ontong, the Construction Economics and Management postgraduate course administrator Ms. Maredia Fagodien, my work colleagues particularly Mark Moodaley, my professional associates, research participants that accepted my invitation and lastly my family for supporting me during the research journey. The turnaround time for feedback and mentorship from the supervisor is particularly acknowledged. The Research Writing in the Sciences (RWS) workshop co-ordinated by Dr Sabirah Adams ignited the fading passion in the middle of the research process. Acknowledgement is also extended to Associate Professor Francois Viruly for the special emphasis on sustainability in the Urban Land Economics, Property Development and Property Portfolio Management modules that he convened.

This study is dedicated to Dhaya Govender, a colleague in the MSc Property Studies programme who tragically passed on in February 2022 just after embarking on his research journey.

Abstract

As Bell & Morse (2018) argued, sustainable development has been notoriously difficult to pin down over time based on the themes, level and the agents that benefit from it. As a result, most indicators to measure sustainability have been binary targets that did not measure the full extent of the sustainability pillars in urbanisation. This study explores urban management and sustainability development in Nelson Mandela Bay Metro (NMBM) and attempts to determine its sustainability on the four dimensions of sustainability: society, economy, environment, and the institutional framework. The research methodology is a single case study of NMBM using a mixed methods approach consisting of structured questionnaires to residents, semi-structured interviews of 'sustainability officials' and secondary data (literature review) from credible sources.

The research findings are that NMBM, as with all South African metros has strong frameworks and guidelines for sustainability but the frameworks are poorly implemented. According to the survey and interviews to residents and 'sustainability officials' respectively in the metro and secondary data (mainly from NMBM and South Africa Cities Network websites), NMBM appears to be regressing on its sustainability and green economy drive. An analysis of the results of the study point to a metro regressing on most dimensions of sustainability with limited sustainability initiatives pursued in a few areas (e.g., energy). The residents' survey found NMBM to be unsustainable (48.4% unsustainable, 28.3% indifferent and 23.3% sustainable) in all the four pillars of sustainability (40.6% economic, 52.2% socio-cultural, 61.7% environment and 38.9% institutional). The management of the water crisis and instability in the metro's leadership, are manifestations of the metro's continued unsustainable management of the city. Recommendations which are consistent with Maslow's hierarchy of needs principle, calls for the metro to manage basic service provision (establishing a stable leadership, managing the water and energy crisis, and improving compliance with its legal universe) before refocusing on the bigger sustainable urban development agenda.

List of Abbreviations and Acronyms

BCM	Buffalo City Metropolitan Municipality
CAPEX	Capital Expenditure
CO ₂	Carbon Dioxide
COGTA	Cooperative Governance and Traditional Affairs
e.g.,	For example,
EIA	Environmental Impact Assessment
et al	and others
Etc.	Etcetera
GDP	Gross Domestic Product
GHG	Green House Gases
IDP	Integrated Development Plan
IPCC	International Panel on Climate Change
IPTS	Integrated Public Transport System
IRR	Internal Rate of Return
LUM	Land Use Management
NMBBC	Nelson Mandela Bay Business Chamber
NMBM	Nelson Mandela Bay Metropolitan Municipality
OECD	The Organisation of Economic Co-operation and Development
SA	South Africa
SACN	South Africa Cities Network
SCODA	South African Cities Open Data Almanac
SDF	Spatial Development Framework
SDG	Sustainable Development Goals
SPLUMA	Spatial Planning and Land Use Management Act 16 of 2013
UN	United Nations

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1. CHAPTER 1: INTRODUCTION

1.1. Background to the Study

The study of sustainability in urban development is important because urban areas contribute 75% of total carbon (CO₂) emissions and accounts for 80% of global GDP (REN21, 2019). 56% of the global population now stay in cities and is projected to be 68% by 2050 (UN, 2022). Whilst urban areas only cover about 5% of the land mass, they account for 90% of resource consumption and environmental degradation (Gonzalez & Lazaro, 2011). Recent awareness has found that current consumption and the associated degradation particularly due to carbon fuels and urban development might be irreversible (e.g., Tibaijuka, 2008; UN, 2022). As a result, sustainable urban development and management has been profiled as a tool to improve global welfare with minimum harm to the ecosystem.

1.2. Brief Overview of Sustainability and Urban Management

The UN Brundtland Report defines sustainability as a way of improving the wellbeing of society and the environment for current use without jeopardising future generational needs (WCED, 1987; Yilmaz, 2014). Early literature has identified the economy, the society, and the environment as three (3) dimensions to sustainability and sustainable development has been taken as the intersection of the three dimensions (Isaac et al., 2016). The dimensions are interrelated, but the environmental dimension has prominently been used as a measure of sustainability (Taylor et al., 2014; Abdulai & Awuah, 2021). Green technologies including efficient energy and water use; indoor environment enhancement and material and resource efficiency have been adopted as the main drivers of sustainable urban development (Abdulai & Awuah, 2021). Later literature adds the institutional framework as the fourth dimension of sustainability (Gashu & Gebre-Egziabher, 2018). Based on Wheeler (1996)'s reviews, six (6) themes, namely: environment, holistic view of the earth and its ecosystem, systematic thinking, balancing economic growth and preservation of the environment and long-term view of sustainability were observed. Some views of sustainability emphasised technology and economic growth while others considered its incompatibility with current economic and behavioural paradigms (Wheeler, 1996). Sustainability has also been classified by

distinguishing between ecology and social issues, but global citizens have now transcended that dichotomy (Wheeler, 1996). Another perception is to question whether the ecological system is in equilibrium according to traditional ecological frameworks. The view adopted determines the willingness to implement sustainable urban development (Wheeler, 1996). The last view is whether indigenous communities should be used as a true measure of sustainability (Wheeler, 1996). With a few exceptions most indigenous communities have lived in harmony with their environments (Wheeler, 1996). Shen & Kawakami (2013) acknowledges seven (7) design pillars to be considered in urban form strategy including sustainable transport infrastructure, efficient energy use, mixed land use and compactness. Shen & Kawakami (2013:1) further considers the classification of urban form into four types namely “*neo-traditional, urban containment, compact city and eco-city*” to be Eurocentric. The One Planet Living framework identifies ten (10) sustainability principles including health and wellbeing, transportation, sustainable use of materials, reduction in wastage and greenhouse gases emissions (Gold & Gold, 2013; oneplanet.com, n d). Figure 1.1 shows the One Planet Living framework.



Figure 1.1: One Planet Living Framework (Source: oneplanet.com, 2022).

Institutions e.g., OKKA Foundation of Finland adopts similar themes with One Planet (<https://koulujaymparisto.fi>, 2022).

The 17 UN Sustainable Development goals (SDGs) are consistent with the One Planet Living principles e.g., SDG No. 3 (good health & wellbeing), SDG No. 6 (clean water & sanitation), SDG No. 7 (affordable & clean energy), SDG No. 11 (sustainable cities & communities), SDG No. 12 (responsible consumption & production) and SDG No. 13 (climate action). Figure 1.2 shows the 17 SDGs (UN, 2022).



Figure 1.2: Global Goals for Sustainable Development (Source: un.org, 2022).

According to Wheeler (1996), sustainability could be understood from four (4) perspectives namely environmentalists, environmental economics, critics of development and lastly social/ethical (Wheeler, 1996). Ratcliffe et al. (2009) identifies a link between town planning and sustainable development (e.g., green belts, restriction of access, using planning for urban densification; environmental impact assessment etc.). National governments (and cities) use international resolutions e.g., Sustainable Development Goals and Global Compact to develop national policy frameworks e.g., National Planning Framework (Edward, 2007; Groese et al., 2020). As Condie & Cooper (2015:v) observed:

“Sustainable urban development will require a conceptual framework which simultaneously considers the macro development framework, the urban context, urban service delivery and investment, social needs and opportunities, economic opportunities, and challenges, institutional architecture and urban policy, decentralization and legislative reform”.

There is no universally accepted methodology for assessing the social dimension of sustainability and this restricts the development of practical models which integrates it with other dimensions (Condie & Cooper, 2015). Seminal work on sustainable urban development by Gibson (2006) and conceptualisation of sustainable development on the environment by

Luederitz (2013) and John et al. (2015) are credited for the formulation of the guiding principles of sustainable development (Condie & Cooper, 2015). These guiding principles are human environment integrity; democratic governance; human well-being, intra & intergenerational equity; and lastly precaution and adoption (Condie & Cooper, 2015). As cited in Bibli (2018), Bibri & Krogstie (2017) have explored shortcomings and differences between smart city and sustainable city concepts e.g., lack of a common theoretical framework and the misconception that technology in smart cities always contribute to sustainable development. Other researchers e.g., Asif (2015) regard components of a smart city (namely innovations; sustainable urban environment, transportation, ICT, health, education, smart buildings, and smart governance) to be essentially the same components as those of sustainable real estate. This report supports the view that there are gaps in knowledge between smart cities and sustainable cities (Bibri, 2018).

Government planning policies have a role in promoting urban sustainability and cities should enable economic growth by accelerating land enablement and providing infrastructure (e.g., roads and water) to stimulate sustainable development and vibrant communities which in turn promotes the social wellbeing of the city (Isaac et al., 2016). Development activities must be environmentally sensitive to mitigate harmful gasses (GHG) emissions and thus control human driven climate change (Isaac et al., 2016). At times, the different dimensions have objectives that are at loggerheads and thus conflicting (Lützkendorfa & Balouktsia, 2017). Most government policies focus on economic viability of developments and ignore the other dimensions, but trends appear to challenge the perception that financial viability should be the overriding factor in project feasibility (Isaac et al., 2016) and the determinant of sustainable development. In South Africa (SA), cities experience gross incapacity to enforce planning controls mandated by statutes (SACN, 2022; Sondara, 2022). Environmental Impact Assessments (EIA) which affects transportation, ecology, etc. are now integral part of the development process. Most EIAs have stakeholder participation provisions which elevates environmental and social pillars to the same level as the economic pillar of development (Isaac et al., 2016).

In a sustainability study of municipalities in SA, Cape Town and eThekweni were found to be the leading municipalities with developed sustainability initiatives but having limited government financial support (Taylor et al., 2014). Climate change was taken to be a subsector of the technical planning and management department (Taylor et al., 2014). Business has been considering sustainability as an opportunity to gain competitive advantage in real estate development (e.g., Taylor et al., 2014). Focusing only on zero emissions and climate change without changing how cities are built and maintained, will have limited success on sustainability (Taylor et al., 2014). As Taylor et al. (2014) argues, there is a bias towards economic and environmental literature with no consensus on (social sustainability) frameworks and that sustainability is based on a narrow context ignoring the socio-political and institutional dimensions. With a high GINI coefficient, inequality in SA increases the exposure to natural disasters to the poorest communities (Taylor et al., 2014). The apartheid system in SA, influenced the location and urban form in most cities with the previously disadvantaged living furthest away from opportunities thus contributing to the degradation of the environment (NDP2030, 2010; NSSF, 2018; Sustainability Institute, 2010; Taylor et al., 2014). There are more than 600 unharmonised metrics of ESG (environmental, social and governance) which makes a universal measuring instrument difficult (ULI, 2021). Abdulai & Awuah (2021) observed that most third world countries place little emphasis on urban planning as a tool to effect sustainable urban development.

1.3. Nelson Mandela Bay Metropolitan Municipality

Nelson Mandela Bay Metropolitan Municipality (NMBM), located in the Eastern Cape province is one of eight (8) metropolitan municipalities in SA. The others being eThekweni (KwaZulu Natal), Mangaung (Free State), Cape Town (Western Cape), Buffalo City (Eastern Cape) and lastly Ekurhuleni, Tshwane, and Johannesburg all in Gauteng (SACN, 2021). Msunduzi, in KwaZulu Natal is not a metropolitan municipality but it is the ninth (9th) city which SACN extensively provided reports on sustainability and urban management (SACN, 2021). NMBM is SA's fifth (5th) biggest urban centre/metropolitan and accounts for 2% of the country's population (Stats SA GHS, 2019) and contributes 2,7% of the country's GDP (NMBM, 2022). Gqeberha (formerly Port Elizabeth), Despatch and Kariega (formerly

Uitenhage) form the major urban centres of the Nelson Mandela Bay Metro. The population of Gqeberha accounted for 27.1% of the NMBM in 2011 (statssa.gov.za,2022; citypopulation.de, 2022).

SACN (2021) records the total number of households in NMBM as 700 000 and considers 50% of the households to be informal. A locality map showing the location of the major precincts in the metro is depicted in Figure 1.3.

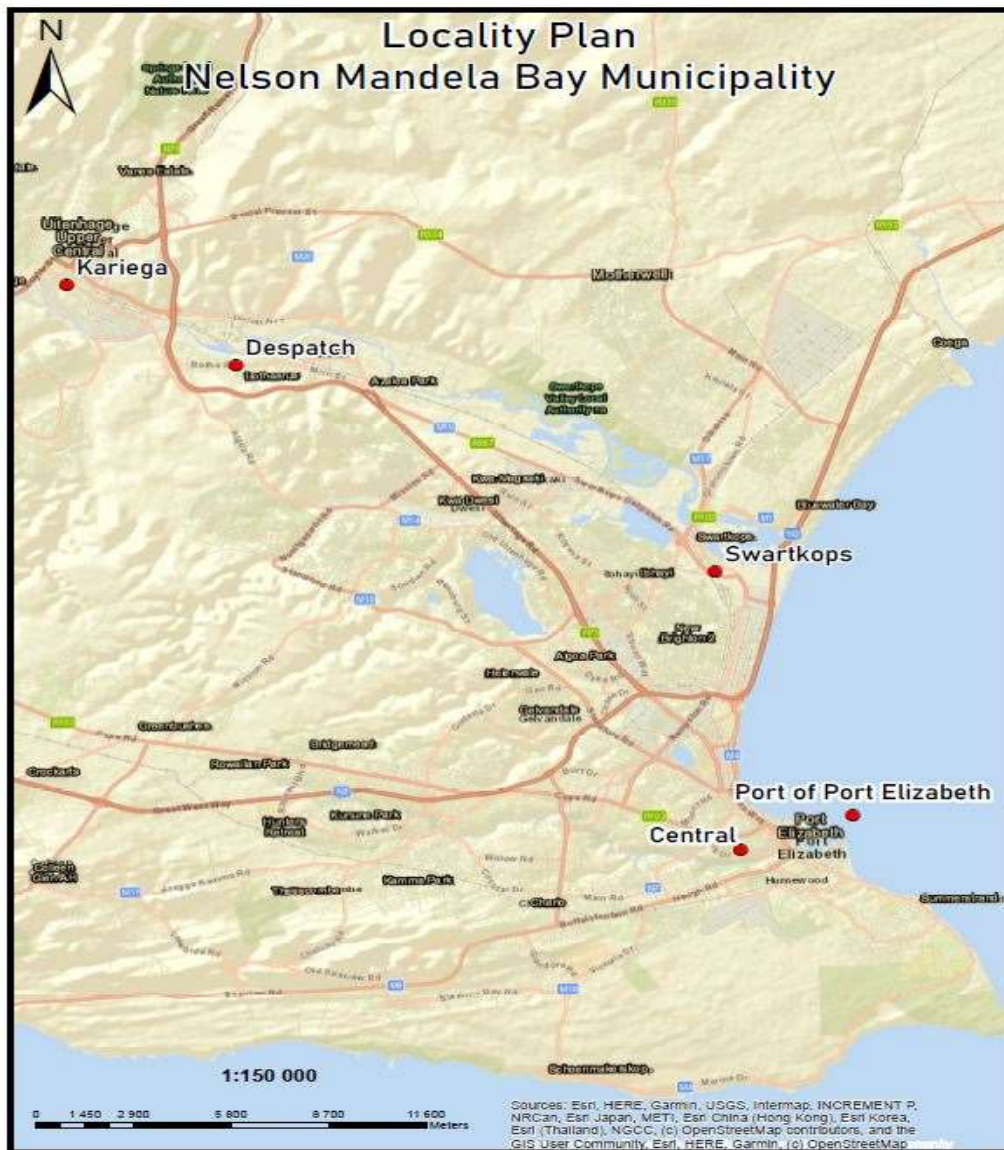


Figure 1.3: Locality Plan of Nelson Mandela Bay Metro (Source: developed by the Author using Google Earth, 2022)

1.4. Statement of the Research Problem

The SA urban environment is home to 67% of the country's population (Stats SA, 2021). The urban development of SA cities was affected by its history of apartheid which affected more than 90% of the population (NDP2030, 2010; NSSF, 2018; Stats SA, 2021). NMBM is the fifth biggest urban centre/metropolitan in SA with a population of about 1 239 463 (Stats SA GHS, 2019) and contributes 2,7% of the country's GDP (NMBM, 2022). With 20% of the population, it is the Eastern Cape's biggest city with a high concentration of social challenges e.g., crime and unemployment. Its population is projected to double every 22 years (NMBM, 2022). As with all metros in SA, emerging risks such as climate change induced droughts, floods, heat and cold waves, water scarcity *etc.* and low economic growth rates are threatening the sustainability of urban environments. The national government has assisted cities in the development of integrated development plans (IDPs), legislation, spatial development frameworks (SDFs) and policies to manage the existing spatial urban environment and develop new strategies to manage cities sustainably (SACN, 2016). South African Cities Network (SACN) literature shows that NMBM has the second highest frequency of sustainable/sustainability terms in its IDP after eThekweni and is rated highly in reviewed indices (SACN, 2015) but residents appear to regard the city as a 'failing municipality'.

According to SACN (2016), NMBM covers an area of 1959km², had a population of 1.15m and 324 392 households in 2011. That translates to 588 people/ km² and 3.55 people per household, with more than 90% staying in formal settlements. On the social dimension using 2011 statistics, the life expectancy is 59.3years, 90% of the population is literate (19.7% matric, 6.8 % higher education) and 29% live below the poverty datum line (SACN, 2016). Electricity constitutes 44.4% of the city's energy consumption and industry is the largest emitter of GHGs in the city (SACN, 2016). Hence, the research problem to be investigated may be stated as:

Little is known as to what holistic sustainability indicators could be used in assessing the sustainability of urban areas in SA and how effective are the used indicators in reversing unsustainable development (e.g., mitigation of climate change).

1.5. Research Questions

What are the most appropriate sustainable indicators to measure urban development and management in NMBM?

1.5.1. Subsidiary Questions

- i. How do the sustainability metrics of NMBM compare with other metros in SA?
- ii. How do the sustainability metrics compare with other cities in Africa and the resourced/developed world?
- iii. What indices have been used to measure the sustainability of the city and which themes have been used?
- iv. What is the most appropriate measure of sustainability for NMBM?
- v. Using the developed/recommended metrics, is NMBM sustainable?

1.6. Research Aim

The aim of this study is to review the adequacy of the sustainability measures/indicators used to assess NMBM and to recommend appropriate sustainable indicators and benchmarks of the developed indicators.

1.7. Research Premise

The research premise of the study is that the sustainable development and urban management of cities can be determined by the performance of sustainable development indices (e.g., health and wellbeing, sustainable extraction, and consumption of resources) developed through the four sustainability dimensions (environmental, economic, social, and cultural and institutional/governance). Using NMBM (Gqeberha) as a case study, the sustainability of the Metro can be confirmed by high scores of suitably developed indicators using the sustainability principles and sub-indicators.

1.8. Research Methodology

This study investigates sustainable urban development and urban management in NMBM. The first stage of the study was to use secondary data including UN SDGs, Integrated Development Plans (IDPs), SA legislation (and by-laws in NMBM), Spatial Development Frameworks (SDFs), and other related policies on urban development. The overarching research methodology is a single case-study of NMBM using a combination of qualitative and quantitative data i.e., mixed method (Guetterman & Fetters, 2018).

Semi-structured interviews to NMBM 'sustainability officials', sustainability stakeholders in the metro/Eastern Cape, service delivery community meetings and a sustainability questionnaire directed to residents of NMBM provided the primary data source of the study. For the qualitative data, semi-structured interviews were undertaken with targeted professionals including built environment professionals within 'sustainability departments' of NMBM, namely Human Settlements, Infrastructure & Engineering, Electricity and Energy, Safety & Security, Roads & Transport, Economic Development, Tourism & Agriculture (NMBM, 2022). In addition, stakeholders involved in sustainability in NMBM and/or Eastern Cape were interviewed using the same protocol as NMBM departments. The aim was to provide a holistic perspective of the sustainability agenda in the metro. The primary and secondary data together provided a holistic picture of sustainability initiatives in NMBM and other metros in SA. A convergent design adopting Creswell and Plano Clark (2018)'s categorisation in which data was collected simultaneously was used (Guetterman & Fetters, 2018). As with Guetterman & Fetters (2018), data was analysed simultaneously by adopting the merging approach cited by Fellers, Curry & Creswell (2013).

Consistent with the positivist paradigm, primary data (interviews, attendance of meetings/forums survey questionnaires) and secondary data (media, reports, documentaries etc.) were adopted and adapted as research tools. Taking cognisance of the validity and reliability requirements of the research project, a non-probability sampling approach for NMBM residences (convenience then followed by snowball sampling) was adopted due to time and budgetary constraints. Consistent with Gashu & Gebre-Egziabher (2018) in Ethiopia and statistical sampling requirements, a sample size of about 246 residents of NMBM and six (6) 'sustainability' stakeholder official was targeted.

Using a structured questionnaire, the researcher collected additional indicator data on the four dimensions of urban sustainability in NMBM, in addition to the secondary data extracted from credible websites (e.g., NMBM & SACN).

As with the Ethiopian study (Gashu & Gebre-Egziabher, 2018), the study adopted a 5-point Likert scale to measure sustainability in NMBM. Interviews were done with NMBM municipal officials and other 'sustainability' stakeholders. The Likert scale adopted scores from 0 to 4 with a score of 0 meaning a very low level; 1 equating to low, 2 equating to average; 3 implying good sustainability and finally 4 reflecting the highest level (very good) of the desirable outcome. The interpretation of the Likert scale was provided to participants when the questionnaires were distributed. Data from current events in the media was also collected where it was consistent with data collection methods.

The qualitative data was analysed using conceptual content analysis with data themes developed from the interview questions protocol. The quantitative data was analysed using statistical methods (spreadsheets, tables, and graphs) developed with Microsoft Excel. Lastly, conclusions were drawn, and recommendations made in terms of the triangulation of the quantitative and qualitative analysis and the literature review on sustainability and urban management in NMBM.

1.9. Research Objectives

The objectives to be achieved by the research are to:

- i. Determine the most appropriate indicators to measure urban development and management in NMBM using Gqeberha (Port Elizabeth) as a case study.
- ii. To compare the sustainability metrics in NMBM with the region and urban environments internationally.
- iii. Investigate the indices that have been used to measure sustainability in NMBM and determine which themes were used.
- iv. To determine the most relevant and appropriate theme to measure sustainable urban development in NMBM.

- v. To determine whether NMBM is sustainable based on the developed sustainability indices.

Table 1.1 below tabulates the research objectives and data sources used in meeting the research objectives.

Table 1.1: Research objectives and data sources

	Research Objective	Data Sources
i	What is the most appropriate sustainable indicators to measure urban development and management in NMBM?	Interviews, questionnaire & public documents.
ii	How does the sustainability metrics compare with other cities in Africa and the developed world?	Interviews, questionnaire & public documents.
iii	What indices have been used to measure the sustainability of the city and which themes have been used?	Interviews, questionnaire & public documents.
iv	What is the most appropriate measure of sustainability for NMBM?	Interviews, questionnaire & public documents.
v	Using the developed/recommended metrics, is NMBM sustainable?	Interviews, questionnaire & public documents.

1.10. Research Limitations

The secondary data was obtained from public websites, the media, and social platforms (WhatsApp & Facebook) while primary data was obtained from semi-structured interviews and structured questionnaires. This limited the usability of the data as some data was unavailable when required and potentially sensitive information could have been deliberately withheld by participants with the possibly of affecting the reliability and validity of the study. Delayed publication of reports (e.g., by SACN and NMBM) has a small probability of affecting the results and recommendations of the study. A statistical sample was chosen but the low number of

responses could have affected the trustworthiness of the findings and recommendations of the study. The fatigue induced by Covid-19 pandemic and most significantly reluctance to provide personal details (name and signature in the consent to participant) limited the number of respondents to the questionnaires distributed to residents of NMBM citing POPIA, Act 4 of 2013 and fear of being scammed after supplying personal details. The initial targeted NMBM sustainability stakeholders were reluctant to participate citing POPIA, Act 4 of 2013 and in some cases an unawareness of the concepts as most turned down the invitation pointing out that they only deal with specific issues of the municipality (e.g., water leaks) and had 'nothing to do with sustainability'. This limited the scope of the study.

1.11. Dissertation Outline

The research report comprises five(5) chapters as follows:

Chapter 1 covers the background to the study, the statement of the research problem, research questions, aims and objectives, the research proposition, a brief research methodology and limitations of the study.

Chapter 2 discusses the literature research strategy, critical literature on sustainable urban management from an international perspective to city level (NMBM). The literature review emphasised the evolution, current trends, standardisation and adequacy of indicator based sustainable urban management.

Chapter 3 introduces the research methodology which was developed after the literature review in Chapter 2. The chapter introduced the case study of NMBM and discussed the three (3) methods in which the research problem was investigated. The methods included a structured questionnaire to residents of the city, interviews based on a semi-structured interview protocol to 'sustainability officials' in the city with an emphasis of municipal officials and lastly secondary data from credible sources including South African Cities Network (SACN) and NMBM websites.

The data analysis and the findings from the collected data are discussed in Chapter 4 and finally Chapter 5 discusses the conclusions and recommendations for further study.

2. CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter provides an overview of urban management and sustainability literature. The review begins with the literature search strategy on Section 2.2, the definition of the key concepts (Section 2.3), sustainability metrics (Section 2.4), a detailed literature review on sustainability and urban management (Section 2.5), challenges of sustainable development in SA (Section 2.6), sustainability conceptual frameworks (Section 2.7) and chapter summary on Section 2.8.

2.2. Literature Search Strategy

The literature search strategy involved searching online scholarly databases at the University of Cape Town (UCT) Library and Google Scholar. Literature with urban management and sustainability subject guides were searched with urban management, sustainability, dimensions, indicators and/or metrics of sustainability, climate change, resilience, United Nations (UN) sustainable development goals, circular economy, urban management, sustainability in South African metros, Africa and the world using multi-Boolean combinations. In addition, public websites e.g., NMBM and South African Cities Network (SACN) websites were searched for urban management and sustainability reports in NMBM and other SA metros respectively. Several hundreds of literature reviews were included but emphasis was placed on current peer reviewed literature, publications from international bodies and post graduate research reports on urban management and sustainability.

