

**AN ANALYSIS OF THE WATER CRISIS AND ITS IMPACT ON
SUSTAINABLE DEVELOPMENT IN CAPE TOWN, SOUTH AFRICA**

by

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I further declare that I submitted this to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

(The dissertation will not be examined unless this statement has been submitted.)

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DEDICATION

This study is dedicated to my late sister, Mavis Sibanda, for her invaluable support and my beloved wife, Lyee Nyoni, who has been the pillar of strength in my life in multiple ways, particularly for her selfless motivation and encouragement throughout this research.

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ABSTRACT

The access and availability of water have been South Africa's challenge for millennia. Cape Town has experienced a severe water crisis, never witnessed since its establishment in 1652. The city's water problems began in 2015 when below-average precipitation was received. Consecutive droughts were experienced until 2018 when water problems reached its peak and became a crisis as taps were expected to run dry. The systems theory and sustainable development concept guided the research process. The study was exploratory and descriptive, following a qualitative approach that used interviews and documentary sources. The study explored the causes and impacts of Cape Town's water crisis and the implemented strategic interventions, and the role of public participation for improved access and availability of water to a population nearing 5 million. Purposive sampling was used because units were sampled strategically according to their relevance to the research problem. Snowball sampling was also used where the researcher asked for referral to other participants. Data-rich participants were selected for interviews, particularly from government, business, industry and institutions. Forty-two participants were interviewed for the required data. Climate change and governance issues were established as critical factors causing the crisis. Impacts were severe across agriculture, tourism, industrial and retail sectors. Local to national level economy as well as individual and households were impacted. Diversification of water sources, especially by desalinisation, reuse and groundwater, as strategic intervention, was established, although with some challenges. Public participation has gained support in alleviating water problems and establishing cohesion in a racially divided Cape Town. The study advances critical lessons, knowledge and understanding required for effective policy reforms, preparedness against climate change, design and implementation of strategic interventions, excellent governance, and the role of public participation in advancing the achievement of Sustainable Development Goals (SDGs).

KEY WORDS: sustainable development; Sustainable Development Goals (SDGs); water crisis; systems approach; water resource management; strategic intervention; public participation; water demand; water supply; governance; collaboration; climate change.

IsiNdebele (Ngokurhunyeziso)

Ukutholakala kanye kwamanzi kanye nokubakhona kwamanzi sekwaba sitjhijilo sesikhathi esingangemileniyamu eSewula Afrika. Idorobha leKapa (Cape Town) lihlangabezane nomraro omkhulu wokuthlogeka kwamanzi, okumtlhago ezange lakhe lahlangabezana nawo solo lasungulwa ngomnyaka ka-1652. Imiraro yezamanzi yedorobha leKapa yathoma ngomnyaka ka-2015 lokha izulu elingaphasi kwesilinganiso esifaneleko nalinako. Ngemva kwalokho kuye kwaba nesomiso kufikela ngomnyaka ka-2018 lokha imiraro yamanzi nayifika ezingeni eliphezulu khulu kanti lokho kwaba mraro khulu, njengombana iimpompi zazilindelwe bona zome kere. Igama elithi umqondo wamasistimu (*systems theory*) kanye netuthuko esimeleleko ngiwo arhola phambili ihlelo lerhubhululo. Irhubhululo belingelinqophe ukuvumbulula nokuhlathulula, lilandele indlela yelwazi (*qualitative approach*) esebenzise iinhlolombono kanye nemithombo yemitlolo (*documentary sources*). Irhubhululo lihlele abonobangela kanye nemithintela yemiraro yamanzi edorobheni leKapa kanye namahlelo amazamo yamano asetjenzisiweko, kanye nendima yokuzibandakanya komphakathi ahlose ukwenzangcono imizamo yokutholakala kwamanzi kanye nokubakhona kwamanzi kunani labantu ababalelwa kumamiliyoni ama-5. Ihlelo lokuthatha isampula i-*Purposive sampling* lisetjenziswe ngesizathu sokobana amayunidi asampulwe ngokwamano, ngokhambisana kwawo nomraro werhubhululo. I-*Snowball sampling* nayo isetjenziswe lapho umrhubhululi abuze khona ukobana akhonjiswe abanye abadlalindima. Abadlalindima abanothe ngedatha/abanedatha enengi bakhethelwe iinhlolombono, ikakhulukazi kusukela kurhulumende, kezebhizinisi, kezamabubulo kanye namaziko. Abadlalindima abamasumi amane nababili bakhethelwe ukobana kutholakale idatha efunekako.. Iindaba zokutjhuguluka kobujamo bezulu kanye nezokuphatha zisungulwe njengemithintela eqakathekileko ebangela imiraro. Imithintela ibemimbi khulu kuyo yoke imikhakha wezokulima, wezevakatjhobukela, wezamabubulo kanye nezeentolo zegrowuzari. Ubujamo lobu bezomnotho bube nomthintela kusukela ephasini loke kufikela eendaweni zemakhaya kanti kwehla kwaya phasi esigabeni semizi kanye nesigabeni sabantu. Ukwehlukani ngeengaba kwamahlelo wemithombo yezamanzi, ikakhulukazi ukusungulwa kwamahlelo wokutsengwa kwetswayi emanzi (*desalination*), ikakhulukazi, ukusetjenziswa kanengi kwamanzi kanye namanzi avinyilika phasi, lokhu kusungulwe njengamano wokungenelela, nanyana bekuneentjhijilo.

Ukuzibandakanya komphakathi sekuthole isekelo elikhulu ekulweni nemiraro yezamanzi kanye nokusungulwa kwetjhebiswano labantu edorobheni leKapa elihlukaniswe ngokobuhlanga. Irhubhululo libeka ngaphambili iimfundo eziqakathekileko, ilwazi kanye nokuzwisisa okufunekako ukobana kube namatjhuguluko asebenzako womthethomgomo, ukuzilungiselela ukulwa nokutjhuguluka kobujamo bezulu, idizayini kanye nokusetjenziswa kwemizamo yamano, ihlelo elihle khulu lezokuphatha, kanye nendima yokuzibandakanya komphakathi ekufikeleleni iinRhuluphelo eziSimeleleko zeTuthuko (*Sustainable Development Goals (SDGs)*).

Amathemu Aqakathekileko: ituthuko esimeleleko; iinRhuluphelo eziSimeleleko zeTuthuko (SDGs); umraro wamanzi; indlela yamasistimu; ukuphathwa kwemithombo yezamanzi; ukungenelela ngokwamano; ukuzibandakanya komphakathi; izinga lokufuneka kwamanzi; izinga lokutholakala kwamanzi; ihlelo lokuphatha; itjhebiswano; ukutjhuguluka kobujamo bezulu.

Tshivenda (Manweleddzo)

U swikelela na u wanala ha maḓi yo vha yone khaedu khulwanesa lwa miḓeniamu. Cape Town yo tshenzhela thaidzo khulwanesa ya maḓi, ine ya sa athu u vha hone u bva tshe ya vha hone nga 1652. Thaidzo ya maḓi kha ḓorobo khulwanesa yo thoma nga 2015 musi hu tshi ṭanganedzwa mudzikiso u re fhasi ha mbalotshikati. Gomelelo ḓine ḓa khou tevhekana ḓo tshenzhelwa u swika 2018 musi thaidzo ya maḓi i tshi vha nṭhesa na u vha thaidzo musi phaiphi dzi tshi lavhelelwa u sa tsha bva maḓi. Musi thiori ya sisiteme dzo fhambanaho na muṭalukanyo wa u dzudza mveledziso zwi tshi endedza kuitele kwa ṭhoḓisiso. Ngudo yo ṭoḓisisa na u wanulusa hu tshi khou tevhedzwa kuitele kwa khwalithethivi kwo shumisaho zwiko zwa inthaviwu na rekhodo dza vhathu dzi kwamaho matshilo avho. Ngudo yo wanulusa zwivhangini na masiandaitwa zwa thaidzo dza maḓi Cape Town na zwiṭirathedzhi zwo shumiswaho kha u dzhenela, na mushumo wa u shela mulenzhe ha tshitshavha kha u khwinisa u swikelela na u vha hone ha maḓi zwa vhathu vhane vha swika miḓioni ṭhanu. Ho shumiswa tsumbonanguludzwa dzo sedzaho kha zwiṭaluli zwa vhathu ngauri yuniti dzo nanguludzwa nga nḓila ya tshiṭirathedzhi u ya nga u tea hadzo kha thaidzo ya ṭhoḓisiso. Ho dovha ha shumiswa na tsumbonanguludzwa dzine muṭoḓisisi a livhiswa kha muṭwe muthu nga mudzheneli hune muṭoḓisisi a humbela u livhiswa kha vhaṭwe vhadzheneleli. Vhadzheneleli vho pfumaho nḓivho ya data vho nangiwa kha inthaviwu, nga maṅḓa u bva muvhusoni, mabinduni, nḓowetshumo na kha zwiimiswa. Vhadzheneli vha 42 vho inthaviwu kha data ine ya ṭoḓea.. Tshanduko ya kilima na mafhungo a kuvhusele zwo bveledzwa sa zwiṭaluli zwa ndeme zwine zwa khou vhangini thaidzo. Masiandaitwa o vha o nḓanaho kha vhulimi hoṭhe, vhuendelamashango, nḓowetshumo na sekhithara dza mbambadzo. Masiandaitwa o vha kha ḓeveḓe ya ikonomi yapo na ya lushaka na vhathu na miṭa. Tshanduko ya zwiko zwa maḓi, nga maṅḓa nga u bvisa muṅo kha maḓi, u shumisa hafhu na maḓi o tou bwiwaho, sa tshiṭirathedzhi tsha u dzhenela, yo thomiwa, naho hu na dziṭwe khaedu. U dzhenela ha tshitshavha ho wana thikhedzo kha u khwinisa thaidzo dza maḓi na u bveledza vhuthihi Cape Town ho fhandekanywaho nga mirafho. ṭhoḓisiso yo bveledza ngudo dza ndeme, nḓivho na u pfesesa hune ha ṭoḓea kha u khwinisa mbekanyamaitete dzo teaho, u lugela u hanedzana na tshanduko ya kilima, u bveledza na u shumisa tshiṭirathedzhi tsha u dzhenelela, kuvhusele kwa maṭhakheni, na mushumo wa u dzhenelela ha tshitshavha kha u bvela phanḓa na u swikelela Zwipikwa zwa u Dzudza Mveledziso (dzi SDG).

Maipfi a ndeme: u dzudza mveledziso; Zwipikwa zwa u Dzudza Mveledziso (dzi SDG); thaidzo ya maḡi; sisiṽeme dzo fhambanaho; ndangulo ya zwiko zwa maḡi; tshirathedzhi tsha u dzhenelela; u dzhenela ha tshitshavha; ṽhoḡea ya maḡi; ndisedzo ya maḡi, kuvhusele; tshumisano; tshanduko ya kilima.

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LIST OF ABBREVIATIONS

ANC	African National Congress
BRVAS	Bergriver Voelvlei Augmentation Scheme
CCT	City OF Cape Town
CFA	Cape Flats Aquifer
CLOSEUP	Centre for Local, State and Urban Policy
DWS	Department of Water and Sanitation
ENSO	El-Nino Southern Oscillation
FBS	Free Basic Services
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
IDP	Integrated Department Plans
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goals
MLD	Million Litres per Day
NDP	National Development Plan
NGO	Non-Governmental Organisations
QFS	Quality Infiltration System
RDP	Reconstruction and Development Programme
SADEA	South Africa's Department of Environmental Affairs
TMD	Table Mountain Group
UN	United Nations
USA	United States of America
V & A	Victoria and Alfred
WCWSS	Western Cape Water Supply System
WFP	Water Framework Directive
WRTT	Water Resilience Task Team
WSUD	Water Sensitive Urban Design

CHAPTER 1.

CHAPTER1: INTRODUCTION AND BACKGROUND

1.1 Introduction

Water shortage is a global problem that has existed for many years and is expected to be worsening in the future. Climate change and rapid population growth contribute to global water issues. According to United Nations (UN, 2021:1), it is estimated that about 1.42 billion people lack clean drinking water worldwide. In Africa, water scarcity is predicted to reach alarming levels by 2025. About 50% of the world's population without clean drinking water lives in Sub Saharan Africa.

Social and economic development depend on environmental resources. Both rural and urban populace worldwide relies on natural resources such as water, which is the chief support system of all their needs, stretching from food production and economic well-being to domestic purposes. Water is the basis for successful economic, social and environmental development. Both natural and human-induced factors significantly contribute to the water crisis. The stress on water supply has become a worldwide phenomenon, primarily instigated by frequent and severe droughts driven by climate change (Parks, McLaren, Toumi and Rivetti, 2019:2). Rapid urbanisation, poor infrastructure and population growth are vital factors that impact water supplies in developing countries, resulting in social, political and economic problems. Developing countries, particularly in Africa, are the most impacted because of their minimum skills, technological, innovation and financial well-being. Moreover, African cities are rapidly urbanising, and the authorities are battling to cope with the ever-changing water demand of society.

The threats presented by the water crisis to communities had a knock-on effect on many United Nations Sustainable Development Goals (SDGs), which were crafted to eradicate extreme poverty globally by 2030 (Parks *et al.*, 2019:2). Clean drinking water and sanitation (SDG 6), good health and well-being (SDG 3), zero hunger (SDG 2), and life on land (SDG 15) were some of the critical water dependent goals affected by the water crisis. Sustainable development demands the implementation of a development option, which allows for appropriate and justifiable social and

economic goals to be achieved, based on the meeting of basic needs and equity, without compromising the natural system on which it is based.

Cape Town is a rapidly urbanising coastal city under a Mediterranean climate. It is in the Southwestern part of South Africa. It has a population of about 4.8 million by 2019 statistics and relies mainly on surface water (Parks *et al.*, 2019:2). The city is a component of the Western Cape Water Supply System (WCWSS), accessing its water from six major rainfed dams responsible for supplying the entire Western Cape region. The region comprises Drakeinsten Local Municipality, West Coast District Municipality, Witzenberg and Stellenbosch areas. The National government is mandated for bulk water supply, local government is responsible for reticulation, and provinces have oversight, support, monitoring and disaster management powers.

This study was qualitative, exploring the causes and impacts of the Cape Town water crisis from 2015 to 2018. It further explored the strategic interventions employed by the city authorities and the role of public participation in advancing water stability in the city. The region's dry climate and its per capita water consumption are the key challenges that expose the city to water scarcity for several years (Parks *et al.*, 2019:2). Although the South African constitution stipulates water as a basic need and right to be supplied freely to indigent communities, many are still yenning for such a precious resource across the city. The city is still characterised by high inequality and informality owing to the country's apartheid era (Ziervogel, 2019:4). Cape Town is South Africa's wealthiest city with the highest income inequality. Blacks and coloureds are the majority of the city living in high-density suburbs and informal settlements that lack essential services such as water. The lack of basic services maintains the endured forced racial segregation alive within the city. Although the government has tried to escalate service delivery since the dawn of democracy in 1994, not enough was done to cope with the rapidly growing population and its demands for basic services. After four consecutive years of low rainfall, the city was unprepared for the disaster, fuelling service delivery tensions within communities.

Due to low dam levels, the city took drastic action to prevent running out of water, a scenario named "day zero", for the first time in its history. Water restrictions were implemented. At the peak of the drought in February 2018, when dam levels were just over 30% of capacity, the city implemented a 50 litre per person restriction (Ziervogel, 2019:4). The government announced a

national disaster over water scarcity in the same month. Lining up for water was supposed to be a reality when dam levels reached less than 13% (Toale and Molfetas, 2019:1). “Day Zero” was anticipated by April 2018. All aspects of urban life were impacted, particularly in the poor, high-density Cape Flats suburbs. The biggest population lived in informal settlements that already had water shortages when supply was stable. The situation was worsened by principal government officials who were not responding to the crisis with one voice. There was political disagreement between and within the provincial governing party, Democratic Alliance (DA) and the national governing party, the African National Congress (ANC). However, several lessons were drawn from the city’s water crisis and can assist many cities worldwide to prepare against future disasters.

Since its establishment, the city had never experienced a drought and water crisis of such magnitude. This water crisis was the first of its kind in the city. Therefore, there is a gap in the city’s water problem that requires further research to ascertain a sustainable water supply. More research is necessary to establish the actual drivers of the problem and the needed interventions which bring an improved water supply system vital for attaining sustainable development in Cape Town.

1.2 Research Background

The historical experiences of South Africa play a significant role in shaping and refashioning the character of water service delivery to its people. Some characteristics of the injustice system of the apartheid regime are still prevailing across the country. Since 1994, the democratic government has instituted several laws to rectify the unjust past experiences. The drafted democratic constitution fully support adequate basic services and rights to the people. However, the prevailing unequal basic services distribution signifies the remnant segregative nature of apartheid. Indigent communities, which are the most affected, are still yearning for basic services such as water. With their rapid population growth, major cities such as Cape Town struggle to make water available to their citizens.

The past experiences of the City of Cape Town have played a more significant part in the circumstances which led to its water crisis. Before Cape Town was established, the Khoisan people were the occupants of the area, who relied on available water, which supported edible plants and wild game (Engvist and Ziervogel 2019:1). Availability of water was the primary reason for the

Dutch East India Company to establish a settlement in the area in 1652, which grew to be Cape Town. The company forcefully drove away from the natives and instituted laws to protect water resources in the area from pollution caused by both settlers and indigenous people. The city was established on racial-based conflicts over access to water (Engvist and Ziervogel, 2019:1). Over the years, the city's growth was based on policies serving the interest of the colonial white population while segregating the indigenous people and the slave's descendants from the Asian continent, brought by the South-East Asia Company.

The imbalances between countries have exacerbated the failure of developing countries to meet their developmental needs, such as water infrastructure, owing to poor financial muscles and economic growth (Engvist and Ziervogel, 2019:3). South Africa is one of the Global South countries described by such characteristics. This is because globalisation and the dominance of neoliberal policies crafted by the West usually favour powerful actors' control of the resource at the expense of more marginalised groups (Engvist and Ziervogel, 2019:3). Developing countries are still economically marginalised, leading to polarisation between the rich countries and the developing countries and even rich and poor people within a country itself.

Unjust power structures became prevalent during the country's long period of colonialism, manifesting in unfair allocation and distribution of resources, anchored by ineffective sustainable development policies. Significant variations in individual and households' incomes became prevalent, thus lowering the living standards particularly of black South Africans up to the dawn of independence in 1994. Such a scenario continues to haunt the country's democracy, presenting a critical challenge to resource allocation and distribution for the democratic government until today. The long history of water rights or laws in South Africa signifies the importance of political apparatus in shaping and refashioning the structure of water rights (Tewari, 2009:14). Unequal power relations have perpetuated in the post-apartheid era, bolstering poor resource allocation and socio-economic consequences, which plummeted individual and household livelihoods. Water services delivery was approached from a commercial point of view with discriminatory policies of separate governance for different racial groups (Ntsime, 2002:4). Hence water services delivery was a privilege to the white minority, yet fragmented and unaffordable to most non-white South Africans, a scenario currently present in South African communities. In the white-dominated cities

and towns, water was adequately supplied for industrial, commercial and agricultural sectors, signifying a water sector steered by commercial interest rather than social and human requirements (Ntsime, 2002:4). Most of the population were exposed to a more vulnerable and catastrophic scenario of poor water service delivery and other basic services.

The democratic transition of 1994 has brought changes to the legislation to redress the racial injustice of the apartheid era. Water policy reform became one of the democratic government's Reconstruction and Development Programme (RDP) (Engvist and Zoiervogel, 2019:1). The Free Basic Services (FBS) policy was conceptualised by the ruling African National Congress (ANC) during the 2000 local government elections run-up. An allocation of 6000 litres of water and 50kWh of electricity were given to households. The Strategic Framework on Water Services (RSA, 2003) explains that the FBS focused on promoting sustainable basic water access through subsidising the continuous maintenance and operating costs of a basic water supply service (Tewari, 2009:15). DWS (Department of Water and Sanitation) considered the policy reasonable to fulfil the constitutional mandate of providing water access sufficiently. However, the policy has become challenging for various municipalities due to institutional and financial resource incapacity. The Strategic Framework stipulates that tariffs should generate adequate funds for operations, maintenance and investment needed to provide water while considering the poor's water affordability. A cost recovery water service was adopted, treating water as both social and economic good appropriate for a scarce resource. Implementing the cost recovery policy has heavily impacted the poor resulting in water cut-offs for non-payment in Cape Town in 2001.

Several acts supporting public participation to involve communities in their development were passed in South Africa in 1994. The Republic of South Africa (1996) Constitution propels public involvement in enhancing democracy and good governance. All these acts concur in those participatory processes and procedures and appropriate mechanisms to be designed to provide municipal services. They strongly support the capacitation of all stakeholder engagement. Communities are usually not fully engaged in activities and decision-making concerning their development. The informal settlements, a dominant characteristic of South Africa's major cities, are the most affected by poor water services delivery. In such settlements, basic services protests are widespread and usually destroy public infrastructure.

Declining water supply and growing demand is currently Cape Town's character. The rate of declining supply alongside the consumption made the situation in 2018 extreme from a global perspective (Engvist and Ziervogel, 2019:5). Climate change is projected to increase the occurrence of droughts by three folds in the coming decades, posing a great threat to water availability and governance. Changes in precipitation and water flow will critically impact how urban land is managed. Cape Town has experienced consecutive droughts from 2015 to 2018. Four successive years of drought clearly showed a lot to be explored, determined, analysed, and immediate remedies to be implemented on time to prevent or reduce the effects of any catastrophe. However, local, provincial, and national governments were aware of the impending catastrophe but waited for it to strike, resulting in detrimental impacts to socio-economic and ecological systems.

1.3 Problem statement

Water is a fundamental resource requiring effective and efficient governance to propel its availability, equitability, quality, and access to sustainable development. It demands socio-political and ecological systems to be integrated into a legitimate regulatory framework (Zhang, Prouty, Zimmerman and Mihelcic, 2016:482). Since the dawn of democracy in 1994, the country's constitution and several legislative acts created at local and provincial levels fully support water as a basic right to the citizens and public participation to improve service delivery. However, several communities, mainly composed of blacks and coloureds, have no adequate access to clean drinking water (Engvist and Ziervogel, 2019:2).¹ Extreme inequality, which is the remnant of the apartheid era, is still haunting these communities. Such communities are still excluded in critical circles of planning, policy and decision making in issues concerning their development. (Engvist and Ziervogel, 2019:2). Therefore, when Cape Town experienced a water crisis, the magnitude of the impacts was very devastating because of its polarised character.

The city of Cape Town has experienced consecutive droughts for four years from 2015 to 2018 owing to climate change, rapid urbanisation, and high per capita water consumption, which

¹ Coloureds refer to people descended from intermarriages of European (white) and African (black) or Asian ancestry as officially defined by the South African government since 1950 to 1991.

resulted in a lack of access, clean, quantity and available water (Ziervogel, 2019:4). The city's water problems started in 2015 with dwindling rainfall, and gradually led to a water crisis at the peak of water shortage in 2018 when taps were expected to run dry. The City of Cape Town (CCT, 2019:2) pointed out that the national DWS has reduced the city's water allocation by 45% owing to low dam levels. Dam levels were at below 20% capacity by the beginning of 2018. The city implemented water restrictions. Major urban life aspects were impacted. Activities in health, education, domestic, agriculture, business, industrial and recreational sectors were affected (Parks *et al.*, 2019:4). Major crop production was reduced by 20.4% from 2016/17 to 2017/18 farming seasons. The Western Cape economy contributes about 13% of the national Gross Domestic Product (GDP), which means a reduction by a single percentage in the province's GDP draws off about 0.13% of the national economy (Parks *et al.*, 2019:4). Fruit and vegetable production dropped by 15% year-on-year in the 2017 – 2018 season. Severe job lay-offs brought misery, anxiety, and insecurity to both individuals and households due to loss of income, affecting sustainable livelihoods, especially the poor. More than 30 000 jobs were lost in the 2017/2018 farming season (Parks *et al.*, 2019:3).

Since its establishment, the city had never experienced a drought and water crisis of such magnitude. Therefore, the water crisis was the first of its kind in the city; hence there is a research gap in the city's water problem. More research is required to unearth the real causes and impacts of the water crisis, strategic interventions to establish sustainable water supply and the importance of public participation in advancing sustainable water resource management systems. Water scarcity indicates the presence of critical challenges which should be determined and resolved hence the need for research to enhance policy and decision making. Examining the city's water scarcity can improve effective planning, policy and decision-making, and implementation strategies to attain improved water availability, quality, quantity, use and access as key to sustainable development. In addition, challenges encountered by the authorities and stakeholders should be determined such that policy reforms and strategic interventions are effectively and efficiently designed and implemented to ensure water security.

1.4 Research objectives

The main objective of this study was to explore the impacts of the water crisis on sustainable development in Cape Town.

The sub-objectives were:

- To examine the causes of the water crisis on sustainable development in Cape Town.
- To explore the impacts of water crisis on sustainable development in Cape Town.
- To ascertain the public's response to the water crisis and their role in water resource management in Cape Town.
- To identify the problems encountered by authorities with water resource management during the water crisis period and the strategic interventions implemented by authorities for improved water services delivery.

1.5 Research questions

- What were the causes of water crisis in Cape Town?
- What were the impacts of water crisis experienced in Cape Town?
- What was the response of the public to water crisis and their role in Cape Town's water resource management?
- What were the problems encountered by the city authorities in water resource management during the water crisis period and the strategic interventions implemented to improve water services delivery?

1.6 Scope of the study

Water is crucial for the sustenance of both human and ecological needs, hence, a key in achieving Sustainable Development Goals. The water crisis severely impacted Cape Town residents. The city, located in the Southwestern part of South Africa, capital of the Western Cape Province, with historical significance, rapid population increase, a major contributor to local and national GDP, has become the most affected city with the water resource crisis in the province although bordered by seawater. The study uses a qualitative approach to explore the socio-economic impacts of the water crisis on the residents of the City of Cape Town. The study focused on the residents of Cape Town, examining how they were impacted by the water crisis in the city, interventions employed by the authorities to improve the residents' water supply and how the city engaged them in alleviating the crisis. Challenges in mitigating the water resource crisis are also examined, and recommendations for water sustainability are prescribed.

1.7 Importance of the study

The water crisis in Cape Town is a new phenomenon that has affected residents' social and economic activities and the environment. Hence, there is a research gap of such a study in the city as it is a new experience ever witnessed since its establishment. Impacts are still unveiled and changed by persistent droughts, primarily tripled by climate change, bringing the city's plus or minus 400 mm annual rainfall (Engvist and Ziervogel, 2019:2). Changes in rainfall patterns present several knock-on effects on how urban land is managed. The activities of Cape Town are intertwined with water, from basic functions such as hospitals and schools to economic values generated by industries ranging from construction to tourism and food security from peri-urban and rural agriculture (Engvist and Ziervogel, 2019:2).

With the water sources dwindling in volume, rapid population increase and droughts persisting, the problem can be expected to deepen and severely impact sustainable development in one of the most popular world cities and the continent's leading tourist destination. Hence, for such a city to experience water crises, yet water is central to achieving Sustainable Development Goals (SDGs), raises many questions requiring examining how the city has been struck and affected by such a phenomenon. Exploring the causes and impacts of the problem advances engagement in effective and efficient planning, policy reforms and adequate strategic interventions to be designed and implemented for water resource provision in the required quantity, quality, and access to the city such that sustainable development is achieved. The study advances the critical knowledge needed for crucial policy reforms, implementation, designing strategic interventions, the importance of public participation, and monitoring and evaluating such policies for an improved sustainable outcome. It advances the guiding principles of sustainability of humans to live within environmental limits, ensuring a healthy and just society, sustainable economic success, promoting good governance, and using information communication technology as a social responsibility. Lessons drawn from the city's water crisis can help other cities across the world to prepare and mitigate such a catastrophe, creating resilient societies that advances sustainable development.

1.8 Limitations of the study

Lack of cooperation from residents and government officials was one of the problems that affected the study, but seeking permission from community leaders such as councillors and top government

management has improved researcher-interviewees' relationship and cooperation. Providing information or sharing experiences with another person was not easy for people, particularly a stranger. Still, when permission was granted for interviews by the interviewee's superior, it comforted the interviewee to give more information.