2.3. Definition of Key Concepts

This section defines common definitions of urban management and sustainability. Urban management is the process of coordinating various activities required for the functioning of an urban environment (CCT, 2021). As defined by the UN Brundtland Commission in 1987, a development is considered sustainable when it satisfies current requirements without jeopardising future generational needs (UNWECD,1987). IUCN(1991) as cited by Bell & Morse (2008:10), define sustainability as “*development that improves the quality of human life while*

living within the carrying capacity of the supporting ecosystem". The concept of sustainable development gained global exposure with the UN 1992 Rio Earth Summit with the principles enriched in Agenda 21 at national and local level (Sustainability Institute, 2010). The Johannesburg 2002 World Summit on Sustainable Development reviewed Agenda 21 initiatives and drafted programmes for their implementation (Sustainability Institute, 2010). However, policies and legislation on sustainable practices have been slow in SA (Sustainability Institute, 2010). The definition adopted by SA's National Environmental Management Act (NEMA), Act No. 107 of 1998, is consistent with both the UN Brundtland Commission (UNWECD, 1987) and IUCN (Bell & Morse, 2008) definitions.

2.4. Definition of Metrics and Measurement

According to Herrmann (2007:24-25) a metric *"is a proposed measure or unit of measure that is designed to facilitate decision making and improve performance and accountability through collection, analysis, and reporting of relevant data"* and a measurement *"is the process by which numbers or symbols are assigned to entities in the real world in such a way as to describe them according to clearly defined rules"*. Sustainability is determined through various indicators that measures its four dimensions namely the environment, social wellbeing, economic development, and governance/institutional arrangements. Traditionally unidimensional indicators that measure the environmental dimension have been used as indicators of sustainable development. With guidelines based on the UN SDGs adopted by 215 nations, attempts are being made to develop indicators that are multi-dimensional (third and fourth generation indicators). Sadly, there are so many metrics adopted to measure sustainability and convergence on the metrics from stakeholders at international, regional, national and city level might not be available for the next two decades.

2.5. Literature on Urban Sustainability Indicators

This section discusses sustainability indicators literature at international level, principally Europe and Asia (Section 2.5.1), then at continental level (Section 2.5.2) and finally at country level (Section 2.5.3).

2.5.1. Global Literature on Urban Sustainability

Braulio-Gonzalo, Bovea & Ruá (2015) proposed the adoption of sustainability indicators for urban environments in Spain and observed that OECD (2014) adopted a similar approach in Europe. The authors identified 134 indicators and 13 tools used to assess urban sustainability (Braulio-Gonzalo, Bovea & Ruá, 2015). The results from the different indicators showed huge differences depending on the methodology used and they noticed a strong bias towards the environment dimension (Braulio-Gonzalo, Bovea & Ruá, 2015).

Hiremath, Balachandra, Kumar, Bansode & Murali (2013)'s research questions including the development of holistic urban sustainable indicators and benchmarking the indicators were of particular interest to this research study. The framework for sustainable urban development in selected twelve(12) Asian countries and resourced global cities used "good governance; improved urban management; effective and efficient infrastructure and service provision; financing and cost recovery; social and environmental sustainability; innovation and change; and leveraging international development assistance" to assess the sustainability of studied cities (Asia Development Bank, 2006:7). Gonzalez & Lazaro (2011) concurred with Ratcliffe et al. (2009) that urban planning and urban development have a critical interlinking role in sustainable development and that human supremacy caused consumption patterns which are now difficult to sustain. The current focus on the sustainability agenda is now moving from a building to city level (Lützkendorfa & Balouktsia, 2017). Lützkendorfa & Balouktsia (2017) argued that sustainable indicator development could either be top down (international to local strategies) or bottom up (led by local networks). The authors presented a typology of indicators that can be influenced directly and those that cannot (e.g., percentage of unemployment) (Lützkendorfa & Balouktsia, 2017). The authors observed that some indicators have antagonistic effects, and that the development of the indicators is influenced by the data needed and the available data sources (Lützkendorfa & Balouktsia, 2017). The major challenge was the data collection in the era where information is protected (Lützkendorfa & Balouktsia, 2017). The Protection of Personal Information Act (POPI), Act No 4 of 2013 poses a similar challenge in SA.

Sofeska (2016) articulated the models of urban structure which arises from environmental theories as polycentric & decentralised, compact city and transport-oriented development. Sofeska (2016) lists the size, shape and coefficient of built-up environment and urban form as

criteria for sustainability indicators in an urban environment. An analysis of sustainable planning documents includes the population; extent and altitude; topography; traffic system; migration patterns; level of industrialisation; economic performance; the density of settlements; productivity of urban agriculture; the housing stock, coverage, vacancy rates and availability of illegal developments in the city (Sofeska, 2016). Legalisation of illegal developments is considered 'destructive' thus an indication of unsustainability (Sofeska, 2016). Motorisation, trips per capita, the state of construction, the density of population and construction were identified indicators of sustainability in urban environments (Sofeska, 2016). Sofeska (2016)'s study concluded that Skopje (Macedonia) was unsustainable but has a potential to develop sustainably.

The sustainability benchmarking of Indian cities was done using UN-Habitat data with city "*prosperity, productivity, quality of life, infrastructure, environment and equity*" indices (Chakraborty & Misra, 2016:436). Randeree (2019) explored the social sustainable dimension using the urban sustainability strategy in Masdar City in Abu Dhabi. Using qualitative analysis, the research found advanced involvement in the environmental and economic dimensions but lower consideration of the social dimension since the initiative was commercially driven (Randeree, 2019).

Przybylowski, Kałaska & Przybylowski (2022) used international standard ISO 37120 and urban sustainable indicators to compare the quality of life in seven(7) cities across four(4) continents. The authors found that the large number of social dimensions were difficult to interpret relative to the surveyed environmental dimension (Przybylowski, Kałaska & Przybylowski, 2022). Their study produced better results for European metros compared to other sampled metros (Przybylowski, Kałaska & Przybylowski, 2022). The study recommended using the bigger databases of population of cities (using WCCD Global Cities Registry) but noted the limitation in that the city registry is still not fully developed (Przybylowski, Kałaska & Przybylowski, 2022).

Sharifi & Murayama (2013)'s review of seven (7) assessment tools in USA, Europe, Japan, and Australia observed shortcomings in weights, scoring and ratings of the sustainability themes and recommended statutory codification, increased citizen's involvement, increased transparency, and simplification of the tools to improve their applicability at regional level. The McKinsey

(2014), Urban China Initiative sustainability index for Chinese cities, has 21 indicators with weights assigned to components of the indicators.

Sustainability has been measured by GRI using social indices e.g., Happy Planet Index, Ecological Footprint (WWF) (Unknown n d.). According to Basiago (1999:149), the criterion for measuring economic sustainability is “*growth, development, productivity and Trickle Down*”. The criterion for social sustainability is “*equity, empowerment, accessibility, participation, sharing, cultural identity and institutional stability*” and lastly “*ecosystem integrity, carrying capacity and biodiversity*” for measuring environmental/ecosystem integrity (Basiago, 1999:149).

O’Hare (2003) studied Queensland’s cultural landscapes together with municipal planning landscape and community involvement with sustainability and found that South Brisbane Peninsula was sustainable using densities of the residential sector; assessment of mixed land uses; existing urban structure; public transport availability; age and type of buildings; demographic diversity, wellbeing and observed community engagement.

Azam & Osman (2012) used the Malaysian Urban Indicator Network (MURNINet) to evaluate the sustainability of Shah Alam City Council. MURNINet uses 11 criteria to measure sustainability. A descriptive and explanatory approach using secondary data from Shah Alam and the national government was used in the case study (Azam & Osman, 2012).

UN SDG No. 11 on sustainable cities aims to make urban settlements sustainable and resilient. SDGs fall in the third-generation indicators according to Gomez-Alvarez (2018)’s classification. The concept of resilient cities is regarded as consistent with the concept of sustainable urban development. Ayub et al. (2020) defines resilience as a city’s capacity to withstand and survive, disturbances to its (urban) system. The 100 Resilient Cities has four (4) dimensions namely health & wellbeing; leadership & strategy; infrastructure & environment; economy & society; 12 goals and 52 indicators which measures safety and affordability of housing; access to water; sanitation; well managed public finances; stewardship of ecosystems municipal services; transport systems; public participation process and robust land use management principles & approval procedures (Rockefeller Foundation, Arup, 2015).

At city level, tools such as inclusionary housing, transit-oriented development (TOD), changing urban boundaries; public sector led regeneration; social inclusion/gentrification; urban sprawl-environmental limits, densification and intensification of infrastructure have been explored to reduce transport costs for the poor; to mitigate climate change: to reduce car usage, environmental impact and allowing densification to occur (Goliath, 2022). Satterthwaite (2015) contends that sustainability is a multi-governance level function. The national government enacts legislation and mechanisms to implement them, and lower levels of governments (municipalities) are responsible for implementing the enacted legislative framework (Satterthwaite, 2015).

The UK sustainable development strategy gives the five pillars of sustainability as: *“living within environmental limits; ensuring a strong, healthy and just society; achieving a sustainable economy; promoting good governance; and using sound science responsibly”* (RICS, 2009:8). Shen & Kawakami (2013) acknowledges Jabareen (2006)’s seven (7) pillars to be considered in the design strategy of urban forms. These concepts are: “compactness, sustainable transport, density, mixed land uses, diversity, passive solar design (energy saving), and greening” (Shen & Kawakami, 2013:1). Shen & Kawakami (2013:1) argued that sustainable urban form can be categorised into four (4) types namely *“neo-traditional development; urban containment, compact city, and eco-city”*. The forms were categorised from a Eurocentric perspective. The authors considered spatial planning as an instrument that can be used to implement planning frameworks at both national and city level (Shen & Kawakami, 2013). Balaban (2013) adopted nine (9) stages in the development of the indicators. Stage 1 is the literature review; Stage 2 is the identification of candidate indicators; Stage 3 are interviews to evaluate indicators; Stage 4 is the revision of indicators; Stage 5 is benchmarking; Stage 6 is finalising the indicators; Stage 7 is data collection; Stage 8 is analysis & calculation of indicators; and Stage 9 is research results; in the development of urban regeneration indicators for the case study in Yokohama Minato Mirai 21(Japan).

2.5.2. Urban Sustainability in Africa

Other than SACN studies in South Africa from 2004 to 2022 (e.g., Angelopulo’s SACN, 2015 study) and Fuseini (2016) in Ghana, Gashu & Gebre-Egziabher (2018) provided one of the most comprehensive indicators sustainability-based study in Africa. Gashu & Gebre-Egziabher (2018)

used the indicator approach to ascertain the sustainability of two urban environments in Ethiopia. The objectives of their study were to derive indicators of sustainability to be considered in developing countries and then to apply the indices in Bahir Dar and Hawassa, two of Ethiopia's rapidly growing settlements (Gashu & Gebre-Egziabher, 2018). OECD (2001:6) identified "*regeneration, substitutability, assimilation and avoiding irreversibility*" as the four criteria for environmental sustainability (Gashu & Gebre-Egziabher, 2018). As reviewed by Gashu & Gebre-Egziabher (2018), Bell & Morse (2008) had raised pertinent questions to be navigated in determining sustainable indicators. These questions are: "*what indicators should be selected? who selects them? why are they selected? how are the indicators to be measured? how are the indicators to be interpreted, and by whom? how are the results to be communicated, to whom and for what purpose? how are the indicators to be used?*" (Gashu & Gebre-Egziabher, 2018:123). As with Gebre-Egziabher (2018), Fuseini (2016) asserts that their study was based on a mixed method, but interrogation of the study indicates that the mix of qualitative and quantitative data used is low and therefore has not been extensively discussed in this study. Fuseini(2016)'s study was mainly based on secondary data (e.g., satellite imagery, GIS & Google maps, and municipal documents). Questions on sustainable indicators raised in turn determines the limitation of indicator-based investigation of sustainability (Bell & Morse,2008). Using previous literature, Gashu & Gebre-Egziabher (2018) contends that determining the framework is the first stage in implementing and analysing the sustainability of an urban environment. This stage is almost a standard approach adopted in most international studies discussed (e.g., Azan & Osman, 2012; Sharifi & Murayama, 2013; Mckinsey, 2014; Turcu, 2013, Przybylowski, Kałaska & Przybylowski, 2022). Gashu & Gebre-Egziabher (2018) chose 26 indicators (8 of which were socio-cultural dimension and 6 of each of the economic, environmental & institutional dimensions) in their study. Gashu & Gebre-Egziabher (2018) utilised both primary and secondary data sources for their analysis. Two focus groups of six (6) professions used for discussions and interviews provided the qualitative data for the research. Interviews were done with municipal officials in the 'sustainability departments' of the chosen cities (Gashu & Gebre-Egziabher, 2018). Gashu & Gebre-Egziabher (2018) used a cross sectional survey to collect quantitative data. This was done using a structured questionnaire which was used to collect each of the economic, socio-cultural, environmental, and institutional dimensional indicators (Gashu & Gebre-Egziabher, 2018). Gashu & Gebre-Egziabher

(2018:124) used a 5-point Likert scale starting with “0 (very low), 1 (low), 2 (average), 3 (good) and 4 (very good)”. Other scales (e.g., Angelopulo, 2015) based on three (3) levels (not yet developed, developing, and developed) are influenced by the research methodology and limitation of data collection and analysis. Sharifi & Murayama (2013)’s review of seven (7) assessment tools in USA, Europe, Japan, and Australia observed shortcomings in weights, scoring and ratings of the sustainability themes and recommended statutory codification, increased citizen’s involvement, increased transparency, and simplification of the tools to improve the applicability at regional level. The McKinsey (2014), Urban China Initiative sustainability index for Chinese cities, has 21 indicators with weights assigned to components of the indicators.

Previous studies at international level (e.g., Przybylowski, Kałaska & Przybylowski, 2022; Chakraborty & Misra, 2016; Sofeska, 2016; Angelopulo, 2015; Gonzalez, 2011) used secondary data e.g., planning documents to generate ‘lower level’ sustainable indicators. As identified by Braulio-Gonzalo, Bovea & Ruá (2015) in their study in Spain and OECD (2014) in Europe, different indicators showed huge differences depending on the methodology used and a strong bias towards the environment dimension. O’Hare (2003) in South Brisbane Peninsula (Queensland, Australia) used a combination of primary and secondary data (municipal planning documents and community public participation). Other studies reviewed (e.g., Azam & Osman, 2012) in Shah Alam City Council (Malaysia) used a descriptive and explanatory approach using secondary data in their case study. The 100 Resilient Cities dimensions, goals and indicators uses standardised indicators derived from secondary data to determine resiliency of cities (Rockefeller Foundation, Arup, 2015) which can be used as a proxy of sustainable development measurement.

In the Tamale (Ghana) study, a mixed method approach (using satellite imagery, google maps and GIS tools) for quantitative analysis and qualitative analysis was used (Fuseini, 2016). The study found rapid growth but development of the associated infrastructure & services by the municipality not coping, and that the stakeholder engagement was inadequate & the city portrayed low levels of accountability to its residents (Fuseini, 2016). The study concluded that legislation alone is not effective in meeting sustainable urban development (Fuseini, 2016). Most

authors pondered on the development, implementation, and standardisation of the sustainability metrics. Most reviewed literature employed secondary data mainly planning policies and legislation with a few augmenting the secondary data with primary data collection.

2.5.3. Sustainable Development Literature Review in South Africa

The Sustainability Institute (2010) acknowledges the fragmentary approach to SA's sustainability education across all disciplines. The National Housing Department, through its 2004 Breaking New Ground (BNG) policy, the Department of Environmental Affairs and Tourism's guidelines on IDPs, South African Green Council and consumers' quest for green products/services are considered driving forces behind the green initiative in SA (Sustainability Institute, 2010). The sustainable development framework (DEAT, 2008) and Water Affairs Department policies and legislation on the environment, waste disposal, use and protection of water, provides excellent platforms for sustainable development in SA. However, there are gaps in enforcing compliance at municipal level (Sustainability Institute, 2010). The SA Sustainable Development Framework (DEAT, 2008) principles which includes socio-economic development (embedded into ecosystems, capable of development meeting basic human needs sustainably in the short and long term) ensures that natural resources are exploited sustainably (Sustainability Institute, 2010). The Sustainable Development Framework principles are based on accepted sustainability concepts (Sustainability Institute, 2010).

The dual housing policies (market related for middle-income and upper-income earners and state subsidised/welfare for low-income earners) adopted by the SA government are unsustainable (Sustainability Institute, 2010). RDP housing is considered the opposite of the main principle of sustainable settlements i.e., the location of housing in areas that are economically active. The Breaking New Ground policy which was aimed at integrating settlements through government intervention in the market resulted in massive settlements in peripheral precincts with limited economic activities (Sustainability Institute, 2010). IDPs e.g., that of Cape Town (CCT, 2007) identified strategies including integrated human settlement to reverse the trend. The BNG policy, however, does not make specific reference to the use of natural resources to promote sustainable settlements (Sustainability Institute, 2010).

2.6. Challenges of Sustainable Development in South Africa

Urban sprawl, the conversion of agricultural land to RDP houses, the low efficient use of resources (e.g., water, waste management, energy, roads network etc.), the increased use of certain resources (e.g., higher transport/fuel costs as distance increases from the CBD), depletion of resources and overloaded infrastructure are the consequence of unsustainable development and management of urban land (Sustainability Institute, 2010). Collapsing sewer, waste management, water, roads and rail infrastructure and erratic supply of electricity from the national grid are testimonies of overloaded utility infrastructure in SA. Metros in SA are experiencing challenges in providing housing stock to its citizens (low cost and middle-income earners) and when opportunities arise most metros ignore the ecological limits of the environment.

2.7. Conceptual Frameworks

The debate on sustainability and frameworks to study it have been contested over the years but there has been divergence on the three dimensions namely environment, economy and social (DFFE, n d). The nested model (see **Figure 2.1**) considers a development to be sustainable when the three dimensions intersect (DFFE, n d).

The Three Spheres of Sustainability

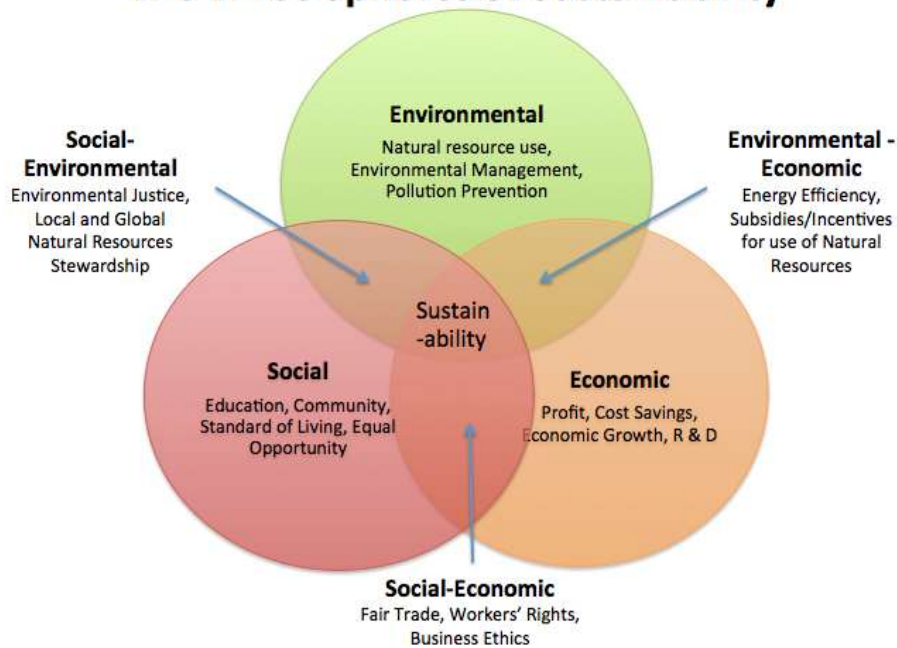


Figure 2.1 Nested Model of Sustainability, (Source: DEA, 2012).

As cited in DFFE (n d), Todorov (2006) introduced the interlocking circles model of sustainability as shown in **Figure 2.2**. It is a systems/institutional approach where the three dimensions are embedded with each other (DEA, 2008; DFFE, n d).

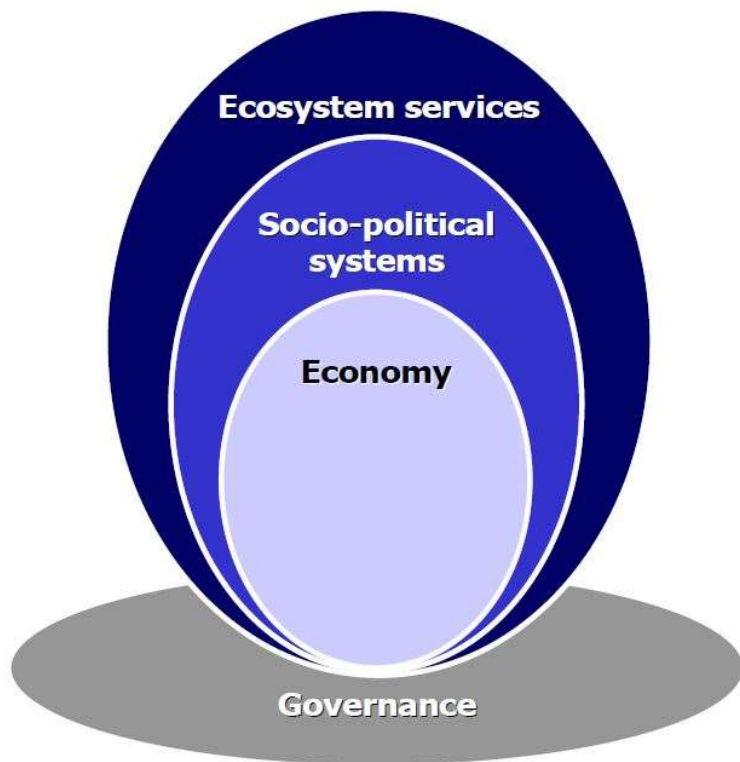


Figure 2.2: Interlocking Model of Sustainability, (Source: DFFE, n d; Adopted from Todorov,2006)

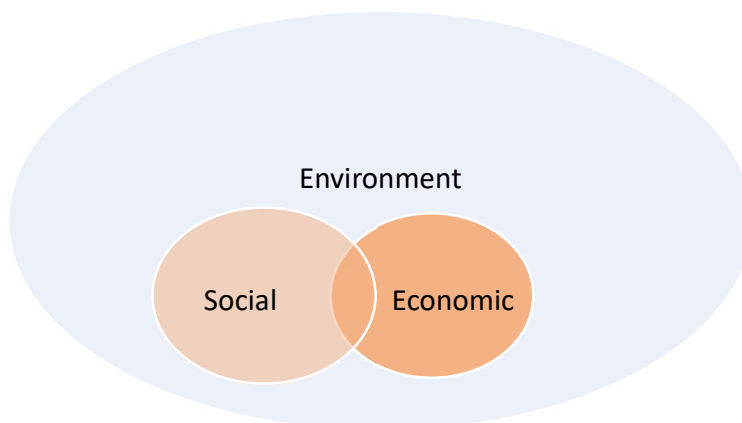


Figure 2.3: Correct Model of Sustainability, (Source: 'Russian Doll Model'- Ang & Wilkinson, 2008).

Others have considered a model where the social and economic environment intersect but are wholly enclosed by the environment dimension (see **Figure 2.3**). The Oxfam sustainability Doughnut (Raworth, 2012) made considering the planetary boundaries as articulated in Azote (2009) is an example of the 'correct' model of sustainability.

The nested model and priorities of implementation (see **Figure 2.4 below**) adopted in the SA framework is aligned to the systems/institutional framework (DFFE, n d).

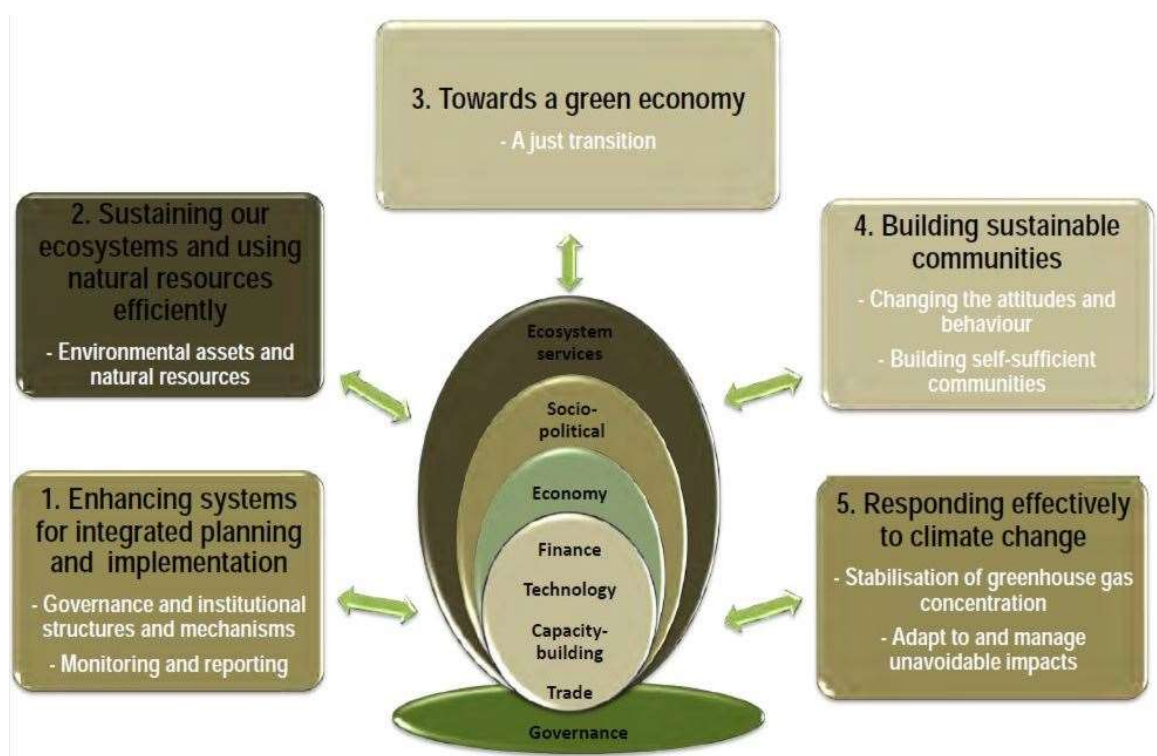


Figure: 2.4 Nested Model, (Source: DFFE n d; Adopted from DEA (2012)).

2.8. Chapter Summary

This chapter discussed the definition of key terms, history of sustainable development, the adopted literature review strategy, a detailed global (Europe, Asia, Americas and Australia) literature review, literature on Africa and finally urban management and sustainability overview in SA and sustainability at the (SA) urban metropolitan level. From the reviewed literature, it has been demonstrated that there is agreement of the definition of sustainability as development

which improves welfare with limited damage to the ecosystem and acceptance of the four (4) pillar conceptual framework of sustainability. However, the fragmented training systems, the limited availability of data and intended use of sustainability indicators makes the understanding and development of sustainability metrics problematic. Reviewed literature has also demonstrated that sustainability guidelines and policies are mainly cascaded from an international level (UN) to country level and then finally to local/municipal level. There are excellent guidelines to cascade sustainability policies in SA but huge gaps in implementation and compliance of the sustainability policies are evident in most metros in SA (SACN, 2022; Sondara, 2022). Certain policies and initiatives (e.g., RDP housing and land invasion legislation) while desirable in redressing SA's triple challenges (unequal society, high poverty levels and high unemployment rate) increases the unsustainability of SA metros as measured by indicators derived from the four sustainability pillars/dimensions.

Before 2015 when SDG goals were adopted, reviewed literature also indicates that the adoption of sustainability initiatives has been lowered by the lack of tools to link sustainability indicators with strategic planning.

The next chapter documents the research methodology adopted in the study.

3. CHAPTER 3 RESEARCH METHODOLOGY

3.1. Introduction

The chapter discusses the philosophical position (Section 3.2), research methodology (Section 3.3), the case study methodology and justification of a single case study (Section 3.4), research methods employed (Section 3.5), the sample sizes (Section 3.6), data analysis (Section 3.7), the instruments used to collect data (Section 3.8), reliability and validity (Section 3.9), ethical considerations (Section 3.10) and lastly, Section 3.11 provides the chapter summary.

3.2. Research Philosophical Position

Blumberg, Cooper & Schindler (2014) identifies three (3) research philosophies namely positivism, interpretivism and realism. The basic principle of positivism is that the world is objective (i.e., quantitative) while interpretivism regards the world to be “socially constructed and subjective” (Blumberg, Cooper & Schindler, 2014:18). Unlike positivism which focuses on uncovering new norms, interpretivism considers researchers to have conscience (‘not puppets’) and focuses on in-depth understanding of their environment. Realism which is argued to be ‘perfect’ for research studies is a research philosophy in which principles of both positivism and interpretivism are used (Blumberg, Cooper & Schindler, 2014). The focus of this study is to develop new indicators and to establish (using the developed indicators) whether NMBM is sustainable, taking into account the research participants’ environment without compromising reliability and validity. Therefore, realism which is a combination of both positivism and interpretivism have been adopted as the research philosophy.

3.2.1 Worldviews (Creswell, 2009)

Literature generally considers that there are three (3) types of research designs namely quantitative (numbers), qualitative (words) and mixed methods. The methods are not discrete but are “different ends on a continuum scale” (Creswell, 2009:3) with the mixed method sitting somewhere in the middle. Creswell (2009) classifies worldviews as falling under four (4) classes namely pragmatism, participatory/advocacy, constructivism and postpositivism. Mixed methods

use a combination of the worldviews because it falls on the middle of the research continuum (Creswell, 2009).

Using Creswell (2009)'s dichotomy, this case study falls on the pragmatism (problem centred and aligned with world situation), part postpositivism (theory verification) and constructivism (meaning and construction). Pragmatism is not cast in a particular philosophical view (the world is not absolute) and hence use of many approaches in the collection of data as truth changes with time.

Creswell (2009) recognises variations of mixed methods as sequential, concurrent, and transformative. This study used a concurrent mixed method variation in which both qualitative and quantitative data are merged/converged in an effort to analyse the research problem. Both types of data are collected simultaneously and then integrated during the interpretation and data analysis part. The study used a concurrent triangulation approach in which both quantitative and qualitative data were collected simultaneously and collected datasets then checked for convergence (Creswell, 2009).

3.2.2 Worldviews on Sustainability

The current sustainability debate recognises ecocentrism and anthropocentrism as the two worldviews on sustainability (Wilkinson, 2013). Ecocentrism considers sustainability to be good for mankind and the ecosystem while the anthropocentrism viewpoint questions the suitability of mankind as the guardian of the planetary ecosystem (Wilkinson, 2013). Carbon dating studies have shown that five (5) mass extinctions occurred between 66 and 440 million years ago. Current studies appear to point to the occurrence of an accelerated sixth extinction aided by urbanisation and industrialisation of the world (Dierwechter, 2017; Dutfield, 2021). Tibaijuka (2008) argues that how global citizens conserve the ecosystem depends on sustainable urban management and asserts that anthropogenic change (climate change due to human activity) was highest since 1970 and the rate is 100 times faster than the natural extinction rate. Whilst acknowledging the four pillars of sustainability, the researcher questions the rationality of making man to oversee the ecosystem noting that mankind has been at the centre of destroying resources on the earth's planet particularly after 1750 (onset of industrial revolution).

Spangenberg (2018) identified 'modificationists' and 'transformationists' as two opposing schools of thought and argues that their choice of indicators is different based on their belief systems and source of knowledge (ontology, epistemology etc.). Modifications are incremental changes of the current system e.g., technology and the market economy (Spangenberg, 2018). It is prominent in the economic dimension which dominates the sustainability 'industry' (Spangenberg, 2018). 'Transformationists', which advocates for limiting human growth, improving resilience, and acknowledging that the planet is a closed system, view modification as necessary but insufficient for sustainability (Spangenberg, 2018). The 'transformationist' viewpoint is a minority in the policy domain (Spangenberg, 2018). Of the 230 indicators of the SDGs, social and economic targets (and tools) are mainly 'transformationist' while environmental targets and governance indicators are sandwiched in between (Spangenberg, 2018).

3.3. Research Methodology

This study investigated sustainable urban development and urban management in NMBM. The first stage of the study used secondary data including UN SDGs, SA National Development Plan 2030, SA Integrated Urban Development Framework 2016, Spatial Development Frameworks (SDFs), Integrated Development Plans, SA legislation (& by-laws in NMBM) and other policies on urban development. The overarching research methodology is a single case-study of NMBM using a combination of qualitative and quantitative data (Guetterman & Fetters, 2018).

Semi-structured interviews to NMBM sustainability officials, sustainability stakeholders in the metro/Eastern Cape, service delivery community meetings and a sustainability questionnaire directed to residents of NMBM provided the primary data source of the study. For the qualitative data, semi-structured interviews were undertaken with targeted professionals including built environment professionals within 'sustainability departments' of NMBM, namely Human Settlements, Infrastructure & Engineering, Electricity and Energy, Safety & Security, Roads & Transport, Economic Development, Tourism & Agriculture (NMBM, 2022). In addition, stakeholders involved in sustainability in NMBM and one in Eastern Cape were interviewed using the same protocol as NMBM departments. The aim was to provide a holistic perspective of the sustainability agenda in the metro. The primary and secondary data together provided a holistic picture of sustainability initiatives in NMBM and other metros in SA. A convergent design

adopting Creswell and Plano Clark (2018)'s categorisation in which data was collected simultaneously was used (Guetterman & Fetters, 2018). As with Guetterman & Fetters (2018), data was analysed simultaneously by adopting the merging approach cited by Fellers, Curry & Creswell (2013).

Consistent with part positivist paradigm, primary data (interviews, attendance of meetings/forums survey questionnaires) and secondary data (media, reports, documentaries etc.) were adopted and adapted as research tools. Taking cognisance of the validity and reliability requirements of the project, a non-probability sampling approach for NMBM residences (convenience then followed by snowball sampling) was adopted due to time and budgetary constraints. A sample size of more than 230 residents and six (6) 'sustainability' stakeholder official was targeted.

Using a structured questionnaire, the researcher collected additional indicator data on the four dimensions of urban sustainability in NMBM (from residents), in addition to the secondary data extracted from credible websites (e.g., NMBM and SACN). The study adopted a 5-point Likert scale to measure sustainability for the quantitative portion of the study. The Likert scale adopted scores from 0 to 4 with a score of 0 meaning a very low level; 1 equating to low, 2 equating to average; 3 implying good sustainability and finally 4 reflecting the highest level (very good) of the desirable outcome. The interpretation of the Likert scale was provided to participants when the questionnaires were distributed. Semi-structured interviews were done with NMBM sustainability officials and other external 'sustainability' stakeholders. Data from current events in the media was also collected where it was consistent with data collection methods.

3.4. Case Study Methodology

3.4.1 Definition of Single Case Study Approach

This study was undertaken by the researcher with no external assistance from any institution. The study employed multiple sources of data (questionnaires to residents of NMBM, semi-structured interviews with sustainability officials both within NMBM and external, attendance of

public meetings and literature review of sustainability documents in NMBM, SA and at international level. Extensive use of the media in NMBM (e.g., The Herald and PE Express) and social media (e.g., Ward and Municipal/Mayoral meetings and postings on WhatsApp and Facebook). For the survey of the NMBM residents, to be statistically significant, a sample size of 246 participants is required. More than 600 questionnaires (250 digitally and 350 printed) were distributed between mid-June 2022 to end of September 2022 (mainly in Gqeberha) and 48 completed questionnaires were received. More than 100 email invitations were extended to NMBM sustainability offices but only five (5) participants responded to the invitation after the onerous authorisation from NMBM. Three (3) external participants with capacity to participate in the research were also invited. As argued by Malterud, Siersma & Guassora (2016), participant (sample) specificity is one of the four critical determinants of saturation (**see Section 3.6.1 Qualitative Research Sample**). Only one (1) external sustainability participant accepted the invitation. The views of the participants that declined the invitation were extensively reported in the regional publications and therefore secondary data was used to extract themes/trends about their views. The semi-structured interviews with 'sustainability officials' lasted for about one (1) hour with each participant.

In addition, chaotic live NMBM mayoral meetings were attended between July and September 2022. The meetings lasted for an average of eight (8) hours each. One ward council meeting that lasted about three (3) hours was attended physically in early August 2022. Feeds from the neighbourhood watch groups that the researcher joined for purposes of the research provided leads to the performance of the sustainability indicators in the metro.

3.4.2. Single Case Study and its Justification

A case study approach can be used to determine an in-depth knowledge of a phenomenon by mixing both qualitative and quantitative methods using realism research philosophy (combination of positivism and interpretivism) so that reliability, validity, and trustworthiness are not compromised (Creswell, 2009). Unlike a situation where a single case study is used, a multiple case study approach involves more than one case. Where a mixed method is used, a

multiple case study approach requires intense participation of the participants and is resource intensive. For example, SACN uses nine (9) cities (all the metros and Msunduzi) to monitor the sustainability of the urban environment in SA. This involves all the cities and the research organisation and is normally done over a five-year period.

The resources and time required would not be feasible for a study carried over one (1) year. However, to ensure that the validity, reliability, and trustworthiness of the research is not compromised, multiple data sources have been employed in this study. Existing data sets also enabled reasonable comparisons with other available sources.

3.4.3. Units of Measure

As discussed under Section 3.6 (Description of Sample), using NMBM demographics (population between 18-60 years, employment rate, poverty datum line and post matriculation percentages), the population was determined as 133 860 citizens. Gqeberha accounts for about 27% of NMBM's population based on the 2011 census (statssa.gov.za,2022; city population.de, 2022).

As briefly discussed in Section 1.8 (Research Methodology), targeted professionals in the built environment within the 'sustainability departments' of NMBM, including Human Settlements, Infrastructure & Engineering, Electricity & Energy, Safety & Security, Roads & Transport, Economic Development, Tourism & Agriculture (NMBM, 2022) and stakeholders involved in sustainability in NMBM, and the province comprised the sample in the qualitative component of the research. The developed indices are similar to the seven (7) indicators under the economic dimension, ten (10) indicators under the socio-cultural dimension, six (6) indicators under the environmental dimension and lastly the seven (7) indicators under the institutional framework dimension given in **Annexure E** Questionnaire. Given the above, the unit of analysis for this study are the sustainability indicators for measuring urban development and management in NMBM.

3.4.2. Justification of Case Study (Gqeberha)

The researcher has been a resident of NMBM for close to a decade, keenly follows the wellbeing of the city and has actively been involved in some aspects of the sustainability indicators from a

property management and land use perspective (planning and geomatics). As a keen observer in the precinct, the researcher was keen to explore whether the visible deterioration in NMBM could be modelled from a sustainability perspective. The statistics and locality plan of NMBM is provided under Section 1.3 (Nelson Mandela Bay Metropolitan Municipality). Additionally, the map showing the urban and natural environment of NMBM is shown in Figure 3.1. Gqeberha (formerly Port Elizabeth) is the urban centre closest to the Algoa Bay.

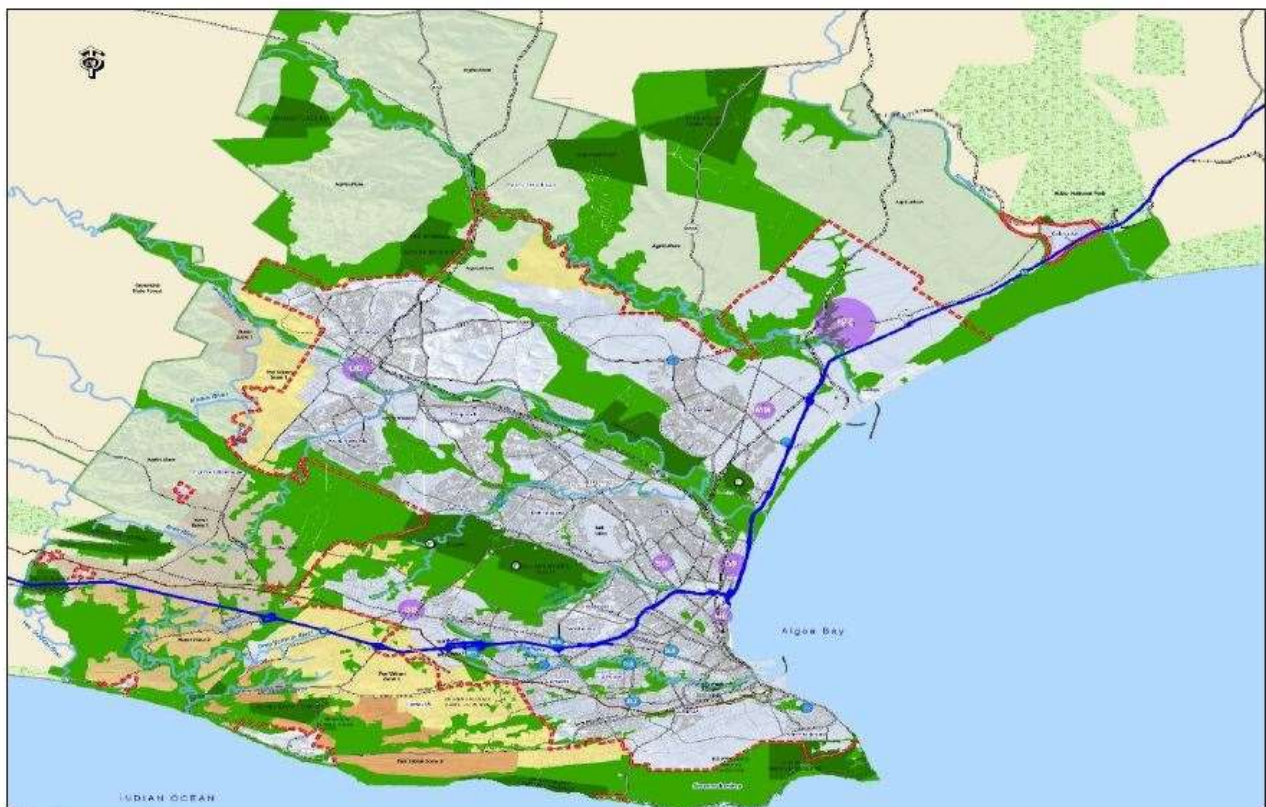


Figure 3.1: NMBM Urban and Natural Environment (Source NMBM, 2020).

3.5. Research Methods Employed

As discussed under Section 3.4, the study was done using a combination of both qualitative and quantitative methods i.e., mixed methods. Subsections 3.5.1 and 3.5.2 below discusses further the methods employed.

3.5.1. Quantitative Research Method (Questionnaire)

A questionnaire to measure the sustainability of NMBM was developed considering the reviewed sustainability and urban management literature. Using the four (4) pillars of sustainability (economic, socio-cultural, environmental, and institutional framework), seven (7) indicators namely transportation, economic growth, ease of doing business, availability of tourism infrastructure, connectivity, employment levels and other participant nominated indicators were developed. On the social-cultural dimension ten (10) indices (income quality, sustainable population growth, education levels, work-life balance, crime rate, provision of decent housing, health system, social networks & other participant nominated indicators) were developed. The environmental dimension had six (6) indicators including environmental risk mitigation, efficient use of energy, good land use management, controlled greenhouse gasses, the availability and management of water. The institutional dimension had seven (7) indicators including institutional capacity, institutional frameworks, quality of municipal services, community/public participation, gender mainstreaming and other participants recommended indicators. A sample of a questionnaire distributed (physical delivery and/or emails) is attached as **Annexure E** (Questionnaire Likert Scale).

3.5.2. Qualitative Research Method (Semi-structure Interview)

After a detailed literature review (e.g., Gómez-Álvarez et al., n d; Koulompi, 2012; Turcu, 2013; UN, 2022), an interview protocol was developed using the four (4) sustainability dimensions (economic, socio-cultural, environmental, and institutional/governance framework) and the principles of sustainability adopting the different generation of indicators depending on the limitations and availability of data. Emphasis was placed in the third and fourth generation indices as articulated in literature (e.g., Gómez-Álvarez et al., n d). Twenty-eight (28) questions ranging from the understanding of sustainability, the relationship with competing trends (smart, compact, and resilient cities), involvement of municipal (and other key stakeholders) in sustainability initiatives, the ranking, importance and relation of sustainable pillars, principles and resolution of conflicting indicators, energy, transport, spatial planning, agriculture, considered view of NMBM sustainability were developed. **Annexure F** (Interview Questions) provides the list of all the interview questions protocol.

3.6. Description of Samples

The study was done in three (3) stages. The first (1st) segment involved a review of literature on sustainable development at international level driven by the UN (from Agenda 21 to 17 SDGs); the Sustainability Indicators at regional levels (northern hemisphere and to a lesser extent Africa), review of sustainability in SA and the nine (9) metros using SA sustainable development policy framework and legislation, SACN publications and metro publications (e.g., IDPs) with a special focus on NMBM. The second (2nd) component of the study involved questionnaires distributed to residents of NMBM either physically or by email where recipients opted for a sustainable way of responding to the questionnaire and the third (3rd) stage was the semi-structured interview of sustainability officials with a particular focus on NMBM sustainability officials.

3.6.1. Qualitative Research Sample

In a qualitative study, the sample size is determined by the level of saturation (Malterud, Siersma & Guassora, 2016). Malterud, Siersma & Guassora (2016) posit that saturation is dependent on the study aim, the conceptual framework used, the specificity of the population (and sample), the nature and level of participation and the adopted data analysis strategy. In their reviews, Vasileiou, Barnett, Thorpe & Young (2018) of interview-based studies, found that 55.4% of reviewed literature considered saturation as the main determinant of the sample size. Vasileiou et al. (2018) further considered six (6) as the minimum sample size for a qualitative study with a narrow study aim, a specific combination of research participants, adopting established theory, with a strong participant participation and employing a longitudinal exploration of the phenomenon.

This study meets Vasileiou et al. (2018)'s criteria. A sample size of eight (8) was adopted and it was at that point that theoretical data saturation was achieved.

3.6.2. Quantitative Research Sample

A non-probability purposive sample was adopted for the quantitative component of the study. The initial sample design framework consisted of all residents of NMBM between 18 to 60 with access to resources (emails, printers, computers, data etc.) and sufficient understanding of the

English language used in the consent to participate and the questionnaire. Using NMBM demographics (population between 18-60 years, employment rate, poverty datum line and post matriculation percentage), the population was determined as 133 860 citizens. With a 20% coverage of the population (95% confidence level), the statistically significant sample size is 246 participants. If the population of Gqeberha (Port Elizabeth) only is considered, the sample size slightly drops to 245. It is consistent with the 230 residents adopted in the Ethiopian study (Gashu & Gebre-Egziabher, 2018).

More than 350 printed questionnaires were distributed to potential participants. An additional 250 questionnaires were emailed to NMBM residents and where contacts were available regular explanations and checks were made with potential respondents. The consent and information sheets discouraged most of the targeted audience from participating even after being sensitised of the mitigated risk of participation.

To enhance transferability of the research, the major assumptions, and the context in which they affect this study have been described. This research assumed that Covid 19 pandemic distorted most trends that affects the sustainability dimensions but the projected trends before and after the pandemic will not be disrupted. Most potential respondents turned down the invitation because they regarded themselves as not concerned with sustainable urban development. It has also been assumed that those that participated have the capacity to comprehend the questionnaire and the implication of the research on future generations. It has been assumed that political stability will continue in the metro and that it will commit to its development plans and sustainability initiatives as cascaded from the global community (UN SDGs) and as reflected in its strategic policy reports. It has also been further assumed that policies and reports are loaded timeously on critical websites and that the available information is not outdated. Lastly, it was assumed that the interviews (with NMBM departments and other stakeholders) are transparent and ethical and major sustainability and urban development challenges were disclosed.

Confirmability and replicability deal with the objectivity and dependability of the phenomenon being studied respectively (Lee, 1998). To ensure conformity, Noble & Smith (2015) recommends diligent data processing and thorough interpreting routines of the results of the

research. The questionnaires by NMBM residents were provided in both paper and digital format. The respondents' digital copies of the questionnaire were password secure. Copies were printed for digital responses and paper copies were scanned to create a duplicate copy of the collected data. The completed questionnaires were reproduced in word (cross checked between both print and digital sources) and then converted to Microsoft Excel for dynamic and simple analysis. Trends emerging from secondary sources were incorporated in the analysis.

The researcher was consistently aware of the research instruments and continuously reflected on them to ensure reliability on the adequacy of the research instruments. Consistent with the ethical consideration of the research, the names of the participants (NMBM residents, departments, and stakeholders) were changed to alphanumeric characters to protect their identities.

The use of three methods to collect data (questionnaire, interviews and secondary data) made it easier to reach saturation. Consistency between data collected from the three methods were checked for efficiency. As Noble & Smith (2015) argues checking for differences and similarities assists with the comparison between and across data. In cases where credible data was obtained and comparison possible, data comparison between and amongst this study and previous data (e.g., NMBM IDPs & SACN indices) were attempted. This is discussed further in Chapters 4 and 5.

Noble & Smith (2015) also recommends other strategies e.g., collaboration with other researchers to control bias and validation of responses. This, however, was not done in this study because of resource constrain but the convergence and saturation of the data collected appear to indicate that bias were insignificant in the results of the research. The interviews were recorded and thus could be replayed during the data analysis and therefore responses could be confirmed from the audio recordings.

Leedy & Ormrod (2015) argues that qualitative research should be balanced, fair and holistic in analysing and interpreting the data and that bias should be declared during data collection, analysis, and recommendations of the study. The data for the qualitative component of the research was extracted from NMBM, SACN and international institutions websites. In addition,

data triangulation using data from the surveys and interviews and other credible sources from reviewed literature was done to cross check the research findings. The indicators used in the survey of NMBM residents research instrument were adapted and adopted from Gashu & Gebre-Egziabher (2018)'s indices for Bahir Dar and Hawassa in Ethiopia. The results under Sections 4.3 to 4.6 attempts to triangulate the various studies on indices-based sustainability indicators relevant to NMBM.

3.7. Data Analysis

The residents survey data was reduced to manageable levels by summarising the data, on an Excel spreadsheet. As recommended by Blumberg et al. (2014), trends in the data were checked by applying statistical analysis. As recommended by Unerman (2000) and Blumberg et al. (2014), the common trends/criteria were developed (informed by the question protocol) for the qualitative content analysis of the semi-structured interviews and/or secondary data. A combination of literature review, and summary of the question protocol, the collected qualitative data was reduced into a smaller size by deduction and interpretation of the trends. The analysis was done using Excel spreadsheets and descriptive statistics. The research adopted a statistical approach (descriptive & inferential) and a thematic analysis to the collected data.

3.8. Data Collection Instruments (Mixed Methods)

The research used a mixed method which is a combination of both qualitative and quantitative data as a data collection method. A structured questionnaire was developed, and an invitation extended to the residents of NMBM i.e., the identified sample of the population and NMBM 'sustainability officials' or stakeholders interviewed.

The questionnaire with the researcher's contact details were handed at public places (at three municipal libraries in Gqeberha) and by email to potential participants. Potential contact email addresses were extracted from public municipal documents (e.g., NMBM documents ward councilors) and the various databases that the researcher had access. Potential research participants were informed of the ethical implications of the study and their rights to withdraw if not comfortable with their participation. In addition to the ethical considerations, participants were assisted with simple activities (e.g., completing the questionnaire digitally) as most participants highlighted their lack of access to printing facilities. As a result, almost 65% of the participants completed their questionnaire online-

The contact details of the NMBM 'sustainability officials' were extracted from the distribution lists of NMBM policies and strategic documents circulation list and in some cases from NMBM documents extracted from the NMBM website. After sending the invitation for the interviews, it was reviewed to the researcher that additional municipal approvals were required. As a result, all interviews arranged before the municipal approval were suspended. The first authorisation from NMBM was approved in mid-August 2022 (almost two (2) months after UCT ethical clearance). The onerous conditions of the authorisation made potential participants to decline their earlier acceptance to participate as their anonymity were compromised. It took almost another month to line up potential participants. The interviews were done between mid-September 2022 and end of October 2022.

The quantitative data (questionnaire) and qualitative data (semi-structured interviews) were analysed using descriptive and inferential statistics together with conceptual content analysis. Secondary data supplemented both the interviews and survey questionnaire thus provided a broader view of the research. The adopted strategy aided in the confirmation of the trustworthiness of the findings, conclusion, and recommendations of the study. Copies of the research instrument (survey questionnaire and interview protocol to NMBM sustainability officials are attached as annexures (see **Annexures E** and **Annexure F** respectively). The same interview protocol used on NMBM officials was also used to interview 'sustainability stakeholders' in NMBM to improve the reliability and validity of the analysis based on other data collection sources.