Financial constraints to continue contacting the informants was a deterrent as some informants were failing to honour appointments agreed upon, affecting the acquiring of essential data from knowledgeable personnel. Hence, more appointments were made to cater to those unable to commit to the appointments.

The city is under DA governance, an opposition party to the national ANC ruling party. Hence some facts were rested on which party the interviewee supports. Different people with different political affiliations were interviewed to improve the reliability and validity of the data.

The current Covid-19 pandemic outbreak has affected data gathering by face-to-face interviews due to national health guidelines of maintaining social distancing. Interviews were done using telephonic and online platforms such as skype, zoom and teams video calling. Hence body language and facial expression were not obtained, especially on the telephonic platform. High airtime cost and connectivity constraints affected both the researcher and the participants. The researcher ended up contacting only those participants with internet access, leaving the indigent, while they were the people with the required information. The researcher was familiar with the participant's contextual realities and technological ecosystem, mostly good network areas to avoid incomplete conversations and unclear audio and video recordings. Lack of computer skills required for downloading and managing online platforms and operating them with inadequate technical support over distance was a challenging issue for the researcher. There was a risk of data loss but repeating the interviews has limited the risk. Protection of collected data was an issue because online platforms can be hacked, resulting in data loss. However, careful consideration was put into choosing the online platform, and data was carefully collected and stored at different, separate, and safe sites and deleted on online platforms.

However, it is essential to acknowledge that, in line with the qualitative methodology used, with interviews as one of the data gathering tools, some participants have forgotten crucial data as the study was retrospective. However, the study's objectives were satisfactorily achieved by triangulation with thorough documentary analysis as another data collection method.

1.9 Chapter layout

The study constitutes six chapters. The first chapter presents the introduction and the historical overview of the research. The nature and magnitude of the problem under investigation was presented and motivated. Importance and limitations of the study were detailed. The second chapter consists of a literature review that establishes the understanding and familiarity of existing studies on the water crisis. Themes and topical issues on the water crisis were critically reviewed. The theoretical and conceptual frameworks, the guiding campus to research, were reviewed. Both frameworks were explained and justified in terms of giving anticipated outcome. Relevant and available literature such as textbooks, academic journal articles, online publication, newspapers and government publications were used.

Chapter three contains the research design and methodology which the study followed. Qualitative methodology was preferred. It was well explained and justified as the study is descriptive and exploratory. More explanation was presented on issues of data collection, analysis, study sample. Issues of validity and reliability, which are data control measures, were thoroughly dealt with. The fourth chapter presents the research findings. The findings were thematically presented in line with study objectives. The causes of the water crisis, the impacts experienced, strategic interventions and public participation were the variables of study. The fifth chapter discusses and analyses the research findings. This chapter presents a detailed analysis of the research findings in accordance to study objectives. The last chapter outlines the study conclusions and recommendations. The conclusions were derived from key findings attained in chapter four. Recommendations were then presented in relation to conclusions made.

1.10 Conclusion

The past experiences of the City of Cape Town have played a greater part in the circumstances which led to its water crisis. The critical issue of its scarcity oscillates on consecutive years of drought and poor water resource governance system. Its scarcity has affected livelihoods in the City of Cape Town. Social and economic sectors were severely impacted. Agriculture, business and industry and tourism were critical sectors impacted. Research becomes essential to improve water management such that its availability, quantity, quality, and access can be improved. It advances the guiding principles of sustainability of humans to live within environmental limits,

ensuring a healthy and just society, sustainable economic success, promoting a good water resource governance system as a pillar to sustainable development. The literature review of the study was presented in the following chapter.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Water is a crucial resource in maintaining life on earth. Water enhances economic power and dignity, promise, health, better education, and improved infrastructure to individuals and society and rights that ensure sustainable development. Access to water in acceptable quantity and quality is a common challenge to developing countries, depriving their achievement of sustainable development goals (Zhang *et al.*, 2016:482).

Climate change and water resource management crisis, among others, were the chief culprits behind the causes of the water crisis (Ziervogel, 2019:3).. In most cases of water scarcity, particularly in developing countries, the current water crisis is not primarily a crisis of lack but a crisis of management constituting vital public governance aspects (Woodhouse and Muller, 2017:231). The scarcity of water impacts human security in all aspects, such as economic security, food security, health security, political security, and environmental security. The poor and the marginalised are the most affected and exposed to increased vulnerability, stresses, shocks, and risks such as political violence and instability, inferior health and education, droughts and environmental degradation (Ziervogel, 2019:3).

Various academic sources, including journals and books, were thoroughly analysed to gather the literature. This study explores the causes and impacts of the water crisis, governance issues as a threat to water security, and the importance of public participation as an essential pillar in enhancing sustainable development. An analysis of diverse water security approaches and the centrality of water in achieving sustainable development using a holistic and integrative approach prompting the systems thinking is discussed. The course of action required to improve water governance is also discussed, emphasising the role of participation processes in water security as key to sustainable development. The study is thematic because water is a global phenomenon that affects different societies or communities.

2.2 World overview of water scarcity

The world has many people facing the challenges of the water crisis. About 1.2 billion people globally have no access to clean and quality water for domestic use. About 900 million people in rural areas lack access to clean water, increasing health risks (Rijsberman, 2006:6). Water is generally scarce in densely populated, arid regions such as Central and West Asia and North Africa, with estimated availabilities of food production of 1 000 m³ /capita/ year (Rijsberman, 2006:9). Africa leads as the most affected continent with a water crisis. The damaging effects of climate change, manifesting in sporadic, insufficient and torrential rainfall, particularly in the tropical regions, are causing many problems of poor quality and inadequate water in many parts of the world, nurturing human insecurity. Water abstraction for domestic, food and industrial use brings increased impact on ecosystems and agriculture. The impact is expected to be severe in Asia and Africa in a few decades to come (Rijsberman, 2005:12). Rijsberman (2005:6) continues narrating that lack of safe drinking water and sanitation as well as lack of personal hygiene results in massive health problems especially diarrhoeal diseases with an estimated cost to lives of 2.18 million people per year, globally, of which three quarters of whom are children under the age of five. The poorest in Sub-Saharan Africa is the most affected, lacking access to water for productive purposes, exposing many to the vicious cycle of malnutrition, poverty, ill health, and unsustainable natural resource management (UN, 2013:3). Rural areas are the most affected in Africa. In South Africa's rural areas, many still lack tap water and still use open water sources, which exposes them to diseases. Some travel long distances to access safe water sources or even open sources.

2.3 The meaning of water crisis, scarcity and security

The water crisis is when the available potable, unpolluted water within a region is less than that region's demand (UN, 2016:1). It is the lack of fresh water resources to meet the required standard water demand of a particular area or region. Water crisis is not simply about too much or not enough water, but often a "governance crisis" where the institutions put in place have failed to build resilience and adapt to changing conditions (Engvist and Ziervogel, 2019:2). Failure of institutions to establish water infrastructure aligning with its population growth, poor adherence to changing weather patterns or climate models and mistiming of strategic interventions can plunge an area into a water crisis. Therefore, it is mainly not the physical water scarcity but a water resource mismanagement. When water is scarce to a point where the usual needs or demands of

socio-economic activities of an area become stagnant and impacts daily livelihoods, then it becomes a crisis. Some Sub-Saharan cities, either receiving adequate precipitation or along coast lines, experience water crisis. Cape Town is one of the cities along a coastal line, had several warnings about looming droughts and surging population. However, the city could not timeously put preventative measures in place for a catastrophe until a crisis knocks at its door where taps were expected to run dry.

Water scarcity is the lack of adequate available water resources to meet the demand of water usage within a region. Water scarcity results from two mechanisms, namely, physical (absolute) water scarcity and economic water scarcity. Physical water scarcity results from inadequate natural water resources to supply a region's demand. Economic water scarcity results from poor management of the sufficiently available water resources due to an institution's failure and poor infrastructure (UN, 2016:1). Water scarcity affects every continent and about 2.8 billion people around the world. At least one month out of every year, more than 1.2 billion people lack access to clean drinking water (UN, 2016.1).

Water scarcity is driven by two converging phenomena: increasing freshwater use and depletion of usable freshwater resources. Water scarcity involves water stress, water shortage or deficits and water crisis. Water scarcity causes a lack of individual access to satisfy the needs of livelihoods such as drinking and domestic purposes. When such conditions are not met, the individual can be described as water insecure (Rijsberman, 2005:6). The area qualifies to be water scarce due to how environmental and people's needs are defined, the quantity of water made available to satisfy human and ecological needs and the spatial-temporal scales used to describe scarcity (Rijsberman, 2005:6). Grey and Sadoff (2007:547) argue that unlike in its various good uses for sustainability on earth, it is not just the absence of water, but also its presence that can be a threat such as the risks associated with flooding (Grey and Sadoff, 2007:547).

Rijsberman (2005:10) argues that water scarcity does not mean that people have inadequate water for their domestic purposes because the amount required for domestic use is very minute compared to other essential uses. Therefore, domestic use is not affected by water scarcity. Still, it practically affects people who lack adequate water supply and sanitation because of poor service delivery or inadequate finances to acquire resources or services.

The definition of water security is quite broad, with many issues, and neither focuses on quality nor its hazard. Its meaning depends on the interests of different disciplines. The Global Water Partnership (in Cook and Barker, 2012:98) defines water security as meeting basic needs, securing food supply, ecosystem protection, sharing water resources, managing risks, valuing water, and adequate water governance. Grey and Saddoff (2017:225) emphasise this point by saying that it is the reliability of required water quantity and quality for health, livelihoods, ecosystem and production, and the required level of water-related risks to people, environments and ecosystems. These definitions oscillate on balancing human and ecological needs to achieve sustainable development.

Water availability varies spatially and temporally. Its quality governs its importance or value to human life and ecological systems; hence it becomes a very complex resource. The complexity is signified by being problematic due to floods and lifesaving in times of droughts. Such characteristics can be experienced in a single locality within a single season or year (Rijsberman, 2005:6). Therefore, the annual average water availability offers very little meaning to measure water scarcity in such a scenario, as exemplified by the Asian monsoon, which experiences critical water scarcity.

In contrast, its annual average availability signifies its abundance (Rijsberman, 2005:6). Insufficient and inconsistent rainfall patterns mainly cause water scarcity, but various factors exacerbate the scenario, such as poor water resources management. Hence, comprehending water scarcity becomes vital as many factors interplay and impact the users' views and those of policymakers on planning, designing, and implementing effective policies in resolving water problems.

2.4 Framings of water security

Water security has diverse framings evolved from the initial focus of quantity and availability to encompass quality, human health and ecological concerns hence requiring broad and integrative conceptualisation as an approach, which initiates convergence of framings to its governance for improving equity, efficiency and sustainability (Cook and Bakker, 2011:94). Four interrelated themes dominated the research on water security. These are water availability, human vulnerability to hazards, human needs (development-related with an emphasis on food security) and

sustainability (access to enough safe water at an affordable cost to have a clean, healthy and productive life while ensuring the protection of the environment) (Cook and Bakker, 2012:97).

The complex and multidisciplinary nature of water security are diverse and evolving, bringing into light the tension between its conceptual (paradigmatic) and operational (programmatic) framings, suggesting a holistic approach at a conceptual rather than at operational level (Cook and Bakker, 2012:97). Holism, prompting systems thinking or approach fosters maximum returns on water security, addressing all the above four framings, balancing both human and ecosystems needs.

A broad, integrative approach is a favoured framework as it incorporates four abovementioned framings. In contrast, a narrow framework linked to policy, modelling and experimental research, which may include lab-based studies, is also necessary to operationalise water security (Cook and Bakker, 2012:98). Narrow framing allows accurate identification and evaluation of a country's specific concerns, such as controlling its productive water potential or limiting destructive potential. Cook and Bakker (2012:99) argue that narrower framing categorises countries in groups of those that control hydrology, are affected by hydrology and secured by hydrology. Hence some countries are regarded as water secure while others are not. South Africa is regarded as water secure due to the engagement of stakeholders in resource management. Coordination with other sectors and classes of water users has been strengthened, and conflict on shared rivers with neighbouring countries has been avoided through governmental commitments to regional cooperation and formal protocol (Woodhouse and Muller, 2017:233). However, both broader and narrower framings have been concluded to complement each other for effective water management, fostering water security.

2.5 Causes of water scarcity

Climate change is the root cause of water scarcity, prompting warming of the planet and escalating temperatures in tropical regions. The tropical regions are deprived of adequate rainfall as the clouds are pushed towards the poles from the equator, the Hadley Cell expansion (Schleifer, 2017:1). Sporadic rainfall also results in its minimum in other areas and abundance in others, triggering floods and droughts with detrimental effects of water insecurity, which increases vulnerability, especially in already vulnerable developing countries. South Africa experiences such

sporadic rainfall, yet most parts of the country, especially the western provinces, are semi-arid, already receiving below-average rain annually.

Groundwater depletion by abstraction of aquifers for agriculture, domestic and industrial processes present a danger to water security. India leads in groundwater extraction globally, resulting in a decrease of its groundwater wells by 54%, indicating replenishment being surpassed by use, posing over-abstraction of its acquirers (Schleifer, 2017:1).

Government policy, war and international relations instigate water scarcity. Poor planning, policymaking, and implementation play a role. Poor policies include and exclude others from access to resources. Preparedness and public awareness to approaching disasters can be lacking, retarding society's resilience. In the Democratic Republic of Congo, Wars can drive people to water-scarce areas. Yet, poor international relations affect the sharing of transboundary rivers and importing water from neighbouring countries. South Africa enjoys importing water from Lesotho because of its sound relationship with neighbouring countries.

Globalisation and the dominance of neoliberal policies crafted by the West usually favour powerful actors' control of the resource at the expense of more marginalised groups. Natural events such as droughts differently impact people depending on structural reasons such as class, gender, and historical legacies of discrimination and segregation (Engvist and Ziervogel, 2019:3). Promoting water justice implies political negotiations, contestations, and struggles. It needs to address the fair distribution of water and equality regarding recognised water rights and participation in decisions concerning it and protecting ecological integrity (Engvist and Ziervogel, 2019:3). The Global Monetary Institutions (World Bank and the International Monetary Fund) make it difficult for developing countries to protect their economies or to have options for defining their development paths. Differences in technologies between the North and the South increases the imbalances between countries. Hence developing countries fail to meet their development needs, such as water infrastructure, owing to poor financial muscle and economic growth (Engvist and Ziervogel, 2019:3).

Declining and poor water infrastructure signifies a threat to water security. Globally, transportation, treatment and discharge infrastructure for the water show a critical state of disrepair (Schleifer, 2017:1). Poor standards of treatment plants, pipes and sewer systems are evidence of a challenge. Burst pipes of clean water and sewer along the streets are common problems of many

countries, and South Africa is no exception. The cost of installation and repair of built infrastructure is exorbitant and beyond the capability of many municipalities and governments. They wait until a problem appears for them to act. Poor financial capital in many developing countries' municipalities affects their capacity to employ effective interventions to improve water availability.

Environmental degradation stirs water scarcity in many parts of the world. Inadequate attention is directed to wetlands and watersheds, which are health ecosystems that act as filters of pollutants, buffers of floods and stormwater, and regulate water supply. Such ecosystems are threatened by human activities, with 22% of their forests across the globe lost in 14 years (Schleifer, 2017:1). Increases in levels of deforestation, overgrazing and urbanisation are causing high surface run-off, and more rainwater flows to the sea, depriving groundwater replenishment that increases with high seepage facilitated by vegetation cover. Pollution of water resources resulting from industrial, mining and agricultural activities has deteriorated the quality of both ground and surface water sources. China has lost much of its freshwater resources due to development processes. Big rivers such as the Yangtze River have been severely contaminated by industrial and agricultural effluent (Liu and Diamond, 2005:1180). In South Africa, rivers around Gauteng province, which has high mining activities, are highly contaminated with mining and industrial waste, posing a threat to humans and the environment.

Population growth is associated with high water demand. The world's population is currently around 7.5 billion, and another 2.3 billion is projected to increase the population by 2050, indicating a strain to the planet to meet the demand (Mugagga and Nabaasa, 2016:218). Rapid urbanisation in Africa with increasing rural-urban migration will concentrate people in major cities, increasing water demand and pollution of nearby reservoirs. Cape Town is one of the cities already facing such a phenomenon due to national and regional migration to the city. Growing incomes also increase water-intensive products, such as meat processing and energy from fossil fuels, needed mainly by affluent populations, particularly in urban areas (Schleifer, 2017:1).

Poor natural resource management claims the damage of water sources (Kotze, 2000:238). Wastage of water resources is increasing, primarily driven by inefficient practices such as in irrigation and cooling water for thermal power plants. Studies indicate that about 80% of the world's wastewater is discharged back into nature untreated or without being reused (Schleifer,

2017:2). This is because the treatment and disposal of wastewater are more expensive than getting clean water. In countries such as South Africa, water is undervalued because water service delivery costs are entirely below the actual cost of its transportation through infrastructure to treatment and disposal.

Moreover, in South Africa, water is a basic need and right that should be affordable and supplied at no cost in informal settlements (Schleifer, 2017:2). When the cost of water is lower than the needed technology, government infrastructure investment becomes a critical challenge. Misallocation of water, poor infrastructure and lack of new technology motivates water distribution inefficiency and poor access, use and quality.

2.6 Impacts of Water Scarcity

Water scarcity has severe effects on the well-being of people and the environment. It affects access to clean, fresh water and vulnerable populations are exposed to poor sanitation, resulting in sewage flows and deadly diseases, especially water-borne such as dysentery and diarrhoea (Mugagga and Nabaasa, 2016:218). Mugagga and Nabaasa (2016:219) argue that 80% of Africa's diseases are waterborne. Worker productivity can also be affected by water shortages and poor quality illnesses. Zhang *et al.* (2016:482) state that water scarcity deprives the success of many SDGs, which in turn affect the sustainable livelihoods of many people in developing countries.

Water gathering can also limit education and economic opportunities, particularly for girls in Africa (Mugagga and Nabaasa, 2016:218). In developing countries, people walk several kilometres to fetch water. This is a tiring exercise with significant consequences such as children missing school because of physical exhaustion or leaving less time to engage in other economic activities, impacting their income potential. This is a common feature in South Africa, particularly in rural areas. Women and girls are the most affected as they are burdened executing household chores. There is an increase in child school dropouts, keeping them from competing with male counterparts in education and economic activities. Several years of this experience creates a cycle in society that exacerbates male patriarchy's weight (Mugagga and Nabaasa, 2016:218).

Water scarcity results in food shortages as agriculture are severely impacted, mostly in vulnerable communities. Poor access to freshwater for agriculture and domestic use decreases food production, impacting individual and household nutrition and eventually poverty and increased

deaths (Dyson and O'Grada, 2002:2). In the Western Cape Province of South Africa, the drought of 2018 reduced agricultural production by 20%, with both quantity and quality of production impacted, thereby affecting both local and national economy as the province is one of the most significant contributors to the national GDP with agriculture as one of the key contributors (Twig, 2018:2). For improved yields, food production relies more on irrigation than natural rainfall in many tropical regions. Hence, increases in water insecurity will result in increased food shortages, with the Global South facing the most considerable risk. By 2050, about 9.6 billion people will face severe food shortages, with a potential for political instability, social unrest, civil war, and terrorism unless food production increases by 60% by 2050 (UN, 2013:1). Migration of people to better water resourced areas can increase. Both domestic and international migration, especially of the rich, becomes consequential. The rich will sell their properties and reinvest elsewhere, impacting the economic well-being of the country they leave.

Conflict can result from water scarcity (Kotze, 2000:236). Upstream and downstream users' relations can be affected as downstream water becomes minimum and usually polluted. The relationship between the affluent and the poor can be strained over resource use inequalities and competition, impacting social cohesion. In South Africa, the poor usually blame the rich for using more water because of their higher domestic demand. The rich blame the poor for paying less or nothing in high-density suburbs and informal settlements, as water is constitutionally a fundamental right. Structural reforms can result in job lay-offs affecting individual and household incomes, reducing purchasing power for goods needed for sustainable livelihoods. Reduction in development processes such as industries and agricultural sectors also increases job losses (Klein, 2003:3). The focus of local and national authorities can be diverted from other essential activities such as infrastructure development, health and education and directed towards water security issues.

Production of water-intensive goods such as cars, food, and clothing, which intensify and proliferate economic development, can be impacted (UN, 2013:1). Poor economic growth triggers job losses, shrinking individual and household income and rising chronic poverty and resource depletion (UN, 2013:1). As industrial production decelerates, water scarcity can grossly impact local, provincial, national, and regional GDP. Water scarcity prompts the increase of water tariffs by authorities. Increased water tariffs for individuals and households can reduce household

disposable income, escalating their poverty. Water scarcity affects energy production. Energy demand can increase in line with increasing modernisation and population growth. Global electricity demand is anticipated to increase by 70% by 2035, with India and China leading, owing to their massive populations (UN, 2013:1). The rise in energy demand requires improved energy production, which requires large volumes of freshwater.

2.7 Water governance in practice – specific examples

Water governance has influenced and has been influenced by theoretical debates and practice (Woodhouse and Muller, 2017:231). Water governance arrangements are mostly framed at a national scale where major reforms are formulated but with many challenges, legal frameworks, institutional arrangements, and effects on socio-economic activities such as agriculture, environment, and local and transboundary conflict management.

2.7.1 European union

In the context of the European Union, reforms on water governance systems have promoted new approaches at the international level by use of aid and associated relationships. Woodhouse and Muller (2017:231) highlight that the Water Framework Directive (WFD) of 2000 has geared for a participative governance approach, using the river basin as a management unit, facilitating economic mechanisms and environmental quality arrangements priority objectives. National, sub-national and national plans and programmes were crafted to achieve essential policy formulation such as multi-national governance, participatory governance and nested policy cycles (Koontz and Newig, 2014:248). The WFD was quite favourable in enhancing environmental standards but has been criticised for not being meticulous and lacking public participation (Bouleau and Pont, 2015:35). It was described as ambiguous and not coherent with the contemporary concept of human-nature interdependence, although deemed useful by other practitioners for achieving harmonised approaches to many issues faced by diversity in spheres of influence.

2.7.2 India

Water governance in India presents challenges across all scales, stretching from individual farmers to managing transboundary rivers and federalism challenges and tensions within governance levels (Woodhouse and Muller, 2017:232). The country's water is mainly drawn from Indus, Brahmaputra and Ganges rivers which are all shared rivers with transboundary governance

characterised by hostilities with neighbours on infrastructure development and operation. Expansive powers of the government restrict federal governments' capacity to foster inter-state resource management and development and even brokering agreements of water sharing with other neighbouring states (Chokkakula, 2012:105). Pollution and overuse of water have occurred in rivers such as the Ganges river. They address topics such as the government's failure due to limited financial resources and decentralised approaches. Mumbai's water supply system was impacted, disputes over irrigation and dam infrastructure increased, and unsustainable groundwater use manifested. As a result of ineffective water governance issues, farmer suicides increased due to falling groundwater supplies (Woodhouse and Muller, 2017:233).

2.7.3 China

China's rapid economic growth resulted in water-related development problems, showing the complexity of water governance issues. Mol and Carter (2006:151-152) argue that, in China, several water governance agencies have sprouted from the national level down to local government, resulting in minimum integration between water resource management, environmental protection and key resource users such as agriculture and urban services provision. Macroscale challenges have emerged, straining the national water reforms. Several regulatory mechanisms and different approaches, including economic incentives, were employed, but there was high demand upstream, and downstream communities suffered from upstream industrial pollution. Lack of national water reform, inefficient infrastructure, unsustainable water uses, and pollution became critical. On transboundary rivers, China denied entering the Mekong River Commission but cooperated in supplying the drought troubled lower Mekong with water from its dams in the river basin (Tiezzi, 2016:2).

2.7.4 South Africa

South Africa has its western part of the country characterised by semi-arid climatic conditions yet facing an increasing water demand owing to its population growth and immigration mainly from other African countries. The 2015–2018 drought was the worst in the city's history, threatening the taps of a 4 million population to run dry. The city had a complex relationship with water even before the drought. South Africa is still crippled with racial inequality of the apartheid era, including its implications for water justice (Engvist and Ziervogel,2019:1). The country is characterised by spatial and economic segregation of people perpetuated by the white colonial

regime during the apartheid era from 1948–1994. The majority, blacks and coloureds, were forcibly settled in inferior housing in low-lying areas prone to flooding and limited access to necessities such as water and sanitation. Post-1994 policies have aimed to promote water justice for all citizens, but municipalities have struggled with implementation, especially in rapidly growing informal settlements (Engvist and Ziervogel, 2019:1).

During the recent drought, Cape Town's city accelerated its water demand management program, including pressure reduction, leak repairs, and public awareness-raising campaigns. But challenges were also met due to poor communication and a lack of trust of authorities, contributing to citizens' anxiety and a near-panic situation at the threat of taps running dry, a scenario dubbed "Day Zero". Dams almost ran dry in the first half of 2018, but the winter rains played a significant role in serving the city. The city engaged in exploring additional water sources and the development of a new Water Strategy. The city's experiences signify acknowledging the interrelated threats of drought and flooding and the range of impacts on sustainable water governance, particularly in a community characterised by acute inequality (Engvist and Ziervogel, 2019:1). Public participation also played a pivotal role in stabilising the water crisis in the city. All stakeholders had a collective response to strategies for averting the water crisis, including diversifying water sources, saving available water, harvesting water, and changing water use behaviour.

2.8 Water scarcity and governance approaches

Water scarcity and governance have brought heated debates among many scholars and researchers on effective approaches to water governance. Developed countries have shifted the focus of water governance from increasing supply to managing demand and environmental protection (Woodhouse and Muller, 2016:227). Managing demand enhances resource preservation by balancing human needs and environmental maintenance. However, this notion works satisfactorily in countries of the North that have the financial muscle for effective governance. Woodhouse and Muller (2016:227) assert that rapid urbanisation and industrialisation and required institutional arrangements to control and monitor water users are critical challenges that make African countries fail in meeting growing water demand. The debate arises on required institutional arrangements, policies for effective governance, implementation strategies and accountability of decision-makers (Woodhouse and Muller, 2016:227)

Participation has gained momentum as a preferred mechanism of water governance. It has always been explicitly stipulated as a theme in water governance debates in the United Nations conferences and publications, exemplified by the 1997 United Nations Mar del Plata conference referred to as Participation (Woodhouse and Muller, 2016:227). All stakeholder participation propels robust decision making, proper resource management, development of successful plans, accountability and fostering of democracy. When consulted, the private sector is regarded as key in implementing plans and policies and providing funding and expertise for successful governance.

Another approach with contestation is the scale matter, where the river basin is chosen as the primary scale for water governance (Woodhouse and Muller, 2016:235). The scale matter emanates where water flows across administrative and political boundaries, cultural groups and economic clusters. Who is in and who is out of decision-making structures becomes a critical issue. The scale of water governance is usually on a national level where political actors and interested parties compete and encourage policymakers and pass legislation by the government for guidance to responsible authorities. Cooperation and the signing of treaties can be required. Sometimes, conflict arises on water flowing across boundaries, such as the river Nile, which runs through Egypt, Ethiopia, and Sudan, as downstream water can be less quantity and quality (Mugagga and Nabaasa, 2016:218).

Turning water into a commodity is another approach to water governance that sparked heated debate. Commoditisation of water serves to collect finances needed for infrastructure development, providing a clearer governance system and guiding its allocation (Woodhouse and Muller, 2016:228). Many countries, including South Africa, have adopted commoditisation. Critiques argue that the poor would be the most affected by the payment of water tariffs, deepening their poverty status and inaccessibility to water (Mugagga and Nabaasa, 2016:219). Water and market-related measures on the water have been implemented for many years, proving to manage and distribute effectively. Woodhouse and Muller (2016:228) continue arguing that water pricing has been used to measure effective and efficient water use campaign instruments for water users. Non-pricing of a scarce resource is regarded as a threat to the natural environment, affecting the ecosystem's sustainability.