3.9. Reliability and Validity

Heale & Twycross (2015), Bush (n d) and Selltiz et al. (1976) all agree that consistent, stable, and repeatable procedures should be adopted for a study to yield similar results if undertaken by a different researcher. To achieve the required reliability, a standardised measuring instrument, reliable observations and reliable data collection routines should be adopted (Bush, n d). This study adopted and adapted a structured questionnaire for NMBM residents as used in similar studies in developing countries (e.g., Ethiopia and Ghana). As part of the research methodology, in addition to secondary analysis of data and structured questionnaires distributed

to NMBM residents, semi-structured interviews and discussions were done with NMBM officials and external sustainability stakeholders involved in urban management and sustainability in NMBM.

Validity in research requires that the research should produce accurate and true findings by ensuring that the research instrument is measuring the phenomenon (Brink, 1993; Heale & Twycross, 2015; Le Comple & Goetz, 1982; Bush, n d). For internal validity stakeholders with knowledge in the 'industry' were interviewed and where necessary follow-up interviews were done ethically. Researcher and participants bias were reduced by designing a structured questionnaire (for residents) and semi-structured interview protocol for sustainability stakeholders. The researcher is not related to the participants but has an association with some members in the built environment. To ensure external validity, sample strategy informed by literature review and by statistical principles was used for the NMBM residents' questionnaire and 'sustainability officials'. In addition, several sources of data collection were used in the data collection process. Further, the analysis was cross referenced with reviewed literature. Data that was used in the analysis was obtained from official websites (e.g., SACN and NMBM) and where data was obtained from 'unofficial' sources, the data was verified before use.

As argued by Lee (1998), the quality of the qualitative component of research is determined by evaluating its credibility, how transferable, replicable, and how it can be confirmed by other researchers. As recommended by Noble & Smith(2015), improvement in the credibility of the study was controlled by minimising personal biases in the research by declaring the researcher's philosophical viewpoint throughout the design, collection, and processing of the collected data. In addition, the researcher was actively aware of biases in the environment of the research. These biases included the researcher's personal experiences in NMBM, the social, economic, and political environment in the metro, the country, and the global community.

3.10. Ethical Considerations

Terre Blanche et al. (2006) recommends that ethics must be considered in the research process (from planning to reporting the research findings) when data is obtained through human participation. All stages of the research processes were executed according to SA legal universe

and ethically. The primary data was obtained from surveys of NMBM residents and interviewing or attending forums with critical stakeholders while the secondary data was downloaded from public websites primarily NMBM and SACN. The same interview protocol used with NMBM departments was used for external professionals. Sources of secondary data were acknowledged in the report, but details of primary data sources were not disclosed. Instead, a unique code was assigned to each source in the final research report. Additional data was obtained from community gatherings, council meetings and local media sources. For ethical reasons names of participants and locations of meetings were reported using codes even though this information was obtained from public sources.

3.10.1. Informed consent

As expected of ethical consideration, participation was voluntary, and it was declared to prospective participants when invitations to participate in the research were extended. Prospective participants were also informed of their rights and procedures of seeking redress where they felt that their rights were violated. **Annexures B and C Informed Consent** provides the sample of the consent letters provided to potential participants. The information sheet and consent letter informed participants that there were no incentives for participation. To minimise risk and harm to the participants, the University and the researcher, participants were advised to skip questions that they were uncomfortable with and to withdraw from participating at any stage without any consequence to them. Further the names of participants were replaced with codes (letter or number) in both the data analysis and findings of the study. **Annexure D** provides the sample provided to potential participants (sustainability officials) to record the interviews. As part of **internal review**, the research proposal of this study was submitted to **UCT Faculty of Engineering & the Built Environment Ethics in Research Committee** for ethical clearance. The application was approved with conditions in June 2022 (**see Annexure A**). These conditions were complied with during data collection. As per NMBM protocols, additional consent was sought to interview NMBM sustainability officials (**see Annexure G**). The negative externality of this requirement was the reduced participation in the study. Sensitive digital data was kept in password secured devices while hard copies were kept in lockable shelves. Both sets of data will be deleted and shredded respectively after five (5) years. Consistent with SA legislation, vulnerable people (below 18 and above 65 years) were excluded from the study.

3.10.2. Additional Information

The research timeframe was aligned with the ethical clearance process and turnaround times in responses to questionnaires and acceptance of interview invitations. Most residents were uncomfortable with providing their personal details and thus ignored the invitations even after several reminders. A general lack of awareness of sustainability initiatives was noticed in most potential participants in NMBM.

3.11. Chapter summary

The chapter discussed the strategies to improve the effectiveness of the methodology, data collection instruments, analysis, and trustworthiness of the research under the prevailing constraints. The use of different sources of data (triangulation) ensured that validity and reliability were built in the research process so that saturation could be reached with smaller sample sizes. The study employed a mixed method research approach which combined both qualitative and quantitative methods. Variations of different philosophical viewpoints were adopted with justifications provided.

The next chapter discusses the research results.

4. CHAPTER 4 RESEARCH RESULTS

4.1 Introduction

A literature review has shown that sustainability guidelines are cascaded from an international to national and then finally to municipal levels. Reviewed literature has also indicated that there are quite robust guidelines and policies at international and national levels but capacity challenges at local level makes implementation and compliance with the guidelines and frameworks difficult.

The aim of this research is to review the adequacy of sustainability measures/indicators used to assess NMBM and to recommend appropriate sustainable indicators and benchmarks of the developed indicators. The question that guided this study was formulated as follows: What is the most appropriate sustainable indicators to measure urban development and management in NMBM? The subsidiary questions established under Section 1.5 of Chapter 1 were used to guide the findings discussed under this chapter.

To achieve the research objectives primary and secondary data was utilized in data collection. Secondary data was obtained from websites (e.g., NMBM, SACN). Primary data was obtained using two methods namely a questionnaire to NMBM residents and semi-structured interviews (with NMBM sustainability departments and external sustainability stakeholders).

This chapter presents the results and interpretation of the research findings on sustainable urban development and management in NMBM. The remaining sections of the chapter are structured as follows: Section 4.2 extends the overview of Nelson Mandela Bay Metro, Section 4.3 discusses the qualitative data; Section 4.4 discusses the qualitative data Section 4.5 discusses the triangulation and convergence of the quantitative and qualitative data, Section 4.6 discusses the findings in literature and finally Section 4.7 provides the summary of the chapter.

4.2 Overview of Nelson Mandela Bay Metropolitan Municipality

As discussed under Chapter 1 (Section 1.3) and Chapter 3 (Section 3.4), NMBM is the largest metro in the Eastern Cape and accounts for 20% of the province's population and almost 30%

4.3 Quantitative Data

The surveys on common sub-indices of sustainability were done with questionnaire to NMBM residents as the research instrument (**see Annexure E**). As discussed under Section 3.6.2, for the survey of the NMBM residents, to be statistically significant, a sample size of 246 participants is required. More than 600 questionnaires (250 digitally and 350 printed) were distributed mainly in Gqeberha and 48 questionnaires were received by the end of September 2022.

The results of the survey of NMBM residents are shown in **Table 4.1** below.

To make the analysis meaningful, the "agree" and "strongly agree" and similarly "disagree" and "strongly disagree" were merged.

On **Table 4.1** Mean 1 and Mean 2 denotes the mean before and after the "agree" and "strongly agree" and similarly "disagree" and "strongly disagree" scales were merged. Similarly, SD1 and SD2 denotes the standard deviation before and after the "agree" and "strongly agree" and similarly "disagree" and "strongly disagree" scales were merged. The standard deviations deteriorated for four(4) indicators namely good work life balance, crime rate, water management systems and water availability after the merger of the "agree" and "strongly agree" and similarly "disagree" and "strongly disagree" scales.

On the economic dimension indicators, the results indicate that the residents disagree that NMBM has good transport infrastructure (48.7%); has positive economic growth (51.2%) and that it has low unemployment levels (64.3%). Most of the respondents however agreed that NMBM has good tourism infrastructure (45.2%) and good connectivity (38.1%). A split of 40.5% either disagreed or were indifferent with the statement that it is easy to do business in NMBM. Only 19.0% of the participants agreed with the statement that it is easy to do business in NMBM.

Table 4.1: Results NMBM Residents

Sustainable urban development and management in NMBM	Agree	Neither	Disagree	Mean 1	SD1	Mean 2	SD2
Economic Dimension Indicators							
Good Transport Infrastructure	30,77%	20,51%	48,72%	20,00%	15,53%	33,33%	14,28%
Positive Economic Growth	25,58%	23,26%	51,16%	20,00%	16,08%	33,33%	15,48%
Ease to do business	19,05%	40,48%	40,48%	20,00%	16,72%	33,33%	12,37%
Good Tourism Infrastructure	45,24%	33,33%	21,43%	20,00%	16,89%	33,33%	11,90%
Good Connectivity	38,10%	30,95%	30,95%	20,00%	16,20%	33,33%	4,12%
Low unemployment	23,81%	11,90%	64,29%	20,00%	13,00%	33,33%	27,46%
Other Economic Indicators	27,27%	45,45%	27,27%	20,00%	17,49%	33,33%	10,50%
Socio-cultural Dimension Indicators							
Demographics-sustainable population growth	22,50%	37,50%	40,00%	20,00%	15,10%	33,33%	9,46%
High Education levels	27,50%	27,50%	45,00%	20,00%	11,59%	33,33%	10,10%
Low Income quality	37,50%	33,33%	29,17%	20,00%	10,79%	33,33%	4,17%
Good Work life balance	17,07%	39,02%	43,90%	20,00%	19,16%	33,33%	14,29%
Low Crime rate	2,44%	2,44%	95,12%	20,00%	26,35%	33,33%	53,51%
Good Health System	11,36%	13,64%	75,00%	20,00%	16,96%	33,33%	36,10%
Adequate Housing	5,00%	15,00%	80,00%	20,00%	19,28%	33,33%	40,72%
Good Social cultural network	23,81%	35,71%	40,48%	20,00%	13,32%	33,33%	8,58%
Other Social Indicators	29,73%	48,65%	21,62%	20,00%	17,58%	33,33%	13,87%
Environmental Dimension Indicators							
Low Environmental risk	28,57%	23,81%	47,62%	20,00%	14,15%	33,33%	12,60%
Sustainable Energy use	15,00%	27,50%	57,50%	20,00%	14,03%	33,33%	21,84%
Good Land use/green spaces balance	33,33%	26,19%	40,48%	20,00%	8,84%	33,33%	7,14%
Low Greenhouse emissions	17,07%	26,83%	56,10%	20,00%	13,73%	33,33%	20,31%
Good Water management system.	2,38%	14,29%	83,33%	20,00%	23,24%	33,33%	43,71%
Good Water availability	2,50%	12,50%	85,00%	20,00%	21,36%	33,33%	45,02%
Institutional Dimension Indicators							
Good Institutional Capacity	38,10%	26,19%	35,71%	20,00%	8,00%	33,33%	6,30%
Established Institutional Framework	43,90%	21,95%	34,15%	20,00%	14,16%	33,33%	11,00%
Good Local Authority Services	11,90%	21,43%	66,67%	20,00%	24,43%	33,33%	29,26%
Good Local partnerships	17,07%	29,27%	53,66%	20,00%	12,48%	33,33%	18,63%
Good Local community participation	30,95%	33,33%	35,71%	20,00%	12,67%	33,33%	2,38%
Good Gender mainstreaming Initiatives	23,81%	28,57%	47,62%	20,00%	10,32%	33,33%	12,60%
Other Institutional Indicators	25,00%	58,33%	16,67%	20,00%	23,36%	33,33%	22,05%
General Comments	26,32%	52,63%	21,05%	20,00%	19,12%	33,33%	16,92%

(Source: Prepared by Author).

On the socio-cultural dimension indicators, the results indicate that the residents significantly disagree that NMBM has a low crime rate (95.1%), a good health system (75.0%) and provides adequate housing (80.0%). Respondents also disagree with the statement that NMBM has high education levels (45.0%). The respondents marginally disagreed that NMBM has a good work life balance (43.9% versus 39.00% who are indifferent). 44.7% of the respondents disagreed with the remark that NMBM metro has good social cultural networks (40.5% versus 35.7% who were indifferent). 37.5% of the respondents agree that the metro has low-income quality (versus 33.3% undecided and 29.2% disagreements). 40.0% disagree with the statement that population growth in NMBM is sustainable (37.5% indifferent and 22.5% agreement).

On the environmental dimension, 47.6% disagree that NMBM has low environmental risk (28.6% agreement and 23.8% are indifferent); uses energy sustainably (57.5%), has good land use/green spaces balance (40.5%); has low greenhouse emissions (56.1%); has a good water management system (83.3%) and lastly has good water availability (85.0%). The very high disagreements on the water availability (85%) and its management (83.3%) are greatly influenced by the drought that the metro is experiencing. 40% of the residents were expected to reach 'Day Zero' by June 2022 (NMBM, 2022).

On the institutional dimension indicators, residents disagree that NMBM has good local authority services (66.7%); has good local partnerships (53.7%), and lastly good gender mainstreaming initiatives (47.6%). The respondents marginally agreed that NMBM has good institutional capacity (38.5% compared to 35.7% disagreements). There was agreement that NMBM has an established institutional framework (43.9% compared to 34.2% disagreement). 54.6% of the respondents were undecided on the need to incorporate other institutional indicators. Residents disagreed marginally (35.7%) with the sub-index that NMBM has good local community participation (33.3% indifferent and 31.0% agreement). Participants were indifferent about the need for other sub-indices (52.6%).

If all sub-indices are assigned equal weights, the results in **Table 4.2** below shows that NMBM is unsustainably managed in all the dimensions (40.6% economic, 52.2% socio-cultural, 61.7% environmental and 38.9% institutional). The overall score is 48.4% disagreement, 28.3% indifferent and only 23.3% agreeing that it is sustainably managed.

Table 4.2: Summary of Results NMBM Residents

Sustainable Urban Development (NMBM)	Agree	Neither	Disagree
Economic Dimension Indicators	29,97%	29,41%	40,61%
Socio-cultural Dimension Indicators	19,66%	28,09%	52,25%
Environmental Dimension Indicators	16,48%	21,85%	61,67%
Institutional Dimension Indicators	27,13%	33,96%	38,90%
Total Score	23,31%	28,33%	48,36%

(Source: Prepared by Author).

Most of the dimensions and/or indicators are correlated e.g., infrastructure and education, education and the healthy systems, economic dimension and crime rate, work life balance and healthy (see Figures 4.2 to 4.6) discussed below under this Section.

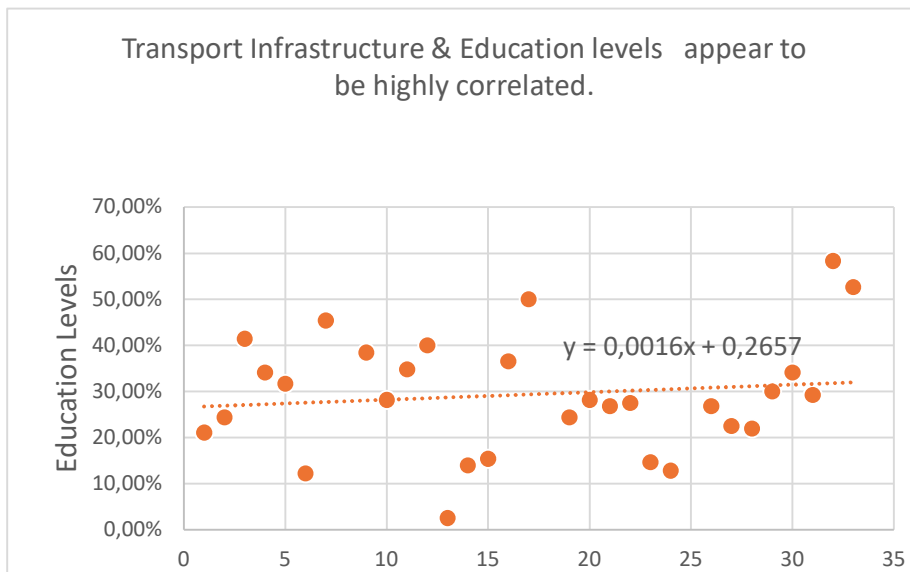


Figure 4.2: Correlation between Transport Infrastructure and Education, (Source: Prepared by Author).

Using the results of the NMBM residents' questionnaires, the availability of transport infrastructure and education levels appear to be highly positively correlated according to Figure 4.2.

As cautioned by Diamantopoulos & Schlegelmilch (2015:206) that “correlation does not prove causality” and data analysis should consider other “practical” findings in addition to the statistical relationships, the correlation discussed in this section (Figures 4.2 to 4.6) should be used cautiously as an aid to data triangulation.

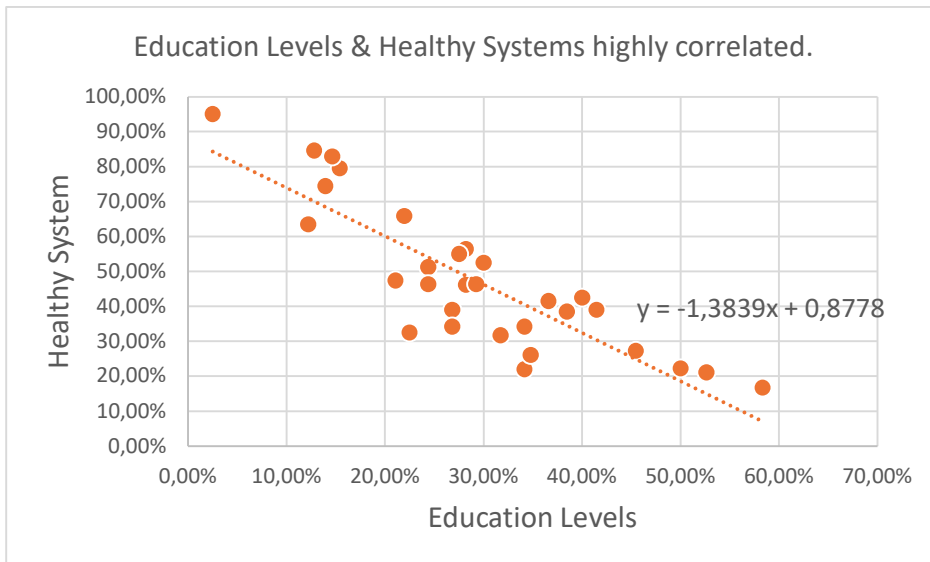


Figure 4.3: Correlation Between Education and Healthy, (Source: Prepared by Author).

Figure 4.3 appear to indicate that education levels and availability of health services appear to be highly negatively correlated from the results of the NMBM residents’ survey.

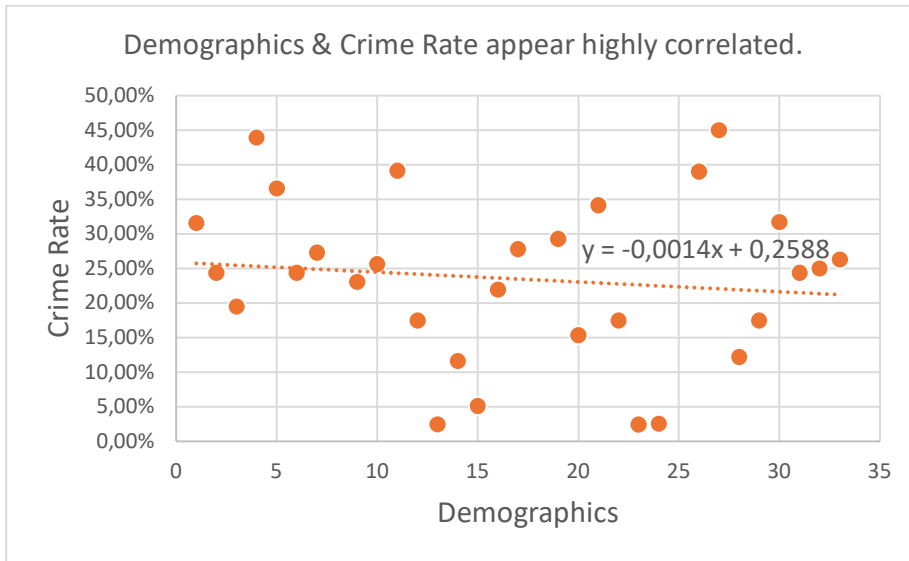


Figure 4.4: Correlation Between Demographics and Crime Rate, (Source: Prepared by Author).

As depicted on Figure 4.4, using the summary of results of the NMBM residents' survey, the demographics sub-index and crime levels appear to be highly negatively correlated.

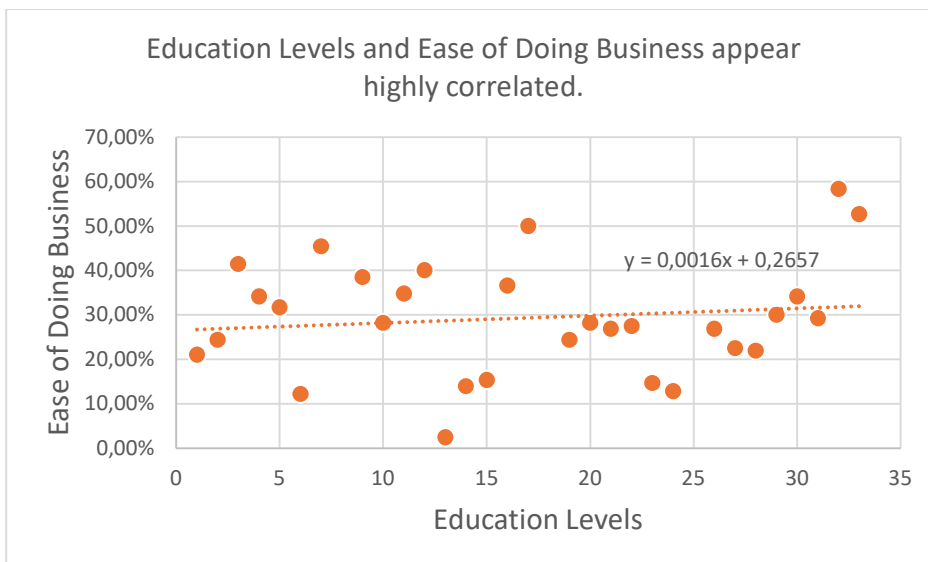


Figure 4.5: Correlation between Education & Ease of Doing Business, (Source: Prepared by Author).

Using the summary of results of the NMBM residents' questionnaires, the education sub-index and ease of doing business appear to be highly positively correlated according to Figure 4.5.

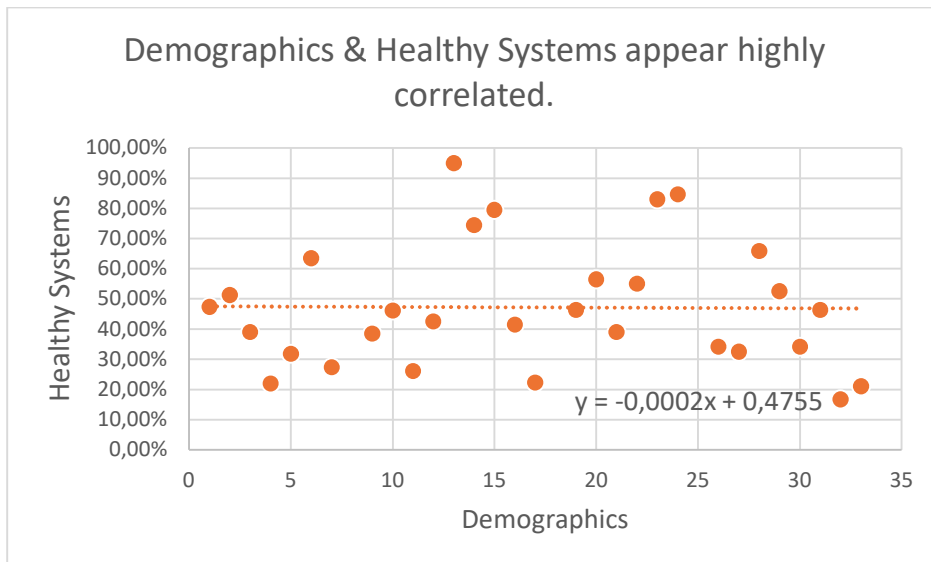


Figure 4.6: Correlation Between Demographics & Health Systems, (Source: Prepared by Author).

Using the NMBM residents' survey, the demographics sub-index and healthy systems levels appear to be highly negatively correlated as depicted in Figure 4.6.

4.4 Qualitative Data (Themes and Conceptual Analysis)

Conceptual analysis is one of the two types of content analysis (the other being relational analysis) in which the existing concepts and how frequently they occur are determined. The themes and levels for conceptual content analysis for the NMBM sustainability were derived from the sustainability dimension sub-indices and the question protocols for the interviews. The common trends in the interviews are: ineffective land use application system; collapsing health system; inadequate road infrastructure maintenance; limited funding; aging and strained electricity, water and sewer infrastructure; political instability; loadshedding (almost 50% of the time in the second quarter of 2021/2022); increasing cost of municipal services; difficult business

environment (decreasing consumer sentiments); low sustainability; low perception of law enforcement; low prosecution rate; pollution; water scarcity and unsustainable supply; energy driven by carbon fuels; ecological degradation; regressive tariff structure; inflation; low revenue collection; poverty and unemployment (welfare net includes $\pm 50\%$ of population); crime; vandalism; day zero/ high water leaks; vandalised substations/high electricity losses; inadequate public participation; low economic development; increasing urbanisation; greenhouse gasses and illegal occupation/dumping.

The criteria used in the analysis were adopted from the interview questions protocol (see Table 4.3). There was no software used for the coding.

Table 4.3 below shows that participants are aware of sustainability initiatives but have a bias towards the economic and social pillars. Participant **1AA** is an industry representative that has exposure of the sustainability challenges (with an economic focus) of NMBM through the media over the past five (5) years. The narrative points to an unstable metro bedevilled by increasing unemployment, rampant crime and vandalism and struggling to provide basic services (published sources). Participant **2BB** is an external spatial planning professional that acknowledges excellent frameworks for sustainability but notices very little evidence of implementation on the ground. Participant **2BB** emphasized the need to apply planning laws (e.g., NEMA Act, 107 of 1998 & SPLUMA, Act 16 of 2013) and had the view that integrating sustainability in metros is difficult, but the function should be housed in the Municipal Manager's office. Regarding illegal settlements, participant **2BB** had the view that law is an impediment to sustainable development. The participant also echoed the issues of rampant vandalism, poor governance, lack of awareness in citizens (e.g., illegal dumping) but acknowledge developed good awareness and/or public participation in water, electricity usage and SPLUMA implementation. Acknowledging, Maslow's hierarchy of needs, participant **2BB** concluded that NMBM is "*miles behind in implementation sustainability initiatives compared to Cape Town*".

Participant **3CC** is the political leadership of the metro (attending livestreams of meetings). The metro has 120 councillors, representing 13 political parties. The ANC and DA with 48 councillors each are the biggest parties followed by EFF with eight (8) councillors. Critical meetings do not quorate because of the political infighting but from deliberations and recommendations, the

political leadership is aware of sustainable initiatives for the metro, but they differ on how those goals can be achieved. The criteria were extracted from four (4) live streamed meetings and publications of the same in the media. Participant **4DD** represents a ward that has experiences of the (un)sustainable development of the metro in all the dimensions (economy, environment, social and institutional framework) (meeting attendance and social media postings). Participant **5EE** is a municipal 'sustainability official' but the criteria were extracted from published sources. Participants **6FF** and **7GG** are municipal 'sustainability officials' with the criteria extracted from interviews (on the virtual platform) in September 2022. The emphasis of participant **6FF** was of improving the metro's sustainability drive through renewable energy sources, the use of technology (e.g., smart water meters), community awareness, education of citizens and the enforcement of legislation in the metro.

On indicators, participant **6FF** particularly noted that the metro was the first to propose the use of renewal energy in 2005 in SA. However, the participant lamented the effect of legislation (e.g., legislation protecting land invasion, slow updating of national electricity and water frameworks, as major hindrances of holistic sustainability agendas. Also, of concern to the economic and social dimension was the creation of jobs in the short term but unsustainable in the long term. The fairly compactness of the metro makes it easy to implement sustainable development initiatives, but legislation, funding and governance hinders the implementation. On whether the city is sustainable participant **6FF** considered the metro "*not to be there yet*" but saw a bigger possibility in the renewable energy sector were sizeable initiatives and learning for sustainable development was at an advanced stage.

Participant **7GG** emphasised the use of technology (smart meters); provided a broad definition of sustainability and its relationship with smart, compact and resilient cities concepts. The participant discussed policies and frameworks (e.g., ERA, NERSA, NEMA, SPLUMA) that affects sustainable development in NMBM. The participant noted that there is no direct policy which discourages use of private vehicles (to reduce CO₂ emissions) in the metro but discussed initiatives to reduce use of dirty fuels in NMBM buildings and proposals to generate energy from household waste and sewer. The participant emphasised further, the need for safety; effective communication(e.g., saving and recycling water, effect on illegal connections; harm to the environment, cables affect supply of electricity) and increasing literacy as an aid to reduce

vandalism, save infrastructure and creating sustainable jobs. Again, as the other participants, participant **7GG** identified the law as protecting the underprivileged when land invasions take place but called upon the government to be proactive in providing planned settlements. Participant **7GG** strongly viewed governance (consequence management) as the pillar that should be assigned the highest weight because *“rules and policies are only as good as they can be policed”*.

The participant (**7GG**) was not aware of other indicators but pointed out first level indices (unemployment, safety, water levels etc.) that are in the public domain and areas where the metro is competitive (e.g., renewable energy and electrification). Noting positive efforts e.g., water harvesting technologies and use of solar energy and negative efforts e.g., extracting underground water and extracting water from Free State (Gariep Dam), participant **7GG** concluded that as with all cities in SA, NMBM is not yet sustainable but *“it will get there”*.

Participant **8HH** provided a broad explanation of sustainability definition and emphasised the need for holistic public participation in sustainable development initiatives. As with other participants, strong relationships of sustainable development with smart, compact and resilient cities were identified. Compact cities, for example, discourage urban sprawl which in turn increases sustainable urban development. The participant lamented the numerous changes of leadership which makes it difficult for the metro to have a long-term view on key strategic issues. The metro is under-funded due to the dwindling budget provisions and the effect of Covid-19 which has exasperated the trend. Other unique contributions from participant **8HH** include acknowledgement of the need for just transition; and the NMBM biodiversity plan as a long-term sustainability model for expenditure optimization. Whilst acknowledging the *‘comfort’* of the metro’s Libongolethu IPTS, the participant highlighted that the public transport system is under-funded by government and thus there are no viable options for residents to migrate from private vehicle usage. Participant **8HH** *“asserts that there are no policies to discourage people from using private vehicles and it is difficult to implement such a policy in the absence of a viable alternative e.g., Gautrain in Gauteng”*. Noting that NMBM is a two ports city (Ngqura and Port Elizabeth), continuous supply of goods e.g., manganese, have to be transported to the ports for export but negative externalities e.g., damage of roads and degradation of air quality creates competing and conflicting requirements which have to be managed and balanced in terms of

the sustainable development pillars. Whilst no fuel disaster has been experienced in NMBM, the participant (**8HH**) was concerned with increased fuel bunkering (transfer of fuel between vessels in the ocean) activities in the two ports. The participant considered the institutional/governance pillar as the most important dimension. Other mentioned sustainable municipal initiatives included installation of solar panels on buildings, recycling wastepaper internally and installing sensor sensitive lights, reduction of water pressure, advertising campaigns, water restrictions and saving techniques and introduction of a punitive water tariff. These initiatives together with green procurement in some instances need to be institutionalised in the municipal policies and processes. Participant **8HH** acknowledged that all dimensions must be considered but without good governance/leadership all other dimensions would collapse.

The municipal initiatives on urban agriculture are challenged by water (availability and who pays). Taking into consideration the carrying capacity of the land, resource availability and state of facilities (e.g., roads), participant **8HH** argued that there were “*more failures than successes*” in the agricultural initiative. The participant highlighted that NMBM was aware of UN SDGs but considers the metro and SA in general to have low levels of development with regards to the SDGs framework. The participant (**8HH**) also noted the indicators in the SACN Status Report which have been discussed extensively under **Sections 4.3.2 to 4.3.5** of this chapter. Circular 88 of 2017 indicators issued by National Treasury in terms of Municipal Finance Act, 56 of 2003 assists metros in assessing implementation of service delivery (in terms of their IDPs) in areas of their jurisdiction. Circular 88 of 2017 indicators are monitored and have set benchmarks. The indicators include indices such as the changing property values and the distance residents travel to work.

In conclusion participant **8HH** observed great consciousness of sustainability at both municipal and national levels but noted with concern the increased hardships, marginalisation and increased joblessness as the metro and the country transcend to sustainable urban management. As with other participants, both NMBM and SA were classified as not sustainable but the availability of policies and frameworks to work with makes the implementation of sustainable initiatives achievable when adequate institutional frameworks are put in place. A recommendation to have a sustainability/ resilience function correctly pitched on the municipal organogram was proposed.

Participant **9JJ** provided a broad definition of sustainability and emphasized the need to have the sustainability dimensions integrated/institutionalised. The participant acknowledged the interrelationship and linkages between smart, compact, and resilient cities. The participant acknowledged the integrated public transport system (IPTS) public transport initiative but raised concerns of safety on some destinations. The participant discussed the metro's waste recycling initiative and support for urban agriculture in the metro. As echoed by other interviewees, participants **9JJ** regarded the law as an impediment in dealing with homeless and illegal settlements. The metro and government departments were found to be reactionary instead of being proactive in dealing with provision of housing to its residents. Participant **9JJ** had the view that the economic dimension should be given the highest weight and other dimensions "*will fall in place*" once the economic dimension is well managed. The participant observed that investors were threatening to pull out their business from the metro because of water shortages and various other challenges bedevilling NMBM. The participant identified the period that the metro processes business permits as an additional indicator that must be improved. The participant particularly noted the long periods that it is taking for the metro to grant business permits.

From the analysis, the metro is strained on several fronts(water shortage, water leaks, pollution of ecosystems, rampant vandalism, aging infrastructure, dwindling revenue collection, rising unemployment, risks of social unrest etc.) that at its current trajectory can be considered unsustainable. Participant **1AA** even called for a "*state of emergency*" to curb vandalism and control crime to at least stop the continuous "*bleeding*" of jobs in the metro since the onset of the Covid-19 lockdown in March 2020.

To ensure validity of the coding and analysis a consistent approach was used in translating the meaning of phrases to the question protocol.

Table 4.3 below summarises the findings.

From the findings, participants understand sustainable urban development; can relate sustainable development with smart, compact cities and resilient cities; there is very good policies and framework for sustainable development. In addition, participants considered the governance dimension as the most important pillar in urban sustainability and resolution of

conflicting indicators. Most importantly, the participants awarded a low score on the rating of the metro, and all considered the metro to be unsustainable.

Table 4.3: Analysis of NMBM Sustainability Stakeholders.

Themes From Interview Protocol	Participant Code									Overall
	1AA	2BB	3CC	4DD	5EE	6FF	7GG	8HH	9JJ	
Understanding of sustainable urban development	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relationship btw smart cities, compact cities & resilient cities	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes
Departments involved/Level of integration	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Policies and legislation promoting urban sustainability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Land use management principles for sustainability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Policies and Frameworks of department	High	High	High	High	High	High	High	High	High	High
Sustainable Transport use project	Low	Low	Low	Low	N/A	Low	Low	Low	Low	Low
Reduction of private vehicles/ Mass transit schemes	N/A	Low	N/A	N/A	N/A	Low	Low	Low	Low	Low
Promotion of higher density/mixed-use development	Poor	Poor	Poor	Poor	N/A	Poor	Poor	Fair	Fair	Poor
Development of pedestrian, cycle lanes and green spaces	Low	Low	Low	Low	N/A	Fair	Fair	Fair	Fair	Low
Sustainable initiatives for Municipal Assets	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Proceses for illegal settlements and homelessness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sustainability in Building and construction	Low	Low	Low	Low	Yes	Yes	Yes	Yes	Yes	Yes
Effect of sustainability on economy & employmenti	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes
Policing of crime and environmental viloation	Poor	Poor	Poor	Poor	N/A	Fair	Fair	Poor	Poor	Poor
Efficient energy use and renewable energies Policy	Poor	Poor	Poor	Poor	N/A	Excellent	Excellent	Fair	Fair	Good
Weights of sustainability dimension	ESG	G	ESG	ESG	N/A	Ec	G	G	Ec	G
Priority for Sustainable indicators	ESGE	G	ESG	ESG	N/A	Ec	G	G	Ec	G
Resolution of conflicting indicators	ESG	ESGEc	ESG	ESG	ESG	ESGEc	ESGEc	ESGEc	ESGEc	ESGEc
Drought & Water Management Initiatives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sustainability awareness	Poor	Poor	Fair	Fair	Poor	Excellent	Excellent	Good	Good	Good
Urban agriculture.	Poor	Poor	Poor	Poor	N/A	Poor	Poor	Fair	Good	Poor
Sustainability indicators in NMBM	ESG	ESGEc	ESG	ESG	ESG	ESGEc	ESGEc	ESGEc	Ec	ESGEc
Advantages and disadvantages of indicators	Holistic	Holistic	Stability	Stability	Stability	Stability	Stability	Holistic	Stabilit	Stability
Recommend Indicators.	SDG	SDG	SDG	SDG	ESG	ESGEc	ESGEc	SDG	Ec	SDG
Involvement in Indicator Development	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Rating of NMBM Indicators	Low	Low	Low	Low	Low	Fair	Fair	Low	Low	Low
Is NMBM sustainable	No	No	No	No	No	No	No	No	No	No
Notes:										
1AA Major Business Representative										
2BB External Sustainability Professional										
3CC NMBM Community Ward Meeting										
4DD NMBM Council Meetings										
5EE NBMM Department										
6FF NBMM Department										
7GG NMBM Department										
8HH NMBM Department										
9JJ NMBM Department										

(Source: Prepared by Author).

4.5 Discussion/Triangulation of Quantitative and Qualitative Data

NMBM has excellent policies and by-laws to support its mandate through the institutional frameworks but as SACN (2021) acknowledges NMBM is a metro in crisis. The performance of many sustainability indicators e.g., crime, unemployment, CAPEX, redress to land invasion issues, turnaround of payments to SMMEs, IDP performance, water, and sanitation etc. as shown by the survey to residents; NMBM and SACN literature and interviews with sustainability stakeholders appears to be worsening. In conclusion, the metro has mechanisms for sustainable urban development but based on the sustainability measurement tools, the metro is unsustainably managed.

As recommended by the UN, cities must adopt circular economy principles in pursuing their sustainability and resilience initiatives (UN, 2022). While the framework and policy guidelines for resilience and sustainability for urban development is in place, the UN recognises the need to build trust to enhance institutional arrangements; improved legitimacy of local governance and a lack of urgency to adopt renewables (and decarbonise) as areas of expected focus by cities (UN, 2022). As the UN (2022) correctly pointed out, public participation and stakeholder engagement for resilience and sustainability for urban development must be multi-sectorial and multi-dimensional. In the case of NMBM, public participation and stakeholder engagements appeared to have worsened since the introduction of coalition governments in the metro in 2016.

As Diaz-Sarachaga et al. (2018) stressed, global indices are biased on some dimensions of sustainability. The emphasis of sustainability has been evolving (e.g., environmental focus on Agenda 21 and socio-economic emphasis on SDGs). Changes in indicators used at a particular time distorts the overall measurement of sustainable development goals (Diaz-Sarachaga et al., 2018).

The quantitative data from the NMBM residents appear to be highly correlated e.g., infrastructure and education (Figure 4.2), education and wellbeing (Figure 4.3), crime rate and sustainable population growth (Figure 4.4), education and ease of doing business (Figure 4.5) and lastly sustainable population growth and wellbeing (Figure 4.6). The correlation of the data (statistical relationships) was also extensively discussed by the 'sustainability officials' (e.g., participants

7GG & 8HH on education and vandalism of infrastructure, participant **9JJ** on economic development and the levels of crime). Correlation measures how variables associate with each other (Leedy & Ormrod, 2015) but as Diamantopoulos & Schlegelmilch (2015:206) cautions “correlation does not prove causality”. Diamantopoulos & Schlegelmilch (2015) recommends the consideration of “practical” findings in addition to the statistical relationships (correlation).

A fourth-generation sustainability indicator using the dimensions used for the residents’ survey with an added emphasis on multidimensional and multisectoral stakeholder engagement is recommended for NMBM. As observed in literature (e.g., Fuseini, 2016; Sharifi & Murayama, 2013; UN, 2022) legislation alone is not effective in meeting sustainable urban development and increased citizen’s involvement and simplification of the sustainability tools and approaching sustainable development in a multisectoral approach could enhance the sustainability of the metro.

The results of the questionnaire regarded the metro to be unsustainable on all dimensions (see Table 4.1) and was confirmed by the participants interviewed during the research (see Table 4.3).

4.6 Discussion of the Findings in terms of the Literature

The research objectives of this study are to review the adequacy of the sustainability measures/indicators used to assess NMBM and to recommend appropriate sustainable indicators and benchmarks of the developed indicators. The remainder of section 4.6 discusses the results of the findings pertaining to the five (5) research objectives.

4.6.1. Research Objective 1 (Sustainable Indicators)

The aim of the first (1st) research objective was to find the most appropriate sustainable indicators to measure urban development and management in NMBM. To achieve this objective, literature on sustainability with an emphasis on SA metros was done. Sections 2.5.1 (Global), 2.5.2 (Africa), 2.5.3 (SA) and 2.6 (challenges in SA) discussed sustainability at a higher

level. This section discusses the literature affecting the research objectives with reflections to links of sub-indices developed in this study.

From literature reviewed, it has been established that one of the strategies to accelerate the greening of the SA transport infrastructure is to incentivise use of public transport systems, cycling and walking (Suleman et al., 2015). Metros can also adopt greening principles on their fleets. As reviewed by Suleman et al. (2015), about 40% of SA's waste in residential areas is organic which when it rots is converted into gases e.g., methane which is harmful to the environment. Methane is 23 times more harmful than CO₂. What Suleman et al. (2015) observed was that most anaerobic digesters are out of commission at many sewer plants of SA metros including NMBM. The country has a capacity to produce 1095M m³ of biogas annually, with metros waste being the main contributor (Suleman et al., 2015).

The observed municipal failings by Suleman et al. (2015) e.g., greening of public municipal transport and harnessing carbon fuel from municipal sewer waste were confirmed in the qualitative and quantitative analysis of this study. NMBM residents, for example, disagreed that most sub-indices affected by Suleman et al. (2015)'s observation were unsustainably managed e.g., transport infrastructure (48.7%), health systems (75%), environmental risk (47.6%), sustainable energy use (57.5%) and good local authority services (66.7%). Qualitative analysis e.g., participant **8HH** of the NMBM 'sustainability officials' argued that the metro can only punish residents for using private vehicles and carbon fuels "*only if the local authority can provide alternatives*".

A 2013 IDC pilot programme in Gauteng reviewed that the running cost of municipal buses could be reduced if buses were converted to run on a diesel-biogas combination (Suleman et al., 2015). Projections showed that capital invested could be recouped in three and half years (Suleman et al., 2015). Several projects to treat sewer and solid waste to produce biogas were recorded in eThekweni municipality by 2009 under its Clean Development Mechanisms (Suleman et al., 2015). These initiatives all promoted sustainable development as measured by most dimensions. Sugar cane and other high carbohydrate crops can be used to produce biofuels but unfortunately uses electricity/energy in the industrial convention process. Strategically reserving agricultural land for biofuel crops, limits land available for food crops and thus impacts on the country's food security (Suleman et al., 2015). Using a survey to obtain transport greening

targets by SA metros, a commitment by metros to reduce GHGs by 15% and to convert 50% of municipal fleets to renewable energy by 2020 was obtained (Suleman et al., 2015). Suleman et al. (2015) observed that lifecycle costs using renewable energy were converging compared with carbon fuels. Suleman et al. (2015) called upon other metros to adopt the greening strategy and learn from Johannesburg and Tshwane that have embarked on the process. However, with the current depressing economic environment, most metros including NMBM are regressing on their greening commitment.

As participants **8HH** and **9JJ** observed, NMBM has very limited capacity to direct and control its food production. As observed by most participants, the city has a water capacity challenge. The survey of NMBM residents had the highest disapprovals of 83.3% and 85.0% respectively of the city's management and availability of water resources. The competing nature of the sustainability pillars (and sub-indices) e.g., use of land for bio-fuel crops affects supply of food crops which in turn affects some sustainability sub-indices e.g., wellbeing. As participant **8HH** recommends, just transition principles should be adopted by respective cities depending on their circumstances.

The Synthesis Report on climate change resilience identified water management, transportation, and food security as focus areas on activities being done by SA metros (SACN, 2017). In addition to the environmental and climate change aspect, the fourth dimension of sustainability (governance) was included in the analysis using sustainable development principles/framework e.g., IDPs. Assessments by Intergovernmental Panel on Climate Change in 2014, has shown that major climate risk factors are highest in towns and cities due to urbanisation (urban sprawl and rapid growth of unplanned settlements) (SACN, 2017). The white paper on climate change response (DEA, 2011) also flagged the hazards of unplanned settlements (SACN, 2017). The Report found Johannesburg to have an emerging resilience system capable of developing to a complete resilience planning platform (SACN, 2017). Others fell in between but Ekurhuleni and Mangaung were at the bottom with undeveloped systems (SACN, 2017). The study identified effective leadership, awareness through training and development; technological innovation, inclusion of resilience in planning process; integration of initiatives within municipal functions; proactive disaster management, operationalisation of strategies; promoting staff buy-in and increasing efficiency in municipal resources towards climate change issues as indicators of

climate change resilience (SACN, 2017). Other identified themes e.g., strong internal capacity, efficient supply chains and procurement systems; information systems on climate/weather, strong stakeholder engagement outside metros' organograms were trends recommended for adoption by municipalities (SACN, 2017). The results, from this study points to worsening trends in NMBM. The Synthesis Report observed that resilience is aligned to IDPs/urban development strategies with the aim being maximisation of development and service delivery and argued for the elevation of resilience strategies beyond existing urban development strategies (SACN, 2017). The resilience strategy should link climate change impact on food, transportation and water management and should also be linked with all planning policies and legislation (SACN, 2017).

The Eastern Cape (EC) Provincial Growth and Development Plan (PDP) lists six (6) goals for its Vision 2030: namely innovative, inclusive, and growing economy; enabling infrastructure development; technology driven growth in agriculture; development of citizens; sustainable environment and efficient democratic institutions (ECPGDP, n.d). The goals are inspired by UN SDGs. The NMBM has been the major contributor to the development of the EC, but the province has consistently been the worst performing province in SA.

Notwithstanding the positive reviews from SACN, both the quantitative and qualitative data analysis considers NMBM to be unsustainable (see Tables 4.2 and 4.3 respectively).

4.6.2. Research Objective 1 (Global Sustainability Indicator Institutions)

In part fulfilment of Research Objective 1, this section briefly discusses, trends in global sustainability indicators. In further fulfilment of Objective 1, Section 4.6.3 below links the development of SA specific indicators with global indicators. Huang, Wu & Yan (2015) reviewed urban sustainability and its indicators using peer reviewed journals, books and public documents at national and international level and found that socioeconomic development has created numerous environmental challenges. The three ESG **dimensions/triple bottom line** of sustainability have been at the centre of most urban literature discussions (Huang, Wu & Yan, 2015). Later literature introduces governance as the fourth(4th) dimension. How substitutable a resource is, has given rise to the distinction of **weak** or **strong** sustainability (Huang, Wu & Yan, 2015). As with other reviewed studies, the trend emphasised the ecosystem (environment) and

socio-economic dimensions (human wellbeing). Some of the reviewed indices included the: **City Development; Environmental Performance, and Sustainable Society Indices**. A brief description of some of the relevant indices are discussed below:

The **Environmental Performance Index** has two (2) themes and focuses on nine (9) areas. The areas include health, air quality, climate and energy, biodiversity and habitat, water, sanitation, agriculture, fisheries, and forests (Huang, Wu & Yan, 2015). It is made of 20 indicators that have been used at national level and no application at metro level has been attempted (Huang, Wu & Yan, 2015). The **Genuine Progress Indicator** has 20 sub-indicators that measure green GDP covering all dimensions of sustainability, except governance (Huang, Wu & Yan, 2015). The **Genuine Savings** indicator is also a greening GDP indicator that has been used in USA, China, and India at metro level (Huang, Wu & Yan, 2015). The **Human Development Index** (UNDP) uses education, life expectancy & living standards and is the mostly used index as it is easy to calculate and interpret (Huang, Wu & Yan, 2015). UN-Habitat 2012 used it for assessing cities (Huang, Wu & Yan, 2015). However, no index for individual cities were found in the UN-Habitat 2012 report. The **Happy Planet Index** links wellbeing and consumption (Huang, Wu & Yan, 2015). The **Wellbeing Index** sponsored by World Conservation Union measures wellbeing and progress and can be used at any level but is no longer widely used (Huang, Wu & Yan, 2015). The **Sustainable Society Index** has 22 indicators under five(5) categories including sanitation, social wellbeing, and sustainable resource use (Huang, Wu & Yan, 2015). The new measure now has 21 indicators with three (3) wellbeing dimensions under seven (7) categories (Huang, Wu & Yan, 2015).

City Development Index Urban Indicators (UN-Habitat): The measure has five (5) sub-indices namely: waste management; level of education; infrastructural development; health and city GDP (Huang, Wu & Yan, 2015). The infrastructure sub-index includes sewer, water availability, electricity availability and telephony communication (Huang, Wu & Yan, 2015). The waste sub-index includes wastewater treatment and solid waste disposal (Huang, Wu & Yan, 2015). The index is effective for urban poverty and urban governance (Huang, Wu & Yan, 2015). As the authors observed the indices discussed are based on three(3) sustainability dimensions and they argued that strong sustainability indicators that measures all dimensions and does not misrepresent the interpretation of sustainability should be adopted (Huang, Wu & Yan, 2015).

The authors further argued that urban sustainability assessment indicators should as a minimum requirement have one strong sustainability indicator (Huang, Wu & Yan,2015). Science For Environment Policy (2018) prepared for the European Union, observed that data availability is a key aspect in selecting an indicator. Science For Environment Policy (2018:11) lists the following as common indicators in Europe and Asia:

“China Urban Sustainability Index, City Blueprint, EEA Urban Metabolism Framework, European Green Capital Award, European Green City Tool, European Green City Index, European Green Leaf Award, Global City Indicators Program, Indicators for Sustainability, Reference Framework for Sustainable Cities, STAR Community Rating System, Urban Audit Cities Statistics, Urban Ecosystem Europe, Informed Cities and Urban Sustainability Indicators”.

Other tools e.g., LEED, Green Star, BREAM etc. have been used as sustainability indicators (Science for Environment Policy, 2018). Gómez-Álvarez et al. (n d) classifies urban sustainability indicators into four (4) classes namely first to fourth generation. First generation indicators measures are simple economic metrics e.g., GDP, population, and urban sprawl (Gómez-Álvarez et al., n d). Examples are the UN World Urbanisation Prospects and World Bank World Development Indicators (Gómez-Álvarez et al., n d). Second generation indicators are broader and use UN Millennium Development Goals as guidelines for their development (Gómez-Álvarez et al., n d). Second generation indicators have been used for local assessment but unfortunately lack a regional perspective (Gómez-Álvarez et al., n d). The Global City Indicators Program (World Bank); UN-Habitat 's Urban Governance Index and Global Urban indicators and The Cities Data Book (Asian Development Bank Indicators) are examples of second-generation indicators (Gómez-Álvarez et al., n d). Third generation indicators use UN 2030 Development Agenda and the 17 SDGs as their guideline (Gómez-Álvarez et al., n d). These indicators are synergic, holistic, multi-dimensional and have human and ecological wellbeing at the centre of their development (Gómez-Álvarez et al., n d). Examples are World Council on City Data; City Prosperity Index (UN-Habitat) and OECD's Better Life Index (Gómez-Álvarez et al., n d). There is a transitional arrangement to move to fourth generation indicators, which as with third-generation indicators, are holistic and comprehensive but in addition also involves several stakeholders (Gómez-Álvarez et al., n d).

Limitations of designing sustainable indicators include lack of access to data, simplicity of compilation and understanding them and lastly their reliability (Kouloumpi, 2012). The worldview on sustainability also affects the development of holistic and comprehensive indicators.