2.9 The role of public participation

Public participation involves people in a community in projects to solve their problems and promote broader development objectives. Participation proponents criticise the state's social provisions, highlighting that they are centralised, bureaucratically managed, governed by impersonal regulations and routines and unresponsive to the needs and problems of people. It not only humanises the bureaucracy but strengthens the capacities of individuals and communities to mobilise and help themselves (UN, 2015:4). Participatory processes demand direct, face-to-face involvement of citizens in development projects and ultimate control over decisions that impact their welfare. The disadvantaged should be empowered to take an active part in the processes. However, in South Africa, participation is even stipulated in the constitution and various government legislations, but the implementation process is still not robust, thereby reducing the gains. The indigent is usually incorporated during the implementation phase, yet their input is most needed during the entire process (Chambers 2000:66).

Participation has gained momentum in facilitating sustainable outcomes in contemporary development projects and programmes. It can connect people and usually break down stereotypes. It initiates people to understand and share the feelings of one another. It can be a symbolic act of reconciliation and a vehicle for forgiveness and healing that are prerequisites for managing ethnic and distributive conflicts (Priscoli, 2004:7). Food Agriculture Organisation of the United Nations (FAO) (1996:6) says that participation improves development work efficiency and effectiveness and eradicates several problems concerning the proprietorship of development activities in communities.

Communities can identify felt needs as well as mobilisation of resources. They present their priorities for development and initiate them to be included in development planning. FAO (1996:6) argues that devolution of management responsibilities is facilitated because of local people's inclusion in the process. Devolution enhances self-reliant development because the responsibility for the management and implementation of development activities will be concentrated in the hands of local people. FAO (1996:6) narrates that people become involved in decision making and control the process and the setting of preferences. Community members can be empowered to analyse, discuss, plan and initiate action plans that fit their needs and wants. Broader social development ideals are promoted by fully participating in decision making (Chambers 2000:66).

FAO (1996:6) states that when communities have a say in the project's design, they can also initiate projects that maximise the use of local resources. Communities can take control of their resources and contribute to their conservation and sustainability. Ordinary people experience fulfilment which contributes to a heightened sense of community and strengthening of community bonds.

Improved mobilisation of local resources for development is heightened, reducing. Sustainable development activities which are technically, environmentally and socially suitable for local conditions can be enhanced due to less dependence on outside agencies. People can benefit from scrutinising their creativity and commitment to a better chance. FAO (1996:6) argues that participation increases linkages between communities and development institutions and agencies involved in development. This can help with monitoring and evaluation, vital for project success.

Local people become educators and analysts due to the empowerment bestowed on them. Continuous learning, which is flexible, adaptive and explanatory, is facilitated and eliminates bias (Chambers 2000:66). People can lead and direct the project process and learn from their mistakes and experience. Everyone's contribution is allowed, empowering local people rather than extracting their information (Du Plessis 2017:60). The process provides listening and learning for all people, especially the poor, women and vulnerable groups. Women empowerment and capacity building are enhanced. However, in South Africa, the society is patriarchal, and women, especially in rural areas, are not fully engaged in many economic activities requiring their participation. Their exclusion affects their empowerment and capacity building.

Sharing culture is enhanced in information and experiences among communities, organisations, government officials and development practitioners (FAO, 1996:6). Participation processes give the community's physical picture or set up their geographical, socio-economical, environmental and cultural issues. This information is paramount in designing successful projects when all relevant data is factored into the planning and implementation of projects phases. (FAO 1996:6).

Participation is, however, plagued by a myriad of factors. The paternalistic role of development professionals creates an unpleasant power dynamic whereby foreign experts claim entitlement to the project design and implementation (Boets and van Rensburg, 2000:42). The community's needs are usually manipulated, and decision making monopolised to fit their preconceived notions of the community's problems, undervalue perspectives of the community. Participation is usually

used to maintain the existing power relations in society, silencing the indigent and legitimising political systems or social control rather than improving the welfare of the poor and empowering decision-making models. Governments are more in a hierarchical mode of thinking which is a deterrent to the participatory development and deprives communities' governing abilities (Boets and van Rensburg, 2000:42).

Participation sometimes becomes selective. The most visible, affluent and educated groups are partnered in development efforts while the disadvantaged, who experience and comprehend the intricacies of poverty, inequality and injustice, are excluded. The decision-making option is left concentrated in the self-appointed elite who are distant from the reality existing in the community. The maintenance of power by the local leader or group leadership in a community can be a hindrance between the development agency and project beneficiaries (Midgley, Hall, Hardiman and Narine, 1986:8). Decision-making at a community level might be trapped in the hands of a small and self-perpetuating group, which can act to fulfil their interest at the expense of the community. This scenario is common in informal settlements of developing countries, which at times lend themselves to an autocratic style of leadership based on patronage, strengthening the prevailing inequality of the existing social structure. In their useful role as mediators for the indigent, sometimes they inhibit the direct and active participation of the poor in community issues (Boets and van Rensburg, 2000:42).

Conflicting interest can emanate particularly in heterogeneous than homogeneous communities. People are usually less likely to participate in participation processes in more diverse communities due to language divisions, ethnicity, tenure, gender, income, age, or politics (Boets and van Rensburg, 2000:42). The lack of shared vision usually enhances difficulties in identifying project goals and objectives. Excessive pressure for immediate outcome underplays the success of participation. Pressure for rapid results sometimes pushes developers to accomplish projects that communities may not want or are unsustainable. Lack of public interest simply because the project does not interest them is one of the factors affecting project design, resulting in unneeded outcomes (Boets and van Rensburg, 2000:42). Sometimes, the failure of previous projects makes people refrain from participating in new programmes. The distrust and sensitive nature of the project may cause people to be reluctant to participate.

2.9.1 Participation in South Africa

South Africa is a progressive democracy exerting effort in realising the goals mandated by its Constitution. The National Development Plan (NDP) stipulates that South Africa belongs to all its people. Its future depends on the collective responsibility of its people in ensuring inclusive growth and solving complex problems such as poverty and inequality, requiring action, change and sacrifice from all sectors of society. The country's transition from apartheid to a democratic state has been a triumph through the collective building of democratic institutions, extended basic services, stabilising the economy and securing a better position in the global family. Emphasis is given on the unleashing of energies of its citizens to participate towards the realisation of a cohesive society.

In South Africa, a formal participatory method called *Izimbizo* is commonly used in presidential, ministerial and mayoral meetings with citizens. *Izimbizo* is a Zulu word that means traditional community gatherings under the chief or elder's convenorship. Political leadership at national and provincial levels usually summon such *Izimbizo* for public relations instead of using it as a real muscle for problem resolution (Nleya, 2011:60).

At the local government level, the centre of participatory democracy oscillates in the hands of a ward councillor. The ward committees set under the Municipal Structures Act of 1998 (RSA, 1998b) comprise ward councillors as the chairperson and approximately ten community members chosen on sectoral or geographical location, representing a diversity of ward interests (Nleya, 2011:60). The ward committee's functionality in advising the councillor is quite limited by law. Piper and Nadvi (2010:219) pointed out that ward committees depend on their councillors for effective functionality. Hence, the ward councillor is responsible for how frequent the ward committee meets, discussions engaged in, information acquired by ward committee members and what information the council obtains from ward committees.

This clearly shows the structural problem in the Municipal Structures Act of 1998 by taking ward committee as an peripheral entity instead of being part of the body inclusive in the local decision-making process. Hence, the institutionalisation of ward committees can stir improved citizen participation. Using ward councillor as the chair can pose a problem of committee members chosen based on political affiliations, thereby excluding members from other parties (Piper and Nadvi, 2010:219).

Whenever things go wrong, citizens' voice is required to enhance the accountability of authorities. Structures of participation were enacted through the design of legislation, particularly at the local level. The local government is regarded as the critical participatory sphere of government. Municipalities have established their strategies to initiate mayoral executive, municipal management, local council, ward committees, and communities to participate in decision-making (NDP, 2011:474). However, several municipalities have not yet achieved expectations. The state is expected to engage communities in their forums instead of hoping citizens to engage with state-created forums. Local, provincial and national government sectors should facilitate the participation of citizens by a variety of two-way information gathering and sharing forums as well as platforms between citizens and government. Both platforms enhance government to inform and capacitate citizens to provide feedback and monitor its performance. This can enable individuals, communities, NGOs, government and private sectors to use such information flow to develop strategies that propel citizens to claim their rights and exercise their responsibilities as enacted in the Constitution (NDP, 2011, 474).

The trust among all development actions and the gathered information must be remarkable, credible and legitimate to all actors. Communities should be engaged to deliberate on Integrated Development Plans (IDPs) processes. IDPs processes are required to be municipality-led instead of outsourced to consultants. Communities should be engaged in their spaces by the local government. Administration officials and elected representatives should be out in communities and private associations rather than expect them to come to government forums (NDP, 2011:438).

Leaders are expected to lead by example and follow the regulations that apply to everyone. They need to be honest, trustworthy and uphold a high degree of integrity. They are expected to uphold the core set of values envisaged in the Constitution in their drive for change and transformation. Leadership must have innovation capacity, drive for an essential but not popular agenda, communicate with people and keep them informed. Listening to different opinions, perspectives or priorities of a community is highly required. Conditions that initiate people to use open dialogue in communication should be created through tolerance, patience, openness to giving and receiving criticism and willingness to admit mistakes and the ability to re-examine one's own supposition (NDP, 2011:374).

Leaders should promote meaningful inclusion to overcome barriers related to class, ethnicity, gender, disability and other exclusion factors. The powerless should be empowered by leaders and bridges built to other sectors of society such as business, civil society, faith-based communities, and all government sectors (NDP, 2011:375). People should be empowered and placed at the centre of development. Such visionary leadership is a catalyst to transformation in a development community. Responsible citizenship and solidarity should be promoted for the interest of shared development and responsibility by paying attention to the peaceful and creative settlement of disputes, which is critical for nation-building in a nation of diverse people.

Public participation is a vital tool for democratising governance processes and facilitating government's responsiveness and accountability to its citizens, particularly to issues concerning their daily lives, such as service delivery. In diverse communities of South Africa, with the atrocities of apartheid still haunting them, participation should be highly articulated to enhance social cohesion and reduce the stretching gap of poverty and inequality. Although there are some challenges in the implementation phase, all stakeholders need more effort to distribute and manage resources for a sustainable future.

2.10 Interventions to water governance

Pragmatic approaches and adaptive and participatory processes should be crucial in managing and using natural resources such as water because of their nature in advancing flexible, cohesive and integrated governance, which is key to water availability, access, and use (Cook and Bakker, 2012:100). Systems involving humans cannot be sensibly contemplated or observed until participation and cooperation in the associated processes have been ascertained (Hjorth and Bagheri, 2005:84). Hjorth and Bagheri (2005:84) continue saying that adaptation is quite fundamental because, if excluded, it can result in thresholds of crises. Therefore, society should be encouraged to learn how to learn, manage social change, and escalate the pace of social learning and become a learning society. Participation by interested parties produce decisions that are better and well accepted. Decisions that can be efficiently and effectively implemented emanate from involvement of interested parties which effectively influence the choice between alternative plans and policies (Woodhouse and Muller, 2016:230). It encompasses the most vulnerable or the poor such that their proposals, suggestions and expertise influence and become considered in planning, policy-making and decision making.

Comprehensive and overarching Environmental Impact Assessments that are effective should be prioritised to prevent environmental degradation of water resources. Woodhouse and Muller (2016:230) argue that international laws heighten the integration of policies and legislation, planning and management. More so, improvements in the quantity and quality of surface and groundwater are equally important.

Good governance and democracy are vital in water resources management. It enhances water infrastructure and institutional development, which warrants effective and efficient water governance by boosting water supply, access, availability and quality to communities, thereby propelling sustainable development (Woodhouse and Muller, 2017:227). Clamping down corruption, accountability of institutions, and a non-conflict environment can be improved, thereby intensifying management and accessibility to water. Political, economic and ethical standards should be enhanced to facilitate effective coordination and cooperation in areas such as sharing of transboundary rivers within the confinement of international laws.

All spheres of government need to work together to ensure alignment between powers and functions, planning processes and budgetary allocations (Ziervogel, 2019:16). On several occasions, these spheres cannot resolve assignment issues independently. There is a need to work with the relevant sector, either local, provincial or national departments. Interaction of all three sectors can help identify coordination problems and use their collective influence to resolve disagreements promptly. In some cases, this may require research to assess the effectiveness of aspects of the intergovernmental system. The three spheres of government need to be strengthened through a more proactive approach to managing the intergovernmental system (Ziervogel, 2019:16).

The public should be educated on the importance and sustainable use of resources. Resource awareness campaigns can be a better tool for educating the public on conservation methods such as water harvesting, reuse, recycle and reduction initiatives. In Cape Town, South Africa, water serving methods have proved their importance. Households have engaged in rainwater harvesting and storing water in tanks as a water conservation method. Financial capital should be made available for infrastructure and institutional development. Water treatment for human consumption requires a substantial financial outlay. Advanced technology and expertise are critical for effective

water resource management, especially in areas such as revenue collection. Municipalities for sustainable water resource management should prioritise training and skills development.

Contemporary water resource management requires a systems approach because of its strength to address and optimise policy, managerial and technological interventions in resource management projects of a community (Zhang *et al.*, 2016:480). The approach links development community projects with economic gains, educational equality, women empowerment, and stakeholder involvement to recognise holistic improvements critical for sustainable livelihoods.

2.11 Theoretical framework

The study uses a theoretical framework as well as the conceptual framework. The systems approach is used to advance the objectives of this study. The systems theory is the overarching, comprehensive and all-embracing approach in achieving the desired outcomes of sustainability. Theories are designed or formulated to forward prediction, analysis, explanation and understanding of phenomena through investigation of relationships within social systems. A theory usually extends and challenges knowledge within the critical bounding assumptions (Montuori, 2011:1). The theoretical framework was a guiding principle that helped address the research questions critically. Evaluation and discussion of relevant issues were done along with the confinement of the theoretical framework. However, like any other theory, it has its limitations.

The study follows the conceptual framework of sustainable development based on the social development model. The study required establishing how the water crisis impacted Cape Town residents' social and economic well-being. Therefore, social sustainability becomes the pathway of the study. Social sustainability occurs when formal and informal processes, systems, structures and relationships actively support the capacity of current and future generations to create healthy and inhabitable communities which are equitable, diverse, connected and democratic, as well as providing good quality and satisfaction of life (Eizenberg and Jabareen, 2017:3). It is a process that creates sustainable places or communities that enhance well-being by comprehending people's diverse needs from the places they work and live now and in the future.

2.11.1 Background of a systems approach

The systems theory is based on the larger ecosystem in which creativity emanates. It is defined as a theory of interacting processes and how they influence each other over time to allow the

continuity of some larger whole (Montuori, 2011:1). The systems theory was postulated in the 1940s by Ludwig von Bertalanffy who pursued to discover a new approach to studying life and living systems. It was postulated to address the increasing complexity of the world's problems. The approach uses a holistic methodology to study the world, country or community as an independent system and overcome the narrow disciplinary specialisation in social sciences (Chariot, 2001:1). The main aim of the theory is to understand and explain unequal wealth and development between societies of a contemporary capitalist world.

The theory has emerged as an alternative to the reductionist theory, a dominant way of thinking and form of inquiry. The reductionist theory failed to address interdependence, wholes and complexity. Systems theorists eliminated reductionism, arguing that it isolates the subject from its environment. Hence, by studying a particular element of a larger whole in isolation, reductionism fails to account for systemic and emergent properties and how relationships and interactions form the organisation of life. The theory is transdisciplinary instead of interdisciplinary. Transdisciplinary means interaction reaching beyond or across disciplines, yet interdisciplinary means between disciplines (Montuori, 2011:1).

2.11.2 Advantages of a systems approach

The theory possesses a myriad of benefits in issues involving humans. The theory's strength is adaptability, interdependency and exchange of resources and energy between different systems (Ziervogel, 2019:16). The theory is used in complex systems where humans are involved such that all issues are holistically addressed, mainly in social and economic sectors. The theory allows a detailed and focused analysis of how the social and economic wellbeing of society can be affected by the scarcity of a resource such as water, a basic resource in achieving sustainability (Hopwood, Mellor and O'Brien, 2003:38).

Sustainability issues are complex such that the systems approach with its non-linear and organic thinking can give an understanding and employ critical interventions to the sources of contemporary global problems (Hjorth and Bagheri 2005:76). The systems approach ensures that sustainable development sectors remain mutually compatible as key development challenges are met through specific actions and interventions to eradicate poverty and severe inequalities. The approach provides holism in understanding the sustainable development concepts by considering dynamic relations in a system where resources are viewed together, interacting with people and

capital and each other (Hjorth and Bagheri 2005:76). Causal loop diagrams identify various dynamic structures that govern global ecological systems.

Ziervogel (2019:16) argues that the systems approach facilitates a broader analysis of elements and their relationship and interaction to achieve sustainability. It allows adequate technological, policy and managerial considerations to be taken to attain desired outcomes. Improved goals and targets can be met, thereby enhancing system performance. Direct and indirect linkages and feedbacks between loops are analysed, and problems of each goal can be identified and rectified in processes such as implementation, research and policymaking. Strategies designed to define, monitor and evaluate the negative and positive influences for effective and efficient interventions can be taken to enhance sustainability (Ziervogel, 2019:16).

The principles of feedback and secondary effects employed by the approach can help managers evaluate the strategies used and determine the results that emerge in the process (Hjorth and Bagheri 2005:81). Learning in a complex system is facilitated together with understanding mechanisms and feedback links. The learning process initiates informed decision rules and visualisation of the real world. Evaluation of various situations can be done by increasing or omitting links and changes in systems parameters to necessitate sound decision support for the selection of better system's strategies and policies (Hjorth and Bagheri 2005:82). The theory initiates open, participatory processes focusing on communication, cooperation and compromises that build consensus among stakeholders.

2.11.3 Applicability of theory to the study

The theory is used in complex systems where humans are involved such that all issues are holistically addressed, mainly in social and economic sectors. The theory allows in-depth understanding and focused analysis of how the social and economic wellbeing of society can be affected by the scarcity of a resource such as water. The City of Cape Town experienced a water crisis impacting both the social and economic wellbeing of residents. The alleviation of the impacts was complex and required a high-level water management system. Any useful component was factored in the process to improve the desired outcome. This indicates that humans had complex interactions in the access and management of water. A systems analysis was required to bring holism, which views and appreciates the interconnectedness of human wellbeing, climate change,

environmental sustainability and resource management. Hence, all stakeholders can determine holistic improvements in water resource management, improving community livelihood.

However, the systems theory has also some limitations, as with all other theories. It fails to offer any tools or techniques to establish integration and the nature of interdependencies between organisations and ecological systems (Santosh, 2021:3). As with many theories, it is quite abstract, making it difficult to apply directly and easily to humanity's practical problems. Determination of the system's boundaries and identification of interrelations of sub-systems becomes problematic.

2.12 The conceptual framework (sustainable social development)

The study follows the conceptual framework of sustainable development based on a social model. This research has particularly focused on obtaining social data. The study requires establishing how the water crisis impacted Cape Town residents' social and economic well-being. Therefore, social sustainability becomes the pathway of the study. SDGs can be fully achieved through a socially sustainable development model. The model is a transformative approach to attain inclusive, people-centred development with no one left behind (UN, 2015:2). It is an approach that holistically integrates all the three dimensions of sustainable development for maximum development benefits; hence it prompts the use of a systems theory.

2.12.1 The meaning of Sustainable Development

The United Nations (UN) (1987:15) defines sustainable development as “development which meets present needs without compromising the ability of future generations to meet their own needs.” South Africa’s Department of Environmental Affairs (SADEA) (2011:6) defines sustainable development as the selection and implementation of a development option, which allows for appropriate and justifiable social and economic goals to be achieved, based on the meeting of basic needs and equity, without compromising the natural system on which it is based. These definitions mean that the provision of people’s needs today should not reduce, decay, collapse and disintegrate the chances of future generations to meet their own needs. The socio-political and ecological systems are embedded within each other. They should be integrated through the governance system that holds them together in a legitimate regulatory framework.

2.12.2 Evolution of SDGs

The UN's World Commission on Environment and Development, commonly known as the Brundtland Commission of 1987, established a document called 'Our Common Future.' The document contained new thinking and emphasis on the environment, development and governance, calling to develop strategies at international, national and local levels for economic growth in harmony with human security and environmental preservation, hence sustainable development (Sneddon *et al.*, 2006:254). Sustainable Development became a project to tackle contemporary global problems practically. In 2000, the Millennium Development Goals (MDGs) were coined by world leaders to guide the international strides for 15 years targeting the reduction of poverty, hunger, ill-health, gender inequality, environmental degradation and poor access to clean water and sanitation (Zhang *et al.*, 2016:481). Progress was made by many countries, mainly in developed countries, in improved sanitation and access to water, but still, developing countries are lagging, especially in Africa. In September 2015, MDGs were replaced by seventeen (17) SDGs with the number six-goal emphasising the accessibility of clean water and sanitation.

2.12.3 Advantages of the concept

Social sustainability occurs when formal and informal processes, systems, structures and relationships actively support the capacity of current and future generations to create healthy and inhabitable communities that are equitable, diverse, connected and democratic, as well as providing good quality of life and life satisfaction (Eizenberg and Jabareen, 2017:3). It is a process that creates sustainable places or communities that enhance well-being by comprehending people's diverse needs from the places they work and live now and in the future. Such communities are quite sensitive to their environment, contributing to a high quality of life, safe and inclusive, properly planned, built and run, rendering equality of opportunity and offering good services for all (Eizenberg and Jabareen, 2017:3).

Social sustainability links the design of the physical realm and social world infrastructure to support social and cultural life, social needs, systems for citizens engagement and space for the people and places to evolve. The social model aims to achieve inclusive and people-centred development with no one left behind (UN, 2015:2). The three dimensions of sustainable development, namely socio-cultural, economic and environmental, are integrated to assist policymakers in confronting the resource management challenges by providing useful concepts

and practical tools that facilitate merging sustainable development pillars into public policy cycles (Sneddon *et al.*, 2005:253). The integration of these three pillars assists policymakers in confronting challenges by providing valuable concepts and practical tools that enhance the merging of sustainable development pillars into public policy cycles (Sneddon *et al.*, 2005:253).

2.12.4 Applicability to the study

Water security is a vital component of a development community. Achievement of developmental goals is linked to the availability of adequate water. The sustainable growth and transformation of any society are strongly linked to water. The scarcity of water in Cape Town has affected its social development. The social aspect of the city was grossly impacted, increasing inequality and poverty among many.

Moreover, the magnitude of the impact was enormous because the society was racially divided. Yet sustainability demands the inclusivity of everyone. It becomes imperative to employ the social sustainability concept to understand the linkage between humans and their resources and improve access to all residents regardless of class, race or gender. The “whole of society” nature connects with the systems theory’s holistic analysis, enhancing maximum sustainable development gains.

2.13 Conclusion

The views and expressions of different authors were analysed in this discussion. The literature review has shown that water scarcity has become a world phenomenon but intensifying in developing countries. Climate change, political, economic, and ethical problems affect water resource availability, resulting in water crisis and impacting sustainable development. Water crises can affect all aspects of life, ranging from agriculture, health, education, business, industry, recreation, and the environment. South African communities, particularly the poor, are the most affected by the water crisis as they are still trailing in the bondage of apartheid rule. Relevant authorities do not effectively implement strategic interventions. Several legislations were passed, but implementing policies that enhance equitable distribution of resources has become a challenge. Public participation has not been effectively articulated. Although a broad integrative approach has become popular because of its holistic approach and systems thinking to water security, implementation is the major hindrance in achieving the sustainable outcome. The systems approach becomes critical in resolving complex issues as it offers holistic analysis and examination

of elements for a better understanding and use of interventions for improved outcome. Sustainable development is a complex issue requiring all its components to be analysed holistically such that the desired goals and targets are attained. The socially sustainable development model has brought the social aspect, a critical pillar of sustainable development. It has integrated social, economic, and environmental aspects to be analysed to better understand and plan and implement development projects for improved livelihoods. The study was conducted using qualitative approach. The next chapter presented the research design and methodology which helped with a thorough planning, collection and processing of valid and reliable data.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The chapter presents a roadmap with which the research journey was taken to achieve research findings and analysis of the impacts of water crisis on sustainable development in Cape Town as explained in chapter 1 and 2. It directs the way research results were obtained and analysed concerning the causes, impacts, strategic interventions and the role of public participation as reflected in the previous chapters (Pham, 2018:2). The principle of ethical consideration, particularly during the Covid-19 pandemic, has been well explained. More importantly, the systems approach theory and the concept of sustainable development guided the research process. The critical terms of the research design and methodology, namely, research paradigm, research design, data collection and analysis, sampling size, validity and reliability of the research study, are explained within the context of the research study.

3.2 Research Paradigm

Interpretivism was the paradigm followed by the study. The key feature of this approach is that the phenomenon or human actions are continuously interpreted to create and establish meaning and definition. It explores and uncovers complex social settings of the research subjects to attain more understanding and knowledge (De Vos and Strydom, 2011:479). As is the case of this study, complex issues fit well to be studied through interpretivism due to the ever-evolving social settings. The subjective view drives the method, unlike quantitative, where the focus is on objectivity. The cause-and-effect link is invalidated as humanity prevails and exist in continuously changing and refashioning settings. Interpretivism employs qualitative methods to understand people by capturing reality through interaction. It is one form of qualitative methodology relying upon researcher and human subjects as instruments to measure phenomena using interviews and textual analysis (such as books and journals). The research follows the interpretivist paradigm because of its tight link with qualitative methodology in data collection. Interpretivism is a methodological approach, while qualitative methodology is the means of data collection. Both interpretivist paradigm and qualitative methodology seek to explore varying human experiences, knowledge, views, understandings, and interpretations of their data to determine or uncover reality rather than rely on statistical numbers (De Vos and Strydom, 2011:479).

3.3 Research design

Research design is the compass to data gathering. Du Plessis (2017:21) argues that data gathering, analysis, interpretation, and observation depend on the research design. It tells the researcher the meaning of data gathering and analysis requirements. A sound research design safeguards errors and fosters precision, which improves the validity and reliability of findings. Issues of reliability and validity, sampling techniques, data analysis and interpretation and ethical considerations become equally crucial for the credibility of the research.

The study was exploratory and descriptive, following a qualitative approach that uses interviews and documentary sources (scholarly journals and municipal policy documents). The explorative approach helps formulate problems, clarify concepts and form hypotheses (Stebbins, 2019:4). It facilitates the investigation and examination of new material to discover relationships between existing background knowledge and unfamiliar content and concepts. It enhances literature searches and in-depth interviews to better understand problems by describing or illustrating. The exploratory type of inquiry of the qualitative research was chosen over other methods. It allowed the researcher to gather factual data, which ultimately provided a variety of meanings, answers, and solutions to the phenomenon studied. Moreover, it leads to more insight into the phenomenon as it entails in-depth interviewing of the participants (Creswell, 2007:21). Explorative is also flexible and adaptable to change in data collection, facilitating the greatest depth and insight (Stebbins, (2019:5).

Descriptive and qualitative research are sometimes used interchangeably as both involve naturalistic data without interaction or manipulation of variables. The descriptive approach helps to describe, explain and validate the research basis for important decisions that are to be made. It provides essential facts and understanding about the nature of the phenomenon (Aspers and Corte, 2019;140). The study is qualitative as qualitative research is primarily exploratory research used to uncover trends in thought and opinions and delve deeper into the problem. Qualitative research is more holistic and often involves collecting data from various sources to better understand individual participants, including perspectives, knowledge, opinion, and attitudes (Aspers and Corte, 2019:142).

The approach was critical to this study because of its holistic nature, which can facilitate a deep understanding of the real causes and impacts of the Cape Town water crisis and the strategic

interventions employed by the authorities in alleviating the crisis. The study employed the qualitative research method as the intention was to investigate the problem in the social and natural settings of the people. The intention was to explore the phenomenon by gathering rich and factual data in participants' social or natural settings. The use of interviews facilitated the researcher to obtain first-hand information from the people impacted by the water crisis. First-hand information has the greatest benefit of giving richer understanding gleaned from personal interaction. A deep and better understanding of the crisis was attained, creating the basis for important decisions that authorities can make to provide sustainable water supply to the city.