An exploratory study on sustainable development indicators in USA with a view of developing or adopting a standard system for the country, showed the availability of 22 systems with 377 indicators (and a database of 145 candidate indicators) (Lynch et al., 2011). The study found that there was insufficient attention provided to social wellbeing and economic dimensions (Lynch et al., 2011). The study further observed that the separation of the dimensions, the equivalence of Gomez-Alvarez et al. (n d)'s lower-level generation indicators reduced the usefulness of the indicators (Lynch et al., 2011).

Diaz-Sarachaga et al. (2018) has observed that global indices are biased on some dimensions and limited data availability on them limits their usability. Diaz-Sarachaga et al. (2018) further argued that emphasis on sustainability dimensions has evolved over time and thus adopting an early generation sustainability indicator might distort the phenomenon being measured.

As the literature review has indicated, there are several reasons, key of which is data availability, the generation of the indicators, perspective, and paradigm (affects measurement of the concept) of the developer and intended use of the information. Indicators are continuously being developed and using an earlier generation might misrepresent the sustainability measure. The energy 'just transition' debate in SA, for example, affects the adoption of greening technologies, urbanisation and employment in urban areas.

4.6.3. Research Objective 1 (SACN and SA Sustainability Indicators)

This section introduces SACN sustainability indicators which are specific to SA, as the last component of Research Objective 1. The assessment of the indices is discussed under Sections 4.6.4 (Objective 2) and 4.6.5 (Objective 3). The Common Data Framework for Cities plan produced by SACN includes a Code Book, an open-source almanac, and a council of city data for the implementation of the standards (SACN, 2017). The Code Book is the common indicators, statistics and metadata in towns and cities; South African Cities Open Data Almanac (SCODA)

is a system available to users without a licence (open source) and South African Council for City Data (SACCD) coordinates the implementation of the common data framework (SACN, 2017). The IMF Data Quality Assessment Framework and ISO Standard ISO 37122:2019 (which deals with sustainability of human settlements) were identified as good examples of data quality standards and smart cities indicators respectively (SACN, 2017). Platforms including Innovate, Open Cities Lab, SCODA and eThekweni EDGE were identified as notable examples of open-source dashboards (SACN, 2017).

SCODA Indicators were developed by SACN for the South African Cities Report (SACN,2021). It is a consolidation of various sources including National Development Plan (NDP), SDGs, Global City indicator, World Council of City Data, and ISO 3720 Standard in City indicators(SACN,2021). SCODA was built on 2004 themes namely sustainable, inclusive, well-governed, city development themes (SACN,2021). From SCODA dashboards prepared by SACN (2021), NMBM has the least population growth of the metros during the period 2011-2019. It had a population growth of 4.8%; Johannesburg had a population growth of 29.4%; Tshwane 24.9%; Ekurhuleni 22.4% and Cape Town was at 20%. BCM at 5.9% had the second lowest population growth (SACN,2021). At 0.2%, NMBM had the biggest decrease of informal settlement dwellers followed by Tshwane at 3.2% during the period 2015-2018 (SACN,2021). The metro experienced the highest increase of beneficiaries with access to food at 14.5%. It was followed by Cape Town at 4.2% and then BCM with a decrease of 1.5% during the period 2016-2020 (SACN, 2021).

Based on SACN (2021), SCODA dashboards show that NMBM has the most desirable change in basic municipal services for the period 2015-2019 on average. From Boyle(2015)'s studies, it was found that Cape Town, just like Durban EDGE portal, had the capacity to develop an Open Data Portal using its internal resources. Confirmation of a similar capacity has not been found in NMBM.

Whilst acknowledging the positive ranking of NMBM, it is worth noting that the SACN indicators are second generational, which as Gomez-Alvarez et al. (n d) argues are not holistic and comprehensive.

Turcu (2013) developed a hybrid of sustainable indicators for the urban built environment. The indicators cover all the four pillars of sustainability (see **Figure 4.7** below). The sub-indices of the dimensions approximate the ones that have been adopted from Gashu & Gebre-Egziabher (2018) and used in the questionnaire send to NMBM residents. Residents have criticised the questionnaire used for the survey that some of the sub-indices are vague and that they do not have rational metrics attached to them. The same argument is applicable to Turcu (2013)'s hybrid model.

The Turcu (2013) and Gashu & Gebre-Egziabher (2018) models have been used in the transitioning of the NMBM specific model based on SACN literature, see Figure 4.7.

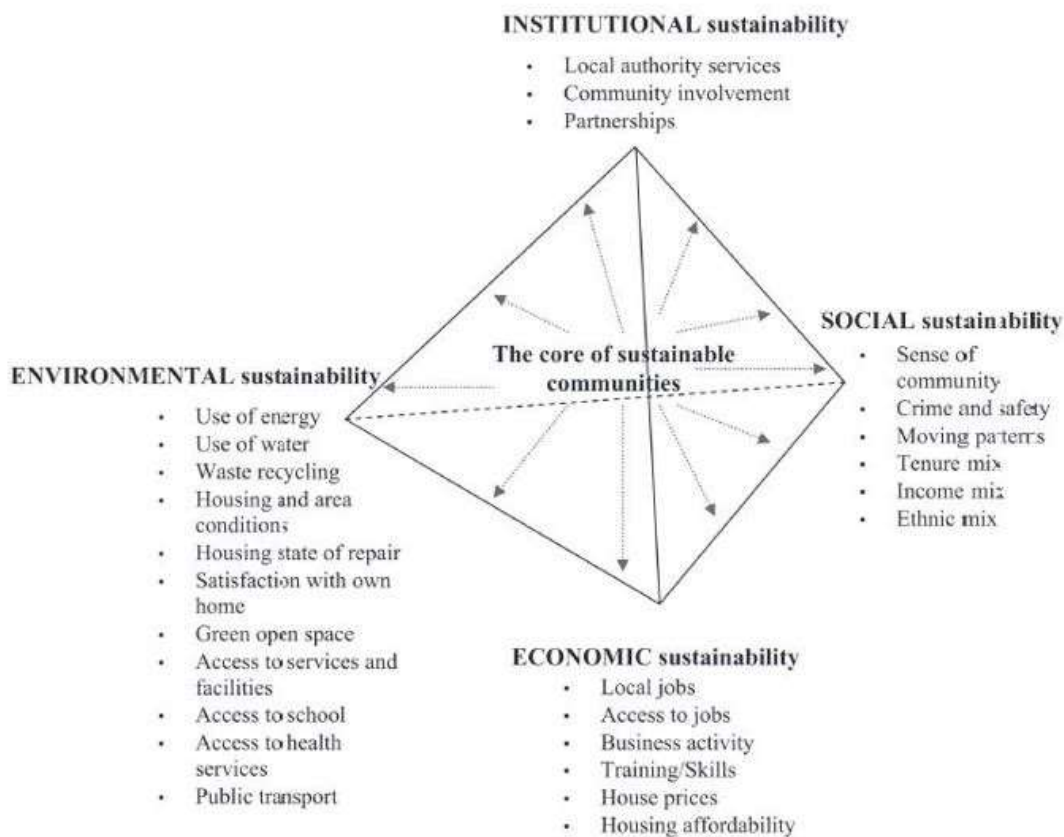


Figure 4.7: A hybrid set of Sustainability Indicators, (Source: Turcu, 2013).

4.6.4. Research Objective 2 (NMBM Sustainability)

The second (2nd) objective was to establish how the sustainability metrics compared with other cities in Africa and the resourced/developed world?

To achieve this research objective, the study used secondary data from the additional literature review mainly from SACN. In addition, to achieving Research Objective 1, Sections 4.6.1 to 4.6.3 provided the background to Objectives 2 to 5. Part of this literature is discussed extensively under Research Objective 3.

Using sustainable urban development and/or smart city concepts in IDPs, Foster (2020) compared the strategic priorities of Johannesburg and NMBM. The author investigated the weight given to the Sustainable Development/Smart Cities management on the metro organogram and the funding; partnership and pooling of resources that the metros have(Foster, 2020). Johannesburg was found to be more sustainable on the simplistic scale (Foster, 2020).

COMPARATIVE ANALYSIS OF PER CAPITA REVENUE IN NOMINAL TERMS, 2015 TO 2021 (RAND)

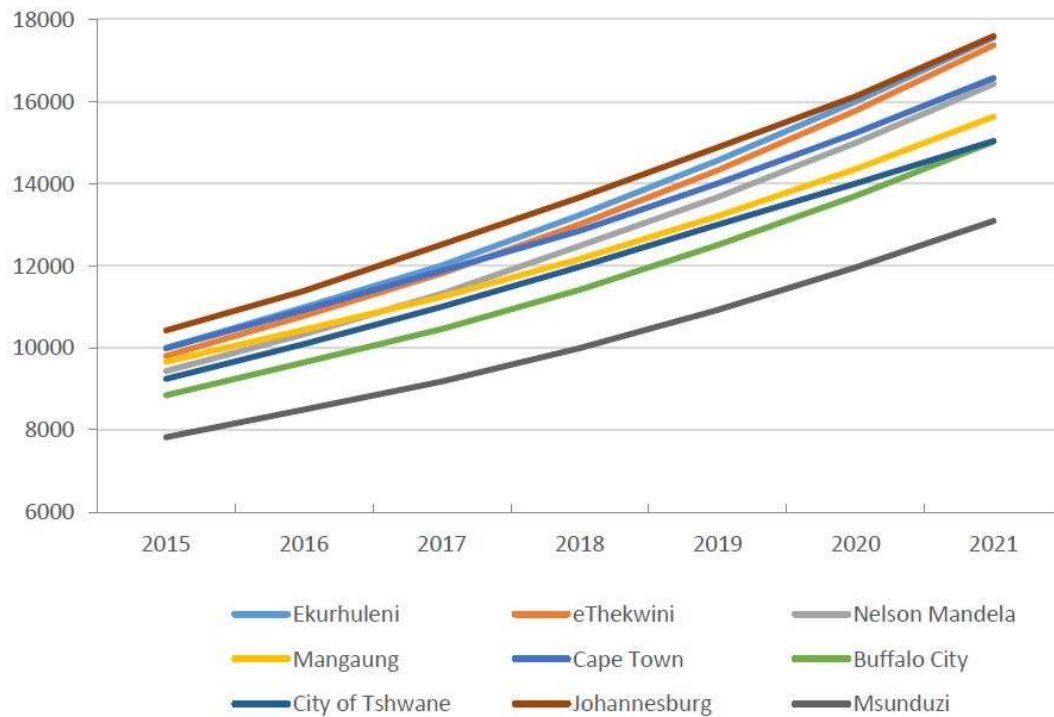


Figure 4.8: Capita Revenue Comparison in SA Metros (Source SACN, 2017).

The interviewed ‘sustainability officials’ were diplomatic in pointing out the unsustainability of NMBM e.g., participant **2BB** that regarded the city to be “*miles behind in implementation sustainability initiatives compared to Cape Town*” and participant **6FF** that considered NMBM “*not to be there yet*”.

In a capita revenue comparison of SA metros, NMBM was ranked fifth (5th) behind Johannesburg, Ekurhuleni, eThekweni and Cape Town (SACN, 2017). **Figure 4.8** above shows the graphical representation.

In a sustainability study of municipalities in SA, Cape Town and eThekweni were found to be the leading municipalities with developed sustainability initiatives but having limited government financial support (Taylor et al., 2014). As Taylor et al. (2014), observed climate change (and by extension resilience and sustainability) was taken as an extension of the technical planning and management departments. Taylor et al. (2014) argued that concentrating on reducing emissions

and climate change mitigation but not considering how urban environments are constructed and maintained, limits the usefulness of sustainability initiatives.

Taylor et al. (2014)'s arguments are consistent with participant **2BB** who considered "*integrating sustainability in metros to be difficult*". This is more-so when municipal governance structures are unstable.

4.6.5. Research Objective 3 (Indices and Themes of SA Sustainability)

The aim of the third (3rd) objective was to find out what other indices have been used to measure the sustainability of the city and which themes had the indices used?

SACN reports e.g., green indicators of SA metros rank metros on various indicators. Using 2005 data the energy related tons of CO₂ per capita, a score of 4.7 was obtained for NMBM (SACN, 2017). The score was the second best after BCM (3.7). Cape Town (at 5.9) and Tshwane (at 7.5) had the worst scores. NMBM had a Gini co-efficient factor of 0.72 which was comparable with other metros (except Cape Town) with factors ranging from 0.72 to 0.75 (SACN, 2017). Cape Town had a Gini co-efficient of 0.67 which has since improved to 0.58 in 2013 (SACN, 2017). Calculations by activists (Sustainable development what, when and by whom) estimates the usage of earth resources to be equivalent to 1.5 earth in 2013 and is expected to be 3.5 earth in 2050 (SACN, 2017).

The city obtained the second based ranking but noting that this measure is second generational (i.e., not holistic), it does not lead to the desired goal which is the sustainable development of NMBM.

The 2017/2018-2021/2022 NMBM IDP, acknowledges the impact of Covid-19, loadshedding, drought, global recession, downgrading of SA, decreased revenue collection, and decreased Treasury allocation, and increasing costs of doing business in the metro(NMBM,2022b). According to NMBM (2022b), the metro has a population of about 1 240 000 and accounts for almost 1 in 5 citizens of the Eastern Cape. It had a pre-Covid economic growth of 1.36% which is substantially smaller than Ekurhuleni (2.47%) and Tshwane (3.1%) (NMBM, 2022b). SACN(2016) credits NMBM as having the lowest proportion of informal households in SA

(NMBM, 2022b). The average number of residents per household declined from 4.25 (1996) to 3.55 (2011) (Stats SA, 2011) and still steady at 3.55 (Stats SA GHS, 2019) and residents below the poverty datum line decreased from 46% to 29% between 2001 and 2011) (NMBM, 2022b; SACN, 2015b). 45% of NMBM citizens are on social grant and this compares to 53.7% in BCM and 45.5% nationally (NMBM, 2022b:9). The NMBM metro contributes 41.81% of EC's Gross Geographic product (NMBM, 2022b:9). The NMBM unemployment has decreased from 46.4% in 2001 to 36.6% in 2011 (SACN, 2016) but has been hovering around 42.3% by December 2020 (SARS, 2021). The metro has low density of 20 houses per hectare and is spatially segregated on income with the northern parts having lower income and higher densities: the southern and western parts having lower densities and higher income. Using the poverty datum levels (29%), social grant recipients (53.7%), unemployment levels (42.3%), NMBM (2022) records and SARS (2020) indicates that NMBM is unsustainable on the income quality and employment level sub-indices. This is consistent with the NMBM residents survey that marginally agreed that the city has low-income quality (37.5%), and that unemployment is high (64.3%).

The Ministry of Cooperative Governance and Traditional Affairs (COGTA) ranks IDPs of metros based on attributes such as SDF, delivery of municipal services, financial health of city, economic growth, governance, participative consultations, and strength of institutional frameworks (NMBM, 2022b). **Table 4.4** below shows the NMBM IDP ratings for the 5-year period from 2017/18 to 2020/21 using a low, medium, and high scale.

Table 4.4 NMBM IDP Ratings.

Attribute/Dimension	2017/18	2018/19	2019/2020	2020/21
Spatial Development Framework	High	High	High	High
Service Delivery	High	Medium	Medium	High
Financial Viability	High	High	High	High
Local Economic Development	High	High	High	High
Good Governance & Public Participation	Medium	High	High	High
Institutional Arrangement	Low	Medium	Medium	Medium
Overall Rating	High	High	High	High

Source: NMBM IDP Ratings (COGTA, 2021).

Other than the institutional arrangement which was rated as low in 2017/2018 and medium for the period up to 2020/2021, NMBM was ranked highly on all other IDP rankings as shown in

Table 4.4 above (NMBM, 2022b). Part of the ranking is consistent with the quantitative analysis (see Table 4.1) where 38.1% marginally agreed that the city has good institutional capacity (35.7% disagreement), 43.9% agreed that the city has established frameworks (34.2% disagreements) while the other components e.g., economic development/financial viability are inconsistent. 51.2% of residents disagreed that the city has positive economic growth.

Table 4.5 below shows the percentage of 7–21 year-olds that are still studying. NMBM has the second highest rate followed by BCM.

Table 4.5: Education 7 to 24 years

Metro	% of 7 to 21 year olds in Education	Additional Remarks
NMBM	75.8	0.8% 20yrs+ no schooling STATS SA GHS 2019
BCM	80.2	Metros Average 1.4% STATS SA GHS 2019
Mangaung	73.2	
Cape Town	69.8	
eThekwini	71.1	

(Source: NMBM, 2022b).

Comparing the metros in the Cape province, NMBM has the least number of adults with Grade 7 as the highest qualification (see **Table 4.6** below). 90% of the NMBM population is literate with 19.7% having matric and 6.8 % having a higher education.

Table 4.6:Adults (20yrs+) with Gr 7 as highest qualification.

Metro	20yrs+ with Gr 7as highest qualification
NMBM	4.1%
BCM	11.4%
CT	6.1%

(Source: NMBM, 2022b).

Table 4.7: Healthy (StatsSA GHS,2019).

Metro	Medical Aid	Public Facility
NMBM	24%	60.3%
Metros Average	25.2%	62.7%

(Source: NMBM,2022b).

The IDP report places NMBM second (2nd) on murder & robbery and third (3rd) on sexual offences & assault in the country (NMBM, 2022b). The latest SACN 2022 rating now places NMBM as the most dangerous metro with 71 murders per 100 000. It is followed by Cape Town at 67 murders per 100 000 citizens (see **Table 4.13** below). This is consistent with views of the residents that agreed that the city has a high crime rate (95.1%).

Tied with Cape Town, **Table 4.8** below shows that NMBM has the second-best performance behind Johannesburg in providing water to its residents (NMBM, 2022b). Unlike Cape Town's "Day Zero" approach, part of the mismanagement of water in the city has to be shouldered by the residents as they were uncooperative to municipal initiatives.

Table 4.8: Water

Metro	%	Remarks
Johannesburg	99.8%	
NMBM	99.5%	Assessing requirements in new informal settlement
CT	99.5%	
All Metros	97.3%	

(Source: NMBM, 2022b).

Table 4.9: Sanitation

Metro	%	Remarks
NMBM	95.8%	Highest budget eradication programme
BCM	95.1%	
Tshwane	83.1%	

(Source: NMBM, 2022b).

NMBM has the highest budget (5700) eradication program. The metro made 1468 connections in 2019/20 and 803 in the 2020/21 financial years (NMBM, 2022).

Table 4.10: Waste Management

Metro	%	Remarks Waste Management
Ekurhuleni	89.5%	
NMBM	88.5%	Second -illegal dumping
BCM	56.9%	

(Source: NMBM, 2022b).

Table 4.11: Electricity

Metro	%	Remarks
NMBM	92%	First-illegal connections(88.8% prepaid)
BCM		(86.8% prepaid)
Johannesburg		(50.3 % prepaid)

(Source: NMBM, 2022b).

Table 4.12: Informal Housing

Metro	%	Remarks
NMBM	7.1	Subsidized houses required 124 342 74690 Female, NMBM 2020
BCM	17.7	
Ekurhuleni	18.4	
Johannesburg	19.1	
CT	19.6	

(Source: NMBM, 2022b).

The IDP reported the following sustainable issues: tarring of 750km of gravel roads; inadequate funding for subsidized housing; limited funding for stormwater; aging infrastructure (water leaks, frequent burst pipes leading to poor service delivery); Nooitgedacht Low Level Scheme implementation to ensure water sustainability in the metro; Fishwater Flats Wastewater Treatment Works (critical socially and economically); NMBM is in the 7th year of a 10 year drought cycle; and 40% of residents were expecting Day Zero in Mid-June 2022 (NMBM, 2022b: PE Express, 2022). The metro is developing a new wastewater works to support Motherwell housing & Coega SEZ (NMBM, 2022b).

From 2009 to 2019, NMBM has been contributing 35.3% of Eastern Cape economic output and 2.7% of SA output with a growth rate (1.92%) better than the national average of 1.68% (NMBM, 2022b). NMBM's pre-Covid rate of 1.12% for the period 2018-2023 NMBM is lower than both the national rate (1.16%) and the provincial average(1.15%) (NMBM, 2022b). The growth rate with Covid for NMBM is projected to be 0.12% for the period 2019-2024. The provincial rate and national rate for the same period are projected to be 0.15% and 0.34% respectively (NMBM, 2022b). The metro reported a water infrastructure maintenance backlog of R648B. The consumption growth of electricity decreased by 2% but consumers increased by 12% in a 5-year period (NMBM, 2022b). 71% of electricity is bought by commercial clients in 2019/20. Worryingly, electricity sales loss has been increasing (6% in 2008/2009 to 12.3% in 2014/2015 and to 19.43% in 2019/2020) (NMBM, 2022b).

In addition to the international push for sustainable development and urbanisation, the low economic growth, the volatile political environment, the increasing cost of energy (electricity and fuel and disruptions of electricity supply in SA and the metro are drivers for the adoption of new technology and adoption of renewables in the sustainable development of the metro (NMBM,2022b). The IDP considers NMBM as having an enabling environment for a green economy with two(2) wind farms situated in the metro (NMBM, 2022b). The report acknowledges that electricity infrastructure and manpower required in the electricity and energy directorate needs to be beefed up. Most of the municipal electricity equipment is obsolete and about R805m is required to rehabilitate it (NMBM, 2022b). The metro received a R300m sustainable energy grant from Germany Development Bank to promote the use of renewal energy.

As discussed above, through its official documents, the city acknowledges its unsustainable management of its water and electricity infrastructure systems.

The processes of the MSDF which supports sustainability in NMBM were identified as:

“analysis of spatial opportunities, constraints, patterns, and trends; identification of the need for spatial restructuring and land reform; provision of spatial solutions to developmental issues; identification of national spatial development principles and their spatial application in the NMBM; understanding of and allowance for the spatial implications of social, economic and environmental sustainability; production of a

document to guide decision-making on developable and nondevelopable areas, including the sequencing of development; creation of a framework for public and private investment decisions to facilitate investor confidence” (NMBM, 2022b:134).

In 2022, the Environmental Affairs Minister accepted a (methane) Coega Gas-to-Power Plant in NMBM's industrial development zone (IDZ) even after acknowledging groundwork's objections. The objections noted the irreversible impact on climate change even with mitigations, but those objections were ignored.

At the time of this study, NMBM was experiencing the seventh (7th) year of a severe drought which was expected to persist for another three years according to the metro's climate pattern. As of July 2022, the combined dam level was 14.7% of that capacity 2.4% was deemed unusable (NMBM, 2022; PE Express, 2022). In its 5-year report on violence in SA metros, SACN rated the metros in SA based on the number of murders per 100 000 citizens of the metro (Businesstech, 2022).

Table 4.13: Murder Rates in SA Metros

Ranking	Metropolitan Municipality	Murder Rates per 100 000
1	Nelson Mandela Bay	71
2	Cape Town	67
3	Msunduzi	54
4	eThekweni	47
5	Buffalo city	42
	National	34
6	Johannesburg	27
7	Mangaung	26
8	Ekurhuleni	26
9	Tshwane	18

(Source: Businesstech, 2022)

The report observed the deteriorating socio-economic environment, growing inequality and food insecurity, corruption (which lowers criminal justice performance and lowering of trust in government), increased use of guns, violence by gangs and taxi groups as the drivers of violence

in SA (Businessstech, 2022). The NMBM was rated as the most dangerous metro in SA, ahead of Cape Town with a murder rate 208.8% above the national average. The NMBM residents survey and semi-structured interviews of 'sustainability officials' confirm the poor rating.

NMBM was the first metro in SA to develop a bioregional plan that was considered in its land use development applications (NMBM, 2022). Eight (8) private and eleven(11) municipal reserves are found in the metro. Because five (5) of the country's biomes are represented in the NMBM metro, it is considered a biodiversity hotspot (NMBM, 2022). The metro's Built Environment Performance Plan has provisions for "climate risk and resilience management". In addition, its coastal management plan which was developed in 2014 provides for a coastal set back limit on all developments which is applicable on 102 kilometres of its coastal zone (NMBM, 2022). As asserted by participant **2BB**, the city has excellent documents, but implementation of the guidelines has been lagging.

The SACN (2018/2019) report on the perceptions of crime in SA, showed that NMBM fared well on social/structural indicators of crime other than youth unemployment and access to firearms. The metro had the fourth highest perception of satisfaction of law enforcement at 59%. Ekurhuleni, Mangaung and Msunduzi occupied the first three (3) positions at 66%, 62% and 61% respectively (SACN, 2020). The SACN (2020) findings are inconsistent with the residents' survey that considered the crime rate to be very high in the city (95.1%).

4.6.6. Research Objective 4 (Optimal NMBM Indicators)

The fourth(4th) objective was to establish the most appropriate sustainability measure in NMBM metro.

SACN (2017) attempted to link population dynamics to revenue collection in SA cities with the aim of finding out the sustainability of development with changes in population and legislative environment (SACN, 2017). Tracking environmental pollution and economic growth in SA has reviewed a correlation between the two (SACN, 2013). This reflects the relationship between intensity of resource use and environmental degradation in the economy (SACN, 2013). The Constitution (Act 108 of 1996), National Strategy for Sustainable Development and Action Plans,

New Growth Path, and National Development Plan 2030 (NPC, 2012) provides the legislative environment for sustainable development in SA (SACN, 2013). SPLUMA (Act 16 of 2013) provides an additional dimension by controlling land use management in the country. SA has developed legislation on environmental issues and economic growth but lack of capacity at municipal level means that most metros struggle with the operationalisation of the intention of the legislative framework (SACN, 2013). Cities do not budget for sustainability/green economy because the environment is not a municipal responsibility and prioritises the economic pillar at the expense of the environmental pillar and furthermore the rigidity of The Municipal Finance Management Act (Act 56 of 2003) hampers the innovation required for sustainable development/green economy (SACN, 2013). As echoed by participants e.g., **2BB**, **6FF**, **7GG** and **8HH**, implementation of some of the planning laws and frameworks necessary for sustainable development were ignored.