3.4 Data sources and collection techniques

Primary (Interviews) and secondary (documentaries) data collection methods were used in this study. Interviews (semi-structured), scholarly journals, and municipal policy documents were used to collect data. Semi-structured interviews were used because they gave the researcher room to get creative in a more open-ended and conversational manner. A semi-structured interview refers to a type of interview whereby an interviewer asks a few pre-determined questions, and the rest of the questions are not preplanned (Pollock, 2019:2). Semi-structured interviews consist of both structured and unstructured interviews. They are essential for collecting information based on people's ideas, opinions or experiences. They help to understand, explain and explore the phenomenon.

A list of topics was prepared to guide interviews, allow probing and developing of questions, and obtain more complex information, particularly from government officials. Although the city is multilingual, the use of an interpreter was not required because the researcher was fluent in many local languages and English.

Interviews were non-contact at the time of data collection due to the Covid-19 pandemic. The data collection period was the month of February 2021, when South Africa was experiencing a second wave of coronavirus infections. Alternatively, interviews were conducted through telephones, text-based instant messaging platforms such as WhatsApp, and video calling platforms like Skype, Zoom or Microsoft Teams. Video calling was most preferred because it facilitated the researcher-participant interaction to determine non-verbal cues, bringing depth to the interview. It also

enhances data to be collected over large geographical areas, even when social distancing measures are absent (Greeff, 2020:4).

Telephonic and digital online platforms were used to contact community gatekeepers, secure appointments, and contact interviews with informed personnel in the Provincial Government's Department of Water and Sanitation (DWS), businesses, and public places such as schools and health centres around the city. Contacts for the above groups of participants were accessed from websites and telephone directories. Citizens were also critical participants considered for interviews. Councillors and community leaders, who are communities' gatekeepers, were contacted to provide referrals for potential participants for the study. Hence snowball sampling was used where the researcher starts with a few people and then asks them to refer others who might be willing to participate in the study.

The officials interviewed from the DWS were from supervisors and above. Such senior staff were informed personnel rich in the required information for the study. Digital voice and video recording were used for data collection, where data was later transcribed into textual format. Interviews focused on examining the causes of the water crisis, impacts exerted by the water crisis to the city, challenges faced by the authorities in stabilising the water crisis, the implemented strategic interventions and their effectiveness in resolving the water crisis and how public participation was engaged and its value as a tool of democratic resolution to contemporary service delivery process.

Businesses, industries and health care officials in both Northern and Southern suburbs at the managerial level, rich in information, were interviewed to give informed data on how they were impacted in their daily operations with the water crisis. The study explored the challenges they faced in keeping their daily activities running, strategies they employed and how the city engaged and assisted them in resolving the water problems for the good of their activities. Their opinions, experiences, and lessons learnt facilitated quality information for the study, enhancing policy reforms to improve water service delivery in the city.

Principals of schools both from Northern and Southern suburbs were interviewed. The school principals elucidated the way the water crisis impacted the education sector. They furnished the study with the interventions taken by the schools in alleviating the water problem and how the schools and the city engaged each other in resolving the water crisis. Schools' opinions,

engagement with authorities, experiences and lessons learnt were vital in achieving the study's objectives.

Household adults (18 – 65), especially the poor, high-density suburbs across the city, were interviewed. The poor were the most disproportionately affected due to lack of an array of survival options in times of a crisis, owing to limited available resources, mostly financial. Their opinions, experiences, coping, and adaptation strategies during the crisis were explored. The information from the most affected population was pivotal to the study to establish a deep understanding of the impact of the water crisis, interventions employed and participatory engagement of communities by authorities such that the study's objectives are achieved.

Scholarly journals and municipal policy documents were used for attaining more detailed data to complement collected data from interviewees on causes, impacts, public engagement and the authorities' strategic interventions in stabilising the crisis. Several journals, government or municipal policy documents and online publications were used to acquire the relevant information to the study. Document analysis increases the validity and reliability of the study by triangulating with data from interviews.

3.5 Sample profile, size and technique

The sample has a common characteristic: it constitutes the City of Cape Town residents, with first-hand information and depending on its water supply. Purposive sampling was the main technique used in the study. It is a technique used to recruit participants to provide in-depth and comprehensive information about the phenomenon (Du Plessis 2017:21). Palinkas, Horwitz and Hoagwood (2015:543) explain that the technique is usually referred to as selective, subjective or judgmental sampling. The technique provides non-probability samples which receive selection based on the characteristics within a specific population group and overall study. The technique helps researchers to extract more information out of collected data firmly. Compared with other sampling methods, it is time and cost-effective and versatile. It provides an opportunity to generalise from the data collected (Palinkas *et al.*, 2015:543). Purposive sampling strategically sampled units based on relevance to the research problem and data-rich participants were selected for interviews. The technique was used first to select data rich participants in DWS, institutions

and business where only participants at managerial level were chosen. Participants were from the level of supervisors and upwards.

Purposive technique was thereafter used to select councillors and community leaders, who were communities' gatekeepers, contacted for interviews. Councillors and community leaders had adequate data of issues pertaining to their areas of jurisdiction; hence they provided detailed data. Thereafter, snowball sampling was used as these gatekeepers were asked to provide referrals of potential study participants. More so, they referred the researcher to people who they knew had useful information for the study.

Snowball sampling was used where the researcher started with a few people and then asked for a referral to others who were willing to participate in the study. The method needed the researcher to create a rapport and reputation for trustworthiness for subjects to participate and refer to the researcher (Crossman, 2019:2). It is a non-probability sampling technique where the current or existing research subjects recruit future subjects from associates or colleagues. The technique is quicker to find samples as referrals make finding subjects as a reliable source provides them. Additionally, referrals are found from a primary source of data. Hence it is inexpensive and convenient compared to other methods (Crossman, 2019:2). Usually, people do not want to participate in research because they want to protect their identity. However, snowball provides a scenario where such people ask for a reference from people known to each other. People with the same experiences, such as sexual assault, can refer to each other. In this study, people severely affected by the water crisis referred to one another. It is a non-probability sampling method utilised when characteristics to be possessed by samples are rare and difficult to reach (Du Plessis 2017:21). This means that participants of the sample group were recruited through chain referral and finding them was quick and easy. The technique was used because it becomes easy to reach potential participants as not everyone was at liberty to take part in disclosing required information by the researcher. The technique saved time and expenditure of carrying out the study.

The total sample size was forty-two (42). The study was non-gendered and non-racial. Participants were both male and female from different races. It was only on households interviews where the study balances the number of participants to be (15) males and (15) females. On the side of informed personnel, the interviews were done with readily available participants regardless of gender or race. The sample size was large enough to obtain sufficient data to describe the problem

of interest and address the research question. Four (4) informed personnel from the provincial government's department of DWS were interviewed. Four (4) informed personnel from business and industry, two (2) school principals and two (2) health care managers were interviewed. Interviewing participants from different sectors affords an opportunity to deeply explore matters unique to the participants' experiences, giving insights into how various phenomena of interest were experienced and understood. These interviewees had informed participants with a wealth of information required to attain the study's objectives. Fifteen (15) households from Southern suburbs and fifteen (15) from Northern suburbs, particularly in high-density suburbs of the city were interviewed, particularly the indigent who were the most affected by water crisis . These participants were obtained through a referral from community leaders and other participants. Adult household members aged 18-65 (one from each household) were selected from various Southern and Northern suburbs communities who were present during the crisis. These were members from the poor communities who possessed the most needed data to achieve the study's objectives. They were the most impacted by the water crisis due to their limited survival options due to the segregation nature of the society and limited financial resources to widen survival options.

However, the study was a retrospective account (a the study that looks at the past or backwards and examines exposures to suspected risk or protection factors in relation to an outcome that was established at the start of the study) of a crisis. Hence some disadvantages have surfaced, such as forgetting important data, difficulties in data validation, the misconception of factors and significant bias as recall could be flawed. Therefore, employing another data source such as documented data rather than interviews alone facilitated the gathering and comparison of more data to increase the credibility of the study.

3.6 Data Analysis and interpretation

The researcher did interviews and recording of data. Audio and video recording and notetaking were used for data collection. Observation notes were taken simultaneously as interviews to compliment audio-taped interviews. Although some indigenous languages were used, the principal language of engagement was English. This was not a limitation as the researcher could converse in many local languages. Data was then translated to English. All recordings were transcribed verbatim before data analysis. Transcription was done as soon as possible to establish whether participants were appropriate for the study or not and whether more questions and probing was

required for clarity. Then all other data analysis and organisation of collected data were done to make inferences.

Thematic analysis was used for identifying, analysing and reporting patterns or themes within data. It is a descriptive method that reduces the data flexibly links with other data analysis methods (Castleberry and Nolen, 2018:808). Thematic analysis is a data analysis strategy that is a frequently utilised approach across all qualitative designs and is a subject of methodology review, appraisal or evaluation. The method is commonly used because of the broad array of research questions and topics it can address. The method is used in research studies and eventually labelled as qualitative research, withholding the necessary details about how the analysis reduced the data into workable themes and emerging conclusions (Castleberry and Nolen, 2018:808). It is a method used for analysing qualitative data that entails searching across data sets to identify, analyse and report repeating patterns (Kiger and Varpio, 2020:847). The method can identify patterns of meaning across a dataset that answer the research question being addressed (Du Plessis 2017:21). It is used for describing data and involves interpretation in selecting codes and constructing themes.

Data patterns were identified through thorough data familiarisation, coding, and theme development and revision. Data was in the form of transcripts from interviews. The deductive method (working from a more general to a more specific or top-down approach) was used for data analysis, where collected data will be organised according to the research objectives. Coding was followed where data was grouped into concepts, properties, and patterns using descriptive coding and, after that, building themes or patterns to gain more meaning. Data were organised, interpreted, linked to research objectives for improving the bases for informed and verifiable conclusions. Data were then synthesised. This means that data was distilled, summarised, and reported meaningfully to readers and respective participants.

3.7 Issues of reliability and validity

Triangulating several data sources and methods provided a confluence of evidence, creating credibility, a deeper understanding of multiple and diverse realities and reducing the potential of bias as data was collected through different methods. Triangulation facilitates the involvement of several investigators and peer researchers, which add value to the data interpretation by searching for convergence among multiple and different data sources to form themes or categories in a study

(Golafshani, 2003:604). Golafshani (2003:604) continue arguing that triangulation enhances a complete understanding of phenomena, confidence in research findings and reliability by reducing systematic (method) error through the use of multiple sources. It provides broader insights into the study.

Clear processing during data collection and analysis, and interpretation has helped improve the study's credibility. Also, acknowledging biases in sampling and ongoing critical reflections of methods have improved the study's credibility. Following the study's theoretical framework has enhanced consistency and adherence to a systematic data collection that addressed the study's objectives. Trustworthiness of the researcher in all steps of the study has ascertained the truth to be established in the research report. The study's validity and reliability were also attained by adherence to the data collection method, sampling, analysis, synthesis of data, and research ethics. During the Covid-19 lockdown, telephonic and online platforms were appropriate data collection techniques instead of face-to-face interviews.

Great care was taken to improve reliability and validity. More than one type of recording was used to ensure quality data capturing. The researcher listened to recorded data as soon as possible after the interview to check for completeness and audibility. In the event of problems detected in recorded data, the interview reconstruction was done for improved detail. More so, the quality of the recordings was tested before the commencement of the interview such that participants were visible to determine non-verbal cues that were essential in bringing depth to the interview. The authenticity of the study was enhanced by sorting opinions of different data sources and making comparisons of different publications, refraining from carelessness and mistakes in the study's conceptualisation, data collection, interpretation of findings and reporting of improved data dependability of the study. Conformability was established by employing an audit trail that made a judgement about the potential distortion or bias of the study. A thorough description of the research context and assumptions that were pivotal to the study was done to enhance the transferability of the study. The use of more than one data collection method assisted with checking for consistency of findings, hence improving the credibility of the research.

3.8 Ethical consideration

This study attained permission for interviewing staff in the DWS through correspondence with the Director General's office of the department concerned. However, during the Covid-19 lockdown restrictions, some staff were not at liberty to engage in online interviews and their decisions were respected.

The research was done after University of South Africa has granted the Ethical Clearance (Annexure A) to the researcher. Ethical clearance ensures that the study is done in a responsible and ethically accountable manner to protect rights, safety and dignity of study participants. It reduces the risk of harm to humans and even animals, ensuring beneficial outcome of the research. Ethical approval ensures that the research design is ethically sound such that anticipated results can be attained with increased legitimacy, vital for decision-making process based on research findings (Henekom, 2018:2).

An interview guide was created, and the researcher chose an appropriate time suitable and comfortable for the participant. Rapport, such as being respectful and polite when communicating and thanking participants after the interview, was built with interviewees. The issues of right to privacy, informed consent, voluntary consent, confidentiality, anonymity and avoiding any harm or risk to participants were considered carefully. Invasion of the participant's rights to privacy, full disclosure of the nature of research, expected duration, the procedure of study, prospective research benefits were given to the participants such that comprehending expectations and a voluntary choice to participate or not was established. Participants' information was held in confidence, particularly information of a private and sensitive nature, if there was any, which participants could willingly volunteer to give. Permission of the participant was sourced if disclosure of information was required. The study did not use identities such as names, pseudonyms or vernacular terms. Participants were not harmed, exploited or given unfulfilled promises, benefits, misrepresentation and delving into their personal lives. Plagiarism was highly guarded against in the use of documentaries. Permission for carrying out interviews is critical in research.

Seeking consent from more participants was necessary to engage the required number of participants needed by the study, and the same applied to businesses, industries, healthcare centres and schools' directorates. Informed consent letters suitable for each group were designed and

emailed for signing by the participants. Obtaining informed consent from participants was difficult during the era of Covid-19 pandemic, but it was critically essential for the qualitative research process, including humans. According to Greeff (2020:1), the process of obtaining informed consent during the time of the Covid-19 pandemic has some challenging issues, particularly to community engagement and community entry. Hence, there were guidelines applicable to qualitative research during the Covid-19 pandemic. Digitalisation has brought a different obtaining informed consent form from the usual face-to-face process (Greeff, 2020:1-7).

As for this study, informed consent documentation was emailed to participants to secure an appointment. An appointment was set up between the researcher and the participant through telephonic or online platforms. The audio-visual option was preferred because it added visual contact between the researcher and participant during the signing process. The participant had an independent person present to co-sign and witness the signing process during the signing process, while the researcher did the same. All four were present during the signing process as visibly undertaken over the video link. This facilitated the informed consent to be done in a fair and safe scenario (Greeff, 2020:4). The researcher and participant agreed to confirm the informed consent process by signing the form together when the situation allows the parties to meet. This was a form of delayed consent. More so, any other format possible could be used if the lockdown continues. After that, the participant should scan and fax the signed document to the researcher and keep the original copy until both can meet, where the researcher obtains the original document. Another option was that the participant could take a photograph of the document by a cell phone and send it to the researcher by WhatsApp.

During the period of Covid-19 restrictions, participants were allowed to withdraw from participation at any time. Participants agreed to participate, and the non-contact research ethics protocol was applied. Interviews were conducted through telephonic conversations and online platforms such as WhatsApp, Skype or Zoom video call. Confidentiality problems and identity theft could have resulted unknowingly, but great care was taken in choosing the online platform for data collection. Data was deleted immediately from online platforms after each interview and was stored in a locked cupboard and electronic password-protected files by the researcher. The researcher and the supervisor were and will only have access to such data.

During the interviews, the process of obtaining informed consent remotely had the need to be repeated and informed consent required to be confirmed by the participant verbally and recorded (Greeff, 2020:4). The same applies to a telephonic interview, which was done with participants who lack internet access to support online platforms and are unable to use such online platforms. However, four people were involved: the researcher and the witness and the witness who should hear the informed consent process. The four parties were visible on the online platform, but not on telephonic platform. However, the process followed was the same as explained above on online platforms. Online platforms facilitate non-verbal cues to be determined and initiate access interaction, although sound quality should be tested for quality recordings. Telephonic interviews lack the richness of observation but are quite critical when internet access is limited (Greeff, 2020:5).

3.9 Conclusion

Research methodology is the study's critical component as it helps determine its authenticity. Research design helped make justifiable conclusions and a deep understanding of the topic. Interviews and published documents were the two methods used in data collection, and adequate data for the study was obtained. Although Covid-19 protocols have changed the usual face-to-face interviews to virtual, the anticipated findings were attained by the study by contacting virtual interviews and thorough documentary analysis. The findings of the study were thematically presented in the next chapter in accordance with the research objectives.

CHAPTER 4: PRESENTATION OF RESULTS

4.1 Introduction

This chapter presents the findings of the 2015–2018 water crisis on sustainable development in Cape Town. The key findings were under the causes and impacts of the water crisis in Cape Town and the strategic interventions employed by authorities, and the role of public participation in stabilising the crisis. This chapter presents the findings in fulfilment of the study's objectives. The detailed methodology used for this study is presented in Chapter 3. The study was exploratory and descriptive, following a qualitative approach. The chapter presents primary and secondary data sources to triangulate the research findings. The data collection methods used were in-depth interviews and an extensive desktop review of relevant documents (scholarly journals and municipal policy documents). The results were organised into themes and sub-themes and were presented under several sub-sections linked to the research objectives outlined in Chapter 1. Findings are primarily from the Cape Town suburbs. The data collection was non-gendered and was confined to informed personnel and ordinary residents, particularly the indigent members of society who were the most impacted by the water crisis. The systems approach was the guiding theory to the study and the needed data for the research question was obtained. Although the Covid-19 pandemic protocol disrupted face-to-face interviews in favour of virtual, data collected fulfilled the requirements of study objectives.

The research thematically presents the findings. The major sub-headings illustrate the findings, beginning with the causes of the water crisis, impacts of the crisis, strategic interventions implemented by the city and the role of public participation in managing the crisis. Drought, lack of foresight, political controversy, migration, infrastructure and poor governance were among the factors contributing to the water crisis. Agricultural production, tourism, business and industry, and domestic activities were hugely impacted. Strategic interventions such as water demand and supply restrictions, diversification of water sources and behaviour change were implemented by the city to enhance a sustainable water supply. Public participation was incorporated as a critical tool in alleviating the crisis although some challenges were met in the process.

4.2 Causes of the water crisis in Cape Town

Climate change is the real phenomenon facing the province with no signs to end or adequate mitigation. Climate change is caused by human activities that release greenhouse gases into the atmosphere. Industrialisation and technological advancement are the major factors that alter temperatures and rainfall patterns. The average annual temperature in South Africa has increased at 0.14°C per decade over the past 30 years (Bonatch, 2017:2). Estimates of future warming are in the range of 1.4°C to 4.7°C, relative to 1971–2000, by 2100. Rainfall may also reduce annually by as much as 9% by 2100, relative to 1971–2000 levels, which are estimated to lead to a 20% reduction in surface water supply (Parks *et al.*, 2019:3). During 2015–18, Cape Town’s catchments received rainfall very late than expected. Rainfall was sporadic, such that some catchments received little or none (Bonatch, 2017:2). Variability in weather patterns signifies that the drought interval, which is the time between less than average rainfall, is getting shorter, bringing a massive predicament if the region is not receiving some good years of rain to bring normality to water availability. More so, variability in rainfall delays the coming of the rains. Consecutive cold fronts which usually bring good rains for almost three consecutive days are rarely being experienced (Bonatch, 2017:2). This shows that the water crisis is getting more profound and quite complex to solve and enhance sustainable water management. The devastating climate change effects are increasingly unveiling in many global regions and escalating the El-Nino impact.

4.2.1 Drought

The provincial DWS officials highlighted meteorological drought as a vital contributor to the city’s water dilemma. Due to global weather fluctuations like El-Nino, the total rainfall in winter varies dramatically, and a given winter is usually either very rainy or very dry (Babis, 2018:3). Unpredictable weather patterns from the El-Nino effect have driven the catastrophe in which the city found itself. According to the United States of America (USA) National Oceanic and Atmospheric Administration, the year 2015 was regarded as the warmest year of the century by most scientists due to its warming of 0.9°C above the average for the 20th century, which is the largest margin by which the annual global temperature record has been broken (Cho, 2016:2). Such warming of the planet leads to El-Nino–Southern Oscillation (ENSO), a phenomenon that drastically alters the normal weather patterns, resulting in heavy rainfall and droughts on different parts of the globe. The El-Nino impact can shift seasonal temperature and rainfall patterns

worldwide through the effects of tropical sea-surface temperatures on the upper atmosphere. It has unusual qualities or characteristics of timing, intensity and precise pattern changes, temperature shifts, and rainfall patterns that never become the same in every El-Nino event. The haphazard fluctuations of atmospheric and sea surface temperature influenced by El-Nino events affect the weather and climate patterns experienced in many parts of the world, enhancing probabilistic seasonal forecasts instead of absolute certainty (Cho, 2016:3). The scenario usually takes place every two to seven years. The 2015–2016 El Niño has been regarded as the super El Niño, the worst in 15 years. Two previous super El Niños occurred in 1982–1983 and 1997–1998 (Cho, 2016:4). Cape Town’s rainfall mostly depends on El-Nino, whereby the stronger the El-Nino, the less the rainfall the region receives, causing retarded river discharges feeding reservoirs, thereby reducing levels of reservoir storage and ultimately water shortage (Wanders, 2018:3).

4.2.2 Lack of foresight

Both local and national governments have contributed to Cape Town’s water crisis due to a lack of foresight. The city’s water crisis owes much to a change from management anchored on science and risks assessment to a more populist approach (Muller, 2018: 4). Muller (2018: 3) argues that South Africa’s key conurbations have used systems models to guide their water resource management since the 1980s. Systems models managed by national governments are regarded as world-class. They show linkages among river basins, reservoirs and transmission channels and utilise historical hydrological data to determine probable river flows. Therefore, those linkages are matched to demand projections to estimate or evaluate the required water storage. Such systems models warrant the provision of real-time water network operations and development planning, critically facilitating planners to determine risks associated with supply failure to various users and evaluations of the success of user responses such as user restrictions (Muller, 2018:3). Systems models have directed policymakers and managers for two decades on time and location to tap sources and reservoir construction to enhance WCWSS to adequately meet the surging demand of both industrial and urban growth.

Since the year 2000, dam construction was put on hold due to campaigns of environmental activists, shifting the focus to the conservation of water and demand management. The construction and completion of the Berg River dam were delayed by almost six years, yet it is the reservoir that kept the taps running in the 2018 summer season. By 2009, the systems models had

already signified the requirement to increase the city's water supplies post 2015. However, the officials ignored or did not consider the recommendations. The authorities failed to understand the financial and social repercussions of their decisions. Money was spent on issues other than water, delaying substantial capital investments. In 2016, one of the councillors closely linked to the city's water services has narrated that they did not consider acting against the approaching catastrophe because,

“It is quite unreasonable to spend billions of rand to safeguard the city from the drought that probably cannot occur.”

They failed to notice that the Cape Wine and Fruit farmers entitled to a third of the region's water supply were not fully drawing their allocation during the period of sufficient precipitation.

The six Western Cape reservoirs that supply water to the city can hold less than two years' worth of supply. It only took two consecutive dry seasons of 2015 and 2016 for the city authority to identify the real problem knocking on its doors (Muller, 2018:4). The region's stream flows dropped by 80% by the end of 2017, compared to the same period in 2013. The city had limited options to prevent the catastrophe except to confront the problem head-on. Such a scenario signifies the presence of water governance problems in the city. Lack of water supply diversification leads to the national government's failure to timeous response and misleading water supply predictions to the heightening drought. Hence, the water restrictions, increased tariffs and other conservation measures of the precious resource began.

4.2.3 Population growth

The increase in population has posed high water resource demand in Cape Town and will worsen the threat of water scarcity in the coming years. As the population of Cape Town has grown (from 1.6 million in 1980 to over 4 million in 2018), water available per person each year has dramatically decreased, from a high of over 500 000 litres (100 000 gallons) per person per year in the early 1980s, to around 200 000 litres (50 000 gallons) per person per year in 2016 (Parks *et al.*, 2019:3). Parks *et al.* (2019:3) continue arguing that, historically, the city had no high access to water; hence the increase in population cannot work in its favour. The Centre for Local, State and Urban Policy (CLOSUP, 2018:3) states that the city's population has doubled over 15 years from 1996–2011, putting more pressure on water sources and infrastructure. Such factors have critically lowered the city's dam water storage levels from over 70% in 2014 to just over 20% in 2018. An

increase in birth rate, rural-to-urban migration, and immigration were labelled as the key contributors to the rapid population growth of the city, which surpasses available resources.

4.2.4 Rural-urban migration and immigration

The search for better economic opportunities such as employment has immensely contributed to rural-urban migration and immigration from other countries. Most immigrants were from African countries, pushed by poor economic status and political instability in their countries. Countries such as Zimbabwe, Malawi, Lesotho and Mozambique are some of the major sources of immigrants. Such influx of people requires clean drinking water and sanitation, which has overwhelmed the City's capacity to provide. A government official pointed out that,

“South Africa is Southern Africa's economic powerhouse; hence economic migrants are flooding major cities to the extent that the available resources cannot cope. Considering the country's current economic growth, which is lower than anticipated, increasing immigration and rural-urban migration to major cities such as Cape Town poses a great challenge of surging demand for basic services.”

4.2.5 Governance system

Poor governance issues were at the centre of the Cape Town water crisis. The absence of political connection between the national government and Western Cape local and provincial governments instigated a complicated relationship between the two authorities. The Western Cape is the only South African province governed by the official opposition party, the Democratic Alliance (DA), while the rest are under the African National Congress (ANC). Most residents affiliated with the DA were arguing that,

“Both the City of Cape Town (local government) and the provincial government have put efforts as expected to prepare for the drought, but the national government did not render adequate action despite warnings which were signified by the provincial DWS and local government authority.”

The national government was inadequately responding to the concerns of other spheres of government. Some of the decisions taken by the national government were not in consultation with the provincial and local government officials. The national government allocated 60% of the Western Cape region's water to the city and the remainder to the agricultural sector in late 2015 without consensus with the lower government structures. Yet drought had peaked in reducing dam

water levels since 2015/2016, and the DWS took no action to retard agricultural water use. The supply system's capacity and the city's safety buffer of 28 thousand megaliters was continuously strained.

During that same year, 2015, the Western Cape provincial government applied R35 million to the national government to execute borehole drilling throughout the province to boost the region's available water supply. However, the national government turned a deaf ear to the provincial request because dams were at 75% complete at that time. The provincial government forwarded another financial application to the national government in 2016. Still, only five out of thirty provinces, Cape Town excluded, were identified and acknowledged as drought disaster areas. But quite surprisingly, none of the recognised municipalities had received the expected funds by October 2017. A provincial government official narrated that,

“Truly, there was gross maladministration in the entire national DWS, such as mishandling of funds, flawed water allocations to agriculture and failure to quickly respond to the local and provincial government's calls for financial assistance to boost the provincial water supply. Since 2015, as the local government, we applied for funding from the national DHSWS to commence water augmentation projects as a response to the looming water crisis in the province, but no response was attained until the disaster struck.”

Water reserve supply, which was available before 2015, simply signifies the national government's turndown to expensive water infrastructure projects funding. On the other hand, it might mean a financial and managerial crisis in the national governance system.

Mismanagement, surging debt and corruption were key issues crippling the government's release of drought relief funds. The Auditor General's report identified wasteful, fruitless, and irregular expenditure of over R110 million on the national DWS's 2016–17 budget. Additionally, the department had no funding allocated to drought relief in Western Cape for the 2017–2018 financial year (Winsor 2018:1). In 2007, the WCWSS's Reconciliation study produced optimistic predictions of future water supply and emphasised the implementation of strategic interventions to improve water supply and drought resilience in the city. By 2015, dam levels started dropping, yet there was the absence of any investment shouldered to mitigate the impending crisis. The local government's vigorous and intense management of water demand had commenced, yielding some

results and decelerating the national government's response efforts to both lower governments' requests. The situation proves poor cooperation and linkages between spheres of government.

4.2.6 Political controversy

Political infighting within the top national and local governments office bearers heightened in 2017, the period when the water crisis had reached its peak. Political disagreements were unfolding between the former mayor of Cape Town, Patricia de Lille and former Western Cape Premier Hellen Zille. The disagreements diverted the concentration of top officers from problems at hand that needed collaborative resolution. In 2017, the ruling African National Congress (ANC)'s Cape Town council Chairman lambasted both leaders saying,

“Bad, lax and lame-duck DA leaders De Lille and Zille must resign ...they contradict each other and lied to residents. The ANC will call for an urgent constitutional intervention to put the Western Cape under administration as the DA cannot deliver on its promises.”

The ANC council leader continued to argue that,

“...the council-sanctioned report had conveyed the information regarding the looming water crisis to Helen Zille about a decade ago, stating that by 2012 the city would face a water shortage. De Lille and Zille had been warned about the looming water crisis a long time ago but opted to reject warnings. It is the same administration which could not implement what was suggested by the report.”

The ANC was blaming the DA's infighting,, arguing that none of the proposed alternatives, encompassing desalination and drilling of aquifers, were on the city's schedule. This clearly shows that political leaders' energy, time, and concentration were directed to resolving their political battles instead of fulfilling tasks mandated to their offices by the electorate. More so, the political tussle between the mayor and the entire DA's Federal Executive diverted the concentration of the leadership from essential governance issues to political disputes. One interviewee narrated that,

“...there was limited time for city officials to execute their duties as infighting among officials was surging that most of the Federal Council's time was spent on stabilising disputes rather than solving a burning issue of the time which was water crisis.”

The former DA Western Cape leader Bonginkosi Madikizela argued that Mayor Patricia De Lille had played a public panic around the water crisis. The leader accused De Lille of delaying budget

decisions and withholding information about the water crisis. De Lille was directing the blame at senior project managers tasked with tackling the drought crisis, which she accused they never managed to come up with an overall plan off the ground. She was at the centre of vigorous infighting within the City of Cape Town's leadership (Dolley, 2018:2). The DA federal executive tabled a motion of no confidence, which witnessed De Lille being removed from directing drought crisis plans in January 2018. Hence, the infighting has directed De Lille's effort to resolve party battles rather than the crisis.

4.2.7 Colonial legacy

The injustices of the past have contributed to Cape Town's water phenomenon. Racial inequality created during the apartheid era from 1948–1994 exists in the city. Political priorities, which had historically catered for the interests of rural commercial white farmers, have continued to date in a democratic government. Cape Town's service delivery was highly differentiated and mainly catered for white South Africans. Less priority was directed towards developing townships and informal settlements where most black and people of colour lived. Residents in informal settlements of both Northern and Southern suburbs concurred in arguing that,

“...the apartheid era scenario is still with us, and our new government did very little to change our lives, specifically when it comes to basic services. Nobody can hear us. Just look at our living conditions and compare them with those in affluent white suburbs; it is very unfair. Imagine the distance we walk to access water at a community tap, yet others have many taps in one yard.”

Presently, the municipality generally struggled with a much weaker tax base, overcrowded neighbourhoods, resource mismanagement and corruption to speedily transform the colonial legacy. When a disaster occurs, the marginalised are the most hit, and recovery takes time due to their high level of vulnerability, deepening their poverty status.

4.2.8 Infrastructure

The collapse of piping infrastructure was one of the major problems the city was battling. Government officials have cited that ageing infrastructure has resulted in water leakages from the bulk piping network to consumers. A retired city engineer explained that,

“The city's highly kept secret is the poor state on sections of its bulk water reticulation system. The bulk water pipeline suffers from electrolytic corrosion. The bulk pipeline is

fitted with devices called sacrificial anodes at different locations of the system. It requires regular inspections and replacement to make sure that it's the anodes being eroded, not pipelines. The inspection of such anodes was last done some ten years ago due to vandalism of systems, especially in informal settlements, and the pipelines were subjected to surging corrosion."

The authorities lacked regular checks on the infrastructure to detect and stop corrosion of water supply pipelines. Some systems had to be inspected, and electrical measurements were taken nearly twice a year to ensure functionality. Reinstating the systems was then expected to be done by an external service provider over a couple of years. Although Cape Town has the lowest average water loss of 16%, compared to the national average of 36%, it is a large volume of water to lose for a city facing a critical water challenge (Joss 2018:2).

4.3 Impacts of water crises in the city

4.3.1 Negative impacts

4.3.1.1 Agriculture

Agriculture, one of the rapidly expanding economic sectors, contributing immensely to both provincial and national Gross Domestic Product (GDP), has suffered severely. Government officials argued that the primary commodities of the Western Cape agricultural sector were particularly horticulture, which are fruits, vegetables, grape vines, wheat, canola and barley, requiring irrigation. Livestock and dairy were also dominant. Farmers relied on municipal water for irrigation as a mitigation tool against retarded rainfall. It was estimated that the major crop production was reduced by 20.4% from 2016/17 to 2017/18 farming seasons, equating to R5.9 billion (US\$415m) loss in agriculture. The Western Cape economy contributes about 13% of the national GDP, which means that a reduction by a single percentage in the province's GDP draws off about 0.13% of the national economy (Parks *et al.*, 2019:4).

Cape Town is one of the world's famous cities, with wine production as one of the critical factors presenting the city on the global map. Wine production was retarded by 20% in the 2017/18 farming season, yet the wine industry is one of the primary foreign exchange-earners of South Africa (Parks *et al.*, 2019:4). The grapes and wine quality were affected by increased temperature and prolonged dry periods. High temperatures usually increase grapes' potassium, acidity and

sugar content, which causes lysis in micro-organisms, resulting in osmotic stress and poor quality of the wine. The aroma and taste of wines can be affected by high temperatures in the Mediterranean climate and increased stressors on grape vines due to increased diseases, shortage of chill units, and rising due to water shortages (Araujo, Abiodun and Crespo 2015:2). Fruit and vegetable production, such as onions, potatoes and tomatoes, dropped by 15% year on year (Parks *et al.*, 2019:4).

Farmers have reduced the planting hectareage because of water shortage. Severe food shortages gripped the city due to both reduced quantity and quality of foodstuffs and increased prices at the market. The poor were the most affected because of their poor financial status, inhibiting them from coping with surging food prices. Travelling to reach the farms where prices would be lower than the city markets was also a challenge for the poor, pushing them away from better nutrition. Both quantity and quality of fresh vegetables and fruits needed daily of many people were affected, increasing malnutrition in already malnourished poor households. A government official argued that,

“Although the city was supplied with some agricultural food products from other provinces that had a better harvesting season at the time, long transportation distance and increasing fuel prices were critical factors increasing food inflation within the city, presenting a severe challenge for the poor households to put a decent meal on the table each day.”

Reduction in agriculture production was a massive problem for a city and country that depends mainly on agriculture as the top contributor to its growth. The reduction in the production of such an important sector, even by a small percentage, can significantly impact the local and national GDP. Even if adequate rainfall can be received in the coming years, the city’s water crisis was not promising to be entirely resolved in short term and production maximised. An alternative water supply and permanent lifestyle change was pivotal for the citizens to stabilise the problem confronting them. A school principal echoed that,

“It is high time for all the residents of Cape Town to change their behaviour towards the water. Everybody should have respect and great care for this precious resource.”

However, behaviour change was required in the city. It was and will not be an easy task to achieve considering the required effort to educate the communities that lack other basic services such as

electricity and shelter. It was not a short-term task but a long-term one because of the time demand and effective community engagement. Moreover, governments usually engage the public effectively to resolve a crisis, but in other development projects, the public can be partially or not incorporated in initial stages such as planning.

4.3.1.2 Tourism

Tourism is one of South Africa's biggest professions, contributing about 11% to the national GDP, the same amount gained from agriculture (Parks *et al.*, 2019:4). The water crisis highly impacted this industry. Government officials confirmed that tourists made many travelling cancellations to the Western Cape for the 2017–18 summer season. The scenario highlighted that tourists were not pleased with the prospect of visiting an area where people stand in queues to access daily water shares. The scenario was uncomfortable for a city that boasts a global tourist destination because a more considerable portion of its income was generated from tourism. The local and national economy was affected. Visual and performing arts were impacted, such as the Cape Malay Minstrel clubs (groups of coloured Afrikaans-speaking singing songs of Malay choirs and ghoema drums). Such arts are income-generating activities that enhance sustainable livelihoods for many households. Artists display and perform all over the city at centres of attraction such as beaches, townships and the city centre. However, the decrease in visitors during the water crisis affected the artists' income, which sustains food supply, education, health, and municipality bills.

4.3.1.3 Loss of income

The city suffered severe loss of income made from municipal water. Government officials have confirmed that about R3.9 billion in water revenue was lost in 2017, 10% of its operating income (Tshwane, 2018:4). The operational costs of the crisis management policies and programmes and water supply projects have compounded the city's loss of income. The contraction of the city's two major industries, agriculture and tourism, decreased employment, value creation, and tax income. A downgrade impacted the city's capital expenditure to rising borrowing costs. This is so because more of it must go on interest payment for every South African rand spend, resulting in a slowdown in actual service delivery expenditure as it becomes less feasible or more costly (Tshwane, 2018:4). Even if the city had excellent strategic plans to alleviate the crisis, it should have been financially well-resourced to execute or implement its plans. Inadequate financial muscle can deter the city from establishing a sustainable water supply system.

4.3.1.4 *Reduced business operation*

Business operations were heavily threatened. Some suspended their operation, and others downsized. In the data provided by the city when ‘day zero’ (the time when the city’s taps were expected to run dry in April 2018) was approaching, more than 6.7% of businesses in Cape Town were expected to shut down while 11% had no jobs for their staff and 79.4% of the businesses had admitted that the situation had worsened and posed a great threat to their operations (Tshwane, 2018:3). Some companies were opting to relocate to a water-stable province like Gauteng, but the profound financial costs became a deterrent. One of the business executives argued that,

“...it is better for us to relocate to other provinces with a better business potential such as Gauteng, as the water crisis in Cape Town has severely reduced our production expectations.”

Such a scenario has driven a massive drop in investor confidence in the entire country and the region, thereby impacting economic growth and sustainable livelihoods. It is common knowledge that no investor can be at liberty to invest in a city or country that lacks basic water supply systems.

The impact on business reduced revenue for the city and affected social order and public health, particularly sanitation. The situation forced businesses to devise alternative water sources, such as the erection of expensive new technologies, such as reverse osmosis water plants, rainwater tanks and boreholes. Private hospitals, such as Vincent Pallotti hospital, were at the forefront in erecting reverse osmosis plants. Business balance sheets were hugely affected. However, while uncertainty is undesirable to humans because of the work and resources it demands, it sometimes brings energy and creativity that is usually not present when society is comfortable.

4.3.1.5 *Job losses*

There were job losses across the economic spectrum, especially in tourism, agriculture, business and industrial sectors. Individual and household income was impacted. South Africa’s unemployment rate surged to 20.7% in the fourth quarter of 2017, and the youth unemployment percentage in Cape Town increased to 31.7%, which is higher than the average national percentage (Parks *et al.*, 2019:4). Parks *et al.* (2019:5) pointed out that more than 30 000 jobs were lost and the most affected were seasonal workers, especially in the agricultural sector. Parks *et al.* (2019:5) continue arguing that the decrease in harvest was predicted to haunt the city for 8 to 10 years to come. Primary producers acted more conservatively and became less prone to invest and create

jobs. Lack of sustainable income impacted food availability that facilitates household nutritional basis. A decrease in salaries was witnessed because of reduced industrial operation capacity.

4.3.1.6 Restricted water supply

Water restrictions were imposed on the residents of Cape Town during the crisis period. The restrictions were evolved and developed progressively as the crisis became more severe. Residents highlighted that transgressive behaviour and excessive consumption of households were punished with fines ranging from R1 000 – R10 000. The highest implemented restriction of level 6B put residents on a bar of a maximum of 50 litres of water per person per day. This created a double impact on residents. Imposed water restrictions and fines were too hefty for consumers. The situation was cumbersome to residents, particularly the poor. Government officials highlighted that restrictions were usually revised on an ad-hoc basis by the municipality, and part of the revisions was done within a month of the previous restrictions. Sanitation was critically affected, mostly in densely populated indigent informal settlements and high-density suburbs. However, such acute water shortages can risk the safety of democracy as dictatorial decisions are needed to maintain water restrictions (Parks *et al.*, 2019:3).

4.3.1.7 Consumer exploitation

Water restrictions caused exploitation of consumers by one another. The poor and the elderly were at a higher risk of exploitation. Businesses, government officials, and household members interviewed concurred that the rapid increase of bottled water resulted in consumer exploitation. At water collection points such as Newlands spring, residents exploited one another. Other consumers were asking for money from one another just for standing in the queue on behalf of the other. Some unscrupulous residents spent lots of time collecting water at the spring to sell to the elderly and many other consumers without adequate time and energy to spend in the queue. One older woman from Newlands complained that,

“It is difficult for someone of my age to stand for a long-time queuing for water. The only option I have is to pay for those who can access it using my government grant money. I spent almost half of my grant income towards water purchase.”

Residents were made to pay for water collected at no cost from natural springs and other main water collection points in the city. Access to such spring water was monetised at inflated prices for both financial gain and reduction of demand pressure for better site management.

4.3.1.8 Increased tariffs

Tariffs were adjusted annually in July during the city's budget review in response to the water shortage. Significant increases took effect from 2016 to late 2018 to reduce water demand, financially disadvantaging the consumers. All households were used to 6 000 litres allocation of free water per month preceding the crisis. An additional 4 500 litres were given to indigent households. However, in the 2017/18 budget, free water allocation was removed for the non-indigent households, and a new fixed monthly connection charge was enacted in the 2018/19 budget, not connected to the consumption volumes and based on the supply pipe diameter entering the property (Parks *et al.*, 2019:3). A new tariff structure was needed to cushion the fixed costs endured in water delivery and mitigate income loss from reduced consumption during a higher tariff period.

Water users were burdened by tariffs which were so unaffordable. Protests were evident in indigent communities, including refusal to pay for water and other services deemed inadequate and inferior. For instance, water pipes were considered inferior, causing excessive leakages that generated water bills far beyond what users could pay. A community leader in Mannenburg asserted that,

"... I don't understand how the municipality calculates its water bills because my bill is too high, it's like I am paying water for the entire street yet its only me and my two children in the house. Am sure we are now paying for leaking water because of their poor pipe maintenance. I will never pay such a bill at all".

Residents were defaulting the payments by then and even at present, resulting in the poor financial status of the city, enhancing reduced services provision such as water piping maintenance. This signified the city's poor infrastructure establishment, maintenance and management, yet the up-to-standard infrastructure is regarded as one of the bases of adequate water services provision.

4.3.1.9 Limited water consumption

Water management devices (WMD) were installed on household supply pipes to enforce a daily water limit for a property. When a maximum daily limit was reached, the service was terminated, only accessed the next day. High consumption households who were not complying with written warnings to reduce water usage and adhere to the 10 500 litres per month were subjected to a penalty of having a water management device installed at their expense. The penalty was so severe that most households could not afford it. Considering that residents were facing major problems

such as job losses, inflated food prices and additional water purchases, such a penalty was a bitter pill to swallow for many. Residents were only entitled to increase their water amount based on the number of dwellers at the residence. Water pressure was reduced, slowing down household activities requiring adequate water pressure, such as washing and bathing. Water pressure has remained low although better than the crisis peak period of 2017/18. Many residents pointed out that,

“Water pressure is still low especially when consumption is high during the day, but it is better than during the peak of the water crisis period.”

Productivity loss was also a major concern. Residents were losing a lot of time in household activities such as bathing and laundry and had to fetch water from collection points. The working class were spending several hours queuing for water at natural springs and strategic water distribution points by authorities. Such time could have been used on other social and economic growth activities, hence impacting the developmental potential of a community.

4.3.1.10 Costly water serving equipment

Many residents have incurred huge costs by installing water-efficient devices, grey water solutions and rainwater harvesting tanks at their own cost. Private boreholes were drilled by business and affluent residents, bringing the number of registered private boreholes in the Cape Metropolitan area to rise from 1 500 to 23 000 between January and December of 2017 (Visser, 2018:3). The city did not offer any tax savings or rebates. Residents were very frustrated. The frustration affected DA, the provincial governing party, in their 2019 municipal election polls.

4.3.1.11 Drought levy

The levy was perceived as an ironic punitive tax by residents to stick to the city’s water preservation campaign. The mayor, Patricia de Lille, introduced a drought charge. The drought charge was based on property value and calculated at between 10% and 11% of the rates portion of the municipal account to pay for the shortfall and costs incurred by the council for providing alternative sources of water. The drought charge aimed to provide an income of R1 billion per year over three years to finance emergency water projects, water delivery, and sanitation services. However, there was a public outcry against such a proposal. Civic organisations such as Greater Cape Town Association and Organisation Undoing Abuse have accused the city of incompetently

following public participation processes to debate the validity of the drought charge. They claimed that a faulty method based on property values rather than water consumption was used to determine properties on which the drought charge would be made applicable. The lucrative Cape, Real estate market was negatively affected, with a reported 5.5% drop in property value (Visser, 2028:4). The scenario has helped increase the city's already fractured relations between the haves and the have nots, emanating from the apartheid era. The imposed levy was a heavier load to the already burdened residents.

4.3.1.12 Poverty and inequality

The gap between the haves and the have nots widened. When any disaster attacks in any community, the indigent are heavily impacted because they lack adequate resources, especially financial muscle, to cushion themselves from trends and shocks of such a phenomenon. The situation worsens for the poor when a disaster brings job losses when employment is usually the only reliable source of income. The inequalities in income distribution within the Cape Metro have remained the highest in the province, mainly due to the drought and water crisis, which ravaged the economy. There was a decline in household expenditure on durable goods and an increase in non-durable goods as households who could not afford durables spent their disposable income on basic necessities. The city has remained the unequal part of the province, while the Cape Winelands and Garden Route trend behind (Felix, 2018:2). Felix (2018:2) continue pointing out that inequalities in income distribution have become generally high in almost all the regions of the province, with all Gini coefficients tending closer to 1 than to 0 in the past 10 years. The Gini coefficient is a measure of statistical dispersion intended to represent income distribution among a nation's residents. The figure varies between 0, indicating complete or perfect equality and 1, representing total inequality in income distribution.

Income inequality has expanded the already substantial divide and historical racial tensions, particularly between the wealthy white minority and the poor black majority. The poor were left with few options aside from cutting back on food to buy water at inflated prices. As fear of urban revolts and unrest became more palpable as the drought worsened, the implemented local measures proved insufficient and urban inequality continued to rise. A ward councillor explained that,

“I am very worried about this water problem we are facing. Residents are frustrated and it’s not surprising if protests emerge in my ward. The trail of property destruction caused by such protests are very costly to amend and am really concerned.”

The lack of a fundamental resource is usually a recipe for violence, crime, social dissolution and anarchy. Lack of one basic requirement can replicate another problem of the same or bigger magnitude. For example, the lack of services delivery such as water has triggered protests, resulting in vandalism of public property. Authorities lacked a sharp eye and determination in the sustainable provision of a basic resource such as water to their citizens.

4.3.1.13 Anger, frustration and anxiety

The city’s aim of citizen behaviour change to water use has resulted in various responses from residents. Citizens have developed anger, frustration and anxiety. People were lashing out at city officials for poor planning in preventing and reducing drought intensity. There was panic within communities signified by very long water collection queues at various collection points like Newlands springs. Households were stockpiling vast volumes of water in containers to cushion themselves from supply failure as the future water stability was unpredictable. Anxiety caught many citizens. They were worried, particularly about what would happen when day zero arrived. One resident said that,

“We are much concerned about what will happen to us when day zero approaches. Life is already unmanageable today while we are still getting some water from the tap. What about when the taps run dry, surely it will be a total catastrophe. It seems the authorities have no clue at all regarding this water issue. They have a culture of not fulfilling the promises they make to us during the election period. Only God knows what will become of us on day zero.”

This shows the unsound relationship between the authorities and the public. Usually, resolving a problem becomes difficult to implement when the relationship between interested parties is broken.

Lack of trust between authorities and the public developed. Many citizens blamed the city authorities, arguing that they are using day zero as a scaring technique to camouflage their poor management and corruption. The government had difficulties convincing both businesses and residents that the water crisis does not have a total collapse on their day-to-day operations.

Authorities' promises to businesses and residents that water would be supplied to strategic commercial and residential areas did little to alleviate people's fears of the disaster. The public did not buy that fact at all. Business and the wealthy citizens decided to get off the municipal grid and shifted their faith towards boreholes, rainwater tanks and contemporary technology such as reverse osmosis water plants. They both leaned on the fact that responsible authorities have done too little too late with desalination as the reliable key option for water security.

Citizens became disobedient to authorities. They disregarded calls of saving water by the municipality by continuous maintenance of green lawns, gardens and swimming pools. The situation was chaotic as people were sharing different views because of the anxiety brought by the crisis. The scenario signifies that communication between authorities and residents was not fluid. The media relayed most of the information with immediate criticism, resulting in shared misinformation. For instance, residents were in need to know the authorities' preventative plans and actions to resolve the crisis and reduce the associated risks. Still, the city authorities supplied information on the state of water on dam levels, demand, quality and models. This showed the city's failure to contain the shared misinformation on social media and the public domain. Lack of public trust resulted, yet it was crucial for managing the crisis and saving water. Citizens needed their voices to be heard while authorities responded accordingly. In that way, the momentum of trust could have been attained.

4.3.1.14 Internal and international Migration

Migration has become one of the options for some residents to cushion themselves from the city's water situation. The affluent migrated abroad, particularly to such as Canada and Australia. The departure of affluent citizens impacted the economy as they transferred their wealth to countries of destination. Businesses also relocated to secure water countries and other cities, impacting national and local economies. Some residents were just relocating to other suburbs within Cape Town. Residents, particularly the affluent, from suburbs such as Pinelands with contaminated groundwater, migrated to other suburbs with clean groundwater where they could sink boreholes as an alternative water source. However, the migration of residents seriously affected their balance sheets as the relocation required high financial capital and was unplanned but forced by the crisis. A resident in Pinelands highlighted that,

“The water crisis was a phenomenon which no individual had prepared for as the information regarding the water crisis was very limited and preparedness lacking even at government level. We were caught completely unaware of the problem. I just put all the blame on both the DA and ANC for putting us through such a difficult situation.”

The unemployed have migrated to other cities across the country to seek better opportunities, and such cities, the increased pressure on already strained local economies and infrastructure (Babis, 2018:3).

4.3.1.15 Risks in the education sector

Education was one of the sectors affected in the city. Both government and school officials have indicated that all schools in these suburbs relied on municipal water for all their water requirements, especially for drinking and sanitation. One principal asserted that,

“... numerous schools across the city rely on municipal water as our balance sheets are very small to diversify water sources even just to drill a single borehole, worse a water purification plant as groundwater in some city suburbs is contaminated by sewage.”

Although few schools managed to sink boreholes in the city, less than half had portable water. Those without boreholes and non-portable water were risking the closure of schools on the reach of day zero. Thanks to the water restrictions implemented by authorities, saving initiatives by water users across the city, cooperation of residents on water restrictions and the arrival of early winter rains, which all put day zero at bay.

Several measures were implemented by school authorities to prevent school closure. School governing boards had meetings with parents and agreed that pupils should bring bottled drinking water to school. A roster system was designed for pupils to get at least five litres of bottled water per month for daily use in class. The affluent were in a better position to such an arrangement, but to the poor, it was a difficult mission to have bottled water every month for a child. School authorities have confirmed that toilet facilities at some schools, for both pupils and staff, were closed, limiting the availability of adequate sanitation. Usually, upstairs toilets were closed, and downstairs toilets were being opened before lessons began, at breaks and after school. Such a scenario forced pupils to urinate in open spaces, risking the spread of diseases. A senior teacher at one of the schools interviewed narrated that,

“We were operating at highly unfavourable conditions which were compromising both staff and pupils’ health as well as pupils’ learning performance.”

Schools adopted various water-saving initiatives like any other city residents to prepare themselves for the approaching day zero. Boreholes and water tanks were erected at some schools. However, only a few had healthy balance sheets to foot the bill, and the majority had their hope on the coming of the rain season.

Government and school officials have confirmed that the Western Cape Education Department issued spreadsheets to schools to monitor water consumption in the morning, afternoons, and weekends and detect leaks. Although it was a good initiative, however, time spent by school authorities giving attention to water-saving tasks was a deprivation of learners’ adequate time for learning. The time was supposed to be used on the real learning programmes. Education subjects such as agriculture and laboratory-based subjects such as chemistry or biology, demanding high water usage, were affected in many city schools. Some experiments requiring vast volumes of water were abandoned, and some agricultural practicals, particularly in crop farming, were not carried out mostly in schools without alternative water sources such as boreholes. A Cape Flats resident complained that,

“...so, it means our children will continue suffering at these poor government-sponsored schools because the water serving initiatives are still in force, compromising the success of our children pursuing practical subjects such as agriculture. Surely our children’s hopes and rights for quality education and a brighter future are no longer a priority of the government”.

The household incomes of the poor were impacted as they were expected to dig deeper in their shallow pockets to meet daily bottled water requirements at schools. The learner’s morale and performance in class was reduced due to anxiety brought by the scarcity of a critical resource in their daily lives. Food security was impacted as money was spared for food and water purchases. Malnutrition affected pupils’ overall performance in class. Some pupils who had inadequate drinking water incurred a risk of drinking from non-portable water sources, posing health concerns at schools.

The South African National Development Plan (NDP), a plan of action for securing the nation’s future as enshrined in the Constitution, explicitly stipulates the importance of education in

achieving sustainable development. Adequate and diverse water sources could have been established to prevent the adverse effects of such an important development sector

4.3.1.16 Health risks

The health sector has suffered impacts ranging from lack of drinking water and pressure on the sanitation system, raising prospects of spreading life-threatening diseases such as dysentery, loss of hygiene (as people cannot wash their hands), dehydration and heat strokes particularly in high-temperature seasons. Management of health facilities was complex, particularly public facilities that had no alternative water sources in place. Workers were spending more time on water issues than on care provided to patients. Admission of patients was highly preferential to reduce water consumption in hospitals. There were escalations in anxiety, stress levels and people getting violent as they tried to access water or overstretched health facilities.

Health and business officials confirmed the lack of drinking water at health centres, households, and public places. Bottled water was one of the water sources but also became scarce in the city during the peak of the drought in 2018. The poor were the most burdened due to lack of purchasing power and access to areas of availability due to logistical problems. Such lack of drinking water created anxiety, unrest and violence in the suburbs as people queued for donated water at strategic points where authorities were distributing water, NGOs and donors. Increased alcohol consumption was a result as some people hydrated themselves with alcohol. This, in turn, resulted in increased violence and abuse of family members and the vulnerable, primarily women and children (Mash *et al.*, 2018:2).

The city relies on a waterborne sewage system, and the inability to flush the toilets resulted in the breakdown in sanitation. The water restriction by the municipality of 50 litres of water per person per day was too little to maintain an individual's daily sanitary requirement. A community leader in Nyanga has cited that,

“We resorted to disposing our faecal waste outside the sanitary system as we were unable to dispose of the waste through flushing toilet system.”

The government officials also confirmed increased environmental contamination and the risk of spreading different viral, bacterial and protozoal diseases that can proliferate in faeces. Infectious diseases such as diarrhoea, vomiting or dysentery such as shigella and salmonella were likely to

spread under such conditions. Still, the health officials were alert to control and combat any possible disease outbreak.

Residents highlighted the loss of sanitation and hygiene (absence of water to wash and bath) at public places such as shopping malls, bus terminus, train stations and sports centres. There were limited flushing points in public toilets, and even today, such points are limited. A shopper at Vangate mall, Athlone, has cited that,

“... not all washing basins have running water in public toilets and we sometimes queue for washing hands and sometimes got annoyed of waiting and get out unwashed. We then get into a restaurant to eat where also there are no water basins to wash our hands. We survived by the Grace of God.”

Mash *et al.* (2018:2) argued that washing hands after using the toilet is one of the top hygienic practices to reduce the transmission of diseases. Failure of such practice increases the hand-to-mouth transmission of infectious diseases, which increases the spread of respiratory viruses that can cause coughs, colds and flu, diarrhoea and dysentery. This, in turn, increases pressure on health facilities resulting in staff workload.