Using economic metrics (GDP, IRR or return on investment) would not capture all dimensions of green economy/sustainable development (SACN, 2013). A 2011 study involving 15 cities covering 11 countries in African used the Green Cities Index (SACN, 2013). The indicator consisted of data on energy, CO₂ emission, green spaces, waste management efficiency, mobility, water & sanitation, pollution, and environmental framework (SACN, 2013). The three (3) largest cities in SA (i.e., Cape Town, eThekweni & Johannesburg) were placed above average in the same group as Accra (Ghana), Casablanca (Morocco) and Tunis (Tunisia). Tshwane was ranked average in the same group as Cairo (Egypt), Lagos (Nigeria), Addis Ababa (Ethiopia) and Alexandria (Egypt). SACN (2013) observed that the indicator did not capture the issues bedevilling SA green economy/sustainable development initiatives. The specific challenges for SA include unemployment, water scarcity, energy driven by coal and imported carbon fuels, high inequality (SA's Gini-coefficient of 63 in 2022 is the highest in the world) and ecological degradation due to over reliance on coal (SACN, 2013). With the partial exception of Ekurhuleni, all SA metros had regressive tax and tariff structures in 2015 (SACN, 2015). This trend has worsened mainly due to deteriorating economic conditions, increasing unemployment and devastation caused by Covid-19 from 2020 and 2022. The 'just transition' debate adds further complications to the balancing of the sustainability dimensions according to the 'correct model' of sustainability.

Consistent with SDG No. 7 (increase of renewable energy sources by 2030), SA Integrated Resource Plan targets that 9% of energy use by 2030 will be renewable (DOE, n.d.). As with most coastal cities, Gqeberha, is prone to heat, floods, rising sea level & heat stress. In 2017, Cape Town experienced a serious drought which caused rationing of water to avoid 'Day Zero'. Because water constitutes 10% of the metro's sales, the drought contributed to the reduction of credit rating, tourism, and agricultural production. The demand for water decreased by 50% in Cape Town during 'Day Zero' period, but demand reduction has not been significant in NMBM (NIP 2050, 2021). Water and electricity constitute the biggest expenditure items of SA metros, but insufficient resources are allocated for their maintenance (Treasury recommends 8%) (SACN, 2018). Coupled with mismanagement of the water crisis, the drought would further strain the financial viability of NMBM. The National Water and Sanitation Master Plan projects a 10-15% water deficit and restricted water use in 75% of all the metros by 2030 (NIP 2050, 2021). Municipal systems account for 30% of water usage in SA (NIP 2050, 2021). Regressive municipal tariff structures particularly from 2010, means that municipal inflation is higher than the national rate and this significantly impacts the proportion paid in municipal bills by lower income households (SACN, 2018) and this increases the risks of volatility (riots, vandalism etc.) in urban areas. Water availability (85.0%) and its management (83.3%) were considered to be significantly unsustainable by NMBM residents survey and some 'sustainability officials' e.g., participant **9JJ** citing the effect of water unavailability on urban agriculture.

Sustainability in City Planning: IDPs provide the direction on how metros drive their developmental activities and how awareness is provided to stakeholders about these activities (SACN, 2015). In a study done to explore how the sustainability agenda/green economy was accommodated into the metros planning initiatives, the number of sustainability/sustainable terms in eight (8) IDPs of SA's metropolitan areas was analysed (SACN, 2015). This was done using text mining and content analysis. The terms sustainable and sustainability appeared most in IDPs. Using this indicator, eThekweni had the highest frequency (395 sustainable, 110 sustainability) terms in their IDPs (SACN, 2015). The eThekweni also had the highest green economy text followed by NMBM with 95 sustainable (and 65 sustainability) terms. The cities of Johannesburg and Ekurhuleni were the last at 7 and 5 terms respectively (SACN, 2018). In a study done by Angelopulo in 2015, SA metros were compared with leading cities in Africa and

outside the continent (SACN, 2015). All SA metros plotted on the medium-low inclusive growth potential segment (SACN, 2015). The order of SA metros in the barometer was Tshwane then Johannesburg followed by eThekweni, Cape Town and finally NMBM (SACN, 2015). The study used the Mastercard Index which identified economic opportunity and inclusive economic growth to improve social well-being of citizens in African cities (SACN, 2015). The indicator has some elements of inclusive growth but does not directly measure sustainability (SACN, 2015). The index adopted several criteria including “urbanisation, governance, specific variables of economic well-being, business friendliness, travel, infrastructure, connectivity and development” (SACN, 2015:10). Education, health, infrastructure and the balance between consumption and production constituted the urbanisation criteria. The governance criteria used World Bank datasets on political stability; levels of violence; effectiveness of government, regulatory universe; rule of law and corruption (SACN, 2015). The report acknowledged positive correlation between economic growth and sustainable development (SACN, 2015). The GDP per capita, household expenditure and amount of middle-income household as a percentage of total households were used in the index as measures of economic growth (SACN, 2015).

Sustainability development professionals in Athens agreed on improved air quality (concentration of pollutants; CO₂ & other harmful gas emissions etc.); renewable energy and efficient energy use; anticipating climate change (flooding risk); water management and city specific aspects (e.g., increased greenspaces) as mandatory tools (Gonzalez, 2011).

4.6.7. Research Objective 5 (Sustainability of NMBM)

The fifth (5th) objective was to determine whether NMBM was sustainable using developed/recommended metrics.

Metros incorporate sustainability into their operations, but the efforts are still insignificant as sustainability must be embedded in all processes within the metros. Additionally, different levels of government operate independent of others (silo mentality) which worsens the metros' sustainability initiatives. Furthermore, there is little awareness of sustainability in metros and the data collected is not holistic to ascertain the sustainability of the cities. Since 2015 when the global community adopted SDGs, the principles have been incorporated into policy guidelines

in SA (SACN,2016). All the 17 SDGs have a bearing on sustainability. SDG No. 11, for example, specifically deals with sustainable cities and communities.

A NMBM survey in 2020 showed how its stakeholders were satisfied with its provision of service (NMBM, 2020). The level of very satisfied clients decreased from 21% with internal NMBM clients to 5% for large business (see **Figure 4.9** below).

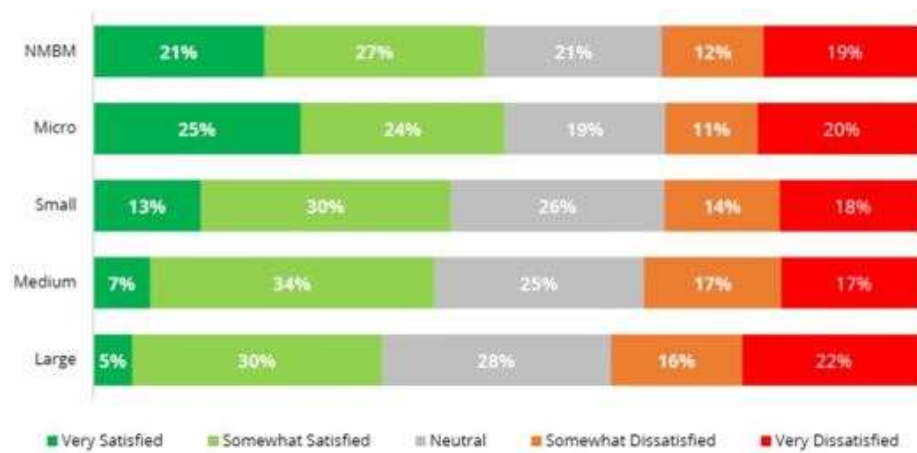


Figure 4.9: Business Satisfaction Survey with NMBM Services, (Source: SACN, 2021).

The official municipal records acknowledge the decline in municipal services. This is consistent with the results of the questionnaire to residents that considered municipal services to be poor (66.7%) and ‘sustainability officials’ e.g., participant **1AA** that has documented decreasing levels of municipal services particularly from 2016.

FIGURE 2: Population growth (2011–2019)

BCM	CPT	EKU	ETH	JHB	MAN	NMB	TSH
5.9%	20.0%	22.4%	13.0%	29.4%	14.9%	4.8%	24.9%

FIGURE 3: Increase/decrease in households living in informal dwellings (2015–2018)

BCM	CPT	EKU	ETH	JHB	MAN	NMB	TSH
↓0.9%	↑0.9%	↓2.4%	↓3.1%	↓1.1%	↓0.4%	↓0.2%	↓3.2%

FIGURE 4: Change in percentage of city population with adequate access to food (2015–2018)

BCM	CPT	EKU	ETH	JHB	MAN	NMB	TSH
↓1.5%	↑4.2%	↑2.6%	↓4.0%	↑3.0%	↑2.4%	↑14.5%	↑2.9%

FIGURE 5: Increase/decrease in unemployment rate (2016–2020)

BCM	CPT	EKU	ETH	JHB	MAN	NMB	TSH
↑0.9%	↓0.2%	↓0.5%	↑1.9%	↑4.1%	↑1.9%	↑4.1%	↑3.4%

FIGURE 6: Change in access to basic services between 2015 and 2018

	BCM	CPT	EKU	ETH	JHB	MAN	NMB	TSH
Electricity	↓0.3%	↓0.1%	↑5.5%	↑0.9%	↑1.7%	↑0.3%	↑0.3%	↑2.0%
Sanitation	↑4.2%	↑0.6%	↑2.5%	↓0.1%	↓0.3%	↓1.7%	↑2.4%	↑1.8%
Water supply	↓3.3%	↓0.1%	↑1.3%	↑5.4%	↓0.1%	↓10.7%	↓0.4%	↓0.9%
Weekly refuse removal	↓3.0%	↑0.5%	↑0.6%	↓0.3%	↓2.0%	↓13.0%	↑30.4%	↑0.5%

FIGURE 7: Households experiencing environmental problems (2019)

	AIR POLLUTION	WATER POLLUTION	WATER REMOVAL & LITTERING	LAND DEGRADATION
BCM	35.2%	24.6%	48.4%	52.3%
CPT	7.5%	7.7%	24.1%	10.5%
EKU	22.4%	11.7%	22.1%	16.5%
ETH	19.3%	18.9%	46.8%	21.2%
JHB	21.6%	24.7%	46.8%	23.5%
MAN	30.7%	24.9%	68.2%	52.9%
NMB	15.2%	5.9%	42.0%	2.7%
TSH	15.5%	14.5%	31.1%	27.3%

FIGURE 8: Increase/decrease in households spending ≥10% of income on public transport (2015–2018)

BCM	CPT	EKU	ETH	JHB	MAN	NMB	TSH
↑8.0%	↑3.3%	↑2.8%	↓6.3%	↑4.2%	↓10.7%	↑3.4%	↓1.7%

Figure 4.10: Other Metrics, (Source: SACN, 2020)

Acts of vandalism in NMBM Bay have steadily been on the rise and more than doubled during the 2021/2022 financial year, compared to 2020/2021 financial year (Bezuidenhout, 2022) for example. 292 cases were reported in 9 months in the 2021/22 financial year compared to 143 cases reported the previous financial year (Bezuidenhout, 2022). Cell phone towers/receiver bases, railway infrastructure, electrical substations, road infrastructure and municipal depots were the most vandalised structures (Bezuidenhout, 2022). The trend has now continued into parks, schools, cemeteries etc. This had huge implications on most indices e.g., crime (95.1%),

transport (48.7%), energy (57.5%% and education (45,0%) which received high disapprovals from residents. Only connectivity (38.1%) had a positive rating from city residents.

As reported in the press, households in Kwazakhele (Mase Street) have complained of flowing sewer for years but with little response from NMBM (Palezweni, 2022). Cases of vandalism are common in the press e.g., the vandalism of the Motherwell's temporal councillor offices in August 2022 (Herald, 2022). The trend is similar with other metros, for example, the Joburg metro police(JMPD) attended 79 protests and made 3291 arrests for the six months ending June 2022 (Luvhengo, 2022). The vandalism and violence reported in the media is consistent with the perceptions of the survey of residents and views of most 'sustainability officials' with participant **1AA** for example calling for a national "*state of emergence*" declaration to curb infrastructural vandalism.

In four (4) years, 748 cases of essential infrastructure (72 cell phone, 84 rail, 89 electrical substations, 23 road infrastructure and 13 Municipal depots) were vandalised in NMBM (Bezuidenhout, 2022). Municipal libraries (Chatty, Allanridge, Motherwell, KwaMagxaki) vandalised in mid-2022 were excluded in the statistic. Most of the vandalism was reported in the hot spots which included Swartkops, Kariega, Mount Road, Kamesh and Algoa Park (Bezuidenhout, 2022). Of particular concern on assessing the sustainability of the metro has been the low prosecution rate of 14.8% (176 arrests, 26 successful prosecutions, 148 unsuccessful). Destroyed essential infrastructure includes cables and public facilities (schools, water distribution equipment, substations, sewerage works, commuter relays) damaging the economy and the ecosystem of the metro (Bezuidenhout, 2022). Stories of illegal dumping are reported in most low-income suburbs. The conversion of the Ingwe Park in Motherwell (NU1) to a recreational park at a cost of R1.5m was a rare success story (Bezuidenhout, 2022).

In the Markman Industrial Area, in Gqeberha, there has been complaints by residents of the use of facilities as manganese ore storage. The ore is destined for export to China, but because of the Covid-19 induced lock down, premises in Markman Industrial area have been used as a storage facility. Property owners have complained of the health hazards of manganese ore dust; the effect of the heavy trucks on roads and drainage infrastructure; the Swartkops River system; traffic contraventions, impacts on the environment, deterioration of buildings and drainage infrastructure (Bezuidenhout, 2022). According to Bezuidenhout (2022), the metro has been

inactive in enforcing environmental and health regulations. Products in other business in the area have been affected by manganese dust which either depreciates the value of the products or increases operating costs. Worryingly, NMBM has been taking long to provide feedback on identified issues (Bezuidenhout, 2022). The same trend has been observed at Fleming entrance of Port of Port Elizabeth (point of exit) and buildings in the precinct. The NMBM Environmental Sustainability Policy acknowledges the pressure exerted on the environment by human activities (urbanisation, farming, animal husbandry, mining etc.) and calls for an urgent need for the conservation and management of the environment (NMBM, 2022). The policy further acknowledges that the grassy fynbos systems are the worst affected by urbanisation (NMBM, 2022).

Destruction of municipal utilities lowers the quality and standard of living of its residents by exposing residents to environmental hazards e.g., manganese contamination and sewer spillage in rivers and the ocean.

NMBM and SACN literature shows that on paper NMBM renders the largest benefit to the indigent consumers compared to the other metros (SACN, 2018; NMBM, 2021). However, the meeting of residents of one of the NMBM Wards in August 2022 and council meetings in 2022 painted an opposite picture. The NMBM 2020/2021 Annual Report, indicates the following: 99.89% water access; 98.9% access to sanitation; 90.8% refuse collection provision; and 98.85% access to electricity (NMBM, 2021). The Report acknowledges increased incidents of vandalism and theft of municipal assets; severe drought; high water losses due to leaks; high electricity losses; poor sanitation in some areas (bucket system); housing backlog; illegal occupation; illegal dumping and a high dependence of grants for its CAPEX development (NMBM, 2021).

The reviews above, are part reflections of the city's unsustainability of sub-indices e.g., water management, energy efficiency and waste management which received poor ratings from residents. This view was also shared by participant **8GG** that acknowledges that "*there are more failures than successes*" in the city's sustainability initiatives.

Additional, positive highlights from the city manager included increased electricity connection (1671 dwellings); 44.63 MWh provision of free basic electricity to indigent households; 95.66% rating performance of planned Electricity Directorate maintenance; additional generator capacity

of 3.79 megawatts installed; 1489 (1222 state-subsidised) properties provided with services (electricity, water, and sanitation); grading of 7.58km of gravel roads and resurfacing of 2.9% of municipal roads (NMBM, 2021). On the economic front, the Report showed turnaround times of 8.30 days for building plan applications and creation of 2 905 employment opportunities through the Public Works Programme (NMBM, 2021). The metro had a recovery rate of 85.5% for its billed 2019/20 revenue and used 81% of its CAPEX Budget (NMBM, 2021). The metro has established an online land use application in terms of planning laws (SPLUMA, Act 16 of 2013).

The NMBM (2021) report that all governance and public participation arrangements were in place. These included functional ward committees; boards and committees (disciplinary, audit and risk Management, Municipal Public Accounts) and ten (10) council meetings in the 2020/21 year (NMBM, 2021). The metro supported sport in the metro including sponsoring Chippa United Football Club; Eastern Province Rugby and the Warriors Cricket Teams for about R6m (NMBM, 2021).

From the review above NMBM (2021) literature depicts an image of a functional governance system, but from participants **3CC** and **4DD**, the system is hugely hampered by unstable local governance.

The report acknowledged the effect of ageing infrastructure coupled with vandalism on the turnaround times of municipal service delivery (NMBM, 2021). The devastating effect of Covid-19 pandemic and Eskom's increased load shedding on economic performance and falling employment rates in the metro (NMBM, 2021) were acknowledged. The Integrated Human Settlements; Roads; Public Transport, Water & Sanitation; Stormwater & Drainage; Electricity; Waste Management directorates are the metro's major service providers (NMBM, 2021).

In July 2022, 3019 cases of drug related crime were reported in the Eastern Cape of which 36.9% were from NMBM for the first quarter of 2022 (Weekend Post, 2022). The NMBM statistic had increased by 7.4% for the same period in the previous year (Weekend Post, 2022). Palezwe (2022) reported rampant vandalism in Swartkops (one of the suburbs of NMBM) involving rail infrastructure and electrical boxes affecting train movements from Port Elizabeth through to Dispatch and Kariega (passenger train) and lack of capacity by SAP to effect arrests due to limited resources (patrol vehicles and staff). The criminals reportedly intimidate community members who patrol the precinct to curb vandalism (Palezwe, 2022). Metal and cables stripped

from buildings and rail infrastructure are sold for scrap to purchase drugs (Palezwe, 2022) in precincts undergoing urban degeneration e.g., Swartkops, Centrahill and North End. In the countdown to 'Day Zero', in June 2022, News24 reported that NMBM fixed 2000 (of more than 3000 outstanding) water leaks in just nine (9) days in June 2022 but consumer confidence with the metro was still at its lowest (MacCain, 2022).

The rampant abuse of drugs affects indicators e.g., quality of life, employability, health systems and crime of which the city is poorly rated by both the residents and 'sustainability officials'.

In a radio interview on SAFM in July 2022, the Minister of Water and Sanitation reported that NMBM repaired 2274 leaks using 60 contractors, but the consumption of water was still high and thus urged residents to drastically reduce their consumption (SAFM, 2022; Polity, 2022). Additional, action plans e.g., boosting security on water and electricity infrastructure; enforcing harsher penalties on offenders to reduce rampant vandalism and replacing copper wires with cheaper alternatives were outlined (SAFM, 2022; Polity, 2022). The, then NMBM Mayor, reiterated the sentiments raised by the Minister but blamed the old administration on accumulation of leaks and non-performance of the budget (SAFM, 2022; Polity, 2022). Mehlwana (2022) reported that municipal clinics were being affected by water shortages as some of NMBM's 48 clinics and 3 referrals were either shortening operations or temporarily closing because of water shortages.

As in June 2022, the water situation was still dire in December 2022, despite concerted effort by NMBM.

The Nelson Mandela Bay Business Chamber (NMBBC) lamented large scale vandalism in SA which is jeopardizing economic investment and job creation and called for a '*state of emergence*' against vandalism (Straton, 2022). NMBBC highlighted the deterioration of NMBM's ability to provide municipal services since coalitions with the associated political instability became a reality in 2016. NMBBC noted non-functioning traffic lights, blocked drains, road infrastructure that is not repaired, derelict buildings, uncollected litter/waste with the management of the water crisis as the '*manifestation of the dysfunctionality*' (Straton, 2022). NMBM loses 29% of its water through leaks and 11% of pumped water is not accounted for (Straton, 2022).

The breakdown in policing during the lockdown created a vacuum for lawlessness which resulted in infrastructural vandalism(e.g., electricity cables, substations, pump stations, rail) which is currently uncontrolled (Straton, 2022). Vandalism of critical infrastructure is sabotaging the already struggling economy and is also making some precincts unsafe for residents and/or workers. Policing in those precincts has also collapsed (Straton, 2022). As a strategy to ensure that basic infrastructure(water, electricity, road, safety, security etc), NMBBC has partnered with NMBM to provide security at substations within industrial areas. As of September 2022, 17 substations were adopted, and more were under consideration (Straton, 2022).

The number of complaints on service delivery has increased by 20% and the resolution rate decreased by 23% in 2022 compared to 2021 for the NMBBC members within a one-year period in 2022 (Straton, 2022a). This is an indication of a difficult environment for doing business. The queries included business operational requirements; water (leaks, pressure, and quality-30% of queries); road infrastructure(potholes & road markings), municipal billing and increased illegal dumping in NMBM (Straton, 2022a). Other issues raised by NMBBC with a sustainability implication on NMBM are fuel and water licence renewals, environmental concern, homelessness, and invasion of private premises, LUM, poor sanitation and information on available business incentives (Straton, 2022a).

NMBBC partnered with NGO (Gift of the Givers Foundation) and NMBM to avoid 'Day Zero' in the metro (funding and coordination of water leaks, drilling boreholes, providing water tanks, and fixing water infrastructure) (Straton, 2022b). The residents have not responded positively to the initiatives to reduce water consumption in the metro (Straton, 2022b; SAFM, 2022; Polity, 2022).

NMBBC called upon NMBM to prioritise maintenance of the stormwater drainage system (Straton, 2022c) which could not cope with heavy downpours, in August 2022, for example. NMBBC stressed the need for strategic planning e.g., LUM that restricts development in flood risk precincts or buffer zones to restrict such developments (Straton, 2022c). NMBBC emphasised the need to enforce rainwater harvesting systems for new buildings and technologies to restrict usage on water, promotion of recycled water and the promotion of the use of grey water (Straton, 2022c).The shortage of personal at Dora Nginza Hospital, for example, is projected to worsen infant mortalities in NMBM (Straton, 2022d).

A municipal survey, in late 2021 by the NMBM air quality office confirmed that residents/workers at Buick, Chevrolet and St George's Streets in Markman industrial area were at risk due to manganese dust in the air but municipal air quality regulations to correct the pollution have not been implemented (Straton, 2022e). The metro only released the results after a Promotion of Access to Information Act (2 of 2000) application by a political party in the NMBM council (Straton, 2022e). The dust also affects Centrahill, Humewood and Summerstrand (around the Port of Port Elizabeth). The NMBM has not been paying SMMEs within the mandatory 30 days and at 72 days the metric is regarded the worst in seven (7) years (Straton, 2022e). SMMEs have embarked on service delivery protests (stopping municipal activities and blocking roads) around midyear in 2022 (Straton, 2022f). This is crippling for the metro with the undesirable statistic of having the highest unemployment rate in the country (Straton, 2022f). The Municipal collection rate is reported to have dropped to 75,67%, way below the national benchmark of 95% (Straton, 2022f). Straton (2022g) highlights the following additional statistics for NMBM for 2021/2022 year: highest debt of R9B, lowest CAPEX of 76%, low indigent household beneficiaries of 54 630; non-technical electricity losses of 17,5%; high number of outstanding LUMs applications (± 400); about 20 000 potholes and 5000 outstanding sewage blockages.

Ward committees which encourage public participation were not in place nine(9) months after the 2021 local government elections (Straton, 2022h). According to Straton (2022h), NMBM performed worst in its service delivery indicators since it has been monitored (only 25% of KPI in Basic Service Delivery Key Performance Area in the first quarter of its performance cycle).

The review points to deteriorating urban infrastructure and poor policing of sustainability frameworks in the city. This deterioration affects all the sustainability dimensions namely governance, economic, environmental, and socio-cultural.

4.7. Chapter Summary

This chapter discussed the qualitative and quantitative data used in the study, the convergence of the two methods and the insight that literature review highlighted. The research objectives of the study were to review the adequacy of the sustainability measures/indicators used to assess NMBM and to recommend appropriate sustainable indicators and benchmarks of the developed indicators.

Results seem to indicate various first- and second-generation sustainability indicators have been used to assess NMBM relative to other metros in SA and Africa. Based on secondary data and literature review, the ratings for most scores have been high based on IDP rankings, poverty and income, education, water, sanitation, Master Card Index etc. However, the crime rate and the rate of unemployment earns the metro the unfortunate title of the most dangerous metro in SA. Results from the residents, interviewed stakeholders, a community delivery meeting and Council proceedings paint a picture of a metro whose sustainability capacity is still underdeveloped. The study also seems to indicate that, whilst the efforts of the metro are fair on the economic, socio-cultural, and institutional dimension, it appears from the sub-indices used in the questionnaire to residents (environmental risks, use of sustainable energy, land use/green space balance, greenhouse emissions, water management) and cited secondary data that the sustainability capacity of the metro on the environment dimension is still underdeveloped.

The next chapter revisits the research objectives and then discusses the conclusions of the findings, limitations, and recommendations for further studies.

5 CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter presents the conclusions and limitations and makes recommendations for further studies. The aim of this research was to review the adequacy of the sustainability measures used to assess NMBM and to recommend appropriate sustainable indicators and benchmarks of the developed indicators. As reviewed in literature and the results of this study, the SDGs now forms the main guideline of third and fourth generational sustainable development goals. The conclusion attempts to acknowledge the effect of ecocentrism worldview on urban management and sustainable development and most importantly the effect of mankind on exponential anthropogenic changes since the 1970s (Tibaijuka, 2008) considering the looming sixth extinction. The recommendations should address the SDG targets with the ecosystem taking a central role. The remaining sections of the chapter are structured as follows: Section 5.2 is the research objectives revisited, 5.3 is the research questions revisited, Section 5.4 is the conclusions of the findings; Section 5.5 discusses recommendations for further study, Section 5.6 discusses the limitations and lastly Section 5.7 provides concluding remarks of the study.

5.2. Research Objectives Revisited

5.2.1. Research Objective 1

Determine the most appropriate indicators to measure urban development and management in NMBM using Gqeberha (Port Elizabeth) as a case study.

Extensive literature review was undertaken from a global, continental, country, and city level. It was found that the adequacy of the indicators is dependent on sustainability worldviews, the intended uses of the indicators, capacity to implement, adequacy of governance, availability of resources and institutional frameworks. It was reviewed that NMBM participates in a lot of sustainability initiatives most of which are driven from the national government (e.g., COGTA, NDP & Treasury). Official documents (e.g., IDP) records fair measures of sustainability for the metro.

The review showed that there is sufficient institutional guidance on sustainability development (e.g., SACN, NDPs, UN SDGs). From the review of sustainability indices in literature (see Sections 4.6.1 to 4.6.3), it has been shown that indices over time have transitioned from first to the fourth generation. Most of the available indices are second generational which are insufficient to singularly predict sustainability because of changing viewpoints on sustainability. It has been observed that there is insufficient political will to address some unsustainable practices e.g., use of carbon fuels & electricity (from either high-grade coal or diesel) and legalisation/regularisation of land invasions.

To a large extent the results of the qualitative, quantitative data analysis and media publications dispute the 'rosy' view presented by official documents that NMBM is sustainably managed. The research objective has been met.