The importance of health as a basic need and SDG is also emphasised in the NDP. Health and educational institutions and public spaces could have been facilitated with adequate and diverse water supply to prevent or reduce the impact of any form of water shortage in the current era of climate uncertainty. Moreover, the provision of adequate water supply, a basic component of sustainable development, could have been a powerful tool to reduce historical polarity, characterising the city's communities.

4.3.1.17 Suspension of household activities

The municipality suspended homestead food production activities vital for sustainable livelihoods. Maintenance or any other household activities, particularly backyard agriculture, requiring large volumes of water were suspended in both industrial and residential suburbs. Moreover, some residents were engaged in homestead animal husbandry for meat supply such as chicken, but water scarcity forced them to abandon such activities. Their food and income support systems were impacted. One of the residents in Rylands, Cape Flats, who was rearing pigeons for consumption and racing as a source of income, reduced his flock size resulting in huge income losses. He narrated that,

“I could not bear the pain of losing all these pigeons because of water shortages. My family’s survival depends on this project as it is the only major source of income in my possession. When water restrictions were instituted and increased during the peak of the water crisis in 2018, I was affected by the fear and anxiety of losing my entire flock. Reducing the flock size was the first option and, in the future, bringing it back to its previous size can take some time. Both my income and clientele base were grossly affected.”

Exorbitant penalties were applied to households that failed to comply with the required water restriction levels, leaving residents with options of abandoning or downsizing most of their home activities. Although many residents resorted to greywater usage from their kitchens and bathrooms, it was too little for the survival of a garden because vast volumes of water are required to sustain succulent garden plants. Household food security and income were threatened. Lack of food and income affects household nutritional health and education, critical for sustainable livelihoods. The lack of such basic necessities had the potential to increase violence, women and children abuse, and protests for the services delivery.

4.3.1.18 Reduced operation of community-based projects

Small informal businesses, which are critical survival strategies at the community level, were affected. Tuck shops, street vending, and unlicensed liquor shops have sprouted as popular survival strategies. The business was primarily dominated by residents who lost their jobs and trying to make a living by self-employment. However, those in the fast-food business across the city were affected as water is the critical resource in food chain operations. There were hygienic and operational concerns affecting employer and employee income, food quality, and quantity, which prompted price hikes.

Community development was grossly impacted, particularly in high-density suburbs and informal settlements. Community-based organisations help to provide greening, growing and developing their communities and conservation, rehabilitation and protection of the environment within the Cape Flats. They improve and maintain the income stability of communities. A large population in the city relies on informal economic activities for survival. Most of these organisations were established as non-profit micro-farming organisations to enhance groups and communities to supplement their existing, insufficient food supplies and create sustainable livelihoods. In the Cape

Flats suburbs of Nyanga and Khayelitsha, Abalimi Bezekhaya (which means farmers of the home in isiXhosa) is one of the organisations formed for communities to establish and maintain their vegetable gardens.

These organisations were relying on municipal water for their daily activities. During the peak of the water crisis, some of their activities were suspended, resulting in reduced income and household food supply. Future of Life Institute (2018:2) argues that almost 50 000 citizens were pushed to live below the poverty line, deepening their poverty situation. The collapse of such organisations creates social and economic instability, mainly at the local level and can extend to the national level. Poverty and inequality levels can increase, widening the gap between the haves and the have nots, resulting in crime, social dissolution, violence, school drop-offs, and abuse of women and children. When support is not channelled to rejuvenate such organisations, there is the probability that these problems can continue to recreating and reshaping themselves while deepening and multiplying their impacts within communities.

4.3.1.19 Social cohesion

Social cohesion, an ingredient of socio-economic development, was severely impacted. There was a rift between the rich and the poor, deepening the unpalatable relations among racial groups created during the apartheid era. Many interviewed households cited that the rich were sorting themselves out and some businesses through drilling boreholes, erecting tanks and pumps and reverse osmosis water purification plants. The poor had limited options except to wait for the municipality water. The affluent had water even on the last floor of a multi-story building because of pumps. Some of them could purchase and truck in water from private companies. Numerous heads of families interviewed concurred on saying that,

“... the apartheid regime long segregated us and today our government is not pulling us out of this messy, the rich are getting more richer, and we are getting more poorer. See how the rich were accessing water from far away sources and even drill boreholes at their households. What about us? Is this the meaning of democracy? Truly we have not yet enjoyed the fruits of democracy if a basic need such as water is inadequately provided, apartheid is still haunting us”.

The division between the affluent and indigent Cape Town communities is commonly along racial lines. The water shortage had the potential to worsen historical divisions (Parks *et al.*, 2019:11).

The City introduced a non-indigent fixed basic charge for water in July 2018, based on the size of the meter connected to the property. The tariff subsidised water for the poor and upkept the operating supply system. Serving people based on the haves and have nots create division, thereby disrupting social cohesion (Mash *et al.*, 2018:2). Imposing increases of tariffs based on the size and value of the property has also affected social relations and even resulted in the default of payments which affected the municipality's balance sheet and, in turn, services provision. When it comes to social cohesion, a lot of collaborative effort is still required to facilitate the abolition of apartheid remnants which are still manifesting in the city through different ways such as increasing poverty and inequality, crime and violence.

4.3.1.20 Suspension of recreational activities

Recreation, a key component in bringing people together, was one of the sectors impacted by the crisis. The functionality of community centres was affected as gatherings of people require huge volumes of water for drinking and sanitary purposes. Government officials pointed out that some functions were suspended, and some were shut down until the water issue normalised. All sports fields watering with municipal water were suspended, affecting lawn cover essential for sporting activities. District parks or open green spaces perfect for dog walking, picnicking and enjoying local flora were transformed into dust grounds. Nantes park in Athlone has lost its attraction, and the green attraction has later recovered with the coming of winter rains. Biodiversity has also been lost in such parks. The environmental impact can quickly approach but eradicating the influence and returning the environment to its original or previous state requires capital, energy and a protracted period. It was still is a burden to the city to restore the recreation sector to its original form.

Signature venues such as Athlone stadium and Turfhall Stadium in Landsdowne, which are historical and heritage sites of the communities, had their functionality altered by the crisis. Their functionality was minimised due to inadequate water, especially for sanitation and maintenance of natural lawn cover. Public swimming pools were closed across the city, such as Athlone and Hanover Park. Minimising and closing recreational facilities affects social activities, particularly youth, which results in reduced public morale and indulging in other harmful activities such as drug abuse. Getting occupied by recreational activities maintains a healthy youth vital for the

development of the community and the entire nation. This is also critical for reduced crime, both drug and alcohol abuse, which is essential for developing sustainable communities.

4.3.1.21 High crime rate

Crime has increased in the city. Due to income losses, residents have cited that crime has increased, especially in informal settlements and high-density suburbs. In any scenario where there is a lack of income and poverty, social problems such as increased crime rate, drug abuse and violence emanate. A middle-aged woman in Milnerton, Northern suburbs, confirmed that,

“...both my twin sons are now into drugs and different sorts of crime. Since they completed their matric education some four years ago, they both couldn’t get work and spent most of their time in the streets, where they got lured into drug abuse. Although lack of opportunities is the major driving factor, their father, who was a truck driver in the Cape Winelands was retrenched in 2018 owing to the water crisis. Hence, we cannot provide enough for our children as my salary is insufficient, it’s even more difficult to send them to colleges to further their education.”

This scenario presents a chain of problems emanating from water scarcity, and the importance of such a resource is highlighted.

In Cape Flats, there was a surge in the crime rate, which raised concerns for the city to be listed among the most dangerous cities globally. In the annual ranking of the 50 most dangerous cities in the world drawn up by the Citizen Council for Public Safety and Criminal Justice based in Mexico, Cape Town was listed at number 15 in 2018, with 66.4 murders per 100 000 population. In 2019 the ranking escalated to a higher record of 68.3 murders per 100 000 population, placing the city at the 8th position (Smith, 2019:1). The increase in ranking indicates that the impact of a crisis can remain in force for a more extended period, has the potential to become worse even if the crisis stabilises and can be difficult to reverse or eradicate.

Nyanga, Phillipi, Mitchels Plain, Mannenberg, Lavender Hill and Khayelitsha were the leading crime-infested suburbs in the city. It becomes clear that when poverty and inequality exist, anchored with lack of basic services such as water, issues such as violence, social dissolution and basic services, protests seem to remain popular in the city.

4.3.2 Positive impacts

4.3.2.1 Public Awareness

The water crisis has raised public awareness of the reality of the effects of climate change. Those tightly inclined to the old order of doing things were driven in a new change path. Water is the immediate phenomenon, but increased fires, migration, health, economic and security are also critical factors requiring society to embrace holism to tackle the problems it is currently facing brought by climate change (Dowling 2018:1). People have started to work cooperatively and innovatively from local to national level. Witnessed and welcomed are domestic, street and faith-based responses, workplace plans and initiatives to render support to the frail and vulnerable. When people work together, merge talents and develop trust, more dots are linked, bringing sustainability issues and cooperative solutions, new meaning and practical application. Drought has brought the idea and desire to divert from water-borne sewage, although it is a politically constrained topic (Dowling 2018:1). A technically sound and appropriate plan is required for saving water as adequate water for facilitating water-borne sewage seems to be for the rich who can afford such a luxury.

4.3.2.2 Government scrutiny

The government was tested and exposed to scrutiny. Its ability to effectively plan and respond to emergency scenarios swiftly, efficiently and effectively has been questioned. The real test of democracy is the extent to which the government commits and remains answerable to the citizens. It should maintain consistence in oversight of its actions and fulfillment of its mandate to the people. The water crisis has exposed weaknesses in the governance system from local to national level. This helps the state organs such as parliament and other institutions to hold the government accountable and ensure improved service delivery for sustainable livelihoods.

4.3.2.3 Conservation and appreciation of resources

Droughts can bring the need to dissociate economic growth from environmental degradation and exploitation of resources. The ability of society to reduce water consumption and bring some positive initiatives in a single year resembles that balancing economic, social and environmental sustainability is possible. The authorities have been made to see the requirement of wastewater recycling as a norm, not only in Cape Town but also in some other major cities. A Cape Flats councillor highlighted that,

“This water problem has taught us that any drop of water counts. As public office bearers, we have to ramp up water recycling plants and motivate residents to reuse and reduce water as critical water conservation initiatives”.

Recycling can reduce effluent to the sea, less river pollution, improve water security, strict control of industrial and commercial outflows, more skills development and training, increase employment for water technicians and enhance understanding of groundwater recharge ramifications. The collection of water from natural springs such as the Newlands natural spring points out the human appreciation of ecosystem services from wetlands, rivers, ocean, springs and aquifers and the real need to protect such resources from pollution and overuse turn foster sustainable development. Humanitarian effects were instigated as the merciful and affluent residents from within and other nearby suburbs were bringing and distributing water and food to the residents at specific points in the suburbs, especially the poor.

Residents practically responded to the water crisis by the erection of rain tanks, reusing, reducing, recycling, bending the ball valve arm in the toilet cistern to reduce flush volume and fitting of aerators to tap nozzles. Improved self-sufficiency and resilience give positive rewards to energy, waste reduction, transport efficiency, and food security. Such positive feedback explains that people are moving towards taking charge of their needs and responsibilities instead of waiting or expecting someone or government to do it for them. A sense of pride is also developed when society solves its problems.

4.4 The city’s strategic interventions in water management

Cape Town has crafted three basic strategic interventions to pass through a crisis period. It initiated strong management of the remaining water in its dams, demand management, and supply management by expanding focus on other water sources such as groundwater and desalination. Dam levels were closely monitored. Demand management aimed to enforce citizens to adhere to the use of stipulated volumes of water per day. Supply management focused on increasing and diversifying water sources to achieve a sustainable water system.

4.4.1 Disaster Management Plan

The intensity of the crisis drove Cape Town to develop a disaster management plan in 2017 for when dam levels dropped to the extent requiring strict action to be considered. The plan aimed to

guide and coordinate the various departments needed for disaster preparedness, and three phases were defined. The City of Cape Town (CCT, 2018:2) asserted that the first restriction was part of Phase 1 of the disaster management plan, focusing on preservation restrictions in response to DWS's need for Cape Town to cut down its water use by 40%. This phase explicitly drives efforts to minimise supply, water pressure management to lower the available water in the system and continued installation of WMDs in individual households to limit overuse (Engvist and Ziervogel, 2019:08).

Phase 2 was expected in a scenario when dams reach a critically low level (at or below the 13.5% mark), calling for the major interruption. Based on consumption scenarios, the Day Zero dam level was set at 13.5%, equating to only 3 months' worth of water at a reduced volume supplied of 350 million litres per day (MLD). The Day Zero calculation is based on conservative consumption assumptions beyond the City's control, including releases to agriculture, urban demand, evaporation and rainfall (CCT, 2018:2). Strict water rationing was needed for water to last for an average of three months before dam levels drop to 10%, a level at which it becomes impossible for water extraction from dams. This phase could have necessitated a contingency plan predicating on various parts of the city facing disconnections from the reticulation system and residents turning to designated collections points established by the municipality. Households had to collect a volume of 25 litres per person from designated distribution points. In January 2018, Day Zero was anticipated to happen April 2018, with weekly dam levels dropping at 1.4%. By March 2018, the weekly dam level drawdown had decreased to 0.4%, with agriculture utilising only 4% of the system's water. In addition, a decrease in urban demand pushed 13.5% dam level anticipation to August 2018. More so, a substantial water transfer was made by a nearby catchment area in February and helped to decrease the dropping of dam levels (CCT, 2018:2). Phase 3 was expected to be in effect when all surface water becomes inaccessible while collection points have only bottled and groundwater mainly for drinking purposes (Engvist and Ziervogel, 2019:08).

4.4.2 Management of dam levels

Agricultural activities mainly caused the major fall in dam levels, the city's consumption and other surrounding municipalities, and evaporation. Dams were prone to sudden drop due to the poor 2017 rainfall. The city and the DWS conducted weekly dam level and consumption monitoring weekly. Effective tracking of agricultural and urban demand *vis-a-vis* allocation was carried out

to enhance strong decision-making on increasing restrictions in line with the drop of dam levels and expected user behaviour. When the 450 million litres per day (MLD) target was surpassed, it was crucial to recover the over-use by future demand reduction. Still, at the same time, augmentation projects were being implemented to lessen further dam level drawdown (CCT, 2018:3).

4.4.3 Managing demand

Demand management has forced individuals to refrain from using more than the stipulated water volume per day regardless of the person's location, either at work, home or elsewhere in the city. The demand target was achievable through the cut down of usage. During the 2015 summer season, the city's consumption was at 1 200 MLD; in the same period, in 2016, the consumption dropped to 1 100 MLD, governed by level 2 restrictions. In 2016/17, under level 3 restrictions, consumption fell to 900 MLD, and by December 2017, a steady demand of 600 MLD was attained. A further reduction of 500 MLD was achieved in January 2018, although a further reduction to 450 MLD was the DWS's expectation (CCT, 2018:3).

4.4.3.1 Water restrictions

In January 2018, level 6 restrictions were implemented and by February 2018, the city had implemented level 6B restriction, which witnessed the achievement of 450 MLD as required by the national DWS. A maximum of 50 litres per person per day was in line with level 6 tariffs. A population of 4 million, consuming 50 litres per person per day equates to 200 MLD, and 150 MLD in approximation was used by industry and commerce and government and others, resulting in 100 MLD less than the needed daily target of 450 MLD. This facilitated the adherence to the anticipated target even though there were some pockets of non-adherence to restrictions (CCT, 2018:4).

The City had a plan to implement three restriction levels with an emergency response if the need arose. After the recovery from drought, water restrictions continue with level 1 implemented when dam levels are below 80%, level 2 at below 70%, level 3 at below 60% and finally emergency response at below 45%.

4.4.3.2 Public engagement

Public participation was engaged to help residents understand the severity of the crisis and the preventative measures to be implemented and observed. The city embarked on communication

campaigns to impart disaster awareness to the citizens. Several communication campaigns were initiated to help people in decreasing their water consumption. The media, in particular, played a critical role in the dissemination of information to the public. Print media (newspapers and magazines), television, radio, and cellphone technology were crucial platforms that helped relay information to residents. However, these platforms were a disadvantage to the indigent because of critical issues such as language barrier, lack of internet, lack of electricity and illiteracy. Many residents concurred on that,

“... most of the information is communicated through radio and television, yet we live in informal settlements without electricity. They use websites while do not have smartphones and computers. Some of us can talk English and Afrikaans but read it. How then do they think we can access the information? They must come and talk to us physically.”

Useful campaigns were initiated for household leakage detection and fixing and adherence to 50 litres per person per day. Although there were communication platform challenges, print, radio and social media were primary proper mediums of infiltrating the information to the public. Minimising consumption to the required 450 MLD, in line with restriction level 6B, was stimulated by such campaigns.

4.4.3.3 Reduced water pressure

Water pressure management not only reduced consumption but also leaks and pipe bursts. A government official narrated that,

“Since we initiated pressure reduction, residents complained, but the initiative has worked in our favour as government because we experienced very few water burst pipes and less consumption.”

Consumption was lessened through suppression of pressure zones. Such a clampdown on pressure facilitated the decrease in consumption and even limited supply, particularly in areas with soaring user behaviour.

4.4.3.4 Installation of WMD

Water management devices were installed at households, especially on those not complying with reduction of consumption to daily requirements and lessen the effects of leakages. However, the challenge was on undetected leakages that stimulated water management devices to be installed at

households abiding by the stipulated restrictions. At level 6 restrictions, households exceeding 10.5 kL per month had the devices installed. At level 6B where the 50 lcd restriction was instituted, the devices were fitted when consumption exceeded 10.5 kL, focusing on excessive consumers. The city preferred to manage the consumption at the household level by using a metering device similar to the one used for electricity, using pre-paid metering or remote monitoring (CCT, 2018:6). Almost 300 000 water management devices were installed by the city a decade ago, resulting in a decrease in demand, and just below 10 000 non-indigent households were surpassing 20 kL per month by the beginning of May 2018, which is more than 88% decrease in a year (CCT, 2018:6).

4.4.3.5 Tariffs

Punitive tariffs were instituted by the city such that excessive use is aligned with increased cost. The tariffs came into effect with level 6 restrictions of February 2018, targeting users exceeding 50 lcd. Excessive usage dropped significantly with such a measure. The city applied adaptation by engaging small and large businesses with possible resolutions. Some resolutions pursued involved the use of private boreholes to capacitate the system.

In the agricultural sector, the city engaged the DWS and Western Cape provincial government to control the release of water. Government officials argued that,

“As a government, we have decided to be strict on water allocation to different users by cutting the supply when the users reached the level of their allocation. To achieve a goal requires high commitment and strict adherence to the plan.”

In February 2018, the national DWS cut the release of water to irrigation boards which struck their allocation point. This boosted the trust of achieving the restriction target of the agricultural sector. The national department also monitored other urban areas such that restrictions were met to ensure that targeted consumption was achieved and maintained. Any business, household or institution which exceeded the daily or monthly allocation was subjected to punitive tariffs. The severity of the tariffs depended or was calculated on the amount of exceeded consumption from the required limit.

4.4.4 Supply management

4.4.4.1 Surface water (Dams)

The city depends on rain-fed surface water dams. The city still pursues further surface water augmentation. The DWS is implementing the Bergriver Voelvllei Augmentation Scheme (BRVAS) with its completion expected in 2021 and adding 23 Mm³ (60 MLD) into the WCWSS. The City aims to continuously depend on its rain-fed dams for the bigger supply of its water due to its affordability compared to desalination, groundwater and reuse. However, the intention is unwise considering the predicted frequency of decreased rainfall by global climate models and invasive plants that threaten surface water sources. Almost three-quarters of its supply will be drawn from rain-fed dams, although investment in alternative water sources is being implemented to boost water security.

The city has committed itself to boost the current water supply by over 300 million litres per day in the next 10 years, commencing in 2018. The investment would increase with demand increases primarily due to a surge in population and economic growth. Wise water use was continuously enhanced through behaviour change of citizens and wastage suppression.

Replacement of ageing and maintenance of existing infrastructure was also considered to suppress water wastage. Improved coordination and leadership within and between governments departments was considered. Improved information dissemination and participatory processes were initiated to lure active citizenry and combine problem-solving. The clearing of alien plants was initiated in catchment areas. Invasive plants impact the system yield currently in the range of 20 MCM per year (CCT, 2018:7). The city increased clearing programmes in its catchment areas and joint work with other governments departments and stakeholders to envelop all its catchment areas.

However, considering the heavy capital demanded by the aims and targets of the city, some of the expectations can be partially or cannot be met. The economic environment is quite strained, especially with the devastating effect of the Covid-19 pandemic on the local, national, and international economies.

4.4.4.2 *Non-surface water*

Although they are more costly than surface water, the City of Cape Town has increased its water supply by non-surface water augmentation schemes. The three vital non-surface sources, groundwater, re-use and desalination, are adding water to the supply system for increased reliability. A government official explained that,

“The City is gearing for the transformation of the City to a water sensitive city comprising of diverse water resources, infrastructure and effective stormwater use and urban waterways to cushion flooding, aquifer recharge, reuse and urban recreation but in relation to environmental morality and fundamentals.”

Diverse water supply sources established resilience against water crisis. Costs comparison of both schemes (surface and non-surface) was made to ascertain financial sustainability. However, alternative water sources will exert an increase in water cost, although the cost can be affordable. The cost is estimated at R1.2 billion (2018 ZAR) over a decade, costing around R2.50/month/person, far less than the cost of a single unit of bottled water. Financial impacts are continuously managed through sustainable adjustments to the City’s tariff structure and level. Water was priced in line with additional supply cost provision but still maintaining the free basic provision of water to indigent citizens who cannot afford water tariffs.

Water reuse

A water reuse scheme comprising of water treatment to drinking standards was established. The Faure water treatment plant was in operation in 2018 and gave an output of 70 MLD with a potential to be expanded to 90 MLD. Water from the Zandvilet reuse scheme is also pumped to the Faure New Water Scheme, further treated and then discharged into the inlet of the Faure waste treatment works and blended with water from Theewaterskloof Dam or Steenbras Upper Dam before undergoing further conventional water treatment. Reuse schemes will expand across the city in relation to the long-term growth requirements of the city. There is a proposed New Water System for the city, which will be designed and operated in accordance with international best practices and associated water safety protocols (CCT,2019:14).

Groundwater

Groundwater extraction became a priority for the city. The total output of the first phase stands at 100 MLD. The incurred operational costs of the three groundwater schemes were used to

determine the speed of rolling out more schemes. The operational commencement of Phase 1 schemes has facilitated a more leisurely development of different phases and schemes for the city (CCT, 2018:3).

The Cape Flats Aquifer (CFA) has a license comprising three phases of extraction of 20, 25 and 30 million cubic metres (MCM) per year. The Cape Flats Aquifer is a sandy shallow aquifer with boreholes in the vicinity of 40 m deep. The Aquifer has been incrementally developed in 2 phases in the following clusters: Strandfontein West, Strandfontein North and East, Philippi, Hanover Park, Bishop Lavis and Swartklip. The scheme will comprise artificial recharge of the aquifer by injection of high standard treated effluent, which involves a seawater intrusion barrier. The water from the aquifer will need further treatment before being injected into the water supply system. The license conditions were imposed by DHSWS on the groundwater abstraction from the Cape Flats Aquifer to ensure the sustainability of the resource. Environmental Monitoring Committees (EMC) will also be set up to ensure long term sustainability. Water monitoring protocols will be implemented to ensure water quality compliance (CCT, 2019:14).

The Table Mountain Group (TMG) aquifer comprises three extraction phases at several locations, yielding between 42 and 130 million cubic meters per year, translating to 115 – 355 MLD sustainable yield. Water obtained from the TMG Aquifer is of relatively good quality but also needs pre-treatment to remove iron and manganese before being discharged into surface water sources such as Steenbras Upper Dam. A government official pointed out that the progress of both the CFA and TMG is slower than initially planned, and the yields will take time to be realised. The Atlantis and Silverstroom aquifers are expected to be injected into the system with a potential of yielding 20 MLD. Water monitoring protocols were set for quality compliance and EMC for enhancing long-term sustainability (CCT, 2019:14).

Atlantis Aquifer is an existing groundwater scheme with artificial recharge operated for almost 30 years. The project aims at improving and expanding the existing wellfield. The project also includes upgrading the existing wellfields to the previous yield levels they were operating at some couple of years ago.

If efficiently and effectively done, all the desired projects of the city have the potential to present a sustainable water supply to Cape Town. However, the success of such projects depends on strong

management systems, which usually demands various strategic actors to be brought on board to speed and maximise the outcome.

Desalination

Desalination was pursued by the city as a reliable solution to improve the water supply (Gosling, 2019:1). It provides a permanent solution to clean water problems to communities as it does not rely on rainfall compared to other sources, giving communities more water independence. It reduces pressure on freshwater sources that may need to be protected. Habitats of endangered species can be preserved as they do not use freshwater sources. Agriculture and livestock production can be enhanced for food security. Economies can stabilise as water availability drives industrial and domestic routines, necessitating SDG achievement. Although desalination consumes a lot of energy, demands high capital outlay, exerts environmental impacts, especially to marine life by chemicals deposition back to the sea, many societies can subsidise its implementation by cost payments and taxing structures for improved water access. Desalination has become a critical water source to many communities considering the current variations in weather patterns owing to climate change (Gosling, 2019:3).

The government officials argued that in 2018 the city acquired expert advice on its review of the augmentation focus of desalination, which requires careful considerations because of its enduring effects on water tariffs. This enhanced the city to conclude that there is a need to strike a balance in the implementation of urgent augmentation projects without sustaining surging exorbitant costs. The city started by building three small scale desalination plants in Strandfontein, Monwabisi and Victoria and Alfred (V & A) Waterfront, which have a combined production of 8 MLD.

The V & A Waterfront plant has faced some challenges. Legal battles erupted between the city and the contracted Quality Filtration Systems (QFS). QFS claimed that the city had misled them concerning the water quality to be treated. The company has approximated the water to be 400% more contaminated than determined and presented to the city. QFS has claimed to have been making three daily filters changes rather than only once a month. The company had to procure extra filters for sewage treatment which put more strain on their balance sheet. QFS filed a lawsuit against the City of Cape Town. The city promised to pay R53 million to QFS, but only R1.7 million was paid, yet extra filters and replacements cost R7 million. The plant's production dropped from 2 million to 500 000 litres a day of drinking water. QFS claimed the city's misrepresentation has

caused them to suffer damages of R58.4 million, which included capital investment on the plant, further capital investment for plant upgrade to purify sewage, non-payment for water produced and loss of profit as agreed in the fixed term agreement (Gosling, 2019:3).

However, Standfontein and Monwabisi plants were contracted to Proxa. Proxa is a water treatment company that provides several water management services covering wastewater solutions and desalination services. The company continued to operate in good relation to the city. Although the company stopped operating for a month in 2018 due to increased algae, there were no contractual disputes with the city. The agreement between the Proxa and the municipality was that production could only stop at extreme conditions such as the bloom of algae; however, the city would continuously pay fixed costs.

Desalination is considered a sustainable water supply system, but its costs remain a challenge to the city. If fully implemented, some other city projects can be financially disadvantaged as the more prominent position of the budget can be directed to desalination. If the rain becomes abundant in the future, desalination can be suspended. That scenario becomes a considerable challenge to the city. The city had even experienced many challenges, such as contractual battles with providers of water management services. Such challenges had plunged the authorities into a problematic situation.

4.5 The dilemma of the city authorities

Pollution is one of the biggest challenges facing South Africa's surface and groundwater resources. Untreated sewage, industrial discharge, and floods are massive pollutants. Cape Town also faces severe pollution challenges of its surface and groundwater resources. Its several waterways are subjected to heavy pollution deterring its transformative desire to a water sensitive city. Groundwater in several suburbs is contaminated with sewerage. A government official asserted that,

“We are very concerned with the increasing levels of groundwater contamination in the city. We really do not know what to do so far. Areas such as Pinelands, a low-density suburb, are sewage-contaminated, and the water can only be purified by reverse osmosis, which is very expensive for the residents.”

Organic and inorganic pollution and littering of the city's fresh water and stormwater systems present a critical threat to ecological systems and human health. Inadequate management of stormwater, freshwater and sewage systems exposes the Cape Town citizens to diseases and localised and widespread flooding. The informal settlements usually suffer due to minimum preparedness and recovery means. The poor health of the city's water systems, such as rivers and wetlands, inhibit their suitability for recreation purposes. Several wetlands and rivers within the city's sphere are also considered unsafe because of increased crime.

Lack of adequate funding has hampered the water supply system of the city. Water infrastructure requires a heavy capital outlay for erection and maintenance. The city loses a large volume of water through leakage and burst pipes. Augmentation projects such as desalinisation require huge capital beyond the financial muscle of local, provincial and national government. Water supply restrictions had saved water and reduced the city's revenue base as consumption retards. A government official alluded that,

“The City is experiencing huge defaults of rates payments, increasing its financial instability and poor services delivery. Water restrictions have reduced consumption which ended up affecting our revenue base.”

Additionally, political, economic and ethical chaos within the government ranks makes it difficult for funding, effective and efficient governance, and monitoring and evaluation of important projects such as water supply systems. Financial mismanagement, lack of accountability, and corruption, common in governing institutions, from local to the national government, have crippled the water supply in Cape Town and across the entire nation. Lack of required expertise, experience, and training is one of the municipality's critical challenges, while such a factor is one of the basic needs of effective water resource governance.

Contemporary technology is also lacking, thereby reducing the city's capacity for effective and efficient planning, implementation, and monitoring and evaluation of its strategic interventions in providing a sustainable water supply system to its citizens. Ignorance on the users and lack of law enforcement affect sustainable water use (Worldwildelife Organisation 2017:3). Lack of effective educational campaigns about water-saving methods such as reuse, recycling, and reduction within communities is lacking, posing a great concern on achieving sustainable water use, bringing insecurity and anxiety to both people and their government. Increasing inequality and poverty

among the residents has increased the gap between the haves and the have nots impacting water availability and access at the household level, especially in informal settlements. The socially sustainable development models demand that no one be left behind in developmental issues. Hence, those in the lower levels of society should be engaged in any development initiatives.

4.6 The Role of Public Participation

Participation has taken centre stage as a feature of public policy in post-apartheid South Africa and has been explicitly set out in the Constitution and many legislative pieces. However, citizen control of the process remains erroneous, although the effort is exerted from both public and private institutions in propelling forward the processes, procedures and mechanisms. Cape Town has implemented participatory processes as an essential attribute in dealing with the water crisis. The city realised that a collaborative relationship depends on trust. Trust emanates where there is transparency and mutual accountability and where stated intentions of all partners are consistently translated into actions (CCT, 2019:29).

The achievement in beating day zero owes much credit to the participation of all stakeholders. Residents' adherence to restrictions, turning to diverse water sources, reuse, recycling and reduced water use became critical in managing the water crisis. Stakeholders have played their part, and the authorities played theirs. The coordination of business, civil organisations and Non-Governmental Organisations (NGOs) has produced significant results of keeping the taps running until the dams were replenished in the rainy season.

4.6.1 Legislative framework

Since the dawn of democracy in 1994, several acts supporting public participation have been passed in South Africa. The Republic of South Africa (1996) Constitution propels the role of public participation in enhancing democracy and good governance. Some of the legislation passed includes the White paper on Local Government (1998), Municipal Structures Act (1998), Municipal Systems Act (2000), The Draft National Policy Framework for Public Participation (2005), Public Engagement Policy of the City of Cape Town (2009) and City of Cape Town Water and Sanitation Services Standard (2008). All these acts concur in participatory processes and procedures and appropriate mechanisms designed to provide municipal services. They strongly support the capacitation of stakeholder engagement. The right to adequate water supply and

sanitation in line with the United Nations SDGs is fully enacted in the legislation. The framework promotes active communities involved in managing their development while claiming their rights, exercising their responsibilities, and contributing to the governance structure, such as at the municipal sphere.

The involvement of communities enhances the building of societies that hold municipalities and political leaders accountable and contribute to the municipality's decision-making process. The municipality was determined to work with local communities to realise sustainable pathways to meet their needs and advancement to quality lives. People's needs require municipal response and communities motivated to engage in policymaking.

4.6.2 Contribution by businesses, institutions and households

Many businesses, institutions and households have effectively invested in alternative water sources. They turned to groundwater, rainwater harvesting and reuse. Alternative water sources have proved to effectively release demand and supply pressure from the municipality as the sole water provider. Some affluent businesses and institutions have switched off from municipal water supply by erecting reverse osmosis water plants on their premises. Vincent Pallotti private hospital in Pinelands was one of the first institutions to establish its own reverse osmosis water plant.

Water serving devices were fitted in many households, businesses and institutions. Water serving showerheads, smaller toilet cisterns as well as low-flow tapes were fitted. Citizens adhered to the authorities' call of using 50 litres of water per person per day. A resident of Athlone suburb asserted that,

“I see it is better that we continue surviving with the allocated 50 litres per day instead of having plenty today and nothing tomorrow.”

Residents took a shower instead of a bath, a shorter shower, flushing toilets, or watered gardens with water leftover from bathing or laundry. Many citizens have changed their behaviour towards water use, and the value of water was well appreciated as a scarce resource. Water sensitive garden plants and lawns were replaced by alternative indigenous plants requiring less water.

Many citizens participated in online surveys of the municipality and researchers, giving important information vital for authorities' policy and decision-making. Many were attending community meetings called by authorities to gather their perceptions about the crisis. Some were not waiting

for the municipality to fix water leaks in their communities or households. They took the responsibility themselves to fix the problems. A Khayelitsha resident narrated that,

“It is quite irresponsible of us to wait for the municipality to do everything for us, yet we are the very people who suffer if the dams are empty, we, therefore, need to be responsible citizens.”

Businesses and institutions were continuously working in partnership with the city, bringing supportive regulations and guidelines for alternative water sources. They helped improve the analytical information base, which is critical for decision making in the management of water resources. Strengthened relationships were built by exchanging expertise, information, infrastructure, and finances, advancing sound planning and cost-effective investments. The overall socio-economic benefit of water was optimised by the collaborative approach of the business, institutions and the city. A more robust and transparent water resource management system was enhanced by the collaboration of the private sector (CCT, 2019:36). In October 2017, the Groenland farmers agreed to transfer water from their privately-owned dams to the WCWSS (Ziervogel, 2019:13). 10 million cubic meters of water were transferred from the Eikenhof dam in Grabouw during the first quarter of 2018. The inter-basin transfer of the water released in Palmiet River was due to cooperation between the DHSWS, Eskom Hydro Pump Storage Scheme and the City of Cape Town. The transfer was done to the Steenbras Upper Dam on an incremental basis.

Research institutions, NGOs, and neighbourhood organisations worked closely with the city by documenting processes for community perceptions, attitudes, and water use needs. Organisations such as Wesgro, GreenCape and WWF played a big role in comprehending business perceptions and needs and communication efficiency between business and the city. Organised Labour has continued to work with the city as a pivotal partner in service delivery to advance the protection and observance of workers' rights.

Research groups such as The Water Research Group, Water Research Commission, African Climate and Development Initiative (ACDI), Water Hub, University of Cape Town's Climate Systems Analysis Group (UCTCSAG) and Fresh Water Forum have continued to engage in applied research work and evidence-based decision making with the city to enhance the realisation of its mandate and water strategy implementation. The city engaged national and international organisations to build new partnerships for sharing knowledge and experience such that the

implementation of its water strategy can be successful. On the other hand, the city also shared experiences with such organisations to play a part in the change of practice in water management to the global community. A collaborative approach enhances joint problem-identification, co-design and co-implementation of solutions. It facilitates joint monitoring and evaluation and shared learning and adaptation, ensuring the presence of coherent and explicit mandates as well as mutual accountability for implementation. (CCT, 2019:27). The city's success in preventing day zero owes much to the cooperation of all stakeholders. Human and financial resources, among others, were brought together to fight a common problem, and a sustainable outcome was achieved.

4.6.3 Challenges of public participation

Izimbizo is commonly used in presidential, ministerial and mayoral meetings with citizens. *Izimbizo* is a Zulu word that means traditional community gatherings under the chief or elder's convenorship, facilitating government officials to meet, hear and respond to citizens' issues. However, the residents of Cape Town were complaining that they were just talking shops. A Khayelitsha resident narrated that,

“Since the officials went to them, there was no revisits to check whether the issues put across between them regarding water supply were resolved or not”.

In 2011, at the State of the Nation Address by President Zuma, the use of social networking sites was advanced for promoting public participation. Still, very few have access to online platforms, considering the country's soaring unemployment rate, economic downturn, and economic inequality. Data is expensive in South Africa, not to mention a smartphone itself. Several indigent households have no access to broadcasts due to limited or no electricity, especially in informal settlements where many indigent people are living. Many citizens' level of education deprives them of participation on online platforms, thereby retarding the expected number of participants. The poor, whose information is vital for aligning services provision with their needs, are the most marginalised.

The city's drought levy proposals requested views of the community. Community inputs were engaged from 12 December 2017 to 08 January 2018. This was a festive season when many citizens were away on holiday. Businesses were closed during that time. Civil society organisations, such as rate payer's bodies, do not possess full-time offices and, therefore, are more difficult to contact for their input during holidays. The Greater Cape Town Civic Alliance

complained that the city had called for public participation during the festive season as a technique to acquire dubious and unscrupulous deals. When civil society is subjected to insufficient time to present its inputs or concerns, the entire participation process becomes worthless as the ordinary people's contribution is much needed in decision making.

On the issue of water management devices installation, many interviewees insisted that they were not consulted regarding the installation project. For the few who acknowledged that they were consulted, a large number was the main household and not the backyard dwellers. More so, the exercise was a sign-up or informing of the device installation rather than a consultation. Another resident explained that,

“Our contribution is to do what they come to tell us. They pretend to listen to us, but when they go back to their offices, I think they just throw away our suggestions because our concerns are not resolved, and they do not come back to tell us what went wrong or when can our grievances be addressed.”

This signified the weaknesses in the participation process and mechanisms in the city. The process was flawed; hence the realisation of the desired outcome could have been better had the process been effectively applied.

4.7 Conclusion

The objectives of the study were satisfactorily attained. The study's findings have indicated that all sectors of sustainable development in Cape Town were impacted by the water crisis, particularly the social and economic sectors. The causes of the crisis revolved around both natural and artificial factors. The water crisis severely impacted agriculture, tourism, business, industry, and domestic activities. Although there were many challenges, authorities took bold decisions to prevent taps from running dry. Diversification of water sources, dam management and water demand and supply management were critical strategic interventions employed by the city to reduce the impact and severity of the water crisis. Several lessons were derived from the Cape Town scenario. Cape Town has given many cities some lessons for improved water management systems that enhance sustainability. Strengthening governance, adaptive capacity building, systems approach and data, expertise and communication took notice as critical factors in developing a sustainable water resource management system. The systems theory's holistic nature

has proved to be important in complex issues comprising of humans and resource use. Through its provision of deep understanding of the way humans interact with themselves and the environment as the source of resources, the theory improves the achievement of sustainable development. The discussion and analysis of the findings of this study were critically presented in the following chapter.

CHAPTER 5: DISCUSSION AND ANALYSIS OF RESULTS

5.1 Introduction

This chapter presents the analysis of the impact of the 2015–2018 water crisis on sustainable development in Cape Town. The research question is well answered in the results chapter. This chapter presents interpretations of findings and implications. The subheadings are derived from attained research objectives beginning with the analysis of the causes of water crisis. Environmental issues, surging population, infrastructure threats, maladministration, poor coordination, and political controversy are critical factors at the centre of the water crisis. Agriculture, tourism, health and education sectors suffer the consequences. Water demand and supply management and diversification of water sources as strategic interventions employed by the city to stabilize the crisis are also analysed. Public participation as an instrument of sustainable water resource management in a polarised society such as Cape Town is discussed and analysed in the last part of the chapter.

5.2 Analysis of drivers of the water crisis

5.2.1 Environmental issues

The study shows that droughts are usually to blame for water-related issues. Of course, as indicated by many researchers of Cape Town's water crisis, meteorological droughts that occur naturally in Cape Town cannot be spared for the city's water woes. However, drought *per se* cannot be labelled as the only major factor that brought the city into such a catastrophe. It is quite easy to blame the water crisis on climate change for water issues, but some factors such as poor water resource management systems play a crucial role in water scarcity. Climate change inevitably impacts weather patterns and eventually decreases water availability and supply. But several mitigation strategies could have been employed by the city several years back to prevent the impact of such a phenomenon.

Several cities worldwide in permanent arid and semi-arid conditions and not bordered by seas have put in place sustainable water supply systems, cushioning themselves against water shortages. Effective water governance systems have worked in their favour. Cape Town was not expected to experience a water crisis, a city stretching along several miles of coastline. Desalination, a very

expensive solution to water problems to many water-scarce societies or cities along coastlines, could have been implemented on time. Israel and Iran have established a sustainable water supply system by implementing desalination systems, yet they are also in arid regions. Cities need to learn from other cities that have experienced the same crisis to build their strength and capacity against climate change stresses and shocks. Cape Town should have drawn lessons from such countries.

South Africa's key cities have used systems models to guide their water resource management since the 1980s. Systems models help planners determine risks associated with supply failure to consumers by providing real-time water network operations. Muller (2018:3) argued that the city's water crisis owes much to a change from management anchored on science and risks assessment to a more populist approach. The study peaked that the city's water management system was based on science. By 2009, the systems models had already signified the requirement to increase the city's water supplies post 2015. It is then surprising why the city has ignored such valuable and informative models. This indicates the inability of authorities to determine and timeously resolve critical problems as they unfold promptly. Good governance requires a sharp eye for identifying problems and timeous and robust implementation of resolutions. Climate change is a real phenomenon with huge and prevalent risks.

Mainstreaming present and future climate vulnerabilities into development is a crucial precondition for sustainable development in developed and developing countries. Competent and long-term planning should be the key to water security. The provision of a multilateral institutional framework supported by law becomes vital to assist with a transparent, participatory and accountable trajectory for accelerating structural transformation required to engage the efforts of powerful actors in the reduction of vulnerability. Climate change causes variability in climate patterns, affecting the amount of rainfall and timing, therefore impacting planning on water resources. Climate change should therefore be integrated into water resource planning and project design. Over the years, there is the probability that climate change effects will be acute and require robust monitoring of historical climate variation and present trends. Strong monitoring can ignite a flexible response to water management in relation to climate change (Ziervogel, 2019,19). Climate change uncertainty presents difficulties in integrating long-term situations into future water resources planning. Hence, all government sectors should escalate awareness in

municipalities and support options to incorporate climate change into planning. Although some institutional and coping capacity existed in communities, it is usually based on data about the past, which might not relate to future challenges given the magnitude of changes by climate scientists. It becomes imperative for communities to be linked upwards to national, regional, and international policy structures such as the Intergovernmental Panel on Climate Change (IPCC) and national scientific academics supporting climate change adaptation. The knowledge of future climate change is based on informal scientific structures. Therefore, communities should be linked to such structures (Yamin, 2005:03).

5.2.2 Surging population

Surging population is the city's great concern. Cape Town informal settlements are sprouting exponentially due to rural-urban migration and immigration. Authorities unplan for such settlements. Surging population triggers increased demand for water, which in turn exerts water insecurity and surging vulnerabilities in the city. This is one of the most significant challenges of Cape Town as a rapidly developing city, demanding effective policymaking and implementation. One of the most problematic issues is the government's incapacity to document the immigrants who usually reside in high-density suburbs and informal settlements. Informal settlements exponentially grow in high-density suburbs such as Khayelitsha, Nyanga, Gugulethu, Philippi and Langa. The surging population presents a massive challenge of services delivery to s and city managers due to estimated rather than actual data. South Africa needs to know who is in their country and why. That can warrant the authorities' effective planning and adequate allocation of resources required to different communities. Within countries, sufficient and equitable distribution of resources and opportunities between urban and rural (and between urban and urban) areas should be effectively done to reduce the flocking of people from rural to urban areas for better living conditions. Such a scenario can facilitate the release of basic services pressure in major cities such as Cape Town. Although migration is a challenge from the global to local level, adequate research is required to establish trends and sustainable measures to the problem, especially in rapidly urbanising cities like Cape Town, where supply-demand for basic services exceeds supply.

5.2.3 Infrastructure threats

Ageing and inadequate water infrastructure threaten water security. The city's water transportation, treatment and discharge infrastructure are not standard. The city's crisis shows that

its installation, repair and monitoring of a built infrastructure is insufficient. In high-density suburbs and informal settlements across the city, water leakages and burst pipes are common features. Restoration of such water infrastructure is not done on time. It can take many days before the burst or leaking pipe is repaired. Municipality or government wait until a problem hit to act. If the city had directed maximum effort and priority to resolve water issues before the crisis approached, the impacts could have been satisfactorily prevented or reduced. This shows the weakness of authorities in usually misdirecting and mistiming their effort.

The city's state of infrastructure exposes the real inadequacies in its water governance system. However, the misfortune could be determined as a wake-up call for effective maintenance and refurbishment of water infrastructure. The situation presents the scarcity of institutional experts in the water sector, which is also directly linked to the critical shortage of skilled personnel such as water engineers. Skills development and competent management system within and between government structures becomes vital for water resource management because of its complexity.

5.2.4 Maladministration

Gross maladministration in the national DWS has brought instability, poor decision making, wasteful and irregular expenditure, and planning based on old data. It is a clear indication of a governance crisis at its peak. The collapse of governance at national level means that every citizen, particularly the poor, can be walloped when attacked by any phenomenon. The youths are also robbed of a brighter future when government fails to provide an essential economic ingredient. Water governance should directly focus on political decision making as one of the principal factors equating to collaborative water management. The evidence disclosed at the State Capture Commission of Enquiry in 2020 by the then Minister Mokonyane, and other high ranking government officials of Water and Sanitation and other related departments resembles profound maladministration practices at the water crisis.

Government appointments should be based on merit, not on cronyism or nepotism. Improvement in political, economic and ethical conduct in the governance system of both public and private sectors should be highly prioritised to attain the needed developmental goals. Government officials should be held accountable for unethical conduct and poor performance. The collapse of governance in one department, especially at the national level, can impact all other departments.

Government departments should work in sync for improved understanding, determination and amendment of arising issues for better results.

In 2019, Cape Town returned R117 million left over from its annual budget allocation of developing informal settlements. Surely, for a city which was still healing from water crisis and with the exponential growth of informal settlements, returning such an amount to the national treasury, while there is plenty of work to be done within the confinements of its intended tasks, signifies some element of maladministration. Better skilled personnel remain a problem for the city, which must be immediately resolved.

Gross maladministration in the national DWS trickles down to the local government. The mishandling of funds, increasing debt, wasteful expenditure, lack of transparency and corruption is the deterrent to the city's economic growth. Private investors into the development of water provision schemes and financiers of water projects are not at liberty to partner in development projects in the presence of such gross maladministration of funds. The study shows that the city's revenue collected from water tariffs is insufficient to meet the demand for infrastructure maintenance and development. The revenue is usually diverted to other priorities instead of directing it to infrastructure maintenance and development. These unfavourable conditions threaten large scale water projects, resulting in them taking too long to be completed, suspended or discontinued.

In South Africa, water is cheaper as compared to other countries. It is undervalued because the price is far from reflecting the real cost of service from its transportation through infrastructure to treatment and disposal. This is one of the problems straining the city's balance sheet as inadequate revenue is collected. Indigent communities, especially informal settlements, are not paying for water use while such settlements are exponentially growing and increasing water demand. Water tariffs' defaults are growing annually due to national poor economic growth and rising unemployment rate. This shows the lack of institutional capacity required to determine and then manage standard parameters in an operational context. Establishing strong institutions backed by law, skills development, and technological enhancement is vital for collecting and managing revenue.

5.2.5 Lack of coordination

Poor linkages, coordination and cooperation within government structures are critical issues requiring attention in the city. Woodhouse and Muller (2017:230) argue that the Cape Town water crisis was not an issue of water scarcity but a crisis of mismanagement.

The central problem in dealing effectively with the crisis point to the politically fractured multi-tiered management, which collapsed the entire water governance system at national level. Fractured political relationship affects coordination and cooperation within government structures, resulting in poor planning, design implementation, monitoring and evaluation of developmental projects. This signifies that social, economic, political and environmental factors should be closely and holistically monitored, evaluated, linked and well understood in a systems manner such that matching and effective interventions can be determined and implemented to yield a sustainable outcome. Government structures need to be well linked, and tasks well defined such that operation is fluid, and where tasks overlap into another structure, coordination and cooperation are effectively articulated.

The country's legislation has contributed immensely to the dilemma of poor collaboration within government structures. The country's Constitution creates separate responsibilities for water resource management and services. The national government is responsible for raw water infrastructure (surface water and groundwater), while water treatment and distribution are the responsibility of local governments. There are differences in primary roles and legal mandates related to water infrastructure. DWS is governed by National Water Act and Water Services Act.

On the other hand, Municipalities are governed by Water Services Act and Municipal Legislation. This situation creates a scenario where the three government structures set out and relay different and conflicting messages about the severity of the crisis. Moreover, political expedience and opportunism become obstructive factors in intergovernmental coordination and dealing with the crisis. Policy reforms should be done to set clear the parameters of each government structure to prevent duplication, overlapping and conflicting tasks, which may cause time and money wastage.

5.2.6 Political controversy

Political battles and controversy played a centre-stage position in the city's water crisis. The absence of political connection between the ANC-led national government and Western Cape DA-led provincial and local governments instigated complicated relationships between the authorities.

This shows that the differences in opinions about the necessary steps to be taken to mitigate the crisis, both between and within parties, impacted the ability of the government to respond to the crisis. Both DA and ANC party leaders responsible for alleviating the water issue were quarrelling and shifting blame to one another. Yet, leaders are expected to unite to fight a common problem.

Nomvula Mokonyane was the former Minister of DWS since May 2014 to January 2018. One of her biggest roles was to address the Cape Town water crisis. The minister blamed the DA leader at the time, Mmusi Maimane, and the then Premier of the Western Cape, Hellen Zille, for misuse of funds appropriated for desalinization plants. She argued that the crisis was not a result of natural calamity but rather mismanagement of the DA government in the province. Deputy president at the time, Cyril Ramaphosa blamed climate change for the Cape Town water crisis. He did not focus on casting blame on the other leaders but rather on bringing together policymakers on shared goals. The former Mayor, Patricia De Lille, has defended her administration by citing that she had made several policy implementations that tremendously reduced the city's water consumption. She argued that she cannot bring the rain to the city and has insufficient powers to address the disaster fully. However, in-party fighting became the biggest challenge to the Mayor which brought her removal as heard of Water Crisis Management. The two leaders, Mmusi Maimane and Hellen Zille, took no responsibility for the blame but casting the blame to the former Minister Mokonyane and ANC national government. They blamed the DWS for lack of infrastructure upgrade and augmentation schemes provision as a measure to curb the crisis. The Minister and national government's poor response to the crisis has instigated Zille to make a claim that "It is a clear demonstration of how out of touch the national government is with the citizens' daily experiences" (CLOSUP, 2018:16). On the other hand, Mokonyane argued that her major focus was to prevent day zero, and that Zille and Maimane were just attempting to defend the province and DA from accountability of the crisis through directing the blame to the national government.

The blame game between the ANC and DA became the major inability of the government to satisfactorily respond to the water crisis. The two were playing politics instead of bringing solutions which even crippled their legitimacy among the electorate in 2019 general elections. Collaboration of national, provincial and local government was key for addressing the crisis effectively. The focus on political concerns of the entire leadership has erased the lessons and experiences gained from the crisis. Political conflict between government actors have detrimental

impact on policy outcomes in times of a crisis. This shows the importance of having explicitly stipulated roles between national and provincial government in a federated model where there is unity and each independently operating in internal affairs. Hence, policy changes are required for creating clearly defined responsibilities in all structures of government.

At the time of the Cape Town water crisis, it also became evident that there were tensions between politicians and technocrats. Politicians had difficulties comprehending technical issues, while technocrats had problems communicating their facts to politicians. Facilitation of greater engagement and understanding between the two sections is vital to building synergy to ensure that responses related to disaster can effectively address the needs of people.

5.3 Analysis of Impact on critical sectors

5.3.1 Agriculture, tourism, business and industry

The impacts on agriculture, tourism, business and industry have grossly affected local, provincial and national GDP. Severe job losses, exorbitant food prices and poor production yields, among others, had a gross impact on sustainable livelihood. The impacts of a crisis are long-term and can exist in the city for several years. These impacts tend to reshape and recreate with the progression of time. Even if adequate rainfall can be received in the coming years, the city's water crisis is not promising to be entirely resolved soon, as impacts can replicate due to new changes, particularly in economic trajectory and approaching new disasters. The Covid-19 pandemic is adding weight to reduced economic growth and severe job losses in an already troubled society. The most affected residents are those who lost their jobs, the already unemployed, the aged and the poor. Recovery from such a scenario takes several years of great effort from all public and private stakeholders.

The authorities have promised assistance to various community-based projects and resource assistance to communities for self-help programmes, but not a lot was done. When communities are not adequately assisted, especially in community development initiatives, their healing from the shocks and trends of the crisis can take long, thereby deepening their poverty status. The community-based organisations have not yet fully recovered, mainly in indigent settlements. Communities lack adequate inputs, which they are pleading to be assisted with by the government,

NGOs, and other well-wishers. Abalimi Vezekhaya is one of the popular and successful vegetable production organisations in the Cape Flats, but they are not yet fully operational since the water crisis hit. Government weakness is signified. Government usually waits for NGOs to intervene, but they cannot do it alone. The situation demands a collaborative approach to enhance sustainable outcomes.

5.3.2 Weak education and health sectors

Education and health sectors were severely impacted, yet they formed a developing community. The impacts should have been prevented earlier. The importance of such sectors in a nascent state requires careful consideration in planning and safeguarding them from trends and stresses of a disaster. Such sectors are the drivers of sustainability in any society through equity, social justice, social mobility and democracy. It is then surprising why such vital sectors in a developing state were not prepared for such a common phenomenon of the current era. Although the city is polarised, a robust and collaborative effort should have been directed in cushioning such sectors from water scarcity. Diversification of water sources should have been prioritised to reduce the gap between the haves and the have nots. It is difficult to imagine what could have happened to the education and health sectors in the city had the Covid-19 pandemic, with its hygienic demands, occurred concurrently with the water crisis. The impact could have been catastrophic. This indicates that the city needs preparedness for any disaster as a series of disasters can approach it. Preparedness for disasters becomes a critical requirement for a sustainable community.

5.3.3 Management of water demand

The city's approach to water demand management could not neutralise the surging uncertainty in rainfall patterns. Although the city's water demand management was a success, it seemed the authorities overlooked that demand management had reached its limit. University of Cape Town researchers pointed out that the city's conventional models used to forecast demand and supply had underestimated the probability of failure in the water system (Rodina and Findlater, 2018:3). The implemented demand management system was efficient and effective but reduced resilience because there were inadequate water reserves during unusual scarcity. The critical issue seemed to be the continuance of outdated thinking about the water system's uncertainty. The city's long-held ideas regarding water demand and supplies should be changed. Institutional capacity, technological innovation, and skills development improve water sources diversification and the establishment of new and reliable buffers such as recycling, reuse, reduction, and desalination.

In the water demand management system, the city had a big issue of failing to maintain the relationship and trust between its formal water management system and informal processes that shape and decorate several vulnerable communities within its jurisdiction. Illegal connections have resulted, making it challenging to locate service leaks and report them. The lack of education and language barriers made it difficult for many residents to protect their rights when the authorities decided to implement Water Metering Devices (WMD). The interventions can disempower people by monitoring or policing their water usage yet not determining and acknowledging the actual problems they face in their daily lives. Some formal interventions presented by the authorities can deter residents from accessing formal service delivery because of unresolved original problems. Hence illegal community self-solutions that bypass the law usually take centre-stage. Illegal water connections are a characteristic of the city, requiring a thorough investigation to eliminate them. When an unlawful act becomes popular in a community, it can be a norm and eradicating it can be challenging; hence strategic interventions need to be established.