5.2.2. Research Objective 2

To compare the sustainability metrics in NMBM with the region and urban environments internationally.

NMBM strategic documents and SACN publications and literature review were used. From literature reviews, there are fairly good sustainable development initiatives compared with other metros (e.g., second highest number of sustainability words in IDP after eThekweni). However, metrics e.g., murder rates (NMBM leads the number of murders in SA, high unemployment rate of over 40%) make the city unattractive for new capital investment. Reflections on the reviewed literature with other collected data enabled easier saturation of the objective.

The research objective was met.

5.2.3. Research Objective 3

Investigate the indices that have been used to measure sustainability in NMBM and determine which themes were used.

NMBM strategic documents, SACN publications and literature review were used to meet this objective. In addition, semi-structured interviews with 'sustainability officials' on common themes

and possible new indicators were undertaken. Comments on additional indicators were invited from NMBM residents in the structured questionnaire. SACN monitors green indicators for SA metro, but it appears the approach is not holistic. In addition, COGTA and National Treasury track some national indicators e.g., green indicators. As with Section 5.2.3, continuous reflections on the collected data enabled easier saturation of the objective.

The objective has been met.

5.2.4. Research Objective 4

To determine the most relevant and appropriate theme to measure sustainable urban development in NMBM.

This was done based on literature review, e.g., worldviews and urgency of climate and effect on planetary systems; SA government legislation and frameworks and lastly SACN & NMBM policy documents. Triangulation of results of the residents' survey & 'sustainability officials' and the secondary data review were continuously reflected in the determination. The data analysis from both the literature review, the qualitative and quantitative analysis show the data to be converging. In the short term, the objective can be considered met.

But because in the long term, the development of sustainability indicators is done collaboratively with the national (and international) community which involves extensive stakeholder engagements, this objective should be considered unmet in the long term. This study is impacted by the 17 SDGs which the UN uses as the bases of the development of sustainable indicators.

5.2.5. Research Objective 5

To determine whether NMBM is sustainable based on the developed sustainability indices.

The determination of this objective was done using a combination of literature review (discussion of generation of indices, worldviews, urgency to reverse climate change, the results of the survey to NMBM residents and semi-structured interviews with 'sustainability officials'. With reflections made on conflicting findings, all research methods (secondary data, qualitative and quantitative

data analysis) converge to the same conclusion that NMBM is not sustainable. Therefore, the objective was met.

5.3. Research Questions Revisited

What are the most appropriate sustainable indicators to measure urban development and management in NMBM?

5.3.1. Subsidiary Research Question 1

How do the sustainability metrics of NMBM compare with other metros in SA?

To answer the subsidiary research question on how the sustainability metrics of NMBM compare with other metros in SA, extensive literature review was undertaken, first to identify the sustainability metrics used in the urban environment in SA and then comparing the ranking/performance of NMBM with other metros on the identified sustainability metrics. The identified indices were mainly first and second generational (see Sections 4.6.1 to 4.6.3) and thus insufficient to singularly predict sustainability because of changing viewpoints on sustainability. Results and reflections from the qualitative and quantitative components of the study ensured saturation of the research objective and answering of the subsidiary research question.

As discussed under Research Objective 1, this research question is related to Objective 1. The research question has been met.

5.3.2. Subsidiary Research Question 2

How do the sustainability metrics compare with other cities in Africa and the resourced/developed world?

To answer subsidiary research question 2, how the sustainability indices used for NMBM compares with other cities in Africa and the world, and as with subsidiary question 1, extensive literature review was undertaken. The literature review identified and then compared the sustainability metrics used in the urban environment in SA with Africa (and globally). In addition to the rating of the metrics of NMBM in SA, ranking the NMBM within the context of the international community was made.

Most of the indices were second generational and therefore did not answer holistically whether NMBM was sustainable. Additional research methods (qualitative and quantitative) with reflections were used to answer the question holistically.

The research question was met as it is related to Research Objective 2.

5.3.3. Subsidiary Research Question 3

What indices have been used to measure the sustainability of the city and which themes have been used?

To answer the subsidiary question, on what indices and themes have been used to measure sustainability in NMBM, a combination of literature review (e.g., NMBM strategic documents, SACN publications), semi-structured interviews with 'sustainability officials' on common themes and possible new indicators were undertaken. In addition, comments on additional indicators were invited from NMBM residents in the structured questionnaire. Other than the literature review, sustainability themes and measures from the NMBM residents and, to some extent sustainability officials, were limited to common first and second generational themes and indicators.

As with Research Objective 3, and using the combination of the three research methods, the research question has been met.

5.3.4. Subsidiary Research Question 4

What is the most appropriate measure of sustainability for NMBM?

Based on literature review, e.g., worldviews and urgency of climate change and effect on planetary systems, SA government legislation and frameworks, NMBM policy documents and results of the residents' survey and 'sustainability officials', the subsidiary research question to determine the most appropriate measure of sustainability for NMBM was partially met. A sustainability indicator framework was developed but because sustainability is best driven from a global (multidimensional and multisectoral) level, the research question is partly met.

5.3.5. Subsidiary Research Question 5

Using the developed/recommended metrics, is NMBM sustainable?

Using a combination of literature review (discussion of different generation of indices, worldviews, urgency to reverse climate change), the results of the survey to NMBM residents and semi-structured interviews with 'sustainability officials', the research question to determine whether NMBM is sustainable was answered by all data sources and NMBM was found to be unsustainable.

On continuous reflection, it was also found that even official municipal documents also converge to the same conclusion that NMBM is unsustainable.

5.4. Conclusions of Findings

The results of the research on the urban management and sustainability of NMBM showed different conclusions based on the used data sources.

As shown by the literature review, there is convergence that sustainable urban development and management requires good public transport systems, strong programmes to protect the environment, housing and health care for citizens, good digital infrastructure, sustainable employment, and excellent institutional frameworks creation (e.g., Garau & Pavan, 2018). As noted by National Treasury (2017), good institution frameworks are prerequisites for sustainable developments. Cities are adopting resilience and green economy approaches to sustainability

and IDPs, SDFs and service delivery implementation plans have been notable strategies for sustainable development within the SA municipal environment.

From NMBM Council Meetings, it was reviewed that the metro has a low CAPEX; low payment rates of SMME; and underperforming IDP performance targets (e.g., sewer blockages and water leaks) in the 2022/2023 budget (NMBM, 2022).

Media reports showed disturbing revelations about manganese dust on human health e.g., manganism. Transportation of manganese damages roads (N9 and N10) and arterial road infrastructure (e.g., Perseverance Road in Swartkops, non-functional traffic signs, blocked drains, and potholes). The migration to rail (back to rail national policy) is hampered by challenges e.g., vandalism and thefts of rail infrastructure and shortage of locomotives. As with taxis, manganese truckers have a low appetite for regulatory compliance.

NMBM is pondering whether to develop Noortgedacht (Phase 4) or construct a desalination plant to guarantee water supply in the metro (Bezeidenhout, 2022). Developing Nooitgedacht Low Level Water Scheme (Phase 4) is regarded as “putting all eggs in one basket” while a desalination plant with its expense and rigorous planning was regarded as diversifying the water mix (Bezeidenhout, 2022). The future diversification of NMBM water mix of 32% surface water, 35% Nooitgedacht, 10% Coega recycled water, 12% desalination etc. (Bezeidenhout, 2022) falls in the ‘modificationists’ school of thought i.e., necessary but not enough for sustainability. In addition to increasing resilience in the water mix by diversifying the source and location of supply, water consumption strategies (and population control) should be implemented to improve sustainable water availability. Nooitgedacht gets its water from the Gariep Dam in the Free State (Bezeidenhout, 2022) which is another indicator of unsustainability.

NMBBC considers the ‘Day Zero’ scenario (looming in mid-2022) to be avoidable if the metro manages leaks and infrastructure issues (Baron, 2022).

As ‘sustainability official’ participant **8HH** asserts, “*there were more failures than successes*” in the sustainability agenda of the metro and while the metro is aware of climate change and the various challenges to its sustainability agenda, it must prioritise the institutionalisation of these

challenges e.g., the integrated incorporation of climate change/resilience into its strategic documents.

5.5. Recommendations and Suggestions for Further Research

To draw further insights into the research questions, the following recommendations are proposed:

5.5.1. Academia

Literature in Africa on sustainability is limited and recommendations in sustainability indicators adopted in sustainable urban development in developing countries including SA) are therefore Eurocentric. Academia should promote the training of sustainable urban development across disciplines as some targeted residents and 'sustainability officials' had limited knowledge on the concepts and therefore opted to withdraw from participating in the study.

5.5.2. Industry

Participation for research in urban sustainability research should be extended to other stakeholders e.g., business which pay most of the cost of the municipal utility costs (electricity and water).

5.5.3. International Frameworks and Government Policy

As Ratcliffe et al. (2009) pointed out, there is strong linkages between urban planning and (urban) sustainable development and therefore there is need to devote more time in researching the land use management framework (e.g., SPLUMA and NEMA) of NMBM to confirm the strength or weakness of its sustainability. In addition, and whilst acknowledging just transition, there should be a concerted effort in operationalising policies e.g., promoting sustainable economic development, sustainable population growth, discouraging regularisation of land invasions and shifting to non-carbon fuels.

5.5.4. Nelson Mandela Municipality

SACN (2015) literature showed that NMBM had the second highest frequency of sustainable/sustainability terms mentioned in the IDP after eThekweni and is rated highly in most reviewed indices (SACN, 2015) but residents and industry appear to regard the city as a '*failing municipality*'. The survey on NMBM residents particularly the high disapprovals on water availability (85%) and its management (83.3%) confirms the serious shortfalls on the urban sustainability sub-indices.

NMBM ranked middle in 2018 in World Bank's "Doing Business in South Africa" for SMMEs for the nine metros in SA. The items ranked were issuance of construction permits, property registrations, enforcement of contracts and connecting applicants to the electricity grid (SACN, 2021). The score was an improvement from 2015. As SACN (2021), correctly pointed out, NMBM is "*a city in crisis*" because of unstable leadership since 2016. The instability must be built in the research design of the research instrument. Measurement of urban sustainability should be treated as more than just a compliance issue.

5.6. Limitations of the Study

The data used in the analysis was obtained from a questionnaire to residents, semi-structured interviews to sustainability stakeholders and literature review mainly based on SACN and NMBM datasets (derived from their respective websites). The usefulness of the study was affected by the non-availability of information when required e.g., NMBM land use 'sustainability official'. The NMBM protocol for interviewing its 'sustainability officials' further delayed the data collection process. Notwithstanding the sustainability policies and guidelines of NMBM and most SA metros, the national challenges such as unstable (and 'dirty') power supply, unstable water supply, failing rail and port systems, escalating criminal activities, corruption (Bussinesstech, 2022b; NIP2050, 2021) and increased lawlessness which drives away investors makes the championing of sustainable urban management a distant dream.

5.7. Conclusion

This chapter summarised the findings of the study and made recommendations for further study. Major issues highlighted include the subjectivity in the choice and weight of indicators. Some government initiatives e.g., the dual housing policies and the formalisation of illegal settlements which to some extent improves certain dimensions are unsustainable on a holistic scale. Collapsing sewer, waste management, water, roads and rail infrastructure and erratic supply of electricity from the national grid are testimonies of overloaded utility infrastructure in SA. Metros in SA are experiencing challenges in providing housing stock to its citizens (low cost and middle-income earners) and when opportunities arise most metros ignore the ecological limits of the environment.

Lastly, the sustainable approach in developing indicators should be 'transformationist' for them to serve the intended purpose.

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Annexure A: Ethical Clearance

Application for Approval of Ethics in Research (EIR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

ETHICS APPLICATION FORM




Please Note:

Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data. The objective of submitting this application **prior** to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the EBE Ethics in Research Handbook (available from the UCT EBE, Research Ethics website) prior to completing this application form: <http://www.ebe.uct.ac.za/ebe/research/ethics1>

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant	Lloyd Goliath	
Department	Construction Economics and Management	
Preferred email address of applicant:	GLTLL0001@myuct.ac.za	
If Student	Your Degree: e.g., MSc, PhD, etc.	MSc Property Studies
	Credit Value of Research: e.g., 60/120/180/360 etc.	60
	Name of Supervisor (if supervised):	Associate Professor K Michell
If this is a research contract, indicate the source of funding/sponsorship	None	
Project Title	Sustainable urban development and management: A case of Nelson Mandela Bay Metropolitan (Gqeberha)	

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

APPLICATION BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Lloyd Goliath		23/05/2022
SUPPORTED BY	Full name	Signature	Date
Supervisor (where applicable)	K.A. Michell		23/05/2022
APPROVED BY	Full name	Signature	Date
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section 1; and for all Undergraduate research (Including Honours).	Dr. Frank K. Ametefe		2022/06/08
Chair: Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the questions in Section 1.			

Annexure B: Informed Consent Letter- Residents



CONSENT TO PARTICIPATE IN RESEARCH

Sustainable urban development and management: A case of Nelson Mandela Bay Metropolitan Municipality (Gqeberha): Residents of Nelson Mandela Bay Metropolitan Municipality.

*You are asked to participate in a research study conducted by **Lloyd Goliath MSc Property Studies**, from the Department of Construction Economics and Management at University of Cape Town. The results of this study will be contributed to a minor dissertation and/or research paper in partial fulfilment of the MSc degree programme. You were selected as a possible participant in this study because you are a resident of Nelson Mandela Bay Metropolitan Municipality and affected by sustainable development initiatives of the city.*

1. PURPOSE OF THE STUDY

The aim of this study is to review the adequacy of the sustainability measures/indicators used to assess Nelson Mandela Bay Metropolitan Municipality and metros in South Africa and to recommend appropriate sustainable indicators and benchmarks of the developed indicators. The purpose of the study is to determine how sustainable is the urban development and management of Nelson Mandela Bay Metropolitan Municipality using the sustainable indicator approach.

2. PROCEDURES

*If you volunteer to participate in this study, we would ask you to do the following things:
Receive a questionnaire from the Researcher and respond to the questions on the indications of sustainability (using social, economic, environmental, and institutional dimensions) in the Metro.*

The participation will be limited to responding to the questionnaire provided to you and returning it back to the researcher. It is anticipated that it would take you about 30 minutes to complete the questionnaire. The researcher will arrange to collect all completed questionnaires in Nelson Mandela Bay Metropolitan Municipality.

3. POTENTIAL RISKS AND DISCOMFORTS

There are no foreseen or unforeseen risks. However, should you feel discomforts in completing some questions in the questionnaire, please skip the questions and indicate the discomforts to the researcher.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

As a resident, participation in this research might raise awareness on levels of sustainable development in NMBM.

The results from the research will be used to assess the sustainability of NMBM, contribute to the development, measurement and interpretation of sustainability scales for metros in South Africa.

5. PAYMENT FOR PARTICIPATION

There is no financial benefit accruing from participating in this research.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding the names and address of participants using alphabetical letters and/or numbers. All completed questionnaires and interviews will be secured (lockable storage and password secured digital storage) by the researcher and only the researcher and research supervisor will have access to data.

No information will be released to any other party for any reason unless compelled for legal reasons.

To maintain confidentiality, the details (name and address) of participants will not be disclosed in the final research report or any publication. Instead, participants will be identified by alphabetical codes generated by the researcher.

7. PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so. This can occur if your participation cannot be secured between 01 June to 31 August 2022.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact the researcher Mr. Lloyd Goliath or the Supervisor Associate Professor Kathy Michell.

The researcher can be contacted on 041 507 1322 /078 518 8393, GLTLLO001@myuct.ac.za/lloydgoliathm@gmail.com, North Union Street, Centrahill, Gqeberha and the Supervisor on 021 650 3444, kathy.michell@uct.ac.za, Department of Construction Economics and Management, University of Cape Town in Cape Town.

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact 041 507 1322/ 078 518 8393.

Annexure C: Informed Consent Letter-Sustainability Officials



CONSENT TO PARTICIPATE IN RESEARCH

Sustainable urban development and management: A case of Nelson Mandela Bay Metropolitan Municipality (Gqeberha): Sustainability Departments at Nelson Mandela Bay Metropolitan Municipality.

*You are asked to participate in a research study conducted by **Lloyd Goliath MSc Property Studies**, from the Department of Construction Economics and Management at University of Cape Town. The results of this study will be contributed to a minor dissertation and/or research paper in partial fulfilment of the MSc degree programme. You were selected as a possible participant in this study because you are an official of Nelson Mandela Bay Metropolitan Municipality involved in managing the sustainable development initiatives of the city.*

10. PURPOSE OF THE STUDY

The aim of this study is to review the adequacy of the sustainability measures/indicators used to assess Nelson Mandela Bay Metropolitan Municipality and metros in South Africa and to recommend appropriate sustainable indicators and benchmarks of the developed indicators. The purpose of the study is to determine how sustainable is the urban development and management of Nelson Mandela Bay Metropolitan Municipality using the sustainable indicator approach.

11. PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

- i. Receive an invitation for an interview with interview questions protocol with emphasis of indications of sustainability (using social, economic, environmental, and institutional dimensions) in the Nelson Mandela Metro.*
- ii. Accept or reject the invitation.*
- iii. Schedule an Interview.*
- iv. Researcher avails himself for the interview.*
- v. Explanation of the research and completion of consent forms.*
- vi. Perform the interview (take notes and/or record responses to the interview).*

The participation will be limited to responding to the interview questions provided to you by the researcher and any follow up questions. It is anticipated that it would take you about 45-60 minutes to complete the interview. The

researcher will arrange to collect all outstanding responses to survey questions from Nelson Mandela Bay Metropolitan Municipality premises.

12. POTENTIAL RISKS AND DISCOMFORTS

There are no foreseen or unforeseen risks. However, should you feel discomforts in responding to interview questions, please indicate your discomforts about the specific questions to the researcher.

13. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

As an official of the Metro involved in sustainable urban development, participation in this research might raise awareness on sustainable development initiatives in NMBM and benchmarking the same with other cities in South Africa and the world.

The results from the research will be used to assess the sustainability of NMBM, contribute to the development, measurement and interpretation of sustainability scales for metros in South Africa.

14. PAYMENT FOR PARTICIPATION

There is no financial benefit accruing from participating in this research.

15. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding the names of participants using alphabetical letters and/or numbers. All completed interview records will be secured (lockable storage and password secured digital storage) by the researcher and only the researcher and research supervisor will have access to them.

No information will be released to any other party for any reason unless compelled for legal reasons.

As a participant, you may request to have a copy of the interview (audio- or videotape) but the edited version will not be used for the research. Other than the participant, only the researcher and supervisor will have access to the recording. The recording will be erased 24 months from the date of the interview.

To maintain confidentiality, the details (name and address) of participants will not be disclosed in the final research report or any publication. Instead, participants will be identified by alphabetical codes generated by the researcher.

16. PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so. This can occur if your participation cannot be secured between 01 June to 31 August 2022.

17. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact the researcher Mr. Lloyd Goliath or the Supervisor Associate Professor Kathy Michell.

The researcher can be contacted on 041 507 1322 /078 518 8393, GLTLLO001@myuct.ac.za/lloydgoliathm@gmail.com, North Union Street, Centrahill and the Supervisor on 021 650 3444, kathy.michell@uct.ac.za, Department of Construction Economics and Management, University of Cape Town in Cape Town.

18. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact 041 507 1322/ 078 518 8393.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to [me/the subject/the participant] by [name of relevant person] in [Afrikaans/English/Xhosa/other] and [I am/the subject is/the participant is] in command of this language or it was satisfactorily translated to [me/him/her]. [I/the participant/the subject] was given the opportunity to ask questions and these questions were answered to [my/his/her] satisfaction.

[I hereby consent voluntarily to participate in this study/I hereby consent that the subject/participant may participate in this study.] I have been given a copy of this form.

Name of Subject and Participant

Name of Legal Representative (if applicable)

Signature of Subject/Participant or Legal Representative

Date

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to _____ [name of the subject/participant] and/or [his/her] representative _____ [name of the representative]. [He/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in [Afrikaans/*English/*Xhosa/*Other] and [no translator was used/this conversation was translated into _____ by _____].

Signature of Investigator

Date

Annexure D: Consent Form For Recording Of Interview

Title of project: Sustainable urban development and management: A case of Nelson Mandela Bay Metropolitan Municipality (Gqeberha)

Name of interviewer: Lloyd Goliath

Title of degree: MSc Property Studies

University of Cape Town

I, confirm the following:

1.	I have read the information sheet provided by the researcher and thus understand the projects aims and objectives.	
2.	I am participating in this project voluntarily and understand that I may withdraw from the interview at any time if I so do wish.	
3.	I acknowledge and understand that confidentiality will be maintained.	
4.	I have been asked permission to record this interview and have given my permission.	
5.	I understand that this data is accessible to other researchers only if they honour the confidentiality agreement.	

Participant

Date

Signature of participant

Name of participant

Organisation of participant.....

Researcher:

Name: Lloyd Goliath

Signature:

Date:

Annexure E: Questionnaire/Likert Scale

Multi-item Likert Scale to Measure the Urban Sustainability of NMBM

You have been selected to participate in the study on **Sustainable urban development and management: A case of Nelson Mandela Bay Metropolitan Municipality**. You are required to respond to the statements in the questionnaire below using the statement that best reflects your opinion.

Sustainable urban development and management in NMBM	Strongly agree	Agree	Neither Agree or Disagree	Disagree	Strongly disagree
<i>Economic Dimension Indicators</i>					
Good Transport Infrastructure					
Positive Economic Growth					
Ease to do business					
Good Tourism Infrastructure					
Good Connectivity					
Low unemployment					
Other Economic Indicators					
<i>Socio-cultural Dimension Indicators</i>					
Demographics-sustainable population growth					
High Education levels					
Low Income quality					
Good Work life balance					
Low Crime rate					
Good Health System					
Adequate Housing					
Good Social cultural network					
Other Social Indicators					
<i>Environmental Dimension Indicators</i>					
Low Environmental risk					

Sustainable Energy use					
Good Land use/green spaces balance					
Low Greenhouse emissions					
Good Water management system.					
Good Water availability					
<i>Institutional Dimension Indicators</i>					
Good Institutional Capacity					
Established Institutional Framework					
Good Local Authority Services					
Good Local partnerships					
Good Local community participation					
Good Gender mainstreaming Initiatives					
Other Institutional Indicators					
General Comments					

Annexure F: Interview Questions

Research Topic: Sustainable urban development and management in NMBM
<i>What do you understand by the term sustainable urban development?</i>
<i>How would relate it the concepts of smart cities, compact cities and/or resilient cities?</i>
<i>How many departments are involved in sustainable urban development and urban management? Are the activities integrated within departments (please give examples)?</i>
<i>What are the Major policies and legislation promoting urban sustainability in NMBM?</i>
<i>What are the major land use management principles used to increase NMBM sustainability initiatives?</i>
<i>Which policies and frameworks are your department involved in?</i>
<i>What programmes is NMBM involved in to promote sustainable transport use?</i>
<i>Reduced use of vehicles, mass transit schemes (reliability, affordability, safety and comfort, frequency of use).</i>
<i>Any priorities to promote higher density settlements along major roads; promotion of mixed-use developments</i>
<i>Any programmes to develop pedestrian, cycle lanes and green spaces in highly developed areas(development nodes)</i>
<i>Any sustainable initiatives for Municipal Assets e.g., Renewable Street lighting, efficient fuel use, electric vehicles etc.</i>
<i>How does NMBM deal with illegal settlements and homelessness?</i>
<i>Building activity and construction in NMBM: What initiatives are employed to promote sustainable development?</i>
<i>What effect does urban development have on economic growth and employment rates in the metro?</i>
<i>What is the extent of policing of general crime and environmental laws and regulations?</i>
<i>What are the policies of NMBM on efficient energy use and renewable energy?</i>
<i>Which sustainability dimension(social, economic, environmental, and institutional) should be allocated the highest weight?</i>
<i>Which Specific indicators of the sustainability dimension should be given special consideration?</i>

<i>How are conflicting indicators(e.g., energy generation and environmental degradation) resolved in NMBM?</i>
<i>What are the major Drought and Water Management Initiatives in NMBM? What are the major challenges in the initiatives?</i>
<i>Awareness programmes to residents on sustainable use of resources</i>
<i>Policies and initiatives promoting Productivity of urban agriculture.</i>
<i>Are you aware of any sustainability indicators used to rank the city?</i>
<i>What are the advantages and disadvantages of the indicators?</i>
<i>Which indicators would you recommend? Please explain briefly.</i>
<i>Where you Department/ section involved in the development of the indicators.</i>
<i>How would you rate NMBM sustainability initiatives with other metros in South Africa, Africa and world cities?</i>
<i>Would you consider NMBM to be sustainable? Please provide a brief explanation.</i>

Annexure G: NMBM Authorisation Letter (Typical)



CORPORATE SERVICES

Your ref:

Tel: +27 (0) 41 506 3247

Our ref:

PO Box 215, Port Elizabeth, 6000
Republic of South Africa

Date: 17 August 2022

e-Mail: tnompand@mandelametro.gov.za

Who deals with this: Ms T Nompandana

Dear Mr. L Goliath
University of Cape Town
Private Bag X3
Rondebosch
7701

LETTER OF AUTHORIZATION TO CONDUCT RESEARCH AT THE NELSON MANDELA BAY MUNICIPALITY (NMBM)

This letter serves as authorization for Mr L Goliath, registered for MSc Property Studies University of Cape Town (UCT), to conduct a research project under the supervision of Dr Kathy Michell, in the Department of Construction Economics and Management, entitled: ***"Sustainable urban development and management: A case of Nelson Bay Metropolitan"***.

Upon a review of the letter sent to us, we are pleased to offer Mr. L Goliath an opportunity to conduct the relevant study in the Nelson Mandela Bay Municipality. All interviews and surveys in the Municipality and the distribution of questionnaires are to be treated as confidential and will be supervised by the Office of the Executive Director: Corporate Services (Skills Development & Employment Equity sub-directorate). Please note that due to the nature of the research, there might be a potential risk to be allowed access to sensitive documents.

In conducting research, please ensure compliance with the regulations in terms of Covid-19, particularly in terms of minimum contact with officials. Due to the limited number of officials currently back at work, be conscious of the time they need to spend on the relevant research exercise.

You are welcome to contact the Office of the Deputy Director: Skills Development & Employment Equity with inquiries. We wish you all the best in your research.

Yours faithfully,


MS T NOMPANDANA
ACTING DEPUTY DIRECTOR: SKILLS DEVELOPMENT & EMPLOYMENT EQUITY

Collectively we can achieve more



Nelson Mandela Bay Municipality



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