Considering the effort put in place by the city, particularly towards diversification of water sources through aquifer extraction and desalination, it seems that water availability and access is being ensured. However, rainfall is getting sporadic and affects river and dam levels, and groundwater aquifers can rapidly deplete. The city depends on a surface water supply that draws 96% of its total volume (Visser, 2018:9). Relying on surface water supply is a recipe for disaster to the city. Desalination becomes a more reliable option, but the success depends on the implementation process's effectiveness, which seems to be a greater challenge to authorities. Funding such big water projects are expensive and coupled with limited established environmental impacts. High salt discharge from the purification process back into the sea has an environmental impact on local water quality. Increased local water temperature can impact the ecosystem. The legal-financial battles which the city is facing with the contracted companies for desalination projects clearly show the high demand for funding required by such projects.

Given South Africa's current strained fiscus, such costly projects are at risk to be suspended or abandoned. Moreover, such expensive water systems can be abandoned during adequate rainfall and become white elephants mainly because of their costly production process and maintenance. The situation poses a great dilemma in the city's long-term planning for water security.

Collaboration of national, regional and international partners can assist in risk-sharing such that any changes and failures in a development project can have less impact on one part.

Data availability is a critical, challenging factor in determining suitable water management responses because of its importance as a planning tool. The city had minimum communication and understating of water supply data and data on the catchment status. Relevant information on WCWSS was inadequate at the onset of the drought. Enforcement of regulations was also insufficient during 2015/16 and inadequately linked to the city's modelling in 'day zero' predictions, resulting in the use of large volumes of water. There was inadequate measured and reported data associated with rainfall and related run-off in WCWSS during the same period. Integration of climate change data was minimum before the crisis, yet such knowledge is vital to determine the appropriate approach to water management in times of climate change. The potential of present systems to manage expected changes is critically required, although climate change reflections are expected over a long time.

5.4 Public participation

The success of Cape Town in preventing taps from running dry owes much to all stakeholder participation, particularly communities' adherence to restrictions, turning to diverse water sources, reuse and recycling. All stakeholders cooperation and involvement, especially the indigent citizens who are most impacted when any disaster attacks, are required for well informed, transparent and coordinated decision-making and planning in the city. The exposure of the vulnerable to an array of threats, shocks and surprises can be prevented by a people-centred development.

Participatory processes are initiated for luring active citizenry and combined problem-solving. Systems involving humans cannot be sensibly contemplated or observed until participation and cooperation in the associated processes have been ascertained (Hjorth and Bagheri, 2005:84). However, the city engaged communities on the implementation phase of water demand measures rather than on the onset of the decision-making process.

This shows a flawed participation process, resulting in limited anticipated gains. If the process is effectively done, more positive results can be attained. Therefore, the entire participatory process

must be observed and implemented effectively through a thorough consultation with all relevant stakeholders from the onset up to the end.

Moreover, the city lacks the mechanisms and tools for effective and productive collaborations. The *izimbizos* were not usually done effectively to achieve the needed goals successfully. Unless the city identifies and acknowledges the informal structures and systems that exist and shape various communities, gaining residents' trust can be difficult. It is difficult to divert people from their dependable model to a formal one unless their perspective is included in the alternative. The city can attain water justice if government interventions and people's lived realities complement each other. A highly multifaceted and unequal society such as Cape Town requires a robust collaborative approach with all stakeholder sourced data to effectively drive action.

Lack of a credible participation process affected the relaying of information, resulting in misinformation and disinformation. The scenario reduces public trust, yet it is a major component of encouraging communities to develop confidence in managing the crisis and saving water. When people work together, merge talents and build trust, more dots are linked, giving sustainability issues and cooperative solutions new meaning and practical application.

The legacy of discrimination and segregation continues within the city's communities, impacting equity and access to basic services such as water. High inequality levels represent a society that cannot reach its potential. The economy cannot grow under high levels of inequality. Moreover, resolving disparities and the effects of vulnerabilities is tasked to various national, regional and international institutions with weak legal mandates not aligned to inspire and construct alternative forms of people-centred development (Yamin, 2007:60). Such a scenario exposes the city to uncoordinated development efforts that replicate or cut across each other, thereby wasting resources, increasing pockets of corruption and escalating difficulties in accountability. Such issues negatively affect the provision of essential services such as water.

In Cape Town, communities are very different regarding access to resources. Critical structural reasons such as class, gender, and historical discrimination and segregation impact communities differently, especially when attacked by natural events such as drought.

Such factors continue to perpetuate poverty and inequality within communities. The city's 'whole-of-society' approach, with its holistic complexion to water governance, if efficiently and

effectively implemented and supported, can encourage the growth of community-based support networks, an essential ingredient for sustainable development. When combined with more stable and adaptable water services, trust can build and improve collaboration.

However, this study shows that the city's call for public participation is not inclusive. Advertisements are put on newspapers, social media and the city's website. Some participation is done through such platforms. This is a great challenge in a diverse society where language becomes a barrier. Moreover, on the access to the internet, newspapers and smartphones, only a few can afford it, and the indigent is left out while their contribution is needed the most. This is one of the greatest challenges to participation, requiring a thorough investigation of breaking the barrier and improving inclusivity.

This study has shown that water access and availability issues are so complex. Such complex problems require a systems approach so that all factors surrounding its scarcity or availability are holistically analysed to enhance a better understanding and explanation of the existing problems. Holism helps to employ suitable strategic interventions to attain sustainable outcomes. Cape Town's water supply demands a water system that considers a broader perspective encompassing social, economic, political and environmental aspects. Such a broad system calls for a better understanding of how the system can change and a fresh system management approach, limited to infrastructure development and some observations such as diversification of water sources. Strong and resilient cities are built from strong partnerships and adaptive management. Cautious considerations should be made when utilising water sources such as rivers, groundwater, and springs. Fit-for-purpose thinking can develop within the relevant stakeholders for sustainable resource use, especially among communities.

Various departments and citizens have a critical role to play in the management of water demand. Hence attention should be given to comprehending behaviour change in society in terms of understanding alternative water use by residents and citizens' response to conservation approaches of non-potable water.

5.5 Conclusion

Climate change is increasingly a threat to Cape Town's water resources. Although natural phenomena increase water scarcity in the city, artificial factors also play a significant role in

strengthening the water problems. The entire water resource management system requires adequate transformation. The impacts of the water crisis on livelihoods are quite devastating and take time to eradicate as they have the potential of recurring, reshaping and recreating. Diverse strategic interventions are needed for an improved water governance system that strengthens sustainable livelihoods. A well-implemented participation process is critical in enhancing an effective water management system vital for sustainable development. All stakeholder collaboration presents a better understanding of communities' actual desires to implement effective interventions. Using a systems approach with its holistic character proves to be effective in attaining maximum water resource management gains. The study summary and recommendations were presented in the following last chapter of the study.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The conclusion and recommendations of the study in this chapter were based on the key findings presented in Chapter 4. This chapter consists of three sections: the introduction, summary of findings, and recommendations. Several conclusions were derived from the study. Climate change was identified as a precursor to droughts and floods. More conclusions were established from maladministration, poor collaboration in government structures, political issues and requirements of a systems approach in resolving complex issues. The need for continued research was established in climate change and enhancing of democratic practices as key to sustainability. The recommendations were then based on the conclusion attained from the study findings. Development of complex models for climate change, infrastructure maintenance, improved governance system, political integration, all-stakeholder participation and the importance of systems approach were key recommendations suggested in line with the study findings.

6.2 Summary of findings

Several conclusions were drawn from this study. The conclusion is based on the study's findings in line with the research objectives. The study analysed the impact of the water crisis on sustainable development in Cape Town. The study's objectives were to explore the causes of the water crisis in Cape Town, determine the impacts of water scarcity on sustainable development, examine the strategic interventions employed by the city in alleviating the crisis and the role of public participation in water resources management. The study was underpinned by an extensive literature review covering all the relevant research sectors. The study was explorative and descriptive, following a qualitative approach was used to achieve the research objectives. The research employed interviews and thorough documentary analysis to meet its objectives. Interviewees were purposively selected to obtain quality data required to obtain the intended results. The challenges encountered along the study were limited, and the objectives were satisfactorily met.

The systems theory and the concept of social sustainable have informed and guided the study. The concept holistically integrates all the three dimensions of sustainable development for maximum

development benefits; hence it prompts the use of a systems theory. The systems approach uses a holistic methodology to study the world, country or community as an independent system aiming to understand, explain and analyse unequal wealth and development between societies of a contemporary capitalist world. The holistic nature of the social sustainable concept and the systems theory brings a strong linkage which provides improved understanding and addressing of the social and economic problems facing humanity hence the study outcome was achieved. The study objectives were met and research questions well answered

The study concluded that climate change is a reality that brings extreme weather events such as droughts and floods. Meteorological phenomena can heavily impact developing countries with cities characterised by the exponential growth of informal settlements. The prevalence of poverty and inequality is exacerbating the impacts of a disaster. In Cape Town, adaptation and mitigation of such events are inadequately established and strengthened on time, mainly owing to inadequate resources to respond effectively to shocks and stresses of a disaster. Communities should be centre stage in determining vulnerabilities to be addressed and how they should be reduced, but inclusivity is still lacking.

The study has concluded that water governance should consider political decision-making as an essential water management system. Although drought played a role in causing the city's water crisis, politics had a greater role than drought. The blame game played by principal office bearers was a pivotal contributor to the disaster felt by the city. The political skirmishes between the ANC and DA officials and within the DA distracted officials' focus from responding effectively to the crisis. This blame game proved the inability of the government to respond to the crisis adequately.

The study established that maladministration at national level and corruption at all spheres of government were also critical factors resulting in a poor response by principal officials to the crisis. Therefore, it is concluded that political, economic and ethical considerations were at the heart of the water governance system.

Adequate water infrastructure development and maintenance are pivotal in a contemporary urbanising city for improved water availability, quality and access. Improved infrastructure presents certainty and control of desired sustainability goals. Diversification of water sources with more reliable sources such as desalination should be prioritized by a rapidly urbanising city, especially in this current era of climate change and its unpredictable weather patterns. The reliance

on one major water source is dangerous to rapidly urbanising cities. Cities can be severely impacted by a catastrophe such as a drought.

Water, whether it is abundant, should be wisely used. Misappropriation, misuse, and wastage of water are common characteristics and major contributors to unnecessary costs to the city. Rapid urbanising cities should use effective and efficient water to conserve the available volume. Water security demands the user behaviour change, which values the resource and its role in daily livelihoods. Hence, the present water crisis is not an issue of its scarcity but a mismanagement crisis.

The study concluded that poor cooperation of on-dialoguing between water managers, scientists, policymakers, government structures, and water users had been one of the biggest challenges in water resources management. The politically fractured multi-tiered management is affecting Cape Town and the entire country. The fragmentation requires to be addressed effectively. Governments, business and industry, civil organisations and NGOs should combine their efforts from local, regional and international levels for improved outcomes in water management.

Collaboration within local government and between the three spheres of government is quite critical in water resource governance. It is concluded that the linkages of such government structures can facilitate accountability through cooperation and coordination. Confusion is usually evident within government structures as mandates of one government structure overlap into another. There should be lucidity and precision in shared tasks or goals, requiring inter-departmental and institutional relations supported by strong leadership and technical know-how. Coordination and cooperation had improved within the City of Cape Town when the magnitude of the crisis was escalating, enhancing success in preventing day zero. However, the study concluded that although collaborative governance plays a critical role in improving the water management system, it cannot give adequate results. A successful outcome requires a combination of timing, trust, and interdependence.

The study concluded that water resource governance is complex. Therefore, it demands complex mechanisms, institutions and processes. Integrated water resource management is vital for attaining equity and sustainability in water resources. Complex systems seek a systems approach that closely monitors every element of a system in a holistic manner to observe and understand trade-offs. Appropriate interventions can be implemented for improved outcomes.

All stakeholder participation is essential during a period of crisis. Had it not been for the cooperation of all water users in the city, such as residents and businesses, the authorities could not have done it alone. Communities should play a central role in implementing, monitoring, and evaluating results. Collaboration of all stakeholders through adherence to water restrictions, reuse, recycling, water harvesting and borehole drilling significantly contributed to preventing the drying up of taps in the city. Developing good relations with all stakeholders, particularly during a crisis, is vital for expert engagement, effective data gathering, improved communication and facilitation of improved decision-making process. Maintaining good relations and partnerships facilitate a quick response from stakeholders to fight against a common problem.

However, the study was not conclusive on the mechanisms of public participation. Participants were divided. It indicated that it is a top-down rather than a bottom-up process. Residents were not satisfactorily engaged, and their concerns were not considered in decision-making. Residents were unhappy with its implementation, primarily through social media and websites, where the poor are deprived of access due to cost and language as major barriers.

The study has picked a significant problem which the city did not identify. The city used technological tools to resolve a social issue. Technical solutions such as Water Metering Devices usually centralises control to the authorities rather than empowering the communities. Such techno-managerial, top-down approaches are ineffectual at addressing injustices that comprise a complex set of issues and needs that confront people on the ground. It is concluded that an inclusive governance system can create action steps to recognise and encompass different types of knowledge that can enable non-technical expertise to inform a water governance system that can bring transformative change and justice to the people.

6.2.1 Research suggestions

Climate change is now a global emergency requiring effective and efficient water resource management. The impacts it present are changing in intensity and magnitude with the progression of time. Therefore, research on climate change should be prioritised as an ongoing process such that adequate data can be available to cushion communities from its trends and shocks, such as water scarcity.

The city's major problem is its growing fractured relationship between public agencies and communities characterised by lack of trust or absence of a social contract. The situation is usually

cultivated by interventions that heavily depend on data collected with incorrect tools, such as its annual survey that captures quantitative data to capture the complexities of informal settlements. In comparison, the qualitative approach gathers a rich understanding of how several interlinked problems combine to build frustration, anger and a sense of abandonment among communities. Qualitative research should be directed to depict the way injustices are daily experienced and push for the built-up of democratic practices.

Regardless of the size, communities are very different in resource access. Critical factors such as gender, age, class, origin and ethnicity play a role in shaping and refashioning them, especially the marginalised communities. Such factors are most remarkable to specific individuals or people's vulnerability and adaptive capacity. Therefore, thorough research should be done or continued on intra-community vulnerability forces to understand better that can assist in effective decision-making, planning, implementation, monitoring, and evaluation of development projects and programmes. Research is also needed in determining a water management system that can thoroughly address the changing demands on water use to advance the achievement of SDGs. Furthermore, new water governance systems are needed and should be timeously and effectively established. Hence, exploring innovative approaches is essential to minimise the stresses and shocks of the future's uncertainty.

6.3 Recommendations

Based on the study's findings, the recommendations are derived according to the objectives articulated by the research. The recommendations can assist prevent, reducing, and mitigating the risks or shocks of a disaster such as the water crisis that has devastated Cape Town, a rapidly urbanising city. Many cities worldwide should draw lessons from Cape Town to develop a more robust and resilient water management system that can drive the maximum achievement of SDGs.

6.3.1 Developing complex models

Extreme droughts and floods in South Africa show that the country is living in the new normal where water should be saved at every opportunity. Cape Town has since had three years of normal rainfall from 2018 to 2020, but water will never be abundant in the city (Wentzel, 2020:3). The city should be wise to consider climate change risks in its planning. The development of more complex models is required to establish an improved understanding of the impact of climate

change on water resources. Adequate and accurate data is essential to justify the required strategies and resources needed by the city to ascertain a sustainable water supply to its citizens. The city should be part of the Resilient Cities Initiative. Cape Town's resilience can be improved as a coastal city by moving away from dependence on surface water to a diverse water supply system. The city's share of water should be from groundwater, water reuse and desalination of seawater, a very expensive process that will make the final product unreasonably expensive. More so, a resilient city must optimise and sustain water use by employing integrated management of surface water managed in dams and wetlands, including urban stormwater runoff, groundwater with recharge, reused wastewater, and desalinated seawater. Diverse sources will increase water supply, which improves reliability and reduces restrictions experienced by the city during the crisis. Therefore, the city must use water sparingly to maximise the benefit.

Climate change is now a reality that contemporary cities must acknowledge and adequately prepare for, including its devastating impacts. Mainstreaming of present and future vulnerabilities of climate change into development should be prioritised at the global level to achieve sustainable development. Learning and drawing lessons from other cities with similar climate change experiences is fundamental to mitigating the impacts (Ziervogel, 2019.02).

6.3.2 Maintenance of infrastructure

Infrastructure maintenance and improvement is critical requirement for the city. Adequate and standard infrastructure is needed to improve its demand and supply system. However, the demand and supply system infrastructure should be done in line with expected legislation and environmental impact assessment. Dam construction, wastewater purification plants and groundwater abstraction should align with the legal framework and sound environmental considerations. Investment in leak detection and repair initiatives is fundamental in reducing water losses. Although technical solutions can not be the major solution to social problems, efforts should be directed towards meter replacement and installing new water meters for quality readings, improving the billing system and revenue. Water meters that comply with required standards must be installed on all properties for effective billing. Water audits must be done to determine all illegal connections and ensure prosecution.

6.3.3 Improved governance system

Good governance is very crucial in sustainable water resource management. Improvement in coordination between and within government structures is of paramount importance to unlock social ideals and possibilities for the future locked within policy and institutional structures (Yamin *et al.*, 2005:11). Government must strive to maintain synergy and coordination between all levels of government, as such a factor is crucial for promoting sustainable development in the country. Both public and private institutions should be transparent and accountable, with checks and balances that can operate at the scale and within the sphere of their responsibility (Hasnan, 2016:12). Institutions should be of scale proportionate with their assignment and well equipped with the power, resources and tools to execute their mandated tasks. They should be capacitated to articulate their tasks independently from special interests and political influence.

6.3.4 Political integration

Adequate unity and integration across political parties and government departments must be established to forge and strengthen essential alliances that promote bold, transformational and prosperous leadership. The tussle between the ANC and the DA governments in the province and between politicians and public office bearers should be ironed out for sustainable management of the city's resources. Profound transformation requires a large-scale collaboration such that ideas or policies are effectively promoted, refined and implemented (Hasnan, 2016:12). There is a need for leadership coordination from the national government to the local government. In particular, the Department of Public Service and Administration (DPSA), the Department of Cooperative Governance, the National Treasury and the Department of Performance Monitoring and Evaluation should have well-coordinated leadership. These departments need to work together to ensure alignment between powers and functions, planning processes and budgetary allocations. In several instances, these departments cannot resolve task issues independently without the assistance of relevant national or provincial departments. Working together can help them identify coordination problems and apply their collective influence to ensure an amicable solution to disagreements.

6.3.5 All stakeholder engagement

Open dialogue among all the affected parties initiates quality water resource management (Hjorth and Bagheri, 2005:84). The City should consider effective participatory impact assessments as a

critical tool for improving policy, planning, and navigating an adaptive management system. This can facilitate a cautious revision, alteration and redrafting of targets and the strategies incorporated in attaining them. Effective participation in the planning and decision-making process involving all stakeholders (users, private sector and public authorities) can constructively facilitate the choice between alternative plans and policies. The participatory process should be enhanced such that both indigenous knowledge and scientific knowledge structures are linked for decision and policymaking and synergies and enable the achievement of collective goals.

6.3.6 Importance of a systems approach

Cape Town's water supply demands a water system that considers a broader perspective encompassing social, economic, political and environmental aspects. Such a broad system calls for a better understanding of how the system can change and a fresh system management approach, limited to infrastructure development and some observations such as diversification of water sources. The systems approach becomes critical in resolving complex issues as it offers holistic analysis and examination of elements for a better understanding and use of interventions for improved outcomes. Sustainable development is a complex issue requiring all its components to be holistically analysed such that the anticipated goals and targets are attained.

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APPENDICES

Annexure A: Ethical Clearance



COLLEGE OF HUMAN SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

14 December 2020

Dear Josias Shiriyedete

NHREC Registration # :
Rec-240816-052
CREC Reference # :
2020 CHS -51871947

Decision:
Ethics Approval from 14 December 2020 to 31 November 2023

Researcher(s): Josias Shiriyedete (51871947@mylife.unisa.ac.za)

Supervisor: Dr A Khan (khana@unisa.ac.za)

Title: *An exploration of the 2015 - 2018 water crisis and its impacts on sustainable development in Cape Town, South Africa.*

Degree Purpose: Masters

Thank you for the application for research ethics clearance by the Unisa College of Human Science Ethics Committee. Ethics approval is granted for three years.

The **low-risk application** was **reviewed** by College of Human Sciences Research Ethics Committee on **14 December 2020** in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.



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4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No fieldwork activities may continue after the expiry date(**31 November 2023**). Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **2020-CHS-51871947** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature : 

Dr. K.J. Maleski
CHS Ethics Chairperson
Email: maleskj@unisa.ac.za
Tel: (012) 429 4780

Signature : PP 

Prof K. Masemola
Executive Dean : CHS
E-mail: masemk@unisa.ac.za
Tel: (012) 429 2298

Annexure B: Interview Guide

1. Households Members (aged 18 -65; both male and female; non-racial).

- a) In your view, what do you think were the causes of the water crisis in Cape Town?
- b) Do you think the causes were natural or human-made (political, financial, infrastructure, etc.)?
- c) How did the water crisis impact you in terms of your household water needs as well as socio-economic activities?
- d) How did you manage to cope with the problem? What measure did you put in place to have enough water available for daily use?
- e) What strategic interventions were the authorities, municipality or government applied to stabilise and enhance water availability? What do you think can help reduce the recurrence of such a crisis? Do you think you are now water-secure in the coming future?
- f) Were you consulted by the authorities to give your views on the water crisis which you experienced?
- g) What role did you play as an individual or community in assisting with stabilising the crisis?
- h) How do you see the city's future in terms of water security?
- i) In your opinion, what do you think should be done by you as an individual, community or authority to prepare, reduce or prevent the recurrence of such a phenomenon?
- j) How do you see the city's future in terms of water security? What do you think you should do as an individual or by the community and the municipality or government to establish a sustainable water supply to the city facing challenges such as climate change and a rapidly increasing population?

2. Government Officials (aged 18 -65; supervisors and above; non-racial; non-gender).

- a) In your view, what do you think were the causes of the water crisis in Cape Town?
- b) Do you think the causes were driven by climate change or human-made (political, financial, infrastructure, etc.)?

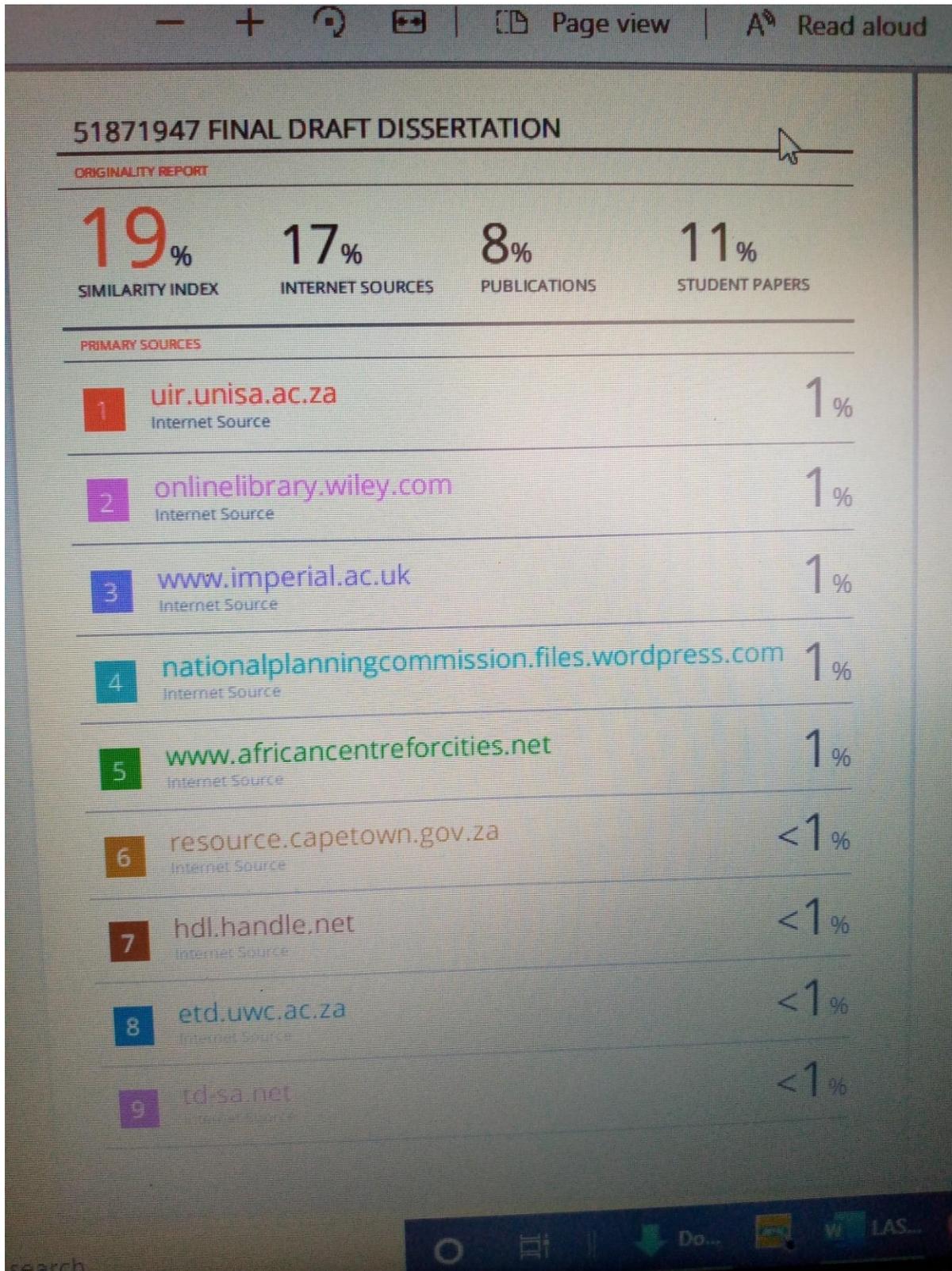
- c) How did the water crisis impact social, economic, environmental and political sectors? Which sector(s) were hardly impacted, and do you have numerical data for more clarity?
- d) South Africa is a diverse society, which the crisis most impacted groups and what exactly was done by authorities in alleviating the crisis in most affected groups or communities?
- e) How did you manage to cope with the demand and supply of water?
- f) What strategic interventions did you apply as government to stabilise and enhance water availability to the city? How sustainable are the interventions to prevent the future crisis?
- g) Were all stakeholders incorporated in alleviating the water crisis namely businesses, industries and Non-Governmental Organisations and communities, particularly the indigent communities
- h) How sustainable is the city in terms of water security?
- i) How prepared is the government in dealing with climate change and its impact, particularly on future water crisis?

3. Businesses, industries and institutions (school principals; supervisors and above; non-racial; non-gender).

- a) In your view, what do you think were the causes of the water crisis in Cape Town?
- b) Do you think the causes were natural or human-made (political, financial, infrastructure, etc.)?
- c) How were you impacted by the water crisis in terms of operations, quality of service or products, profit margins, and business goodwill?
- d) How did you manage to cope with the problem?
- e) What strategic interventions were the authorities or government applied to stabilise and enhance water availability?
- f) In your opinion, were the applied interventions effective in curbing the water crisis and giving hope for the sustainable water supply for the future, considering the momentum of climate change effects.

- g) Were you consulted by the authorities to give your views and participate in the fight against the water crisis? Which other stakeholders participated, how effective your participation was, and the benefits it rendered to the entire city. Do you recommend all stakeholder participation in times of a future crisis?
- h) In your opinion, what do you think should be done by an individual, community, business, industry or government to prepare, reduce or prevent the recurrence of such a phenomenon?
- i) How do you see the city's future in terms of water security? What do you think should be done by an individual, the community, institutions, business, industry or government to establish a sustainable water supply to the city facing challenges such as climate change and a rapidly increasing population?

Annexure C: Turnit in report



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AN ANALYSIS OF THE 2018-2019 WATER CRISIS AND ITS IMPACT
ON SUSTAINABLE DEVELOPMENT IN CAPE TOWN, SOUTH AFRICA

by
JOSIAS SHIRIYEDETE

STUDENT NUMBER: 518 719 47

Submitted in accordance with the requirements for the degree
MASTER OF ARTS IN DEVELOPMENT STUDIES

in the School of
DEVELOPMENT STUDIES

